

Large Efficient Intelligent Heating Relay Station System

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Abstract. The design of large efficient intelligent heating relay station system aims at the improvement of the existing heating system in our country, such as low heating efficiency, waste of energy and serious pollution, and the control still depends on the artificial problem. In this design, we first improve the existing plate heat exchanger. Secondly, the ATM89C51 is used to control the whole system and realize the intelligent control. The detection part is using the PT100 temperature sensor, pressure sensor, turbine flowmeter, heating temperature, detection of user end liquid flow, hydraulic, and real-time feedback, feedback signal to the microcontroller through the heating for users to adjust, realize the whole system more efficient, intelligent and energy-saving.

1. Introduction

The design of large and efficient intelligent heating relay station system by improving the heat exchanger, research and development of intelligent control system, to solve the traditional central heating system of low efficiency, high energy consumption, serious pollution problems[1], and gradually extended to the whole country, realize the efficient nationwide heating system, energy-saving and intelligent.

2. Design of intelligent heating system

2.1. The design of the control part.

ATM89C51 is a powerful microcontroller, a wide range of uses, and has been applied in many fields [2]. Therefore, in the control part of this design, ATM89C51 series microcontroller is adopted. Compared with the existing PLC control system in foreign countries, the utility model has the advantages of simple structure, convenient operation, fast processing speed, less power consumption, strong environmental adaptability, etc.[3]. SCM schematic as follows(Figure 1):



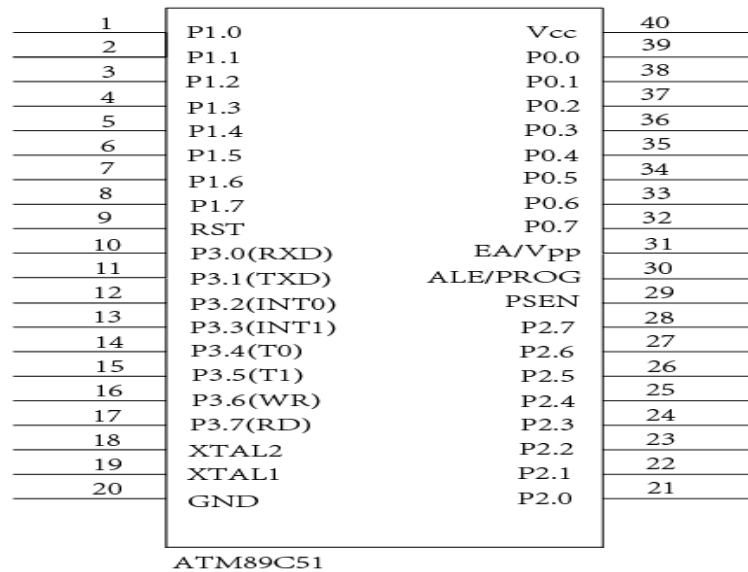


Figure 1. Single chip computer schematic diagram

The single chip microcomputer controls the electromagnetic pump directly through the chopper control circuit. Because the electromagnetic pump connects the plate heat exchanger, the single chip microcomputer will receive the feedback signal of the three sensors in real time (Figure 2):

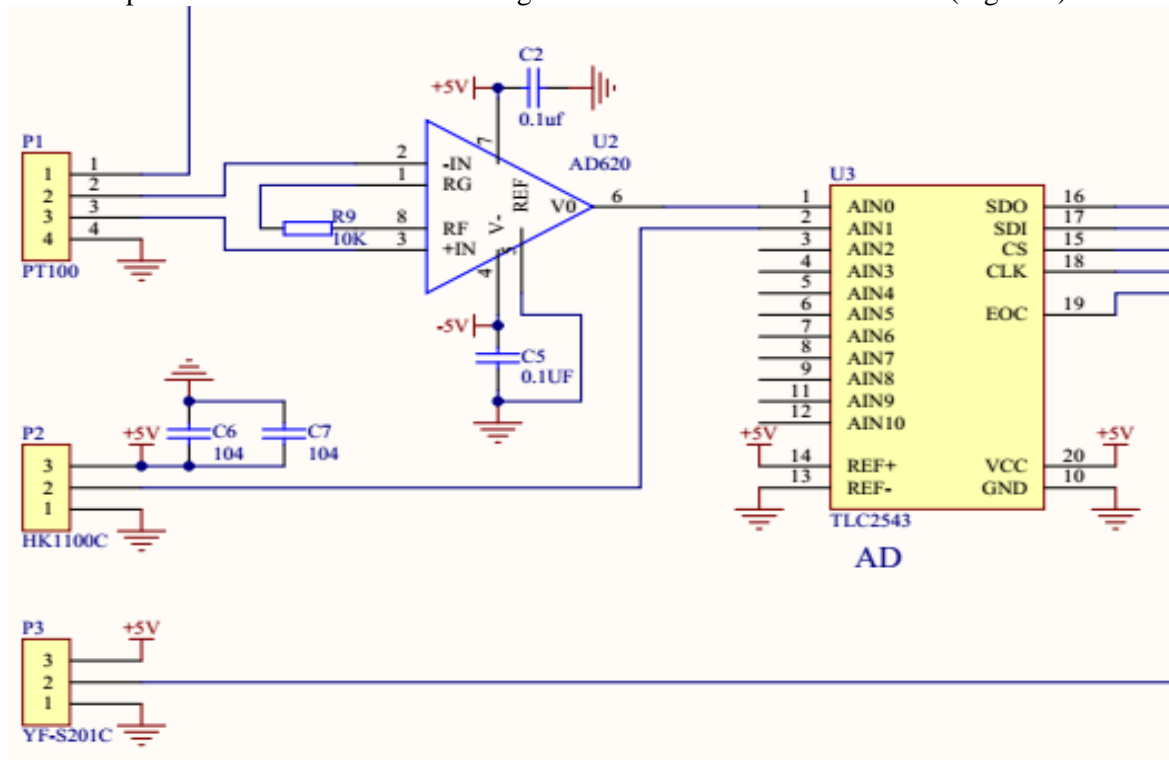


Figure 2. single chip microcomputer feedback signal of real time

The single chip microcomputer carries out real-time control of the electromagnetic pump through the signals returned by the three sensors, so as to control the heating of the plate heat exchanger and realize intelligent control. The three sensors convert analog signals into digital signals through the AD conversion circuit and feed them back to the microcontroller[4].

2.2. The design of the sensor temperature sensor

This design uses the PT100 temperature sensor. The PT100 temperature sensor is an instrument that transforms a temperature variable into a transmitted output signal. Usually consists of two parts: sensors and signal converters. The sensor is mainly a thermocouple or a thermal resistor, and the thermal resistance sensor is used in this design.

Works: The relationship between temperature and resistance change in PT100 temperature sensor .

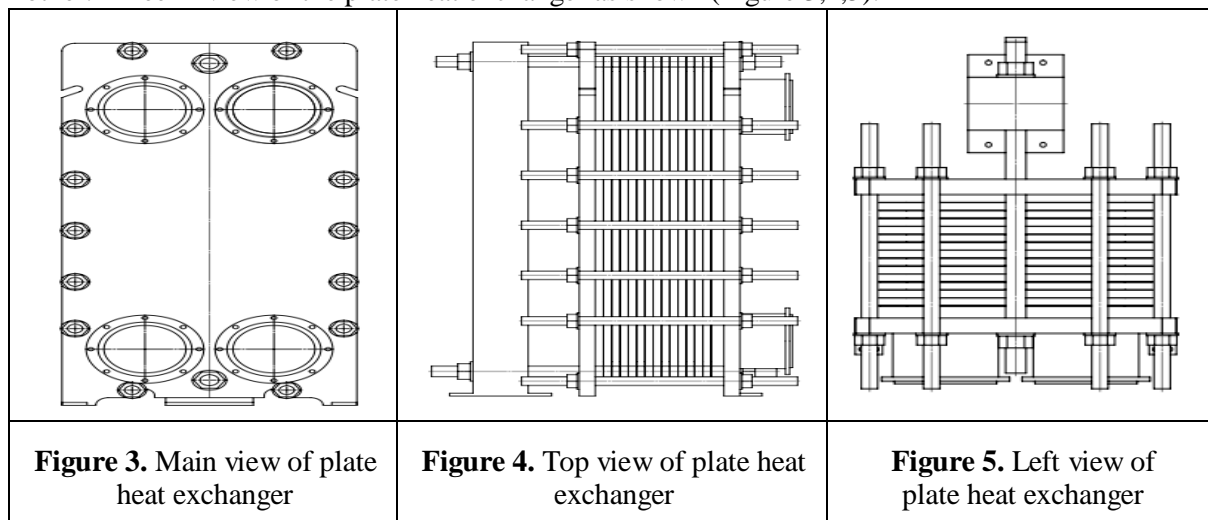
Differential pressure sensor: The pressure acts directly on the diaphragm of the sensor, causing the diaphragm to produce a slight displacement, resulting in a change in the capacitance of the sensor. The electronic circuit in the sensor detects this change and converts it into a corresponding electrical signal that is fed back to the control unit. For this design, a change in the hydraulic pressure changes the capacitance in the sensor, which changes directly back to the control section.

Turbine flowmeter: Turbine flowmeter is a common sensor for testing liquid velocity in China. It belongs to the speed flow meter. Its main characteristics are compact structure, high reliability, intuitive reading, no interference from external power supply, and resistance to lightning stroke.

3. The design of plate heat exchanger components

3.1. Overall design of plate heat exchanger.

In the heat exchanger, with two water inlets and two outlets through the middle plate to the heat transfer effect, both ends of a set of inlet and outlet, can pass through the same medium, can also be through two different kinds of media, and about the heat transfer on both sides are not affected each other. Three in view of the plate heat exchanger as shown (Figure 3,4,5):



Compared with shell and tube heat exchangers, plate heat exchangers have the following advantages: (1) The heat transfer coefficient of plate heat exchanger is higher; (2) Small temperature difference at the end; (3) Small footprint; (4) Overall light weight; (5) Small heat loss.

3.2. The component design of plate heat exchanger.

The structure of plate heat exchanger consists of metal plate, fixed compression plate (front end plate), movable compression plate (rear end plate), clamping bolt, upper guide rod, lower guide rod and strut.

3.2.1 Front and rear end plate

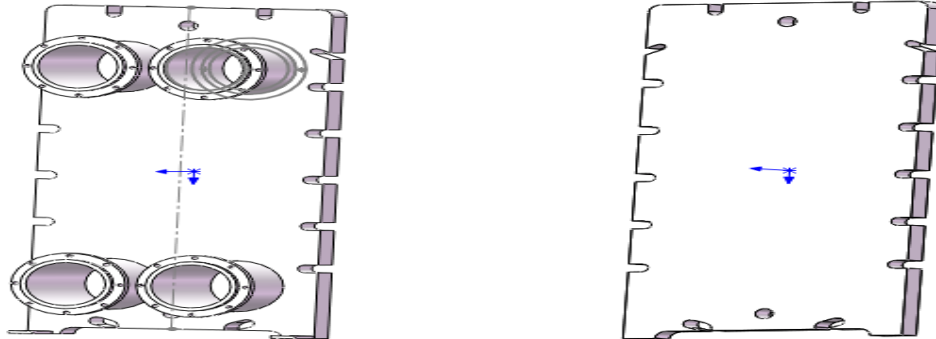


Figure 6. Front plate (fixed clamping plate) **Figure 7.** Back end plate (moving clamping plate)

After analysis, the end plate is not only in the middle of the clamping plate, the heat transfer process, the four corners of the front plate and the back end plate, each side will be in direct contact with the fluid, and some fluid is corrosive, so in the selection of materials, need to consider the material resistance corrosive, and need to have certain compressive strength. Considering the above factors, 0Cr18Ni14Ti stainless steel is selected. This material has sufficient compressive strength and corrosion resistance. For the front and rear end plates, corrosion resistance is the most important performance, so it is necessary to treat the front and rear end plates with solid solution. Figure 6 is a fixed clamping plate, and Figure 7 is a moving clamping plate.

3.2.2 Guide bar and screw rod.

Guide bar and screw rod need good wear resistance and good tensile strength, so 45 steel can be used. In the plate heat exchanger, the guide bar needs to bear the shear stress and the tensile stress in the horizontal direction, and the wear resistance of the threaded part is higher. Also, due to the plate screw with the nut on the middle of the clamping screw rod, so by the horizontal direction of the tensile stress is larger, the thread is more easy to wear, so for a guide rod and a screw rod, comprehensive mechanical properties need to be optimized, so the need for a guide rod and a screw rod for quenching and tempering.

3.2.3 Hexagon nut.

Because of the plate changing in use, the plate, the screw and the nut need to be removed and the loss is greater. Therefore, the 45 steel material with higher cost performance is chosen. When the nut matches with the guide bar and the screw rod, the thread is worn more seriously, and the nut is not affected by other external force except the thread force. Therefore, the nut can be treated with low temperature tempering at the time of heat treatment.

3.2.4 Sheet bar.

When considering the sheet material, it is necessary to consider its corrosion resistance and service life. Compared with stainless steel, titanium has better corrosion resistance than stainless steel, and can adapt to more kinds of fluids, and its service life is longer. Moreover, the density of titanium is only 0.6 times of that of stainless steel, the quality is light, and the pressure on the guide bar is small, which can greatly reduce the total weight of plate heat exchangers. Therefore, in this design, the plate is made of titanium.

3.2.5 Pillar.

Pillars play a supporting and stabilizing role in plate heat exchangers and prevent them from tilting and moving during operation, so they need to have certain mechanical properties. Because of the poor

mechanical properties of cast iron, Q345 structural steel is used here. As shown in figure 8. for the pillar.

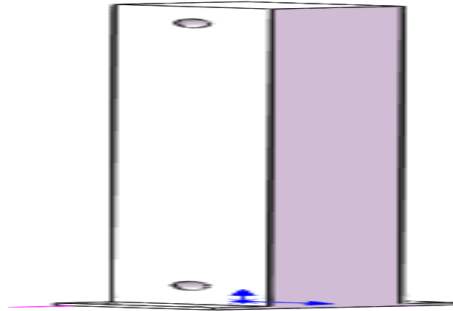


Figure 8. Stanchion

3.2.6 Materials and heat treatment.

Taking into account the functions and forces of the main components, select the appropriate materials to meet the work requirements, as shown in table 1.

Table 1 Materials and heat treatment details

Part name	Material	Heat treatment process
Front panel (moving clamping plate)	0Cr18Ni14Ti	Solid solution treatment
Back end plate (fixed clamping plate)	0Cr18Ni14Ti	Solid solution treatment
screw	45	Quench + high temperature tempering
Guide bar	45	Quench + high temperature tempering
nut	45	Harden and low temperature tempering
plate	Ti	No heat treatment
stanchion	Q345	No heat treatment

Conclusion

This paper designs a kind of energy saving heating relay station system. From the design process of intelligent heating system, first through the microcontroller and sensor to achieve the intelligent control of the relay station system, improve energy efficiency; secondly, we improved the existing heat exchanger, by replacing the improvement on the part of the guide rod and plate material, reduce the overall weight of plate heat exchangers the increase of the service life of the plate. This design makes up the deficiency of the existing heating system in China, and realizes the high efficiency, intelligence and energy saving of the heating system.

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