CHAPTER 16

AUTOMATED COOLING SYSTEM

16.1. GENERIC INTRODUCE:

Automatic control refrigeration equipment system is a combination of automatic control devices and control subjects to ensure the optimum operation mode or a given mode don’t participate of automator. Automatic equipment include: automatic control equipment, measurement devices and signals, control facility, valves and some other control elements.

16.2. AUTOMATIC CONTROL REFRIGERATION COMPRESSOR SYSTEM:

Automatic control systems used to on, off in the time order and required or the signal specified by controlled member or its partial elements.

Automatic control system could connected to the protect system and automatic signal to ensure the highest performance of the equipment in automatic working mode.
In the control circuit, we use convention symbol designated control devices and signal measuring instrument, sensors.

16.2.1. Continuous control method cooling load of compressor.

In the screw compressor is often controlled by the changing position of the adjustment bar and the effective length of the screw axis changes, its cold capacity modify.

16.2.2. Automatic Protect refrigeration system.

Protection system when the suction pressure below the permitted level.

For compressors had capacity below 500KW, we often used low pressure relay to turn off compressor drive motor.

Protect the compressor when the pressure pushed higher the permitted level:

Protective equipment is high-pressure role, it will turn off the motor circuit when pressure higher limit and installed on the compressor discharge line.

Protect the compressor when the lubricating oil pressure don’t enough:

All compressors used lubricating oil pump, we often used differential pressure switch type circuit breaker to turn off start the compressor motor when the oil pressure, cacte pressure lower the permitted level.

Protect the compressor when the motor temperature is too high:

In the hermetic or serviceable hermetic compressor, we usually mounted the role temperature or temperature sensor to put the turn off signal when the compressor stator temperature higher the permitted level. These roles are set for each phase and will impact the loss of phase, when the solvent flow of compressed air nozzle too little is not enough to cool the engine, the compressor overload.

Protect the compressor when difference discharge and back pressure the permitted level:

In machine had volumetric flow rate greater 0.03 m³/s, we put the safety valve discharge steam switch on compressor suction pressure to reduce the effect of protecting the structure safe for compression.

Protect against the snow formation in the evaporator:

When coolant freezes, the vapor pressure decreases, the coolant stops working, the phenomenon is test equal roles temperature, coolant flow role, low pressure roles located on the top of compression.

16.3. Automatic Power Control System:

16.3.1. The order of operation of the refrigeration system:
a. Pump and cooling tower fan operate.

Circuit protection: water pressure roles or electric current role, when the pump and fan operate, role display status for the water passes through the pipe, or the status of the fan and pump.

When not satisfy this protection, design devices in the order don’t operated, jointly in the circuit protection device overheating, to protect the device.

b. Compressor operate:

To satisfy the condition pump and fan operation then compressed at the ready state if the control signal for the compressor, the compressor operate.

Start conditions and operate compressor 1 & 2

Role compressor thermal protection 49C1 (column 34), 49C2 (40) to close.

Point contact 52P1 (column 29) or 52P2 (column 30) close, contact 52F1 (column 29), point contact 52F2 (column 30) is closed, contact X7 (column 30), X11 (30), X8 (column 34) or X9 (column 40) to close.

16.3.2. Principle of operation of the control circuit.

Order of operations:

a. Cooling tower fan run:

Press the ON button (column 2), the current runs through the wire switches to 52F1 (column 2), coil switch motors impact 52F1 52F1 (column 1) open normally closed, maintain the current through the circuit. Dynamic circuit in the main contacts usually open 52F1 closed, the first cooling tower fan operation. open and regular contact 52F1 (column 22) series of conditions open compressors closed.

b. Cooling water pump:

Press the ON button (column 8) current flows through the coil switches to 52P1 (column 8), coil switch motors impact 52P1 52P1 (column 7) open normally closed, to maintain current through mach.o The main motivation of the circuit usually open 52P1 closed, the first condenser water pump operation. Same time tiep1 often they 52P1 (column 29) chain conditions open compressors closed.

Press the ON button (column 11), the current flows through the coil motor switch 52P3 (column 11), coil motor switch 52P2 impact contacts 52P2 (column 10) open normally closed, the second condenser water pump action. At the same time point usually open 52P2 (column 29) chain conditions open compressors closed.

c. Chilled water pump:
Press the ON button (column 14), the current flows through the coil motor switch 52P3 (column 14), coil motor switch 52P3 impact contacts 52P3 (column 13) open normally closed, maintain the current through the circuit. In dynamic circuits the eel often hoop352P3 contacts closed, the pumps are the first average evaporation. At the same time point usually open 52P3 (column 29) chain conditions open compressors closed.

Press the ON button (column 1), the current flows through the coil motor switch 52P4 (column 17), coil motor switch 52P4 impact contacts 52P4 (column 16) open normally closed, maintain the current through the circuit. In the circuit at the main contacts often they 52P4 closed, water pump operation per second evaporation. At the same time point usually open 52P4 (column 30) chain conditions open compressors closed.

d. Start-up the compressor.

When the necessary conditions are ready, the compressor can operate when the control signal.

Compressor 1 operate:

Press the ON button (column 34), the current flows through the coil boot from 52S1 (column 31), motor activity in star mode, and also go through relays time TR2 (column 36). Time timer relay to impact normally closed contact open slowly TR2 (column 31) and slow open normally closed contact TR2 (column 32). After 15 seconds, starting from 52S1 (column 31) is no longer power, the engine did run mode. And start 52D1 (column 32). Compressor operation mode change from star to delta. Bright lights, in the circuit at the main contacts often they 52C1 closed, the compressor operation.

Compressor 2 operate:

Press the ON button (column 40), the current flows through the coil boot from 52S2 (column 37), motor activity in star mode, time, electric current passing through their roles TR 3 (column 42). Role counting the hours to impact normally closed contact open late TR3 (column 37) and slow open normally closed contact TR3 (column 38). After 15 seconds, starting from 52S2 (column 37) is no longer power, the engine did run mode. And boot from 52D2 (column 38). Compressor operation mode change from star to delta. The morning light, the circuit dynamics of the contact openings 52C usually closed, you should work.

16.3.3. Principle of operation of the circuit to reduce the load, Protection Problem:

Compressor 1:

As low suction pressure signal, point usually open X10 (column 43) is closed:
If you turn the switch in the auto position, the power through the solenoid valve coil from SV1 (column 44), solenoid valve for oil and control piston offloading.

If the switch is rotated in Man, the position is always held in the compressor.

Where the compressor startup, point usually open 52S1 (column 47) is closed, the compressor discharge load on boot mode starts.

**Compressor 2:**

As low suction pressure signal, point usually open X10 (column 48) is closed:

If you turn the switch in the Auto position, the coil solenoid valve SV2 (column 49), the electromagnetic valve for oil control piston offloading.

If the switch is rotated in Man, the position is always held in the compressor.

Where the compressor startup, point usually open 52S2 (column 52) is closed, the compressor discharge load on boot mode starts.

16.3.4. **Principle of Operation Circuit Protection and alarm:**

1. **Cooling tower fan 1:**

   When the cooling tower fan 1 is overloaded. Overload protection 51F1 (column 2) circuit breakers, switches to 52F1 (column 2) does not have the power, the engine stopped running. And mechanical overload protection plays through contact openings, intermediate coils role X1 (column 3) electrical connectors often exposed X1 (column 53) is closed, the alarm circuit program (column 53), the coil TRIODO control alarm red flashing lights. Open points X1 (column 63) close to the fire alarm light.

2. **Cooling tower fan 2:**

   When the cooling tower fan 2 is overloaded. Overload protection 51F2 (column 5) circuit breakers, switches to 52F2 (column 5) does not have the power, the engine stopped running. And mechanical overload protection plays through open contacts, intermediary role coil X2 (column 6), connectors often exposed X2 (the 54th column) closed, alarm bells circuit (column 54), the coil TRIODO control alarm red flashing lights. Connectors often exposed X3 (the 65th column) closed fire alarm lights.

3. **Cooling water pump 1:**

   When cooling water pump 1 is overloaded. Overload protection 51P1 (column 8) circuit breakers, switches to 52F2 (column 8) does not have the power, the engine stopped running. And mechanical overload protection plays through open contacts, intermediary role coil X3 (column 9) electrical connectors often exposed X3 (column 55) closed, alarm bells circuit (column 55), the coil TRIODO control alarm red flashing lights. Connectors often exposed X3 (the 65th column) closed fire alarm lights.
4. **Cooling water pump 2:**

When cooling water pump 2 is overloaded. Overload protection 51P2 (column 11) circuit breakers, switches Medical 52P2 (column 11) does not have the power, the engine stopped running. And mechanical overload protection plays through open contacts, intermediary role coil X4 (column 12), connectors often exposed X4 (the 56th column) closed, alarm bells circuit (column 56), the coil TRIODO control alarm red flashing lights. Connectors often exposed X4 (column 66) close-up of the fire alarm light.

When the problem first in the second compressor pump overload occurs can still activities temporarily, to report the incident to the operation of the quyet. Khi the second pump is overloaded, then the compressor stops working completely.

5. **Chilled water pump 1:**

When coolant pump 1 is overloaded. Overload protection 51P3 (column 14) circuit breakers, switches Medical 52P3 (column 14) does not have the power, the engine stopped running. And mechanical overload protection plays through contact openings, intermediate coils role X5 (column 15) electrical connectors often exposed X5 (column 57) closed, alarm bells circuit (column 57), the coil TRIODO control alarm red flashing lights. Connectors often exposed X5 (column 67) close-up of the fire alarm light.

6. **Chilled water pump 2:**

When coolant pump 2 is overloaded. Overload protection 51P4 (column 17) circuit breakers, switches Medical 52P4 (column 17) does not have the power, the engine stopped running. And mechanical overload protection plays through contact openings, intermediate coils role X5 (column 15), point usually open X6 (column 58) closed, alarm bells circuit (column 58), the coil TRIODO control alarm red flashing lights. Point usually open X6 (column 68) close to the fire alarm light.

7. **Low cooling water pressure protection:**

When cooling water pump operation, if there is no water pressure, water pressure protection role 63PW (column 20) is closed, the current through TR1 time role (column 20) timer after 30 seconds to 90 seconds (the as required by the system) is open normally closed contact within TR1 (column 21) closed, intermediary role X7 (column 21) electric impact the normally closed contacts X7 (column 30) open, the compressor stops operation. Point usually open X7 (column 30) openings, compressed shut dong. Tiep point usually open X7 (column 59) is closed, the program (column 53) alarm, coil control TRIODO lights flashing. Point usually open X7 (column 69) is closed, the fire alarm light.

8. **Protect low oil pressure compressor 1:**
When low oil pressure, oil pressure role 63O1 closed, the current through the resistor (column 23) bimetallic heating temperature (column 24). After 30 seconds to 90 seconds (depending on adjustment), if the oil pressure is not enough, the bimetal circuit breakers, current no longer through intermediate roles X8 (column 24) intermediate role X8 impact on the contact often open (column 34) open, the compressor stops working, normally closed contact X8 (column 60) is closed, the alarm bell circuit (column 38), light control TRIODO alarm flashes. Normally closed contact X8 (column 70) is closed. Fire alarm lights.

9. **Low oil pressure compressor protection 2:**

When low oil pressure, oil pressure role 63O2 closed, the current through the resistor (column 25) bimetallic heating temperature (column 26). After 30 seconds to 90 seconds (depending on adjustment), if the oil pressure is not enough, the bimetal circuit breakers, current no longer through intermediate roles X9 (column 26) intermediate role X9 impact on the contact often open (column 40) open, the compressor stops working, normally closed contact X8 (column 61) is closed, the alarm bell circuit (column 38), light control TRIODO alarm flashes. Points often play X9 (column 71) is closed. Fire alarm lights.

10. **High condensing pressure protection:**

When the high condensing pressure, role 63H closed, the current through intermediate roles X11 (column 28). Role mediated effects normally closed contact X11 X11 (column 30) openings that interrupt the compressor, contact X11 (column 62) closed alarm contacts normally open X11 (column 72) close to the fire alarm.

16.3.5. **Reset circuit after the incident:**

Cooling water pressure is low, turn off the compressor. When you want to restart the compressor to press the reset button (column 61), the current through intermediate roles X13 (column 61). Role X13 intermediate effects normally closed contact X13 (column 22).

When the bell and the emergency light, turn off light and the bell, operator puts ALARM STOP button, the current through intermediate roles X12 (column 58) the impact normally closed contact X12 (column 55) openings, the bell and lights turn off.