Air Dryer

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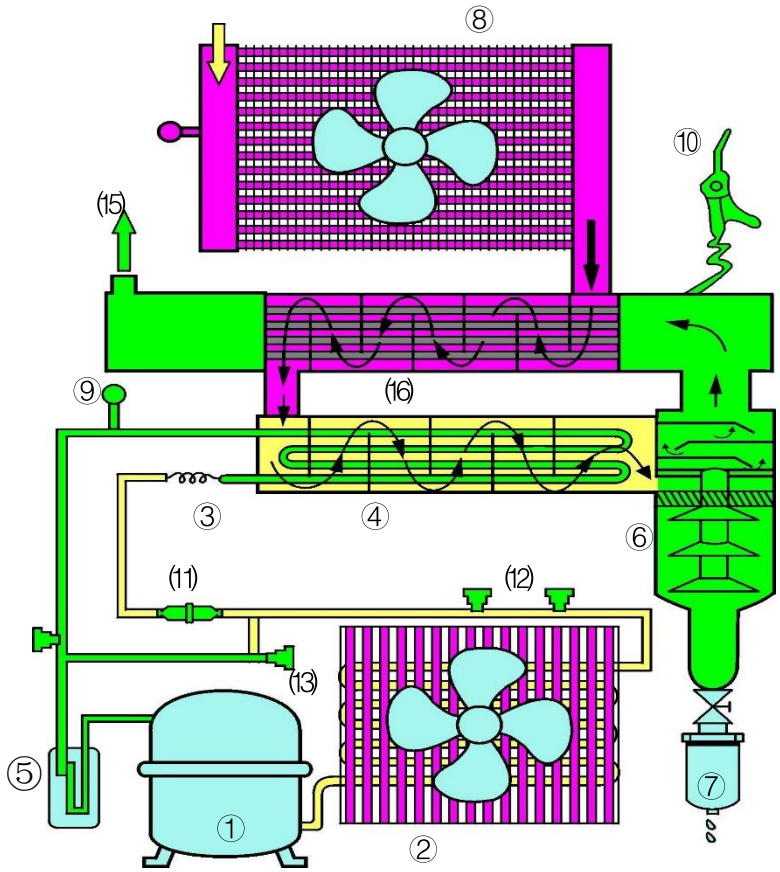
XL-1NF

Working principle,

Maintenance of freezing dryer

1. Flow chart of refrigeration dryer system



① compressor

② condenser

③ throttle valve

④ evaporator

⑤ Reservoir

⑥ Gas water separator

⑦ Automatic drain

⑧ Pre cooler

⑨ Pressure gauge

⑩ Air gun

(11) Drying filter

(12) High and low voltage protection switch

(13) Hot gas bypass valve

(14) Compressed air inlet

(15) Dry air outlet

(16) Precooling regenerator

working principle

The humid and high-temperature compressed air flows into the pre cooler (special for high-temperature type) for heat dissipation and then flows into the heat exchanger for heat exchange with the cold air discharged from the evaporator to reduce the temperature of the compressed air entering the evaporator.

The compressed air after heat exchange flows into the evaporator and exchanges heat

with the refrigerant through the heat exchange function of the evaporator. The heat in the compressed air is taken away by the refrigerant. The compressed air is cooled rapidly, and the moisture in the humid air reaches the saturation temperature and condenses rapidly. The condensed moisture forms water droplets after condensation, and rotates at a high speed through a unique air-water separator. The moisture is separated from the air by centrifugal force,

After separation, the water is discharged from the automatic drain valve. After cooling, the dew point of air pressure can reach 2 ℃.

The cooled cold air flows through the air heat exchange to exchange heat with the high-temperature humid and hot air at the inlet. The heat exchanged cold air absorbs the heat of the inlet air and increases the temperature. At the same time, the compressed air is heat exchanged with the high-temperature refrigerant again through the **secondary condenser of the refrigeration system** (unique design of our industry) to fully heat the outlet temperature and ensure that the outlet air pipeline does not condense. At the same time, the cold source of the outlet air is fully utilized to ensure the condensation effect of the refrigeration system of the machine and the quality of the outlet air of the machine.

Description of main instruments and main control switches of the machine

The main instruments of the unit are composed of compressor air pressure gauge, refrigerant high pressure gauge and refrigerant low pressure gauge; The main controller is composed of on / off button switch, high and low protection switch of refrigeration system and antifreeze switch.

① The air pressure gauge is installed on the instrument panel to display the pressure of compressed air on the machine. The table is composed of several scales. The lower MPa and middle kg / cm2 in the table represent the unit value of pressure. When reading the pressure value, observe the scale value corresponding to the pointer on the table plus its relative unit value.

② The refrigerant low gauge is installed oon the instrument panel to display the pressure or temperature of the low-pressure end of the refrigeration system. The gauge is composed of several scales and the reading method is the same as that of the high-pressure gauge.

Main controller

① The on / off button switch is installed on the instrument panel of the machine to control the operation and stop of the machine.

② The high and low voltage protection switch of the refrigeration system is installed in the machine to control the refrigeration system

The pressure of the high-pressure end and the low-pressure end can avoid the damage of the equipment caused by the pressure of the machine exceeding the use range.

③ The defrosting solenoid valve is installed in the machine to control the condensing pressure of the machine to avoid the ice blockage of the evaporator due to the low condensing pressure of the machine.

Main parts of freezing dryer

① Compressor

At present, most of the refrigeration compressors used in the cold dryer are medium and high temperature fully sealed reciprocating compressors, which are characterized by compact structure, small volume, light weight, small vibration, low noise and high energy efficiency ratio. Since the motor of the fully sealed compressor and the main body of the compressor are sealed in a steel shell, the motor operates in the gaseous environment of the refrigerant, with good cooling conditions and long service life. There is a specified amount of lubricating oil in the lower part of the housing. When the compressor is working, it will automatically supply oil to all parts. It is not necessary to add lubricating oil at ordinary times. Semi hermetic reciprocating machines or screw compressors are also used in large-scale dryers. They are characterized by high cooling power and can be adjusted to meet different needs.

② Heat exchange, evaporator

The main role of heat exchange in the dryer is to use the cooling capacity carried by the compressed air cooled by the evaporator (for most users, this part of cooling capacity belongs to waste cooling) and use this part of cooling capacity to cool the high-temperature compressed air carrying a large amount of water vapor, thus reducing the heat load of the cooling system of the dryer and achieving the goal of energy saving. On the other hand, the temperature of the low-temperature compressed air rises in the heat exchanger, so that the outer wall of the exhaust pipe will not be dewed due to the low temperature.

The evaporator is the main heat exchange component of the cold dryer. The compressed air is forced to be cooled in the evaporator, and most of the water vapor is cooled and condensed into liquid water and discharged out of the machine to dry the compressed air. In the evaporator, the convection heat and mass exchange between air and low-pressure vapor of refrigerant is conducted. The low-pressure refrigerant liquid after passing through the throttling device changes into low-pressure refrigerant vapor in the evaporator, absorbs the surrounding heat in the process of phase change, thereby cooling the compressed air.

In order to obtain a high heat transfer effect as much as possible, the heat release coefficient must be increased, that is, the heat exchange area of the heat exchanger must be added. Therefore, the outer wall of the evaporator and the copper tube of the heat exchanger of the cold dryer is covered with aluminum fins. At the same time, after the copper tube of the heat exchanger is covered with fins, the impact of air on the copper tube can be reduced and the rupture of the copper tube can be avoided.

③ Condenser, secondary condenser (precooling regenerator)

The function of the condenser in the dryer is to cool the high-pressure and superheated refrigerant vapor discharged from the refrigerant compressor into liquid refrigerant, so that the refrigeration process can continue. The heat discharged by the

condenser includes the heat absorbed by the refrigerant from the evaporator and the heat converted by the compression work. Therefore, the load of the condenser is larger than that of the evaporator. The condensers in the dryer are divided into air-cooled (air-cooled condenser) and water-cooled (water-cooled condenser).

The secondary condenser (precooling regenerator) has the same function as the heat exchange on the machine. The difference between the two is that the heat exchanger mainly exchanges heat of high-temperature and low-temperature compressed air, while the secondary condenser mainly uses low-temperature compressed air to cool the high-pressure part of the refrigeration system to make the refrigerant

To achieve sufficient cooling, so as to improve the refrigeration efficiency of the machine, and avoid high-pressure tripping or machine failure caused by poor heat dissipation of the condenser of the machine.

④ Cyclone separator (gas water separator)

Cyclone separator is also an inertial separator, which is mainly used for gas-solid separation. After the compressed air enters the separator along the tangential direction of the cylinder wall, it rotates inside. The water droplets mixed in the gas also rotate together and generate centrifugal force. The centrifugal force generated by the water droplets with large mass is large. Under the action of centrifugal force, the large water droplets move to the outer wall, and when they meet the outer wall (also the baffle), they will gather and grow up and separate from the gas.

⑤ Hot gas bypass valve

When the compressed air is cooled in the evaporator, a large amount of condensed water is separated out. If the evaporation temperature of the refrigerant is too low, so that the surface temperature of the copper pipe of the evaporator is lower than the freezing point of water under the load condition, the condensed water will freeze in the evaporator, blocking the air flow channel and paralyzing the air supply pipeline in serious cases. In order to prevent this situation, the evaporation temperature of the

refrigerant must be controlled. The simple and effective measure is to add a hot gas bypass valve between the condenser and the evaporator, and the pressure measuring pipe of the hot gas bypass valve is directly connected with the evaporation pressure. When the evaporation pressure is lower than a certain level, the hot gas bypass valve will automatically open, and the high-temperature refrigerant vapor in the condenser will directly enter the evaporator to increase the evaporation temperature and avoid ice blocking.

⑥ Thermal expansion valve or capillary tube (throttle valve)

Expansion valve (capillary tube) is the throttling mechanism of refrigeration system. In the cold dryer, the supply of the evaporator refrigerant and its regulator are realized by the throttle mechanism. The throttling mechanism allows the refrigerant to enter the evaporator from the high-temperature and high-pressure liquid. When the load changes, the thermal expansion valve adjusts the opening of the valve core by detecting the overheated temperature of the compressor suction, so as to control the supply of refrigerant into the evaporator. The capillary tube has self compensation characteristics, that is, when the evaporation pressure decreases, the pressure difference at both ends will rise correspondingly, thereby increasing the amount of refrigerant flowing into the evaporator. Because of its simple structure, the capillary works

Stable and widely used in small-scale cold drying machines.

⑦ Automatic drain valve

In the freezing dryer, the condensed condensed water shall be discharged out of the equipment in time to avoid the rise of air moisture content due to the untimely discharge of condensed water. In order to facilitate the discharge of condensed water, the equipment is equipped with an automatic drain valve. When the water level in the water cup of the drain valve does not reach a certain height, the pressure of compressed air will press the floating ball down to close the drain hole, There will be

no air leakage: as the water level in the water storage cup rises (there is no water in the cold dryer at this time), when the floating ball rises to a certain height, the drain hole will be opened, and the condensed water in the cup will be quickly discharged out of the machine under the pressure. In addition to the floating ball type automatic drainer often used, electronic automatic drainer is also often used. The time of this drainer and the time interval between two drainages can be adjusted, and it can withstand high pressure. It is also widely used.

⑧ Drying filter

In the refrigeration unit in operation, due to the presence of water, solid powder, dirt and other impurities in the refrigerant and refrigerant oil, the orifice of the throttling structure will be blocked in serious cases. Therefore, a drying filter must be installed before the refrigerant supply pipe. In addition, the trace moisture in the refrigerant is the most harmful to the refrigeration system. It is very important to dry the refrigerant, refrigerant oil, evaporator, condenser and piping.

Refrigerant cycle principle of refrigeration system

☆ after startup, the refrigerant is compressed by the compressor from the original low-temperature and low-pressure state to high-temperature and high-pressure steam.

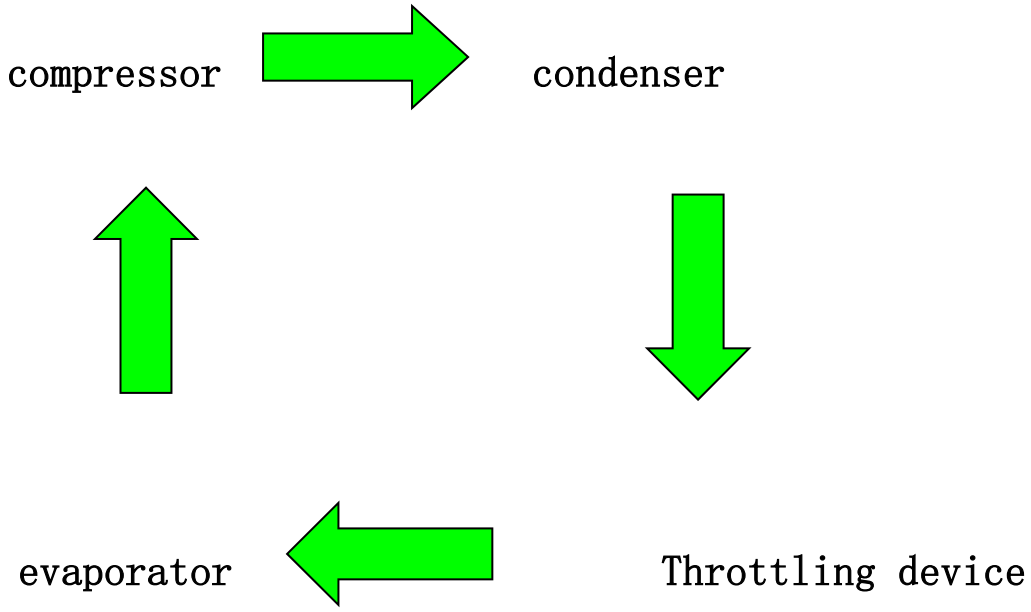
☆ the high-temperature and high-pressure steam flows into the condenser and the secondary condenser, and its heat is taken away by the cooling medium through heat exchange. The temperature drops, and the high-temperature and high-pressure steam becomes a liquid at normal temperature and high pressure due to condensation.

☆ the liquid refrigerant with normal temperature and high pressure flows through the expansion valve. Because the throttling pressure of the expansion valve decreases, the refrigerant becomes a liquid with normal temperature and low pressure.

☆ after the liquid at normal temperature and low pressure enters the evaporator, the liquid refrigerant boils and evaporates into low-pressure and low-temperature gas due to the decrease of pressure. When the refrigerant evaporates, it absorbs a large amount

of heat of compressed air, so that the temperature of compressed air decreases to achieve the purpose of drying.

☆ the evaporated low-temperature and low-pressure refrigerant vapor flows back from the suction port of the compressor, is compressed and discharged into the next cycle.



Operation and maintenance of the machine

① Inspection items before startup

1. whether the power supply voltage, phase number and frequency meet the requirements (please refer to the nameplate), and whether the power line wiring is firm.

2. whether the connecting parts of all piping of the system are locked.

3. check whether the refrigeration system pressure of the machine is normal. (Please inform our dealer or our service department if the indication of pressure gauge is lower than 0.2MPa)

4. whether the dryer is properly placed and whether the ambient temperature meets the use requirements.

5. check whether the ball valve at the front of the automatic drain valve is open.

6. whether the inlet temperature of the dryer exceeds the specified value.

7. in order to better improve the air quality, please start the dryer and make it run smoothly before sending compressed air. When closing, please close the compressed air first and then close the dryer, and empty the compressed air in the air pipeline to avoid affecting the air quality due to poor drying or residual water in the pipeline.

② **startup and operation**

1. send the power to the control box, press the on button of the on / off button switch, and the operation indicator light indicates that the machine

2. the contactor is closed and the compressor operates. At this time, the pointer of the refrigerant low-pressure gauge should indicate 60 ~ 85psig.

3. if the load exceeds this range, please adjust according to evaporation pressure regulation.

4. after the compressor runs smoothly, the pressure of the refrigerant high-pressure gauge rises to 120 ~ 240psig. When the refrigerant is under high pressure

5. if the force is higher than this range, please check whether the heat dissipation of the condenser is good, whether the inlet temperature of the air compressor and the ambient temperature are

6. too high. When it is lower than 140psig, the antifreeze switch acts, and the condensing fan stops to raise the pressure to ensure the machine

7. If the machine operates under low pressure for a long time, please check whether the refrigeration system leaks

8. whether the ambient temperature is too low. To avoid damage to the compressor due to frequent startup. It takes more than three minutes to restart after shutdown.

9. the valve on the machine has been adjusted before delivery. Do not adjust it by non-professional personnel to avoid unnecessary damage to the machine.

③ Stopping the machine

1. please shut down the air compressor before shutdown.
2. after turning off the air compressor, press off of the on / off switch to turn off the machine
3. turn off the power of the machine.

④ Commissioning of machine (adjustment of evaporation pressure)

1. when the low pressure of the refrigerant deviates from the normal value after the machine starts and runs smoothly, please adjust the hot gas bypass valve as follows.
2. when the evaporation pressure of R-22 refrigerant is lower than 0.4MPa, adjust the hot gas bypass valve clockwise with a hex wrench to make the hot gas enter the system, and the evaporation temperature is high. When it is higher than 0.5MPa, adjust the hot gas bypass valve counterclockwise with a hex wrench to reduce the evaporation temperature.
3. when R-12 refrigerant is used, the evaporation pressure range is between 0.18 and 0.32mpa. When it is lower than 0.18mpa or higher than 0.32mpa, the hot gas bypass valve shall be adjusted. The adjustment method is the same as that of R-22 system. (R12 is gradually phased out)
4. before adjusting the bypass valve, check whether the machine load is too large, whether the ambient temperature and inlet temperature are too high, whether the condenser is dirty and blocked, etc. in case of the above conditions, it shall be eliminated before adjustment. If the normal value cannot be reached after adjustment, please contact our dealer.
5. the evaporation pressure has been adjusted before delivery. Do not adjust it if there is no change in pressure.

⑤ Maintenance of the machine

The maintenance of the machine is to ensure the normal operation of the machine and

the air quality. The maintenance of the machine can be divided into daily maintenance and periodic maintenance.

⑥ **Routine maintenance items**

1. Before starting the machine, check whether the condenser on the back of the machine is clean to avoid poor heat dissipation. Check whether the safety device is reliable before startup.
2. Check whether the working pressure and current are normal after the machine runs for 10-20 minutes. After the compressed air is introduced, run for 10-20 minutes to check whether the automatic drain functions normally.
3. Please open the blowdown valve of the machine more than twice a week.
4. The manual drain valve of the machine must drain water more than twice a day.
5. When the ambient temperature is high, please check whether it exceeds 40 ℃. If it exceeds 40 ℃, please improve.

⑦ Periodic maintenance items

1. Clean the condenser on the back of the machine with dry compressed air or copper brush more than once a week.
2. Check whether the automatic drain valve is blocked every month. If it is blocked, please clean it. Check whether the cooling fan blades have bad vibration every three months.
3. Check and tighten all screws, bolts and various fixing devices every year. Check, clean and tighten all electrical connectors every year.

⑧ **Judgment and treatment of common faults of the machine (freezing dryer)**

High voltage trip

Fault condition: the fault indicator light is on after the machine jumps. After the high-pressure pressure drops, the fault indicator light is off, and the machine starts to operate as usual.

Reason 1: the ambient temperature of the machine site is too high (more than 40 ℃)

1. The machine room is located on the top floor of the plant, with direct sunlight and poor ventilation.

2. The machine room is too small and there is no exhaust fan, so the ventilation is poor.

3. The air compressor is not equipped with an exhaust pipe, and the hot air emitted in the machine room causes the ambient temperature to rise.

In view of the above problems, the manufacturer is recommended to improve the heat dissipation of the machine room.

Cause 2: the condenser and cooler are dirty and blocked

1. The condenser has a lot of dust and impurities. (air cooled type)

2. The cooling water pipeline is not equipped with Y-shaped filter, and the poor water quality causes no temperature difference at the inlet and outlet of the condenser (water-cooled type)

3. Cooling water tower damaged

Teach the user how to clean the condenser according to the above problems.

Reason 3: machine placement

1. The machine is placed too close to the surrounding wall (not less than 50cm)

2. Front and rear placement of the machine (air-cooled)

3. All heat sources in the machine placement site (direct sunlight or hot gas discharged from the air compressor)

4. There is much dust in the place where the machine is placed

In view of the above problems, the user is recommended to improve the placement position and place of the machine.

Reason 4: condenser fan motor does not rotate

1. Fan motor starting capacitor is broken down

2. The bearing of the fan motor is stuck

3. Fan motor coil burnt

Reason 5: the horsepower of the air compressor (air handling capacity) does not match the refrigeration drying

Reason 6: compressed air is mixed in the refrigeration system.

The machine trips when the machine current is too high

Fault condition: the machine cannot be started because of the indication of the machine tripping fault indicator. It can be restarted only after manually resetting the overload relay.

Cause 1: the unstable on-site power supply voltage leads to large current fluctuation of compressor, fan and motor in the machine.

Cause 2: the compressor is stuck inside, resulting in excessive starting current.

Cause 3: the starting capacitor of the compressor is damaged.

Cause 4: the compressor overheat protection is damaged.

Cause 5: the distribution wires are loose, resulting in poor contact of wires and excessive current.

Cause 6: the machine circuit is short circuited.

Cause 7: poor contact of AC contactor leads to high current.

Cause 8: the setting of overload relay current is too low or damaged.

Cause 9: the compressor is started and shut down too frequently

water removal effect is poor

Fault condition: there is water on the gas use site

Reason 1: the automatic drain valve does not drain water

1. Filter screen at the inlet of automatic drain valve is blocked

2. The float ball of automatic drain valve is broken

3. The drain rod of automatic drain valve is stuck

4. The use pressure of automatic drain valve is too high

5. Automatic drain valve (ball valve) is not opened

6. Electronic drain valve solenoid burnt out

Reason 2: the evaporation temperature of the dryer is too high

1. The inlet temperature of the dryer is too high (exceeding the maximum inlet temperature marked on the machine)

2. The ambient temperature of the machine room is too high and the radiator condenser is blocked without cleaning

3. Excessive regulation of hot gas bypass valve

4. The air compressor operates continuously, but the pressure is low and the on-site air consumption is too large.

Reasons: 3. The evaporation temperature of the dryer is too low

1. Refrigerant leakage of refrigeration system

2. Dry filter clogged

3. The expansion valve is blocked or damaged

4. The antifreeze switch is damaged, and the fan operates continuously.

Reason 4: The horsepower of the air compressor is not matched with that of the cold dryer

Reason 5: the bypass valve in the air pipeline of the dryer is not closed tightly

Reason 6: the startup sequence is wrong. The dryer should be started for 5 minutes before the press is started.

Note: under the condition that the dryer is running normally, there are concave and convex spots on the work-piece during spraying.

How to judge:

1. Whether the compressed air contains oil (can be inspected on site)

2. Whether the sprayed raw materials are clean (can be tested on site)

3. Whether the spray gun has problems (can be operated on site)

4. Whether the cleaning agent used to clean the spray gun is defective (can be operated on site)

5. Whether there is any problem with the operation of the on-site painting personnel (you can learn from the user)

6. Whether the concave and convex points of the work-piece appear at a fixed time (can be inquired from the user)

7. Whether there is any problem in the field environment (field test is available)

Low voltage trip

Fault condition: after the machine jumps, the fault indicator will indicate that the machine cannot be started.

Cause 1: the refrigerant leakage in the refrigeration system of the machine is divided into external leakage and internal leakage.

I. the external leakage can be checked by visual inspection or soapy water (mainly check the following points)

1. Refrigeration accessories (pressure gauge, pressure switch, angle valve, expansion valve, charging valve, refrigerant discharge valve, etc.)

2. Refrigeration system pipeline (condenser inlet and outlet welding, copper pipe elbow tee, capillary welding leakage, each welding point of refrigeration system copper pipe)

II. The internal leakage can be detected by compressed air or by sections

Compressed air detection method

1. Open the bypass valve of the air pipeline and close the inlet and outlet valves of the dryer

2. Discharge all the pressure of the refrigeration system, and then open the inlet valve of the dryer to allow the compressed air to enter the dryer. If there is a leakage point in the evaporator or the secondary condenser, the pressure gauge of the refrigeration system will have a pressure indication, and the final indicated pressure will be as high as the pressure

of the compressed air.

Segmented detection method

1. The copper pipes at the inlet and outlet of the evaporator and the condenser are cut into sections, and the pressure maintaining and leakage detection are carried out for the evaporator and the condenser respectively.

Reason 2: low pressure protection pressure is set too high

Reason 3: the refrigerant in the refrigeration system is blocked;

Reason 4: the ambient temperature is too low

Reason 5: there is too little refrigerant

Pressure drop occurs at the inlet and outlet of the machine

Fault condition: there is a pressure difference between the inlet pressure and the outlet pressure of the freezing dryer.

Cause 1. The evaporation temperature of the dryer is too low, causing ice in the evaporator

Cause 2: the diameter of the compressed air pipeline is smaller than that of the air inlet and outlet of the dryer;

Cause 3: there are too many bends in the compressed air pipeline

Cause 4: the filter element of the precision filter is blocked;

Cause 5: the inlet and outlet valves are not fully opened;

Cause 6: the compressed air configuration pipeline is too long

the machine cannot run

Cause 1: wrong connection or disconnection of power supply

Cause 2: AC contactor coil burned

Cause 3: overload relay contact burned

Cause 4: high and low voltage protection switch contact burned out

Cause 5: fuse or non-fuse switch tripped

cause 6: machine start switch contact open circuit

Cause 7: poor contact of oil pressure switch and flow switch

cause 8: failure to reset after tripping of high and low voltage protection

Cause 9: the phase of the incoming power supply is inconsistent with the phase of the compressor

cause 10: the display circuit board and the internal programming of the relay are faulty

⑨ How to check the refrigerant leakage of the refrigeration system

Leakage detection shall be carried out under the working pressure of the system or under the condition of filling a certain amount of refrigerant. The following methods are commonly used to check the leaking refrigerant:

Leakage detection by visual inspection:

In the refrigeration system, if there is oil leakage and dripping at a certain part, it can be concluded that there is refrigerant leakage at that part. This method is applicable to the refrigeration system that has already used the machine.

Halogen lamp leakage detection:

Halogen lamp is suitable for leakage detection of refrigeration system filled with a small amount of refrigerant.

Halogen leak detection lamp is one of the commonly used instruments. Because its leak detection is more accurate and less error. It consists of a portable propane or liquefied petroleum gas tank, a suction hose and a special burner containing copper. The gas is supplied to the burner and ignites a small fire. The probe of the suction hose is close to the leakage point. When the leaked refrigerant vapor is sucked into the straw and sent to the burner with copper element, the flame of the halogen lamp changes from red to green. When a large amount of refrigerant burns, the flame is purple. Carefully observe the change of flame color during leakage detection of burner. If you have experience, even if the leakage is small, you can detect it.

Specific operation method:

if all the refrigerant in the system has been drained. The machine must be refilled with refrigerant to make the refrigerant pressure reach about 0.25MPa, and then pressurized to 1.23mpa with inert gas (nitrogen) to start leak detection.

Note: oxygen or combustible gas cannot be used for pressurized gas

Halogen leak detector leakage detection:

Halogen leak detector is also known as electronic leak detector. Its working principle is produced by Freon ionization

The ion current is generated to deflect the pointer of the micro-ammeter and make a beep. When using, turn on the power supply first, align the probe with the leakage detection part and move it slowly. In case of Freon leakage, the pointer will deflect and there will be a beep prompt. The halogen leak detector has high sensitivity and is mainly used for fine inspection after refrigerant is charged into the refrigeration system to find the leakage points that are difficult to find.

Soapy water leakage detection:

The specific operation method is to fill dry nitrogen to make the system pressure reach 14MPa, and then wipe it on all joints and welding joints with soapy water. If bubbling occurs, it proves that there is leakage here. This inspection can ensure that there is no mistake. This method is simple and convenient.

When inspecting the leakage refrigerant of the machine, each step of the leakage detection process should be followed, and care should be taken to ensure that the fault point can be quickly found.

Leakage detection by pressurized water immersion method:

Immerse the whole equipment or parts filled with working pressure into warm water, and observe carefully after the water surface is calm. If there are bubbles escaping, it indicates that there are leakage points. This method is suitable for leak detection of single parts or small refrigeration equipment, and is simple and practical.