industrial microwave heating equipment

The electrical system of industrial microwave heating equipment is based on weak current control of strong electricity, closed loop control and operating priority
The principles are designed. The basic control method is to control the opening and closing of the AC contactor and the relay to achieve the alignment
Control of systems such as wet exhaust fans, material transfer motors, microwave power supplies, and automatic deflection adjustment;
Industrial microwave heating for feedback components such as photoelectric proximity switches, infrared temperature measurement, temperature meters and thermal overload relays
The operating state of the equipment is sent to the control system to achieve closed-loop control; the operating priority of the industrial microwave heating equipment is
Turning on the microwave power supply must be carried out on the basis of the safety of personal equipment. The most direct performance is to turn on the microwave high.
Before the pressure, the microwave suppression system and safety must be in place. For example, the microwave cavity door must be closed and the equipment ground wire is in good contact;
The microwave high-voltage magnetron and transformer cooling system must be operated in advance, and the equipment must be in the microwave cavity.
There is a load that absorbs microwave energy, and it is prohibited to turn on the microwave high voltage without load or light load.
2.3 Box microwave heating equipment system design
Nowadays, the heating of lunch boxes in large gatherings is a must-have item.
A microwave heating device is also considered, and such heating is also a conventional device. Conventional industrial microwave heating equipment [28-29]
Divided into small multi-tube and single-tube two-class, small multi-tube equipment microwave part is 700W to 1000W low-power magnetic
The composition of the tube, the microwave part of the single-tube equipment is composed of a high-power magnetron of 10 kW or more. Small multi-tube tunnel industry
Microwave heating equipment belongs to the conventional industrial microwave heating equipment and has certain representativeness, according to electrical control and
The operation function can be divided into four functional parts: microwave control, transmission control, moisture control and monitoring system.
2.3.1 Microwave control design
Microwave control is mainly based on the production needs of the household to control the opening and closing of the magnetron to achieve different power
Microwave energy control method. The microwave power is calculated according to the user's production plan; microwave control work
The energy part also includes cooling control, that is, cooling of the magnetron and the transformer, and the selection of the cooling fan is also
It is calculated by selecting different magnetrons.
The microwave heating equipment usually contains a certain amount of water, and the rice has a higher water content.
All of them use microwave energy to act on the material molecules, so that they can be heated or evaporated to meet production needs. If water is used

According to the thermal formula, the microwave energy can be calculated within the specified time required for the water temperature to reach the expected temperature.
rate,
Box microwave heating equipment is mainly for the rapid heating of cold chain food, also known as cold chain box rice heating equipment. It is widely used in enterprises, schools, fast food companies, exhibitions, etc., and small food and beverage stores use large microwave ovens for heating. This large microwave oven is also called fast food heating machine. Its advantages are high output, fast and fast, and short The temperature requirement can be reached in about a minute. Does not destroy the nutrients of the food, does not change color, does not change the flavor. At the same time, due to the combined effect of the thermal effect and the non-thermal effect of the microwave during the heating process, the food has a bactericidal effect and meets the hygiene requirements of the food. Microwave heating box rice is the best choice for current box heating equipment. The size of the equipment can be designed according to the customer's output in a targeted and reasonable manner.

Microwave box rice heating process:
Central kitchen cooking --? Food distribution --? Quick frozen --? Packaging --? Refrigeration --? Delivery --? Microwave heat sterilization --? Meal
Where m is the weight of water, t is the heating time of the material, and m/t is the production throughput, which can be used
The amount of production processing calculates the actual amount of microwave power required, and the power data is then passed through the thermal energy loss and equipment. After the efficiency is calculated, the number of magnetrons and the selection can be determined. According to the above, the basic design can be designed to meet the requirements.
The microwave power of the industrial microwave heating equipment required by the mission. The lunch contains a lot of water, which can be replaced by the specific heat capacity of the water when designing its microwave heating equipment. One
The lunch is about 0.3Kg. If you want to supply about 100 people in 5 minutes, the production capacity is
3Kg/min is also 180Kg/h; the temperature of the lunch is 45°C, and the room temperature is generally -5°C.
Calculate ? T to 50 ° C and substitute equation (2-3).
P=4.2m? T/t=4.2*180*50/1?52.5(kW)
The heat energy loss during heating is about 0.2, and the equipment efficiency heating efficiency (material absorption efficiency) is about 0.8.
The budget microwave power is designed to be 52.5/((1 - 0.2)*0.8) ? 82 (kW), plus 10% capacity calculation
The post design microwave power should be 90kW.
(1) Magnetron selection: The total microwave output power is 90kW, and 90 Panasonic 2M244-M1 magnetrons are selected.
Tube, this magnetron is 1kW microwave energy output.

Microwave box rice heating equipment product detailed parameters:
Model: VYS-60HM
Power input: three-phase 380±10% 50HZ;

Output microwave power: 60KW (power adjustable)
Frequency: 2450MHz ± 50MHz
Equipment (length × width × height): 10350mm × 1900mm × 1700mm
Microwave leakage: in line with national GB10436-89 standard ? 5mw/cm2
Meet GB5226 electrical safety standards
Microwave heating equipment output (650~700g/box): 1200 boxes/hour (cold chain) 2400 boxes/hour (hot chain)
(2) Control function: use transformer to convert AC220V industrial power into AC3.3V filament voltage and
AC2100V high voltage, high voltage is half-wave rectified by high voltage diode and then doubled by high voltage capacitor
The high voltage of DC4200V is applied to the filament to meet the working requirements of the magnetron [30-31].
(3) The electrical circuit diagram is shown in Figure 2-7. The magnetron used is 2450MHz [32-33], and the control is used.
The AC contactor is disconnected to control the primary voltage of the high voltage transformer, thereby controlling the output of the microwave energy.
Whether or not. In the figure, BX1 is a short-circuit protector for emergency disconnection in the event of a dangerous situation such as overload or short circuit;
K1-1 controls the primary voltage of the T1 high voltage transformer for the AC contactor K1 to be electrically closed and opened; C1 is
High voltage capacitor, V1 is high voltage diode, VE1 magnetron.
(4) Power supply incoming current calculation: I=P total / U, where P is the total working power of a single magnetron, and P total
=P real / ? = 1000 / 0.65 ? 1538W, I = P total / U = 1538 / 220 ? 7A. Considering the current when the magnetron is working
Large, use the incoming line 380V three-phase five-wire system for power supply, using the "triangle" connection method to meet the magnetron tube
Source requirement, the advantage is that the current passing through the zero line is small, and only when the three phases are unbalanced, the current passes; the disadvantage is that
The three magnetrons of the group must work at the same time, and the current flowing through the neutral line is not large at the same time. 90 magnetrons are divided into
In group 30, the current per phase of the total incoming line is I total = I * 30 = 210 A.
The cooling control is because the magnetron and the transformer self-heat when working, to ensure stable operation for a long time.
Both need to design a cooling system for air or water cooling.
The cooling control is mainly designed to ensure the safe and stable operation of the microwave power supply. In industrial microwave heating equipment
High-voltage transformers, in order to obtain the smallest geometry, the high-voltage transformer is designed to work with magnetic flux density and electricity.
The flow density is very large, resulting in a high operating temperature rise for the transformer. Transforming under air-cooled working conditions
The temperature rise of the device exceeds 120K, and the magnetron also generates a large amount of heat during operation, which requires industrial microwave heating.
The equipment has a corresponding cooling control system during long-term stable operation.
(1) Control function: realize the air-cooling device before starting the microwave high voltage

and working.
(2) The electrical circuit diagram is shown in Figure 2-8, using the control AC contactor and relay to open and close
Control air-cooled cooling fans. In the figure, BX1 is a protection short circuit protector for cooling fans.
Emergency disconnection in dangerous situations such as overload or short circuit; K1 is an AC contactor wire package to control its closing and breaking
Open to control the fan and solenoid valve.
(3) Calculation of cooling air volume: The following five conditions must be known to calculate the air volume of the fan:
1, 1 card is equal to 1g of heat required to raise the temperature by 1 °C by water at 0 °C;
2, 1 watt of power working for 1 second is equal to 1 joule, 1 card is equal to 4.2 joules;
3, air constant pressure (10mmAq) specific heat (Cp) = 0.24 (Kcal / Kg ° C);
4, standard state air: temperature 20 ° C, atmospheric pressure 760 mmHg, humidity 65% of the humid air as the standard
Quasi-air, at this time the weight per unit volume of air (also known as specific weight) is 1200g / M * 3;
5. CMM and CFM refer to the volume of air discharged per minute. The former unit is cubic meters per minute;
The unit is cubic miles per minute.
The fan air volume calculation formula is as follows (2-4), where H is the total heat output of the fan, Cp is the specific heat, and W is the weight.
The amount, ?Tc container allows for temperature rise.
H=Cp×W×?Tc (2-4)
And the weight is equal to the product of the volume and density between units (per second).
W=(CMM/60)×D (2-5)
=(CMM/60) ×1200g/M3
=(Q/60)×1200g/M3
Substituting the formula (2-2) into the formula (2-1) gives the total heat formula (2-6)
H=0.24(Q/60) ×1200g/M3×?Tc (2-6)
The electrical heat calculation formula is as shown in formula (2-4), where H is the electrical heat, P is the power, and t is the time.
The unit is seconds.
H electricity = (P × t) / 4.2 (2-7)
The fan air volume formula (2-8) is known from formulas (2-6) and (2-7).
0.24(Q/60) ×1200g/M3×?Tc=(P·t)/4.2
Q=(P×60)/1200×4.2×0.24×?Tc Q=0.05P/?Tc (2-8)
In the calculation of the magnetron working power input line, P is 1538W, and the normal transformer operating temperature is 70°C.
In summer, the maximum temperature is 40 °C, then ?Tc=70-40=30°C according to the formula Q=0.05P/ ?Tc
Q=0.05×1538/30?2.6 The fan air volume is calculated to be about 2.6 CMM, which is 2.6M3/min. Optional
125FZY2-S fan, power supply is AC220V, power is 26W, and the speed is 2400r/min.
2.3.2 Transmission Control Design
Transmission control is an essential part of tunnel microwave heating equipment, and

conventional transmission control is electromagnetic speed control.
The method of driving the motor, this control method is relatively backward, the control precision is not enough, and it can not meet the online reality.
Speed control. Consider the versatility of control and the ability to design a tunnel type microwave oven
Meet the requirements of online real-time speed control, that is, to meet the process of box lunch heating in different seasons and different temperatures
For speed requirements, the inverter is selected as the transmission control core of the transmission part. The inverter has continuous operation and operation
The advantages of simple setting, etc.; the inverter control motor can realize soft start and soft shutdown, and can be used according to actual conditions.
It is intended to adjust the acceleration or deceleration time of the motor, and the startup can be reduced by the soft start and soft shutdown of the inverter.
The current is 1.5~2 times of the rated current when the motor starts, and the current rated current is 6 times when the motor is normally started.
Starting current, so it will bring a certain load to the frequent running and stopping of the motor; the inverter can be based on raw
Production needs to change the running speed of the motor at any time; the inverter also has analog signal control and output functions.
RS485 communication function, easy to interface with the upper control system.
(1) Control function: use the inverter to control the motor operation, drive the conveyor belt to transfer materials, if the conveyor belt
Longer, it is necessary to increase the automatic leveling device to prevent the conveyor belt from running out of fault.
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2.3.3 Design of dehumidification control and monitoring system
The moisture control is to discharge the steam heated by the lunch out of the heating box to reduce the water vapor.