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## I Principle of high frequency induction heating

The principle of high frequency induction heating is that apply high frequency alternating current to a conduct that is curled to cyclic (normally copper tube) to produce flux, then put the metal in this area to make the flux run through it, and eddy current will be generated in the direction of **self-capturing with flux** (rotary current), the induced current then generates heat under the influence of the eddy current, so this heating method is called induction heating. Hence, metal and other objects under heated can be heated without contact. At this moment, the character of the eddy current relies in that the induction heating on the object nearby the coil is outwardly strong but inwardly weak. With this principle, the heating body can be concentratedly heated where needed to achieve instantly effect, thereby the production output and work capacity are both improved.

## II Model selection instruction for induction heating equipment

Heating type	Application range	Frequency selection	Power selection
Soldering	Complex welding of bits, cutters, reamers, milling cutters, drills and other tools as well as various of materials of stainless pan bottom	Principle: the greater the welding volume is, the lower the frequency should be. For tools with volume smaller than 30*30*30, high frequency may adopted;	Based on the shape, materials, solders and other elements.
Workpiece diathermy	Processing such as hot heading and hot rolling of fasteners, standard parts, auto parts, hardware tools, riggings and twist drills	Principle: the greater the diameter of workpiece is, the lower the frequency should be. For example: mediate frequency (1-20KHZ) for $\Phi$ greater than 20; high frequency (20-100KHZ) for $\Phi$ between 5 and 20; low frequency (100-500KHZ) for $\Phi$ lower than 5.	Select appropriate power on a basis of production efficiency – the higher the efficiency is, the higher the speed is. For details please inquire the technicians of our company.
Heat treatment	Shafts, gears, sprockets, accessories of guide rail of machine tool, metal wire annealing, hydraulic fittings, auto parts, cutting pliers, stainless steel pot annealing, etc.	Principle: the thin the quench-hardened case of workpiece is required, the lower the frequency should be. For example: ultra high frequency (100-500KHZ) for thickness lower than 1mm; ultrasonic frequency (20-100KHZ) for thickness between 1mm and 2.5mm; mediate frequency (1-20KHZ) for thickness greater than 2.5mm.	Considering the shape, quench method, quenching hardness, quenched case requirements and materials and other integrative factors. For details please inquire the technicians of our company.
Smelting	Precious metals such as gold, silver, copper and lead.	Mediate frequency, but high frequency may be selected for small volume.	Based on the smelting furnace and production efficiency.
Other	Heating and laminating of aluminum pipes, steel pipes, cables and wires; aluminum foil seals used in food, drink and pharmacy industries.	Up to the actual situation.	Based on the production rate, materials and temperature.
Special functions and support equipments	For instance, dual frequency equipments, multi-load matching type (double-head, multi-tap), autocontrol type, one for two, bridge oil pipeline bend, constant-power and constant-current, soft connection inductor		

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### III Main features

1. The company adopts the latest current alternating control technology to deliver higher reliability and durability.

2. Constant power control and optimized heating effect:

It is featured with constant current and power control, which optimizes the heating process of metal to the maximum to realize high efficient and speed heating, therefore the superiority of products is brought into full play.

3. High efficiency and energy conservation to save your cost:

All things being equal, its energy efficiency is much higher than conventional tube high frequency heating equipments for it can save twice electricity as much as that of the latter. So it seems that our products wastes its “power” on a petty job, gets twice the result with half the effort and reduces the electrical load and compatibilization to save your cost.

4. Very small volume and weight:

The products are only 40-70Kg in weight, which is fraction or even several tenth of conventional equipments, so it is convenient for transportation and installation, use and maintenance, and can save lots of space for you.

5. Convenient and easy for installation and use:

By connecting corresponding water, electrical and heating inductors and workpieces according to the instruction, the machine could be switched on without waiting for preheating. A simple heating adjusting knob enable you to achieve needed heating effect, and you can use this product easily without special training.

6. Safety:

Compare this product adopts low voltage (several hundred volts) with conventional high frequency products employ high voltage (higher than 10000 volts), the formal can efficiently prevent electric shock and high frequency radiation to lift your worry.

7. Multi-function

It is featured with heating-heat preservation two stage setting, the power of these two stages is adjusted respectively. Heating and heat preservation processes are available to adapt to lot sizing and repeatedly heating site.

More than ten kinds of fault protections and displays including over current, over voltage, under

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water and lack of phase.

Control of constant current and constant power selection.

Current, power and frequency display.

Output interface combining control with external equipments.

8. Absolute full load design which can be continuously working for 24 hours.
9. High reliability and durability.

The main parts of this product adopt products of famous company in Japan and Europe. The machine was strictly tested before rollout to make you use at ease.

#### IV Main technical parameters

Model	15KW	Max input power	15KVA
Input voltage	single-phase 220V 50HZ	Max oscillatory output power	15KW
Output control method	Constant current method	Temporary load rate	100%
	Constant power method	Cooling water pressure	0.06-0.12MPa
Oscillatory output frequency	30—80KHZ	Water flow	>6L/MIN
Weight	Host machine	30Kg	Volume
	Submachine		
			550*220*470
		Submachine	
Heating oscillatory current	200—600A	Length of coupling hose	1.5m (max length 6m is available)
Heat preservation oscillatory current	200—600A	Time for heat preservation	1—99s (auto status)
Heating time	1—99s (auto)	Cooling water temperature	<40℃

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## V Description of functions of the panel (refer to appendix 1)

### Indicators

1. Power: after close the power switch on the front panel, if the lamp is on, it indicates power up.
2. Working: when heating, this lamp flashes, and the buzzer beeps with frequency 1s.
3. Over voltage: the max permissible voltage of this equipment is 250V, when applying excessively high voltage, the equipment will stop heating automatically and the over voltage indicator will be on with continuous beep.
4. Over current 1: if on, it indicates the equipment in output over current, which will stop heating automatically, the over current indicator 1 will be on with continuous beeps. The alarm may be eliminated by power on after power off. If over current alarm is triggered every time start the machine, it indicates there may be fault on it, please refer to the troubleshooting guide.
5. Over current 2: if on, it indicates the part of high frequency current alternating of the equipment in output over current, then the equipment will stop heating automatically, the over current indicator 2 will be on with continuous beeps. The alarm may be eliminated by power on after power off. If over current alarm is triggered every time start the machine, it indicates there may be fault on it, please refer to the troubleshooting guide.
6. Lack of phase: if on, it indicates the three-phase supply is lack of phase.
7. Internal under voltage: if on, the equipment will stop heating with continuous beeps, which indicates that the DC voltage fed in AC current can not be built, please refer to the troubleshooting guide.
8. Under water: the inductor of the equipment and main parts inside are cooled by water. If this lamp is on with the buzzer beeping, it indicates insufficient pressure or excessively high temperature of cooling water or the pipeline inside the machine is blocked. After improving water supply, the alarm eliminates automatically.
9. High frequency: if the lamp is on with alarm, it indicates the equipment with excessively high output oscillation frequency, the heating power (heating current) will be attenuated automatically to prevent current alternating devices. At this moment, it indicates the inductor is not suitable, you can improve this through following methods:  
  
Raise the inductance of the inductor (increase the number of turns), lengthen the diameter of the inductor or increase the length of the lead wire of the inductor.

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10. Low frequency: if the lamp is on with alarm, it indicates the equipment with excessively low output oscillation frequency, the heating power will be attenuated automatically to prevent current alternating devices. At this moment, it indicates the inductor is not suitable, you can improve this through following methods:

Reduce the inductance of the inductor (decrease the number of turns), shorten the diameter of the inductor or decrease the length of the lead wire of the inductor, also you can use purple copper tube or square tube with longer diameter to serve as the inductor.

11. Current: if on, it indicates the current value with high alternation frequency.

12. Power: if on, it indicates the effective output power.

13. Frequency: if on, it indicates the output oscillation frequency.

14. Light load: if on, it indicates the workpiece is not put into the inductor (empty load) or the coupling between the inductor and the workpiece is too loose (light load). At this moment, the power (current) of the equipment will be decreased automatically to reduce no-load loss. When this fault occurs, please follow below steps:

(1) Re-put the workpiece into the inductor, then the heating power will be recovered automatically;

(2) reduce the size of the inductor to decrease the space between it and the workpiece, hence the engagement between them is tightened. This product is featured with light load protection which is very useful for workplace requires continuous operation. When the workpiece under heating is put into the inductor, the heating power of the equipment will be recovered automatically. After remove the workpiece from the inductor, the equipment will go to light load protection status.

15. Heating: this function is available in “Auto” or “Manual” work state, if the lamp is on, it indicates the heating process is ongoing.

16. Heat preservation: this function is only available in “Auto” work state, if the lamp is on, it indicates the heat preserving process is ongoing.

**Buttons:**

1. Start: by pressing this button, the equipment begins to heat.

2. Stop: by pressing this button, the equipment stops heating.

3. I/P display: this is a display button, by pressing this, “Current” or “Power” indicator is on, the

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digital meter displays oscillation current (A) or output power (KW), which shall be used combining with “Constant current/ Constant power” selection switch to display the value of current or power..

4. Frequency display: by pressing this button, “Frequency” indicator is on, which displays the oscillation frequency (KHz) at this moment.

**Switches:**

1. Constant current/Constant power selection switch:

When the switch turns to “Constant current”, the control method of the equipment is auto controlling the oscillation current unchanged; when the switch turns to “Constant power”, the control method of the equipment is auto controlling the output power unchanged, i.e. constant power method.

2. Manual/Auto selection switch:

- a. When the switch at “Manual”, time control is not working, and time display shows the heating time without heat preservation state.
- b. When the switch at “Auto”, heating and heat preserving time are controlled by the time controller inside the machine.

**Adjusting knobs**

1. Heating power adjusting knob: adjust the magnitude of oscillation current to adjust the heating speed when in manual or auto state.
2. Heat preservation power adjusting knob: it only works in auto state, used to adjust the magnitude of oscillation current in heat preserving.

**Time display**

In manual state: display the heating time; in auto state: display heating and heat preservation in turn.

**Digital display meter:**

It displays “Oscillation current”, “Output power”, and “Oscillation frequency”. When the “Current” lamp is on, it indicates “Oscillation current”. The rest can be done in the same manner.

**Digital meter for time setting:**

There are “Heating time” and “Heat preserving time” settings, which can be set to 1-99 seconds (customized product is also available).

**Socket for remote control:**



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Connected with the remote switch box, on which the buttons substitute for the Start and Stop button on the panel of the equipment.

**Rear panel:**

1. Control fuse: 0.5~1A
2. Main switch
3. Grounding screw
4. Control interface (optional): featured with various signal input and output required by other peripheral equipments.

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## VI Installation instruction

### 1. Cooling water connection

Special notice:

Better control of water quality and temperature  
is key to the life of the equipment

Water cooling is very important to induction equipment heating: poor water quality may result in rusting, encrustation, blockage, which may directly damage the equipment. Besides, some live parts inside the equipment electricize the water for water cooling, so poor water quality may increase the risk of electric shock.

- Water flow:  $\geq 6\text{L}/\text{MIN}$
- Minimum water pressure:  $0.12\text{MPa}$
- Maximum temperature of the inlet:  $40^{\circ}\text{C}$
- Water quality requirements: PH between 7.0 and 9.0 (i.e. alkalescent)

Content of oxide  $< 20\text{PPM}$

Content of nitrate  $< 10\text{PPM}$

Content of calcium carbonate  $< 250\text{PPM}$

Resistivity below  $25^{\circ}\text{C}$   $> 2500\Omega^{\circ}\text{C}.\text{CM}$

Total content of dissolved solid impurities  $< 250\text{PPM}$

Temperature without appearance of solid impurity  $T < 57^{\circ}\text{C}$

Add degaussing agent, preservative and ethanediol (max content: 4/1000) anticoagulant when necessary.

(2) Recommended cooling water:

Distilled water-soft water-pure water-filtered tap water

(3) Prohibited cooling water:

Sea water, salting water, unfiltered river water and well water.

(4) Recommended water supply method: closed circular supply + water cooling heat exchanger

(5) Connection between the cooling water and the equipment:

- a. Connect the water inlet tube to the rear of the equipment (host machine), connect the water outlet tube to the rear of the equipment (host machine), then fasten with hose clamps.

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- b. Connect the water inlet tube to the rear of the submachine (transformer), respectively connect water outlet tubes to the rear of the submachine.

**Special notice:**

The two water outlet points shall drain separately without holding together to avoid affecting cooling effect.

- c. Respectively connect water inlet tubes to the inductor.

**2. Equipment power connection**

- a. Soft copper wire with sectional area over 10 mm<sup>2</sup>  
b. Capacity of power of supply: higher than 65KVA.

**3. Connection between the host machine and the submachine (refer to appendix 2)**

**For split model LH-25AB**

Connect the hot machine and the submachine with high frequency cables and signal control wires according to the diagram.

**Special notice:**

The power must be cut off when unplugging/plugging the connecting plug between the host machine and the submachine.

**4. Protective grounding wire connection:**

Ground the equipment reliably with 6mm<sup>2</sup> wires to prevent electric shock.

**5. Mounting of induction coil**

The inductor contacts with water and is charged with high induction heating current (2400A to the maximum), which is directly related to normal use, so the users shall mount it carefully. In addition, clamps and nuts used to fix the inductor must be made of copper. All iron materials including stainless hose clamps used to fasten the inlet and outlet tube to the inductor, shall keep a distance of over 50MM from the parts of the outlet side and the inductor that are got through by current, so as to prevent being heated.

When the machine is operating, there are three water routes to cool the components and inductor inside the machine, of which two routes are under pressure protection, but the inductor is not covered by machine protection for its independent water supplying. To prevent the inductor from damage for water shortage, it is recommended that the users adopt the supplying method of one valve with three routes when designing ways for water supplying.

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Note, short circuit should never occur in the induction coil, and the metal workpieces must not contact with the induction coil, otherwise it may generate sparks. Under this circumstance, the self-protection of the machine cannot be started, in more serious cases, it may damage the machine or induction coil.

#### **6. Connection to the foot switch or remote box**

Foot control or remote control: in manual mode, plug the foot switch into the socket for remote control. The start and stop function on the panel switches to foot switch by this time. Push down the pedal to start, release the pedal to stop. It is recommended that select manual mode in early use and adopt auto mode after having a good command of the machine.

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## **VII Operation Instruction**

### **1. Design and installation of the induction coil**

a. Because it generates resistance heat when high frequency heavy current running through the inductor, in high frequency application site, it is recommended that use purple copper tube with diameter over $\phi 6$  ( $\phi 8$  for the best) and shell thickness  $> 1\text{MM}$  or square copper tube with similar size, in order to reduce the heat loss of copper and increase the heating efficiency. If the copper tube is too small or too long, it is featured with high resistance heat, which may burnout the inductor or heat the cooling water to boiling with sound “babble”, that are should be avoided as far as possible.

b. Recommended value derived from experiences:

Total length of the induction coil: 500-1500MM

c. Sufficient conduction contact shall be the ensured for installation of the inductor. If the working condition allows, the length of the lead wire shall be shortened as far as possible.

### **2. Selection of control method of “Constant current/Constant power”**

a. Turn the “Constant current/Constant power” switch to “Constant current”.

At this moment, the machine is working in constant oscillation current control state, its heating power and speed will be changed along with conditions such as the temperature, network voltage fluctuation, in order to keep the magnetic field strength generated by the inductor unchanged. It is specially applicable for high frequency soldering under the situation with heating temperature between  $600-900^{\circ}\text{C}$  and high heating speed in cool state (high heating power) and low heating speed in hot state ( $700^{\circ}\text{C}$ ). It is also applicable for all heating situation.

b. Turn the “Constant current/Constant power” switch to “Constant power”.

In this state, the output efficient power (including heating power, loss power, etc.) will be controlled unchanged. Whether the workpiece is cool or hot, magnetic or nonmagnetic, or there are condition changes such as ferromagnetic materials converting from magnetic to nonmagnetic and fluctuation of network voltage, the machine will strive to keep the control output power constant, that is ensure the heating power unchanged basically, to gain quicker heating speed, higher heating temperature, etc..

Specially recommended site: heat treatment, heat rolling, smelting, even heating of progressive, etc..

### **3. Selection of manual/auto switch**

a. When selecting position “Manual”, the time setting and heat preserving adjusting knob are not working, and heating parameters are adjusted with heating power adjusting knob.

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- b. When selecting position “Auto”, the time of heating/heat preserving/cooling is set up accordingly, and the heating and heat preserving knobs are turned to right place.

#### **4. Selection of panel operation or pedal (remote control) switch operation**

- a. When selecting panel operation, please unplug the pedal switch (or remote switch). When in “Manual” control state, press “Start” button to launch the machine, press “Stop” button to stop the machine (note: if not unplug the remote control plug of pedal switch, the machine cannot be launched with the “Start” button on the panel); when in “Auto” control state, by pressing the “Start” button, the machine starts to operate and work and switch according to set up heating/heat preserving time automatically, when heat preserving time is over, it stops working automatically and goes to “Cooling” timing until time up, which is called a complete work cycle. During this period, “Heating” and “Heat preserving” lamps are turned on in turn to indicate that a process is on going, you can interrupt operation by pressing “Stop” button at any time.

Note: before completing the three processes, press “Start” button will disturb the work procedure, which results in abnormal operation of the machine.

- b. Select the pedal switch (or remote switch) to operate

When in “Manual” state, push down the pedal switch to start, release the pedal to stop. When the machine is in combining control with peripheral equipments, normal on/off contacts on a set of relays could be used for controlling.

When in “Auto” state, by single pushing down the pedal switch (release immediately after pushing down), the machine operates with time and procedure set up. When “heat preserving time” is over, it stops working automatically and goes to “Cooling” time control until time up, which is called a complete work cycle, and next operation can be carried out at this moment. In addition, it is not working to stop the machine with the pedal switch, but should only use the “Stop” button on the panel to interrupt operation at any time..

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## VIII Notices

- a) Input voltage range: 180—250V. When network voltage higher than 250V, please never use the equipment.
- b) After electrify the machine, it is forbidden to touch the input/output connectors and the connection terminals between the host machine and the transformer of the submachine.
- c) Connecting plug between the host machine and the submachine must be removed and mounted when the power is cut off.
- d) Parts inside the machine and the inductor must be cooled by water, and the cleanliness of water source shall be ensured to prevent cooling pipeline blockage which may results in overheat and damage.
- e) Please ensure the case grounded to prevent electric shock.
- f) The equipment shall avoid being in adverse environment such as insulating, drenching, humid, etc..
- g) The equipment shall be repaired by professional staff.

## X Troubleshooting

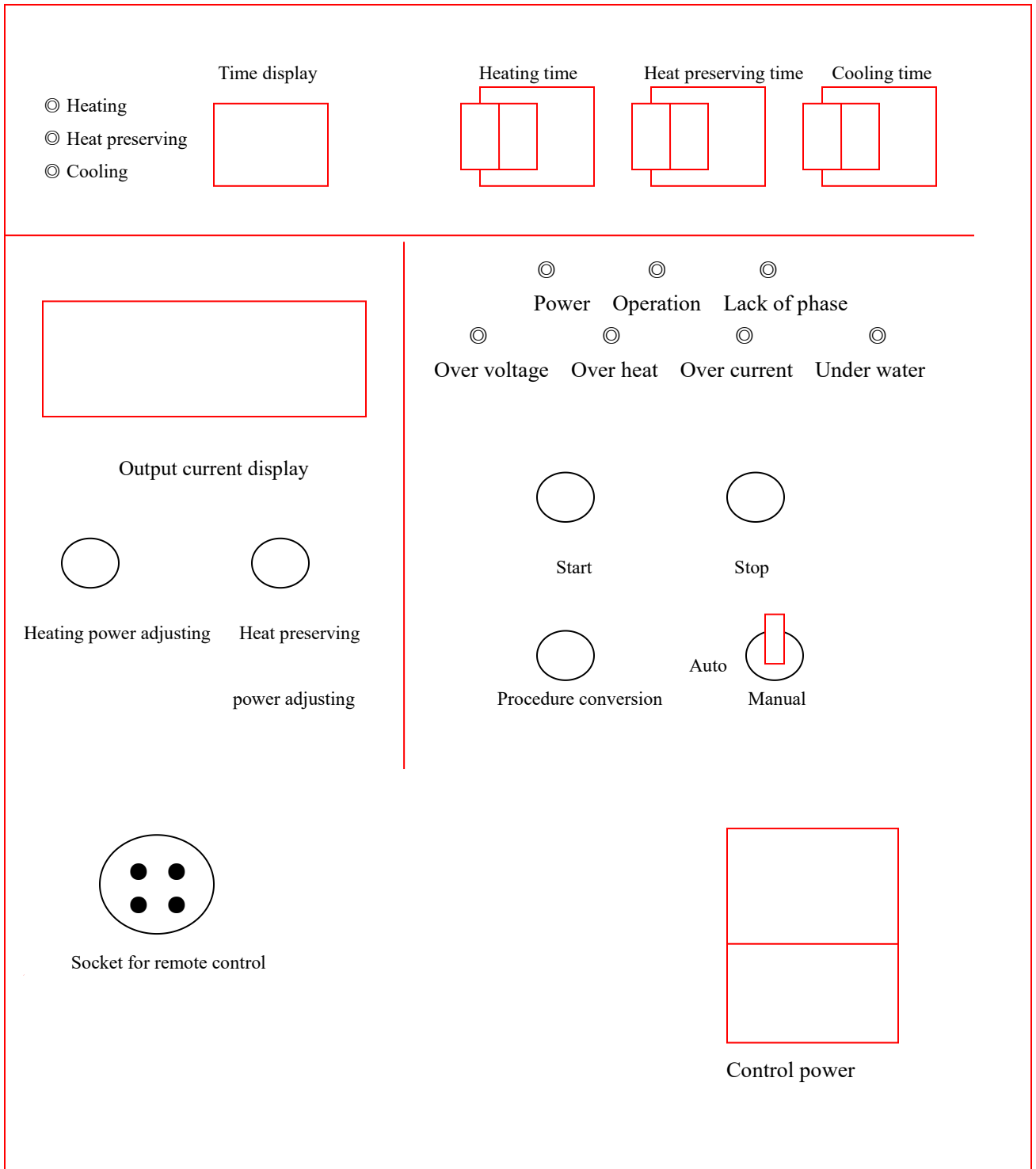
Faults	Causes	Resolutions
No power display	<ol style="list-style-type: none"> <li>1. Air switch or control switch is not closed</li> <li>2. Blown fuse</li> <li>3. Damage to air switch or control switch</li> <li>4. Others</li> </ol>	<ol style="list-style-type: none"> <li>1. Close the switch</li> <li>2. Replace the fuse</li> <li>3. Replace the switch</li> <li>4. Contact the manufacturer for repairing</li> </ol>
Can not be started. When press the “Start” button, the current is displayed as “0”, the machine makes frequent noises and the noise disappears 5s later automatically.	<ol style="list-style-type: none"> <li>1. Short circuit of the two coils of the inductor.</li> <li>2. The connector of the inductor in the panel is loose.</li> <li>3. Tapes on the connector of the inductor.</li> <li>4. Equipment failure</li> </ol>	Contact the manufacturer
It can be started with current display, but cannot heat and heat slowly	Short circuit of the two coils of the inductor	<ol style="list-style-type: none"> <li>1. Remove the short circuit fault.</li> <li>2. Contact the manufacturer</li> </ol>
Alarm in operation	Refer to the instruction of panel	Contact the manufacturer
Alarm in operation repeatedly	Equipment failure	Contact the manufacturer
It raises alarm of over current with heavy current but normally works with low current	<ol style="list-style-type: none"> <li>1. Network voltage too low</li> <li>2. Equipment failure</li> </ol>	Check the power supply, if the voltage is too low, please use with low current
Power down immediately after start, power switch trips.	Equipment failure - bridge rectifiers damage	Contact the manufacturer

To constantly improve the product quality, our company preserves the right to change the machine without prior notice. Any problem, please contact our company.



# Appendix 1

## Front panel of the power



# Appendix 2 Electrical diagram

