200W desktop integrated laser welding machine manual

Specification

Laser medium	Nd^{3+}:YAG
Laser Wavelength	1.064μm
Output power	200W
Pulse width	0.2~15ms adjustable
Pulse Repeated Frequency	1~20Hz adjustable
Maximum single pulse power	100J
Maximum input power	6KW

Product Summarize

The surface of the metal will be changed by the laser, it has been heated and conducted to the deepper of metal rapidlys, and the surface will be melted when the consistency of laser power is enough, some parts is momentary vapored for the high consistency ,and it is come into being the weld crater.

The laser welding compares with other welding craft can realize the very many material welding, compares has the superiority, welds the component thermal deformation to besmall, the attachment quality is high. The laser welding superiority in with can realize partially the very small scope heating characteristic, widely uses with the precision component like jewelry, the battery, the automobile industry, aviation industry some other applications and so on.

The MW-DW200 laser welding apparatus are the pulse welding way, in the welding the pulse energy and the pulse width can adjust, pulse energy influence melting quantity, width influence melting depth. Meanwhile adjusts the weld point through the outside path of rays adjustable expender to adjust the focusing faculae the size.

MW-DW200 laser welding system is a new improved product. It can be used to process the spot welding and seam welding for many small scale metal components, such as Titanium, Nickel, Aluminum, Stainless steel, Gold, Argentine, Copper, Platinum and so on. It can process the spot welding on the contactor of the relay, the steel strip of the computer floppy disk driver, the pins of the printer, and also process the seam welding of the metal tube and belt, the core of the servo motor, process the sealing welding of the cover of the relay, the IC package, the pressure device, the cover of the heart pacemaker, the cover of the Tantalum capacitance and Lithium battery, etc.. It also can be used to cut and drill the small scale metal components.

This system is especially suitable in the jewelry industry. There is no special block needed during the processing. The pieces to be processed can be hold by hand, and to be welded under the microscope conveniently.

1. System configuration

Main parts	Brief describing
Laser	Φ7 superior YAG crystal， ceramic focus cavity
Laser power supply	MW-DW200 pulse power supply
Special Cooling System	Unitization special chiller，over temperature alarming，flow protecting。
Control System	Singalchip(pic)
Viewing System	10X microscope viewing system

2. Specification

2.1. Laser

Laser medium: Nd^{3+}:YAG
Wavelength: 1.06μm
Pump lamp: pulsed Xenon lamp
Pulse frequency: 0~15Hz adjustable
Pulse width: 0.2~15ms adjustable
Energy of the single pulse: 0~100 J
Laser power: 200W

2.2. Welding spot size:

Diameter : 0.2~1.5mm，adjustable according to the requirement.

2.3. Optical system

(1) Beam expanding and focusing
The ratio of the expanding: 3X
The focus length: 100mm

2.4 Cooling system

Cooling system

It adopts dual circulation water cooling system. The inner circulation water which is drove by the magnetic motor is used to cool the laser and the pump lamp. It has the over temperature and over flow control protection. The inner circulation water must choose the deionized water whose specific resistance is higher than 0.5 MΩ-cm. The heat of the inner circulation is taken away by the cooler and sent into the air by the fans.

2.5. The requirement of the power supply

Single phase, AC 220V±10%，4KW

2.6. Working environment

Clean and far from the source of vibration. Temperature around 10℃~32℃, humidity low than 85%.

2.7. Continuously workingtime

It can continuously work more than 8hours.

3. The description for the structure and themaintenance

The system is composed of the laser, power supply, optical working system, control box and the cooling system. According to the function of each parts, it can be sorted in the following parts:

(1) Laser (2) Laser power supply (3) Optical system

(4) Control system (5) Cooling system

3.1 Laser

3.1.1. The brief introduction of the laser

The laser is the device of transforming the electricity energy to the laser energy. In this system, the laser is Nd^{3+}:YAG laser. It is mainly composed of the following parts: (1) pump

lamp (2) laser rob (3) cavity (4) optical resonator (5) other accessories

Pump lamp excites the laser medium to transform the electricity energy to optical energy. The laser rod transforms the optical energy to laser energy. In this system, the pump lamp is the pulsed Xenon lamp and the laser medium is Nd^{3+}:YAG rod.

In the cavity, the light emitted from the pump lamp is focused on the laser medium. In our system, it is the close ceramic cavity.

In the optical resonator, the laser is amplified to form the high intensity laser output. There are two high damage threshold coated plane mirrors which are set parallel in the resonator.

Only 3% of the electricity energy is transformed into laser energy during the laser working, the other electricity energy is transformed into heat and distributed in the pump lamp, laser rod, and the cavity body. To protect the laser, this heat has to be taken away. In this system, the pump lamp, laser rod and the cavity body are cooled by the circulation deionized water.

Besides the above parts, there are still the other accessories as follows:

(1) High voltage electrode， (2) The insulating base， (3) Positioning support, (4) The adjustable mirror support, (5) Laser support.

3.1.2. Caution and the maintenance

The laser system is the opto-mechano-electrically integrated. It is very precise and need to be operated by the authorized person who has the professional technology andtechnique.

A. Optical resonator

The optical resonator is composed of two medium film which are set strictly parallel in the resonator. These two mirrors can not be touched and moved after the adjustment and keep clean, otherwise, the surface of the mirror may be destroyed. So, the laser cover can not be moved any time. When the laser power becomes low, firstly, it has to be checked whether the surface of the mirrors are stained. If it has been stained, use the lens paper or absorbent cotton to erase softly with the cleaning liquid (the mixture of 50% no water ethanol and 50% anther). Then, check the adjustment of the resonator.

B. Cooling system

There are two water pipes connected to the pump lamp and the laser rob respectively. Either of the pipe is blocked, unredeemable damage may be caused. Every time when the system is reinstalled, before starting the laser, it has to be checked carefully that the water

flow is correct.

C. Change lamp

The pulse Xenon lamp is consumable part. Its service lifetime is 10^6 flash times. To guaranty the normally work of the system, the lamp has to be changed when it reaches its service lifetime and the laser energy becomes low.

If the Xenon lamp is damaged or reaches the service lifetime early (can not be ignited or there is no laser output when the voltage rise to 500V), it also need to be changed.

More attention must to be paid to the two ends of the Xenon lamp during the changing:

(1) Turn off the system, close the water and discharge the remain charges in the energy store capacitance;

(2) Unload the electrode of the lamp;

(3) Remove the top of the lamp, draw outthe Xenon lamp carefully besidethe reflecting mirror;

(4) Clean the cover tube with the cotton and the cleaning liquid;

(5) Check the size of the Xenon lamp;

(6) Insert the lamp, close the top and installation the electrode;

(8) Check the water leaking;

(9) Turn on the main power supply to check the discharge;

(10) Check the laser output power by using the single pulse mode. If the laser output power can not meet the requirement, the resonator need to be re-adjusted repeatedly;

(11) Close the laser cover.

D. Nd^{3+}:YAG rod

Nd^{3+}: YAG rod is the core of the laser, it must be very careful to handle the rod during the installation and using. The two end of the rod must be keep parallel strictly. If there is dirtiness on the two end surface, it has to clean the room firstly, then ask the professional service people to handle the rod. Take out the Nd^{3+}: YAG rod, clean it by using lens paper with cleaning liquid (the mixture of 50% no water ethanol and 50% aether). The reasons of the rod damage may be the followings:

a. The flow of the cooling water is low or the water hose is blocked. It causes the overheatin the lamp and the laser rod and breaks the lamp and laser rod.

b. The end of rod hurt by something hard.

c. The films is burnt out because of the dirtiness on the surface.

d. The strong and uneven stress from the installation of the rod breaks the laser rod. So, usually, the operator can not open the laser cover and can not touch the YAG rod. If there is dirtiness on the end surfaces of the YAG rod, it has to be handled by the professional service people.

E. The maintenance of the cavity

The cavity is made of ceramic which has very high reflectivity. It is no need to do the maintenance. So taken apart is not allowed.

F. The protection for high voltage

To start the laser, there are three voltages applied to the Xenon lamp. They are the triggering voltage: about 15~20kV; the pre-igniting voltage: about 1.7kV~2kV and the arc discharge voltage: about 500~1900 voltage. It must keep at least 15mm distance with the surrounding component. During the operating, the insulating board must be kept clean and dry to prevent the short-circuit of the high voltage.

3.2 Laser power supply

The system can be controlled by the operating panel and operating stick.

3.2.1. Specification

The laser power supply in this system is pulse mode power supply. The IGBT is supplied by the L-C resonating charging and the energy storing circuit. The control circuit has two SCM as the core. So the output power and the repeatability can be adjusted conveniently. The power supply can be adjusted independently or together with the control system. There are multi-inter-lock protections in this system, to shut off the main power supply in emergency situation.

3.2.2. Description for the electric circuit

The electric circuit is composed of the followings:

Main circuit: include the charging circuit, energy storing circuit, discharging circuit loop and pre-igniting circuit.

The control circuit: include the electric control circuit, microcomputer control circuit and all kinds of the protection circuit.

A. Voltage rising/rectifying circuit

By rising the single-phase voltage, the voltage rising / rectifying circuit convert the 220 ACV to 620 DCV to supply the power of the charging circuit.

B. The charging circuit

The charging circuit is composed of a voltage doubler circuit. This kind of circuit can increase the repeatability of the charging.

C. The discharging circuit loop

The discharging circuit loop is controlled by the SCR. During the discharge, the discharging IGBT power transistors have to be shut off. After the charging of the energy storing circuit, the charging IGBT power transistors are shut off, waiting for sometime delay, the discharging IGBT power transistors are turned on to discharge. When the energy storing capacitor discharging finished, the discharging IGBT power transistors will be shut off automatically.

D. The pre-igniting and the triggering circuit

It includes the voltage rising transformer, high voltage rectifier, filter, barretter, current relay, high voltage pulse transformer and high voltage triggering circuit.

The pulsed Xenon lamp is working in the aura discharging during the pre-igniting, which has the characteristic of the negative resistance. To maintain the aura discharging of the Xenon lamp after the arc discharging, the pre-igniting circuit must have the characteristic of constant current. So the pre-igniting circuit must have very high limitresistance.

The triggering mode in this laser is inner triggered by 50Hz pulse automatically. When the pre-igniting circuit works, the high voltage pulse transformer produces the high voltage of 15,000V ~ 20,000V. When the pre-igniting begins, the triggering circuit shut off automatically and immediately.

E. Control circuit

The control circuit includes two parts of operating circuit and microcomputer control circuit. The operating circuit controls the water pump, pre-igniting circuit, main power supply, the power supply of the control circuit and the inter-lock protection by means of

the components such as the button, contactor and relay. The microcomputer control circuit is integrated in a PCB.

G. Protection circuit

a) Pre-igniting shut-off protection circuit

When the pre-igniting circuit shut off, the pre-igniting shut-off protection circuit takes into function and sends out the fault signal.

b) The water flow inter-lock

When the water flow is low in the cooling system, the water flow relay breaks and shuts off the pre-igniting circuit and the main power supply, thus to stop the system.

3.3 Optical system

3.3.1 Binocular microscope

To observe the working piece clearly, the binocular large caliber and long focus length microscope has been used in this system. Before the object lens, there is a filmed protection glass to protect the lens from the spatter during the laser processing. The ocular can be taken down by loosen the fixing bolt for the shipping and maintenance purpose.

3.3.2 Laser beam expander and the focusingsystem

To ensure the laser welding spot in the center of the view all the time during the focusing, the laser beam has to be co-axial with the beam path of the microscope. In this system, the laser beam and the optical path of the microscope share the same object lens. The offset of the focus point is adjusted by the up and down keys. The offset of the focus point is determined by the experiment according to the welding processing technology.

3.3.3 The indication of the welding spot

Because the YAG laser is invisible infrared ray of 1.06μm, there is a cross in the ocular, whose intersection accords to the laser spot, to indicate the laser position. Thus the laser beam can be aimed at the welding position on the piece to be weldedeasily.

3.3.4 Caution for the optical system

(1) It is forbidden to touch the surface of the optics by hand and something hard. It is also forbidden to blow the optics by mouth. It can be blown by the special blowing ball or cleaned by the long fiber absorbent cotton ball or the lens paper, if the optics is stained.

(2) Normally, don't disassemble the optical system to prevent from the damage and thedust.

(3) Move the tube of the object lens carefully and don't touch the protect glass. Before changing the protect glass, remove the front tube of the object lens first and the press ring carefully.

3.4 Cooling system

3.4.1Construction

The cooling system is the main part of the laser system. It is composed of the heat exchanger, magnetic pump, filter, water tank, switch of water flow, the temperature contactor, ABS hose and valves to form a closed circulation water system.

3.4.2The principle of the cooling

The inner deionized water in the water tank is pumped by the magnetic pump to cool the YAG rod, pulse lamp, two electrodes. The heated deionized water goes through the heat exchanger and returns to the water tank. The resistivity of the deionized water must be higher than 0.5 MΩ-cm. When the deionized water becomes dirty or the resistivity of it becomes higher, the Xenon lamp may can not be ignited and the laser cavity and the glass tube may be stained. In this situation, the deionized water has to be changed immediately. (the deionized water should be changed one time every week when the laser system is operatedcontinuously)

4. Installation

4. 1 Installation condition

Because the laser welder equipment adopt the precision optic parts, So good running after right installation.

Item	Installation Condition	Remark
Temperature	15-35℃	No dewing
Humidity	30-80%	
Dust	Less than 0.20mg/m3	
Oil mist	Not allowed	
Power supply	1 .Single Phase AC 50Hz/60HZ ≥ 25A 2 .Voltage within ±10%	Assemble electrical table which supply main power supply
Cooling Water	use distilled water, deionized water recommended	Integrative machine 10L

5. Operation manual

5.1. Description for the control panel

Notice：Before any attempt is made to operate this laser welding system, this description has to be read carefully to prevent from the incorrect operation.

5.1.1 Power Startup

After long distance transport, you should check again according to the following steps:

(1) Printed boards is loose or not.
(2) Whether or not there are off signs of thedevice.
(3) Wire beezer is loose or not.
(4) Wiring connection is correct or not, include power line、power box, etc.

As all attachments are correct, you should close air switch ,switch on the power supply and connect the power supply control circuit .Then, the water injection system starts up.(Fig 1) After the water box has been injected completely, the water temperature and ambient temperature will be detected and displayed on the touch screen .At last, the touch screen starts working, and the power supply system begins self-check. Water protection system and Charge and discharge system is detected. The touch screen will display abnormal information if there is any abnormal detection .(Fig 2)

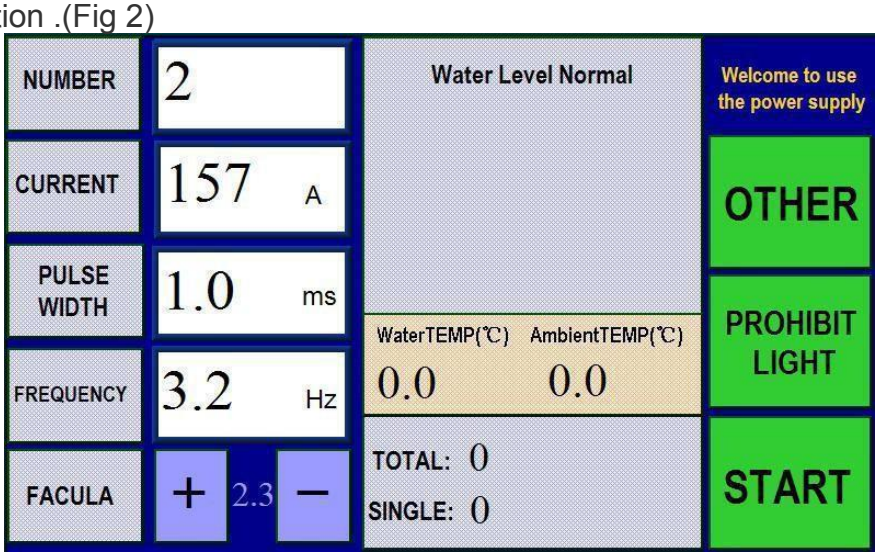

Fig 1 Water injection

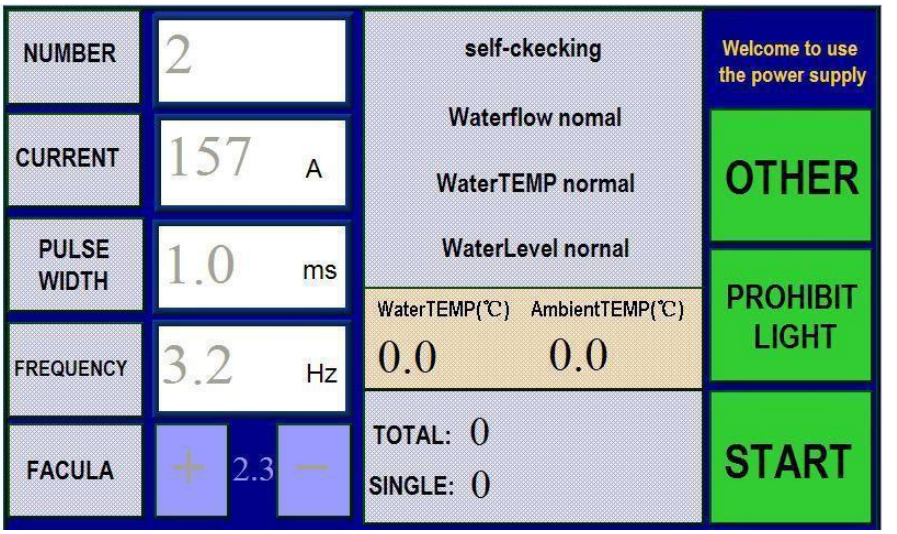

Fig 2 Main Window

After self-check finished, click the START button for starting the laser power supply. After about 40 seconds, the power is slowly up and contactors attract .After about 10 seconds, simmer circuit start to work and lighting precombustion of Xenon lamp in high-voltage starts to run. After about 2 seconds, a short buzzer sound is let out and then the laser power supply successfully start.

Warning: The system takes about 1 minutes to normally start, don't make any operation on the touch screen during the start process.

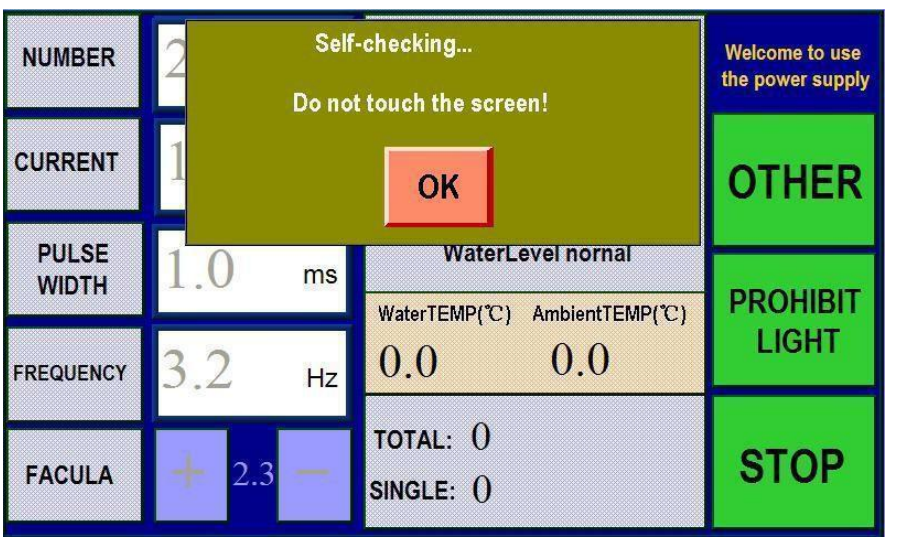

Fig 3 Alarm Dialog Box

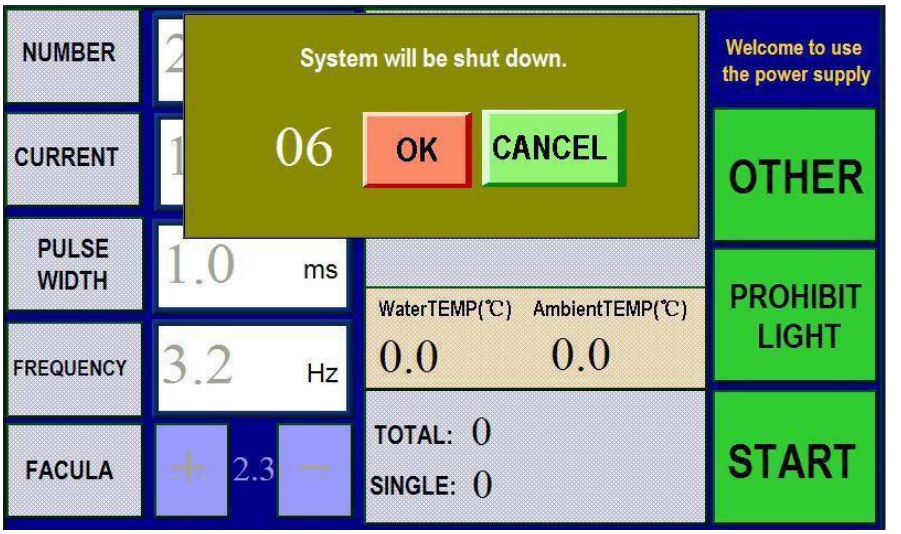

Fig 4 Shutdown Dialog Box

During the whole running period, if ambient temperature is threshold value, the alarm box will be appeared.(Fig 5)

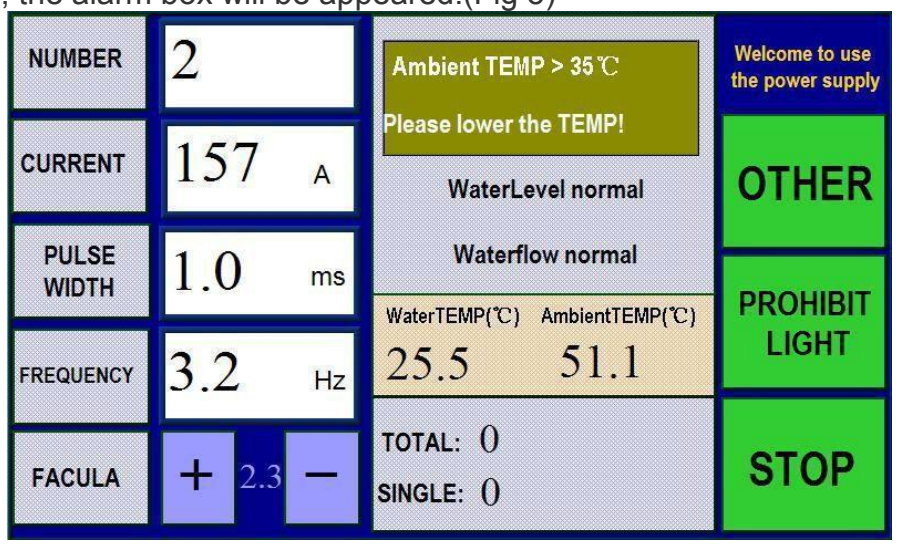

Fig 5 Temperature alarm Box

5.1.2 Weld Waveform

(1) The main window mainly (Fig 1) contains 3 buttons: OTHER 、ENABLE LIGHT/PROHIBIT LIGHT and START/STOP. START/STOP button has two status: start and stop. The start status is used to start the system and the stop status is used to shut down the system. ENABLE LIGHT/PROHIBIT LIGHT button also has twostatus:

enable light status and prohibit light status, and it must be used when the system has been started. The enable light status is used to enable light and the prohibit light status is used to prohibit light. OTHER button is to set the parameters of the system.

(2) The main window (Fig 2) has the following status indication: waterflow、waterTEMP、waterlevel. waterTEMP status indicates the temperature of the water tank; waterlevel status indicates the water level is normal or not and the waterflow status indicates the water control system is normal or not. Moreover,SINGLE status indicates the lighting mumble between stepping on the pedal and releasing it. TOTAL status indicates the total light mumble of the system.

(3) Waveform storage number selection: click the NUMBER input textbox, user can input any number in the range of 0~31.Each number represents a kind of waveform with different current 、 Frequency or Pulse Width.

(4) Current input: click on the CURRENT input textbox, user can input the default value of current.

(5) Pulse width input: click on the PULER WIDTH input textbox, user can input the default value of pulse width.

(6) Frequency input: click on the FREQUENCY input textbox, user can input the default value of optical frequency, which is in the range of 0~150Hz. Here, 0Hz represents working in dot control mode, which means that the laser power supply only light once during the process of stepping on the pedal and releasing the pedal. If another laser pulse is needed in this mode, user should firstly release the pedal, and then step on the pedal again. 1HZ~150Hz represents working in continuous mode, which means that the laser power supply emits light in accordance with certain frequency during the process of stepping on the pedal and releasing the pedal. In this mode, the laser power supply starts emit light when the pedal is stepped on and the laser power supply start stops emit light when the pedal isreleased.

Note: if a joystick is used to set the system parameters, there will be flicker on the button, which represents that the corresponding parameter is being changed.

5.1.3 Prohibit Light

User can prohibit light for security when the laser need not be used. Click the ENABLE LIGHT/PROHIBIT LIGHT button, user can switch

between the enable function and prohibit function. When PROHIBIT LIGHT button has been clicked, the system will not light (fig 6).

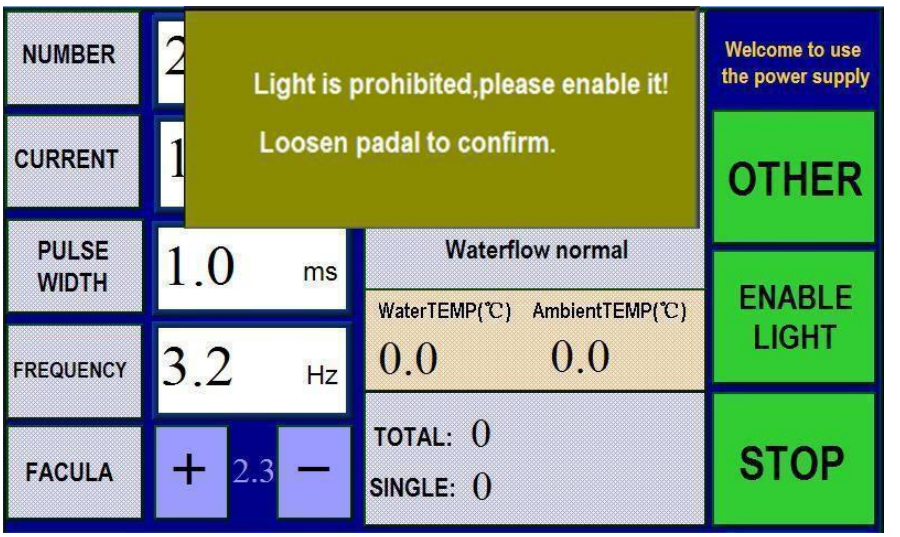

Fig 6 Prohibit light Dialog Box

5.1.4 Setting

The setting window (Fig 7). is popped up when clicking the OTHER button on the main window. The setting window can set the following parameters: total light number reset (Fig 8). 、 gas open and off delay time and system language.

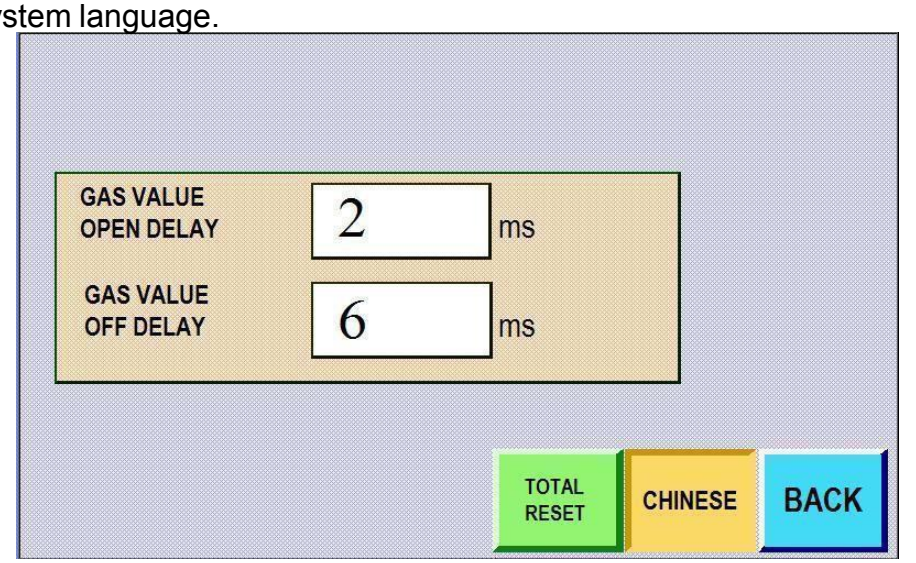

Fig 7 Setting Window

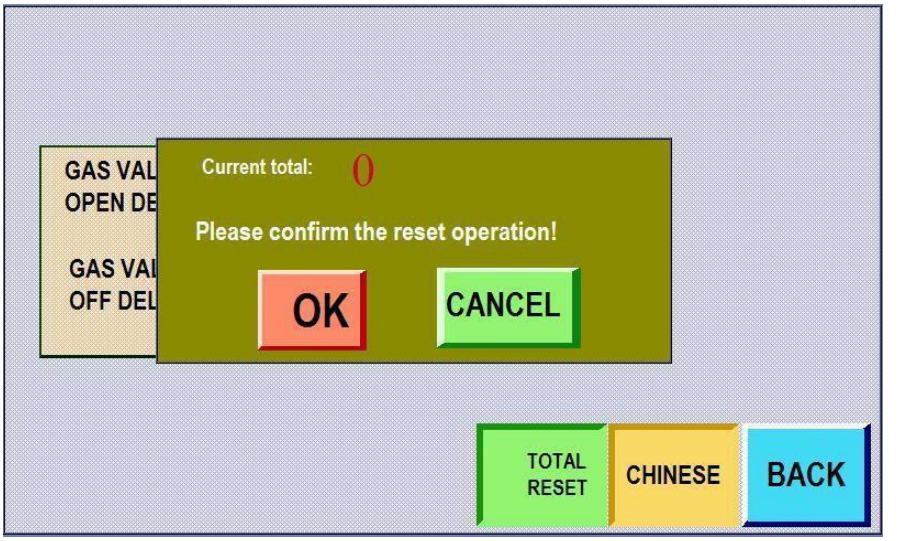

Fig 8 Reset total number

5.1.5 Panel Interface

(1) Manual rocker is led from X6 on the main control panel, including 4 button: UP、DOWN、LEFT and RIGHT (Fig 9).

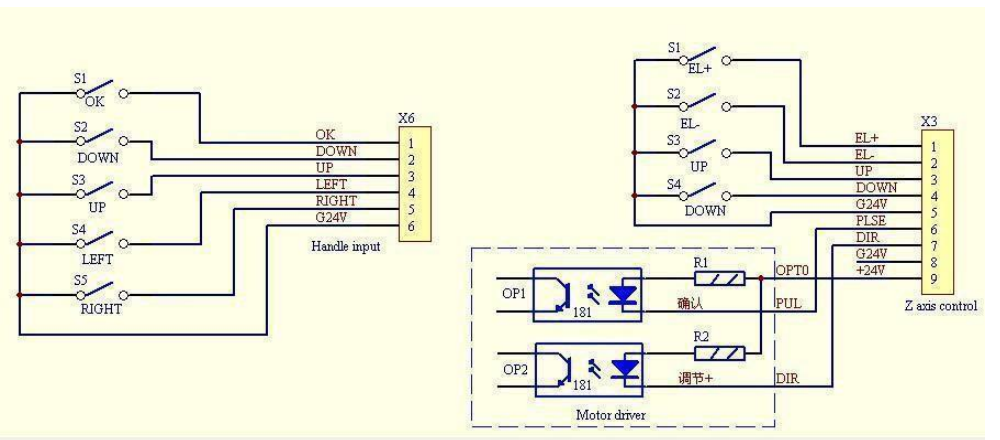

Fig 9 Manual rocker Circuit

(2) Driver motor is led from X3 on the main control panel, individually connecting the EL+、EL-、DIR and PLSE ports to Z axis limit switch and motor drive (Fig 9).

5.2. The procedure of the starting the system

1. Turn on the main power supply;
2. Turn on the key switch;
3. Chose the “Start” (“√”) to start the laser;
4. When the laser working situation shows “On”, step on the foot switch tosendoutthe laser.

5.3. The procedure of the stopping the system

1. Chose the “Stop”(“×”) to stop the laser;
2. Turn off the key switch;
3. Turn off the main power supply.

Notice：

There are the red buttons on the right side of the machine surface and operation room，it is use for emergency，it can stop the any actions for the equipments power box immediately when you press it.

suitable welding parameters according to the characteristic of the work piece, such as the pulse width, frequency, voltage and the offset of the focus point.

After chosen all the parameters, move the work piece up and down , observing the work piece through the binocular microscope, to make the image clearest in the view, then move the cross in the ocular to the superposition of the point to be welded, and step on the foot switch to process the welding.

In the room of operation, it has two screws, adjusting the laser to the middle of cross. Turn on the red light, observing the surface of workpiece prepared to welding, checking the red light in the middle of cross, if not, adjust the two screws.