LWM-CY-WY300A

General Laser Welder

User Manual

The above picture only for reference
Please on a real configuration basis

Contents

1.Overview

WY series laser welding machine is specifically designed for mold manufacturing and repair industries, and mainly used for precision mold repairing. The working principle of this laser machine is to take the advantages of the laser deposit welding and uses the technology of collective and spot welding with high heat of laser. It can effectively treat the welding defects of tiny parts and conduct repair work. This technical advantage fills the gap of the traditional argon-arc welding and cold welding, which cannot reach the precision requirements of fine welded surfaces.

Laser Welding not only can be used for repairing for the mold, but also can used for modifying the design size for the mold to shorten the time for product's R&D. During the operation, the operator can select the output power, frequency and pulse width and other parameters by the touching control panel, the operator can also be moved either forward or backward to achieve high welding efficiency. Different wave shapes can be set according to the welding materials so as to allow the welding parameters to match the welding requirements, generate plane and neat welding seams and points and optimize the welding effects. The equipment especially fits the manufacturing, molding and repairing of plastic molds, die-casting molds, extrusion molds, glass molds, plastic blow molds and rubber molds, and is widely used in mold manufacturing and mold industries for products like cell phone, digital devices, automobiles and motorcycles.

2. Initial Installation& Application

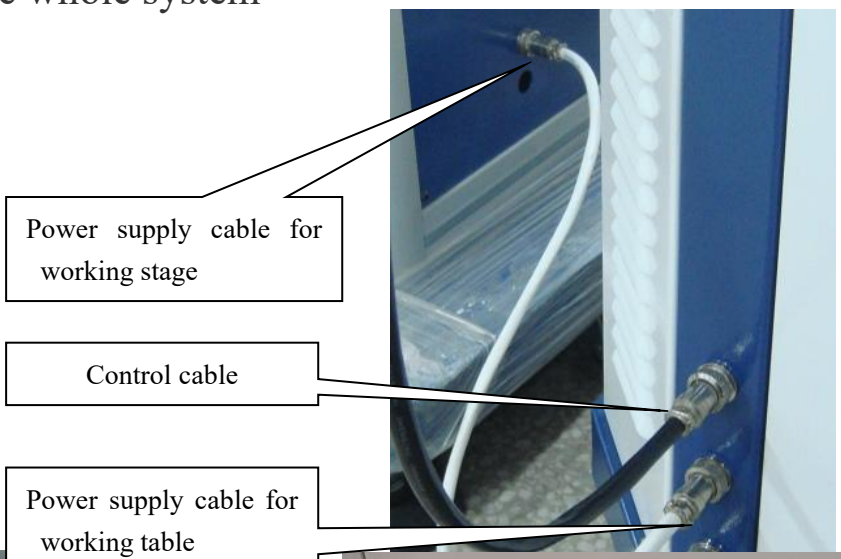
(Before package）

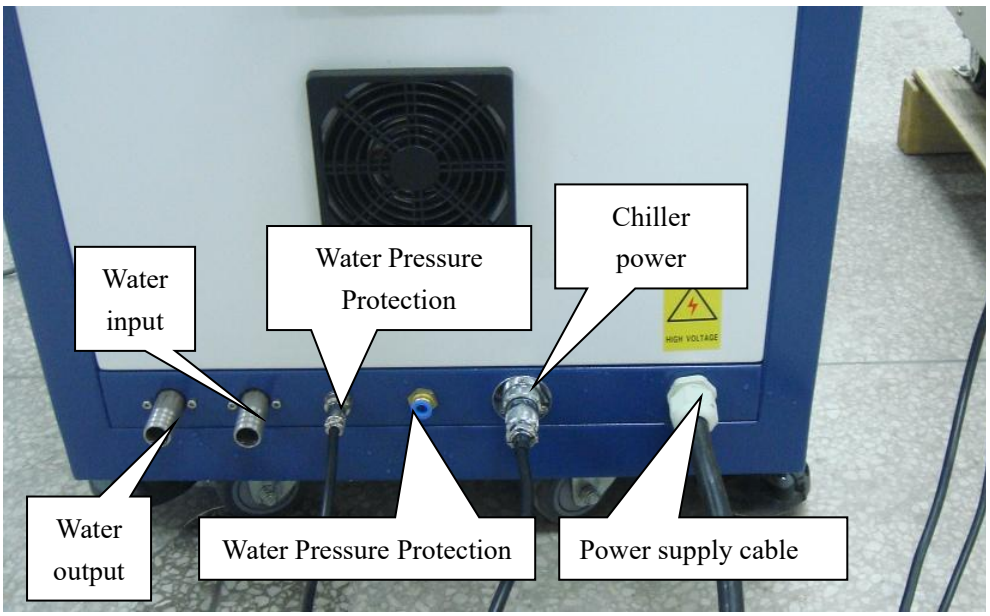
（Spare parts）

（Whole System）

3. Brief Description & Specifications

3.1 wiring for the whole system

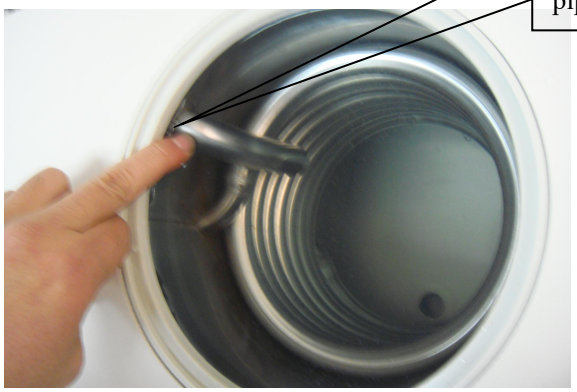




Please fix up the two screws after install the microscope

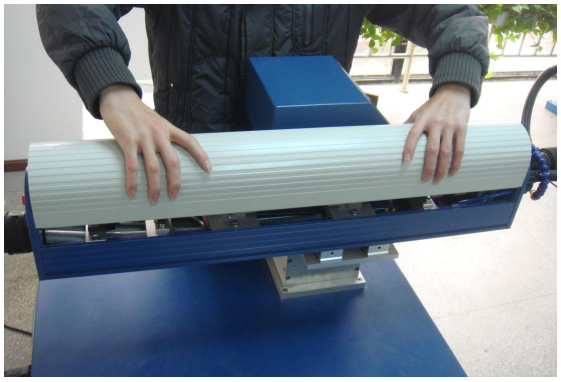
You may adjust the angle after loose the screws

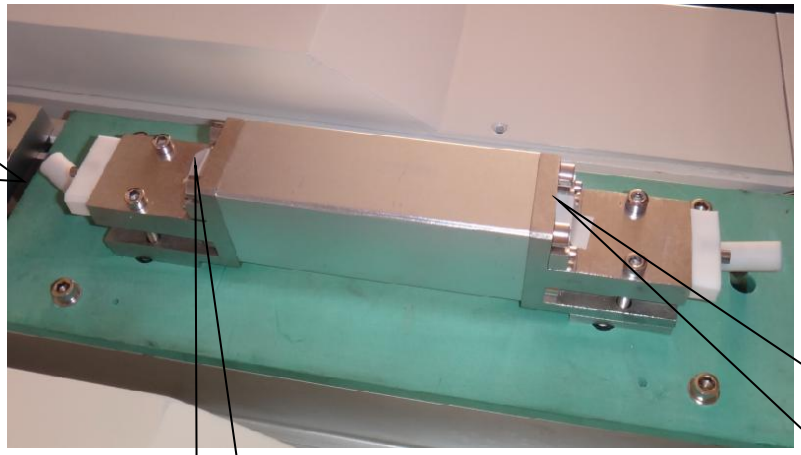
Please fulfill the chiller; the level of the water should over the cooling pipe.



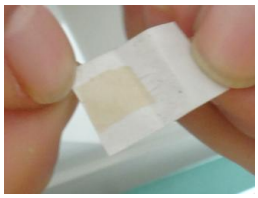
3.2 Alignment for the optical path of the laser cavity

(Here we take Spot Laser Welder as an example which has same structure with WY series welder)

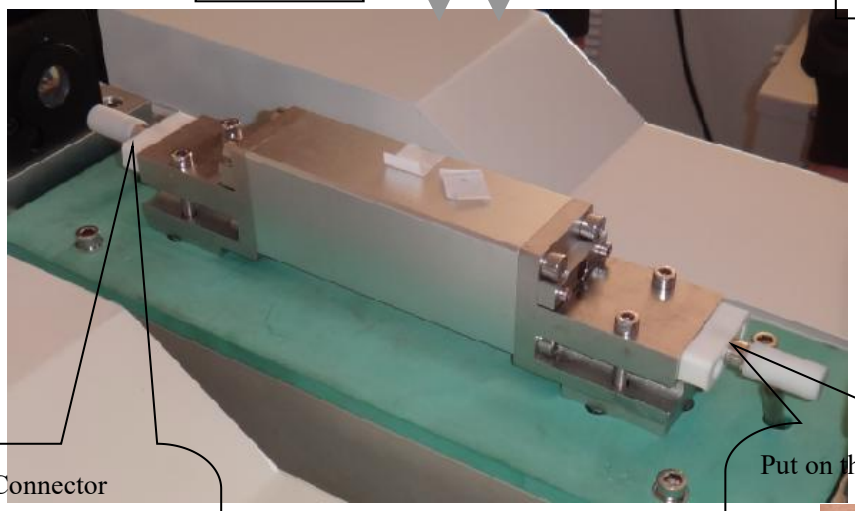




Remove the cover

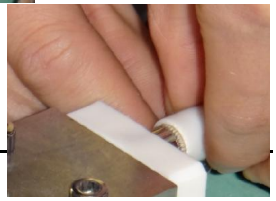


Remove
the cover



Put on the Connector

Put on the Connector



After connecting the power supply, we need to take off the cover of the laser cavity and make the alignment.

1、 Take the cover of the cavity.

2、 Remove the small paper from the two side of the YAD ROD.

3、 Set the White ROD cable to the two side of the Lamp.(Be carefully, the movement should be only left and right but not up and down. Otherwise, the lamp will be broken.)

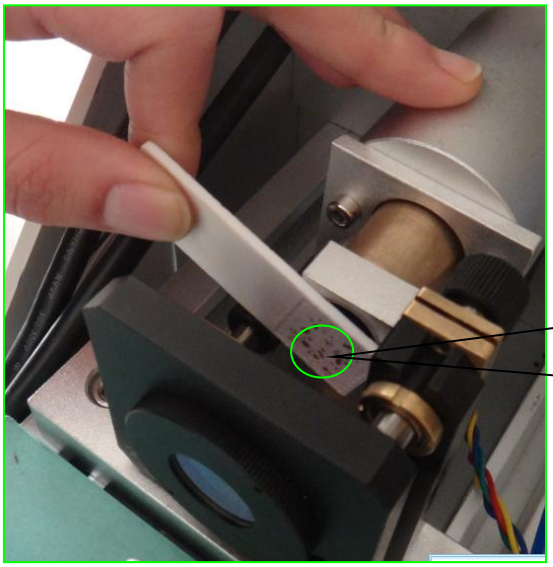
4、 Start the laser system, set the parameter as :

Curt:100A

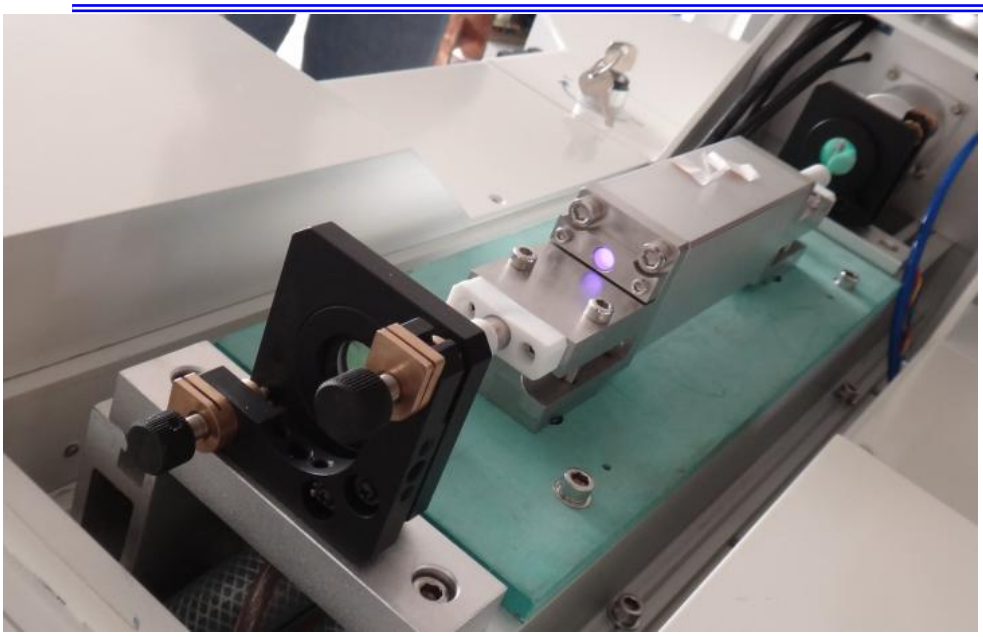
Wid:1ms

Fre:1 Hz

Use left hand to take white slice (beam watcher), use right hand to adjust the two screws, check the green light big and round.



Adjust the green dot as brightest and roundest as you can. Then the laser beam quality will be very good for welding.



3.1 Brief Description

Laser mold welding machine is mainly used for the repairing of precision plastic molds and suitable for the repair welding of different types of mold steel. In addition, it also can be used for the welding of all sorts of small and precision metal parts (K gold, Platinum, Titanium, Silver, Copper Nickel, Aluminum, Magnesium, Stainless steel, etc.), featuring firm welding joints and smoothly welding lines.

Benefits of laser repair welding for molds:

1. Welding point's diameter only to 0.1-3.0mm, with high precision and accuracy;
2. Wavelength of the Laser is 1064nm.
3. Small heating scope ensures distortion free and bubble free work pieces;
4. Compensating the deficiency of traditional argon-arc welding and cold welding in repairing the fine surfaces; low oxidation effects and color change free for work pieces;
5. Welding operations can be done within the small spaces or deep cavity areas, no damage will be caused to the surrounding walls. No distortion on the mold nor dents around the weld pool can occur.
6. Edge won't be damaged by burning when the fine parts are repaired.
7. Argon gas protection ensures the repairing parts and base materials won't be burned nor oxidized.
8. Joystick control, movable work piece, fitting and curve;
9. Operations monitored by microscope, ensuring good vision of fine parts;
10. Imported welding wires, fitting different kinds of imported mold materials, Polishing and texturing can also be realized.
11. Costs can be greatly saved in materials, labor and time used for mold modification, repairing and special work pieces.

3.2 Technical Index

Model	CY-WY300
Laser working substance	Nd^{3+}：YAG ceramic cavity
Max. single-pulse energy	90J
Rated output power	300W
Max. peak power	9kW
Laser wavelength	1064nm
Focal beam diameter	Φ 0.2-3.0mm adjustable
Min. molten pool	0.3mm
Pulsed width	0.3-20ms adjustable
Pulse depth	0. 5-1mm
Pulse frequency	≤50Hz adjustable
Electricity	380V,50HZ,60A
Power cooling system	internal air cooling
YAG cavity cooling	external water chiller
Load bearing	200kg
Controlling system	Single chip/PLC optional
Observing system	Microscope/CCD optional
Weight	250-350Kg

4. Overall Structure & Maintenance

The whole system is composed of five sections: control cabinet, cooling system, power supply, laser and optical system.

4.1 Laser

(1). Laser Structure

The laser is a device that converts the electrical energy into the laser energy. The machine employs Nd^{3+}：YAG laser, consisting of the following parts:

a) Laser lamp: It converts the electrical energy into the optical energy that can activate the substances for laser processing. The machine adopts pulse xenon lamp with repetition rate of XMC7-125. Both the electrode and quartz glass tube surface need to be cooled during working.

b) Laser Crystal: It converts the optical energy into the laser energy. This machine employs the crystalϕ7*145mm Nd^{3+}:YAG as its working substance.

c) Pump Chamber: It focuses the light from the laser lamp to the working materials.

d) The optical resonator cavity can provide optical feedback, allowing the laser to be magnified to form high strength laser for output. This machine employs the plane and parallel cavity made up of flat mirrors with ceramics as its medium. The full reflector's transmission is less than 0.4%, output reflecting mirror's transitivity is 85%

e) Other parts: High voltage electrodes, insulation base plate, positioning bracket, adjustable diaphragm frame and laser holder.

(2). Precautions and maintenance

As the machine is highly precise equipment whose discharging features the high pulse voltage and charging features the large capacity, and the laser focusing energy is highly centralized, the operators must obtain professional knowledge and skills before they work on the machine.

A. Optical resonant cavity

The two medium diaphragms of optical resonant cavity is absolutely parallel to the laser bar's end face, touching or random adjustment is not allowed. Do not open the laser outer hood of the laser randomly and keep the optics surface highly clean. Otherwise, the high-energy laser will damage the diaphragm layer. When the laser output energy is lower, the operator should first check whether the medium diaphragm is clean. If any dirt, you can use lens paper or cotton wool moistened by the cleaning agent (liquid mixture with ethanol absolute and ethanol respectively occupying 50%, the same when mentioned in the following part) to clean it gently. Then check the resonant cavity to see if it is misadjusted.

B. Cooling system

The laser has one water inlet pipe and one outlet pipe, respectively connected to the cooling channels of the lamp and bar. Unsmooth water flow at any part will cause large loss. Each time when the equipment is assembled, the operator should check the water flow at each path and make sure no fault exists before starting up the laser.

C. Changing the lamp

The average service time of the pulse xenon lamp is 10^8 times of blinking if it works under its rated power and belongs to the consumptive pieces. To ensure the normal performance of the machine, the lamp must be replaced when it has reached its rated blinking times (about 10^8 times) and the energy becomes low. In cases that the xenon lamp is damaged or its service time is shorted due to other causes (for example, it can't pre-illuminate or no energy output is available when the voltage is increased to 500V), the xenon lamp should also be replaced.

As the strength of the sealing at the lamp's two ends is relatively low and apt to being damaged, special caution should be offered when substitution the lamp. The procedures are as following:

a. Turn off the machine, cut off the water supply and discharge the remaining electricity on the energy-storage capacitor;
b. Remove the electrodes of lamp;
c. Remove the gland of lamp, carefully pull out the lamp from the side of the full reflector;
d. Use cotton moistened by cleaning agent to clean the sleeving;
e. Check to see if the appearance, size and other aspects of the new lamp is they are reliable;
f. Install the new lamp into the chamber, press the gland tight and mount the electrodes;
g. Connect to the water supply and check the sealing of each part to see if they are reliable;
h. Turn on the main power to check whether the lamp can discharge normally;
i. Try single spot operation, check whether the output energy of laser meet the requirements. If

the output is not ideal, repeatedly adjust the resonant cavity;

j. Cover the laser with outer hood.

D. Nd^{3+}：YAG crystal is the core part of the laser, and is fairly expensive. Therefore, it should be installed with great care. The two end faces of Nd^{3+}： YAG crystal rod is absolutely parallel to each other and has high cleanliness. If there is any pollutant on the end faces, the luminous efficiency will be lower, the facular mode will deteriorate, or even can't illuminate normally. In that case, the space housing this machine must be cleaned and professionals should be called for related treatment. Take out the .Nd^{3+}： YAG crystal rod, use lens paper or absorbent cotton moistened by cleaning agent (liquid mixture with ethanol solution and another respectively occupying 50%,) to remove the dirt gently. The causes leading to the damage of crystal rod can be described as follows:

a. The flow of cooling water is over or interrupted, the energy input into the lamp makes the lamp and rod overheated. Which results in the cracking of the lamp and rod;
b. The end surface is bumped, scratched or even damaged by hard object;
c. As the diaphragm layer is polluted, the bar is damaged when the high strength laser passes by;
d. The bar is pressed too tightly or the applied force is uneven when it is installed, the over high interior stress breaks the rod. In this case, the operator should not open the hood of the laser, nor operate the YAG rod. If the end surface is found polluted, professionals should be called for the related treatment.
e. The condensing cavity doesn't need maintenance work. Normally, it is not allowed to dismantle the condensing cavity.
f. Over voltage protection

   There are three kinds of voltage applied to the pulse xenon lamp in succession, namely, trigger voltage about 13-18kv, pre-burning open-circuit voltage 1500-1800v and arc-discharge voltage about 500-2500v.Therefore, the lamp electrode should not get too close to other metal objects, and a distance of more than 15mm should be kept. The insulation panel's surface should be kept dry and clean, so as to avoid pollutions which may lower down the insulation performance to bring short circuit.

4.2 Power Supply

This machine can be operated either through the keys on the control panel or the joystick.

(1) Principle

The laser power supply system with repetition rate is employed; the L-C resonance charging is adopted for the charging circuit. The capacitance-inductance energy storage network is used for supplying the power for the lamp. The control circuit is centered by the single-chip microprocessor, which can be used to adjust the output energy of power and the repeated frequency. The system also features its multiple linked protections, ensuring the emergency stop of the power under abnormal conditions.

(2) Electric circuit

The electric circuits are made up of the following parts:

Main return circuits: including the charging circuit, energy storage network, discharging circuit and pre-burning and trigger circuit.

Controlling circuits: including the electric controlling circuit, microprocessor controlling circuit and different kinds of protection circuits.

A. Step-up/rectification circuit: it employs the single-phase stepping up, which converts AC220V into DV500V that supplies power to the charging circuit.

B. Charging circuit

The charging circuit is composed of the IGBT switch tubes. This charging mode will increase the repetition rate of the circuit.

C. Discharging circuit

The discharging circuit can be controlled by the silicon controlled switch that must be kept shut off. After the energy storage network is charged, the silicon controlled switch is shut off, then after the delayed time, the discharging can be realized by turning on the silicon controlled switch. Once the energy storage capacitance is fully discharged, the silicon controlled switch will be automatically shut off.

D. Pre-burning and trigger circuit

It is made up of the step-up and transforming circuit, high voltage bridge rectifier, filter, current-limiting resistor, current relay, high voltage pulse transformer and high voltage trigger circuit.

As the pulse xenon lamp is in the state of normal glow discharge when it is pre-burned, it has the nature of negative resistance. To ensure the normal glow discharge of the xenon lamp after the arc-discharge is finished, the pre-burning circuit must have the nature of high current source and its current-limiting resistor must be relatively high. The internal triggering mode is employed for this machine, with 50Hz automatic triggering. Once the pre-burning switch is closed, the high voltage pulse transformer will generate high voltage of 15-20KV to be applied onto the resonance cavity. As long as the pre-burning is established, the trigger circuit will be disconnected immediately.

E. Protection circuit

a.) Pre-burning disconnection protection

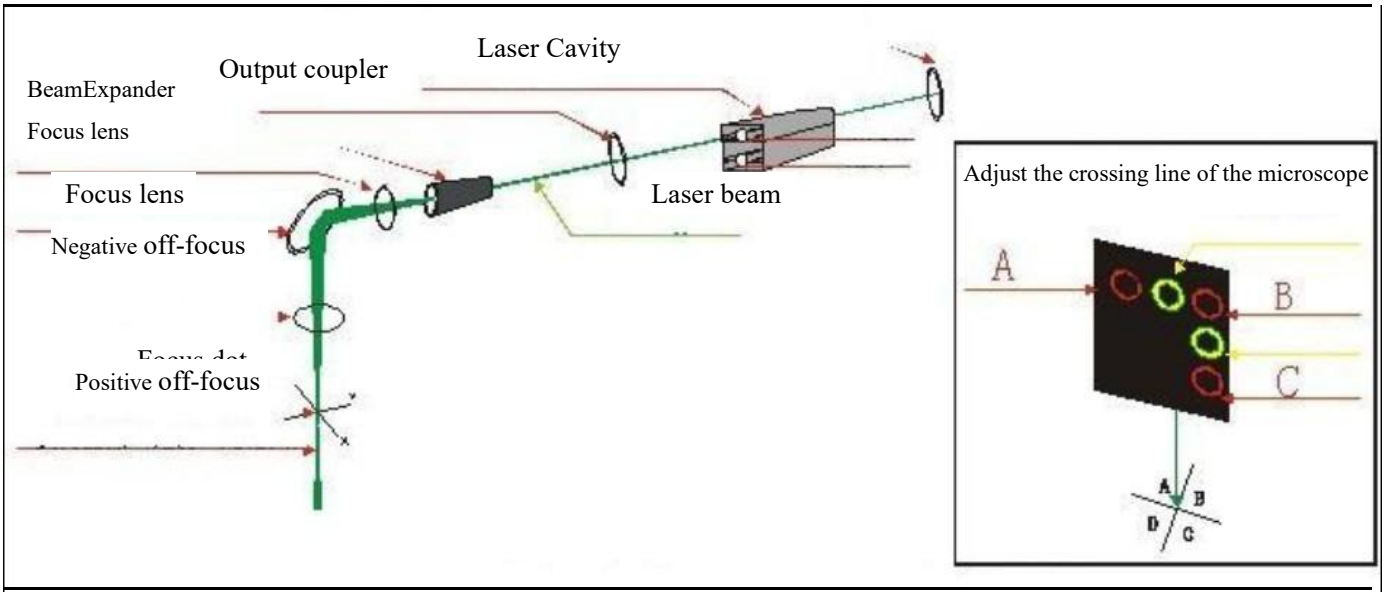
When the pre-burning current is shut down, the discharging circuit will have failure, the protection circuit will be activated to send out failure signal.

b.) Flow interlocking protection

When the flow of the circulating water inside the cooling system is insufficient, the flow breaker will be opened and the pre-burning circuit and main circuit will be disconnected, resulting in the shut off the whole machine.

4.3 Optics System

Optical Principle Diagram of Laser Welding Machine



Impact of focus set over on welding

The Laser welding normally needs a certain degree of off-focus operation, for the welding point can be vaporized into a hole if the power density at facula center of laser focus is excessively high. The planes that are not with the laser focus will have relatively even distribution of power density.

Two off-focus modes are available: positive off-focus and negative off-focus. If the focal plane is above the work piece. It is called positive off-focus. Contrarily, it's called negative off-focus. According to the theory of geometrical optics, when the positive off-focus distance is the same as the negative off-focus distance, the power density on corresponding planes will approximate to each other. However, the shape the obtained molten pool is different. Under the circumstance of negative off- focus, the large penetration depth could be reached, which is related to the forming of the molten pool. Experiments show that when the material is heated by laser for 50~200us, it begins to be molten, forms the liquid-phase metal and the evaporation appears to form the pressure-applying vapor that spurs at extremely high speed with dazzling white light. At the same time, the high-density gas moves the liquid-phase metal to the edge of the molten pool to form the dent at the center of the molten pool. Under the circumstance of negative off-focus, the power density inside the material is even higher than the surface, which is apt to cause stronger melting

and vaporizing that pass the optical energy into the in-depth part of the material.

Therefore, in actual applications, if the large penetration depth is required, the negative off-focus operation should be carried out. When thin materials are welded, the positive off-focus operation is needed.

(1) Microscope

This machine employs the binocular zoom stereo microscope, featuring its clear and stereo vision. The coated protection glass is added in front of the object lens to avoid the pollution which can be caused by the splashing metal articles during processing. For transportation and storage, the ocular can be removed by loosening the fixing screws.

(2) Laser extending and focusing system

The machine employs the design that both the laser and the beam path of the microscope share the same object lens. The focus set is determined by the welding process and adjusted by the off-focus handle, with procession graduation marks.

(3) Welding point indication

There is a reticle in the object lens, the intersection point of which is overlapped with the laser power point. Through the intersection point of the reticle, the laser beam can be aligned to the welding part during work.

(4) Precautions

A. The surface of optical parts can’t be contacted or wiped with hand ,cotton yarn or hard object, nor blown with mouth. The blowing ball can be used to remove the dust on them. If there is any pollutant, the operator can use cotton wool or lens paper moistened by cleaning agent to clean them.

B. To avoid damage, do not dismantle the parts. Otherwise, dust or smoke may enter into the inside of the optical system.

C. When the protection glass needs to be replaced, the object lens and the press ring should be removed. Replacement work should be done with great care.

4.4 Cooling system

(1) Structure

The cooling system is enclosed water circulation system composed of heat exchanger, magnetic pump, filter, water tank, flow switch and temperature contactor, valve and other parts.

(2) Working Principle

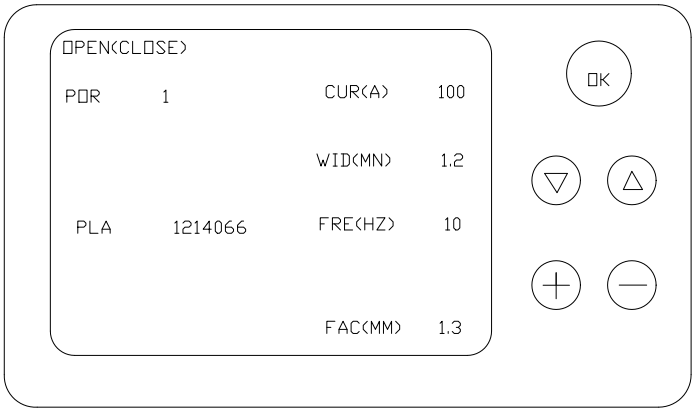
The magnetic pump pumps the deionized water in the water tank that will cool the working material (YAG

rod) ,Xenon lamp, lamp electrode of the laser. The deionized water with absorbed heat will pass by the heat exchanger discharging the heat and flow back to the water tank.

The resistance rate of the deionized water is required to be higher than 0.5 ＭΩ—cm. After some time of use, the deionized water's resistance rate will drop and it may have impurities, dirt or turbidity that will make the xenon lamp not lightened or pollute the laser cavity and glass tube, and lower the luminous efficiency. If so, the used deionized water should be substituted immediately (if the machine is continuously operated, the deionized water in the system should be replaced once a week).

The heat exchanger works through the Freon to exchange the heat for the cooling water and carry away the heat in the purified water. A flow controller and over-temperature contactor are installed in the cooling system to monitor the water that comes into the laser. Once the flow of the circulating water is insufficient or the water pump in the system works abnormally, the power for the laser should be turned off immediately so as to avoid the accident that can be caused by the explosion of the lamp and rod.

5. Panel operation



Power supply switch key

Adjust the laser beam, microscope and Crossing use these 3 screw to alignment.

LCD Display illustrate:

CLOS for turn off the machine POR for Storage PAL for Pulse

CUR for current WID for pulse width FRE for frequency FAC for beam size

Pay more attention on Buzzer alarm protection on following sections:

Presslow / Temp /Waterepre /Overtime /Commerr

5.1 Precautions:

Please read these manual carefully before starting up the Laser Welding Machine.

Operation Instructions

The two Select buttons are used for selecting the menu on the screen; the change of the parameters is controlled by the adjust button on the panel. When the cursor is moved to the corresponding place, the relate button can be pressed to set the required parameters.

Width

It displays the pulse width of the laser discharging, with the unit of millisecond, minimum value of 0.1 milliseconds and maximum value of 20 milliseconds. The wider the pulse width is , if the working voltage is the same, the higher output energy of laser will be press the Up/Down key on the control panel for one time, the pulse width of laser discharging will be increased or decreased by 0.1 millisecond.

Frequency:

It displays the frequency of laser discharging ,with the unit of Hz. The higher the frequency is ,the more times the laser will be sent out. Press the Up/Down key on the control panel for one time, the pulse width of laser discharging will be increased or decreased by 1Hz.

Light Shielding:

When the pedal switch is closed and the word “Laser” is displayed on the screen, the liquid crystal light valve can shield the flashing light. Under non-work conditions, the word “ Laser” won’t be displayed.
Working current:
It displays the discharging current for the laser. When the pulse width is identical, the higher the working voltage is, the higher the output energy of laser will be. Press the Up/Down key on the control panel for one time, the discharging current for the laser can be increased or decreased by 1A, ranging from 100-600A.
Start-up:
To start the laser, press the movement stop button, and the OK button to confirm it. Then the laser will be started. At the time , the power supply for the laser begins to work and the pre-burning process will lighten the xenon lamp. The whole start-up process needs about 1 minute. When the cooling system will be started first. If the cooling system begins to work normally, the word “OK” will appear. If not, the word “ERROR” will appear. In the latter case, the next procedure won’t be started.

5.2 Start-up procedure
1. Close the brake for the power supply;
2. Turn on the cooling system
3. Turn on the Key switch clockwise;
4. Select the Work key;
5. The word “Open” will be displayed on the upper left corner of the screen;
6. After the lamp is turned on for 30 seconds, you can hear the sound when the relay of the machine casing is closed and a sound of “tick” from the buzzer, which means the laser lamp is lightened. The word “ Close” will appear on the upper left corner, meaning the machine is working normally.

5.3 Shut-off procedure
1. Move the cursor to the place “Close”, Press OK key. The word “Close” will be displayed. A sound will be heard when the relay in the machine casing is disconnected.
2. Turn the KEY switch counter-clockwise to OFF position.
3. Turn off the cooling system after 1 minute.
4. Turn off power supply;
5. Turn off the valve of the argon gas cylinder to avoid leakage.

6. Welding Operations

Firstly, the appropriate parameters, such as width, frequency and current, should be selected according to the nature of the work piece to be welded. The pulse width, frequency and working current can be adjusted through the off-focus adjusting device at the optical head. Once the parameters are properly set, the operator can observe the work piece to be welded through the object lens of the microscope, while the work piece can be moved upward or downward so that the work piece can form a clear image in the visual field, the ejected faculas are shape as fish scales, no concave or dent around the edge of facula can be seen . To adjust the facula, the operator can use the three adjusting screws to allow the intersection of across to

be overlapped to the welding point on the work piece. At the time, step down the pedal switch to activate the laser to start the welding process.

7. Specialties

The machine features its small size, easy operation, firm and good-looking welding point, and is suitable for repairing of different kinds of metal materials and can work for long hours, with small heated area and pollution free worksite. It can be used for welding different sorts of steel as used for making molds, beryllium copper, stainless steel, aluminum, platinum, K gold, silver and titanium and different metals and alloys.

8. Typical Applications

The laser welding machine can not only be used for repairing molds, but also for the precision welding of small articles, such as jewelry, electronics, telecommunication devices, hardware, watch and clocks, products of military industry, etc.

9. Warranty

CY OPTO guarantee that the technical parameter of the machine WY200 laser welder accord to the technical requirements. The guarantee covers a period of twelve (12) months from the date of produce.
The guarantee shall not apply in the event that the sub-assembly identification markings have been removed, defaced or altered or if any sub-assembly or part has been replaced or modified without the express consent of CY OPTO.

The guarantee does not apply to equipment or components for which inspection by CY OPTO shall disclose it has became defective or unusable due to misuse, mishandling, accidental damage, negligence or any other cause which does not comply with the requirements given in the instruction manual, This includes:

- Out of range power supply voltage.
- The guarantee of the parts which we purchaser from other supplier will obey the supplier's warranty.
- Misuse, mishandling, accidental damage.

- Do not obey the requirement parameter.
- Mishandling to make the fiber burnt and damaged.
- Unauthorized to open the laser box or change the components.
- the guarantee do not included any freight cost of shipping

10. Service Report

Customer registered at (Time & Date): Under Warranty: ☐Yes ☐No

Customer：	Date of Commencement	Time	Date of Completion	Time
Address：				
Contact Person：	Tel：			
Mode：	Serial No.：		Date of Setup：	
Fault Descriptions：				
Fault Identified：				
Measures Countered：				

Replaced Parts List：			
Part name and model	Quantity	Unit Price	Total Price

Customer’s Feedback：

- ☐ Acknowledge that service has been completed;
- ☐ Service is in progress;
- ☐ Others：

Customer’s signature & Company’s Stamp:

_____

Date: _____

CY OPTO Service Engineer’s Signature:

_____

Date:_____