DW-320

User Manual

DRAWELL
Artist of Science

Please read operating manual before installation and operation.

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Content

Chapter 1 Introduction

1.1 Purpose

Atomic Absorption Spectrometer is a kind of instrument for the analysis of inorganic components. It is widely used in environmental protection, medicine, sanitation, metallurgy, geology and petrochemical industry fields for micro analysis and trace analysis.

1.2 Instrument Fundamental

The fundamental of this instrument is that the characteristic spectrum of the element to be measured is emitted from light source and absorbed by the ground state atoms of the same element in the sample steam when passing the flame or non-flame atomizer. The decrease of this spectrum is detected, and then the content of the element in the sample is obtained.

1.3 Features

1) High Sensitivity. The characteristic concentration of flame method is mg/L～μg/L order. The characteristic quantity of graphite furnace method is 10^{-9}～10^{-12}gram.

2) This instrument has comparatively complete functions and is operated simply. Its functions include logarithm conversion, direct concentration reading, slope reset, auto-zero, LED display, etc.

3) The sample chamber is commodious, so that the graphite furnace, the hydride quartz-tube furnace and other accessories can be installed or uninstalled conveniently.

A thermal blanket is installed to decrease the atomizer's thermal effect on the other parts of the instrument.

1.4 Performance Characteristics

1.4.1 Wavelength Range and Wavelength Precision

Range: 190～900nm

Precision: ±0.5nm

1.4.2 Resolving Power

Can resolve the 279.5nm and 279.8nm manganese double lines, and the energy value between the two line is less than 40%.

1.4.3 Characteristic Concentration, Characteristic Quantity, Detection Limit and Relative Standard Deviation (Precision) of the Representative Elements

1. Characteristic Concentration, Detection Limit and Relative SD of Flame Method:

Copper (Cu), Detecting Wavelength 324.7nm

Characteristic Concentration≤0.05μg/ml/1%

Detection Limit≤0.008μg/ml

Relative SD≤1%

2. Characteristic Quantity and Relative SD of Graphite Furnace Method:

Cadmium (Cd), Detecting Wavelength 228.8nm

Characteristic Quantity≤1×10^{-12}g

Relative SD≤5%

1.4.4 Stability

Copper (Cu), Detecting Wavelength 324.7nm

Drift of Zero in 30minutes≤0.006A(Value of Coordinates without Expand)

1.5 Technical Specification

Name	DW－320 Type AAS	DW－310 Type AAS
Wave Band	190nm～900nm	190nm～900nm
Power of Lamp	Hollow Cathode Lamp Current: 0～10mA; D_2 Arc Lamp Current: 70～140mA; Power Supply: Rectangular Pulse, 400Hz, Proportion of space occupied 1:5.	Hollow Cathode Lamp Current: 0～10mA; Power Supply: Rectangular Pulse, 400Hz, Proportion of space occupied 1:5.
Atomization System	Flame Method: Pre-mix Type Non-flame Method: Graphite Furnace System (Selection) Hydride Method: Hydride-Generator (Selection)	Flame Method: Pre-mix Type Hydride Method: Hydride-Generator (Selection)
Optical Dispersion System	C-T Monochromator; Dispersion Part: Plane Diffraction Grating; Line Density: 1800lines/mm; Twinkle Wavelength: 250nm; Focus: 277mm; Spectrum Band Width: 0.1, 0.2, 0.4, 0.8, 1.6, 2.5nm; Wavelength Adjustment: Two Manual Wavelength Scan Mode, Fast and Slow.	
Optical Signal	Single Beam; Photomultiplier Tube Detection; Detecting the phase difference between the signal of D_2 arc lamp and of hollow cathode lamp when background correction.	Single Beam; Photomultiplier Tube Detection
Measured Signal	Transmission (Energy); Absorbency; Concentration.	Transmission (Energy); Absorbency; Concentration.
Display	LED; Printer (Selection)	LED; Printer (Selection)
Signal Processing	Auto-zero,Coordinates Expand; Slope Reset; High Voltage Auto-balance, D_2 arc Lamp Auto-balance	Auto-zero, Coordinates Expand; Slope Reset; High Voltage Auto-balance
Protection	Combustion Gas Leak Alarm in Gas Control Box	
Power	220V, 50Hz, 220W	
Dimensions	102 (W)×49 (D)×54 (H) cm	
Weight	80Kg	

NOTICE: All the presentations of graphite furnace, power supply of graphite furnace, D_2 Arc lamp and background correction in this manual are only fit for the 320 type instrument. The 310 type instrument doesn't have the above functions.

Chapter 2 Working Environment and Device Requirement

2.1 System Well-running Conditions

1. Environment Temperature +10℃～30℃
2. Indoor Relative Humidity Range 30%～80%
3. Atmospheric Pressure 500～1060hpa
4. No Strong Magnetic Field Interference Indoor
5. No Shake Enough to Affect the Instrument Running Indoor
6. Cleanly, Dry, No Dust, No Corrosive Gas Indoor
7. Temperature at the water entry of the water-cooling device is No more than 25℃
8. Power Supply AC 220V±22V 50Hz

2.2 Necessary Lab Conditions

All the requirements mentioned in this section must be provided before user install and run the instrument normally.

2.2.1 Power Requirements

1. Power Supply

(1) Host Instrument: Monodirectional AC 220 V±22V 50Hz, Power 150W

(2) Printer: Monodirectional AC 220 V±22V 50Hz, Power 100W

(3) Air Compressor: Monodirectional AC 220 V ± 22V 50Hz, Power 240W, Start Instantaneous Power about 2.2KW

(4) Power Supply of Graphite Furnace: AC 220V, 50Hz, 4KVA, Instantaneous Output Power 6KVA.

2. Power Supply Cables

Voltage stabilizing power is suggested to use for the power supply of host instrument and printer. The lab switchboard cables and socket norms are shown in Fig.2-1.

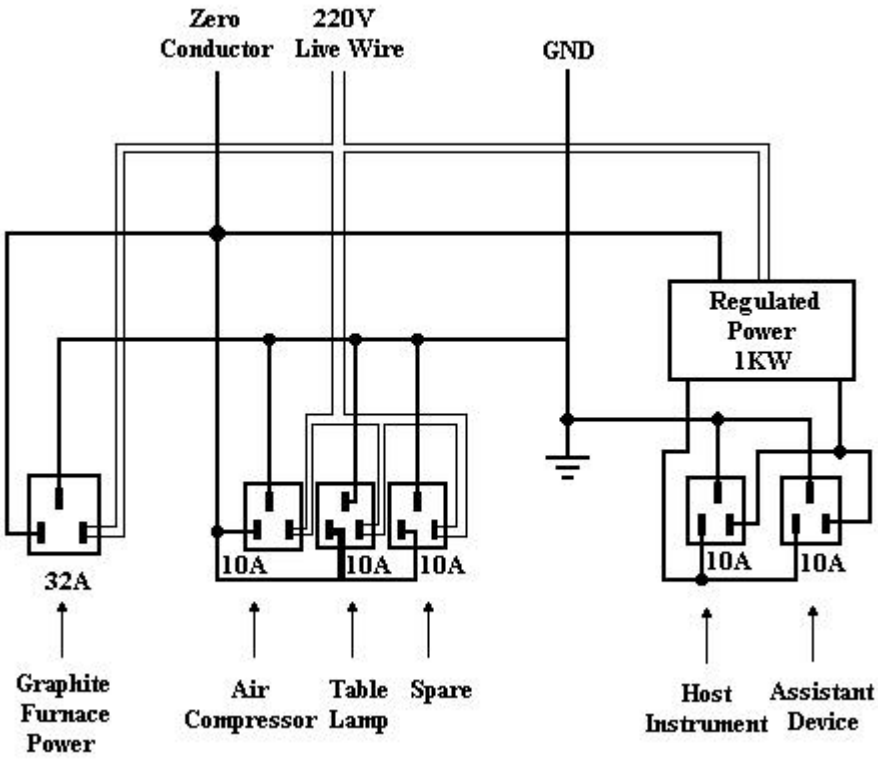


Fig. 2-1 Lab Switchboard Cables and Socket Norms

3. Ground

The earth wire of the instrument should be connected to a metal board buried one meter under the ground, in order to ensure the instrument running stably and operating safely. The ground resistance should be less than 100 Ω . This ground wire is functional grounded, not protection grounded.

2.2.2 Gas Supply Requirements

1. Necessary Gas

(1) Compressed Air: The exit pressure of air compressor should be adjusted to 0.3MPa. Necessary for flame method.

(2) Ethine: Special decompress adjustor for Ethine must be equipped when steel bottled Ethine is used. The exit pressure is 0.05 ～ 0.07MPa. Gas purity is analyzing purity (99.99%). Necessary for flame method.

(3) Argon: Use steel bottled Argon. Oxygen or Argon decompress adjustor should be

equipped. Entry pressure is 2.5MPa, and the adjustable range of exit pressure is 0～0.4MPa. The purity requires 99.99%. Necessary for graphite furnace method or hydride method.

2. Place Requirements

(1) Ethine steel bottle should be placed in well-ventilated room solely. No fire around. Near the workaround.

(2) Safe gas steel bottle and air compressor can be placed in lab.

(3) All steel bottles should be placed firm and avoid falling down.

2.2.3 Cooling Water Requirements

Cooling water is used for graphite furnace method.

1. Tap water with flux of 1.8L/min or cooling circulating water system.

2. Pressure of upper hose had better be 0.15MPa.

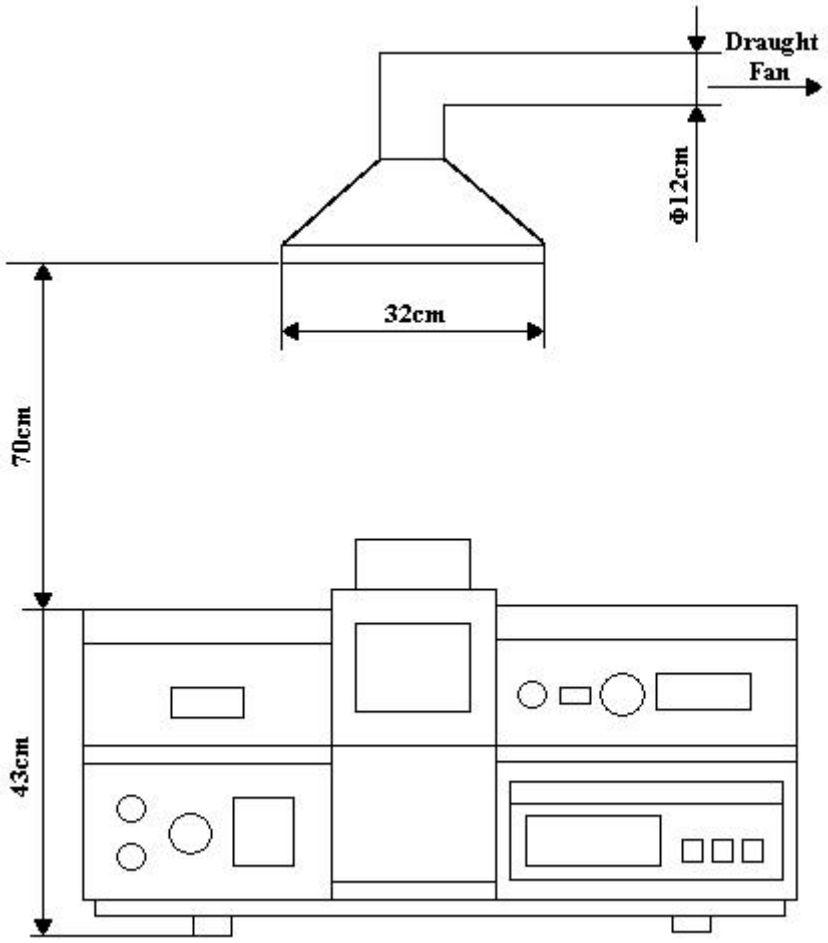


Fig. 2-2 Installation of Draught Apparatus

2.2.4 Ventilation Requirements

1. Draught apparatus is necessary in lab.

2. The draught hood should be placed above the atomizer. The dimensions of draught apparatus can refer to Fig.2-2.

3. The wind flow volume is favorable when a paper is just absorbed by the back of the draught fan. Neither too large nor too small is advisable. The former will affect the stability of the flame, and the latter isn't useful for ventilation. The wind flow volume depends on the volume, length and direction of the draught flue. Requirement is 10～20m^3/min.

4. It is better to use metal draught apparatus. The plastic draught apparatus must not be adopted.

2.3 Other Lab Conditions

1. Worktable

(1) Dimensions of worktable: 250(W)×90(D)×70(H)cm

Worktable should be firm and ametabolic with great weight.

(2) The table-board should be flat, and covered by a shockproof corrosion-resisting plastic or rubber board.

(3) Leave some space around the worktable, in order to connect the gas paths or examine and repair the instrument conveniently.

2. No dust indoor. No exquisite change of room temperature. Air condition needed if possible.

3. The AA lab must be separated from chemistry lab, in order that the AAS instrument is prevented from acid, alkali and other corrosive gases, steam and smog.

4. For trace analyzing and super trace analyzing with graphite furnace method, the lab must be cleanlier. Air pressure indoor is positive, and the air should be filtered. The floors and walls are equipped with dustproof materials. Especially when analyzing those easy-polluted elements, such as calcium, kalium, sodium, magnesium, zinc, the lab can only be decorated with inert plastic, Teflon. To obtain precise results, touch the vessels slightly, and be sure that the environment is cleanly.

Chapter 3 Installation

3.1 Inspection of Packing

When the packing is coming, do immediately receive the instrument and inspect if the name and number on the detailed packing list accord with those on the order contract. And inspect if the instrument packing is intact and if there is distinct damage after transport. If it is damaged, negotiate with the forwarder about that.

3.2 Unpacking

1. After unpacking, take out the technical files and inspect if all the accessories and parts are ready. And inspect if the instrument is damaged. If so, negotiate with those concerned about that.
2. Read all the operation manuals of the instrument, and know the fundamental, structure and operation guide.
3. Provide the work conditions and necessary lab conditions according to this manual, and then install the instrument according to this chapter.
4. Test the performance characteristic of this instrument. The learners need specialized technical personnel's help when installing.

3.3 Installation

3.3.1 Necessary Devices

1. Hollow Cathode Lamp: Necessary for both debugging and analyzing. Certain element's hollow cathode lamp must be corresponding to the element to be measured.
2. Prepare some plastic barrels with volume of 5～10L for loading waste liquid or deionized water. The barrels for different use must have obvious marks. Glass

containers are not suggested to fill waste liquid.

3. Printing Paper: Narrow row continuous printing paper (240 × 280) or A4 duplicating paper.

4. General Tools: Besides the accessory screwdrivers and inner hexagon spanners with the instrument, user should prepare some screwdrivers of various standard, shifting spanners, sharp nose pliers, and so on.

3.3.2 Instrument Installation

1. Take out the host instrument, all accessories, parts and components from the packing box, and put them in the lab. Place the graphite furnace power supply, host instrument, and printer in turn from left to right.

2. Put the host instrument on the worktable, and ensure that all its foots compact the tabletop. If any not, adjust the four height-adjustable foots and make the instrument balanced and firm. Leave enough space behind the instrument to connect the gas paths or examine and repair the instrument conveniently.

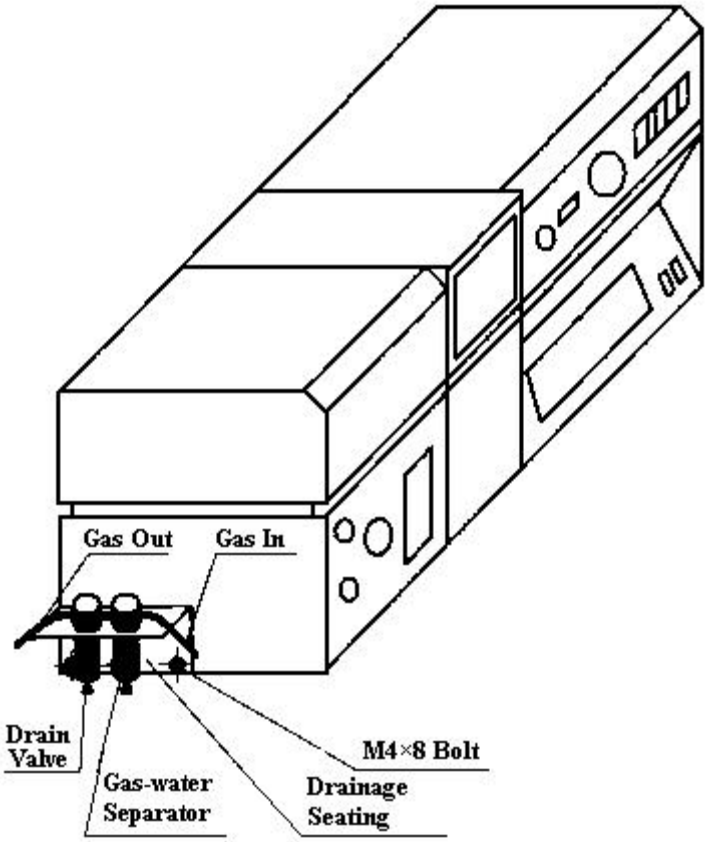


Fig. 3-1 Installation of Gas-water Separator

3. Gas-water Separator Installing Step

(1) Take out the drainage seating from the bag and fix it on the host instrument with accessory three bolts, as shown in Fig. 3-1.

(2) Connect the gas-water separator of air compressor in series with drain valve and hang it on the drainage seating.

(3) Connect the Air OUT to the Air IN of the host instrument, and then connect the Air IN to the Air Exit of air compressor.

(4) After air compressor running, do drain off when the water in the gas-water separator overrun 1/3.

(5) Drain off: Connect a container with the gas-water separator below, and then unscrew the drain valve to drain off the water. Screw it at last.

3.3.3 Host Instrument Installation and Circuit Connection

The connections of host instrument inner electrical system have been already finished before leaving factory. Don't change or dismantle these connections unless there are troubles in the instrument. Fig. 3-2 illustrates the connections between the host instrument and other parts and power supply.

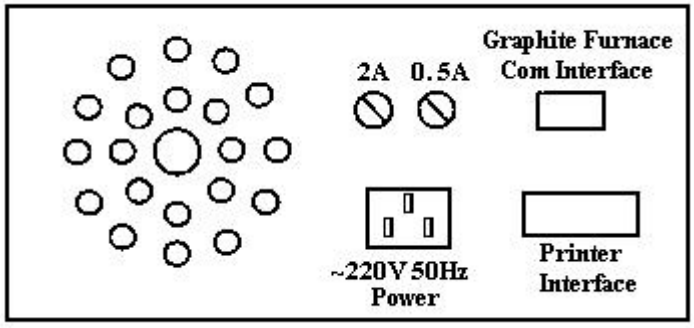


Fig. 3-2 Cables between Host and Peripheral Devices

Don't power the instrument when the following occur. Please check all parts of the host instrument carefully, especially the electronic components, socket connectors and connection wires. Be sure that there is no short circuit before powering.

1. Placed in very execrable environment for a very long time.
2. Hard bumped during transport.

3.3.4 Installation of Flame Atomization System

Flame atomization system is composed of atomizer, burner and gas feed system.

1. Connections of Gas Paths

The gas control box lies in the left bottom of the host instrument. Its back panel has four nozzles: they are Ethine IN, Air IN, Ethine OUT, Air OUT and are all marked.

(1) Connections of flame atomization system gas paths:

A) Ethine steel bottle's OUT → Gas control box's Ethine IN

B) Gas control box's Ethine OUT → Burner's Ethine IN nozzle behind host instrument → Atomizer's Ethine IN

C) Air compressor's Air OUT → Gas-water separator's Air IN

D) Gas-water separator's Air OUT → Gas control box's Air IN

E) Gas control box's Air OUT → Burner's Air IN nozzle behind host instrument → Atomizer's Air IN

All are illustrated in Fig. 3-3.

(2) Gas source and gas control box are connected with gluey flexible tubes. Gas control box and host instrument, host instrument and atomization burner are all connected with Φ6(external diameter)×1mm plastic fluidal tubes.

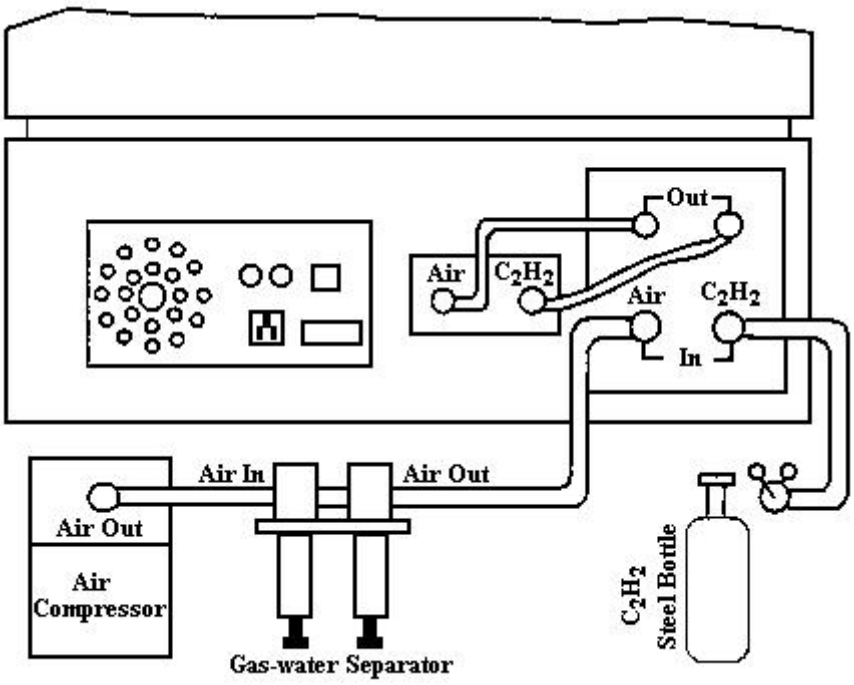


Fig. 3-3 Gas Paths Connections of Flame Atomization System

2. Installation of Air Compressor

(1) Do inject the No. 18 frozen engine oil into the compressor for lubrication if the air compressor is low noise type.

(2) Be sure that the air compressor runs normally before it is connected to the gas control system.

Firstly, be sure the air compressor start normally after powering. Secondly, test if the air compressor can do the following: auto-start at certain pressure (about 0.5MPa) and auto-stop at certain pressure (about 0.7MPa). Thirdly, test the normality of the oil-water separator and the air filter-decompressor, and be sure that the exit pressure could be adjusted to the expected value(generally 0.2～0.3MPa).

For oil free air compressors, do not need to do the above, but be sure that it runs normally before it is connected to gas paths.

3. Installation of Ethine Source

(1) Place Requirements

Ethine source should be placed outside of the lab with good ventilation. Ethine is guided into the lab with qualified pipe special for combustive-gas. Fire mark should be placed where Ethine source lies and fire extinguisher must be equipped.

NOTICE 1: NO OPEN FLAME OR HYPERTHERMAL OBJECTS AND HIGH TEMPERATURE OBJECTS AROUND ETHINE SOURCE!!!

NOTICE 2: DO NOT PLACE ETHINE SOURCE AND OXIDATIVE GAS SOURCE TOGETHER!!!

(2) Ethine steel bottle must be equipped with special pressure regulator. Use the accessory open tools of the pressure regulator to open or close the main valve of ethine steel bottle.

Ethine steel bottle should be placed vertically and firm. Avoid falling down!

4. Connections of Waste Liquid Pipelines

There is a waste liquid nozzle on the atomization system(at the front bottom of the atomizer). Prepare a 1.5m long, Φ 11(external diameter) × 1.5mm plastic pipe and connect one end to the nozzle. Coil the middle of the pipe into a circle with the diameter of about 15cm, and fix the circle. Inject some water into the pipe and make it stay in the circle as water seal that prevents the spray chamber from the atmosphere.

The height of the water level is referred to Fig. 3-4, more than the radius of the circle. Put the other end of the waste liquid pipe into a plastic barrel with the volume of 5～10L, but don't put it under the liquid level.

NOTICE 1: DO NOT PUT THE WASTE LIQUID PIPE INTO THE LAB WASTE LIQUID SYSTEM, TO AVOID CORRODING THOSE PIPELINES.

NOTICE 2: WHEN ANALYZING WITH FLAME METHOD, BE SURE THAT THE WATER SEAL IS GOOD, TO AVOID BACKFIRE, BLAST AND LEAKAGE OF COMBUSTION GASES!!!

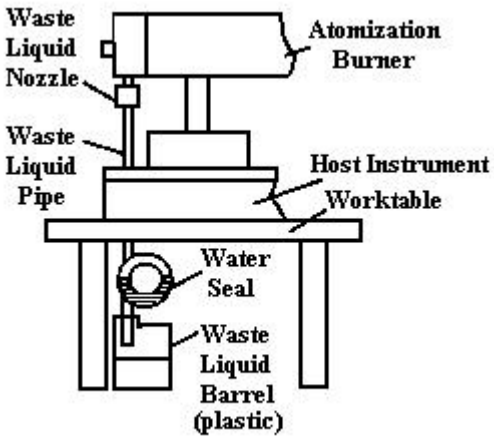


Fig. 3-4 Connections of Waste Liquid Pipes

5. Check of Gas Leakage

After the installation of flame atomization system and before running the instrument, do inspect if any pipeline junctions or parts of gas control box have leakage, especially the intactness and sealing performance of the explosion-proof pellicle, otherwise backfire will occur when ignition.

3.3.5 Installation of Graphite Furnace System

Graphite furnace atomization system is composed of graphite furnace and graphite furnace power supply. WF-1C/1D type graphite furnace power supply and WF-4D graphite furnace (back lead) can match this instrument. Graphite furnace system includes the connections of circuits, gas paths and water paths, which must be finished before the normally running of instrument. The following are the details:

1. Connections of Circuits

(1) Graphite furnace electric supply cable: one end is large-scale four-core round

aviation connector plug, which is connected to the socket marked 'XS1' lies in left bottom of the power back; the other is AC 250V, 32A connector plug, which is connected to the socket of AC 250V, 32A electric supply, as shown in Fig. 2-1.

(2) Graphite furnace large heating cables: one end is connected to the cable joint marked 'GF' on the back panel of WF-1C/1D, and is fixed by bolts; the other is fixed on the graphite furnace cable joint seating by bolts when installation. To avoid the electromagnet interference, it's better to make these two large cables side-by-side or twisted together.

(3) Graphite furnace overheat protection wire: one end is temperature relay, which is fixed on the top of the graphite furnace metal water-cooling jacket by bolts when installation; the other is nine-core D type plug, which is plugged into the nine-pin D type socket marked '4XS15'.

Notice: Temperature relay should be fixed on the water-cooling jacket of graphite furnace fixed pole seating.

(4) Remote control signal wire: refer to Fig. 3-2 in section 3.3.3.

(5) Temperature-control wire: Its nine-core D type connector plug is connected to the nine-pin D type socket marked '6SX10' behind the WF-1C/1D's power supply. Its Q9 plug is connected to the Q9 socket of WF-4D type graphite furnace (only for WF-1C type power supply).

2. Connections of Gas Paths

Connect inner, outer and pressure the three gas paths between WF-1C/1D graphite furnace power supply and WF-4D type graphite furnace correspondingly with Φ6 (external diameter)×1mm nylon pipes. Connect the pressure regulator of the Argon steel bottle and the gas-entry of WF-1C/1D graphite furnace power supply with Φ10 (external diameter)×1mm nylon pipes.

3. Connections of Water Paths

Connect the tap(or the water-exit of circulating water system) and the water-entry of WF-1C/1D graphite furnace power supply with Φ10(external diameter)×1mm plastic pipes. Connect the water-exit of WF-1C/1D graphite furnace power supply and the water-entry of WF-4D type graphite furnace. Guide the water from the water-exit

of graphite furnace to the sewer(or circulating water system) with Φ 10(external diameter) × 1mm plastic pipes. Ensure that the water-exit pipe is fixed beside the sewer, to avoid that the overflowing water dirty the laboratory.

3.3.6 Installation of Hydride Atomization System

This series instruments may select accessory automatic hydride-generator and quartz-tube furnace as hydride atomization system to do AA analyzing with hydride method. About the operation guide and installation method of this accessory, please refer its specification.

3.4 Acceptance Inspection

After the installation of the instrument according to the above requirements and rules, the acceptance inspection will begin. Firstly, read the specification carefully and know the functions of all buttons and knobs and the operation methods and steps. Then power the instrument. Laity of instrument CAN'T touch the switches or dismantle the movable parts randomly, otherwise man induced troubles or damages maybe occur.

The purpose of acceptance inspection is to detect the quality decrease of instrument caused by transport or placement, which lead to troubles in running the instrument. And find the reasons of quality decrease in order to process immediately.

1. Projects of Acceptance Inspection

(1) Inspections of the performance characteristic in Chapter 1 of this specification.

(2) Other functions such as auto-zero, coordinates expand, etc.

2. Requirements of Acceptance Inspection

(1) Acceptance inspection should be executed in before-mentioned lab conditions. Otherwise execrable environment will lead to troubles of instrument.

(2) Acceptance inspection work should be executed as the following operation guide.

3. Method of Acceptance Inspection

(1) Wavelength Range and Wavelength Precision

1) Wavelength Range

Check 193.7nm line of Arsenic Lamp as short wave

Conditions: Lamp Current is 3mA. Slot Width is 0.2nm order.

Requirements: High voltage of PMT no more than 700V when the display of this line's intensity is 99.

Check 852.1nm line of Cesium Lamp as long wave

Conditions: Lamp Current is 3mA. Slot Width is 0.2nm order.

Requirements: High voltage of PMT no more than 700V when the display of this line's intensity is 99.

Notice: ① Copper Lamp's 205.5nm line is alternate for short waves check, and Hydrargyrum Lamp's 871.6nm line is alternate for long waves check.

② When using Copper Lamp, the intensity of its 324.7nm line is checked firstly. In the conditions of 3mA lamp current and 0.2nm order slot width, the high voltage of PMT should be in the range of 300 to 400V(or smaller) when the display of this line's intensity is 99. If it is not satisfied, the radiation intensity of this lamp is unqualified.

③ After the hollow cathode lamp is fixed on the lamp turret, adjust its placement to maximize the light intensity into the monochromator (energy display).

2) Wavelength Precision

Check the following lines of Hydrargyrum Lamp: 253.7nm, 435.8nm, 546.1nm, and 871.6nm.

Operation: Power the Hydrargyrum Lamp and turn the wavelength hand-wheel about to the following wavelengths respectively: 253.7nm, 435.8nm, 546.1nm, and 871.6nm. Then turn the wavelength minitrim hand-wheel slowly and find the position where its intensity is largest. The difference between the wavelength counter's value of this position and the theoretic value of this line's wavelength should meet the wavelength precision standard in Chapter 1.

Notice: ① Because the intensity differences between each line of Hydrargyrum Lamp spectrum are very large, the high voltage of PMT should be respectively adjusted for each line with different intensity, in order to locate the display of energy in a seemly range.

② **Wavelength indication must be in the range of 190nm to 900nm when turning the wavelength hand-wheel!!!**

(2) Resolving Power

Check the double lines 279.5nm and 279.8nm of Manganese Lamp.

Conditions: Lamp Current is 3mA. Slot Width is 0.2nm order.

Operation: Turn the wavelength hand-wheel slowly and maximize the energy of 279.5nm line. Then adjust the high voltage of PMT until the display of this line's energy is 99. And then turn the hand-wheel toward the long wave direction. Notice that the display of the smallest energy between 279.5nm and 279.8nm lines should be no more than 40.

Notice: The energy of Manganese Lamp's 279.5nm line should be more than that of 279.8nm line.

(3) Stability

Conditions: Check the 324.7nm line of Copper Lamp. Lamp current is 3mA and slot width is 0.2nm order. Coordinates are expanded 10 times.

Operation: Power the Copper Lamp and adjust the wavelength precisely. Warm up the instrument for half an hour. Readjust the wavelength precisely and zero, then begin time-keeping inspection. The drift of zero should meet the standard of stability in Chapter 1.

(4) Characteristic Concentration (Characteristic Quantity) and Detection Limit of Representative Elements

Generally detecting one kind of element's characteristic concentration (characteristic quantity) and detection limit could judge the quality of an instrument.

1) Detect Copper with Flame Method

Conditions: Check the Copper 324.7nm line of Copper Lamp. Lamp current is 3mA, and slot width is 0.4nm order. Copper standard solution is 1.3 μ g/ml + 0.5%HNO_3 solution. Blank solution is 0.5%HNO_3 solution.

Method: ① Select 'AA' mode. Detect blank solution and zero. Then detect Copper standard solution 1 μ g/ml+0.5%HNO_3 continuously for three times. Calculate the characteristic concentration with the following formula. It should meet the standard listed in Chapter 1.

$$\text{Characteristic Concentration Cc}=\frac{0.0044\times 1}{\overline{A}}(\mu g/ml/1\%) \qquad (3\text{-}1)$$

$\overline{A}$ is the average of the three absorbencies.

② Select 'AA' mode, and expand the coordinates 10 times. The integral time is 3 seconds. Detect the blank solution continuously for 20 times. Calculate the detection limit with the following formula. It should meet the standard listed in Chapter 1.

$$\text{Detection Limit}=\frac{3\sigma\times 1}{\overline{A}}(\mu g/ml) \qquad (3\text{-}2)$$

$\overline{A}$ is the average of the twenty absorbencies.

σ is the standard deviation of the twenty results of blank solution detection(σ is non-expand value).

③ Select 'AA' mode. Detect blank solution and zero. Then detect Copper standard solution 1 μg/ml+0.5%HNO_3 continuously for eleven times. Calculate the relative SD with the following formula. It should meet the standard listed in Chapter 1.

$$\text{Relative SD}=\frac{\delta}{\overline{A}}\times 100\% \qquad (3\text{-}3)$$

δ is the standard deviation of the eleven absorbencies.

$\overline{A}$ is the average of the eleven absorbencies.

2) Detect Cadmium with Graphite Furnace Method

Conditions: Check the Cadmium 228.8nm line of Cadmium Lamp. Lamp Current is 3mA and slot width is 0.4nm order. Cadmium standard solution is 1 μg/L, and sample volume is 20 μl.

Method: ①Select favorable atomization conditions (the following is reference)

Dehydrating Temperature 70～100℃ Dehydrating Time 25s

Cineration Temperature 200～300℃ Cineration Time 15s

Atomization Temperature 2000～2200℃ Atomization Time 3s

② Sample Volume: Pump 1 μg/L Cadmium standard solution 20 μl with micro

sampler.

③ Operation: After starting the program, print absorbency A for seven times totally. Calculate the characteristic quantity with the following formula. It should meet the standard listed in Chapter 1.

$$\text{Characteristic Quantity } Q=\frac{1\times 20\times 0.0044\times 10^{-12}}{\overline{A}}(g) \qquad (3\text{-}4)$$

$$\text{Relative SD}=\frac{\delta}{\overline{A}}\times 100\% \qquad (3\text{-}5)$$

δ is the standard deviation of the seven absorbencies.

$\overline{A}$ is the average of the seven absorbencies.

Notice: ① The solution with very low concentration, such as 1 μ g/L Cd solution, should be prepared just before the detection. Otherwise, there is comparative large error between its actual concentration and the expected value.

② Prevent various pollutions from preparing the solutions with low concentration, in order to eliminate the result abnormity caused by solutions.

③ Detections of characteristic concentration and characteristic quantity with both flame method and graphite furnace method are directly affected by the selection of analyzing conditions and instrument parameters. When encountering problems, adjust the analyzing conditions and working state of instrument in the aspects of flame character, flame height, spray state, atomization condition and each functional module parameters of instrument time after time, until get good results.

(5) Inspection of Other Functions

Inspect the data processing function referring to Chapter 5.

4. Please take inspection notes about instrument parameters, detection method, results and phenomena during acceptance inspection. If any unqualified performance characteristics are found, these notes can be offered to help the servicing to find out the solutions.

Chapter 4 Structure and Function

4.1 Structure of Instrument

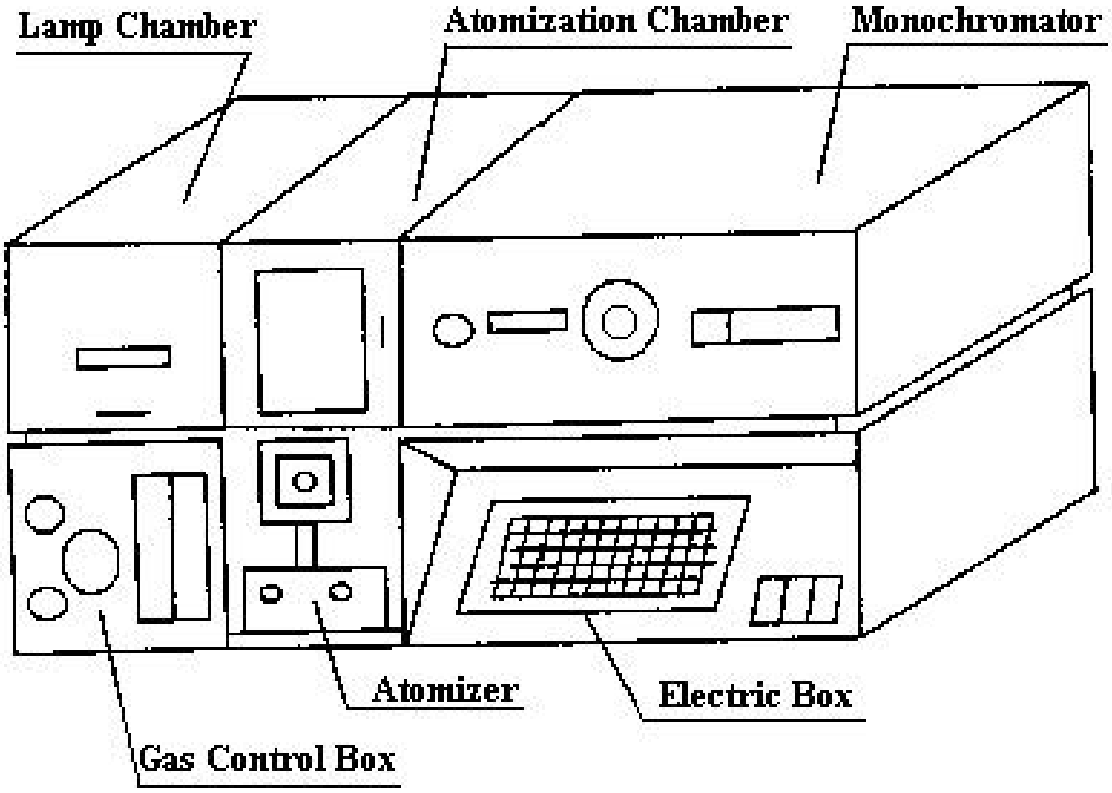


Fig. 4-1 Structure of Instrument

4.2 Optical System

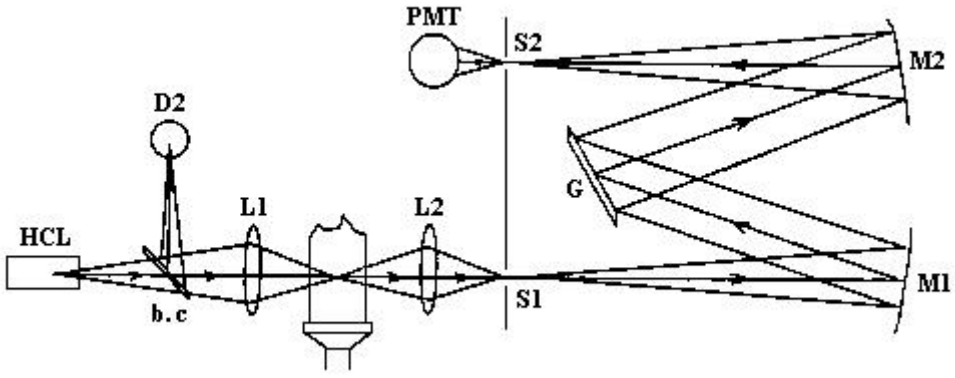


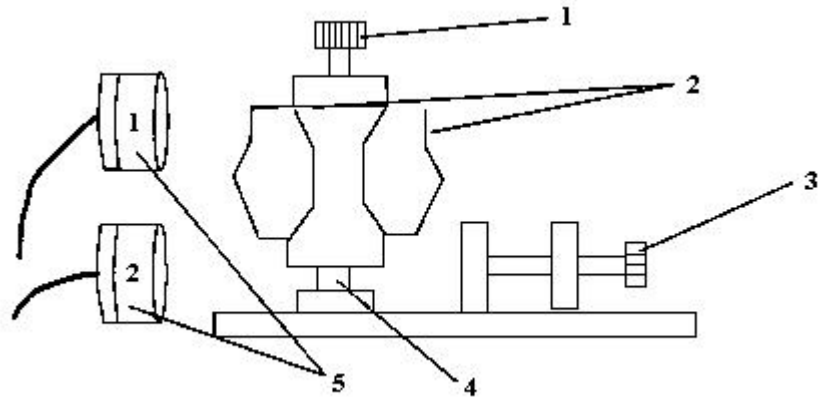
Fig. 4-2 Optical System

As shown in Fig 4-2, spectrum emitted from hollow cathode lamp(HCL) is focused on the incidence slot S1 by lens L2 and enters the monochromator through S1. The 320 type instrument is equipped with D_2 Arc Lamp background corrector. D_2 Arc lamp emits a beam with different radiation time and phase from HCL. Through the beam combinator, this beam and the HCL spectrum are combined into one optical circuit. The monochromator is C-T type and the dispersion part is plane diffraction grating.

The performance characteristic of optical system is evaluated by the standards in 1.4.1 and 1.4.2. Instrument has been inspected qualified before leaving factory. If the optical system has troubles or decrease of performance after transport or long time use, except those projects allowed to be repaired by user, the manufacturer should solve all the problems.

4.3 Hollow Cathode Lamp Turret

Hollow cathode lamp turret lie in the lamp chamber, left top of the instrument. Its structure is shown in Fig. 4-3.



1—Vertical Adjust Knob, 2—Spring Clamp, 3—Horizontal Adjust Knob, 4—Rotation Axis, 5—Lamp Sockets

Fig. 4-3 Hollow Cathode Lamp Turret

Plug the HCL into the lamp socket (Lamp1 or Lamp2), and then put the HCL in the spring clamp. Push or pull the axial-direction adjust Knob 3 to align the working lamp in the optical circuit. After powering the element lamp, adjust the position of the lamp

precisely through turning the axial-direction adjust Knob 3 and the heave adjust Knob 1 according to the size of the facula or the light energy. The other lamp can also be powered simultaneously for warm-up.

4.4 D_2 Arc Lamp Turret

D_2 arc lamp turret is also in the lamp chamber, left top of the instrument. Its adjust parts is on its shield, as shown in Fig. 4-4. D_2 arc lamp is placed in this turret. D_2 arc lamp is used in background correction.

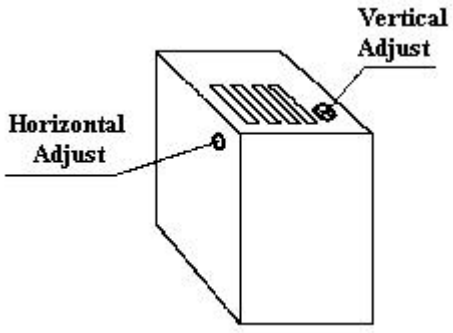
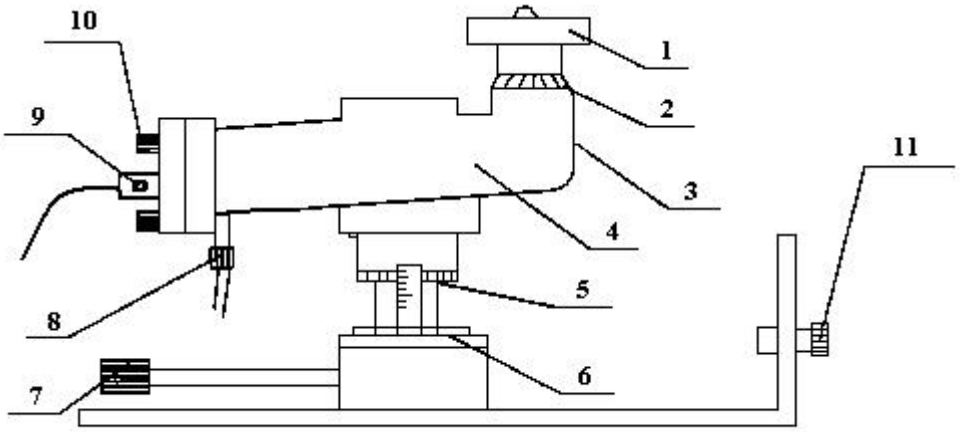


Fig. 4-4 Adjust Structure of D_2 Arc Lamp Position

4.5 Atomizer

Atomizer is a place where the element to be measured in the sample transform into ground state free atoms that could absorb this element's spectrum. This instrument has two atomizers. One is atomization burner, used in flame AA analyzing; the other is graphite furnace system, used in non-flame AA analyzing.



1—Burner, 2—Angle Graduation, 3—Explosion-proof Pellicle, 4—Spray Chamber, 5—Vertical Graduation, 6—Horizontal Graduation, 7—Vertical and Horizontal Position Adjust Handle, 8—Waste Liquid Pipe, 9—Glass Nebulizer, 10—Locking Bolt, 11—Air, Ethine Entries.

Fig. 4-5 Atomization Burner

4.5.1 Atomization Burner

Atomization burner is the atomizer of flame AA. This instrument adopts the pre-mix atomization burner. It is composed of nebulizer, spray chamber, burner and position adjust parts, as shown in Fig. 4-5.

4.5.1.1 Nebulizer

Nebulizer is the key part of atomization burner. It could transform the solution into exiguous and uniform fog drop. Metal sheath glass high-efficient nebulizer is used widely in each type of our AAS instruments. It is corrosion resisting and has stable performance. But as glass product, it is breakable, so be careful when holding or putting it. In addition, it is not suitable for the solutions or samples containing hydrofluoric acid.

Structure: There is a movable Venturi tube with a bump ball at the spout of the coaxial glass nebulizer. The glass nebulizer is fixed in the stainless steel protection sheath, whose outline is fit for the nebulizer seating of the host instrument. The sheath is welded with a stainless steel air-in nozzle. The isometric current-limiting sample pipe is connected when analyzing.

Installation: Unscrew the four bolts on the end of the spray chamber. Take off the bump ball, and insert the nebulizer into the seating hole. Then fix the bump ball from

inside. Adjust the best position of the bump ball through spray test. At last, screw the end onto the spray chamber.

The position of bump ball is adjustable and will affect the sensitivity and stability. Open the air source and pump blank solution. Press the bump ball close to the spout (do not overexert), and turn it to and fro to let the fog rush ahead. It's best that the fog is axial symmetry and has big solid angle. The spliced pole of bump ball should be underside.

About fault handling and maintenance please refer to the specification of metal sheath glass high-efficient nebulizer.

4.5.1.2 Spray Chamber

This instrument adopts cylinder type spray chamber. Its inwall is cone-shaped. It is fixed on the adjust parts and connected with nebulizer and burner. It is made of PPS and is corrosion resisting. The spray chamber eliminates large fog drop and mix the combustion gas and combustion-supporting gas equably. It smoothes the gas flow and decrease the flame noise.

4.5.1.3 Burner

The burner shapes the flame where the sample is atomized. The burner is single-slot ridge type. The slot is 0.5mm wide and 100mm long. Used for air-Ethine flame.

4.5.1.4 Position Adjust Parts

The position adjust parts are shown in Fig.4-5.

1. Turn the right handle to adjust the height of the atomization burner. There are height graduations on the seating.
2. Turn the left handle to adjust the horizontal position of the atomization burner along the direction parallel with the optical axial. There are horizontal graduations on the seating.
3. Turn the burner and change the inclination between the slot and optical axial. There are angle graduations on the joint of burner and spray chamber.

Height and horizontal position adjust could change the relative position between flame and optical axial, in order to let the beam pass through the atomization area of the flame for best sensitivity. Burner turning adjust could change the length of the

optical paths in flame, which could change sensitivity.

The atomization burner is fixed on the base plate fixed in the middle of sample chamber (middle of instrument) by locking bolts. It can be taken off as one block and alternated by other atomization burner.

4.5.2 Graphite Furnace System

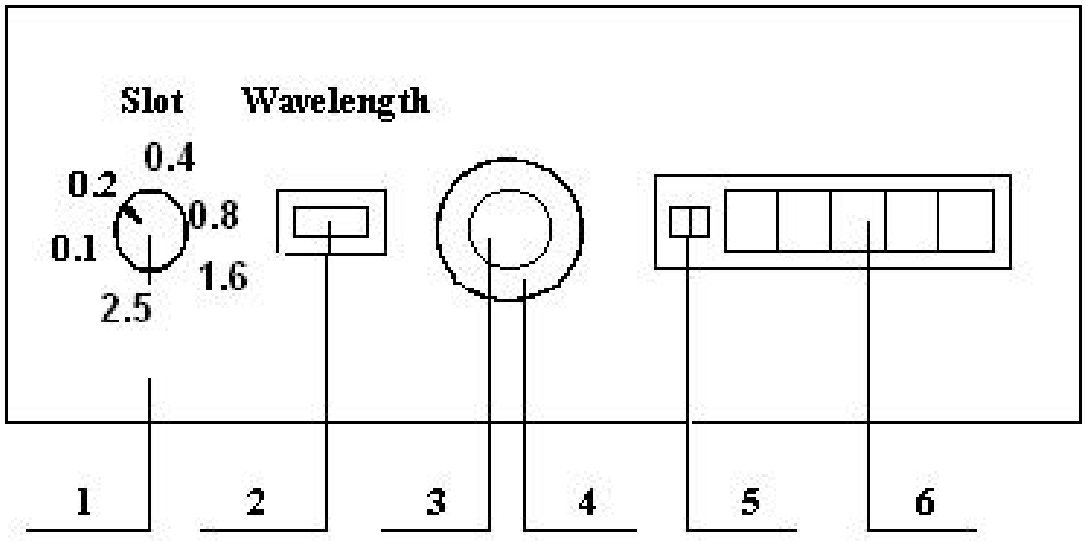
Graphite furnace system is the atomizer of non-flame AAS, and the 320 type instrument can select it. About the structure, function and operation guide of graphite furnace system please refer to its own specification.

4.6 Right Bottom Panel

There are Power, D_2 Arc lamp power and HCL power in the right of this panel. There is a keyboard in the left of this panel. Its functions are introduced in next chapter.

4.7 Right Top Panel

This panel is shown in Fig. 4-6. There are slot hand-wheel, wavelength counter, and wavelength hand-wheel on this panel. LED display is on the right of this panel. The



1—Slot Hand-wheel, 2—Wavelength Counter, 3—Wavelength Hand-wheel(fine adjust), 4—Wavelength Handle(coarse adjust), 5—Energy Display, 6—Result Display

Fig. 4-6 Right Top Panel

small one has two bits for energy display and the large one has five bits for results or input display.

Turning the slot hand-wheel and align the indicator to the four number respectively will set the four various orders of slot width: 0.1nm, 0.2nm, 0.4nm, 0.8, 1.6, 2.5nm.

When turning the wavelength hand-wheel, the wavelength value will display on the wavelength counter simultaneously. The unit of wavelength display number is nm. The counter has three bits and the first bit after radix point need to be estimated.

The wavelength hand-wheel can be turned fast or slowly. Make the handle on this hand-wheel vertical to hand-wheel and turn it for coarse adjustment. Make the handle down and turn the hand-wheel for fine adjustment.

4.8 Back Panel

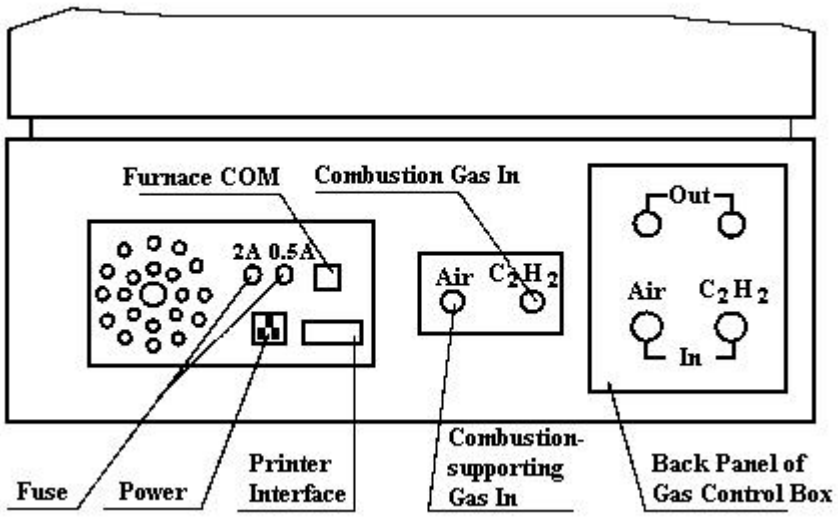
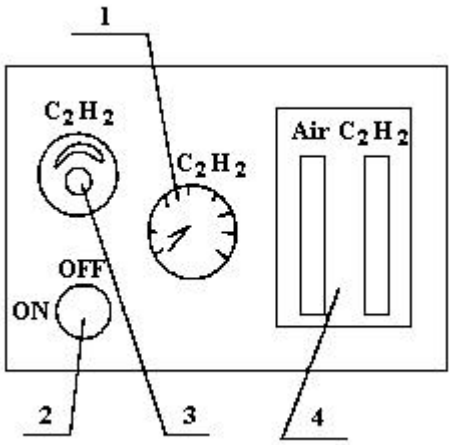
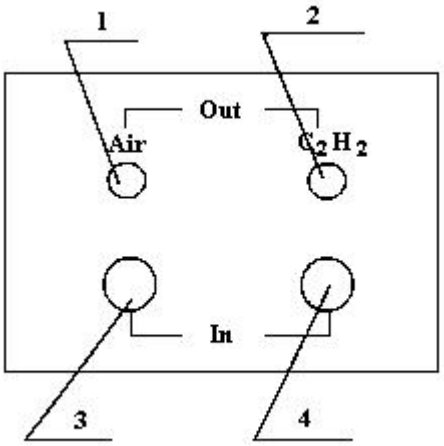


Fig. 4-7 Back Panel of Host Instrument

4.9 Gas Control Box

Gas control box controls the flows of the combustion gas and combustion-supporting gas. The front panel of gas control box is shown in Fig. 4-8. The range of combustion-





1—Pressure Meter of Combustion Gas
2—On-off Valve of C_2H_2
3—C_2H_2 Flow Volume Adjust Needle Valve
4—Double Flow Meter

Fig. 4-8 Front Panel of Gas Control Box

1—Air Out 2—C_2H_2 Out
3—Air In 4—C_2H_2 In

Fig. 4-9 Back Panel of Gas Control Box

supporting gas flowmeter is 1.0～1.5L/min. The pressure meter of combustion gas indicates the input pressure of combustion gas and its range is 0～0.25MPa. The range of combustion gas flowmeter is 0.8～8L/min. Controls the on-off of Ethine with combustion gas valve for security.

5.1 Regulations of Instrument Operation

5.1.1 Specification of All Functional Keys

The positions of all functional keys are shown in Fig. 5-1. In the 310-type instrument, keys have the same functions but not the same positions and number.

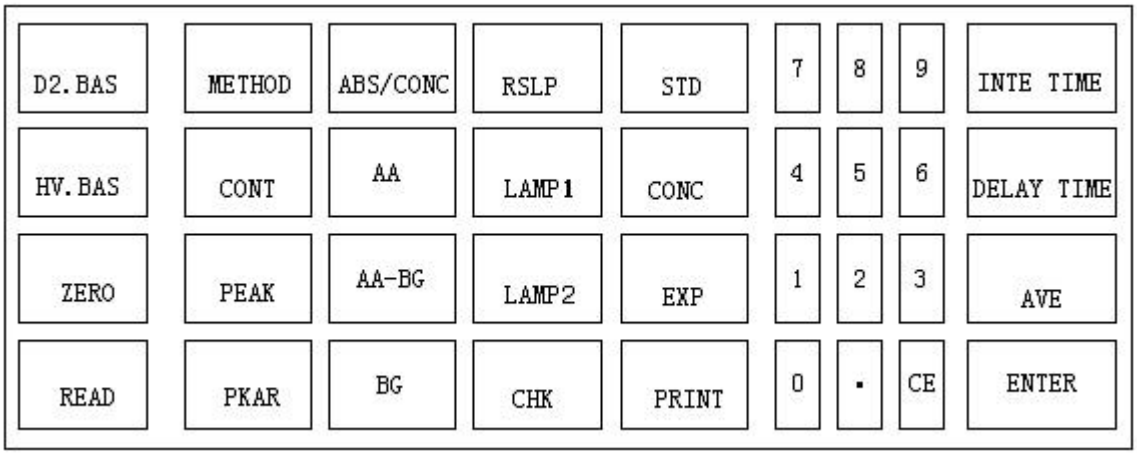


Fig. 5-1 Keyboard Panel

1. ○ D2.BAS Key: Auto-balance of the energy of D_2 arc lamp.

Usage: When the energy of HCL is in the range of 90～99 and the energy of D_2 arc lamp need to be equal to that of HCL, firstly power D_2 arc lamp, then press ○ BG Key. Now the energy of D_2 arc lamp is displayed. This value must be in the range of 80～90. Press ○ D2.BAS Key, balance the energy of D_2 arc lamp and that of HCL. If the balance fails, refer to the following two methods.

a) If the energy of D_2 arc lamp is less than 80 and the balance fails, press CE Key to decrease the HCL current. Then press ○ HV.BAS Key, and then press ○ D2.BAS Key again. Thus, the balance successes.

b) If the energy of D_2 arc lamp is more than or equal to 90, press CE Key to increase the HCL current. Then press ○ D2.BAS Key, and then press

○ D2.BAS Key again. Thus, the balance successes.

After ○ D2.BAS Key is pressed, the indicator lamp of this key illumines, and D_2 arc lamp current automatically changes. When the energy of D_2 arc lamp is equal to that of HCL, the change of D_2 arc lamp current is stopped and the indicator lamp goes out.

2. ○ HV.BAS Key: Auto-balance of high voltage.

Usage: When the settings of wavelength, position of HCL and lamp current are all ready, press ○ HV.BAS Key, then its indicator lamp illumines and the high voltage of PMT automatically goes up. When the energy of HCL reaches the range of 92～97, the ascend of HCL high voltage will stop and the indicator lamp goes out. So the high voltage is balanced automatically.

3. ○ ZERO Key: Auto-zero.

Usage: Auto-zero the absorbency. Press ○ ZERO Key and its indicator lamp illumines. The lamp goes out after the auto-zeroing.

4. ○ READ Key: Read result. (Do power the printer or set the printing mode to Mode 0 before pressing this key)

Usage: Press ○ READ Key, then data are processed in integral time. When over, the result will be displayed.

a) When select ○ CONT mode, the display is the average.

b) When select ○ PEAK mode, the display is the peak value.

c) When select ○ PKAR mode, the display is the peak integral area.

If detect for many times, the indicator lamp will goes out company with two toot after the detection times reach the setting times and the reading is finished.

5. ○ METHOD Key: Analyzing Method Choice. (310-type instrument hasn't this key and it is set to flame method as default)

Usage: Choose the analyzing method. Press this key, and if the indicator lamp

illumines, the graphite furnace method is chosen. Press it, and if the indicator lamp goes out, the flame method is chosen. The default choice is flame method (lamp is out) after powering. Alternate between the two methods through circularly press this key.

6. ○ CONT ○ PEAK ○ PKAR Keys: Continuation Mode, Peak Value Mode, Peak Integral Area Mode.

Usage: Select the reading result mode. The three keys are mutually exclusive. When one is pressed, its indicator lamp illumines and the other two lamps go out. The key whose indicator lamp illumines is selected and effective.

7. ○ ABS/CONC Key: Display Content Choice (Absorbency or Concentration)

Usage: Press this key, and if the indicator lamp illumines the concentration will be displayed. Press it and if the indicator lamp goes out the absorbency will be displayed. The default choice is absorbency (lamp is out) after powering. Alternate between these two choices through circularly press this key.

8. ○ AA ○ AA-BG ○ BG Keys: No Background Correction, Background Correction, Background Detection.

Usage: Select the signal detection mode. The three keys are mutually exclusive. When one is pressed, its indicator lamp illumines and the other two lamps go out. The key whose indicator lamp illumines is selected and effective.

9. ○ RSLP Key: Reset the Slope.

Usage: If the analyzing conditions change during the analyzing, the standard curve will change. Now the standard curve needs to be reconstructed. In this instrument, it is not necessary to detect several standard points for the reconstruction of standard curve. It needs to only detect the second point.

For example, the concentrations of the three standard solutions are 0.3ppm, 0.5ppm, 0.7ppm, and the standard curve is constructed. Its slope needs to be reset for the changes of analyzing conditions.

Operation: Insert the sample pipe into the second solution of 0.5ppm. When the absorbency is stable, press ○ RSLP Key. Then the indicator of this key and that of

○ READ Key all illumine, and the system begin to reset the slope. After the reset is finished, the two lamps go out.

10. ○ LAMP1 Key: Input the Current of HCL 1.

Usage: Press ○ LAMP1 Key, and input the current value and then press ENTER Key. After the indicator lamp of this key illumines, the input of HCL lamp current is finished. The range of current setting is 1～9.9mA. The minimum input current value is 0.1mA.

For example, set the current of HCL 1 to 3mA.

Operation: press ○ LAMP1 Key → 3 Key → ENTER Key.

11. ○ LAMP2 Key: Input the Current of HCL 2.

Usage: Same as ○ LAMP1 Key.

12. ○ CHK Key: Examine Each Function State.

Usage: In order to examine the state of each functional key, press this key and then press that functional key. Now the indicator lamp of ○ CHK Key illumines. When the examination is over, press this key and the lamp goes out.

For example, examine the high voltage of PMT.

Operation: press ○ CHK Key → • Key, the high voltage value is displayed then.

13. ○ STD Key: Construct Standard Curve

Usage: When the indicator lamp of this key illumines, the instrument is in the construction of standard curve. The lamp goes out after the construction.

Operation: refer to later sample.

14. ○ CONC Key: Input the Standard Solution Concentration.

Usage: After press this key, the display is '0000', and now please input the number of the standard samples(in the range of 3～7); After the input, the display becomes '1000', and now may input the concentration of the first standard solution; Then the display becomes '2000', and can input the concentration of the second standard

solution; Do this action, until the last point.

For example, input three standard samples' concentrations: 0.3ppm, 0.5ppm, 0.7ppm.

Operation: press ○ CONC Key, and display shows '0000'. Press 3 → ENTER, and set the sample number to 3. The display shows '1000', and press 0 → • → 3 → ENTER, set the concentration of the first point. The display shows '2000', and press 0 → • → 5 → ENTER, set the concentration of the second point. The display shows '3000', and press 0 → • → 7 → ENTER, set the concentration of the third point.

15. ○ EXP Key: Expand the Coordinates.

Usage: Enlarge or diminish the absorbency. Expand times are in the range of 0.1～99.

For example, expand the coordinates 10 times.

Operation: press ○ EXP → 1 → 0 → ENTER Keys.

16. PRINT Key: Select Printing Mode.

There are four printing modes.

a) Mode 0: No printer.

Operation: press PRINT → 0 → ENTER Keys.

b) Mode1: Only print data. This is the default selection of instrument after power.

Operation: press PRINT → 1 → ENTER Keys.

c) Mode 2: Print the results data and signal figure.

Operation: press PRINT → 2 → ENTER Keys.

d) Mode 3: Print the analyzing conditions. Auto-reset to Mode 1 after printing.

Operation: press PRINT → 3 → ENTER Keys.

17. INTE TIME Key: Integral Time.

Usage: When the reading result is in Continuation Mode, press this key to set the average sample time; when the reading result is in Peak Value Mode or Integral Area Mode, press this key to set the sample time.

Time setting range is in 0.1～19.9s.

For example, set the integral time to 2 seconds.

Operation: press [INTE TIME] → [2] → [ENTER].

18. [DELAY TIME] Key: Delay Time.

Usage: Select the initial sample time. It is in the range of 0.9～9.9s.

For example, set the delay time to 2.5 seconds.

Operation: press [DELAY TIME] → [2] → [•] → [5] → [ENTER].

19. [AVE] Key: Detection Times.

Usage: Set the detection times for one sample. It is in the range of 1～99 times.

For example, detect one sample for 11 times.

Operation: press [AVE] → [1] → [1] → [ENTER].

20. [ENTER] Key: Enter.

Usage: Input each function parameter into the system. No matter what function state is set, do press this key after pressing the number keys. Otherwise, the instrument is being in setting state and will not run normally.

For example, set the current of HCL 1 to 3mA.

Operation: press [○ LAMP1] → [3] → [ENTER], and the indicator lamp of [○ LAMP1] Key illumines. If [ENTER] Key is not pressed, the display is '0003', so the instrument is in setting state and can't run normally. Only if press [ENTER] Key, the instrument could exit the setting state.

21. [7] Key: Number Seven & Set the Maximum of Y-coordinate of the Printing Figure.

For example, set the maximum of Y-coordinate (absorbency value) to 0.3 Abs.

Operation: press [7] → [0] → [•] →[3] → [ENTER].

If functional keys are pressed formerly, [7] Key is pressed as the number seven.

22. [•] Key: Radix Point & Set the High Voltage.

Usage: For the setting of high voltage, press this key, and then input the voltage value. For radix point, press functional keys, and then press this key and number keys.

Example 1: Set the high voltage to 300V.

Operation: press [•] → [3] → [0] → [0] → [ENTER].

Example 2: Set the current of HCL 1 to 1.5mA.

Operation: press ○ LAMP1 → 1 → • → 5 → ENTER. Then the indicator lamp of ○ LAMP1 Key illumines.

5.1.2 Samples of Key Operation.

Sample: Construct standard curve with three standard samples with concentrations of 0.1ppm, 0.3ppm, 0.5ppm. Method is flame.

Operation:

1. Press CONC Key.

The display shows '0000'. Press 3 → ENTER to set the sample number.

The display shows '1000'. Press 0 → • → 1 → ENTER to set the first concentration.

The display shows '1000'. Press 0 → • → 3 → ENTER to set the second concentration.

The display shows '1000'. Press 0 → • → 5 → ENTER to set the third concentration.

2. Press PRINT → 1 → ENTER to set the printing mode.

3. Press AVE → 3 → ENTER to set the repeat times.

4. Press INTE TIME → 2 → ENTER to set the integral time.

5. Press ○ ZERO to zero the absorbency.

6. Press ○ STD to start the construction of standard curve.

7. Insert the sample pipe into the blank solution. After the absorbency is stable, press ○ ZERO Key. When the indicator lamp of ○ ZERO Key goes out, press ○ READ Key. When the indicator lamp of ○ READ Key goes out, the data process is finished and the result is displayed. Simultaneously, the printer outputs the three results and their average.

8. Insert the sample pipe into the standard solution of 0.1ppm. After the absorbency is stable, press ○ READ Key. When the indicator lamp of ○ READ Key goes out,

the data process is finished and the result is displayed. Simultaneously, the printer outputs the three results and their average.

9. Insert the sample pipe into the standard solution of 0.3ppm. After the absorbency is stable, press ○ READ Key. When the indicator lamp of ○ READ Key goes out, the data process is finished and the result is displayed. Simultaneously, the printer outputs the three results and their average.

10. Insert the sample pipe into the standard solution of 0.1ppm. After the absorbency is stable, press ○ READ Key. When the indicator lamp of ○ READ Key goes out, the data process is finished and the result is displayed. Simultaneously, the printer outputs the three results and their average. The average absorbency of the above four points and the standard curve is output too. Thus, the construction is over.

11. Insert the sample pipe into the standard solution of 0.3ppm, and change the position of the flame. The absorbency also changes in a sort. Press ○ RSLP Key, and the indicator lamps of ○ READ Key and ○ RSLP Key illumine. When the two lamps go out, the result of changed slope is displayed and printed. (This step is performed only if the absorbency changes.)

12. Press ○ ABS/CONC Key, the indicator lamp illumines. (The display result is concentration.)

13. Insert the sample pipe into the standard solution of 0.1ppm. After the absorbency is stable, press ○ READ Key. When the indicator lamp of ○ READ Key goes out, the data process is finished and the result is displayed. Simultaneously, the printer outputs the three results and their average.

14. Insert the sample pipe into the standard solution of 0.3ppm. After the absorbency is stable, press ○ READ Key. When the indicator lamp of ○ READ Key goes out, the data process is finished and the result is displayed. Simultaneously, the printer outputs the three results and their average.

15. Insert the sample pipe into the standard solution of 0.5ppm. After the absorbency

is stable, press ○ READ Key. When the indicator lamp of ○ READ Key goes out, the data process is finished and the result is displayed. Simultaneously, the printer outputs the three results and their average. The above three points are the concentrations of standard samples after curve correction. Thus, the curve correction is finished.

Notice: During the above process, before every inserting the sample pipe into certain standard solution, do insert it into the blank solution for zero. If it can't be zeroed , press ○ ZERO Key.

5.1.3 Powering

1. Put all the switches in the right bottom panel in 'OFF' state. Adjust the burner under the optical paths.
2. Switch on the electric supply.
3. Turn on the total power switch in the right bottom panel, and the indicator lamp in it will illumine. The LED in right top panel will display 3 • 2 1 9 (maybe a little error)
4. Turn on the element lamp power switch, and its indicator lamp illumines. Open the door of lamp chamber in left top of the instrument, and plug the expected HCL into the lamp socket mentioned in section 4.2.
5. Input the appropriate current of the expected lamp, and power the HCL.
6. Insert the powered HCL into the spring clamp, and adjust the position of the HCL to make the facula lie in the center of the lens L2.
7. Turn the slot hand-wheel, and select proper slot width.
8. Set the high voltage of PMT to 220V.
9. Put up the coarse-adjust handle on the wavelength hand-wheel and turn fast toward to the expected wavelength(not exceed to the range of 190～900nm). When approach the wavelength, adjust the wavelength fine until the energy is maximized.
10. Adjust the position of HCL to make the energy display maximized. Press ○

HV.BAS Key, range the energy in 90～97.

11. If background correction, power D_2 arc lamp. Adjust the current of D_2 arc lamp or HCL to make their energy equal. (Namely, the energy display of selecting ○ AA is the same as that of selecting ○ BG.
12. If the results and figure need to be printed, the printer should be connected and powered.
13. After all the above steps, warm up the instrument for 15 to 30 minutes. Then the instrument can run normally.

5.1.4 Operation of Flame Method.

When the adjustment of host instrument is over, the analyzing with flame method can begin as the following steps.

1. Install the atomization system refer to section 3.3.4.
2. Turn the horizontal adjust handle of the atomization burner (Fig. 4-5), and make the slot of the burner parallel to and just below the optical paths. Insert a clock screwdriver of Φ 1.5mm into the slot and move it along the slot. When the screwdriver moves to the middle of the slot, turn the horizontal adjust handle to let the energy display be near to zero. Move the screwdriver to the end of the slot, and turn the burner to let the energy display be in the range of 30～50.
3. Power the air compressor, and adjust the exit pressure to 0.3MPa.
4. Turn on the combustion gas source, and turn on the combustion gas valve. Adjust the gas pressure to make the pressure meter indicator on the gas control box to display 0.05～0.07MPa. Turn the needle valve of gas flow meter to adjust the flow of the combustion gas to a proper value.
5. Ensure the water seal qualified and fire with ignition gun.
6. Bump the bland solution and adjust the high voltage to make the energy display be in the range of 90～97. Then press ○ ZERO Key.
7. Detect the standard solutions and note the absorbency results.
8. If the sensitivity is low, shut off the fire and adjust the spray referring to section 3.4. Then re-fire and detect. Repeat this action, until get the best results.

9. Detect a group of standard solutions and note their absorbencies.
10. Print the working curves. Then press ○ ABS/CONC Key for the detection of the concentrations.
11. After the detection, bump deionized water for several minutes to wash the spray chamber.
12. When shut off the fire after finishing all the above work, do cut the combustion gas source firstly! After the left Ethine is burned off, shut off the Ethine valve on the gas control box panel. At last, cut the air.

5.1.5 Operation of Graphite Furnace Method

1. When detecting with graphite furnace method, please remove the atomization burner from the instrument. The gas paths connected to the burner and the waste liquid paths should also be dismantled.
2. Fix the graphite furnace into the sample chamber with bolts.
3. Connect the water paths, gas paths and circuits of graphite furnace system according to the specification of graphite furnace.
4. Install the graphite tube in the furnace.
5. Adjust the position of the furnace in order that the energy of beam passing through the graphite tube is maximized.
6. Select graphite furnace analyzing conditions, including the working conditions of host instrument.
7. Connect the remote control wires of graphite furnace system referring to section 3.3.3.
8. Burn the blank graphite tube.
9. After the graphite furnace running normally, inject the standard solution for detection, and confirm the best analyzing conditions of this method.
10. Detect the standard solutions and samples with the best analyzing conditions.
11. Calculate the element content in the samples.
12. Detection is over and shut off the printer, protection gas source of graphite furnace, cooling water and power supply of graphite furnace. Then cut the power of host

instrument referring to section 6.6.4.

5.2 Usage of Hollow Cathode Lamp

1. Sample of Running Normally

Most HCL are filled with neon, and few are filled with argon. After powered, the normal HCL filled with neon will radiate indigo light, observed from the direction of glow hue. If the HCL filled with neon radiate pink or white light, gas of impurities must be in this HCL. So it should be degassed.

The HCL running normally radiate from its hollow cathode. If it radiates from outer of hollow cathode or anode, the polarity of the footprints maybe are connected wrong or in reverse.

2. Selection of Lamp Current

This instrument adopts the rectangular pulse power. So the current display is the average current, not the peak current.

The general principles of selecting the lamp current are that the current is not too large or too small. The former will cause self-absorption of spectrum, which will affect the analyzing results, and the latter will cause unstable radiating. But the current had better be a little small under the premises of enough energy value and high SNR, in order to improve the sensitivity, expand the range of linearity and prolong the life of the HCL. The best lamp current is determined by actual analyzing process.

3. When adjusting the position of the HCL for maximum energy, notice that for few HCLs, only if the orange red facula deviates from the center of the monochromator's entry, the energy will be maximized. Because the center of the light window was not aimed when the HCL was made. But this has no effect on using the HCL.

5.3 Usage of D_2 Arc Lamp

1. Spectrum Distribution of D_2 Arc Lamp

D_2 arc lamp is a kind of continuous light source. Its radiation spectrum distribution is shown in Fig. 5-2. The maximum intensity lies in about 250nm. The energy of the waves around 250nm and above 350nm is much lower.

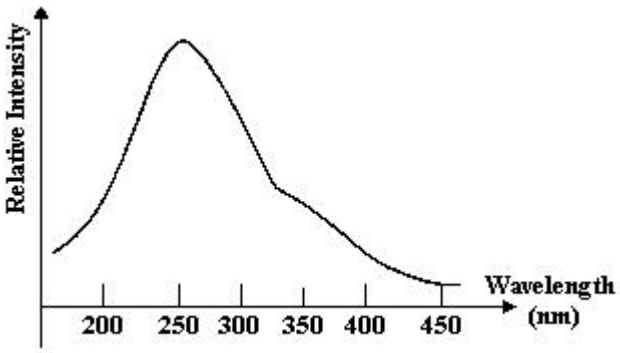


Fig. 5-2 Distribution of D_2 arc Lamp Intensity

For those elements whose analyzing wavelength is in this band, the energy of D_2 arc lamp is hard to balance to that of the HCL. So D_2 arc lamp background correction is used in certain band.

2. Adjustment of D_2 Arc Lamp Position

D_2 arc lamp's facula is small, so it needs to be carefully to adjust the height and corner bolts to make the facula enter the optical path. If the position isn't adjusted well, not only the energy is affected, but also it's hard to aim the facula to that of the HCL, then the background correction is affected. Generally the standard is the energy of D_2 arc lamp (BG).

5.4 Usage of Optical System

1. The whole optical system is composed of the outer optical paths and the monochromator, which are all adjusted to qualified state and fixed well before leaving factory. User should not adjust these parts at random.
2. If D_2 arc lamp is defective and need to alternate a new one, do adjust it with the adjust parts on the D_2 arc lamp turret to let the facula be in the middle of the slot. Generally the beam combinator need not be adjusted.
3. User doesn't adjust the imaging position of monochromator. When trouble, manufacturer should solve it.
4. If wavelength precision changes, make a difference between different conditions.

If the change exceeds to the instrument performance characteristic(± 0.5nm) but the error is not very large, this will not affect using. It is OK to add or decrease the error when searching certain wavelength, because the precise wavelength is determined by the maximum energy. If the change of wavelength precision is relatively large, user doesn't adjust it unless mastering the optical system. Contact the manufacturer.

5. Method of Searching Precise Wavelength: Slowly turn the wavelength hand-wheel clockwise or counter-clockwise beside the expected theoretic wavelength. Simultaneously, observe the change of the energy display. Turn toward the direction of enlarging the energy, until the energy is the maximum. If the display deviates from the maximum position, turn back and make it maximum again. Now the wavelength counter shows the precise wavelength value.
6. The slot hand-wheel only can be turned to four positions, and there are clamp parts beside those positions. So when the hand-wheel is up to the limit position, do not turn it more, otherwise the slot will be damaged.

5.5 Selection of Instrument Working Conditions

5.5.1 General Principle of Selecting the Instrument Parameters

The principles of selecting the instrument parameters are the same in whatever methods, which is for the best SNR.

1. Light Source: Generally the larger current of HCL is, the larger intensity is, and the higher SNR is. But the spectrum will be widen, if seriously the spectrum will self- absorb and cause the decrease of sensitivity. How to select proper lamp current for high SNR and enough sensitivity need more practice.
2. Analyzing Lines: The line with the highest sensitivity will be selected generally. It is primary sensitive line. If there are serious spectrum interference or background interference on this line, the second sensitive line should be selected and the sensitivity is decreased.

3. Spectrum Passing Band Width: The wider spectrum passing band is, the higher SNR is, and the higher spectrum interference is. This width is determined by the element or samples to be analyzed. Generally for those elements with relatively complicated spectrum, such as iron family, it is better to select small spectrum passing band width. For those elements with low- intensity spectrum, it is better to select large spectrum passing band width for higher SNR and stable results.

5.5.2 Flame Method.

The following are the suggested working conditions for flame method.

1. Reading Mode is continuation mode, and user selects the integral time. The integral time should be long when analyzing those unstable elements.
2. Selection of coordinates expand is determined by many conditions like sensitivity, range of concentration or quantity in sample and stability of results. For high sensitive elements, it's better that the expand factor is less than 1 for stability. If the content of the analyzing element is very low in sample, the absorbency is very small. So the coordinates expand is selected for precise results. The expand times should be selected properly. Too large times will cause unstable results.
3. The ratio of combustion gas and combustion-supporting gas will affect the analyzing sensitivity. The performance of flame is selected primarily through practice. User may adjust the combustion gas flow while analyzing, until get the highest sensitivity.
4. Different part of the flame has different sensitivity. So user may adjust the flame in the aspects of flame height, angle, horizontal position and vertical position while analyzing, until get the best sensitivity.

5.5.3 Graphite Furnace Method

The signal in graphite furnace method is different from that in flame method. It is an instantaneous pulse with the character of fast appearance and transitory persistence. So the host instrument parameters of this method are different from that of flame method.

1. Coordinates expand is generally not used. Because the absolute sensitivity of graphite furnace method is hundreds of to one thousand of times larger than that

of flame method. No coordinates expand will get better stability.

2. The graphite furnace signal is often printed for observation. Peak value mode or integral area mode could be selected and the instrument outputs the signal's maximum value or the area of figure.
3. The background interference in graphite furnace method is more serious than that in flame method. So D_2 arc lamp background correction is often used in actual sample analyzing. When background correction, the facula of HCL and that of D_2 arc lamp should be adjusted overlapped as best for better correction effect.
4. The selection of the graphite furnace and its power supply parameters, namely of the graphite furnace atomization conditions, has more important effects on the analyzing results in graphite furnace method. About the selection of these parameters, please refer to the specification of graphite furnace.
5. Those elements with the analyzing line about 500nm, such as barium and cerium, need high atomization temperature and long atomization time, which will cause the interference of radiate light. To decrease these interferences, improve the lamp current, and widen the spectrum passing band, so that the high voltage of PMT will be decreased and the interference will be reduced.

Chapter 6 Maintenance and Servicing

6.1 Notice of Maintenance.

When the instrument runs abnormally, please diagnose the troubles and process correctly according to the comments in this chapter. If user can't solve the problems, please send the detailed diagnosis to servicing department of us for timely servicing.

In addition, just after the cargo comes, for verdancy of instrument, user often requires servicing for some problems that actually aren't troubles. To avoid these conditions, please read the operation manual of the instrument carefully.

Notice: Some parts of the instrument are beyond retrieve once they are dismantled. So don't act in a hurry if not necessary or not safe.

The following are something needs to notice.

1. Do take out the power cable when open the cover board or mantle of the instrument when maintenance.
2. Cut the water source and gas source of the atomizer before maintenance. Shut off the total valve of gas steel bottle, especially the valve of the combustion gas steel bottle.
3. Don't leave the components like bolts or gaskets in the instrument. If some drop off, please take them out try your best.
4. Don't touch the working plane of the optical parts when maintaining the monochromator. If the monochromator need to be adjusted, before open the mantle of the monochromator, do not set the high voltage of PMT.
5. Be careful when maintaining the printed-circuit board not to damage them.

6.2 Replacing and Adjustment of Parts and Accessories

Some parts and components of AAS are expendable or vulnerable, so they need to be

replaced after a time use. For examples, the HCL, graphite tube, graphite wimble is all expendable. Nebulizer and burner are vulnerable and easily etched after a long time use. And some parts need readjust to ensure the performance after replacing.

6.2.1 Replacing of HCL.

The HCL is the main light source of the instrument, and its life is 5000mA hours. But different element's HCL has different life. And the life of HCL has something to do with the lamp current.

Replacing the HCL is very simple, for it is often replaced in analyzing. Take out the old lamp from the socket and plug the new one into it and insert into the turret. The two lamp of this instrument can be plugged at random or together.

6.2.2 Replace and Readjust of D_2 Arc Lamp.

1. D_2 arc lamp's life is generally at least 500 hours. When replacing it, ensure that the outline of the new one must be the same as the old one and the new working parameters must be expected for this instrument.

Anode current: 3mA; Tube drop: 70VDC; Filament voltage: 10VAC;

Filament current: 1A; Ignition voltage: above 200VDC.

2. The D_2 arc lamp of this instrument has four lead wires. The red one is anode lead; the two black are filament leads; the yellow one is auxiliary electrode lead. Don't touch the window of D_2 arc lamp.

3. When dismantling the D_2 arc lamp, take out the black cover and the four lead wires (remember the sequence of the four lead wires on the socket). Thus, the D_2 arc lamp can be dismantled.

4. Aim the window of the D_2 arc lamp to the half-transmission-half-reflection lens when installing the lamp.

5. The facula of D_2 arc lamp is small, so readjust its position carefully. If readjust badly, the optical energy is decreased and it is hard to overlap the facula of D_2 arc lamp to that of HCL, which affects the background correction.

6. Method of Adjustment.

(1) Power the D_2 arc lamp, and set the slop to 0.4nm order. Power the Cd HCL and set the current to 3mA.

(2) Select 'AA' mode, and adjust to make the energy display to be 90.

(3) Select 'BG' mode, and maximized the energy through the adjust parts of D_2 arc lamp on its turret.

7. Be careful that the powered D_2 arc lamp is very hot. Don't let it scald hands.

6.2.3 Replacing of Nebulizer.

Nebulizer is the key part of atomization burner. The analyzing sensitivity and detection limit are determined by the nebulizer's working state to a great extent. A good working state of nebulizer is ensured by daily maintenance. For this part is the only path way that the samples enter the system, sample pipes, spray nozzle and bump ball are all directly etched by sample solutions. So wash them with deionized water after every analyzing. When the working state is bad, inspect if it is need to replace or wash the nebulizer.

Method of Replacing the Nebulizer.

1. Unscrew the four bolts in front of the nebulizer.
2. Take out the Venturi tube carefully.
3. Nip the metal seating of the spray nozzle and take it out slowly. If it needs to be washed, dip the glass part of the nebulizer in the acid solution.
4. After washing, or for replacing a new one, install the nebulizer at the sequence of step 3～1.

Notice: (1) The spliced pole of bump ball should be underside when installing the Venturi tube, otherwise, the SNR will be affected.

(2) When screwing the four bolts, don't forget the sealing ring. And the four bolts must be screwed equably to avoid backfire or leakage of gas.

6.3 Declaration of Servicing

We guarantee to keep the instrument in good repair for free for the troubles occurring during normally running in one year after the claim time. But in the following conditions the guarantee is invalid. (The claim time is two months.)

1. User dismantles the instrument without authorization and can't retrieve it.
2. This instrument is a kind of precision instrument and can't be placed in strong corrosive, moist and dusty environment. Because the working environment is not qualified, the optical parts are deteriorated obviously fast.
3. Because of wrong operation or processing, the parts or components are damaged.
4. Loss occurs for ineluctable reasons, such as natural disasters, man-made calamities, etc.

6.4 Daily Maintenance of Instrument

6.4.1 Light Source

1. Hollow Cathode Lamp.

(1) Be careful when installing or uninstalling the HCL and don't break it up. Keep the light window clean. If the window is dirtied with oil stain or fingerprint, it will decrease the energy of light, especially the short wave light. Finding oil stain, may wipe it with absorbent cotton moistened by the mixture of alcohol and aether (the ratio is 1:3). User should hold the metal seating of the HCL when holding or putting down it.

(2) The HCL can't be left unused for a long time, because it could not be powered or run normally after that for the reasons of gas leakage, gas absorption or gas free. Hence, every three or four months user should power those HCLs left unused for two to three hours. User should pay great attention to this point; otherwise batches of HCL will be obsolete. It is suggested not to buy those HCLs ahead of using them for a long time.

If the HCL is broken, the cathode substance is exposed. Some element materials are harmful to health of human. So don't cast them off at random. The poisonous substance should be processed according to the standard method of laboratory.

2. D_2 Arc Lamp

(1) Avoid frequently powering and shutting off of D_2 arc lamp, to prolong its life.

(2) Don't touch the light window. After replacing of D_2 arc lamp, do wipe the light window with the mixture of alcohol and aether, and then power the lamp.

6.4.2 Optical System

1. Don't touch the lens in lamp chamber and burner chamber. Keep them clean.
2. Don't touch the aluminized half-reflection lens of the beam combination in the lamp chamber, and don't wipe it with anything!
3. If the lens is dusty, blow it with air blower or wipe it slightly with lens paper.
4. If oil stain or fingerprint is found on it, wipe it with absorbent cotton moistened by the mixture of alcohol and aether carefully, and don't scratch it.
5. The monochromator cover should not be opened generally. If necessary, set the high voltage of PMT to zero at first. Don't touch the surface of the grating and the reflectors and don't wipe them with lens paper or absorbent cotton.
6. Don't talk, breathe out before the grating and don't spatter the saliva onto it. If dust found on it, may blow it with cleaning air blower.

6.4.3 Atomization System.

The samples of AA are often corrosive. In order to prolong the atomizer's life and keep it well, user should maintain it termly, including the atomizer of flame method and graphite furnace method.

6.1.3.1 Atomization Burner System

1. Daily Cleaning and Maintenance.

(1) Operate the following after a batch of samples:

a. Keep the flame on and pump the deionized water for about ten minutes, in order to eliminate the remnant samples during analyzing.
b. The overflow solution drop, especially organic solution, should be eliminated.
c. Dumpage the waste liquid in time.

(2) Routine Maintenance.

Wash the atomization burner system every week, including nebulizer, spray chamber and burner. If the analyzing samples are high-concentration or turbid, wash them every day. If analyzing the organic solutions or pump the solutions of Cu, Ag or Hg when using air-Ethine flame, wash them just after analyzing, because non-stable

acetylide may be generated which is easy-explosive.

Wash operation after pumping organic solutions: firstly pump the organic solution resolved with the samples each other for five minutes, and then pump 1% HNO_3 solution for five minutes.

2. Maintenance of Nebulizer.

(1) If the front of the nebulizer is built up, do not poke it with metal wire, which will damage the glass parts. The correct method is that blow it back with air blower or pump back. For the stem of organic solvent, take out the nebulizer from the seating and insert the front of the nebulizer into the potassium dichromate solution to resolve them.

(2) If deposit stay in the nebulizer, the pump volume will be decreased and so dose the sensitivity. Take out the nebulizer seating and uninstall the bump ball. Then take out the nebulizer and wash it with cleaning water.

(3) If the plastic sample pipe is bent to be obsolete, soap it in hot water and make it soft. Drag it straight and cool it for reuse.

3. Maintenance of Spray Chamber.

Take out the nebulizer and pour 50ml deionized water into the top port and drain it off from waste liquid pipe. Repeat it for many times. If this could not clean the chamber, take it out and wash it with surface active agent solution, and then wash it with deionized water. If the instrument is left unused for a time, do clean the drops in the chamber.

(1) Don’t attack or wrest the spray chamber and its seating.

(2) Uninstall the seating of spray chamber slightly. Don’t cast it.

(3) Wash the inwall of the chamber with water or solvent; don’t scratch it with metal or other hard thing.

(4) The connection of the neck of chamber and the burner is depended on the rubber sealing ring. When dismantling the burner, turn it slowly and pull it out along the direction of the neck. Don’t overexert to avoid the damage of the burner neck.

4. Maintenance of Burner.

The flame from the long slot of the burner should be steady. If obvious and

anomalistic flame occurs for a long time, the slot must be built in by deposit. User should power the air compressor and blow it, simultaneously scratch it with monohedral blade carefully. The air flow will blow the scratched deposit. Ensure that don't damage the slot. User can also wash the slot with corrosive soap solutions.

6.4.3.2 Graphite Furnace System

The maintenance of graphite furnace system is primarily the cleaning of graphite furnace, including graphite tube, graphite wimble and quartz window. When analyzing with graphite furnace method, there is no dust or deposit of samples generally. The spacing interval of every maintenance is determined by actual practice. About detailed maintenance method please refer to its specification.

6.4.4 Gas Paths System

The combustion and combustion-supporting gas supply system of flame method is composed of gas control part, air compressor, Ethine steel bottle and pipe structure. The carrier and protection gas supply system of graphite furnace method is composed of gas steel bottle, gas control part and pipe structure.

1. Inspect the pipe channels termly and see if the leakage of gas occurs in valves and joints. If so, solve it in time.
2. Often inspect if there is water in air compressor loop. If so, drain if off in time. Often drain off the water in the gas-water separator of the air compressor to avoid that overfull water enters the air flow meter. For the air compressor using oil, do drain off the oil water in the filter and air bomb termly, and inspect if the air compressor need to be filled with oil. (Detail please refer to the air compressor specification)

6.4.5 Electrical System.

1. Power the instrument termly to avoid that the electrical components is obsolete for long time unused, especially in the south moist area. Avoid that short circuit instance occurs because of moisture and corrosion. The instrument should be covered by dust-proof mantle.
2. Clean the dust covered on the instrument used for a long time. After shutting it off, remove the dust on the printed-circuit board with soft hairbrush, or blow it with

air blower. And remove the dust on all the other board carefully.

6.5 Circuit Schematic and Function Specification

6.5.1 Introduction.

The main circuit of DW-300 series AAS is in the right circuit box. Lamp power supply is in the back of lamp chamber. The circuit schematic block diagram is shown in Fig. 6-1.

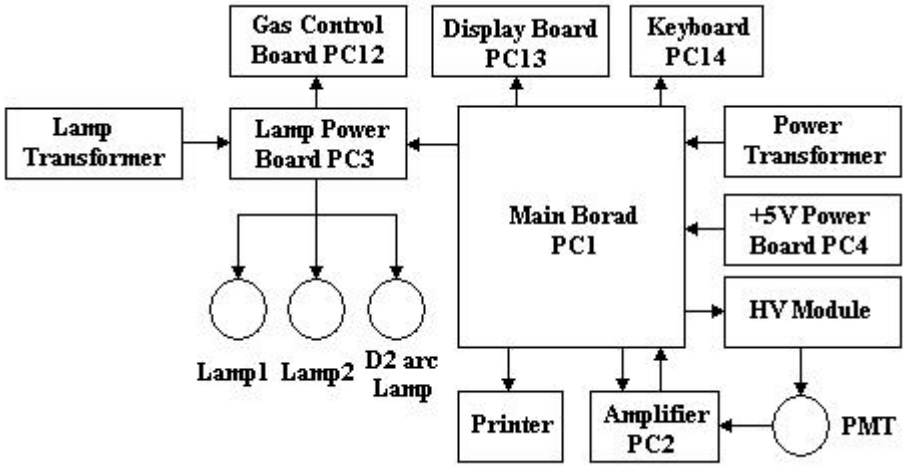


Fig.6-1 Circuit Block Diagram

6.5.2 Circuit Schematic of Main-board (PC1)

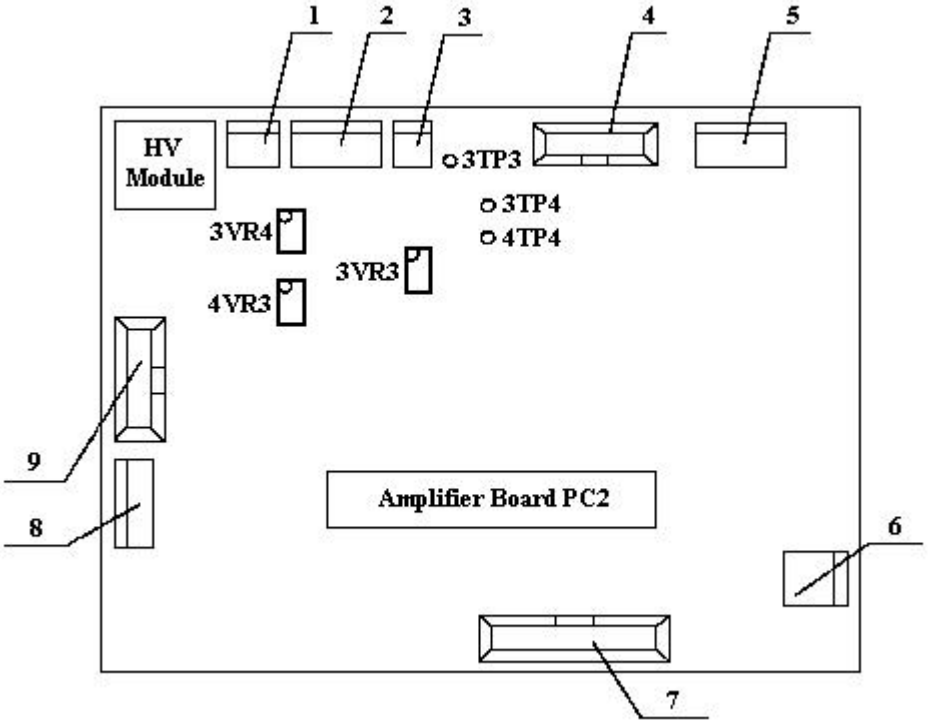


Fig. 6-2 Main Board

1— High Voltage Module Control Socket: 1 → GND(black), 2 → +15V(red), 3 → Control Signal(yellow).

2— Lamp Power Supply Board Socket. Supply ±15V, +9V, +5V.

3— +5V Power Supply Socket. +5V supply of PC4 output.

4— Display Board Socket.

5— AC Socket: 17VAC, 17VAC, 13VAC.

6— Graphite Furnace Control Socket.

7— Keyboard Socket.

8— Lamp Power Supply Control Socket.

9— Printer Control Socket.

3TP3— High Voltage Control Signal. When HV is 500V, this point should be +2.5V through adjusting 3VR4.

3TP4— Lamp 1 Current Control Signal. When input 9.9 as Lamp1 current, this point should be +5V through adjusting 3VR3.

4TP4— Lamp 2 Current Control Signal. When input 9.9 as Lamp2 current, this point should be +5V through adjusting 3VR4.

6.5.3 Amplify Board (PC2)

In this board, 2TP1 is the energy signal of the HCL and 2TP2 is that of D_2 arc lamp.

6.5.4 Lamp Power Supply Board (PC3)

In this board, 3TP1 is +200V DC power supply of D_2 arc lamp, and 3TP2 is +400V DC power supply of element lamp.

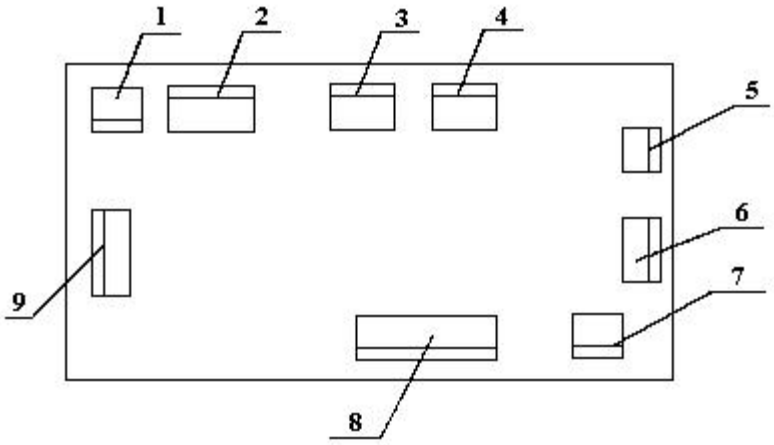


Fig. 6-3 Lamp Circuit Board

1— Gas Control Board Power Supply Socket. Supply +9V and +15V to gas protection board.

2— Lamp Power Supply. ±15V, +9V, +5V from main board.

3— Element HCL Socket. Foot 1 and foot 4 is Lamp1; foot 2 and foot 3 is Lamp2.

4— D_2 Arc Lamp Socket. 1 → Red, 2 → Yellow, 3 and 4 → Black.

5— Lamp Transformer. ~300V supply to element HCL.

6— Lamp Transformer. ~10V, ~150V supply to D_2 arc lamp.

7— Lamp Transformer. ~220V AC Socket.

8— Power Switch and Fuse Socket.

9— Lamp Power Supply Control Socket.(Connected to this socket of main board)

6.6 Familiar Troubles and Resolvent

6.6.1 Processing of Emergence.

1. Abrupt Power Cut.

In this situation, cut the power of instrument and peripheral devices rapidly and cut the gas sources. Make the instrument stopped. When electric supply is all right, restart the instrument again.

2. The color of flame is abnormal with great turmoil.

This is because the combustion gas is polluted seriously. The normal color of air-Ethine flame is baby-blue. In this situation, cut the combustion gas in time. After cleaning the combustion gas, fire again.

6.6.2 Familiar Troubles and Resolvent.

1. Power is out of work.

Inspect if the connection of ~220V AC is normal and if the fuse blows.

2. HCL has not light.

(1) Ensure the fine connection of lamp socket.

(2) Replace a new lamp to judge if this one is obsolete.

(3) Replace another lamp circuit to judge if this lamp circuit has trouble.

3. The energy display decreases.

(1) The energy of HCL itself decreases. — Replace a new one to judge it.

(2) The position of HCL is not adjusted well and HCL is not in the optical path. — Adjust the position of HCL.

(3) Instrument is used for a very long time and the optical performance is decreased.

(4) Atomization burner system gets in the way of optical beam. — Adjust the height of atomization burner.

(5) Excursion of Wavelength: If energy decreases when analyzing all elements, please do the following.

a. Power Hg HCL; high voltage is about 200V; slot width is 0.2nm order. Turn the hand-wheel slowly at about 253.7nm line and observe the change of wavelength. Stop when the energy is largest and note the actual wavelength.

b. Unscrew the bolt or set screw pointed by an arrow shown in Fig. 6-4. Then take out the cover of wavelength adjust structure, and the character wheels is

exposed shown in Fig. 6-5.

c. Turn the belt pulley slowly and make the energy largest, as shown in Fig. 6-5. Unscrew the set screw, and throw out the character wheels in sequence with keeping the belt pulley stopped. Then turn and let the indicator be 253.7nm. Recover the connection between character wheel and belt pulley, and screw the set screw. Reinstall the instrument in the counter sequence of dismantle.

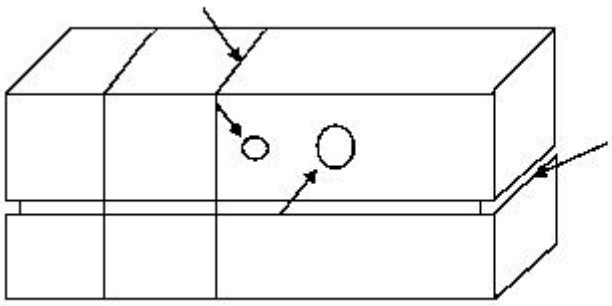


Fig. 6-4

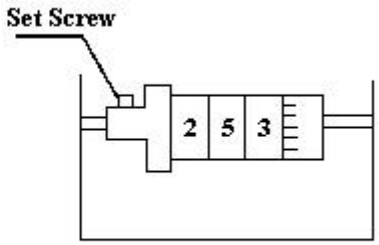


Fig. 6-5

4. Instrument Alarm.

Alarms may be occur in five minutes after starting the instrument, because the electrical components haven't enter the normal working state. This is a normal phenomenon. If alarms occur after those five minutes or during the fire process, user should shut off the fire. Screw the two bolts of M3 at the bottom of the gas control box back, and draw out the gas control box from front. Inspect where is the leakage of gas, and repair it.

5. Instrument is unstable.

(1) Static noise is great.

a. Inspect if the instrument is grounded according to the installation requirements. It is best to install regulated power supply.

b. HCL is unstable. Inspect it with Cu HCL. Some element's HCLs are unstable originally.

c. Electrical system of instrument has troubles, please contact with us.

(2) Dynamic noise is great.

a. The Ethine is impure. — User may add filter.

b. The position of the flame is not the best. — Adjust the position of atomization burner.

c. The flow volume is unstable. — Inspect the exit pressure of gas source and leakage of gas in gas paths.

d. The position of nebulizer is not the best. — Shut off the fire. Unscrew the four bolts on the nebulizer seating and the take it out. Power the air compressor and pump the water to observe the spray state. Adjust the position of the bump ball to let the fog rush ahead equably. Then reinstall the nebulizer seating.

e. The waste liquid is hindered. — Waste liquid should be drained off in time and lay the waste liquid pipe comfortably with no dead turn.

6. The sensitivity is low.

(1) Excursion of wavelength. — Inspect the wavelength excursion.

(2) The position of flame is not the best. — Adjust the Ethine flow volume and the height of the flame.

(3) Atomization system is built up. — Scratch the burner slot slightly; replace a new sample pipe(if have spare parts); nebulizer is soaped in acid solution or replaced.

(4) The current of HCL is too high. — Decrease the current for high sensitivity.

(5) The blank solution is polluted. — Prepare new blank solution.

(6) The solutions are laid for a long time. — Prepare new solutions.

(7) The element HCL is older. — Replace new HCL.

(8) The slot width is not proper. — Re-select the slot width according to the analyzing manual of flame method.

7. Fire back occurs.

(1) There is no water seal at the waste liquid exit. — Add a water seal.

(2) The burner slot becomes wider. — Replace it.(If the slot width is wider than 0.7mm, fire back will occur.)

(3) There is leakage of gas at the explosion-proof pellicle. — See if the explosion-proof behind the atomization system is dropped or damaged.

6.6.4 Notice of Instrument Operation.

1. Sequence of Starting the Instrument.

Power the printer → Power the host instrument → Power the HCL → Input the lamp current → Input the high voltage → Turn the wavelength hand-wheel and adjust the position of the lamp for largest energy → Balance the high voltage → Fire and detect.

2. Sequence of Closing the Instrument

Shut off the fire → Set the HCL current and high voltage to zero → Cut the power of HCL → Cut the power of host instrument → Cut the power of printer.

3. Sequence of Fire.

Wait for five minutes after starting the instrument → Power the air compressor → Adjust the exit pressure to 0.2～0.3MPa → Open the Ethine steel bottle → Adjust the Ethine exit pressure to 0.05～0.07MPa → Turn on the valve of Ethine on the gas control box → Adjust the Ethine flow volume to 1～2L/min → Fire with ignition gun.

4. Sequence of Shutting off the Fire

Directly cut the total valve of Ethine steel bottle. After the fire goes out slowly, shut off the Ethine valve on the gas control box. At last, cut the power of air compressor.

5. Often inspect the gas-water separator on the side of the instrument. And drain off the water in it in time to avoid vapor enter the air flow meter, which is hard to detected.

6. When turn the wavelength hand-wheel with coarse adjustment, don't exceed to the range of 190～900nm. Otherwise, the wavelength structure will be damaged and the wavelength linearity is disordered.

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