TIME OF FLIGHT

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INSTRUCTION MANUAL

FIG - FAST ION GAGE
POWER SUPPLY D-403 Rev-2

WARNING

THIS EQUIPMENT USES VOLTAGES WHICH
ARE DANGEROUS TO LIFE. IT SHOULD BE
SERVICED ONLY BY QUALIFIED PERSONNEL
USING PROPER SAFETY PRECAUTIONS.
DISCONNECT **ALL** CABLES BEFORE
REMOVING TOP COVER

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1.0 SPECIFICATIONS

1.1 MECHANICAL SPECIFICATIONS

Cabinet size	19.0" W x 13.5" D x 3.5" H.
Cabinet weight	11.5 Lbs.
Probe Mounting Flange	2.75 OD Conflat
Insertion Depth (flange face to grid center)	Adjustable to 6" maximum
Bakeout Temperature	150°C maximum
Operating Pressure	1×10^{-4} Torr maximum

1.2 ELECTRICAL SPECIFICATIONS

Emission	0-10 milliamps
Grid Voltage	50-300 Volts
Output Signal	0-12 Volts

1.3 SERVICE REQUIREMENTS

Input Power	100/120/220/240 Volts 1 Phase 50/60 Hz.

2.0 GENERAL DESCRIPTION

The FIG - Fast Ion Gage is a Bayard Alpert type high vacuum gage on which the grid dimensions have been reduced to increase speed of response.

It can be used to observe the time profile of a short duration pulsed molecular beam.

3.0 INSTALLATION

Mount the probe onto the vacuum chamber such that the beam will intersect the center of the grid. Rotate the tube so that the beam will not hit the filament or its support post.

Make certain the clamp is tight.

Pump down the vacuum system.

4.0 DESCRIPTION OF CONTROLS

4.1 FILAMENT ON PUSH BUTTON

Turns on the Fast Ion Gage filament.

4.2 FILAMENT LED

Shows filament power supply is on and the filament is activated.

4.3 FILAMENT OFF PUSH BUTTON

Turns off the filament.

4.4 EMISSION CURRENT ADJUST KNOB

Adjusts emission current from 0 to 10 milliamps.

4.5 EMISSION CURRENT LIMIT

Adjusted to limit the maximum emission current to 10 milliamps.

4.6 EMISSION CURRENT METER

Displays emission current in milliamps.

4.7 GRID VOLTAGE ADJUST KNOB

Adjusts grid voltage from 50 to 300 Volts D.C.

4.8 GRID VOLTAGE METER

Displays the grid voltage on the Fast Ion Gage Probe.

4.9 OUTPUT

Connected to an oscilloscope and displays a 0 to 12 Volt wave form proportional to the beam pressure pulse.

5.0 CONNECTIONS

Before connecting the mains, make certain the Voltage Selector Switch (100/120/220/240) is set properly. If the voltage wheel needs to be changed, a fuse with the value shown in the following table should be inserted into the fuse holder.

Mains voltage:	Fuse holder:
100V 50/60 Hz	1.2A slow-blow
120V 50/60 Hz	1A slow-blow
220V 50/60 Hz	½A slow-blow
240V 50/60 Hz	½A slow-blow

Connect the FIG Power Supply to the FIG Probe with the cable supplied. Connect the FIG "OUTPUT" to an oscilloscope input. Connect the PSV trigger monitor to the trigger input of the scope. The trigger monitor pulse is a 2.25 volt positive pulse about 20 microseconds wide. Set the oscilloscope sweep speed to 20 microseconds and the sensitivity to 2 volts/DIV. Adjust "GRID VOLTAGE" and "EMISSION" to mid-scale. You should now be able to observe a negative pressure pulse. Inverted, it should look something like Fig. 1 (shown below), only with a more pointed top. Now adjust "EMISSION CURRENT" and "GRID VOLTAGE" until the peak is about 8 Volts high. Emission Current that is high in proportion to Grid Voltage will raise the front of the curve at the top. High "Grid Voltage" in proportion to "Emission" will do the same to the tail of the pulse top. Balance these two so that the top of the curve is as flat as possible. This is the best approximation to the true pressure curve.

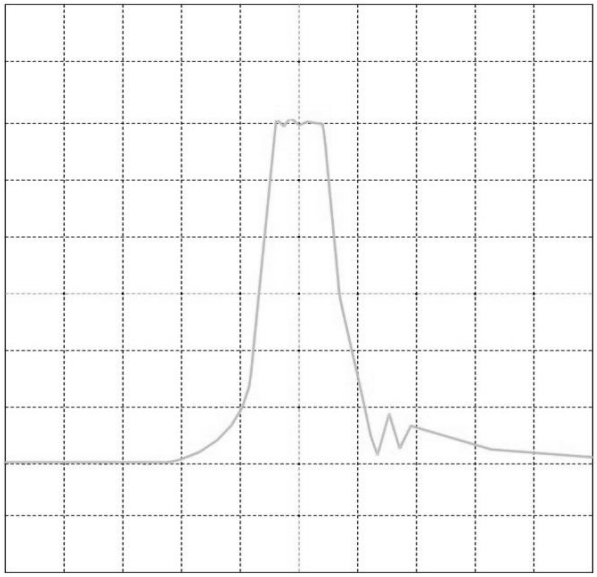

Figure 1: Fast Ionization Gage Pressure-Time Curve
Sample Pressure: 1.0 Atm. He
Nozzle Diameter: 0.5mm
Gage Distance From Nozzle: 5.0cm

At this point it should be noted that it is not possible to make a pointed top flat by adjusting the controls. If the true profile is not flat in the first place, there is no way to flatten it using the controls. On the other hand, peaks appear more pointed until the FIG is "tuned".

Should the average local pressure at the Probe exceed 1 x 10^{-4}, the filament will trip off.

In the event that the grid current gets too high, both meters will go to zero, the "FILAMENT" LED will still be on and the filament will be full on. Should this occur, turn off the power supply. Unplug the unit from the line power and remove the top cover. Replace the 1/32 Amp fuse on the P.C. Board.

6.0 OPERATION

With Gage tube, (Probe) pumped below 1 x 10^{-4} Torr the power switch can be turned on. The power light should turn on as well as the grid voltage reading between 50 to 300 Volts D.C. The "FILAMENT" LED should be off. There should be no indicated "EMISSION CURRENT". When the "FILAMENT ON" button is depressed the "FILAMENT" LED should light and "EMISSION" should be adjustable from 0 to 10 milliamps.

7.0 MAINTENANCE

7.1 CONTAMINATION

Most problems with the Fast Ion Gage are due to contamination. The most troublesome contaminant can be easily avoided. This is Silicon pump fluid. Do not use Silicon pump fluid in instrument applications, especially where Microchannel Plates are used. Polyphenol Ether such as SANTOVAC V is known to be satisfactory. For very large pumps the cost may seem prohibitive. It is not likely to be as expensive as a shut down for instrument cleaning and replacement of Microchannel Plates.

Other common contaminants are recondensed hydrocarbons from fingerprints, etc. and other substances which are introduced as samples for analysis.

7.1.1 SYMPTOMS

Non conducting substances can condense onto electrode surfaces and form a dielectric coating which will surface charge and cause a distortion in the local field. Evidence of this is usually time dependent. Elements which have been tweaked for sensitivity must be readjusted. This is most noticeable with turn-on.

Conducting substances can coat insulators and create leakage paths between elements. This will cause various circuit elements to "talk to each other" and erratic meter readings or variations in the detected signal. Sensitivity can build up, then drop due to breakdown between elements.

7.1.2 REMEDY

Return probe to the factory for reconditioning.

The grid structure may be submerged in solvents such as acetone and cleaned ultrasonically. This is usually adequate to remove the light yellow deposits of tungsten oxide caused by filament burn-out.

Filaments may be replaced by spot welding to the supports while under slight tension.

8.0 CONTROL UNIT SERVICE PROCEDURES

8.1 SAFETY PRECAUTIONS

This equipment uses voltages up to 400 Volt D.C. and capacitors which store dangerous amounts of energy. The control unit should be unplugged from the line power before opening.

Although bleeder resistors are provided, all high voltage capacitors should be discharged by shorting their terminals before touching any electrical components. The high voltage capacitors are C7 and C6.

If energized testing of internal circuits is required, connections to test points should be made with the equipment off. The cover interlock can then be overridden by pulling the plunger.

8.2 TROUBLE SHOOTING

8.2.1 No power or meter lamps.

Check power source and 1 Amp slow blow fuse on rear panel.

8.2.2 No grid voltage

Check 1/32 Amp fuse on the Printed Circuit Board.

8.2.3 "FILAMENT" LED doesn't light, no emission current.

Check 3 Amp slow blow fuse on rear panel.

8.2.4 "FILAMENT ON" button has been depressed, "FILAMENT" LED lights, but turns off immediately.

Leakage or short circuit to gage tube collector. Q3 shorted or A2 or A3 blown.

8.2.5 Replacing IC's

All integrated circuits in this equipment are mounted in sockets and can easily be changed. Do not reverse position of IC's or they will be destroyed. IC's have a notch on the end near Pin No. 1 and/or a dot over Pin 1. The IC sockets have a notch on the one end to show the position of Pin 1.

9.0 CONTROL UNIT CIRCUITRY DESCRIPTION

9.1 CONTROL UNIT

The control unit includes a regulated high voltage supply for the grid voltage, a low voltage high current supply for the filament, and a high gain amplifier with protection circuits for pressure measurement.

9.2 CIRCUIT DESCRIPTION

See Control Unit Schematic, Drawing No. D0403.

9.2.1 Power Supply

Line power (100, 120, 220, 240 Volts, 50 or 60 Hz) is brought in thru a fuse, line switch, interlock switch, and a voltage selector switch to the main power transformer, T301.

The power indicator light, meter lights, and +15 Volt power supply are powered from one of the 120 Volt primaries of T301.

A 617 Volt secondary of T301 is used to power the grid power supply.

A 10 Volt secondary of T301 is used to power the filament power supply.

9.2.2 Grid Voltage Regulator

Capacitor C7 is charged to 380 Volts by CR6 and CR7 with R18 as a bleeder resistor. F1 limits the current from C7 to 30 milliamps. R23, CR11 and CR12 make a 320 Volt Zener regulated Power Supply with R101 and R32 making the voltage from the Zener regulated Power Supply adjustable from 62 Volts to 320 Volts. The voltage goes to the gate of Q203 which charges C6 to the voltage set by the "Grid Voltage Adjust" pot R101 located on the front panel. CR4 and CR5 protects the FET (Q203) from C6 discharging into it when F1 blows or the supply is turned off. R19 limits the current to Q203 to 100 milliamps while F1 is blowing. R17 is the bleeder resistor for C6, and R16 makes the "Grid Voltage" meter (M101) read 0-300 Volt full scale.

9.2.3 Filament Voltage Regulator

C301 is charged to 10.8 Volts by CR301. This voltage goes to the regulator (REG 201) thru F202 which limits the current to the filament to 3 Amps. R201 turns on CR201 which floats the 5 Volt regulator (REG 201) to give an output voltage of approximately 6 Volts. This voltage then goes to the emission current regulator circuit.

9.2.4 Emission Current Regulator

Emission current is the current created by the electrons being emitted from the filament to the grid. Zero to 2.7 Amps of filament current creates 0 to 10 milliamps of emission current.

NOTE: The following voltages are referenced to +6 Volts common, not to ground.

When the "FILAMENT ON" switch is depressed it allows current to pass thru R1 to Q1 which turns on RL1. The normally open contacts of RL1 close, which powers the emission circuit as well as keeping the relay on. The relay is turned off by the "FILAMENT OFF" switch or by Q3 turning on (safety interlocks), which causes the current going to the base of Q1 thru R1 to be diverted to ground, which turns off Q1 causing the relay to open.

The voltage divider made by R3 and R9 puts 3 Volts on R5 and R6. With zero emission current CR3 is reverse biased so that the 3 Volts on R5 and R6 goes to Pin 10 of A1-3. The front panel "EMISSION" control (R102), "EMISSION LIMIT" control (R103) and R8 make a voltage divider that puts an adjustable voltage of 4 Volts (minimum emission) to 0 Volts (maximum emission) on Pin 9 of A1-3. The difference in voltage between pins 10 and 9 of A1-3 (V Pin 10- V Pin 9) is amplified and goes to Q2 and Q202 which controls the filament current. If the voltage on Pin 10 is greater than Pin 9, filament current increases which increases the emission current. If the voltage on Pin 10 is less than Pin 9, filament current is decreased which reduces emission current. The emission current passing thru CR3 starts it conducting which causes a voltage drop across R5 and R7 reducing the voltage to Pin 10 of A1-3. A1-3 raises and lowers filament current until the voltage across CR3 is equal to the voltage set by the front panel "EMISSION" control.

9.2.5 Collector Amplifier

The amplifier has a protection circuit that limits the collector voltage into the amplifier A3 to 8 Volts. A signal larger than 8 Volts from the collector starts Q5 and Q6 conducting so that any voltage over 8 Volts is dropped across R29. This protects the amplifier if the collector accidentally shorts to the grid.

Amplifier A3 uses R26, R27 and R28 as its feedback circuit. Any D.C. currents arriving at the collector have to go thru input resistor R29 which gives A3 a gain of 2. Any currents with a period less than 100 microseconds bypass R29 by going through C14, which gives A3 a gain of 55.

9.2.6 **Over Pressure Protect Circuit**

When the average pressure at the Fast Ion Gage tube reaches 1 x 10^{-4} Torr, the front panel "Output" is 2.0 Volts D.C. A2 will put out a positive voltage that saturates Q3 which turns off the filament. R22 and C8 filter out any fast voltage changes so that the output from the beam pressure pulse does not trip the filament.

10.0 **SPARE PARTS LIST**

3 each - Filament

5 each - Screw. 8-32 x 3/8" socket cap

1 each - O ring, #210 Viton

1 each - 9/64" Hex Key

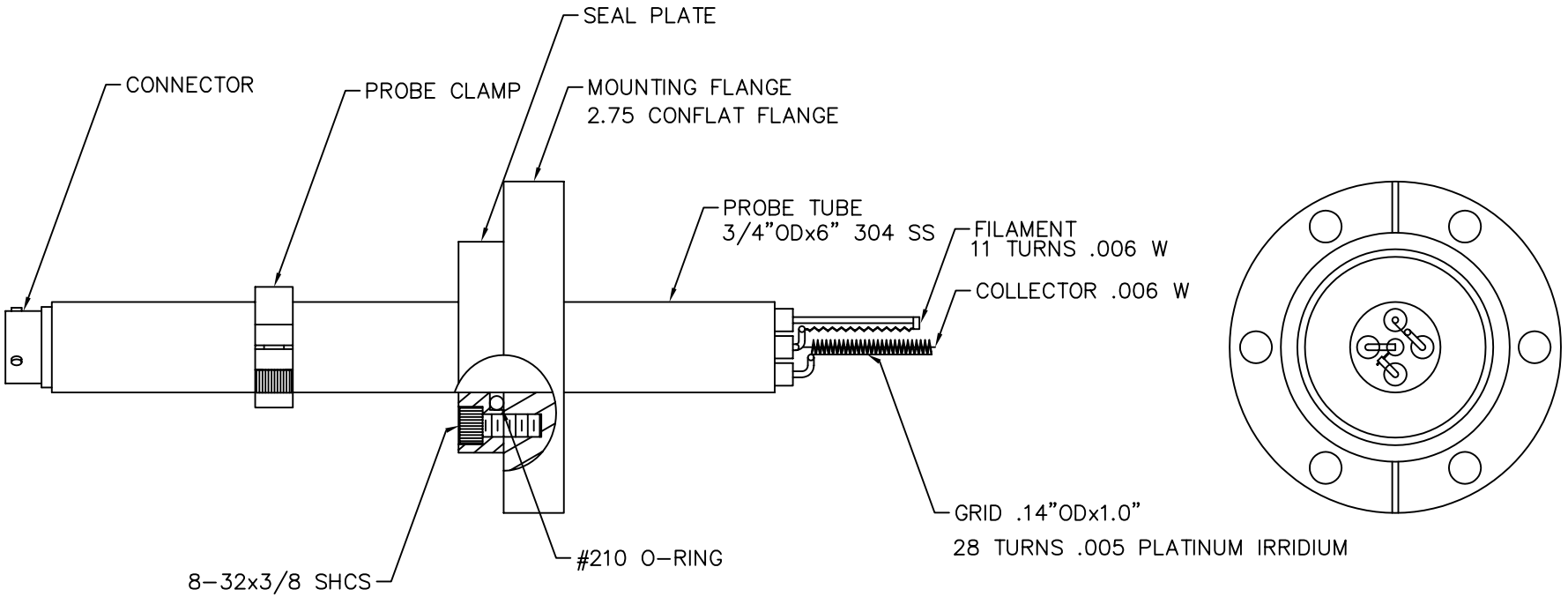

FIG PROBE ASSEMBLY

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