Plasmatronics Inc.

HILL TYPE 1

PLASMA SPEAKER

REPAIR MANUAL

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PROPRIETARY NOTICE

The Hill Type 1 technology is covered by patents but, in
idition, there is proprietary information contained throughout
iis manual. Therefore, the manual in part or entirety is not to
: reproduced or shown to anyone outside the repair organization.
.so, all technical details contained herein are not to be verbally
· otherwise disclosed to anyone outside your organization, unless
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tter.

SECTION A. FOREWARD

1 SCOPE

The Hill Type 1 has been modularized to permit fast field pair, which most often requires that the problem be isolated to a rticular circuit board and that the board be exchanged with a placement. Plasmatronics will then be happy to exchange good ards for damaged ones. We recommend that the distributor purchase repair kit consisting of all likely component and board replacements order to save shipping time to the factory. The factory can then place all defective components, free under warranteed conditions, t later without causing customer's inconvenience. In some cases, e distributor may feel competent to repair obvious board problems d save shippping inconvenience and expense, at his option. This nual should provide enough information to make this possible but do not want to inconvenience our distributors more than absolutely cessary and urge them simply to exchange bad boards.

The manual covers field repair of the main speaker units and plains calibration procedures internal to the interface but does t cover interface repair. Because of its small size and ease of ipment coupled with its relatively complex and difficult to field rvice circuitry, we feel that it is simplest for the distributor exchange the entire unit with the factory as though it were a rcuit board. Note that an entire interface is included in each pair kit. The distributor may wish to field repair the interface cases where a broken connection may be easily spotted, or vacuum

tubes or L.E.D.'s need replacement. A quick check for this type of obvious problem is recommended.

A-2 USE OF THIS MANUAL

Field engineers should thoroughly read first the Owner's Manual and second the entire Repair Manual to gain general background information prior to attempting any form of service. This is particularly important since service could be quite dangerous unless the individual is well acquainted with the entire system. Once this familiarity is gained, the engineer may refer directly to the detailed description in Section D.

Field service personnel are invited to communicate directly with Plasmatronics personnel on any matters where additional guidance not found in the manual would be helpful. We at Plasmatronics are eager to assist in any way possible and want to know about any recurring problems so that corrective design improvements can be made where appropriate and extended as field modifications where necessary. We feel most of the "shakedown" for this product is behind us, but will always strive to make it more reliable wherever possible. Your cooperation and understanding in this area will be greatly appreciated.

SECTION B. GENERAL WARNINGS AND INTERLOCK DEFEAT PROCEDURES

B-1 PERSONAL QUALIFICATIONS

For most domestic dealers, Plasmatronics prefers to personally handle all but the simplest repair situations. The distributor will have well qualified engineers (or equivalent level people) required to service this complex and unusual equipment. The distributor should take care that only such people work on this product and that they are thoroughly familiar with the contents of this manual. Any questions they have will be gladly answered by the staff of Plasmatronics.

B-2 ELECTRICAL HAZARDS

Extremely lethal voltages and currents exist within the plasma driver electronics and should be serviced by individuals well familiar with such hazards. In addition to using the appropriate standard practices, we particularly call attention to certain relevant procedures.

1) Be sure that the power cord is disconnected and that the high voltage capacitors mounted to the upper deck are discharged before contacting any circuits.

2) The service personnel should be intimately familiar with the location of all dangerous electrical circuits and be aware that high

voltage can "jump" to nearby objects without making physical contact. Locations of the most dangerous areas are summarized as follows (please refer to Figures 5, 6 and 7).

a) the diode rectifier section of the control board, Figure 5a.

b) the two terminal boards attached to the main power transformer, Figure 5c.

c) connections underneath the upper deck of the main chassis, particularly the high voltage filter capacitor terminals and power resistors (Figure 7a).

d) most conductors connected to the power amplifier board, including 100 watt power resistors and anode connectors (Figure 7).

e) upper and lower brass tubes which conduct helium into the plasma chamber (Figure 6b).

f) turn-on relay and nearby terminal strip on the rear right hand corner of the upper deck, main chassis (Figure 5a).

When installing tubes, care should be taken not to force the power resistor under the upper deck near to the chassis.

B-3 HIGH PRESSURE GAS HAZARDS

Aside from electrical hazards, the high pressure gas containers also demand proper respect. They should never be left standing and uncapped. This is because if they fall over and the valve is broken, they take off like rocketships due to the high pressure of escaping gas!

Be sure that only helium gas is used. Note that while standard thread connections are used to prevent inadvertant use of a dangerous gas, these standards are <u>not</u> universal world-wide.

Outside of the United States such inadvertant substitution may be possible.

B-4 HOW TO DEFEAT INTERLOCKS

Occasionally, as with all electronic equipment, internal diagnosis or adjustment must be made during operation so that it will be necessary to defeat interlocks. Having made sure to heed the foregoing remarks on safety and personal qualifications (A-3 and A-4), interlocks may be defeated when necessary as follows:

To defeat the low tank interlock wedge a light, flat object such as a tongue depressor between the microswitch and the plunger on the pressure switch body (see Figure 6a). Depressing the microswitch will simulate a full tank. Warning! Never allow a plasma to exist without sufficient helium flow as this will destroy the electrodes.

The back screen interlock may be defeated by taping the switch shut.

B-5 LIABILITY NOTICE

If the instructions are carefully followed by knowledgeable people there should be no accidents. But please note that Plasmatronics assumes no liability for injuries or damage resulting from working on the Hill Type 1 Plasma Speaker System.

SECTION C. ARCHITECTURAL FAMILIARITY

A general explanation of the basic system functions and location descriptions are presented in this section.

C-1 INTERFACE

Although we are not treating the interface as generally field serviceable at this time, its brief functional description will be given as important background. Refer please to Figure 1. The interface accepts the audio signal from the users preamplifier into its internal active midrange to plasma crossover network. The low frequency signals are routed to the users external bass power amplifier and the amplified signal back to the interface where it may be sampled by the high-low comparison circuit and delivered to the bass section of the speaker through the braid part of the triax interconnection cables. Within the main cabinets is located additional passive crossover circuitry which controls the woofer to low mid-driver slopes as well as the mid-driver upper rolloff. Meanwhile, the high frequency output of the interface crossover is routed into an intermediate vacuum tube Class A amplifier and cathode follower which serves as the driver stage for the "final" current regulating amplifier circuits located in the main speaker chassis. The center conductor of the triax provides the link between these two stages. High frequency cable losses are eliminated by driving the cable with a high level, low impedance signal.

In addition to the high frequency signals, a DC voltage is also

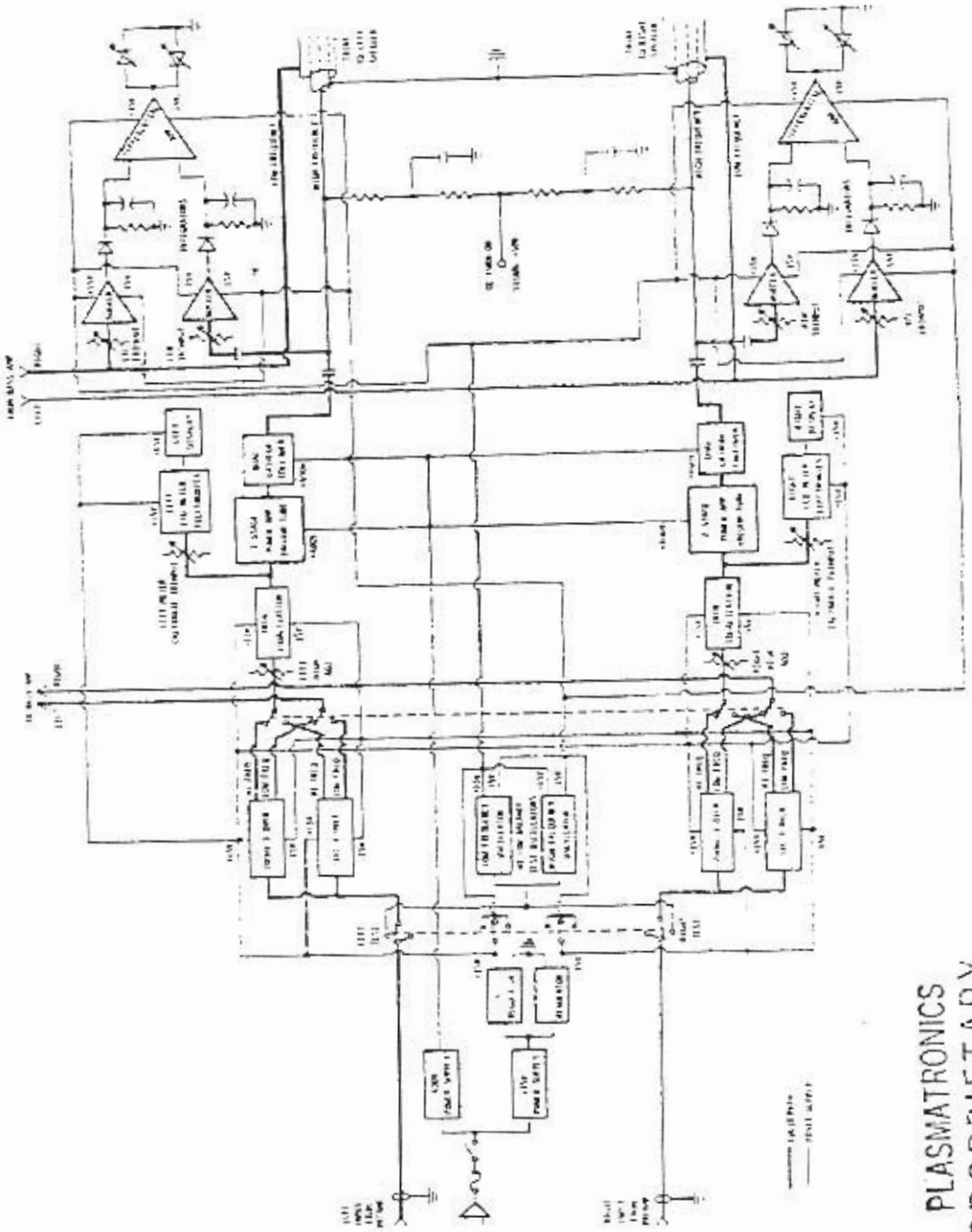

Figure 1 Interface Unit

impressed on the center conductor of each triax by the interface which causes the main speaker chassis to energize when the interface is turned on.

The interface also contains a balance circuit which differentially compares the high and low frequency component amplitudes of an internally generated complex signal after passing through amplifiers and crossover circuits. These circuits are calibrated as explained in Section E so that the differential output of this circuit indicates a null on two L.E.D.'s when the biamplified system is balanced. The remaining interface circuitry includes LED-VU meter electronics, optional 1000 cycle crossover, a 400 volt power supply for the vacuum tube circuitry and a ±15 volt power supply for the solid state circuitry.

C-2 MAIN CHASSIS

The basic systems which are located on the main chassis include:

1) A turn-on relay and drive circuit,
2) Safety interlock circuit, including tank pressure sensor,
3) 3500 volt high voltage power supply,
4) Plasma driver,
5) Start-up and purge gas control circuit,
6) Five parallel vacuum tube plasma current control amplifiers.
7) Screen grid, bias and filament supplies,
8) Mechanical helium gas flow control assembly.

For ease of understanding we have provided three levels of complexity in diagraming these components and their interrelationships

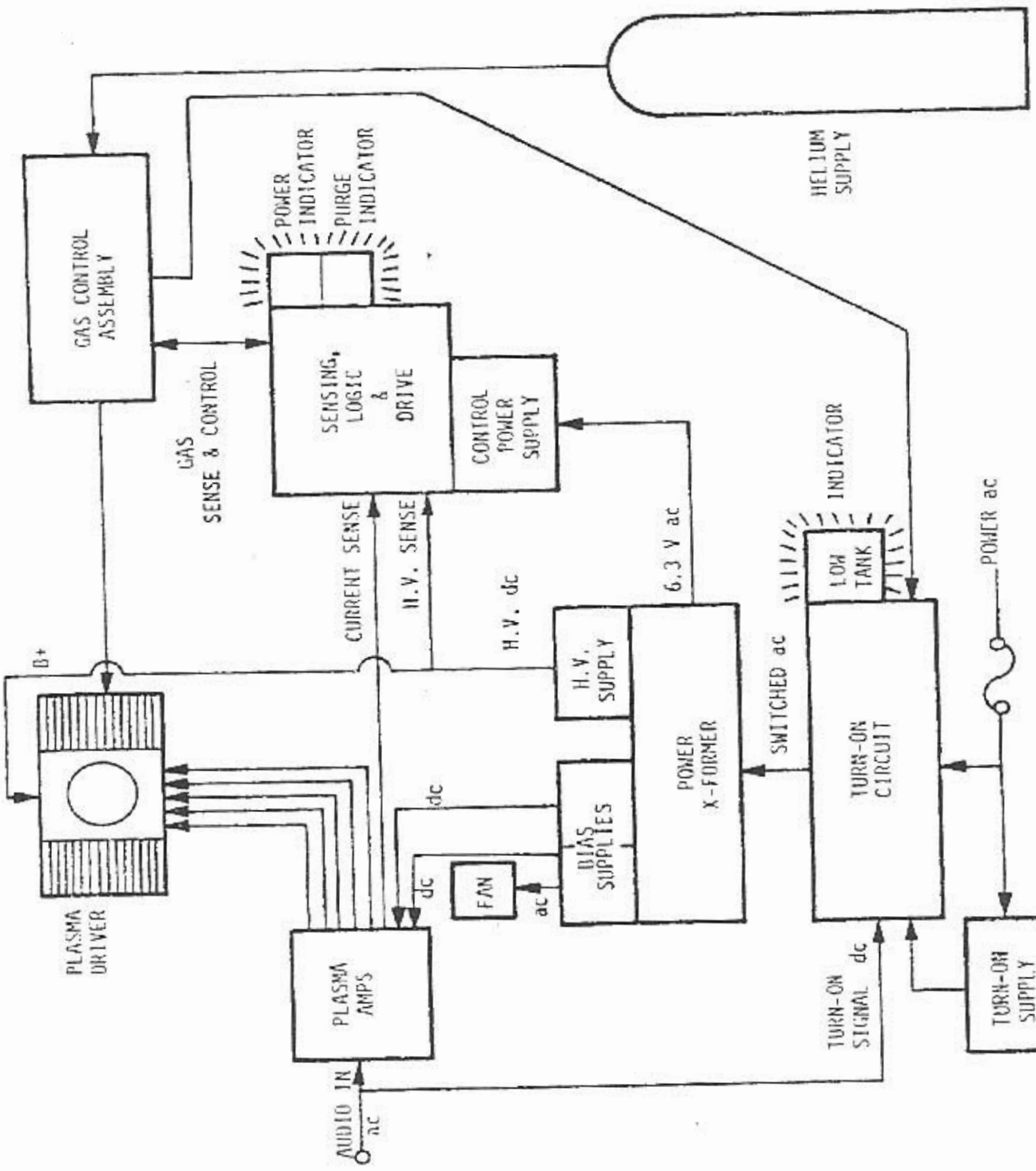

Figure 2 Main Chassis Simplified Block Diagram

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to each other. To get a basic understanding of how the above systems interact, refer to Figure 2. A short description of what happens when the unit is turned on will help to guide this understanding: a separate turn-on circuit is continuously powered in a standby mode. Upon receipt of a turn-on signal provided by the interface, this circuit engages a turn-on relay which, in turn, supplies the main power to the system. Either low gas pressure or broken electrical interlock can interrupt this turn-on. Upon relay closure, the main helium gas flow valve is opened and high voltage is applied to the plasma unit. However, the discharge will not strike without purging the system with additional helium. This additional purge to start the plasma is held off by a delay circuit until the tubes have had a chance to warm up. The additional purge is then shut off by a circuit which senses that both voltage and current characteristics of the plasma are normal, indicating successful completion of the start cycle.

To get a more detailed understanding, please refer now to Figure 3, which shows still in block form more intricacy. You will note that there are five parallel vacuum tube circuits which control and modulate the respective currents applied to five gas discharge cathodes. These are single-ended Class A current regulator amplifiers all driven from the center of the triax cable connecting to the vacuum tube circuit located in the interface. (The DC turn-on signal is decoupled via capacitors from the five parallel output stages.) Each of these five circuits has an associated bias control plasma current meter and fuse located on the

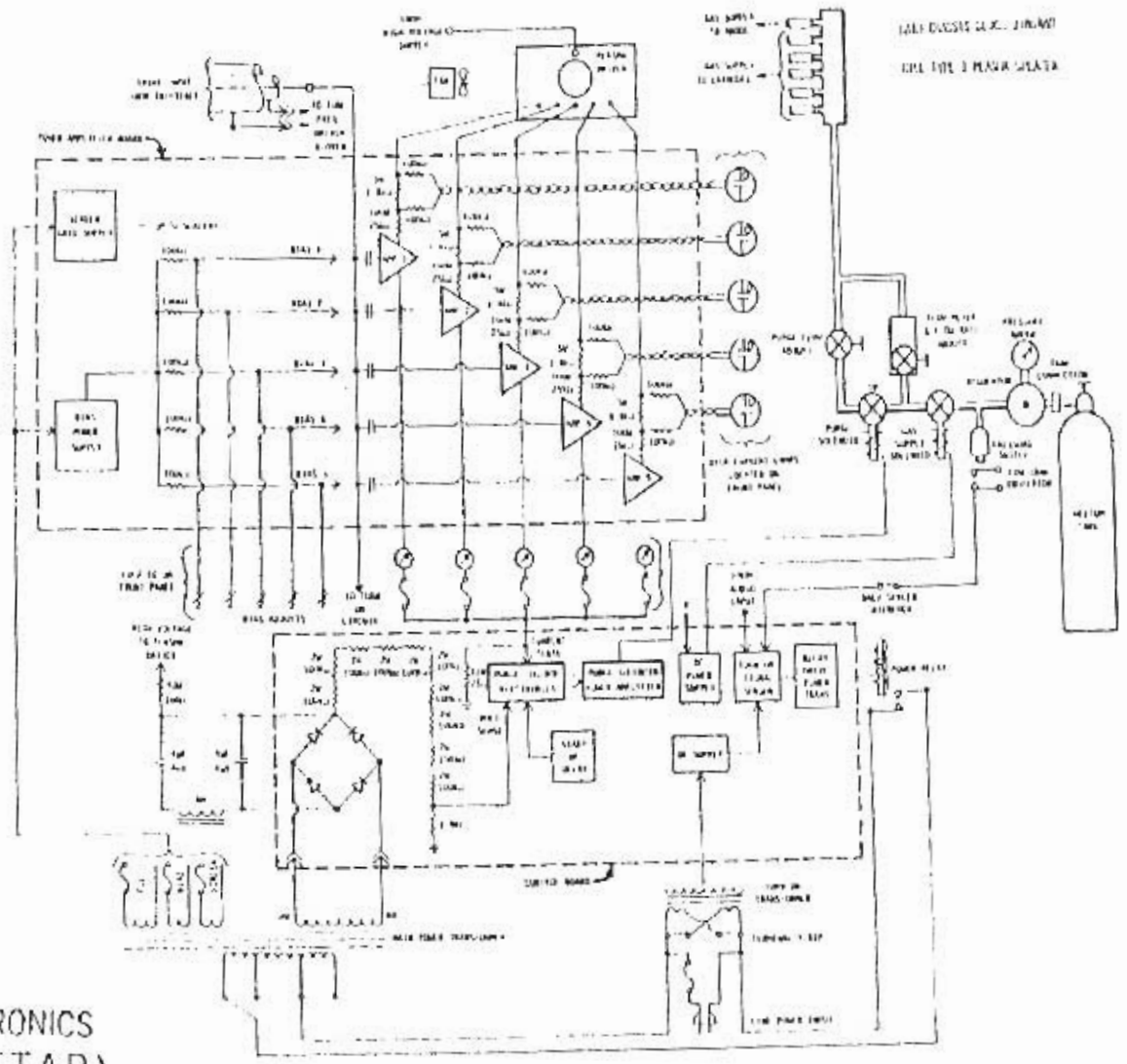

Figure 3 Main Chassis Block Diagram

front panel. Helium is supplied to each of the electrodes from a mechanical gas control assembly for which detailed description will be given in Section D-3.

The level of detail presented in Figure 3 in combination with descriptions found in Section D should prove most convenient to handle most repair situations, particularly if replacement circuit boards are on hand as we recommend. However, if the problem is unusually complex or you are not able to simply switch a board, you may wish to refer to Figure 4 for detailed schematic information.

Section D will outline details of operation and location of each subsystem together with listings of possible problems and cures for each subsystem.

Figures 5, 6 and 7 may be consulted to locate components, subsystems and hazardous areas.

Figure 4 Main Chassis Schematic

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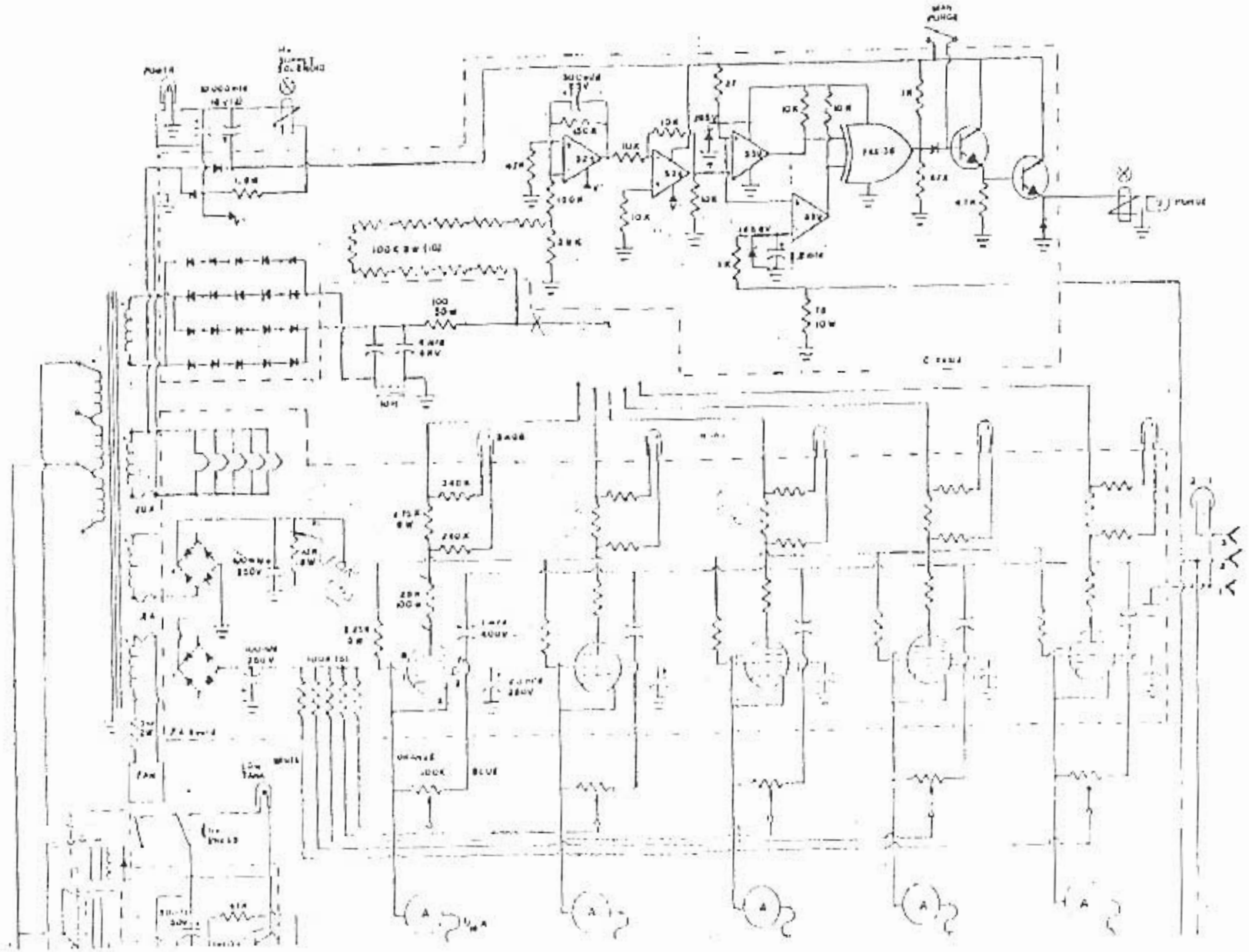

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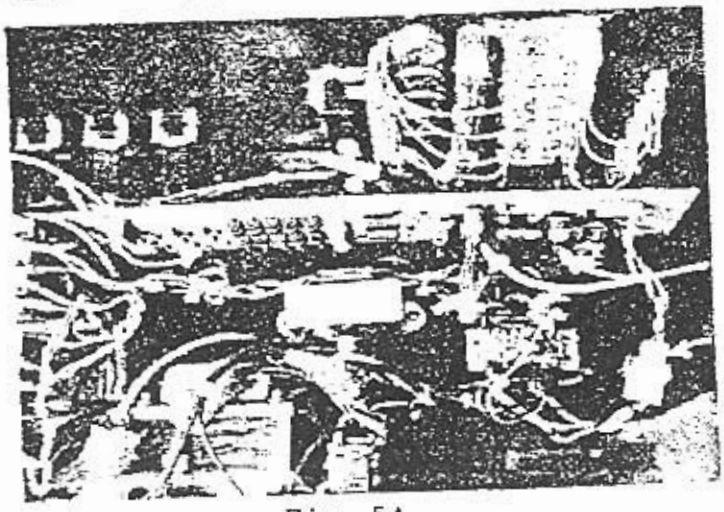
Figure 5 Upper Deck Component Locations

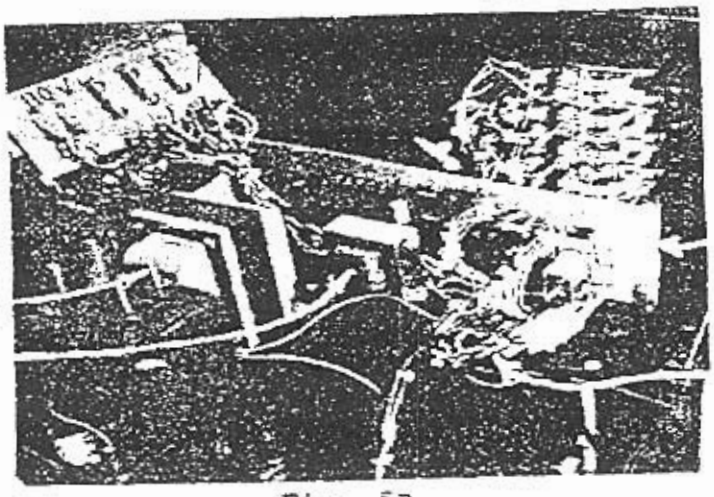
High Voltage Connections (Danger)



9 Pin "D" Connectors

6 Pin Connector

Fig. 5A



Control Board

H.V. Choke

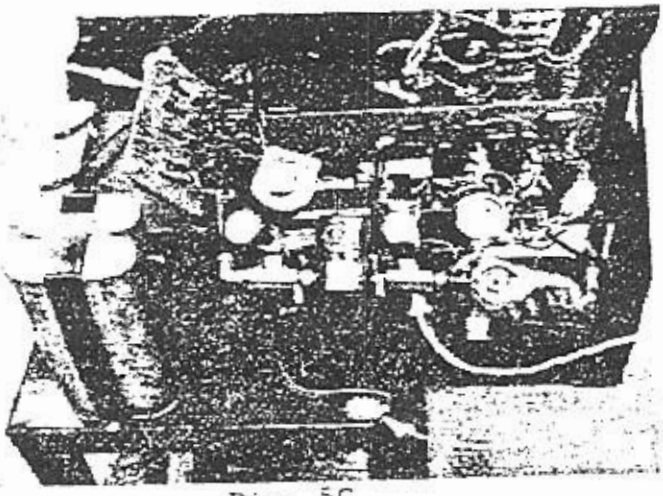
n-on Transformer

Danger: AC Power

Fig. 5B

Power Connections
& Fuse Board

nger: High Voltage



H.V. Filter Caps

Gas Control Assembly

Back Screen Interlock Switch

Fig. 5C

Figure 6 Gas Control Component Locations

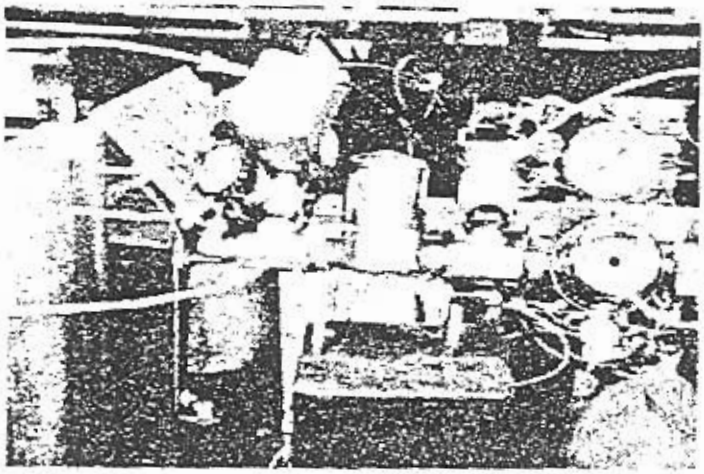


Fig. 6A

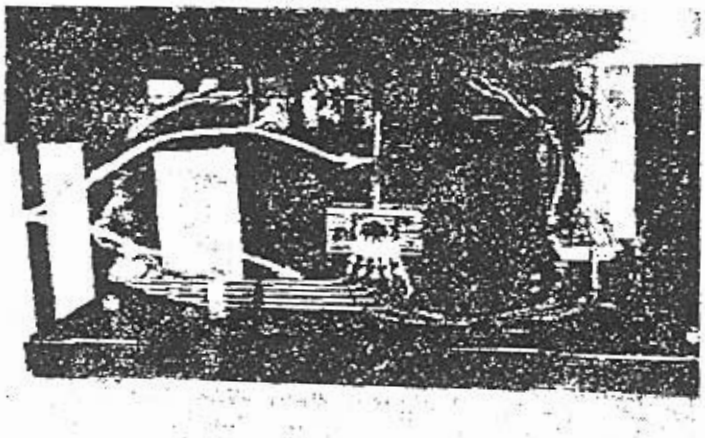


Fig. 6B

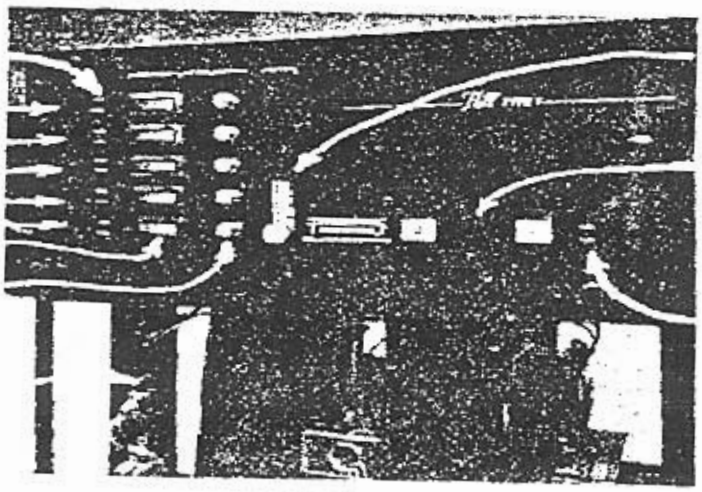


Fig. 6C

Figure 7 Power Amp Board Removal

Danger!
High Voltage!

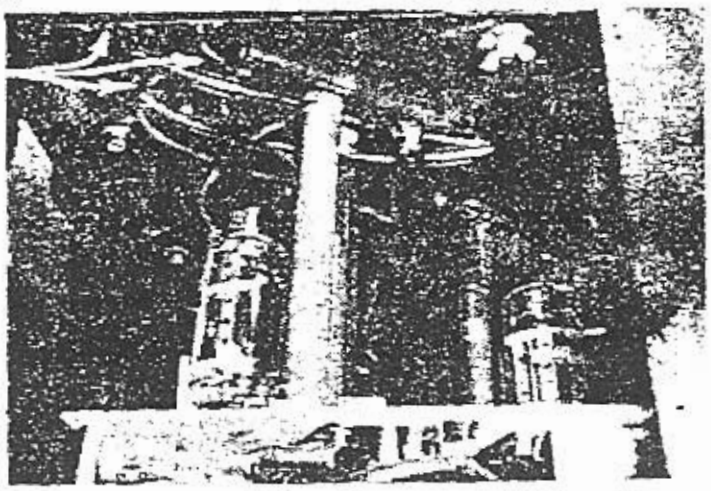


Fig. 7A

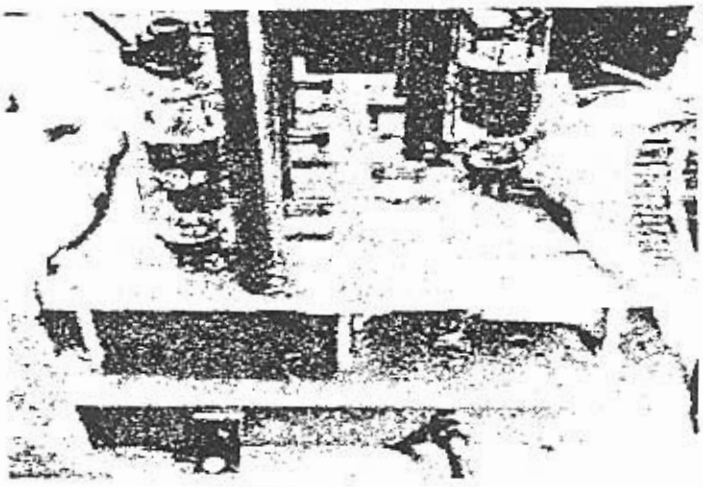


Fig. 7B

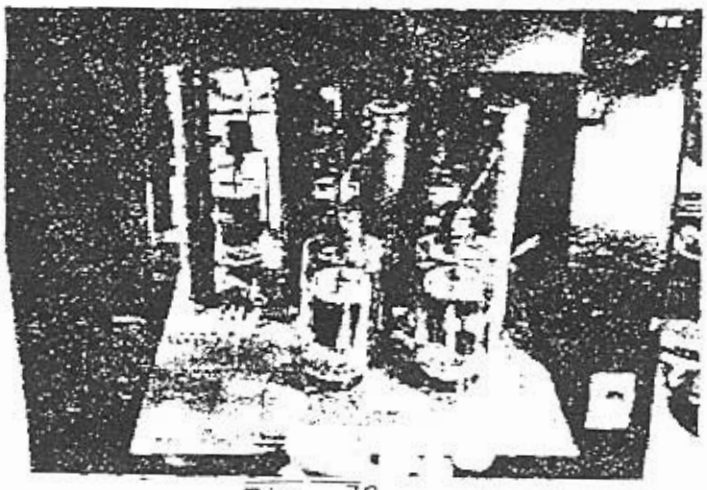


Fig. 7C

SECTION D. INTERNAL SYSTEMS AND THEIR POSSIBLE FAILURE MODES

In order to locate components discussed throughout Section D, please refer to Figures 5, 6, & 7 of the proceeding section.

D-1A POWER SUPPLY DESCRIPTION

There are five basic power supplies, four of which are derived from the three secondaries of the power transformer and the fifth from the secondary of the turn-on transformer.

1) The turn-on transformer is connected through the main fuse directly to the line and is thus powered as long as the speaker is plugged in. The 20 volt AC secondary is rectified with a full wave bridge and filtered with a 50 uf capacitor. This DC supply is routed to the pressure switch where, depending on pressure sensed, the power is sent either to the "low tank" light or to the safety interlock. If the interlock is closed, the power is sent to the coil of the power relay (see Figure 3). If a turn-on signal is present, the relay drive transistor pulls current through the coil to ground. The relay closes and power is sent to the power transformer.

2) The high voltage winding of the power transformer is rectified through 20 diodes located on the control board and filtered with two 4 uf, 4KV capacitors and one 6 Henry choke in a Pi filter configuration. This DC high potential voltage is sent, at this point, both to the control board for sensing and, through a 100 ohm, 50 watt resistor, to the top electrode of the plasma driver.

3) There are two 130 volt AC windings- one which supplies power to the fan and negative bias supply, and the other which is the positive screen grid supply (see "main chassis" diagram, Figure 3). The AC from these windings is rectified and filtered by two separate full wave bridge filter cap circuits located on the plasma amplifier board.

4) The 6.3 volt AC winding is two supplies in one. It supplies the tube filaments and, after half wave rectification and filtering, supplies the control board circuits with approximately ±7 volts. The rectifiers used are located on the control board (see Figures and the 10,000 uf capacitors are located under the top deck near the power relay. The LM 324 IC receives the positive and negative 7 volt supply while the logic circuits receive a Zener regulated -5 volt DC from the same source. The purge drive circuit also uses unregulated power from this positive supply, while the "power" indicator and gas supply solenoid uses power from the negative supply.

D-1B LIKELY SOLUTIONS TO POWER SUPPLY RELATED PROBLEMS

Solutions are listed in order of probability.

1) Problem: no sign of activity.

a) check plug

b) check interface

c) check audio cable and connector

d) check back screen interlock

e) check tank pressure

f) check main fuse

2) Problem: transformer hums but has no "power", no "purge" and no filaments.

a) check 20 amp fuse (see Problem #4)

3) Problem: blows main fuse located on front panel.

a) wrong fuse

b) bad high voltage diode string on control board

c) wrong transformer line tap (see Section E)

d) 100 ohm, 50 watt resistor shorting to underside of chassis top deck (see Figure 7).

e) bad high voltage wire connections or short (watch for arc)

f) bad transformer, capacitor or choke

g) metal fragment on P.A. boards

4) Problem: blows 20 amp fuse located on transformer block.

a) bad tubes

b) loose metal on foil of P.A. board

c) bad control board filter caps

d) bad control board

e) shorted solenoid coil

5) Problem: blows 0.2 amp fuse located on transformer block.

a) bad tube(s) on P.A. board*

b) shorted fan on underside of P.A. board*

c) shorted 2.25 Kohm, 5 watt resistor on underside of P.A. board*

d) shorted 100 Kohm, ½ watt resistor on underside of P.A. board*

e) shorted rectifier bridge(s) on underside of P.A. board*

f) shorted filter caps on underside of P.A. board*

* See also Section D-4, problems related to power amplifier board.

6) Problem: Noticeable hum from plasma.

a) interface and/or users electronics

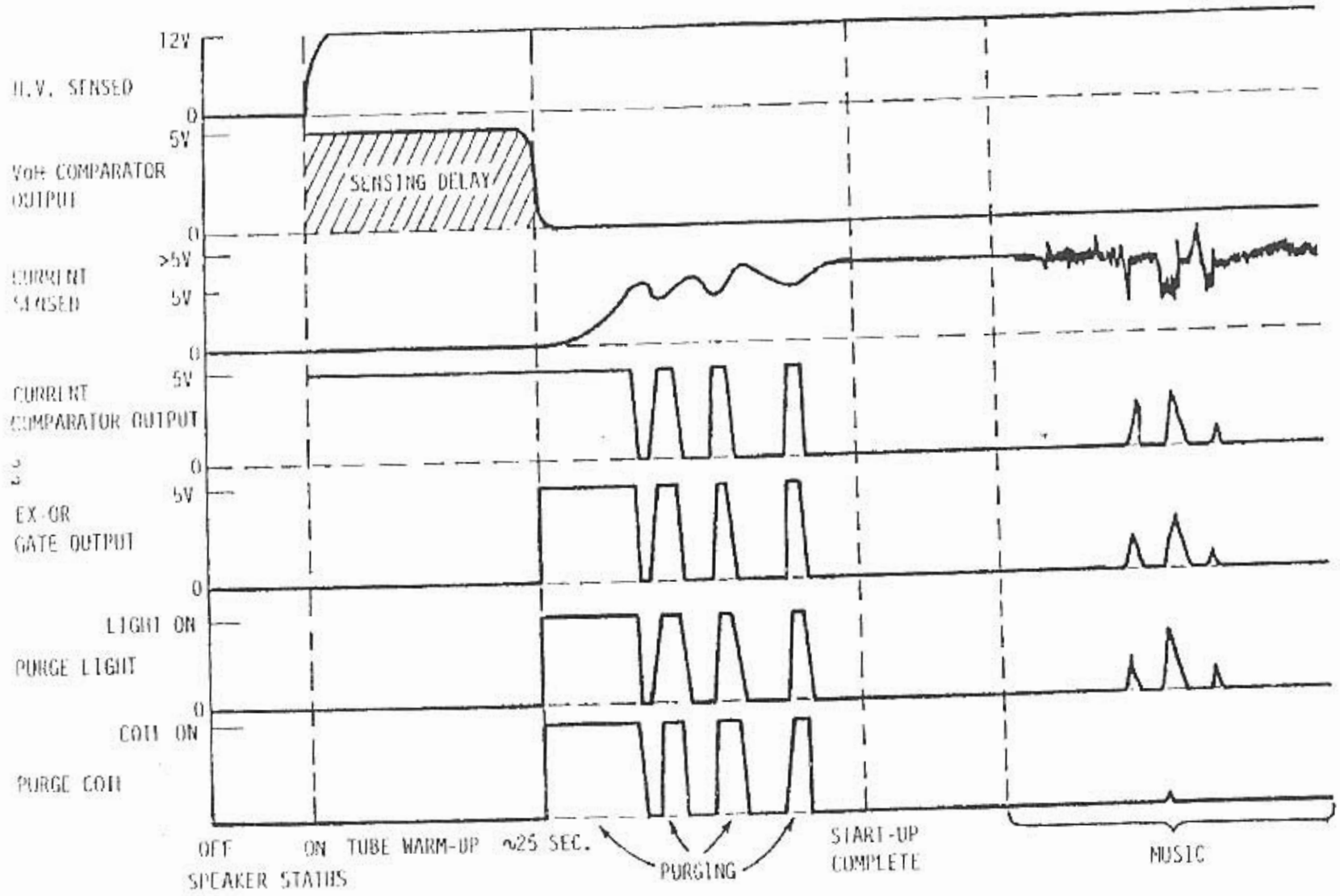
b) bad high voltage supply component

c) bad bias filter capacitors on P.A. board*

d) bad power transformer

D-2A GAS PURGE CIRCUITRY DESCRIPTION

In order to start the plasma, an additional burst of helium must be injected into the plasma chamber. To inject this extra purge gas, a solenoid is used to bypass the front panel flow control. A needle valve upstream from this solenoid controls the purge flow rate (see Figure 6-a). The purge process begins after a tube warm up period and ends when proper plasma voltage and current flow conditions are sensed. This process is accomplished as follows: After an initial delay of approximately 25 seconds a tiny fraction of the high voltage supply provided by a resistance divider is compared to a reference voltage. A second voltage measured across the 75 ohm, 8 watt resistor is proportional to the plasma current. This voltage is also compared to the reference voltage.if either sensed voltage is greater than or equal to the reference, the comparator will output a logical 0. The outputs of these comparators are fed to an Exclusive OR Gate. If either one of the comparator's outputs is logical 1, while the other is 0, then the exclusive OR Gate will output a logical 1 (purge). This output drives a transistor which drives a power transistor which, in turn, drives the purge solenoid and the "purge" indicator. Figure 8 shows the sequence of events from speaker turn-on to plasma stability. The top graph of Figure 8 shows the high voltage monitor



PURGING SEQUENCE
(TIME-RELATED TRUTH TABLE)

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signal. Next shown is the logical output of the voltage comparator. Note that for the first 25 seconds after turn-on, the comparator does not show that high voltage is present. This is because a delay device, which is part of the high voltage sensor, keeps the comparator from knowing that high voltage is present for this time period. After 25 seconds, the tubes should be sufficiently warmed up and can now be expected to draw current. The third graph from the top shows that the actual current drawn is slowly rising with tube warm up. At this time, the conditions are met for purging, i.e. the current comparator output is logical 1 from the beginning (fourth graph from the top, Figure 8) and the voltage comparator goes to a logical 0. The purge "command" can be seen at the Exclusive OR Gate output (fifth trace from the top, Figure 8) and is seen to follow the output of the current comparator. Whenever the current sensed crosses below the threshold set by the reference voltage (5 volts, third graph from the top, Figure 8) the system then purges. The system will purge intermittently until the tubes are stable (start-up complete) at which time it no longer affects the system. Please note on the graph that when music is playing very loud, the reference can be crossed very briefly- long enough to light the purge indicator but not long enough to open the purge coil. This is a normal and acceptable condition. The current sensor sums all five plasma currents, therefore one channel could read low current and it will not trigger a purge if the others are sufficiently high.

The manual purge button located on the front panel overrides the logic system and allows the operator to purge at will if need be to alleviate an instability (see instruction manual).

D23 GAS PURGE CIRCUITRY PROBLEMS AND SOLUTIONS

Malfunction of control circuits are most likely due to low line voltage. As mentioned earlier, proper transformer tap selection is important. Please check your line voltage and refer to Section E. If it is determined that the problem is due to some circuit on the control board itself, then the quickest solution (and the most satisfactory for the customer) is to simply replace the board as follows:

First, be sure that the speaker has been unplugged for at least ten minutes prior to taking the back screen off and, in addition, it is good practice to make sure the high voltage capacitors are totally discharged. Referring to Figures 5A & B, unplug the two 9 pin D connectors, the five high voltage connectors to the left, and the white 6 pin connector to the right on the control board. Next, on the right side of the board, remove the 4-40 screw and locknut leaving the "L" bracket in place on the chassis. On the left side of the board, remove this bracket from the chassis leaving it attached to its board. This will require that a proper size Hex wrench and nut wrench be used above and below the upper deck, respectively. The control board can now be removed. NOTE: always clean the pins and sockets with contact cleaner.

Below is a list of symptoms and causes which will help determine if control circuitry is at fault.

1) Problem: purge light on, will not strike.

   a) contaminated helium gas

   b) bias pots not adjusted correctly (see Owner's manual)

c) purge valve out of adjustment (see Section E)

d) main gas valve not open (see SectionD3)

e) "weak" tubes

f) blown fuses

2) Problem: purge light off, will not strike (even when manually purged).

a) blown 20 amp fuse on main transformer

b) bad connection to control board (9 pin)

c) transistor C11 shorted to heat sink C14 on control board

d) bad diodes (see control board picture with 6.3 rectifiers)

3) Problem: purge light works only when manually purged- strikes plasma.

a) bad connection- High voltage #3 (see Figure5A)

b) bad I.C.'s on control board

4) Problem: Buzzing solenoid coil (if buzzing is continuous, then on-off solenoid coil, if buzzing occurs with purge, then purge solenoid coil).

a) bad low voltage caps under top deck, right side

b) bad control board connection (9 pin)

D-3A GAS MECHANICAL SYSTEM DESCRIPTION

The plasma speaker with its gas system can be compared to an automobile. It has a gas tank, gas gauge with a low tank warning device, a valve which allows gas to flow, a device which can alter the gas mixture (carburetor) and a choke which enriches the mixture

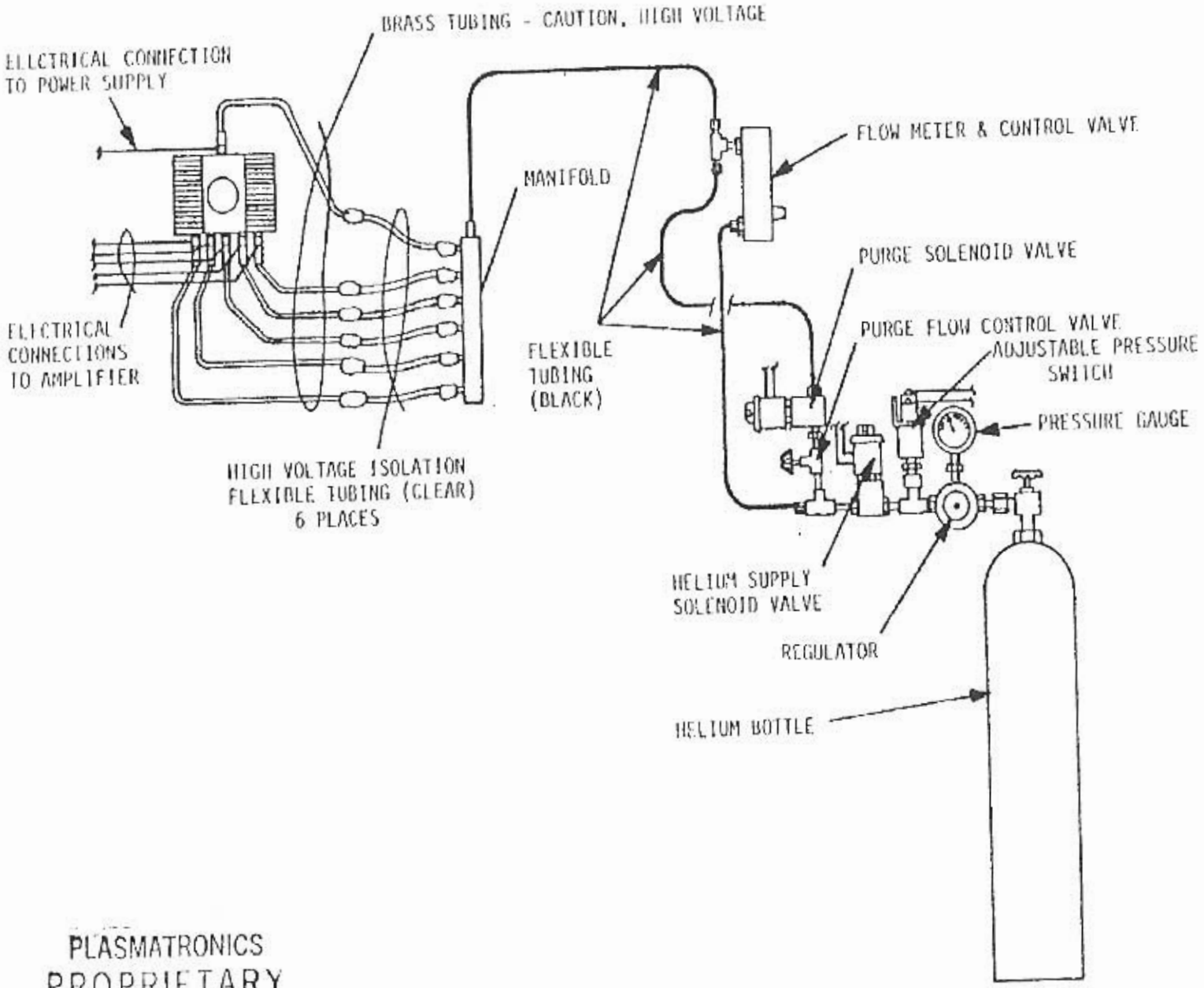


Figure 9 Gas Control System

for cold starts. Of course the difference is that the plasma does not actually burn any gas. Please refer to Figure 9. The gas tank contains pure helium at a pressure of approximately 2000 psi (pounds per square inch). Through the valve on top of this tank, gas is fed to the regulator which displays pressure inside the tank and reduces it from 2000 psi to about 50 psi (adjustable) at the outlet. Here the pressure is sensed by a pressure switch which overrides all systems and shuts the power off should the tank get low on gas. (This prevents the possibility of plasma electrode burn-up should the tank run out). The 50 psi gas is held back in this section of piping by the helium supply solenoid valve. When the speaker is on, this valve opens sending helium directly to the flow meter and control valve where the helium flow to the plasma chamber is controlled. If the purge valve is opened, gas may also flow through the purge flow valve and bypass the flowmeter altogether. The helium from both sources flows into the distribution manifold where it is diverted to the six hollow electrodes in the plasma chamber. Please note that the gas system, up to and including the distribution manifold, is safe to touch. However, the hollow metal electrode pipes should be avoided as they carry lethal voltages (see Figure 6B).

Warning! Please refer to remarks on safety considerations in Section B3 regarding high pressure gas.

Gas leakage can occur for different reasons with different symptoms as outlined in Part B of this section. This existance of a major leak may be quickly verified as follows: With the system turned off, open and then close the main tank valve

located on top of the helium gas bottle. This traps a small quantity of high pressure gas within the regulator assembly. An hour (or longer) after the valve has been closed, observe the regulator pressure gauge as you again open the tank valve. The pressure change should be barely detectable. (An acceptable leak rate under these conditions is 15 lb/hr when the helium tank is near full, i.e. pressurized to ≥2000 psi).

If these tests indicate a leak, it may be located by applying soapy water to all nearby connecting joints on the gas control assembly. Soap bubbles will indicate gas leakage. Be sure to check the connection from the regulator to the tank. Remember that failure to fully open tank valve when in use can cause a leak since this valve is designed to seal against an "O" ring seat in both fully open and fully closed positions.

Gas may be lost rapidly if the helium supply valve fails to close. This can be caused by small metal particles holding the rubber seat away from the gas exhaust cone inside the valve. Please read the valve maintenance instructions (see Appendix I) and be sure the valve parts are clean should a leak be evident.

D-3.2 OUTLINE OF POSSIBLE PROBLEMS AND CAUSES

1) Problem: leaks (gauge drops too fast when bottle valve is shut).

a) check tightness of regulator to bottle.

b) check all joints up to helium supply solenoid (use soapy water).

c) check helium supply solenoid for seal (see maintenance instructions).

2) Problem: uses too much gas (but gauge doesn't drop when tank alve is closed).

a) check flow

b) check tightness of all flex tube joints

c) check for tears in flex tubes

d) check tubing connections to distribution manifold

3) Problem: speaker turns on until purge, then oscillates on and ·ff continually.

a) pressure adjustment needed (see Section E)

b) pressure switch needs adjusting or is faulty (see Section E)

4) Problem: will not strike plasma, purge light on

a) see Section D2

b) contaminated gas: try switching tanks

D-4 PLASMA AMP BOARD

) Circuit Description: The removable P.A. board is located on the lower deck of the main chassis as shown in Figure 7. The components which occupy this board are encircled with a dotted line on the schematic of Figure 3 and are comprised of a negative bias supply, a positive screen grid supply, and five parallel vacuum tube output stages which control and modulate plasma currents. These are single ended Class A amplifiers for which the plasma forms direct loads. Thus, the waste energy normally associated with Class A operation is now harnessed to maintain the plasma. There is associated with each stage a bias control, an over current sensor and a fuse, respectively, all located on the front panel.

Another amplifier component which is not located on the P.A. board is a 10 watt, 75 ohm cathode resistor common to all five tubes.

This is located on the control board since it also provides a plasma current reference to the purge control circuits.

The overcurrent neon lamps sense voltages developed across a 10 watt, 1.75 Kohm resistor in the plate circuit of each output stage, respectively. These resistors are located on the underside of the P.A. board. In the event that the screen grid of a driver tube becomes shorted to the plate, this resistor and/or the 100 watt power resistor on top of the P.A. board may become damaged (see listings below). This is the only likely interactive, multiple failure type problem since all others should be protected against by the front panel fuses.

Slight flickering of the neon lamps <u>during</u> reproduction of high level sound is simply an artifact of the circuitry and not a sign of malfunction or clipping. These neon lamps should be recognized as overcurrent indicators only during periods of low (or no) audio reproduction.

As with the control board, problems with the P.A. board are best remedied by replacement of the whole board.
First, make sure that the speaker is unplugged and has been for at least ten minutes! Next, remove the large back screen from the speaker cabinet and the small back screen from the chassis revealing the P.A. board as shown in Figure 7A. After making sure the high voltage capacitors are totally discharged, remove the four 6-32 slot head screws from the four corners of the board. Referring to Figure 7B, grasp the board edges as shown and carefully rock the board from side to side until it becomes free. At this point, just one end may become

free, in which case the pins under the board are in danger of being bent and damaged. Please be sure that the board comes away from the socket as level as possible! Once the board is free, rotate it 90° clockwise and bring it carefully out of the chassis (see Figure 7). Note: always clean pins and sockets with a suitable contact cleaner whenever installing a new board to insure that no contact related problems will arise.

(B) Problems and Solutions:

The following problems and causes will aid in determining what could be wrong with the plasma amplifier related circuits.

1) Problem: one or more channels drift up and down and must be rebiased often.

a) bad 1.75 Kohm resistor and/or 25 Kohm, 100 watt resistor could be caused by or have damaged a tube in that channel.

2) Problem: current meters all drift high.

a) blown 0.2 amp fuse on power transformer

3) Problem: one current meter drifts high.

a) bad 100 Kohm, ½ watt suppressor resistor in bias circuit on P.A. board

b) bad tube

4) Problem: no current reading on any meter.

a) see Sections D1, D2.

5) Problem: no current reading on one meter.

a) bias adjustment needed

b) bad 2.25 Kohm, 5 watt resistor on P.A. Board.

c) bad tube

d) blown 1/16 amp fuse

e) bad connection- check sockets and pins

f) one electrode clogged

g) requires manual purge

6) Problem: no current on one meter- over current light on.

a) bad 1.75, 5 watt resistor

b) bad tube

BASS SYSTEM

In the unlikely event that the bass system malfunctions, the owing will be useful in diagnosing and remedying any problems.

1) Should it be necessary to replace one of the drivers, se be aware that the 6½" driver enclosure has a specially cted and positioned rock inside of it. This rock is not to be urbed as its position is rather critical to speaker preformance. , please take care that the round gasket which provides an ight seal is properly installed. If the seal is adequate, the driver will take about 6 to 7 seconds to recover from being pushed ll the way. The 6½" should take 3-4 seconds with the same test. ight prove necessary to use caulk in order to restore the ssary seal.

2) Driver polarity test: If it is necessary to replace a driver, following test will insure phasing is correct: With the front le removed, apply the minus side of a 6 volt battery to terminal A2 the plus side to the terminal C2 which are located on the speaker . The 14" driver should push outward. Now, connect the battery

plus side to D2 and the 6½" driver should push inward. These conditions indicate correct driver polarity.

3) Crossover Diagnoses: In order to determine if the crossover is functioning properly, remove all jumpers from the back of the cabinet; then using an ohm meter, compare resistance measurements between all possible terminals with the values indicated in the table of Figure 10. Many readings will be infinite, others will be about 2 ohms while still others, marked "C" for capacitive reading, will first register about 10,000 ohms and slowly rise to about 100,000 ohms as capacitors get charged by the ohm meter. In the unlikely event a reading does not agree with the table, please consult the factory and provide us with deviation information and we will advise how to proceed.

4) High Frequency Terminator: Some high quality amplifiers may oscillate unless their speaker cables are properly terminated. The Hill Type 1 has a built-in terminator which is designed to match our cables (although it will function satisfactorily with nearly all cables). The terminator is located inside the cabinet just behind the jumper terminals and consists of a 27 ohm resistor in series with a 1 mfd capacitor.

Loss of either component in this circuit could allow the power amplifier to oscillate at very high frequencies. These are inaudible but will fully load the amplifier, which will probably blow its fuses. But take note that other causes may product similar effects, such as incompatible hook-up of bridged amplifiers and certain ungrounded Audio Research amplifiers. These may be used following the modified hook-up described in the Owner's Manual.

	A1	A2	B1	B2	C1	C2	D1	D2
A1	-	∞	∞	∞	∞	∞	∞	∞
A2		-	∞	C	C	∞	2	∞
B1			-	∞	∞	∞	∞	∞
B2				-	2	∞	C	∞
C1					-	∞	C	∞
C2						-	∞	∞
D1							-	∞
D2								-

Figure 10 Passive Crossover Resistance Checks

Both crossover and terminator repair requires entry through the woofer port and removal of stuffing. We recommend that you double check with us before committing to such procedures as these failures are extremely unlikely.

D-6 MISCELLANEOUS

(A) The Front Panel Indicators:

There are two types of lighted indicators on the front panel: 1) five over current neon bulbs and 2) three incandescent bulbs of different voltage ratings. When replacing the neon indicators, be aware that they are at high potential with respect to ground and therefore are well insulated from the panel. Silicone rubber sealant and a small piece of mylar was used at the factory for isolation. When replacing these bulbs, be sure to restore similar insulation. To replace an incandescent bulb, simply pull out the lens housing which contains the bulb and putting a new bulb in its place. Make sure the correct bulb is used, since each requires a different voltage specifically: 28 volts= low tank bulb; 6 volts= purge bulb; 14 volts= power on bulb.

(B) Safety Systems:

1) Grounding the Front Screen: The front screen if left ungrounded, will charge electrostatically and then arc to the chassis making a small clicking sound. To prevent this, the screen has a small copper strip which touches the chassis electrically and continually drains the charge from the screen. This screen also helps protect children should they poke metal objects through the

screen into the plasma. Please be certain that these metal surfaces are kept clean and make good contact.

2) Fan: The fan is powered through a voltage dropping resistor by one of the 130 volt secondary windings on the transformer. This fan is very important to the operation of the speaker. Should it stop blowing, turn the speaker off immediately and remedy the situation.

SECTION E. BASIC INTERNAL ADJUSTMENTS

The adjustments covered in this section have been made at the factory prior to shipment; however, due to changing circumstances such as local atmospheric pressure, line voltage, or room acoustics, the distributor may find it desirable to recalibrate in the field. These fall into two categories: 1) gas pressure and line voltage adjustments made inside the main speaker units and 2) signal measurement calibrations made inside the interface unit.

E-1 PURGE FLOW ADJUSTMENT

The purge flow adjustment is located on the gas manifold as shown in Figure 6A. It is very sensitive and alsovulnerable to disturbance during installation. If the plasma will not strike during start-up as described in the owners manual, it may be necessary to open this valve slightly to get the unit started. Once start-up is accomplished, fine adjustments should be made as follows:

1) Defeat the power interlock switch so that the adjustment may be accessed while running. WARNING: This adjustment can be made without having to get dangerously near to hot electrical connections, but be very familiar with locations of the hazardous areas, making sure to avoid them. Note carefully the proximity of power transformer connections to the purge control shown on Figure 6A before proceeding.

2) Be sure helium tank pressure does not read nearly empty, as this condition will affect the purge adjustment validity.

3) Start-up unit as usual, increasing purge adjustment slightly if units will not start.

4) After automatic purge shuts off, make sure front panel flow meter adjustment is proper as described in the owner's manual.

5) While plasma unit is operating, have an assistant continuously depress the manual purge button located on the front panel while he watches the plasma.

6) While panel purge button is pressed, start from closed (counterclockwise) position and slowly open the purge valve so that five independent, purple plasma jets are visible. If plasma is not entirely purple, the purge valve is too closed, and when the plasma becomes turbulent and makes an audible rushing sound, the purge valve is too open. Some care is needed to achieve a critical balance between these two extreme conditions. You will not have opened the valve very far to reach this condition.

Upon releasing the front panel purge button, the plasma should change from five separate, stable purple plumes back into the normal diffuse, solid yellow triangle with purple areas near each electrode, as sketched in the owners manual.

E-2 PRESSURE REGULATOR ADJUSTMENTS

The pressure regulator requires adjustment when the speaker power and low tank lights alternately flash on and off. The time period for this low tank shut-off instability can range from seconds to minutes and can occur when local barometric pressure differs largely from conditions in Albuquerque, New Mexico where

the initial adjustment is made. To correct this, use a suitable hex (Allen) wrench which fits inside the socket on the regulator (see Figure 6A). Turn this socket clockwise in 1/8 turn increments until instability stops and unit stays on. Then open an additional ½ turn clockwise. The rear cover must be removed and power interlock defeated to make the adjustment while the unit is operating so please observe all general warnings. In the unlikely case regulator adjustment does not correct this problem, there is one further related adjustment found on the low pressure switch, as indicated in Figure 6A. This adjustment is made with a standard ½" wrench. Please check with factory personnel if you think this adjustment is needed! Note that over-adjustment of either regulator or pressure switch will cause premature low tank shut down, thus slightly diminishing the listening time per helium tank.

E-3 CHANGING TRANSFORMER TAPS

Certain areas have slight differences in line voltage which, if great enough, can cause the speaker to malfunction. To insure that this does not happen and in order to optimize performance, the power transformer has three separate voltage taps. Refer to Figure 11 and wire the jumpers as shown to correspond to operation within the nearest voltage range indicated on the table.

E-4 INTERFACE HIGH-LOW BALANCE AND VU METER CALIBRATION

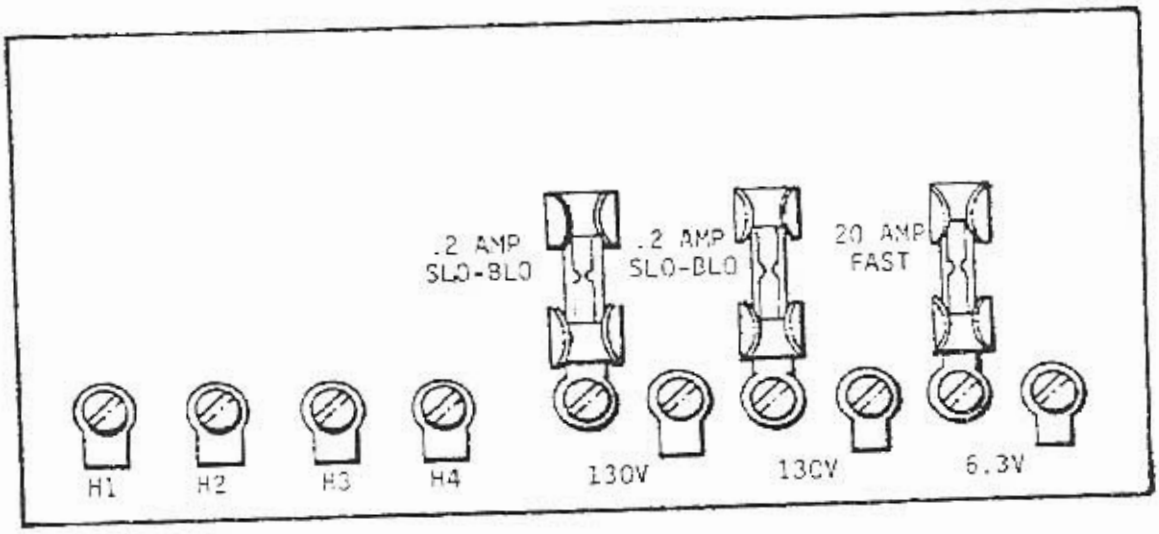
Preliminary set-up

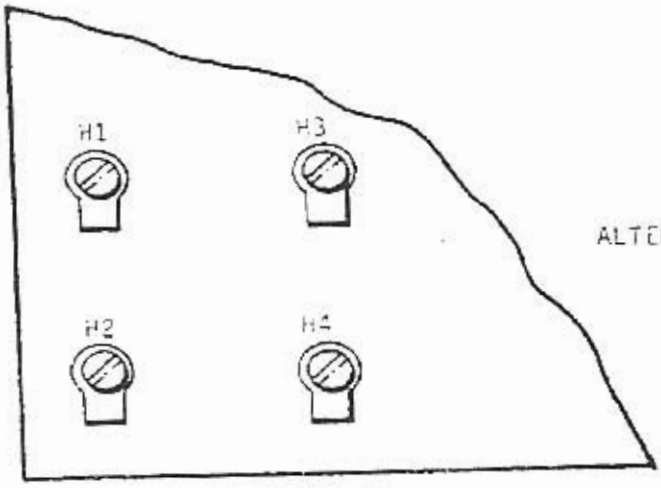
The following calibration requires:

1) a spectrum analyser with instrumentation quality microphone,

2) an unweighted VU meter,

Figure 11 Line Voltage Correction Jumper Connections





ALTERNATE CONNECTION ARRANGEMENT

NOM. LINE VOLTAGE	CONNECTIONS
220 V	H1 & H2
230 V	H1 & H3
240 V	H1 & H4

3) a 4 KC sine wave generator.

4) a pink noise generator.

The IVIE IE30 system with the above peripherals makes an ideal set-up for these tests.

Both balance and meter calibration require that the test microphone be optimally positioned in front of the plasma speaker corresponding to the interface channel being dealt with. Ideally, this testing would be conducted within the intended listening room, although a large room where speakers are located away from walls may be used. Let us assume that the right channel is being calibrated first. Place the microphone in the vertical plane of the plasma and midrange drivers on horizontal axis with these drivers and 76 cm (30 inches) away from front grille. The microphone should be centered vertically between plasma and midrange drivers which places it just below upper lip of wooden border surrounding the low frequency section. This microphone position is approximately 1 meter from the plasma driver and positioned nearly correctly for hi-low balance measurements as well. At this point both LED and hi-low balance calibration should proceed for the miked channel only.

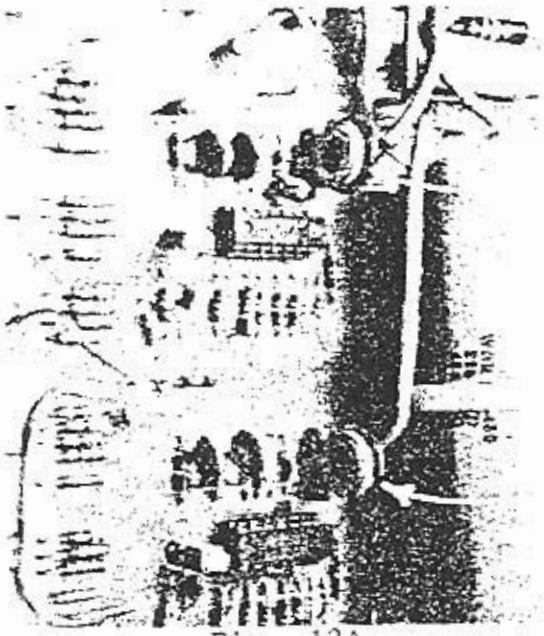
VU Meter Calibration

Remove interface top and locate the left and right VU trim pots by referring to the photographs, Figure 12 A.

WARNING: You need not fear getting shocked by touching connections adjacent to any trim pot during operation, but please carefully avoid contacting other areas, particularly the vacuum tube section which contains 400 volt potentials and the terminal strip at the back where AC wiring is exposed.

Figure 12
INTERFACE CALIBRATION POTS

LED Meter Calibration



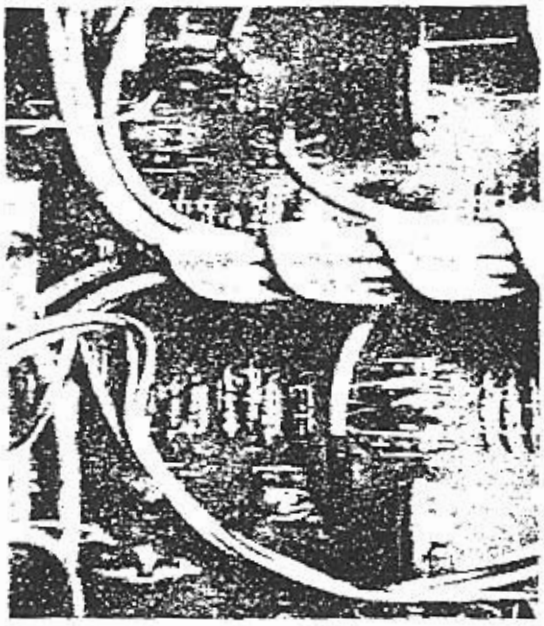
Left v.u. Pot

Right v.u. Pot

Fig. 12A

Hi-low Balance Calibration

L.T.L. Pot



L.T.H. Pot

R.T.L. Pot

R.T.H. Pot

Fig. 12B

Set both plasma level controls on the interface panel approximately midway and the selector switch to "operate". Next, with the entire system including the base amplifier operating, connect a 4 Kiertz sine wave source into the input of the interface channel being tested and raise its level until 90 DB SPL sound output is measured by the microphone, positioned as described above. Next, make fine adjustments to the position of the microphone by moving it all directions, but not more than 5 cm in any direction from its original position to achieve the position of maximum measured DB SPL. Now readjust strength of the sine wave source until once again until exactly 90 DB SPL is measured by the microphone.

At this point, referring to Figure 12 A, set the VU trim pot corresponding to the channel being tested so that the LED VU meter on the front panel reads 90 DB. That meter is now calibrated and you may proceed with high-low balance for the same channel.

Hi-Low Balance

Start with system set-up exactly as it is after proceeding with the above described VU meter calibration. Substitute the pink noise generator for the 4Kiertz oscillator used previously to drive the system. Increase pink noise input until about 90DB SPL output (now indicated correctly by the LED meter) is reached.

Without changing its position, hook the microphone to an octave based spectrum analyzer*. Next, with the selector switch in normal position, adjust the right balance control on the front panel so that low and high frequency ranges are balanced as best

* Note: alternately, white noise may be used with a linear-based spectrum analyzer, as may a linear swept, syncronized oscillator. In the latter case, however, allowance for room modes must be made.

possible. Now, make repositioning fine adjustments to the microphone and alternately fine tune the balance control until the flattest possible spectrum is indicated. Having achieved actual balance, the trim pots may now be adusted to indicate that this balance setting is correct. To do this, set the calibrate selector switch to produce an audible dual tone over the right speaker. Locate the trim pots marked R.T.L. (right test low) and R.T.H. (right test high) on Figure 12 B. These trimpots control respective LED balance indicators located on the front panel. Starting from approximately the mid-position of both trim pots, adjust them both, so that the low and high red balance LED indicators are making a transition between on and off; that is, both are half lit. The two pots interact so alternate readjustments may be necessary.

This completes calibration of the right channel VU meter and high-low balance.

Now reposition the microphone in front of the left speaker and repeat the entire process for that channel. The corresponding left side trim pots are positioned as indicated in Figure 12 A and Figure 12 B where they are labled as left VU pot, LTL (left test lower) and LTH (left test higher), respectively.

APPENDIX I, Figure 1

MAINTENANCE INSTRUCTIONS

2-WAY DIRECT ACTING SOLENOID VALVES NORMALLY CLOSED OPERATION — 1/4 N.P.T.

SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the hand only for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power supply and depressurize valve before making repairs. It is not necessary to remove the valve from the pipe line for repairs.

CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary depending upon media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean valve strainer or filter when cleaning solenoid valve.

PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign materials as possible.
2. While in service, operate the valve at least once a month to insure proper opening and closing.
3. Periodic inspection depending on media and service conditions of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

IMPROPER OPERATION

1. **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A magnetic click signifies the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or burned out fuses, open-circuited or grounded coil, broken lead wires or splice connections.
2. **Burned Out Coil:** Check for open-circuited coil. Replace coil if necessary.
3. **Low Voltage:** Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
4. **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
5. **Excessive Leakage:** Disassemble valve and clean all parts. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

COIL REPLACEMENT

Turn off electrical power supply and disconnect coil lead wires. Refer to watt rating stamped on nameplate for identification of solenoid construction. When you have determined the watt rating of solenoid, select the correct paragraph below.

FIGURE 3 SHOWS A SOLENOID WITH A WATT RATING OF 6 A-C, 9 D-C OR 9 A-C.

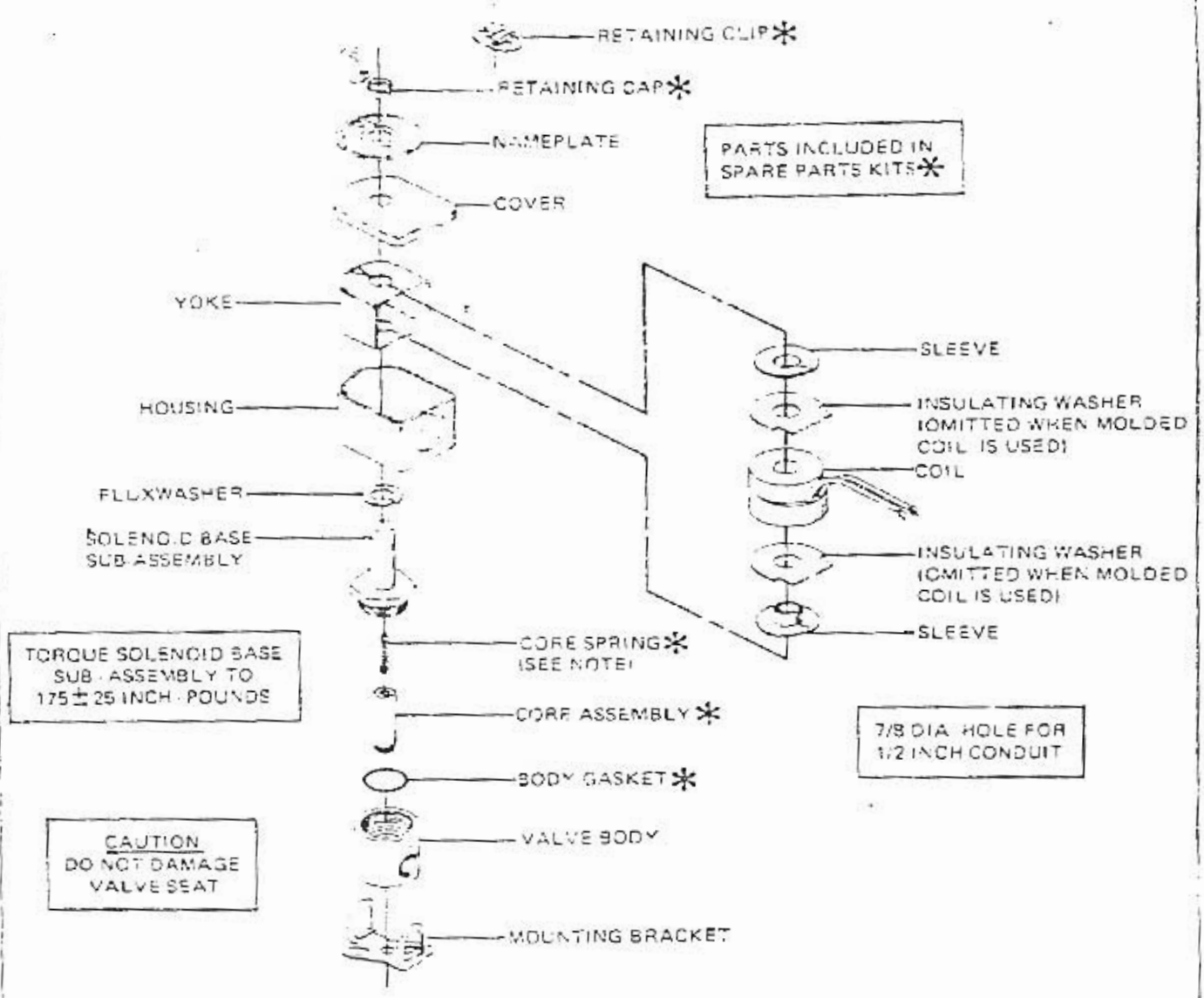
1. Remove retaining clip or slip, nameplate and cover. CAUTION: When metal retaining clip disengages, it will spring upward.
2. Slip the yoke containing a coil, sleeves and insulating washers off the the solenoid base subassembly. Insulating washers are omitted when a molded coil is used.
3. Slip coil, sleeves and insulating washers from yoke.
4. Reassemble in reverse order of disassembly, paying careful attention to exploded view provided for identification and placement of parts.

VALVE DISASSEMBLY AND REASSEMBLY

Depressurize valve and turn off electrical power supply. For valves with a watt rating of 6 A-C, 9 D-C or 9 A-C, refer to Figure 3. For valves with a watt rating of 10.5 A-C, 11.2 D-C or 16.7 A-C, refer to Figure 4. Proceed in the following manner:

1. Remove retaining clip or cap and slip the entire solenoid enclosure off the solenoid base subassembly. CAUTION: When metal retaining clip disengages, it will spring upward.
2. Unscrew solenoid base subassembly and remove core assembly, core spring and body gasket.
3. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.
4. Reassemble in reverse order of disassembly, paying careful attention to exploded views provided for identification and placement of parts.
5. Replace body gasket, core assembly, core spring and solenoid base sub assembly. Torque solenoid base subassembly to 175 ± 25 inch-pounds.
6. After maintenance, operate the valve a few times to be sure of proper operation.

APPENDIX I Figure 2



NOTE: A-C (ALTERNATING CURRENT) CONSTRUCTION SHOWN. FOR A-C CONSTRUCTION, EITHER END OF THE SPRING MAY BE INSTALLED INTO TOP OF CORE ASSEMBLY. FOR D-C (DIRECT CURRENT) CONSTRUCTION, INSTALL WIDE END OF CORE SPRING IN CORE ASSEMBLY FIRST; CLOSED END OF CORE SPRING PROTRUDES FROM TOP OF CORE ASSEMBLY.

Figure 3

Bulletin 8262 10 A-C, 9.7 D-C Or 9 Watts A-C
General Purpose Solenoid Enclosure Shown
For Explosion-Proof, Watertight Solenoid Enclosure, See Form No. V-5391