

4.2.6 Auto Regulator Panel - E-000-2943 - Attached to this panel is the Automatic Regulator - D-000-077. The purpose of the auto-regulator circuit is to provide a high gain as part of the regulation loop. Built into the chassis is a variable reference voltage, which is compared with a signal derived from the high voltage divider board current, through a sensing resistor. The error is amplified and transmitted to the innerloop amplifier. Thus, the auto-regulator part of the servo loop continuously, and dynamically, regulates the accelerator over its full range of specified voltages. It also provides a manual control of the accelerator voltage. The auto-regulator circuit may be broken down into five sections to simplify the operational description. These five sections are:

4.2.6.1 Reference Voltage: This is obtained from PS-1, a 150 volt regulated power supply. The output of PS-1 is further regulated by a 5651 voltage regulator tube VT1. R1 limits the conduction current thru VT1, and R2 is a fine adjustment for the reference voltage obtainable across R3. This 50K 10 turn helipot has a .1% linearity for precise control. SW1 is a polarity reversing switch to allow using the same reference voltage for both electron or positive ion operation.

The high voltage divider current flowing into J2 and R12, and out of J3, to ground, develops a voltage across R12 equal in amplitude, and opposite in polarity, to the reference voltage set between the wiper R3 and J2.

Since the reference unit is highly stable, any error in input to Amp-1 would have to be caused by a change of divider current.

4.2.6.2 Amp-1- This is a chopper-stabilized amplifier with a gain of 10^7 . This amplifier is used as an integrating amplifier, and because of the finite impedance of C1 and/or C2, the actual operating gain is about 10^4 . Being the highest gain element with the slowest frequency response in the entire operating loop, Amp-1 is the primary element of regulation for the Dynamitron. (The frequency response of Amp-1 is set by the time constant of R5 and C1 or C2). The reason for two time constants is that, below 1.5 MV terminal potential, the rectifier tubes on the stack are not at full brilliance (filament temperature), thus, the time constant is a direct function of the thermal response of the rectifier filaments. In order to keep the regulation loop stable, C1 and R5 provides a slower time constant than the rectifier thermal response. Above 1.2MV terminal potential, the rectifiers are at full brilliance and the terminal response is much faster allowing the entire regulation loop to be operated at a faster time constant. This is accomplished by inserting C2 in series with C1, essentially increasing the response by 10X. The output of Amp-1 becomes the input of Amp-2.

4.2.6.3 Amp-2- In conjunction with SW2, is primarily a polarity reversing circuit for either electron or positive ion operation. R15, 16, 17, and 18 is a balance circuit to initially set zero output of Amp-2 with zero input. R7 and R8 is a gain variable from unity to 11X, if needed, for a high accuracy of regulation. Note: Care must be taken so as not to increase this gain beyond a stable loop condition. Z1 and Z2 are protective diodes to insure Amp-2 does not reach a saturation condition during operation. R30 is a Hum Buck control which minimizes 60Hz ripple on the output of Amp-2.

4.2.6.4 Cable Driver (VT-3) The function of VT-3 is to provide a low impedance output, capable of driving a transmission line of up to 200 feet in length. Assuming 30 pF per foot of coax cable, the transmission line would offer a capacitive load of 6000 pF to Amp-2. This would be beyond the maximum tolerable capacitive load and would cause Amp-2 to become unstable. Z3 provides a 100 volt differential, which is necessary because the input to the inner loop amplifier (out of J6) must be from 0 to -200 volts. The output of Amp-2 is +100 volts to -100 volts.

R31, 32, and C11 comprise a transient suppressor for the arc suppressor which is connected to J5.

VT3 is used as a cable driver for either manual or automatic control, by means of the transfer relay K20, whose control is on the front panel.

4.2.6.5 Balance of Null Circuit - In order to insure that control transfer from automatic to manual, or vice-versa is done without large excursions of terminal potential, VT2 provides both, a meter circuit between the automatic and manual control voltage so the operator can see when they are equal, and a relay circuit, between both controls, insuring that K20 cannot be actuated if there is too great a difference.

4.2.7. Elapsed Time Meter Panel - D-000-2472-2

This panel contains three elapsed time meters and one oscillator tube filament voltage meter. The elapsed time meters are:

- 1.) " Oscillator Tube Filament Hours " , actuated by the " Filament On switch. "
- 2.) " High Voltage Rectifier Hours " , actuated the High Voltage On switch.
- 3.) " Beam Tube Filament Hours " which is actuated by the " Arc " drive when it is above the lower limit.