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TECHNICAL REPORT

"HIGH-REPETITION-RATE PARTICLE INJECTOR FOR ELECTROSTATIC ACCELERATOR

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HIGH-REPETITION-RATE PARTICLE INJECTOR FOR ELECTROSTATIC ACCELERATOR

Certain classes of experiments conducted on the TRW two-million-volt accelerator, particularly those intended to simulate long-term micrometeoroid bombardment, require a large number of particle impacts. An automatic particle-injection system capable of satisfying this requirement has been developed and is currently in use on the accelerator.

The charged-particle injector requires the application of a large negative voltage pulse in order to inject particles into the accelerator. In the original system the pulse was initiated by the manual closure of a switch, which discharged a capacitor through a pulse-forming network. The pulse from the network was fed to the grid of the high-voltage pulse tube. The operation of the switch and voltage adjustments were accomplished from the operator's console by means of solenoid-driven control rods that are an integral part of the Van de Graaff accelerator. This manual mode has been incorporated into the new system.

In the automatic system an electronic subassembly generates triggering pulses at a predetermined rate. The automatic pulsing system contains two major units, one located within the Van de Graaff console and the other in the high-voltage terminal. The pulse rate control and indicating unit shown in Fig. 1 is located within the Van de Graaff console. Indicator lamps on the control panel show the position of the console stepping switch, which corresponds to the position of a stepping switch within the terminal. The time delay insures that the solenoid is actuated long enough to allow the terminal stepping switch to step and to prevent the stepping motor from being on more than 2 seconds to prevent overheating.

Pushing the pulse-control button advances the pulse-rate

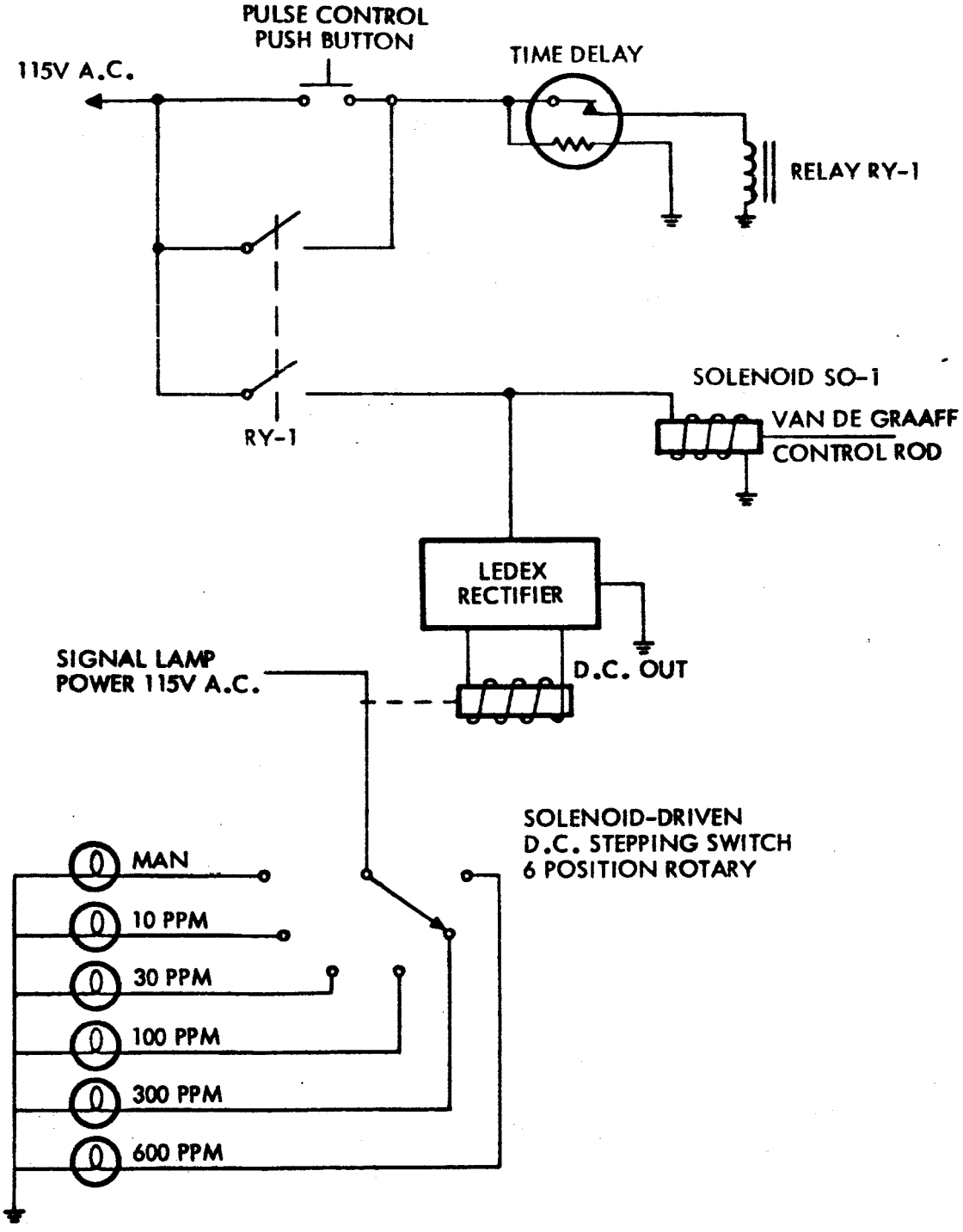

Fig. 1 Schematic of Automatic Pulse Control and Indicating Unit

switch to the next step. The sequence operates in one direction only, from manual to the slowest automatic pulse rate (10 pulses/min) and on through progressively faster rates, returning to manual one step after the fastest pulse rate (600 pulses/min).

The function of the unit located within the Van de Graaff high voltage terminal (Fig. 2) is to provide the proper pulsed and d-c voltages to the particle injector for both manual and automatic operation. A multivibrator (labeled V-1 in Fig. 2) generates the pulses employed in the automatic mode. Pulse rates are selected by changing the multivibrator coupling capacitors. Switching of the capacitors is accomplished by S-1, a solenoid-driven stepping switch. The switch is stepped by closing micro-switch S-501 by operation of a Van de Graaff control rod (as indicated in Fig. 1).

Trigger pulses for manual operation are produced by a pulse-forming network consisting of R-6, C-11, and R-8. With the manual injection switch S-503 open, C-11 charges through R-6 to 300 volts. Closing the switch discharges C-11 through R-8, producing a trigger pulse. C-12 and R-7 suppress arcing at the switch.

The trigger pulses produced by either V-1 or by the pulse-forming network are coupled to a univibrator V-2. The output pulse from this tube is 75 volts in amplitude and about 10 msec in duration, the length of the pulse being adjustable over a limited range by R-14. The pulse from V-2 is fed to the grid of V-3, which is normally cut off but conducts for the duration of the pulse, producing a voltage drop across R-20. The magnitude of the voltage pulse is determined by the voltage divider consisting of R-16 and R-17. R-16 is a potentiometer that is adjusted by a selsyn-driven control rod from the operator's console. The high-voltage pulse obtained at the plate of V-3 is applied to the particle injector.

The number of particles injected per pulse is a function of pulse amplitude and duration, which are normally adjusted so that

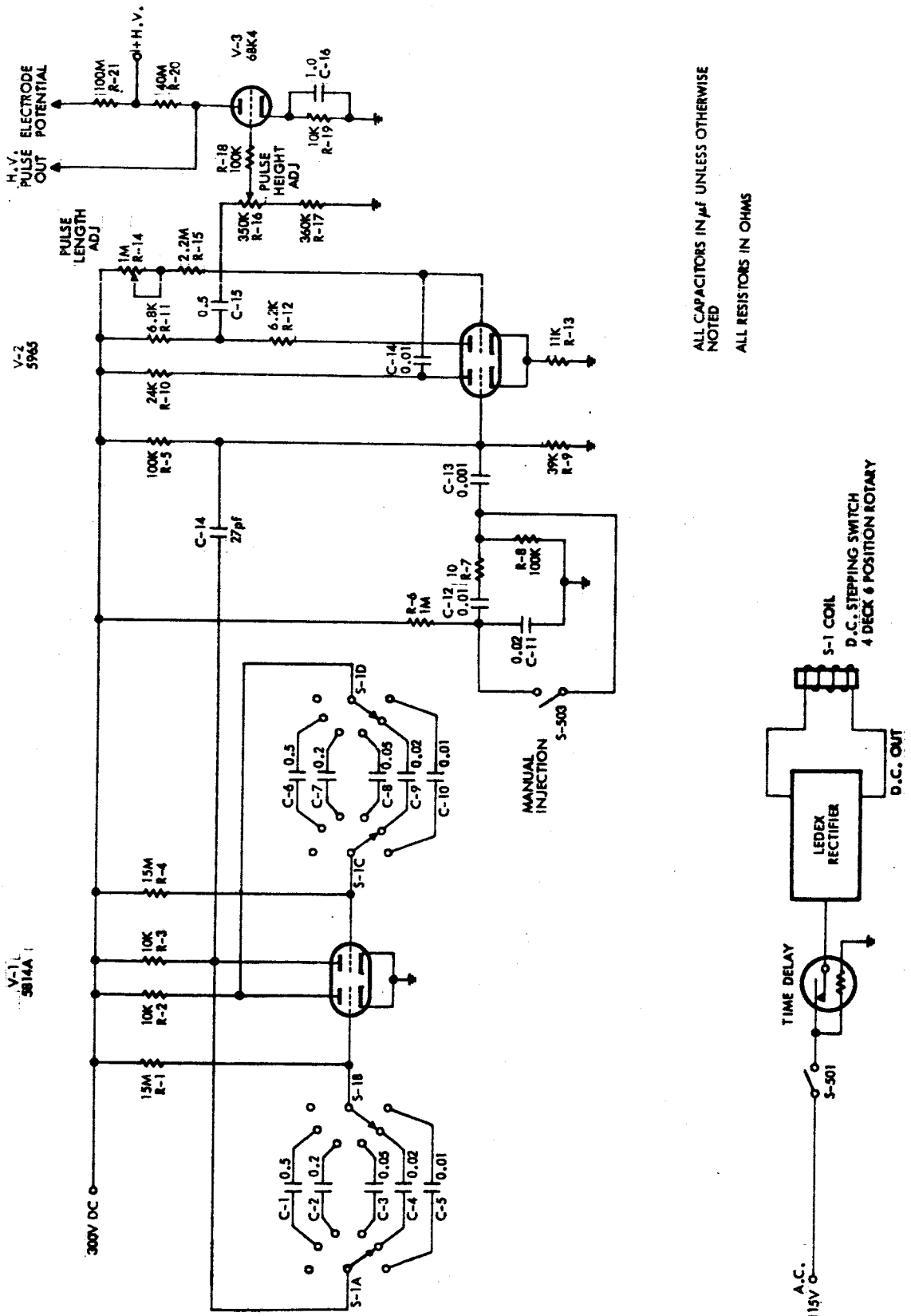

Fig. 2 Schematic of Automatic Pulser Unit within Van de Graaff Termi[illegible]

the average rate is about one particle per pulse. The injector has been operated under these conditions at the rate of 10 particles per second for periods of over 100 hours with no noticeable deterioration in performance.

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