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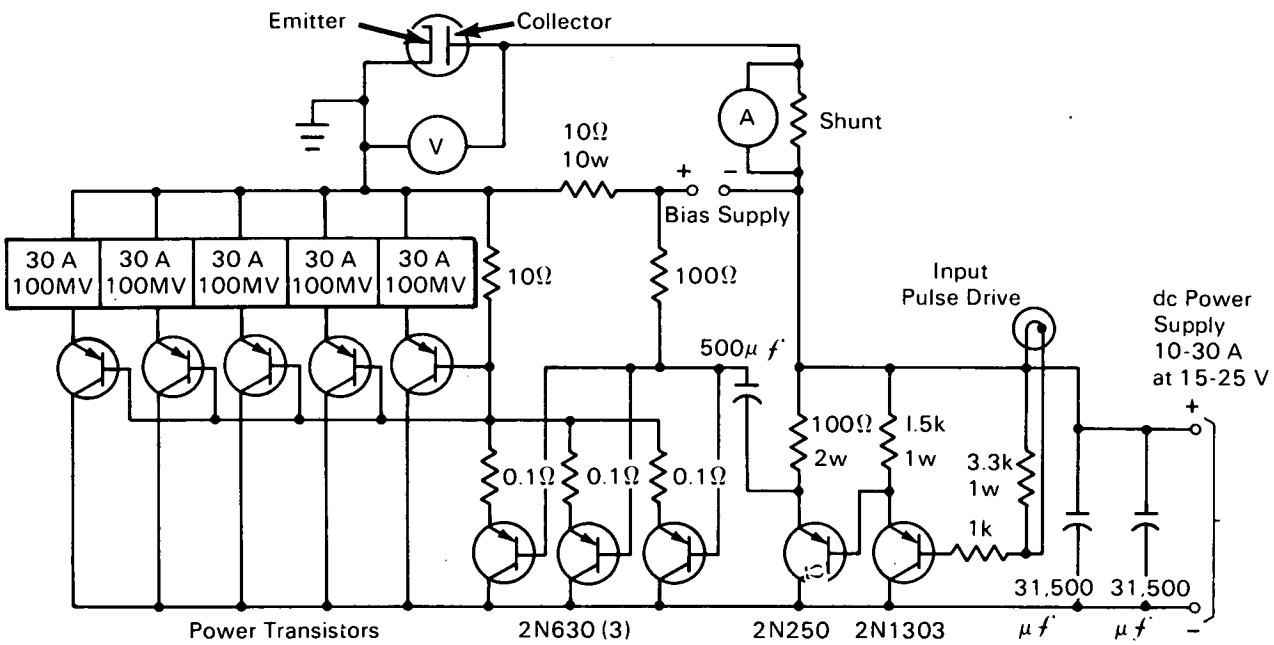
NASA TECH BRIEF

Load Cell for Thermionic Converter Tests



A variable energy heat sink that can control and absorb large currents at low voltages is required in thermionic converter tests. Several types of variable loads have been developed for this purpose including variable resistances, transformers, and electronic load cells. The advantage of an electronically controlled load cell is the ease with which the steady state operating point can be set (the starting point for a voltage and current excursion) and in the simplicity with which the range of loading can be controlled. However, some electronic loads exhibit undesirable instabilities when connected to the highly nonlinear characteristics of thermionic converters. Also, the electronic loads often require large auxiliary power sources so that the converter can be driven into the positive bias condition.

A stable, low duty cycle transistorized emitter follower load cell that has evolved from those used in converter testing is shown in the figure. Auxiliary power source requirements have been reduced through the use of energy storage in capacitors. The low duty cycle pulse mode of operation reduces the average power handling requirement of all components, alleviating to a large extent the drifting and instability problems caused by thermal effects in components.

A negatively-going pulse is required to drive the load cell. The early stages of amplification reduce the power requirement of the driver (the input shown

(continued overleaf)

lightly loads a wave generator whose specifications are 15 volts into 600 ohms). This stage is coupled to the main output stages through the 500 μfd capacitor to guard against bias changes and hence base width clipping under heavy current loads.

The degenerative coupling of the paralleled transistors provides load balancing, stability, and wave shaping. At high currents, the rate of change of current and the magnitude of the voltage excursion are both reduced, a desirable feature in these kinds of tests. The output voltage swing referenced to the emitter is a positively-going pulse rising off the dc level of the bias voltage. The amplitude of the pulse is easily controlled by the amplitude of the input drive.

The duty cycle in this application is dictated by the thermal inertia characteristics of the thermionic converter and is about 1 to 5 percent. The main bank of power transistors can easily pass a triangular current pulse of over 300 amperes peak with a base width of 2 to 3 milliseconds. The nonlinear characteristics of thermionic converter loads permit larger base widths at this current level. The energy in the current pulse can be increased by increasing the size of the energy storage capacitors.

Notes:

1. Although specifically designed for thermionic converter testing, the load cell adapts to other similar high-current, low-voltage uses.
2. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   Lewis Research Center
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   Reference: B70-10470

Patent status:

No patent action is contemplated by NASA.

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