I. INTRODUCTION

Ballistic Piston Compressor

The Naval Surface Weapons Center (formerly the Naval Ordnance Laboratory) Ballistic Piston Compressor, ERCA III, is a laboratory device that produces a hot, dense gas sample with a characteristic linear dimension of 5 cm at temperatures of the order of 5,000 K and pressure of 1,000 atm. These conditions persist for intervals of roughly 500 μs during which spectroscopic observations are made and pressure, temperature, volume and density measurements are recorded as functions of time. The device has most recently been used for spectral line broadening measurements and for studies of equations of state for gases subjected to these extreme conditions.

Figure 1 shows a schematic diagram of the principal components of ERCA III. The configuration is similar to a conventional shock tube. The distinguishing feature is the use of a heavy, tight-fitting, metal piston that is propelled along the eight-meter tube by compressed gas released from the reservoir by the quick-release plunger valve. Detailed descriptions of the mechanical and optical features of ERCA III can be found in references 1 and 2.

Diagnostic Measurements

The primary functions of the electronic systems described in this report are to provide signal conditioning for transducers installed in ERCA III, and to provide accurately timed trigger signals to optical and mechanical accessories that must be synchronized with compressor phenomena. These transducers and accessories are briefly described here.

A pressure analog signal is obained from a commercial quartz piezoelectric transducer. The unit presently in use is a Kistler High Pressure Transducer, Model 607B, which has a range of 0-5,000 atm and a rise time of 1.5 μs. The electrostatic signal is fed to a Kistler Charge Amplifier which provides a voltage analog of the gas pressure as a function of time.

The compressor operates in the free piston mode which results in a train of pressure pulses of decreasing amplitude until the piston comes to rest. Only the first pulse, which yields the maximum pressure, is of interest in the compressor experiments. This pulse is a symmetrical, "bell-shaped" curve with a typical width at half-maximum of 1 ms. Figure 2 shows a 1,000 atm pulse obtained with the present electronic system.

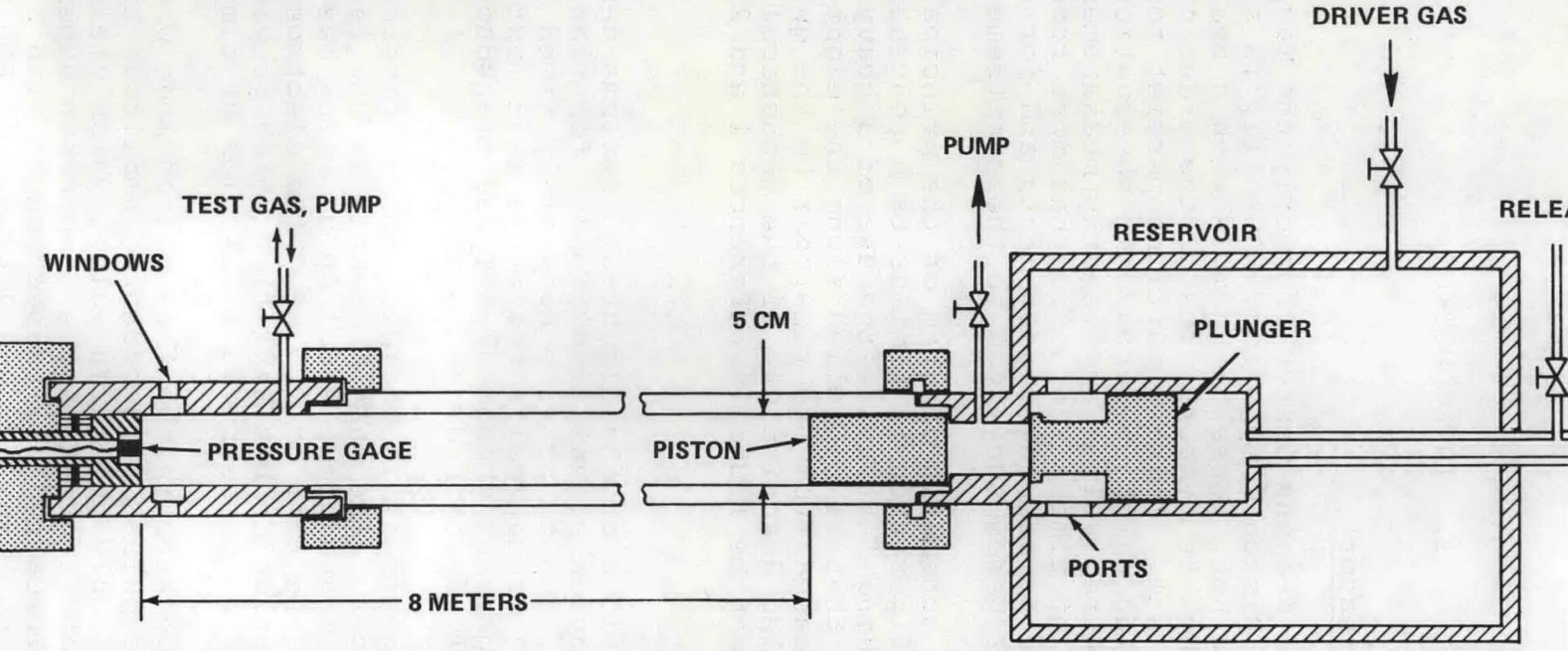

FIG. 1 SCHEMATIC DIAGRAM OF ERCA III.