A calibration voltage signal is recorded on the camera film along with the pressure pulse during each firing of the compressor as may be seen to the right of the pressure pulse in Figure 2. The calibration pulse generator system is triggered by the action of the PISTON SEATED switch when the piston is fired. Calibration pulse generation occurs during the first 10 ms after firing as the piston is traveling down the tube as shown in the pressure signal trace in Figure 5.

Signals from the magnetic pickup are recorded in two forms on the oscilloscopes. The recorded sinusoidal analog signals from the MPU are interpreted by the operator to determine the turn-around point of the piston with good resolution. Analog signals from the MPU are also converted into a digitally compatible rectangular waveform for recording on another oscilloscope. Using a voltage ramp on one input to the oscilloscope and the gated oscillator triggering technique described above for producing multiple sweeps, a positive going raster is generated as the oscilloscope display. Mixing the digital waveform of the MPU with the ramp signal in a dual-trace plug-in yields a time-expansion of the MPU signal as the final oscilloscope display.

III. CIRCUIT OPERATION

Pressure

Figure 6 is the pressure transducer control system schematic. These circuits are contained in three of the five plug-in modules in the instrument package.

Starter Circuit Gates

The starter circuit gates are the necessary interface between the mechanical TEST and PISTON SEATED switches and the digital integrated circuits. Their purpose is to provide a "bounce-free" logic level change to trigger the calibration circuit multivibrators and to enable other circuits in the system.

Besides exhibiting the characteristic contact bounce associated with mechanical switches, the PISTON SEATED switch undergoes false operation during a firing due to shock waves as mentioned earlier. To prevent unwanted triggering of the recording system by these spurious switch closures, the PISTON SEATED switch triggers a 555 Timer circuit operated as a one-shot multivibrator. When triggered, the timer produces a clean pulse on its output with a duration in excess of 6S. During the pulse interval, the timer can not be reset or retriggered by spurious closures of the PISTON SEATED switch. This interval is long enough to cover the duration of a firing of the compressor.

Initially, the piston is seated at the reservoir end of the tube holding the PISTON SEATED switch closed. At the moment the piston is fired, the switch opens causing the output of the 857 NAND gate G1 to change logic states from HIGH to LOW. This negative-going level transition triggers the 555 Timer generating a positive pulse on pin 3. The positive pulse is converted to the needed negative pulse by an 834 INVERTER circuit and sent to the 857 NAND gate G2.

When the TEST switch is used in preparing for a compressor firing, a bounce suppressor circuit formed by 857 NAND gates G3, G4, and G5 sends a negative going level change to gate G2. Thus, both switches will cause the output of gate G2 to go to logic HIGH.

Gate G2 is the control gate for the remainder of the circuits in the system. Its logic state establishes the initial conditions of the circuits and prevents spurious operation of various sections by disabling certain gates during standby.