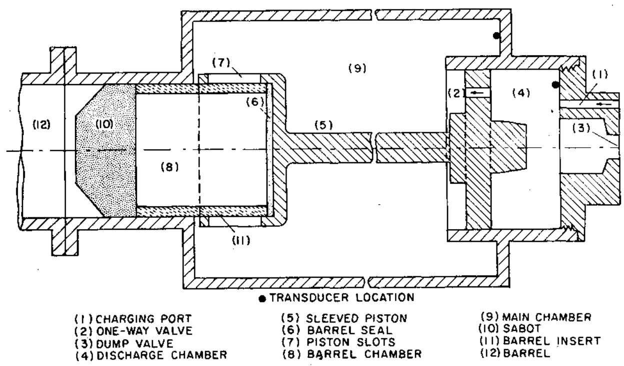

Fig. 1 Schematic of sleeved-piston gas gun.

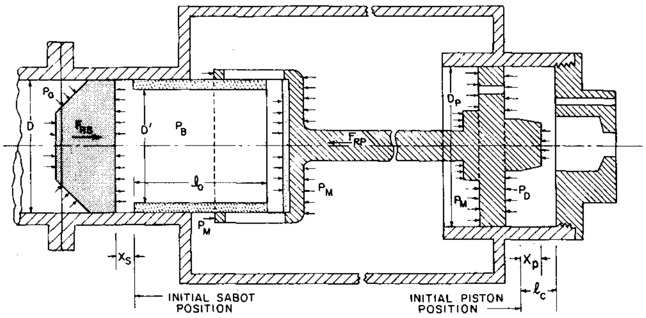

Fig. 2 Gun geometric relationships.

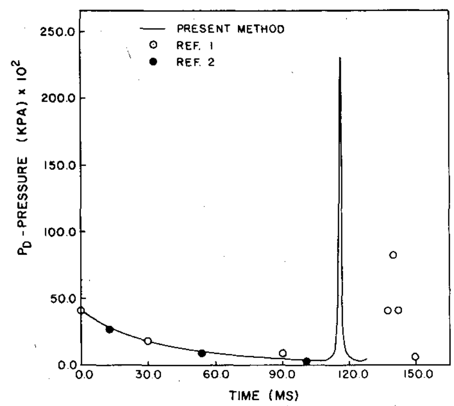

Fig. 3 Discharge chamber pressure history.

Equations (3-10), which are the governing equations for the dynamic and gasdynamic motions of the gun, can be written as a set of seven nonlinear, ordinary differential equations by defining the second-order derivatives in Eqs. (3) and (4), respectively, as $\dot{x}_p = u$ and $\dot{x}_s = w$. Initially the piston and sabot are at rest. The barrel chamber pressure is atmospheric, the main chamber pressure is the charge pressure, and the discharge chamber pressure is given by Eq. (1) evaluated at time t. The equations of motion are integrated from these initial conditions using a fourth-order Runge-Kutta scheme.

Results

Experimental pressure histories for the sleeved-piston gas gun were determined by West[1] with transducers mounted in the discharge and main chambers in the locations indicated in Fig. 1. Additional data in a simulated discharge chamber were acquired by Pakarat.[2]

A typical pressure correlation is shown in the discharge chamber pressure history of Fig. 3. The spike near the end of the firing cycle is caused by piston rebound after the initial discharge. The displacement of this spike from the experimental data can be attributed to model deficiencies imposed by the assumptions of isentropic nozzle flow and frictionless piston motion.

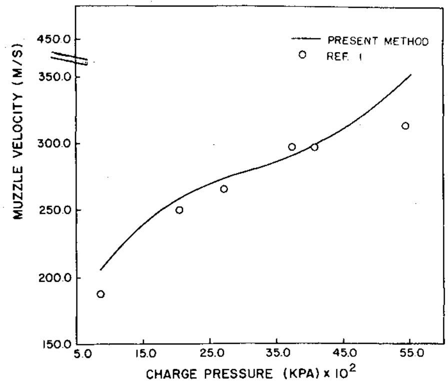

Fig. 4 Sleeved-piston gas gun performance.

Calculations at various charge pressures were performed to provide an indication of gun performance. These results, shown in Fig. 4, compare favorably with experimental data for low to moderate charge pressures. The deviation at high charge pressures can be attributed to increased sabot friction and distortion.

Conclusions

A one-dimensional analytical model has been developed to evaluate the performance of a sleeved-piston gas gun. The model has been shown to predict projectile muzzle velocity for a range of charge pressures with acceptable accuracy. The model also provides detailed information on internal kinematics and pressures during the gun firing cycle.

Acknowledgment

Portions of this work were supported by U.S. Air Force Contract F08635-79-C-0134.

References

[1] West, K.O., Unpublished Experimental Data for a Sleeved-Piston Gas Gun, U.S. Air Force Armament Testing Laboratory, Eglin, Fla., 1979.

[2] Pakarat, A., "Pressure Variation in a Gas Gun Chamber," MS Thesis, Louisiana State University, Baton Rouge, La., Dec. 1980.

Errata

Predictive Surveillance Technique for Air-Launched Rocket Motors

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EIGHT paragraphs of this article were inadvertently transposed in printing. Paragraph 4, page 162, concluding, "...applicability of the concept," ends the Introduction section and should be directly followed by the section on page 163 headed "Technical Approach." The intervening text should be inserted on page 164 following the paragraph concluding, "... batch-to-batch differences..."

Equation (4) should have been correctly printed as follows:

$$\frac{N_m}{\bar{N}} = \left[-\ln\left(1-\frac{m}{n+1}\right)\right]^{1/\alpha} \Big/ \Gamma\left(1+\frac{1}{\alpha}\right)$$

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