Fig. 4 at 0.4-μsec intervals following the impact of the projectile, and the profiles are numbered sequentially. The first profile shows both the shock front in the projectile, which is 0.32 cm thick, and the shock in the target, and the top of the wave is essentially flat. The effect of the elastic relief wave is clearly shown by the profiles numbered 3 through 9. The amplitude of this relief wave is about 0.03 megabar, and the entire shock wave is reduced in amplitude, or attenuated, by 0.03 megabar in about 3.6 μsec. After the initial interaction, the profile is again relatively flat (see profile 10). The elastic relief wave is reflected from the shock front, becoming a backward-facing compression wave. This compression wave must be an elastic wave, since the region into which it propagates, marked A1 in Fig. 5, must be represented by a point on a curve such as that labeled *ef* in Fig. 1. This backward facing wave then interacts with the plastic rarefaction centered at the point *B*, Fig. 2. There results another forward facing elastic relief wave which subsequently overtakes the shock front and causes the process to be repeated. Profiles numbered 12 through 18 show this latter wave overtaking the shock front. Hence the ever-changing shapes of the pressure profiles are due to the interaction of the elastic waves with the shock front and with the following plastic relief wave as shown in part in Fig. 5.

The profiles of Fig. 6 show the effects of elastic and plastic wave interactions on the particle velocity for the same problem that was illustrated in Fig. 4. Results of the calculations can be presented more compactly by showing only the envelope of the stress profiles or of the particle velocity profiles. Such curves are shown in Fig. 7, which give the peak particle velocity as a function of the nondimensional distance x/d for both the elastoplastic model and the fluid model. For the latter, the equation of state

$$P = A\left[\left(\frac{V_0}{V}\right)^k - 1\right]$$

was used for which pairs of values of A and K were chosen to fit the Hugoniot data for the material. Three pairs of values of A and K were used in separate calculations to show the sensitivity of the calculations to the way in which the Hugoniot data were fitted. The method of characteristics was used in these calculations. Results of the fluid model show that the relief waves overtake the shock front at a greater depth in the target than do the relief waves for the elastoplastic model. That is, the shock is attenuated more rapidly by the elastic relief wave than by the relief wave in the fluid model. This observation is true for any reasonable means of evaluating the constants A and K from the Hugoniot data.

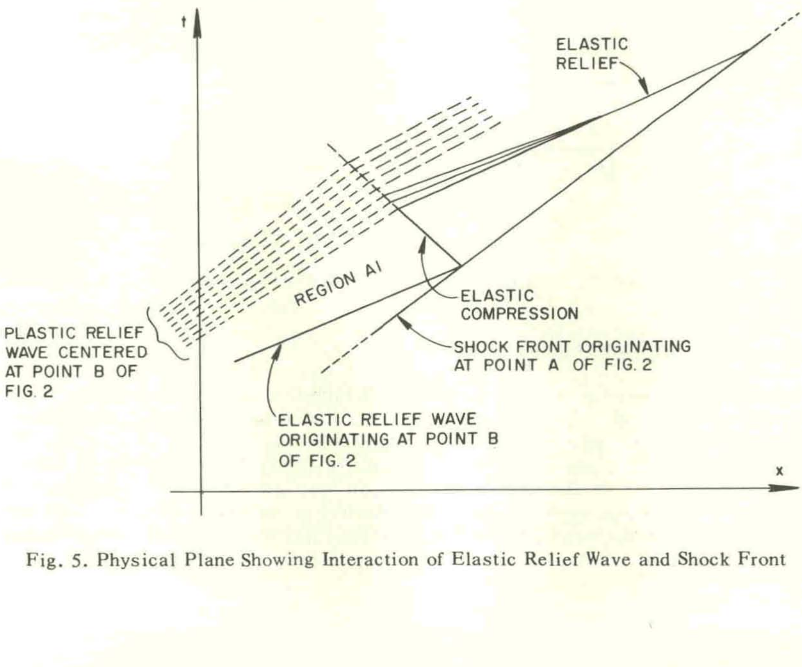

Fig. 5. Physical Plane Showing Interaction of Elastic Relief Wave and Shock Front

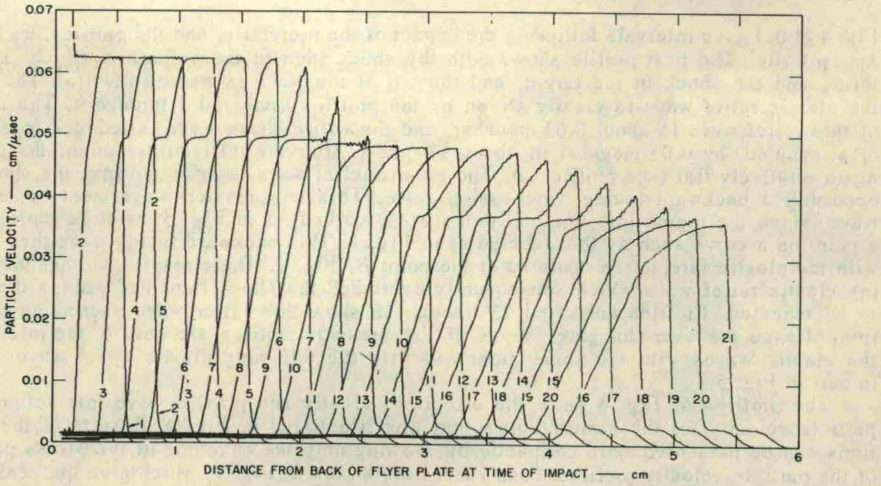

Fig. 6. Profiles of Particle Velocity for Aluminum Projectile Hitting an Aluminum Target. Projectile thickness 0.322 cm. Projectile velocity 0.125 cm/μsec.

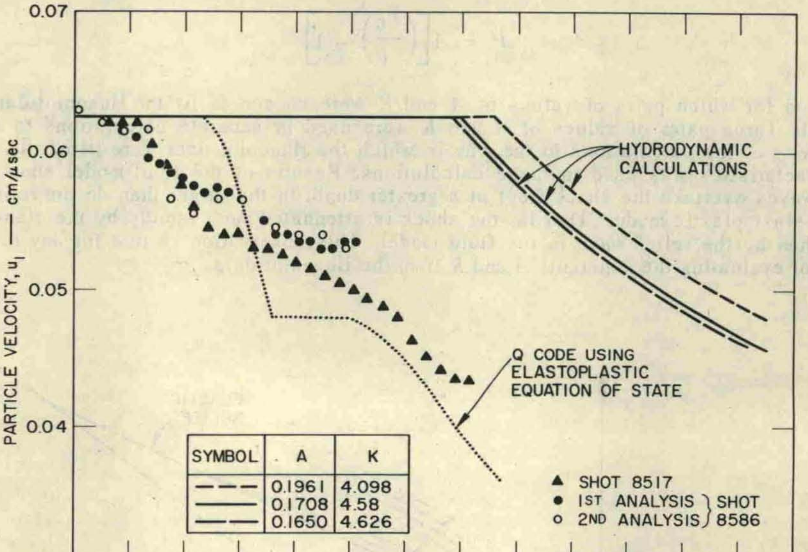

Fig. 7. Peak Particle Velocity in Aluminum Target Hit by an Aluminum Projectile

IV. Comparison with Experiment

Experiments have been performed in which 1/8-inch-thick aluminum plates have been projected at velocities of about 0.125 cm/μsec [7, 8]. In such an experiment, the observed quantity is the velocity of the free surface of the target. It has been shown that the free-surface velocity is approximately equal to twice the particle velocity behind the shock which hits the surface [9]. Although the derivation of this relation was based on the assumption of a fluid-type equation of state, the approximation is expected to be reasonably valid for the elastoplastic model. Thus, by the use of targets of different thicknesses, data can be obtained which