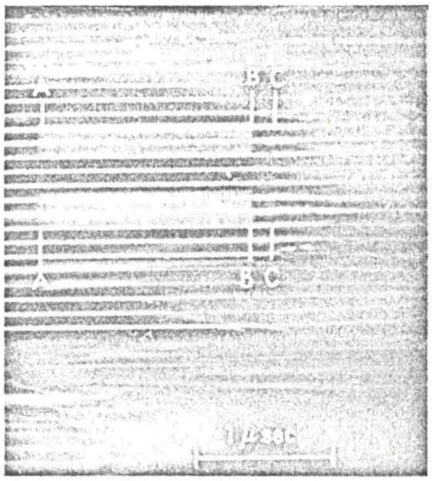

FIG. 1. Typical record of attenuation shot.

unobserved elastic wave causes negligible error in the measurements.[5] When annealed 2024-T351 aluminum specimens, whose thickness was 0.125 in. were hit by a flyer plate of the same material (unannealed) at 110 kbar, the free-surface velocity as recorded by an 0.001-in.-thick shim was essentially the same as the velocity of the projectile plate. In this case the gap was about 0.19 cm, so the shim was in motion for about 1.5 μsec. During this time, relief waves from the back of the projectile plate overtook the front surface of the specimen and slowed it. The record (Fig. 1) shows the arrival of a shim at a witness plate (line *B-B*) and a fraction of a microsecond later the arrival of the surface of the target (line *C-C*). Thus, the time of flight of the shim across the gap gives the initial velocity of the surface even when the shock is not uniform.

B. Fluid Gauge

A second technique was used to obtain a better estimate of the velocity of the relief wave in aluminum. A complete description of the "fluid gauge" has been given elsewhere[6] and only a brief description is included here. The gauge consists of an aluminized Mylar foil (0.00025 to 0.0005 in. thick) suspended in a cell containing a fluid. The bottom of the cell is the specimen in which a shock wave is induced. The foil is oriented at a small angle to the bottom of the cell. When a plane shock wave propagates into the cell, the foil is turned and the amount of turning is monitored by use of the streak camera. Typical records from fluid gauges and the method of reducing the data are given in Ref. 6.

Of present interest is the determination of the depth in water at which the shock is first attenuated. Figure 2 shows the x, t diagram of the interaction of shock waves with surfaces and interfaces after a flyer plate hits the thin specimen of aluminum used as the bottom of a fluid gauge. The shock front *ASP* is overtaken in the water by the relief wave *BCOP* at the point *P*. The wave diagram is constructed in the following way. The slopes of the line segments *AB* and *AS* are obtained by using the known flyer-plate velocity to give the particle velocity behind the shocks. Shock velocities are then obtained from the Hugoniot data for aluminum. Interpretation of the gauge record gives both the pressure behind the shock in water and the distance of the point *P* from the interface. Hugoniot data for water are used to calculate the slope of the line segment *SP*, which locates point *P* in the diagram. Both the sound speed and the particle velocity behind the shock are determined by use of the Hugoniot data for water. Hence the line segment *OP* is drawn. There remains the drawing of the segments *BC* and *CO*, a process which is complicated by the refraction due to the wave which was reflected at *S*. If the thickness of the cell bottom is chosen so that the point *P* is very close to the interface, the bending of the ray, *BCO*, introduces an insignificant error in the interpretation of the experiment. For other cases various assumptions can be made concerning the stress–strain relief path for aluminum in order to obtain approximations of the velocity of the relief wave front.

III. EXPERIMENTAL RESULTS

A. Low-Velocity Flyer Plates

Results of experiments in which both the flyer plates and the targets were as-received 2024-T351 aluminum are shown in Table I and in Fig. 3, where the free-surface velocity is plotted as a function of the thickness of the target. Target thicknesses are given in multiples of the flyer-plate thickness, x_0, which for the

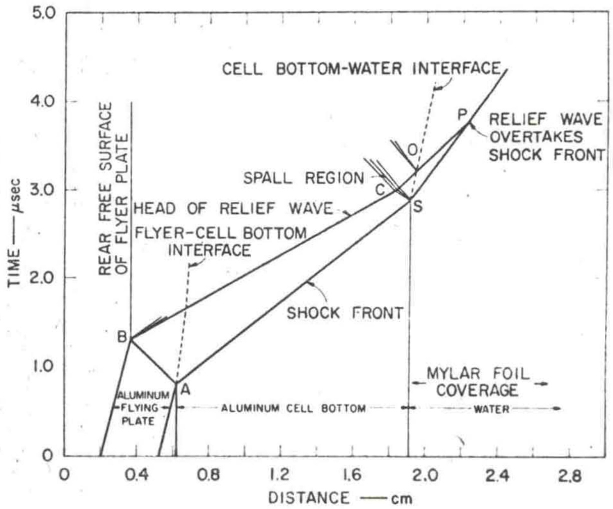

FIG. 2. Time–distance diagram illustrating the wave trajectories in shot 11 762.

[5] At 110 kbar, the elastic precursor separates very slowly from the following plastic wave. Above ∼130 kbar, no precursor exists.

[6] T. J. Ahrens and M. H. Ruderman, J. Appl. Phys. 37, 4758 (1966).