es*

ol have been
um plates in
he velocities.
89, 292, and

this reflected wave on
sequent change in the
gible in the following
ve travels through the
action overtakes and
e corresponding to the
hen in further travel
tion corresponding to
overtakes and reduces
ck front. Shock front
on of the thickness of
tatively as shown in
e-thickness curve may
on the pressure profile
particular, corresponds
the detonation wave.
at the explosive-inert
. 3, one can write

$-U_m),$ (1)

etonation wave, P_m is
material, and the ρ's,
e velocities, and shock
ctively, particularized
he detonation wave, m
and r referring to the
Conditions in front of
superscript zero. All
the particle velocities
the momentum con-
$_x$ and $P_m=\rho_m{}^0U_mD_m$,

kness

ction of material thickness
pressure corresponding to

one obtains

$$P_m/P_x=[\rho_m{}^0D_m/\rho_x{}^0D_x]\times[(\rho_x{}^0D_x+\rho_r{}^0D_r)/(\rho_m{}^0D_m+\rho_r{}^0D_r)]. \quad (2)$$

If one makes the acoustic approximation $\rho_r{}^0D_r=\rho_x{}^0D_x$, Eq. (2) simplifies to

$$P_x=(P_m/2\rho_m{}^0D_m)(\rho_x{}^0D_x+\rho_m{}^0D_m). \quad (3)$$

Error analysis shows P_x to be quite insensitive to error in $\rho_r{}^0D_r$; for example, in Composition B a 10% error in $\rho_r{}^0D_r$ corresponds only to a 1% error in P_x. A more precise treatment of the interface interaction by W. Fickett and R. D. Cowan[7] gives for the cases of interest in this paper values of explosive pressure only about 1% higher than those resulting from the acoustic approximation.

If in Eq. (3) one identifies P_m as $P_m{}^*$ and P_x as the C-J pressure (P_{cj}) of the explosive, then P_{cj} can be established since $\rho_x{}^0$ and $\rho_m{}^0$ are the simply measurable initial densities of the explosive and the inert, D_x is the

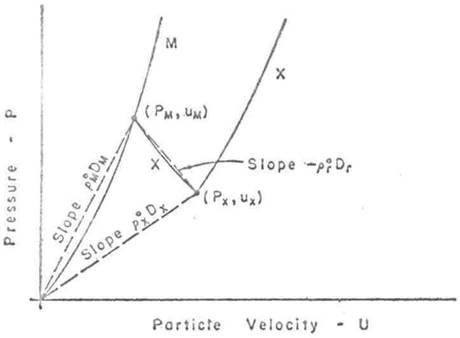

FIG. 3. Interaction at the interface between explosive and inert material in contact with it. M is the inert material Hugoniot; the X's are Hugoniots for the reacted products of the explosive.

readily measurable detonation velocity[8] and $D_m{}^*$ and $P_m{}^*$ are available from equation of state data if one hydrodynamic variable of this state is measured.[9] The quantity established in these experiments was the free-surface velocity ($U_{fs}{}^*$).

An alternative method of establishing the C-J state, which minimizes the hitherto neglected effect of the reflected wave in the explosive on the reaction kinetics, is to establish the $P_m{}^*$ state for each of several inert materials of different shock impedance. The state points define a curve in the pressure-particle velocity plane which closely approximates the locus of all possible shocked and rarefied states (for one direction of wave travel) from the C-J state of the explosive. It differs from this locus only insofar as the wave reflected back into the explosive affects the reaction kinetics; however, the amplitude of the reflected wave approaches zero as

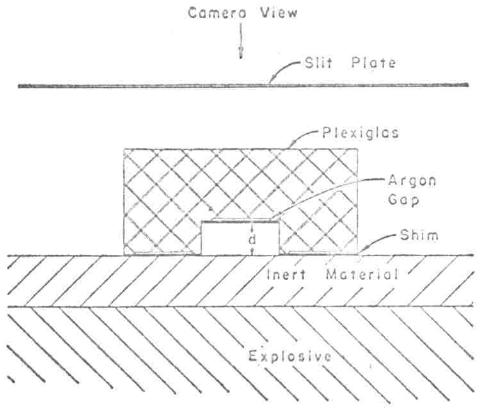

FIG. 4. Plexiglas block assembly for measurement of free-surface velocity of an explosive-driven plate.

one approaches the C-J state on this curve. The C-J state must also lie on the line $P_{cj}/U_{cj}=\rho_x{}^0D_x$ (where U_{cj} is the C-J particle velocity). The C-J point is thus established as the intersection of this line with the aforementioned curve at the point where the perturbation of the reaction by a reflected wave is minimized.

EXPERIMENTAL TECHNIQUE

The value of free-surface velocity corresponding to $P_m{}^*$ for a given explosive and inert material was determined by measurement of free-surface velocity of an explosive-driven plate as a function of plate thickness. These velocities were measured photographically by use of a rotating-mirror smear camera with a writing speed of 3.2 mm/μsec. A Plexiglas block assembly such as that of Figs. 4 and 5 was placed on the surface to be studied. This was viewed by the camera through a slit and swept on the film in a direction perpendicular to the slit image. When the explosive-driven plate on which such an assembly is placed begins to move, the argon gaps near the plate surface are closed first and yield a brilliant

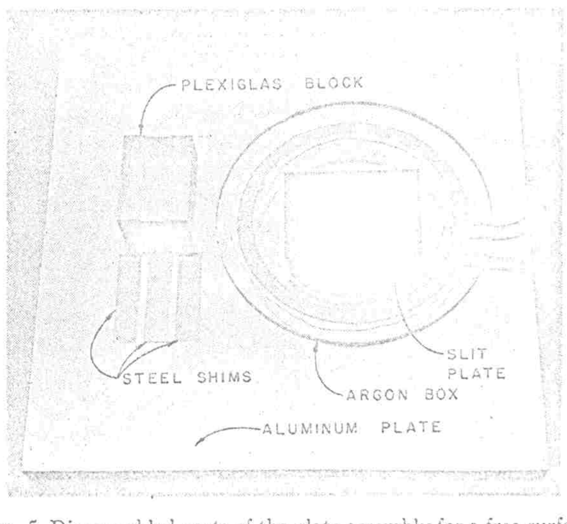

FIG. 5. Disassembled parts of the plate assembly for a free-surface velocity record such as shown in Fig. 6.

[7] R. D. Cowan and W. Fickett, J. Chem. Phys. 24, 932 (1956).
[8] Campbell, Malin, Boyd, and Hull, Rev. Sci. Instr. 27, 567 (1956).
[9] Walsh, Rice, McQueen, and Yarger, Phys. Rev. (to be published).