where U_2^* and w_2^* are velocities *relative to the velocity of flow in the original shock 1*. The *absolute* shock and flow velocities after collision are thus $w_1^*+U_1^*$ and $w_1^*+w_2^*$. Formula (11) can be applied in the same way as (6) to trace the course of the final compression curve from the starting point (P_1^*, V_1^*, T_1^*). In the present work we have calculated the properties of secondary shocks based on three starting points, all on the primary Hugoniot centred on the unperturbed state $P^*=0$, $V^*=1\cdot0503$, $T^*=0\cdot75$.

An interaction of special interest is the head-on collision of two *equal* shock waves, which is mathematically equivalent to the total reflection of a single shock at a rigid boundary. Such a collision must reduce the absolute flow velocity to zero and the final conditions can be found by imposing the restriction

$$w_2^*=-w_1^*. \tag{12}$$

Interactions of this kind will be discussed in Section IV (*d*).

(*f*) *Shock Conditions for Liquid Argon in Contact with the Explosive 60/40 RDX/TNT*

In Section III (*c*) we considered the transmission of a shock wave from an LJD fluid into another material. We shall now examine the converse process of transmitting a shock from a high explosive into an LJD fluid. Again the boundary conditions require that the pressure and flow velocity be continuous across the interface. These conditions can be satisfied by the reflection of either a compressive shock or a rarefaction wave back into the explosive products.

It is, of course, necessary to match the *absolute* pressures P and flow velocities w at the interface, not the reduced quantities P^* and w^*. This means that we must sacrifice generality and specify the materials of the explosive and the fluid. We have selected the explosive 60/40 RDX/TNT both because it is widely used in experimental work and because Deal (1958) has made a thorough experimental study of the propagation characteristics of shock waves and rarefaction waves in its products of explosion. We have chosen argon as the LJD liquid and transformed our theoretical LJD results into absolute units by means of the following factors derived from the second virial coefficient of gaseous argon (Hamann 1960*b*).

$$\begin{aligned} P&=P^*\times P_0 && P_0=415 \text{ atm},\\ V&=V^*\times V_0 && V_0=24\cdot0 \text{ cm}^3\text{/mole},\\ T&=T^*\times T_0 && T_0=120\ ^\circ\text{K},\\ U&=U^*\times u_0 \\ w&=w^*\times u_0 && \Big\}\ u_0=158 \text{ m/sec}. \end{aligned}$$

The conditions at the interface are given by the point of intersection on a P/w diagram of the Hugoniot curve for forward-going shocks in argon and the curve for backward-going shocks and rarefactions in the explosive products (cf. Fig. 5).

(*g*) *Shock Conditions in Precompressed Liquids*

It is not difficult to repeat the calculations of Section III (*b*), starting not from pressures near zero but from quite high pressures. We have made a few calculations of this kind in order to determine the effects of precompression on the final shock conditions in LJD fluids. In particular, we have estimated the shock properties of precompressed argon in contact with 60/40 RDX/TNT (cf. Section III (*f*)).

IV. Results and Discussion

(*a*) *The Properties of Plane Shock Waves in Classical LJD Liquids*

Figure 1 illustrates the results of some of our calculations of Hugoniot curves for classical LJD liquids. It will be seen that the pressure rises much more rapidly with decreasing volume than it does under isothermal or adiabatic conditions. This is a reflection of the fact that a shock wave always increases the entropy of the material through which it is travelling (Hirschfelder, Curtiss, and Bird 1954, p. 789) and so raises its temperature above the value that would be reached in adiabatic (isentropic) compression over the same volume interval.

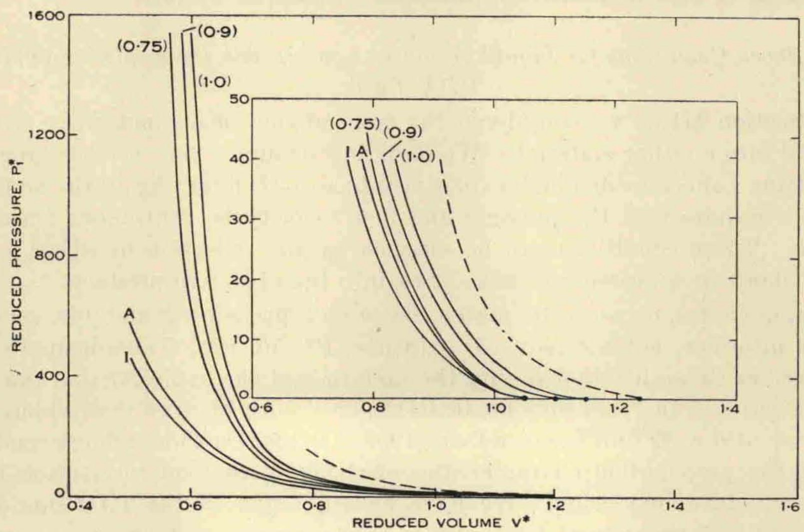

Fig. 1.—Calculated shock Hugoniot curves for LJD fluids. The compressions start at $P^*=0$ and at values of T^* indicated by the numbers in brackets. The curves labelled *I* and *A* are the isotherm and adiabat based on the starting point $P^*=0$, $T^*=0\cdot75$. The dotted curve is the Hugoniot for a quantal liquid ($\Lambda^*=1$) starting from $P^*=0$, $T^*=0\cdot75$.

Table 1 lists some of the thermodynamic properties of an LJD liquid along the Hugoniot based on the starting point $P^*=0$, $T^*=0\cdot75$.

Several points emerge from these results. First, the relationship between the increase in temperature and the shock pressure is accurately described by the simple formula

$$T_1^*-T^*=0\cdot0198(P_1^*)^{1\cdot21}, \tag{13}$$

which is close to being a linear function. In this connection it is significant that Rice and Walsh (1957) concluded from explosive shock experiments on water that the temperature was " almost linear in pressure ". For an ideal gas it would be exactly linear, in the limit of very strong shocks.