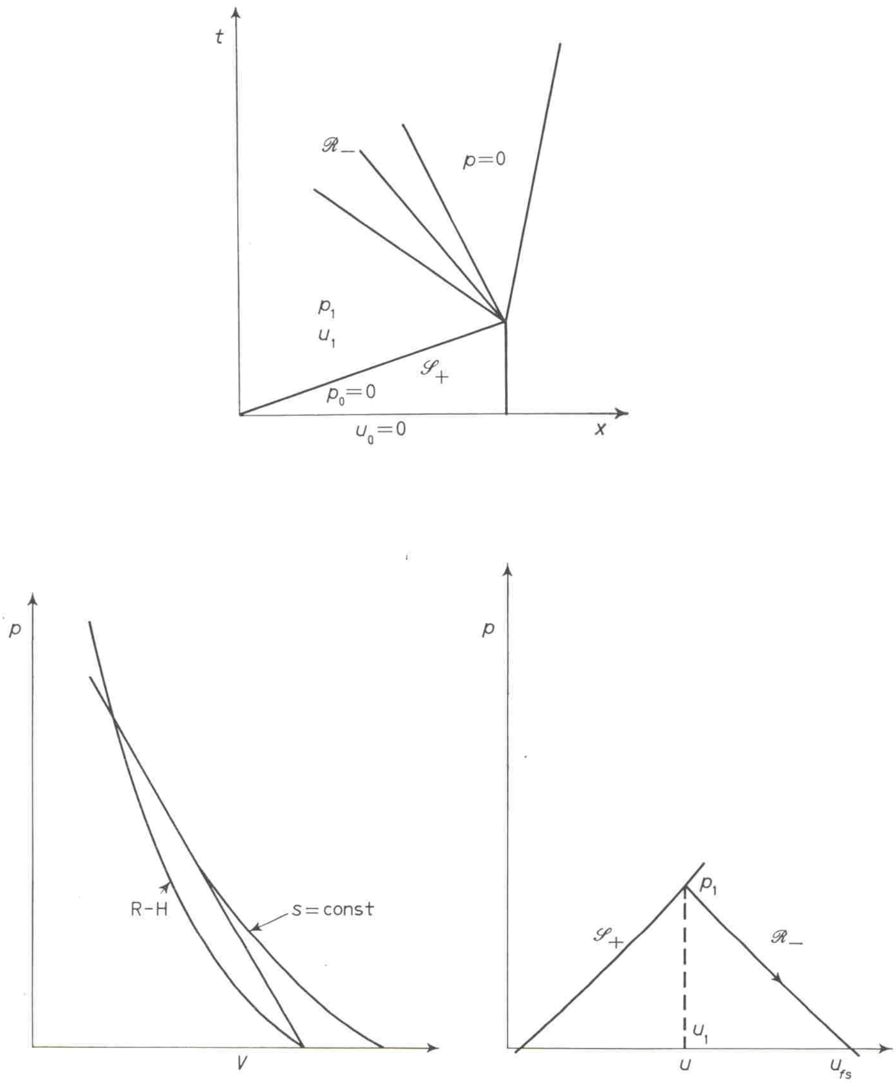

Fig. 9. – Uniform shock on a free surface.

material, u_{fs} is approximately equal to and usually slightly greater than $2u_p$.

Figure 10: Transmission of a uniform shock through an interface: The shock is incident from material I on material II. The (p, u) curves labelled I and II are images of the Hugoniot (p, V) curves of the respective materials. The final state (p_2, u_2) is common to both materials since p_2 and u_2 are to be continuous across the interface. This final state must be reached from (p_1, u_1)

by a backward-facing wave in material I and from $(p_0 = 0 = u_0)$ by a forward-facing wave in II. The required state is as shown. Material II was arbitrarily chosen so that its Hugoniot image lies above I. In that case the wave reflected back into I is a shock wave. For II below I, the reflected wave is a rarefaction. It sometimes happens that the two curves cross; then the reflected wave is a shock or a rarefaction, depending on the amplitude of the incident shock. For an incident shock at the intersection there is no reflection. An analytic expression for the amplitude of a reflected shock can readily be obtained from the jump conditions written for the incident shock, the reflected shock, and the transmitted shock:

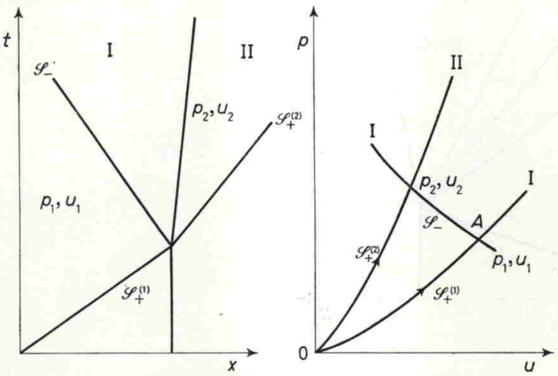

Fig. 10. – Transmission through an interface; $\varrho_{02} D_2 > \varrho_{01} D_1$.

$$\frac{p_2 - p_0}{p_1 - p_0} = \frac{1 + \varrho_0 D_1/\varrho_1 D'_{21}}{\varrho_0 D_1/\varrho_1 D'_{21} + \varrho_0 D_1/\varrho'_0 D_2}, \tag{37}$$

where

ϱ_0 = initial density of material I,

ϱ'_0 = initial density of material II,

D_1 = velocity of incident shock,

D'_{21} = velocity of reflected shock *relative to the material ahead* $= u_1 - D_{21}$,

D_{21} = velocity of reflected shock in laboratory co-ordinates,

D_2 = velocity of transmitted shock,

ϱ_1 = density behind initial shock.

The products ϱD appearing in eq. (37) are *shock impedances* corresponding to the various waves. Shock impedance for a given transition is equal to the magnitude of the slope of the corresponding chord in the (p, u) plane. For example, $\varrho_0 D_1$ is the slope of the chord OA in Fig. 10. In the limit of small amplitude waves, the shock impedance becomes equal to the acoustic impedance. Then eq. (37) reduces to the expression for acoustic reflection:

$$(p_2 - p_0)/(p_1 - p_0) = \delta p_2/\delta p_1 = 2\varrho'_0 c'_0/(\varrho_0 c_0 + \varrho'_0 c'_0). \tag{38}$$