or, since n is zero when $\overline{u}$ is zero,

$$\overline{u}(t) = (\lambda/2\tau)\, n(t)$$

where n is the number of fringes counted.

The resolution of the system is controlled by the delay leg. For very small delays the number of fringes per velocity change is small and the resolution in velocity is correspondingly reduced. With a typical delay leg of 10 nsec and a wavelength of 6328 Å, the coefficient,

$$d\overline{u}/dn = 31.64 \text{ m/sec/fringe.}$$

The time resolution, on the other hand, is equal to the delay time. This can be seen by observing that the technique effectively measures the separation of two surfaces displaced in time by τ. Consequently, a constant velocity, for example, will not be observed as constant until both surfaces move with constant velocity, i.e. until the specimen surface has travelled with constant velocity for a time τ.

The balance to be struck between these two resolutions depends on the experiment. The values indicated above, however, show that reasonably good resolution of both time and velocity are attainable.

Although laser methods are somewhat restricted in application, the high time resolutions attainable and the accuracy with which they can be calibrated makes them essential tools in the experimentalist's repertoire.

III. INTERPRETATION OF EXPERIMENTS

As indicated above current experimental techniques in general provide measurements of pressure-time or velocity-time histories at locations fixed with respect to the material, i.e. in Lagrangian coordinates. If the measurement is made at a boundary where the shock impedance changes, as in free-surface measurements or quartz gauge measurements, the recorded data are characteristic of two superimposed waves - the incident wave plus the wave reflected from the boundary. To separate the effects of each wave requires knowledge of the constitutive relation (in general, time-dependent) of the material. Thus, in principle the derivation of a constitutive relation from such measurements requires prior knowledge of the constitutive relation and the analysis is somewhat circular.

Valuable information can nevertheless be obtained through a series of successive approximations. The question of convergence of these methods does not seem to have been treated theoretically, but frequently the results are not sensitive to small errors in the assumptions. Some of the techniques do not suffer from this uncertainty - notably piezoresistive pressure transducers and electromagnetic velocity gauges. However, these techniques have other limitations so that most of the techniques in use are complementary.

Once stress-time and/or velocity-time data are obtained for the undisturbed wave in the sample the question arises how to interpret the data to derive a one-dimensional strain constitutive relation. If the compressive part of the wave is steady the jump conditions (Eqs. (1)-(3)) are valid and the analysis is straightforward. In the rarefaction portion of the wave one usually assumes that the states, while not steady, are nevertheless equilibrium states and that the stress is a function of the density only, i.e. the flow is assumed isentropic. The jump conditions can then be applied incrementally to yield a stress-density "isentropic" relation for the rarefaction part of the wave. The Riemann integral, Eq. (6), is just the integrated momentum jump condition (Eq. (2)).

Unfortunately these assumptions are frequently not met in an experiment and the interpretation is accordingly not rigorous.

An alternative means of interpretation is to assume a constitutive relation and attempt to reproduce the experimental observations by trial and error using a computer. This method is not only expensive but offers no guarantee of uniqueness.