II. DESIGN CONSIDERATIONS

The major design parameters are length, diameter, operating pressure, and gas reservoir volume.

Projectile diameter is probably the most important parameter. Good measurements of plane stress wave propagation can be obtained only while the stress wave is accurately one-dimensional, i.e. before any signal from the lateral edges of the sample under investigation can influence the measurement. This restriction requires that the ratio of diameter to thickness of the sample be at least three and preferably four or more. If sample thicknesses up to one inch are to be studied, or if it is desired to compare two or more thinner samples under identical impact conditions, a projectile diameter of about 4 inches is necessary. The experience of other investigators with guns varying between 2.5 and 6 inches indicates that these are reasonable limits;[2-4] a six-inch gun, however, is expensive to build and to operate. We therefore decided on a diameter of 4 inches as the maximum that is practicable within the bounds of reasonable construction and operating costs.

The length was chosen to some extent on the basis of available space, with consideration given also to desired projectile velocities and operating pressures.

At 6000 psi operating pressure, which is a convenient limit in terms of availability of compressors, gauges, and tubing, a barrel length of more than about fifty feet does not materially increase the attainable projectile velocities. The length chosen for the gun was 14 meters in order to fit conveniently into the room available. Figure 1 shows the projectile velocity as a function of barrel length for various values of the ratio of mass of driven gas to projectile mass. The length chosen for the gun is clearly well beyond the knee of these curves and is sufficient to extract nearly all the velocity possible from a given reservoir at the maximum operating pressure (6000 psi).

The gas reservoir volume was chosen to give a maximum ratio of mass of gas to projectile mass (G/M) of about five. The maximum velocity increases very slowly with G/M beyond this value, as shown in Fig. 2, and