F. Projectile

In the first three shots the impactors were made of 6061-T6 aluminum. Extraneous signals were observed due to inductive coupling between sample and the metal projectile face. The remaining shots were done with a fused quartz or a sapphire impactor clamped to an aluminum projectile (Fig. 1). Impact misalignment was measured only in the first two shots. Tilt values recorded were 0.25 and 0.28 milliradians. In the case of non-conducting impactors the projectile alignment was checked with an auto-collimating telescope. Impactor face was perpendicular to the launching tube axis within 0.1 to 0.3 milliradians. The sapphire target was also aligned optically to the tube axis. But the actual tilt on impact was not recorded, since the small-diameter, non-conducting impactors precluded such recording.

Impact alignment was tested with an aluminum disc clamped to the projectile in a manner similar to that used for the non-conducting impactors. Impactor misalignment before the shot was measured as 0.35 milliradians; tilt measured on impact was 0.35 milliradians. It should be noted that the projectile has enough clearance for a possible 0.5 milliradian wobble on impact. This is not usually observed, however.

As received, the fused quartz and sapphire impactor discs were typically flat to within about 2 μm across the area which generated the stress pulse in the foil. Late in the experiments it was discovered that clamping a disc to a projectile head distorted the disc out of flat as much as 8 μm; this would contribute to deviation from planarity in the shock wave generated by impact, degrading rise time by about the same amount as a number of other existing experimental conditions (Sec. IV.C). The distortion could also contribute to lateral deformation as discussed in Appendix C.

G. Recording System

The pulsed current source was a Pulsar Model 301 power supply with three channels, each consisting essentially of a 90 microfarad capacitor, charged to 500 volts, in series with 8.3 ohms (Fig. 3). The three channels were triggered simultaneously 15 to 30 microseconds before impact. The current attainable was limited by the transient current rating of the silicon-controlled rectifiers which switch the current on and off. Current pulses were limited to 50 microseconds duration, preventing sample heating during preshot pulsing.

One oscilloscope recorded the initial voltage step as well as voltage change across the foil upon shock compression. Two other oscilloscopes recorded only the voltage change due to shock compression. This was achieved by suppressing the initial voltage step using a differential comparator amplifier. The oscilloscopes used were 580 series and 7000 series Tektronix, Inc. models; system rise time was 4 to 5 nanoseconds. Oscilloscope traces were recorded on Polaroid film.

Time calibration was achieved using a Tektronix, Inc. 2901 Time Mark Generator. Voltage calibration was done by recording pulses of known voltage on the oscilloscopes. These