The first harmonic is reduced by 1/e in a distance

$$y_o = \frac{a}{2\pi},$$

while higher harmonics fall off even faster. Therefore, ripple in the magnetic field is less than 1% at a distance from the grid equal to the period of the grid. In this case, it is about 20 to 30 mil.

Another problem is the end effect or reduction in the magnetic field due to the finite length of the solenoid. For a rectangular solenoid of dimensions b and c with $c >> b$, the end effect error is

$$\frac{H_I - H_e}{H_I} = \frac{1}{2} - \frac{1}{\pi} \tan^{-1} \frac{x}{b}, \qquad (4.2)$$

where H_e is the actual field, H_I is the infinite solenoid field, and x is the distance into the solenoid from the end. The solenoid must be constructed sufficiently long to nullify this error in the region of the specimen.

4.2. Application of Strain Field

The strain field required in the magnetic sample was produced by planar impact of a projectile accelerated in a four inch gas gun.[51] The sample, solenoid, and required electronics are assembled in a target which is mounted at the muzzle end of the gas gun. This in turn, is enclosed in an evacuated target chamber. Impact tiles are characteristically on the order of 10^{-4} radians.

4.2.1. Experimental Construction

The normal metal faces of the projectiles were replaced by nonconducting material, usually Lucite or a ceramic such as aluminum oxide, in order to eliminate moving metal from the vicinity of the solenoid and, hence, reduce gross movement of magnetic flux during the experiment. The velocity of the

projectile is measured by contact pins prior to its arrival at the target face. This is required for determining the final state of strain in the YIG. The velocity contact pins also serve to trigger the current supply.

The target is constructed so that the plane wave propagates through the solenoid and then into the YIG. See Figure 4.3. Materials through which the wave travels between projectile and YIG are, in order, 0.75 millimeters of Lucite, 0.025 millimeters of alternate copper and epoxy, 0.75 millimeters of Lucite, and 0.025 millimeters of epoxy which includes the front face of the pickup coil. All electronic components are mounted behind the solenoid assembly and are completely potted in epoxy.

There are several problems associated with propagating a planar shock wave through the periodic grid defined by the front surface of the solenoid.

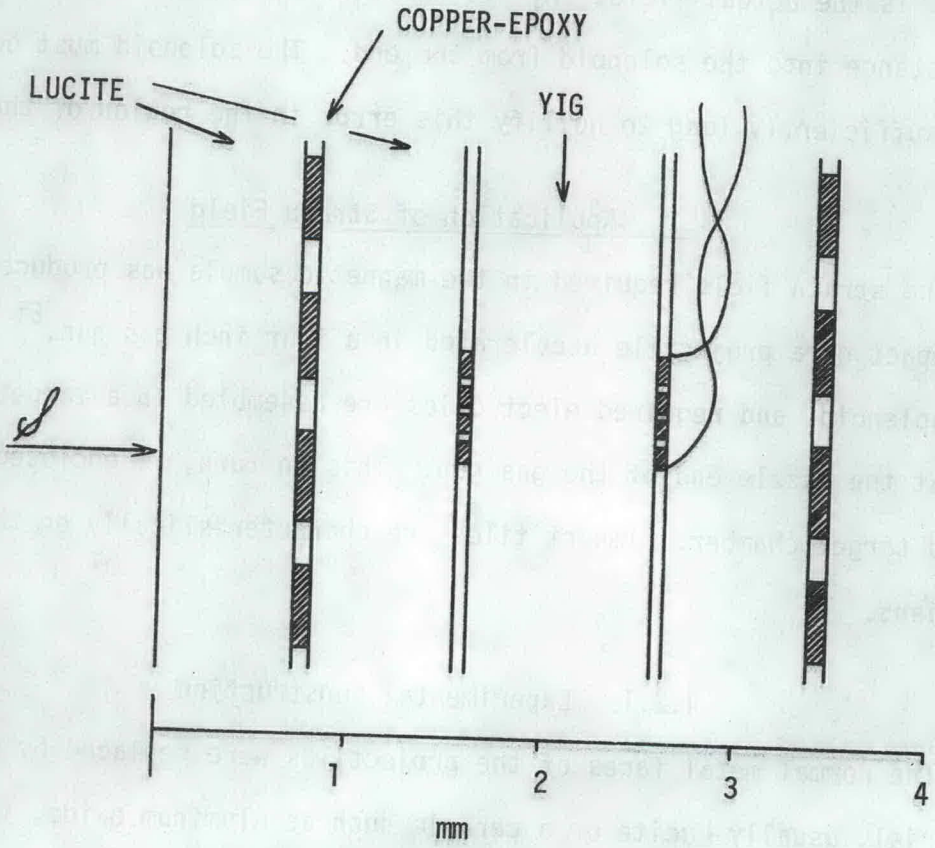

Fig. 4.3.--Solenoid construction.