VLBA ACQUISITION MEMO #324

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886

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Telephone: 508-692-4764
Fax: 617-981-0590

To: VLBA Data Acquisition Group

From: Alan E.E. Rogers

Subject: A simple method to measure friction in vacuum columns

The static and dynamic friction in the vacuum columns can be measured by shimming the outer wall of one of the vacuum chambers to provide a differential tension. This differential tension is sufficient to overcome the idler and edge contact friction and will drive the tape when loaded around the idler (bypassing the capstan). The differential tension in the absence of friction for a shim (see Figure 1) is

$$\Delta = aWP/2 \sim 5.4 \times 10^{-3} lbs$$

where a = shim (30 mils)
W = tape width (1")
P = vacuum pressure (10" H_20 = 0.36 psi)

This differential tension is countered by the following fractional forces

$$\Delta = \mu_o + 3\mu_1 x_1 b\ WP/2$$

where μ_o = idler roller
μ_1 = edge contact friction coefficient
x_1 = fractional force on edge contact (~2% see VLBA Acquisition Memos 318 & 124)
b = width of vacuum column (~2.5")

where the factor of 3 arises from the 2 inner edge contacts plus half of the two front door edge contacts. The remaining friction (outer edge contact plus half front door) is driven by the reel motors which are servoed to maintain a constant loop position. Equating the forces and neglecting the idler friction, the observed coefficient of friction is normally

$$\mu_1 = a/(3bx_1) \sim 0.2$$

for a good tape and clean edge contact regions.

A thicker shim will make the tape move faster and provide a measure of the dynamic friction. At 10" vacuum, increasing the shim from 30 mils to 60 mils will increase the tape speed from barely moving to 30 IPS. Changing the vacuum provides a method for determining and separating the idler friction from the edge contact friction on the assumption that the idler bearing friction is independent of the tape tension.

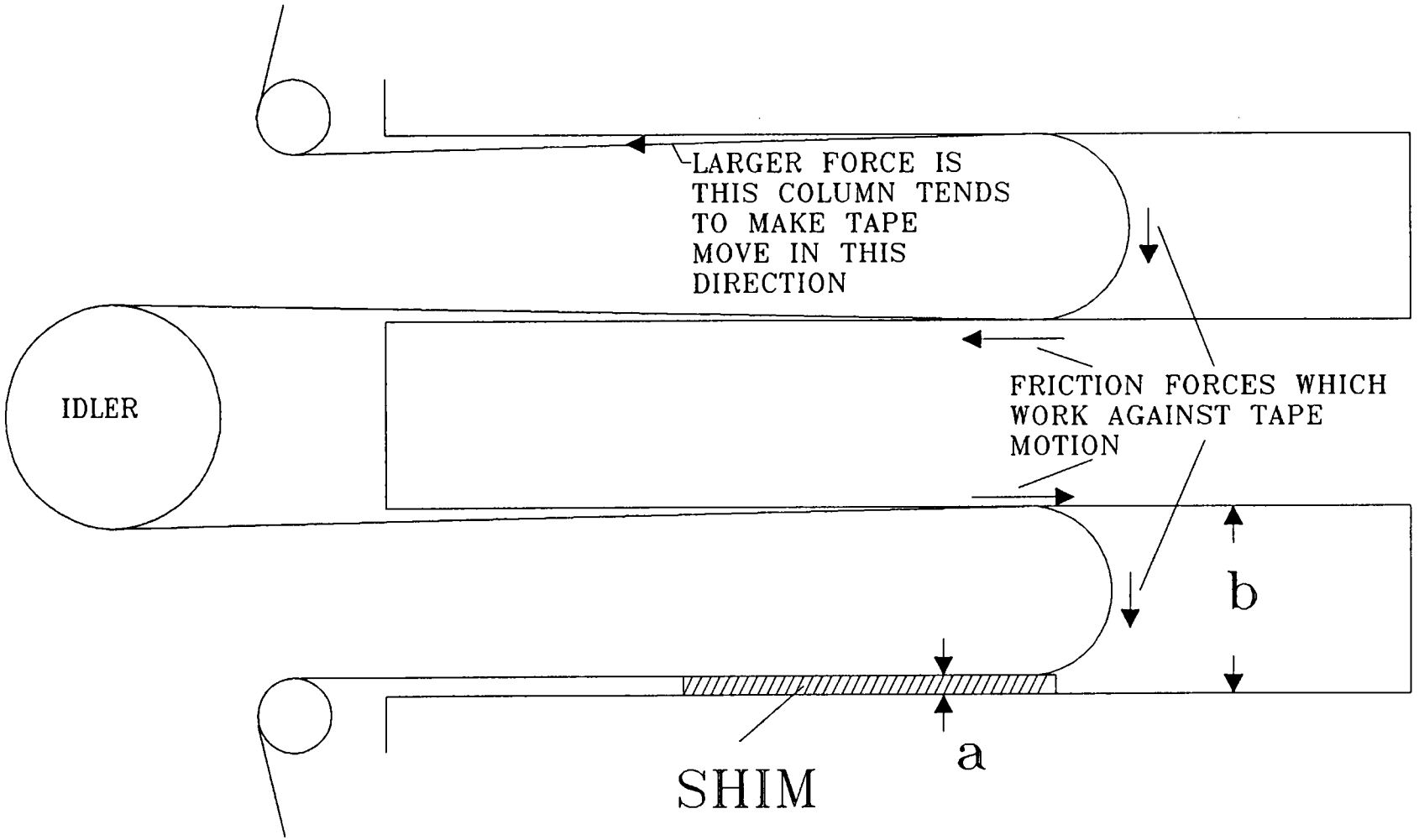

FIGURE 1 USING UNBALANCED VACUUM FORCES TO MOVE THE TAPE