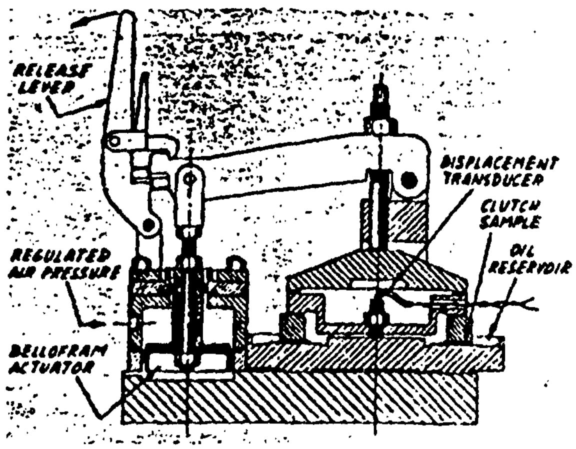

Fig. 4 - Schematic of squeeze film fixture

the oil film thickness for constant force, nonrotating applications (Fig. 4). The apply force is set by adjusting air pressure to the Bellofram actuator with a precision regulator. A single clutch plate, located in a pool of oil, is supported by low rate springs (not shown) to provide a known initial oil film thickness. Individual clutch faces also may be tested by bonding clutch plates directly to the base. When the release lever is tripped, the voltage signal from the displacement sensor triggers a storage oscilloscope which records the variation of displacement with time.

The squeeze film fixture was tested with precision ground steel plates to compare experimental oil film thickness-time test results with analytical values. The test and analytical thickness-time curves were coincident down to 70μ in. Below 70μ-in the results were somewhat erratic, presumably due to a randomly occurring, very slight cocking of the plate. Above this film thickness the test results were repeatable within an indicated 10μ in.

New paper plates were found to require up to 100 applications to achieve repeatable behavior. This was believed to be the result of air removal from the interior of the paper structure. When new plates were vacuum impregnated with the test oil, the oscilloscope traces were immediately repeatable, within 15μ in, over the entire trace. Test results then matched well with calculations from the squeeze film analysis for porous facings when the transient vibrations were filtered (Fig. 5). The initial contact occurred at roughly 200μ in, apparently due to a slight cocking of the plate.

This squeeze film apparatus has served as a means to measure conveniently and rapidly the average permeability of complete clutch facings and the elastic response of the paper. As might be suspected, both the squeeze film and elastic deflections differ between hot-pressed and ground paper plates of similar paper structure (Figs. 6 and 7). These differences nearly vanished after both plates were ground in an identical manner, cleaned, vacuum impregnated, and retested (Figs. 8 and 9). The horizontal lines on the right of the traces denote the equilibrium deflection for each load.

FLUID EFFECTS - Continued squeeze film cycling on this

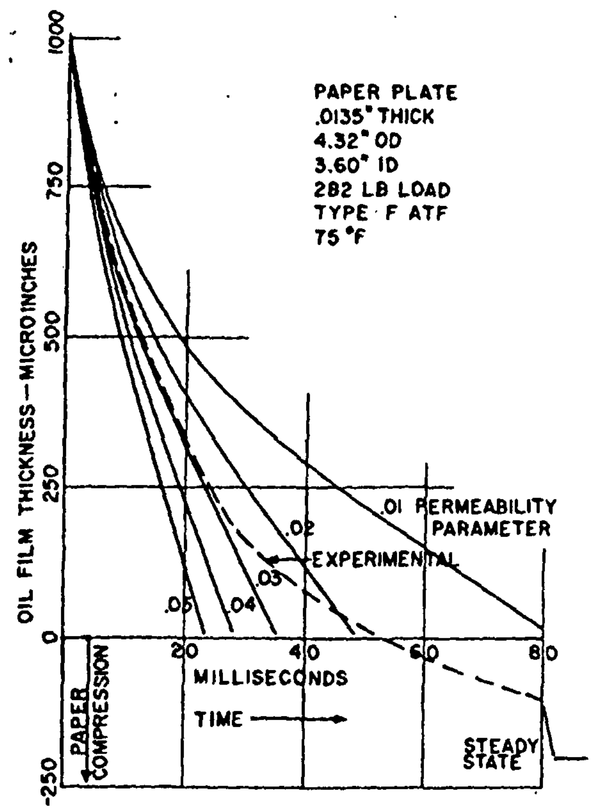

Fig. 5 - Comparison of squeeze film results

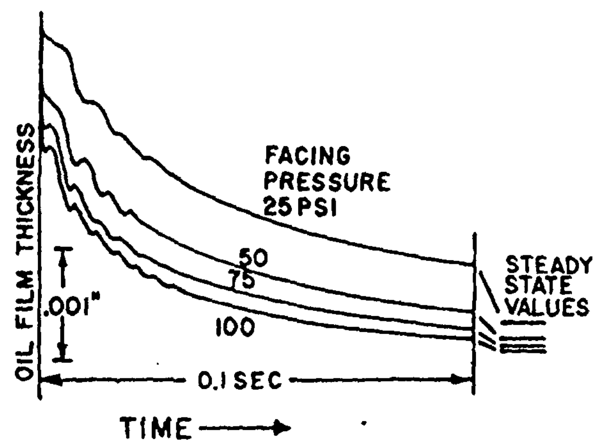

Fig. 6 - Squeeze film traces for new pressed paper plate Type F ATF, 75 F

fixture with an ATF using a high molecular weight viscosity index (VI) improver resulted in an apparent loss of paper permeability after about 1000 cycles. No such effect was noted when a similar fluid with a low molecular weight VI improver was used. Furthermore, the squeeze film behavior could be restored by pentane extraction of the fluid within the paper plate and reimpregnating with fresh oil. Some used plates which exhibited abnormally low friction levels in

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