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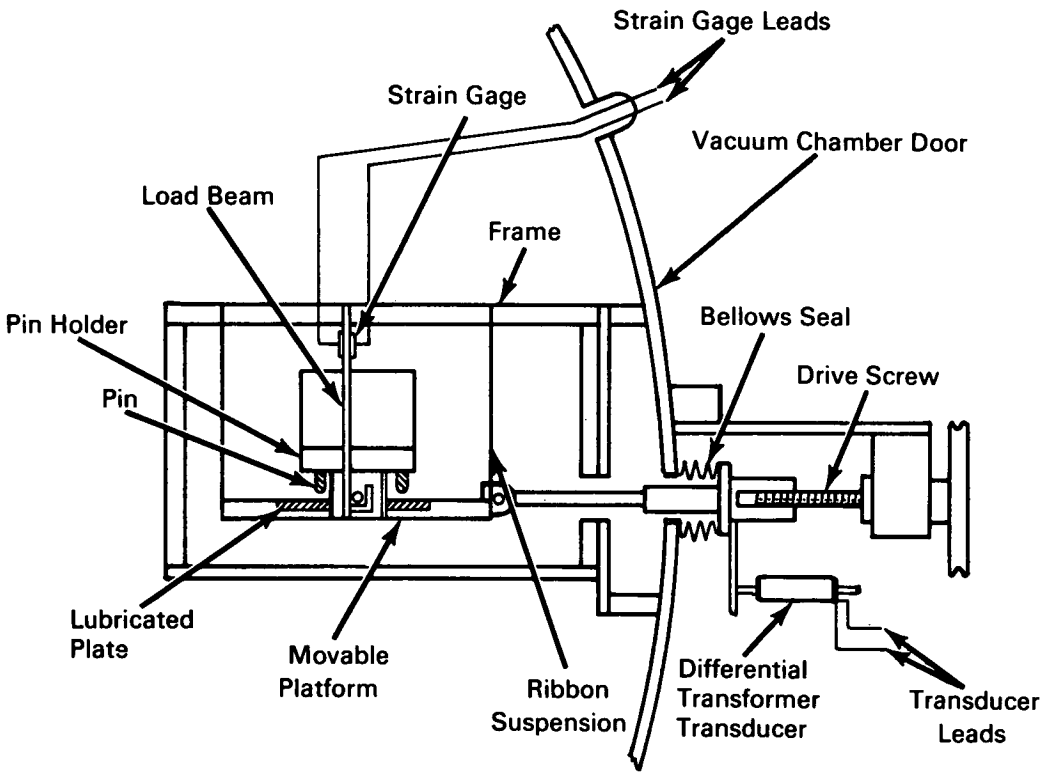
NASA TECH BRIEF

Machine Tests Slow-Speed Sliding Friction in High Vacuum



The problem:

To design a machine to measure the effectiveness of solid lubricants (e.g., molybdenum disulfide) between slow-speed sliding members at various frictional loads in ultrahigh vacuum.

The solution:

A testing machine that operates without any lubrication of the machine elements within the vacuum chamber. The machine measures static, or starting friction as well as kinetic, or sliding friction at very low speeds. Moving parts are held to a minimum to simplify operation in the vacuum chamber.

How it's done:

The friction pair (sliding surfaces) to be measured consists of three spherically tipped, equidistant pins, and a plate specimen. Pins and plate, or the plate alone, are coated with the lubricant to be evaluated. When only the plate is lubricated, the pins are polished to a 400 grit metallographic finish.

(continued overleaf)

The movable platform, which carries the plate specimen, is suspended from the frame by four flexible steel ribbons. A shaft attached to one end of the platform passes through a bellows seal in the door of the vacuum chamber to an exterior drive mechanism. The pin holder supports weights which press the pins against the plate. The force measuring system consists of two beams with four bonded strain gages. These gages are connected in a conventional Wheatstone bridge arrangement, with leads passing through a seal in the chamber door to an external amplifier–recorder circuit.

As the platform is driven back and forth in a linear motion by the drive mechanism, friction between the attached plate specimen and the contacting pins tends to move the pin assembly along with the platform and plate. However, the linkage between the pin holder and load beams restrains the pin holder, so that the pins slide against the plate. Because of the frictional force, the load beams bend slightly and correspondingly deform the strain gages. The resultant unbalancing of the bridge circuit provides an electrical signal which is proportional to the frictional force. This signal is amplified by a two-channel strain gage amplifier–recorder and appears as an ink pattern on one channel of the recorder chart. The position of the pins relative to the plate is determined from the output of the differential transformer transducer attached to the shaft drive mechanism. This output signal appears simultaneously on the second channel of the chart.

Note:

Details concerning the design and operation of the machine as well as the results of experiments with typical solid lubricants may be obtained from:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B67-10379

Patent status:

No patent action is contemplated by NASA.

Source: C. Wilkinson and J. Skyrus
of Douglas Aircraft Co., Inc.
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