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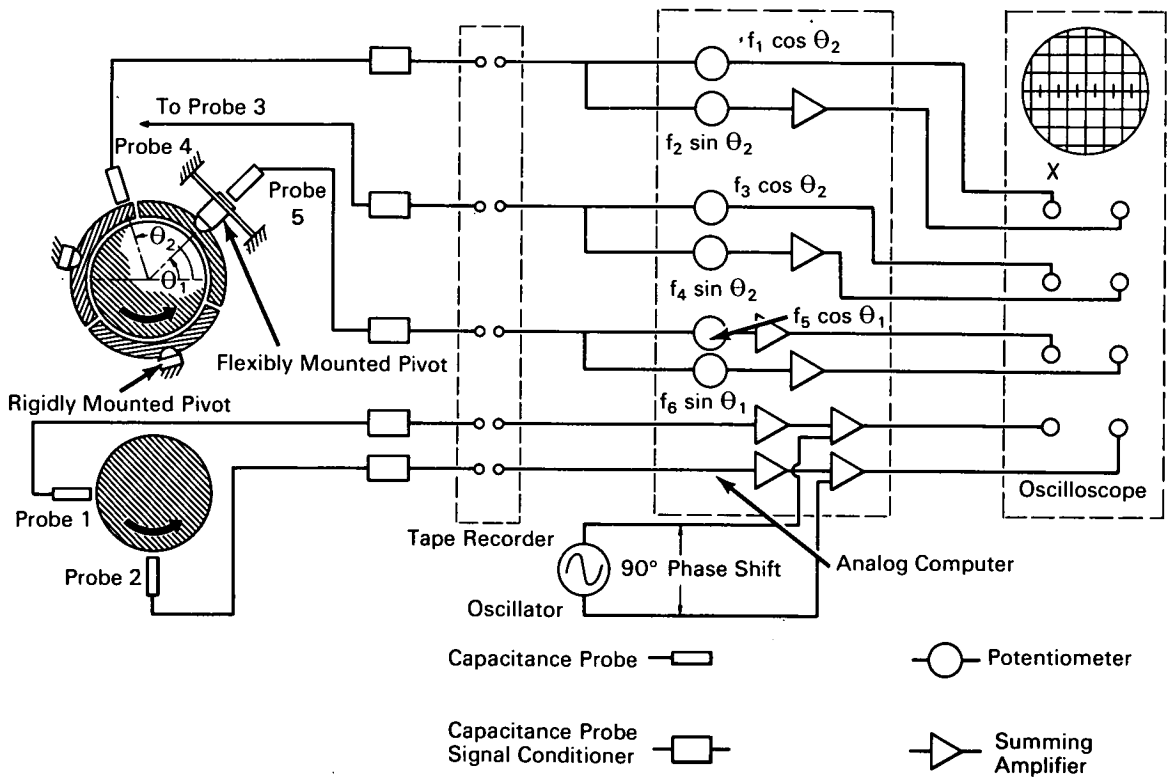
NASA TECH BRIEF

Electronic Visualization of Gas Bearing Behavior



In experimental investigations of gas bearings for rotating machinery, clearance probes are often placed at various locations to monitor bearing component motion. To analyze bearing operation, it is necessary to establish the relationship among the outputs of the various probes in order to determine the relative motions of the bearing components. The outputs from the clearance probes are usually displayed on the vertical axis of a multitrace oscilloscope or oscillograph with a time scale on the horizontal axis. In analyzing these traces, the circumferential location of the probes must be carefully identified and small changes in phase relationship between the traces are not readily detectable.

A visualization technique has been developed, by which the outputs from the various clearance probes were combined electronically to produce a visual simulation of bearing operation. In this simulation, the shaft journal appears as a circle on an oscilloscope with radial motions greatly exaggerated relative to the

(continued overleaf)

size of the circle. The radial motions of the corners of the leading edge of one of the pads pivoting on one of the rigidly mounted pivots, and the radial motion of the flexibly mounted pivot, appear as moving points on the oscilloscope screen.

Visual Display Procedure

The clearance probes are of the capacitive type used for noncontact sensing connected to high-frequency oscillator-amplifiers. A change in distance between the probe and the sensed object produces a proportional change in capacitance, which in turn changes the amplifier output voltage.

At each bearing, two probes are mounted 90° from each other to sense shaft motions. A probe is mounted behind the flexible diaphragm directly over the pad pivot to sense pivot radial motion and diaphragm deflection. Two probes are used to measure the radial motion of the leading edge of one pad pivoting on one of the rigidly mounted pivots in each bearing. The capacitance probe outputs are recorded on magnetic tape.

The taped signals are processed by an analog computer to combine selected signals and to accurately establish the angular relation between the probes. The computer output signals are displayed on an oscilloscope screen using four X–Y displays, and recorded with a high-speed motion picture camera.

Actual shaft frequency was approximately 640 hertz; but in order to visualize the bearing operation, a speed reduction factor of at least 320 was needed. Part of this reduction was accomplished by reducing the tape speed to eliminate multiple traces caused by persistance of the oscilloscope screen. Further reduction was obtained by photographing the oscilloscope display at 130 frames per second, and subsequently projecting the film at slower speeds. The result is clear motion pictures of the complex motions of a cross section of the bearing in operation.

Notes:

1. Documentation for the innovation is available from:

   Clearinghouse for Federal Scientific
   and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10073

2. Technical questions concerning this innovation may directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   B69-10073

Patent status:

No patent action is contemplated by NASA.

Source: Robert Y. Wong, Hugh A. Klassen, and Robert C. Evans (LEW-10711)