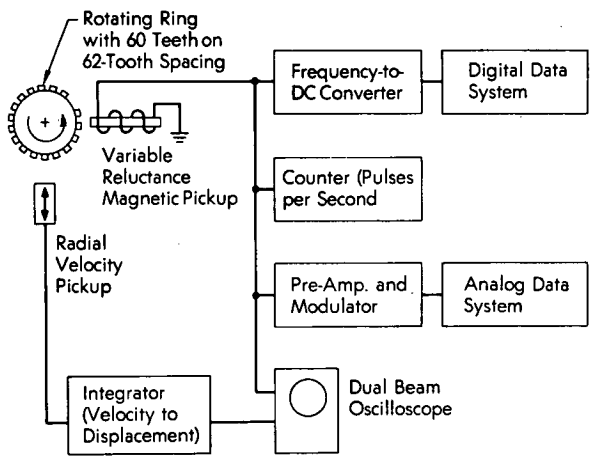
NASA TECH BRIEF

Ames Research Center

Improved System for Measuring Speed of Rotating Machinery

The problem:

A conventional method of monitoring the speed of rotating machinery uses a gear with 60 teeth and a magnetic pickup as a sensor to indicate the number of teeth per second passing by it; the number of teeth



passing by in one second as indicated by an electronic counter connected to the pickup equals the speed in revolutions per minute. When a vibration or stress problem is under investigation, it is customary to use an additional 1-tooth gear and a second magnetic pickup to provide a rotational reference point for the vibration or strain sensor. Use of the two gears and two magnetic pickups with their associated equipment constitutes a redundancy and requires an inconvenient arrangement.

The solution:

A gear that combines both functions and does not require duplicate electronic equipment to provide indication of speed and reference position.

How it's done:

A gear is designed with spaces for 61 or 62 teeth, but only 60 are included in the finished gear; the 1- or 2-tooth gap constitutes a reference point that can be detected electronically, and the convenient count of 60 per revolution is retained. Since the gear is only a minor part of the speed-measuring system, existing equipment can be used without modification.

The diagram illustrates a typical application of the speed-measuring system when used in conjunction with a velocity pickup to detect the radial motion resulting from unbalanced forces acting on a rotating body. For this purpose, the gear notch is related to the position of the magnetic pickup and a vibration sensor by installation on the machine. The electronic counter provides a real-time display of machine speed in the form of pulses per second or revolutions per minute. The output of the magnetic pickup can be converted to a proportional DC voltage, using conventional frequency-to-DC converters, and presented visually by a digital voltmeter. Alternatively, for recording speed in analog or real time, the output is first conditioned by a preamplifier and modulation system.

As indicated in the diagram, the phase relationship of a radial displacement relative to the notch in the gear can be presented visually during a test with the aid of a dual-beam oscilloscope. One beam displays

(continued overleaf)

the output of the tooth sensor, while the other displays a vibration or strain signal. In the instance depicted by the diagram, a radial velocity pickup provides an indication on one beam of the oscilloscope of the magnitude-time relationship of the displacement while the other beam provides a reference mark corresponding to the notch in the gear.

This system can be calibrated by adding a known unbalance at a known position on the rotating mass, and noting the effects on the oscilloscope.

Notes:

1. Any unbalance caused by the lack of symmetry of the gear is neutralized in the usual manner prior to installation as a test device.
2. The notched gear could be permanently installed in any rotating machine to measure speed and to provide a method of locating rotational position.
3. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B72-10179

Patent status:

No patent action is contemplated by NASA.

Source: Eugene G. Smith of
General Electric Company, Aircraft Engine Group
under contract to
Ames Research Center

(ARC-10413)