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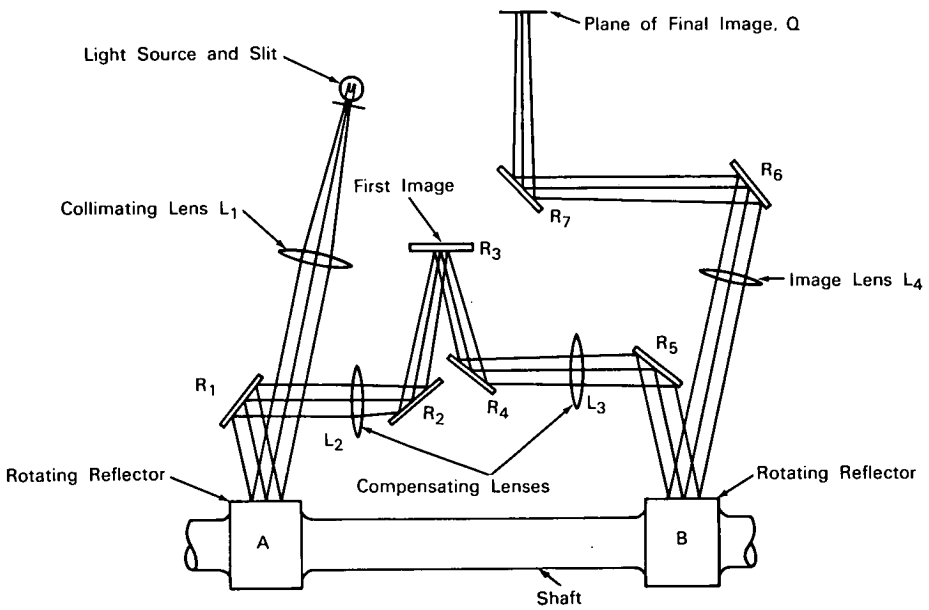
NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the space program.

Optics Used to Measure Torque at High Rotational Speeds



The problem: In measuring torque transmitted by a shaft rotating at high speed, the slip rings required with strain gages do not operate satisfactorily and electromagnetic meters require fixed alignment of the moving parts.

The solution: A torquemeter was devised that includes a shaft, an optical system, and readout servosystem. The system has only optical contact with moving parts, is statically calibrated, and has an accuracy of one percent to extremely high rotational speeds.

How it's done: The optical system light source consists of a lamp masked with a narrow slit, the long dimension of which is in the plane of the figure. Light passing through this slit is collimated by lens L_1 and reflected from the first rotating reflector A to a fixed reflector R_1. The light beam is converged by lens L_2 and reflected off fixed reflectors R_2, R_3, and R_4 to lens L_3. The light is recollimated by L_3 and reflected from the second rotating reflector B to the final image lens L_4. This lens forms a final image of the light source slit at the entrance aperture of the readout servosystem. This entrance aperture is formed by two selenium photovoltaic cells followed by a servosystem that positions the cells so that the gap between them follows the final image. Output voltage of the servosystem is a linear function of this photovoltaic cell displacement.

When torque is applied to the shaft, reflector B may be considered as being rotated at an angle relative to reflector A, and the final image of the slit is displaced.

(continued overleaf)

The displacement is proportional to the rotation of B with respect to A. The output voltage of the servo-system is, therefore, a linear function of torque.

Notes:

1. This system has measured torque of 100 to 26,400 inch-pounds at speeds up to 50,000 rpm. No speed limitations have been established.
2. Further information concerning this invention is described in NASA TN D-1437, "Optical Torquemeter for High Rotational Speeds" by Alois Krsek, Jr. and Marvin Tieferman, October 1962, available from the Department of Commerce, Office of Technical Services, Washington, D.C., 20230; price $1.00. Inquiries may also be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio, 44135
   Reference: B63-10338

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA Headquarters, Washington, D.C., 20546.

Source: Alois Krsek, Jr., and Marvin Tieferman (Lewis-13)