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NASA TECH BRIEF

Goddard Space Flight Center

Torque Control System

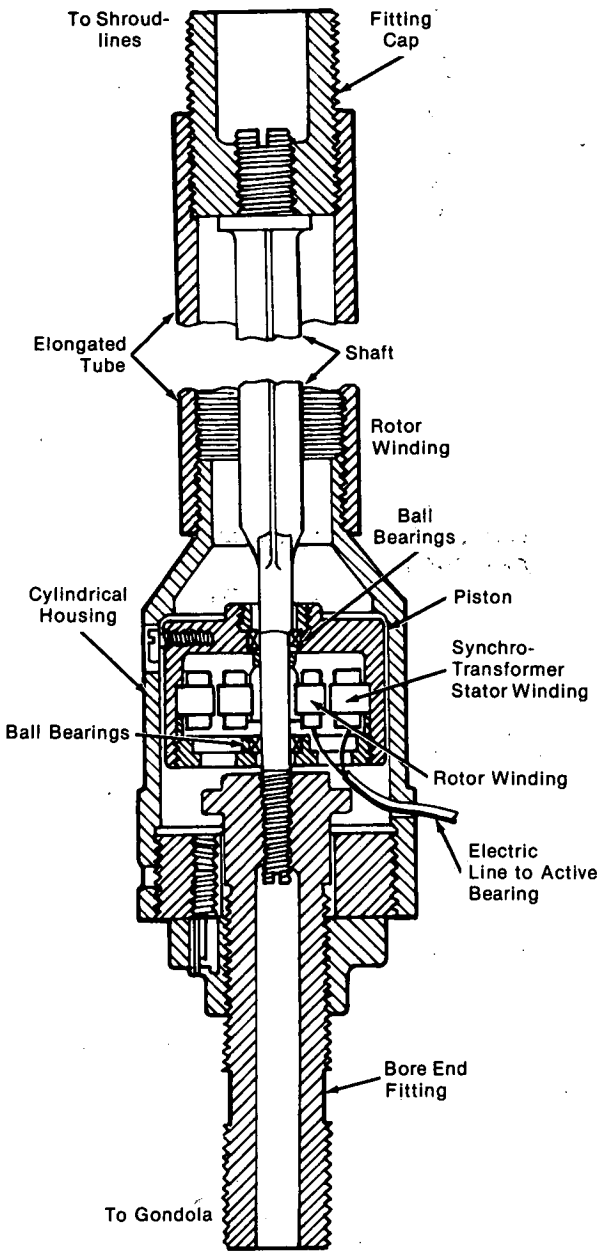

Figure 1. Torque Sensor

The problem:

Gondolas carried by high-altitude balloons are often used as platforms for tracking telescopes. The telescopes must be constantly aimed at specific targets. Unfortunately, once the balloons reach the altitude of approximately 100,000 feet (30,000 m), they start to rotate at a slow rate. This rotation is transferred to the gondolas through parachute shroudlines. Various devices have been used to stabilize the gondolas; however, none has the accuracy necessary for the tracking telescopes (5 arc-seconds).

The solution:

A new torque control system stabilizes the azimuth of a gondola to within 5 arc-seconds.

How it's done:

The system comprises a torque sensor and an active bearing. The torque sensor is connected between the lower ends of the shroudlines and the gondola and senses torque applied by the shroudlines to the gondola. The sensor generates pulses proportional to the applied torque. The pulses are fed by electrical lines to an active bearing which is located between the upper end of the parachute and the lower end of the balloon. The bearing is driven either clockwise or counterclockwise to counteract the detected torque. This system is designed to stabilize a 2,500-pound (1,136-kg) gondola.

The sensor as shown in Figure 1 includes a shaft approximately 20 inches (50 cm) long. Much of the shaft is cruciform in cross section which allows it to be shorter than an ordinary rod and still provide the same axial strength and torque sensitivity. The top end of the shaft is screwed into a bore in the fitting cap, and the bottom end is similarly connected to the bore end fitting. The top and the bottom are connected, respectively, to the shroudlines and the gondola.

(continued overleaf)

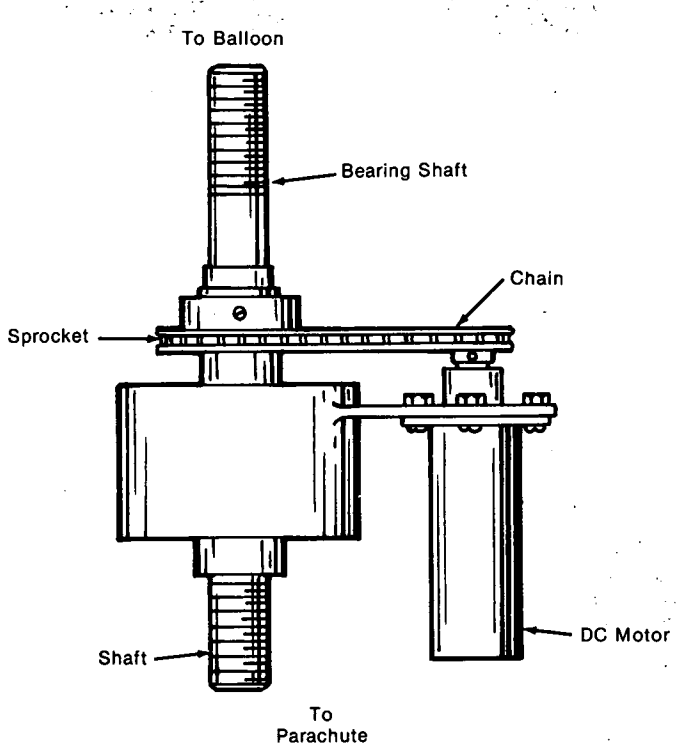

Figure 2. Active Bearing

The sensor also includes a synchro transformer. The transformer rotor winding is bonded to the cylindrical portion of the shaft. The stator winding is concentric with the rotor and is mounted on a piston which is fixed to the upper end of the shaft. Two ball bearing assemblies support the shaft which rotates relative to the piston.

In operation, when a torque is applied by the shroudlines, the shaft begins to rotate. The rotation is sensed by the transformer which is fed by a 400-Hz square-wave source. The transformer feeds a circuit which generates an error signal. This signal is fed to the active bearing.

The bearing as shown in Figure 2 includes a thrust bearing housing. Two shafts extend from this housing: The top one is a bearing shaft connected to the balloon, and the bottom shaft is connected to the parachute. The bearing shaft is driven through a sprocket-and-chain drive connected to a reversible dc motor. Pulses generated by the torque sensor drive the motor which compensates for the torque applied to the gondola.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
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Greenbelt, Maryland, 20771
Reference: TSP75-10085

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,698,667). Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

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