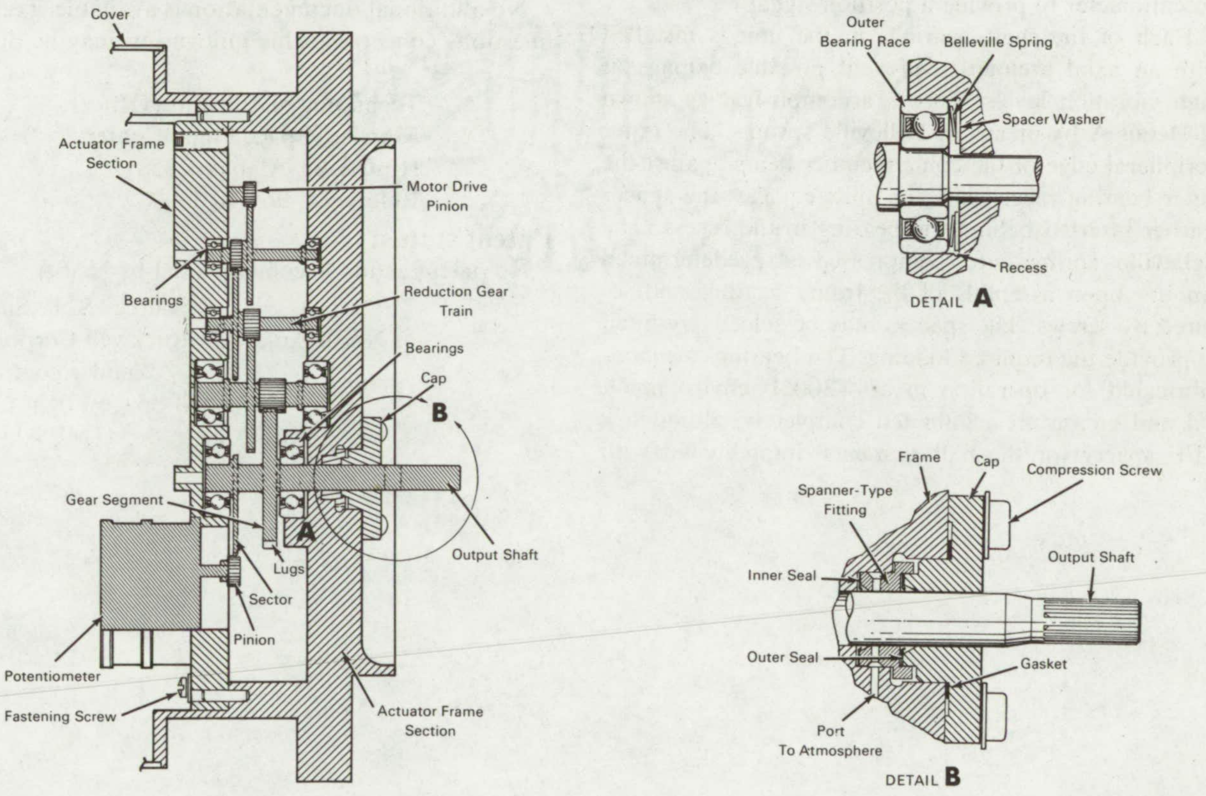
NASA TECH BRIEF

Electromechanical Rotary Actuator Operates Over Wide Temperature Range



The problem:

To design, an electromechanical actuator that will operate over the temperature range from $+140°$ to $-300°F$. Available actuators were not suitable for cryogenic applications. Also, stroke limiting was effected either by an infinitely rigid stop or a clutch. In the first case, the impact loading on the gear train was undesirable, and in the second, precise control of the detent with respect to positioning would increase the complexity of the actuator, with a reduction in reliability.

The solution:

An electromechanical rotary actuator incorporating a spring stop which has been calculated to limit internal deceleration loads to a magnitude equal to stall torque. Overtravel is below 1½ degrees, which is less than one full revolution of the motor. Thus, overloading of the gear train is avoided. Cryogenic capability is

(continued overleaf)

obtained by use of dry lubricant on the gears and no lubrication on the bearings, which perform properly at all operating temperatures. The actuator is designed for applications requiring accurate positioning of the stroke limit and for low-temperature environments in which petroleum based greases become unsuitable for lubricating purposes.

How it's done:

The actuator unit comprises a reduction gear train, motor drive pinion, output shaft, and potentiometer. Rotation of the shaft is limited to approximately 60° travel. The gear segment on the shaft includes a pair of lugs which engage limit stops. The stop members are in the form of small cantilever beam elements secured to the actuator frame. The sector mounted on the output shaft drives the pinion on the shaft of the potentiometer to provide a position signal.

Each of the shaft bearings in the unit is installed with an axial preload to prevent possible damage at high vibration levels. This is accomplished as shown in Detail A by means of Belleville springs. The outer peripheral edge of the conic member bears against the outer bearing race, while the apex engages the spacer washer inserted behind the bearing in the recess. The Belleville springs are compressed a predetermined amount upon assembly of the frame sections and secured by screws. The spacers may be selectively fitted to provide the required loading. The bearings are nonlubricated for operation in a —300°F environment. Oil and grease are eliminated completely, although a TFE spacer for the ball elements, impregnated with dry lubricant material, may be used.

The entire assembly is environmentally sealed by welding a cover to the frame. The output shaft, which serves to move the valve member (not shown) extends through the frame section on the right. To avoid penetration of fluids along the shaft, inner and outer seals (Detail B) are provided. The inner seal is retained by a spanner type fitting against which the outer seal is seated and retained by the projecting portion of the cap. A gasket is located between the cap and outer surface of the frame and held in compression by screws. The area between the seals is ported to atmosphere to drain any fluid passing the outer seal and thereby avoid the possibility of such material entering the inner sealed area.

Notes:

No additional documentation is available. Technical questions concerning this innovation may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
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Patent status:

No patent action is contemplated by NASA.

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