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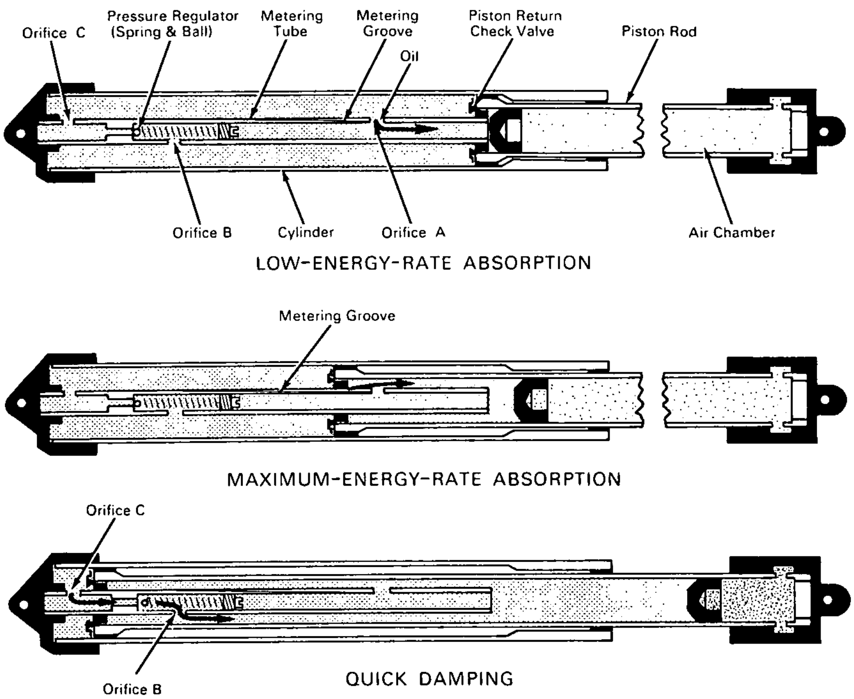
NASA TECH BRIEF

Shock Absorber Operates Over Wide Range



LOW-ENERGY-RATE ABSORPTION

MAXIMUM-ENERGY-RATE ABSORPTION

QUICK DAMPING

The problem: To provide a vehicle shock absorber that will operate over a 10:1 range of kinetic energy loading rates.

The solution: A piston-type hydraulic shock absorber with a metered damping system that responds to different rates of energy loading.

How it's done: The metering system contained within the hydraulic (oil-filled) cylinder consists of a central metering tube with three orifices, a metering groove, and a spring-and-ball pressure regulator valve. Fluid seals are used between the outside diameter of the piston and the cylinder bore, and between the inside diameter of the piston and the metering tube to ensure oil flow through the proper channels (orifices, metering groove, or pressure regulator) when different energy loadings are encountered.

When low energy rates are encountered, the piston rod moving into the cylinder causes the oil to flow through orifice A only. This orifice has a constant damping coefficient, so that the force resisting the motion of the piston will vary as the square of the piston velocity.

Maximum energy rates cause the piston to move past orifice A, forcing the oil to flow through the metering groove. This groove is tapered to vary the damping coefficient as a function of piston stroke and

(continued overleaf)

thus provide an essentially constant damping force for maximum energy absorption.

Quick damping to absorb rotational energy of the vehicle is provided after the piston has moved past orifices A and B. Oil then flows sequentially through orifice C, the pressure regulator, and orifice B. In this phase of operation, the hydraulic force resisting motion of the piston is constant, regardless of piston velocity, and of sufficient magnitude (controlled by adjusting spring compression in the pressure regulator) to minimize the piston displacement required to absorb the relative angular momentum of the vehicle.

Notes:

1. The damping characteristics, and thus the forces generated during the three phases of operation, can be independently varied to achieve the desired overall action of the shock absorber.
2. The general design of the device may be modified in a number of ways without affecting the principle of operation. One or more of these devices may be mounted to operate singly or jointly on a vehicle.
3. This device should be useful for absorbing shock and vibration on mounted machinery, heavy earth-moving equipment, and vehicles with widely varying cargo weights and relative motion.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center
   P.O. Box 1537
   Houston, Texas, 77001
   Reference: B65-10241

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

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