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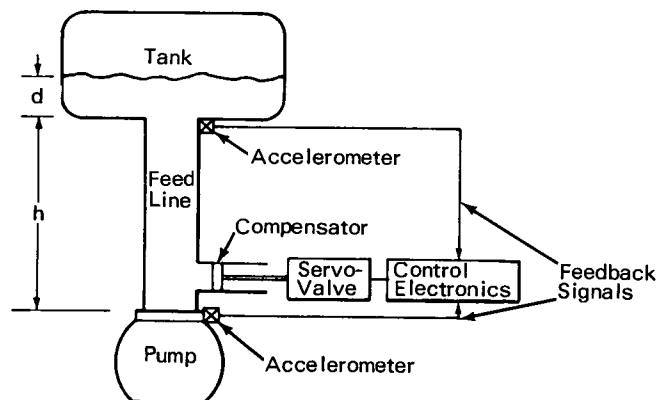
Marshall Space Flight Center



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Servo-Controlled Decoupler Eliminates Oscillations in Fluid Flow: A Concept

An active control technique, which uses an accelerometer-controlled servovalve to operate a compensating piston, can effectively eliminate all pressure fluctuations due to longitudinal structural vibration, within a relatively wide bandwidth. Previous passive



techniques employing standpipes, tuned pistons and accumulators could only reduce the amplitude of vibration-induced pressures, and required a knowledge of the system resonance, damping and transfer characteristics. The new technique has simplified the fluid system design and has eliminated the necessity for knowing the system response characteristics.

The decoupler (see fig.) works by sensing fluid acceleration and modulating the motion of a piston to produce an opposing acceleration. The feedback signals from low-frequency accelerometers are integrated by the control electronics to supply the servovalve with a signal that is proportional to the component of fluid acceleration above a minimum frequency. This allows vibration cancellation only above that minimum frequency. Although loops can be designed with a limit as low as desired, a minimum of 1 Hz is more practical.

Physically, the compensator can be a simple piston in a tee (as shown in the figure), a differential-area pulser, a cylindrical or toroidal piston in a manifold, or any other displacement device that can be driven by the servo. The response of the servovalve determines the maximum frequency, with values of 35 to 50 Hz easily obtainable. Within this relatively wide frequency range, pressure oscillations caused by mechanical vibration can be completely eliminated, with little regard to the actual system dynamics.

Notes:

1. In systems with long feed lines (i.e., small values of d/h), only a single accelerometer located at the pump is required. For larger values of d/h , a second accelerometer located at the tank must be added, and must be compensated for the effects of feed-line resonance. In systems intended for use in moving vehicles, a third, reference accelerometer (not shown) is required so that the control system will be insensitive to overall system acceleration.
2. Requests for further information may be directed to:

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