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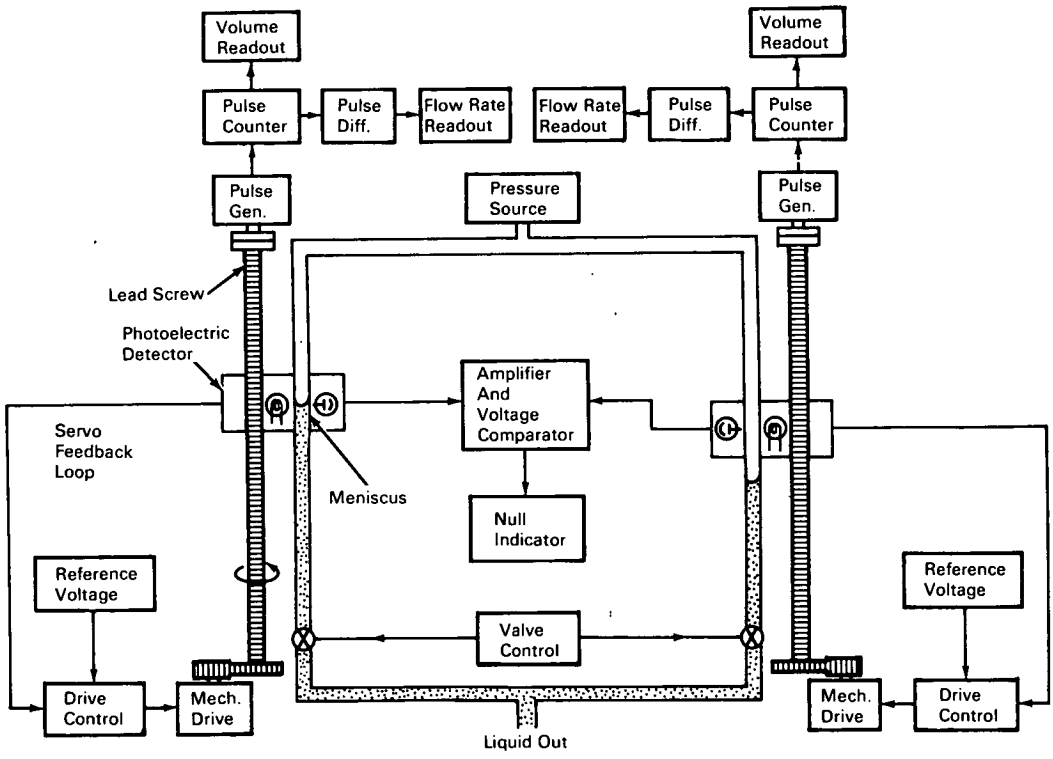
NASA TECH BRIEF

Electromechanical Flowmeter Accurately Monitors Fluid Flow



The problem: Providing an instrument that will remotely and accurately monitor the flow rate and total volume of a transparent liquid being discharged from a dispensing system. One approach for continuous flow indication is through the use of a photoelectric detector and light source that are mechanically driven along a transparent dispensing tube to track or follow the displacement of the liquid meniscus. Previous instruments based on this approach do not give an accurate indication of the total amount of liquid dispensed since they depend upon an inherently inaccurate reference point that cannot be set from a remote location. These instruments do not compensate for temperature variations which expand or contract the liquid and thus alter the level of the meniscus in the dispensing tube.

The solution: An electromechanical flowmeter employing two similar dispensing tubes and two photoelectric detectors that are accurately driven on lead screws to track the meniscus in each tube. A null indicator connected to the outputs of the detectors

(continued overleaf)

fixes the level of the liquid in one tube as a reference with respect to the level of the liquid in the other tube. Compensation for any temperature variations is maintained by alternately referencing between the two tubes as the liquids are dispensed.

How it's done: A gas pressure source and two remotely controlled valves connected to each of the dispensing tubes are used to regulate the flow of liquid from the system. The photoelectric detectors are positioned for parallel longitudinal movement along the dispensing tubes to sense the position of each meniscus. Signals from the detectors are coupled to a conventional amplifier and voltage comparator circuit which in turn is connected to a null indicator. This indicator registers a null or minimum reading only when the voltage levels of the signals from the two detectors are approximately equal and thus establishes the position of the meniscus in one of the tubes as a reference for the meniscus in the second tube.

As liquid is dispensed, each detector independently tracks the displacement of the meniscus in the tube with which it is associated. The detector outputs and reference voltages (equal to the output voltages from the respective detectors) are fed to the remote drive controls which regulate the variable-speed motors that drive the detectors along the lead screws. For each of the dispensing tubes, the electrical output line from the detector, the drive control, the mechanical drive, and the lead screw constitute a feedback circuit which automatically positions the detector in accordance with the position of the meniscus of the liquid in the corresponding tube. The pulse generators, coupled to each lead screw, generate a predetermined number of pulses for each revolution of the lead screw. The pulse counters and readouts, by means of multiplication circuitry not shown, give the volume of liquid dispensed. Liquid flow rates are obtained by connecting the pulse counters to pulse differentiators and additional readouts.

Notes:

1. Since the entire operation may be controlled from a remote station, this flowmeter should be particularly useful for accurately monitoring the flow of small quantities of hazardous (radioactive toxic, or explosive) liquids, or liquids that must be dispensed in closed chambers, such as vacuum chambers.

2. The same principle of operation may be used with more than two dispensing tubes.

3. Instead of using the dual dispensing tube system to provide a relative level reference between the liquids in each tube, the same principle can be applied to one or more tubes by connecting an independent reference voltage source to the amplifier and voltage comparator.

4. If the dispensing tube or liquid is opaque, magnetic detectors may be used instead of the photoelectric detectors. In this case, a buoyant slug containing magnetic material will have to be placed on the liquid surface in the tube.

5. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10273

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA, and a patent application has been filed. When patented, royalty-free nonexclusive licenses for its commercial use will be available. Inquiries concerning license rights should be made to NASA, Code AGP, Washington, D.C., 20546.

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