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SURGE-DAMPING VACUUM VALVE

J. C. Bullock
B. E. Kelley

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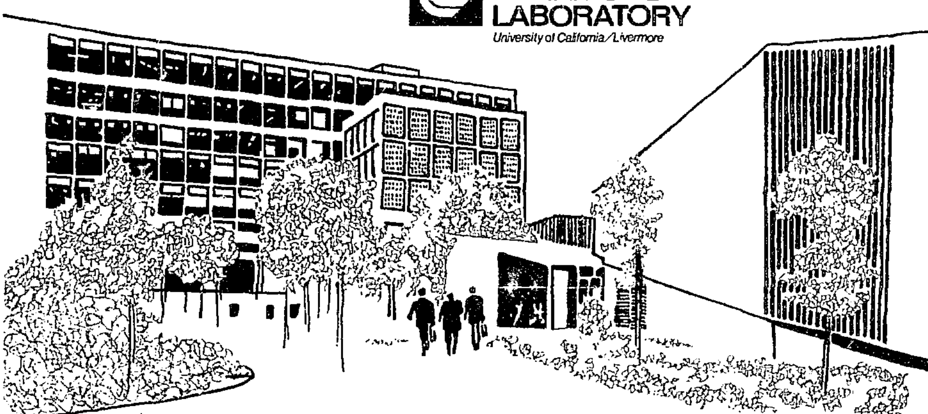

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ABSTRACT

We have described a valve for damping out flow surges in a vacuum system. The surge-damping mechanism consists of a slotted, spring-loaded disk adjacent to the valve's vacuum port (the flow passage to the vacuum roughing pump). Under flow surge conditions, the differential pressure forces the disk into a sealing engagement with the vacuum port, thereby restricting the gas flow path to narrow slots in the disk's periphery. The increased flow damps out the flow surge. When pressure is equalized on both sides of the valve, the spring load moves the disk away from the port to restore full flow conductance through the valve.

Flow surges are very common in vacuum systems. They are usually inconsequential, but in some systems they can damage the delicate apparatus or fragile parts that are used or stored within the system. The surges can also contaminate vacuum pumps by sweeping unwanted materials into them.

The valve was specifically designed and built to protect 2000-Å-thick lead foils stored in a bell jar, although the concept is general and may be used in most vacuum systems. It is automatic, thus eliminating the need for an operator to open a manual valve slowly. Figure 1 shows the surge damping mechanism; Figs. 2 and 3 show the valve operation under flow surge and normal conditions, respectively.

Testing. In the initial test of the system, the surge-damping valve was mounted on a 90° bellows-type vacuum valve that in turn was mounted on the inlet to the roughing pump. When the valve was manually opened, the surge valve closed and did not open again until the system was equalized at approximately 1000 Torr. The system then pumped down normally to its base pressure.

Discussion. The valve is automatic, almost maintenance free, and could be incorporated in several places on the roughing side of a vacuum system. It does not need to be manipulated nor does it need an internal power source. It could be used to protect fragile windows that are in line-of-sight pipes and that are under vacuum. It might also be used to protect glass vacuum systems.

The conductance of any given vacuum line may be reduced by installing the valve in it because of the circuitous path the gas must take through the valve and because the annulus may be smaller in area than the inside diameter of the vacuum line. However, if this becomes a problem, an electromechanical bypass system can be installed and actuated by the opening of the valve.

Associated Effort. UCLLL invention case #IL5533 (S-42, 141, RL5757) by C. Hugenberger (Figs. 4 and 5) describes a vacuum flow regulator that automatically damps out flow surges by movement of a spring-loaded disk located within a flow passage. After testing, Hugenberger found that the regulator worked as intended for pump down but did not work for venting because the gas velocity was not high enough in the latter mode.

Conclusion. The surge valve and the flow regulator are presently being used in several vacuum systems at LLL and could probably be used effectively in many other systems at the Laboratory. However, note that neither device is a check valve; that is, neither device totally interrupts the flow at a preset pressure.

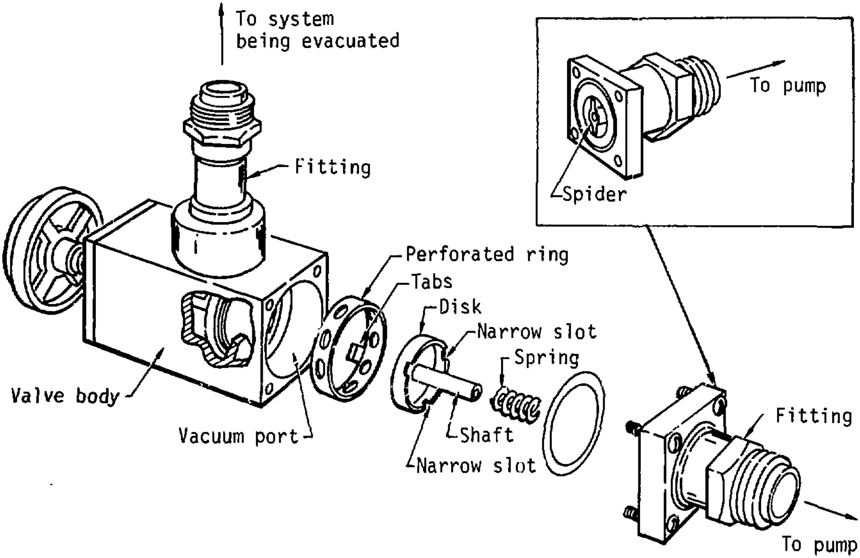

Fig. 1. Surge damping mechanism. The mechanism consists of a disk with several narrow slots on its periphery. The disk is mounted on the end of a shaft centrally positioned by a spider (inset). A spring on the shaft forces the disk against the tabs on a perforated ring positioned within the vacuum port of a valve body. The fittings connect to the system being evacuated and the roughing pump.

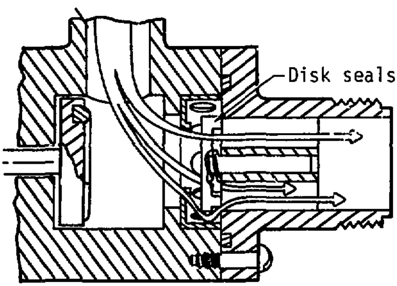

Fig. 2. Valve operation under flow surge conditions. The momentary pressure differential forces the disk into a sealing engagement with the fitting, thus restricting the gas flow through the slots.

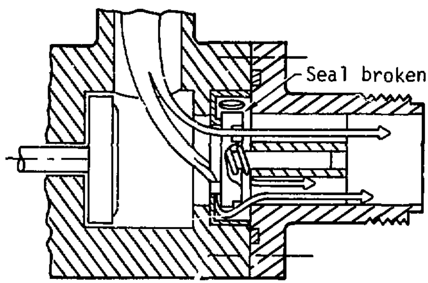

Fig. 3. Normal valve operation. The increased flow resistance (see Fig. 2 caption) damps out the flow surge. When the pressure equalizes on both parts of the valve, the spring forces the disk out of engagement with the fitting, thereby restoring full flow conductance through the valve.

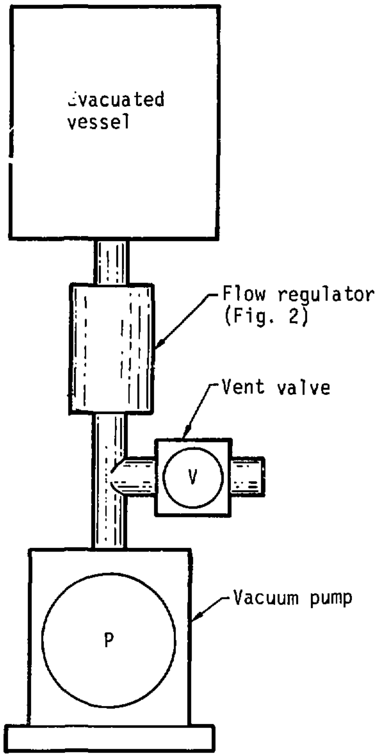

Fig. 4. Placement of flow regulator.

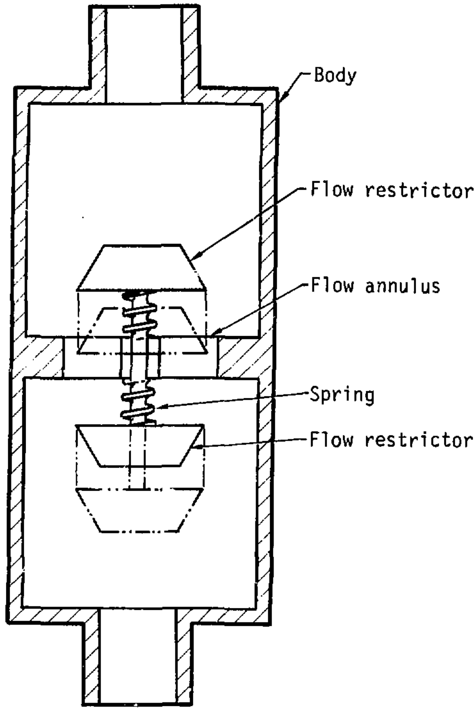

Fig. 5. Flow regulator.

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