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VARIABLE ORIFICE FOR DIFFERENTIAL PUMPING IN A VACUUM SYSTEM

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VARIABLE ORIFICE FOR DIFFERENTIAL PUMPING IN A VACUUM SYSTEM

In differential pumping, the pumping speed has in the past been controlled by the size of the orifice between the vacuum chamber and the diffusion pump. This fixed orifice is usually in the valve gate of a high-vacuum valve (or in a baffle plate). To change the pumping speed, then, the valve must be removed and another valve with an orifice of a different size must be inserted. This process is time consuming and risks contamination of the system, which would require another pumpdown and bakeout.

We have developed a simple shutter that controls pumping speed without requiring any change in components. The shutter consists of 20 leaves arranged as an iris that opens to a 6-in.-diam orifice or closes to 0.25 in.

The shutter consists of a mounting ring (Fig. 1a), the leaves, a drive ring, and a drive gear (Fig. 1b). Each leaf is stainless steel with a pivot pin at one end and an offset pin at the other. The leaves are placed in the mounting ring (Fig. 1c) and the drive ring and the drive gear are attached (Fig. 1d). Rotating the drive gear moves the leaves and changes the orifice size (Fig. 1e).

The complete shutter is stainless steel. Each leaf is made of 0.015-in. stainless steel sheet that is electroetched after assembly to 0.011 in. At 0.015 in. the shutter will close down to only 0.75 in.; thinning the leaves provides the extra 0.5-in. closure. We believe that further thinning would cause the leaves to collapse.

The drive mechanism for the shutter is a spur gear rack rolled inside out to form the diameter of the drive ring. It is driven by a spur gear through a vacuum feedthrough in the base plate of the vacuum system. A synchronous motor provides the power. The shutter can be controlled manually, automatically with a thermocouple gage, or by computer.

We have built one of these shutters and used it successfully with a 4-in. diffusion pump system. In this system the pressure is 100 μ in the vacuum chamber and 0.0001 μ at the diffusion pump. The shutter was placed above the cold trap so it could be used for both diffusion pumping and roughing.

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(a)

(b)

(c)

(d)

(e)

Fig. 1. The variable orifice. (a) is the mounting ring with an opening 6 in. in diameter. The small inner holes hold the pivot pins of the leaves. (b) shows four of the leaves, the drive gear, and the drive ring with grooves for the offset pins. The movement of the pins in the grooves makes it possible to vary orifice size. (c) shows the leaves in place in the mounting ring. (d) shows the drive ring and the drive gear in place, with the shutter completely open. (e) shows the shutter partly closed.

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