

Mechanical and Fluid Systems

Cryogenic Butterfly Valve

[A Butterfly Valve That Can Rotate and Translate](#)

Typical butterfly valves cannot seal at ambient and cryogenic temperatures. In cryogenic environments, valves experience vast temperature ranges, causing them to grow and shrink, changing critical dimensions such as distance between the disc and seat. Therefore, valves must be able to compensate for these changing dimensions, and seal tightly at both extremes. The variable dependability of butterfly valves available, resulted in the need for a novel valve design which provides a more reliable seal in cryogenic settings. The Cryogenic Cam Butterfly Valve (CCBV) is designed so that the disc rides on a cam shaft and is held rigid by a torsion spring, which provides both axial movement of the disc in addition to the standard 90 degree rotation of a standard butterfly valve. Because the valves disc can rotate and translate, it can hold a tighter seal, preventing leakage despite dimensional changes caused by changing operating temperatures. The novel concept enables functional advantages similar to a globe valve. The CCBV not only offers also low leakage at both ambient and cryogenic temperatures, but also offers when compared to competing valves, a drastically simpler design as well as reduced manufacturing and maintenance costs.

BENEFITS

- Improved seat leak performance over a wide range of temperatures
- Simple seat design with a larger
- Oxygen compatible soft goods
- Soft seat ensures zero leakage

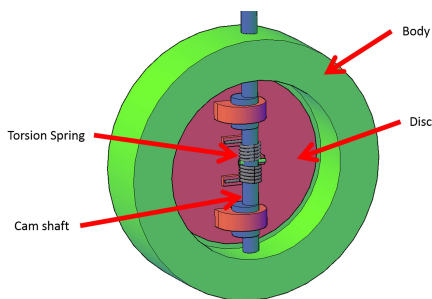
technology solution



THE TECHNOLOGY

A globe valve controls flow by translating a disc over an opening. A butterfly valve controls flow by rotating a disc in an opening. The disc and seat have to create a tight seal exactly when the disc meets the 90 degree mark. If additional torque (energy) is added to the actuator of a butterfly valve, the disc will rotate past 90 degrees and the valve will open again. Therefore, with a standard butterfly valve, additional actuator energy cannot be added to reduce or minimize seat leakage, like with a globe valve.

The novel Cryogenic Cam Butterfly Valve (CCBV) design, functions like a typical butterfly valve: the handwheel is rotated to open or close the valve. However, unlike a typical butterfly valve disc that can only rotate, the hybrid CCBV implements both control methods, translating and rotating to control flow. The main parts of the CCBV include a body, disc, cam shaft, torsion spring and 180 degree actuator. In the full open position, disc rotation is 0 degrees and the disc is situated approximately perpendicular to the valve body to enable maximum flow through the valve. However, unlike a typical butterfly valve where the disc is not pinned to the shaft, the CCBV has a preloaded torsion spring mounted concentrically on the shaft with the spring legs against the disc, and a pin to keep the disc coupled to the shaft. The torsion spring is preloaded with sufficient torque so that the disc/shaft assembly acts like the disc is rigidly pinned to the shaft. The first 90 degrees of the actuator and shaft rotation rotates the disc, just like a typical butterfly valve; however, at approximately 90 degrees, one edge of the disc makes contact with the body seat, while the opposite edge is slightly off of the body seat. At this point, the disc can no longer rotate. The cam shaft then converts rotatory motion into translational motion. Because of the cam shaft lobes, as the actuator continues to rotate the shaft, the disc can now translate towards the body, and enables more of the disc to seal against the body seat. Therefore, all actuator and shaft rotation beyond 90 degrees translates the disc towards the body seat to create a tighter seal, similar to how globe valve functions. When the valve is in this position, seat leakage will be reduced and with additional actuator rotation, stopped. Eventually, a tight seal is formed, in the full closed position. Then, with opposite shaft rotation, the valve will open. Essentially, the CCBV is a butterfly valve developed with the additional advantages of a globe valve incorporated into the design.



Conceptual Illustration of the Cryogenic Butterfly Valve

APPLICATIONS

The technology has several potential applications:

- ➔ Aerospace
- ➔ Petrochemical plants-piping systems
- ➔ Chemical industry-piping systems
- ➔ Cryogenic fluid systems, fluid

PUBLICATIONS

Patent Pending

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