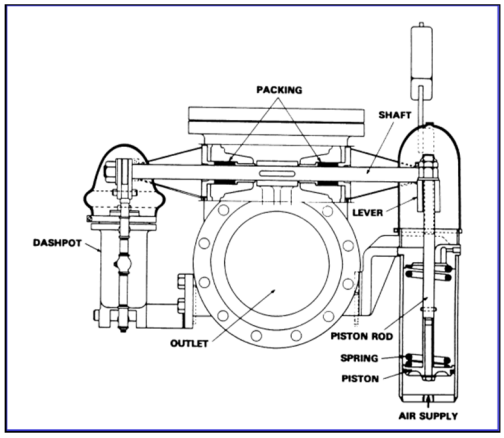
FCC Air Blower (Axial Compressor) Discharge Check Valve



Purpose

The purpose of the special check valve installed in the FCC main air blower discharge line is to prevent backflow of catalyst from the FCC regenerator. This is an extremely hazardous scenario as hot catalyst from the regenerator could be discharged to atmosphere at temperatures up to 535 ºC via the blower anti-surge blowoff valve. The check valve is required to remain open without chatter, slamming or vibration over the full range of operating conditions and to close immediately on loss of air flow or on flow reversal. A low pressure drop is required over a wide range of operating conditions in order to minimise utility consumption at the blower driver for a given coke burn capacity (air demand). A rapid closure time is required on loss of air flow in order to provide maximum protection for axial-type main air blowers which are very sensitive to pressure surges due to tight clearances between the rotor and stator blades.

Description

The most common type of non-slam check valve used in FCC main air blower service is an externally counterweighted swing-type valve with an oil dashpot and a spring-loaded air piston for spring closing. The valve essentially consists of a body with streamlined internal contours, a self-aligning disc connected to a large diameter hinge with hardened stainless steel bushings, and a top cover. It has an inclined seat which reduces the opening angle, resulting in lower pressure drop at full flow and quicker closing on loss of flow. The valve is typically supplied with bevelled inlet and outlet connections for welding into a horizontal section of the main air blower discharge line. The top cover is typically bolted for easy access to the valve internals (enabling in-situ inspection and repair).

Operating Principle

The disc swings away from the valve seat to allow flow in the forward direction. An internal stop provides the proper degree of disc opening while maintaining the edge of the disc within the flow stream, so when forward flow stops the disc returns to the valve seat. The counterweight balances a portion of the disc weight in order to reduce pressure drop at low flow so that the flow is not required to raise the full weight of the disc. The dashpot prevents excessive swinging, chattering or vibrating of the valve in service.

The spring-loaded air piston acts through a lever on the shaft such that when air pressure is applied to the cylinder, the spring is compressed and there is no force from the piston rod tending either to close the valve or to keep it open. The lever also serves as a useful indicator of the valve disc position. When air pressure is released from the cylinder, the spring exerts a force through the lever on the shaft, tending to close the valve, but not necessarily fully closing it against a flow of air in the normal direction. The centre of gravity of the disc assembly creates a positive seating moment so as flow drops off the weight of the disc acts to seat it and hold it firmly against its seat.

Installation

Ideally, the check valve should be installed at least 5 pipe diameters downstream of the nearest flow disturbance in order to minimise pressure drop and prevent uneven wear of the seats. On initial installation, the counterweight is moved along the lever to a point at which the disc will close by gravity from any position and is then secured with set screws. (Some refiners cut off the end of the lever to ensure the counterweight cannot be relocated further out on the lever.) Sleeves are fitted over all exposed rotating and sliding surfaces to protect them from rain, snow, dust etc and to retard rusting or fouling with dust or dirt.

Alternatives

Axial flow non-slam check valves have become increasingly popular in recent years. These have several advantages over the traditional swing-type valves including lower pressure drop (due to venturi-shaped body), quicker reaction and closure times on loss of flow (due to spring assist and shorter disc travel), and reduced maintenance requirements (due to absence of external components). The disc in an axial flow check valve always remains perpendicular to the flow, so the area exposed to flow remains constant (the area exposed to flow reduces in a swing-type check valve).

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