ABSTRACT: A one-way valve for controlling the flow of abrasive liquids is provided which consists of a pivoted closure member and a valve seat against which the closure member may seal. The closure member is formed by an enclosed chamber and means are provided for alternately filling the enclosed chamber with air to cause the closure member to become buoyant and with water to cause the closure member to sink in the abrasive liquid being handled.
ONE-WAY VALVE WITH BUOYANCY ADJUSTMENT

The present invention relates to one-way valves and in particular one-way valves for controlling the flow of abrasive fluids.

In a previously proposed hydraulic one-hoisting system, pressure responsive one-way valves have been used to control the flow of abrasive fluids through a conduit. Such valves include a valve member which is normally biased to a closed position in which it blocks the conduit and which is movable in response to a predetermined pressure to an open position in which it lies clear of the path of fluid flow through the valve. However, since the valve is purely pressure responsive, minor fluctuations in the fluid pressure will cause the valve member to intermittently move into and out of the path of the fluid passing through the valve. The abrasive fluid impinging on the valve member erodes the valve member and consequently shortens its life.

It is an object of the invention, to provide a one-way valve which is particularly suitable for controlling the flow of an abrasive liquid through a conduit and which overcomes the aforementioned disadvantage.

A valve according to the invention, has a pivoted closure member, an enclosed chamber connected to or integral with the member, means for alternately filling the chamber with fluids of different densities on being less dense than the abrasive liquid being handled to cause the member to become buoyant and the other being a density which will cause the member to sink in the abrasive liquid being handled, and a valve seat against which the closure member is adapted to seal when it becomes buoyant.

A feature of the invention is that means are provided to clean the valve seat against which the closure member is adapted to seal.

In the accompanying drawing there is shown schematically a valve according to the invention, which is particularly suited for controlling the flow of abrasive fluids through a conduit in a hydraulic one-hoisting system.

In a previously proposed hydraulic one-hoisting system, the rock is mixed with a liquid (e.g. water) and is fed from a reservoir through a conduit into the cylinder of a hydraulic ram. The mixture moves into the cylinder during the retraction stroke of the ram and is expelled from the cylinder during the displacement movement of the ram.

The valve of the invention may be positioned in the conduit(s) of such a system to control the flow of rock and liquid into and out of the cylinder.

The valve shown in the drawing, comprises a housing 10 which is provided at its upper end with a liquid inlet 12, the lower end of which forms a valve seat 14 for a valve closure member 16 pivoted to a lug 18 on the housing 10.

A replaceable sleeve 20 within the inlet 12 guides liquid, entering the valve past the valve seat 14.

A series of irrigation passages 22 extend from an annular chamber 24 surrounding the fluid inlet 12, to a directring ring 26 adjacent the valve seat 14.

The valve closure member 16, which is shaped to seal against the valve seat 14 and seat (or seal) the lower end of the sleeve 20, has an enclosed chamber 27 into which extends a flexible air tube 28 and a flexible water tube 30. The tubes 28 and 30 are connected to a valve system (not shown) for controlling the flow of air and water through the tubes 28 and 30.

At its lower end, the housing 10 is provided with a liquid outlet 32.

At the start of a cycle, a reservoir connecting to the conduit is filled with water, and rock which is to be hydraulically hoisted, is placed into the reservoir and mixed with water. The chamber 27 is at this stage filled with air and the valve member 16 is held closed by the pressure within the cylinder of the hydraulic ram which at this time is completing the displacement stroke of the pressure cycle. The valve closure member is at this time in the position shown in the drawing. The valve is closed.

When the ram completes its displacement stroke it retracts, releasing the pressure within the cylinder and thus, via outlet 32 of casing 10, the pressure on valve closure member 16.

Shortly before the release of the pressure by the hydraulic ram on valve closure member 16, water is introduced through tube 30 into the chamber 27 to reduce its buoyancy. As the ram begins to retract, the valve closure member 16 moves away from the valve seat 14 under the combined influence of the decreasing buoyancy of the chamber 27 and the increasing negative pressure differential between the inlet 12 and the outlet 32. The contents of the reservoir are thus connected to the hydraulic ram.

As the amount of water in the chamber 27 increases, the valve closure member 16 becomes less and less buoyant and moves to its open position which is shown in dotted lines in the drawing.

Initially, as per the previously proposed hydraulic rock-hoisting system, only water will move through the valve, and by adjusting the speed of opening of the valve, it is possible to ensure that, until the valve closure member 16 reaches its fully open position, only water has passed through the valve, thus obviating erosion of the valve closure member 16 during opening of the valve due to impingement of rocks on it. The opening speed of the valve may be controlled by adjusting the rate at which the chamber 27 is filled.

As the ram retracts further, both rock and water pass through the valve. It will be noted that during rock flow, the valve closure member 16 is retained out of the path of the rock by the water in the chamber 27. Therefore the valve closure member 16 remains in the fully open position and is not effected by pressure fluctuations in the flow of liquid through the valve.

When at the end of its retraction, the ram begins to displace the rock and water in the cylinder, which is consequently expelled, via the delivery conduit, pressure is applied to the valve outlet 32.

Shortly before the commencement of the displacement stroke of the ram, air is blown into the chamber 27 through the tube 28 to expel water from the chamber 27 through the tube 30 thereby increasing the buoyancy of the valve closure member 16. On commencement of the displacement stroke of the ram, the valve member 16 pivots upwards to its closed position under the combined influence of its increasing buoyancy and the pressure applied by the ram to the valve.

Simultaneously, as the valve closes high pressure water may be introduced via the annular chamber 24, the passages 22 and the directing ring 26, on to the valve seat 14, to clean it and ensure that a positive seal between the valve closure member 16 and the valve seat 14 is achieved.

The same mode of operation, is applied when the valve of the invention is used in the previously proposed hydraulic rock-hoisting system to control the outlet from the hoisting system into the delivery conduit carrying the hydraulically hoisted rock to its destination.

I claim:

1. A one-way valve for controlling the flow of an abrasive liquid through a conduit, the valve comprising a pivoted closure member, and enclosed chamber connected to or integral with the member, means secured to the chamber and extending to the exterior of the assembly and providing for selective adjustment of the buoyancy of the closure member in any varying position of same and under conditions of fluid flow in the conduit, and a valve seat against which the closure member is adapted to seal when it becomes buoyant in the abrasive liquid being handled.

2. A one-way valve as claimed in claim 1 in which the means secured to the chamber includes an air tube and a water tube.

3. A one-way valve as claimed in claim 1 including means to clean the valve seat.

4. A one-way valve as claimed in claim 3, in which the valve seat cleaning means comprises means for directing water under pressure on to the valve seat.
5. A one-way valve as claimed in claim 4 in which the means for directing water under pressure on to the valve seat comprises a series of spaced water passages terminating in or adjacent the valve seat.

6. A one-way valve as claimed in claim 5 in which the valve seat is annular and the water passages are arranged in a ring.