flow switches must not activate below a certain flow threshold, commonly four gallons per minute (GPM), but must not fail to activate below 10 GPM. In order to meet this requirement across the range of common sizes of pipe in which such flow switches and check valves are installed, switches having mating paddles for each size of pipe are employed. The position of the paddles in response to flow through the valve within the regulatory-imposed criteria triggers a micro switch to initiate the alarm. However, such systems are delicate, cannot withstand large flow rates or high pressure flows, and thus limit the rate at which water can fill the piping network volume. The paddles also cause increased resistance to flow and measurable pressure head loss through the pipe. Because the paddles are within the flow stream and mechanically connected to the dedicated external control box housing the micro switch, it is necessary to drain the entire system to effect adjustment, repair or replacement. Where such check valves are installed in systems which have pressurized air or other gases downstream of the check valve, regulations prohibit the use of paddle flow switches. Check valves in such systems, commonly called, dry, preaction, or deluge systems, are made significantly more complicated by the inability to use paddle flow switches, instead using an intermediate chamber between the pressurized water supply upstream of the check valve and the pressurized air or gas in the system downstream of the check valve. This intermediate chamber is connected to a separate water flow pressure switch used to monitor for opening of the check valve by detecting pressure increase in the intermediate chamber due to opening of the check valve. There is clearly an opportunity to improve check valves and the systems in which they are installed, including check valves used in fire protection systems.

Summary

According to an aspect of the present invention, there is provide a flow rate sensor comprising a housing having an inlet and an outlet, said housing defining a flow path between said inlet and said outlet, a shaft rotatably mounted within said housing, an obturation body positioned within said housing between said inlet and said outlet, said obturation body being mounted on said shaft and movable relatively to and independently of said shaft and relatively to said housing in response to fluid flow between said inlet and said outlet. A sensing arm having a first end fixedly mounted on said shaft and a second end engaging said obturation body, a sensor system adapted to sense rotation of said shaft relatively to said housing.

magnet is positioned within the housing. In a particular example, the magnet is mounted on an end of the shaft. The magnet is surrounded by a non-magnetic sheath projecting from the housing in an example, the sensor system being positioned on an exterior of the housing. The sensor system may comprise a non-contact sensor, for example, a sensor selected from the group consisting of magnetic sensors, Hall effect sensors and capacitive sensors. In an example embodiment the sensor system comprises a magnetic position sensor. By way of example, the sensor system may further comprise a controller in communication with the magnetic position sensor. In another example, the sensor system comprises an adjustable delay circuit in communication with the controller for delaying communication of an alarm signal from the controller.

In another example, the invention concerns a valve. In an example embodiment the valve comprises a housing having an inlet and an outlet. A seat surrounds the inlet. A shaft is rotatably mounted within the housing. A valve closing member is positioned within the housing and sealingly engageable with the seat. The valve closing member is mounted on the shaft and movable relatively thereto between an open position, allowing flow from the inlet to the outlet, and a closed position preventing reversal of the flow. A sensing arm has a first end fixedly mounted on the shaft and a second end portion engaging the valve closing member. A spring acts to bias the sensing arm into contact with the valve closing member. A sensor system is adapted to sense rotation of the shaft relatively to the housing.

In an example embodiment the spring acts between the housing and the sensing arm.

Another example comprises a projection extending from the sensor system into the housing. The spring acts between the projection and the sensing arm. The spring acts to bias the valve closing member into the closed position. By way of example, the sensor system may be mounted on the housing. The projection may have an eccentric cross section.

In an example embodiment the sensing arm comprises a first projection extending from the second end portion and a second projection extending from the second end and in spaced relation to the first projection. The first and second projections engage the valve closing member. In an example embodiment the first and second projections are aligned along a line oriented parallel to the shaft.

In an example embodiment the valve closing member comprises a disk sealingly engageable with the seat. A first lug projects from the disk. The first lug defines a first

What is claimed is:

1. A flow rate sensor, said flow rate sensor comprising:

a housing having an inlet and an outlet, said housing defining a flow path between said inlet and said outlet;

a shaft rotatably mounted within said housing;

an obturation body positioned within said housing between said inlet and said outlet, said obturation body being mounted on said shaft and movable relatively to and independently of said shaft and relatively to said housing in response to fluid flow between said inlet and said outlet;

a sensing arm having a first end fixedly mounted on said shaft and a second end engaging said obturation body;

a sensor system adapted to sense rotation of said shaft relatively to said housing.

2. The flow rate sensor according to claim 1, wherein said obturation body comprises a disk oriented transversely to said flow path.

3. The flow rate sensor according to claim 2, wherein said obturation body further comprises at least one lug extending between said disk and said shaft, said lug defining a hole receiving said shaft.

4. The flow rage sensor according to claim 3, wherein said hole is sized to permit rotational and translational motion of said disk relatively to said shaft.

5. The flow rate sensor according to claim 2, further comprising a seat surrounding said inlet, said obturation body being configured to sealingly engage said seat.

6. The flow rate sensor according to claim 5, further comprising a spring acting between said obturation body and said housing for biasing said obturation body into engagement with said seat.

7. The flow rate sensor according to claim 6, further comprising a projection extending from said sensor system into said housing, said spring acting between said projection and said sensing arm.

8. The flow rate sensor according to claim 5, further comprising a seal positioned between and mounted on one of said seat or said obturation body.

9. The flow rate sensor according to claim 1, further comprising a weight mounted on said sensing arm distal to said shaft.

10. The flow rate sensor according to claim 1, further comprising a link extending between said sensing arm and said obturation body, said link being positioned distal to said shaft for flexibly connecting said sensing arm to said obturation body.

11. The flow rate sensor according to claim 1, further comprising an actuator for moving said sensing arm, said actuator comprising a push rod having a first end extending from said housing and a second end engageable with said sensing arm proximate to said shaft, said push rod defining a line of action eccentric to said shaft thereby enabling a force applied to said push rod to rotate said sensing arm about said shaft.

12. The flow rated sensor according to claim 11, wherein said actuator further comprises a solenoid adapted to move said push rod.

13. The flow rate sensor according to claim 1, further comprising an actuator for moving said sensing arm, said actuator comprising:

an axle having a first end projecting from said housing and a second end positioned within said housing proximate to said shaft;

a cam mounted on said second end of said axle, said cam being rotatable into and out of engagement with said sensing arm upon rotation of said axle to effect rotation of said sensing arm and said shaft.

14. The flow rate sensor according to claim 13, further comprising an electric motor engaged with said axle and adapted to rotate said axle for rotating said cam.

15. The flow rate sensor according to claim 13, wherein said actuator further comprises a lever arm attached to said first end of said axle, said lever arm extending transversely to said axle.

16. The flow rate sensor according to claim 14, further comprising a solenoid engaging said lever arm and adapted to move said lever arm and thereby rotating said axle.

17. The flow rate sensor according to claim 1, further comprising a magnet fixedly mounted on said shaft, said magnet being positioned proximate to said sensor system.

18. The flow rate sensor according to claim 17, wherein said magnet is positioned within said housing.

19. The flow rate sensor according to claim 18, wherein said magnet is mounted on an end of said shaft.

20. The flow rate sensor according to claim 19, wherein said magnet is surrounded by a non-magnetic sheath projecting from said housing.

21. The flow rate sensor according to claim 1, wherein said sensor system is positioned on an exterior of said housing.

22. The flow rate sensor according to claim 1, wherein said sensor system comprises a non-contact sensor.

23. The flow rate sensor according to claim 1, wherein said sensor system comprises a sensor selected from the group consisting of magnetic sensors, Hall effect sensors and capacitive sensors.

24. The flow rate sensor according to claim 1, wherein said sensor system comprises a magnetic position sensor.

25. The flow rate sensor according to claim 24, wherein said sensor system further comprises a controller in communication with said magnetic position sensor.

26. The flow rate sensor according to claim 25, wherein said sensor system further comprises an adjustable delay circuit in communication with said controller for delaying communication of an alarm signal from said controller.

27. The flow rate sensor according to claim 7, wherein said projection extending from said sensor system into said housing has an eccentric cross section.