Double-flapgate airlock valve: A solution for tough applications

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Keeping a bulk solids processing or handling system airtight is critical for both operation efficiency and worker safety. Selecting the correct airlock valve for your application can provide a steady material flowrate while preventing costly air leakage and pressure drops. One type, a double-flapgate airlock valve, is especially well-suited for abrasive materials and high-pressure or high-temperature applications.

While the rotary airlock valve is the most commonly used airlock valve in solids processing and handing systems, it can require constant maintenance and frequent replacement when handling abrasive materials or in extreme conditions. In these applications, a double-flapgate airlock valve, as shown in Figure 1, can be a more long-lasting solution. Unlike a rotary valve, the double-flapgate valve seals completely and isn't subject to the kind of wear the rotary valve would sustain under extreme conditions. These advantages make the double-flapgate valve ideally suited for many applications in the cement, chemical, pulp and paper, mining and minerals, fly ash, power generation, and other industries.

How the valve works

While the double-flapgate airlock valve comes in many variations for different applications, such as high-pressure or high-temperature operating conditions and abrasive materials, the valve's design is simple with few moving parts, as shown in Figure 2. The valve consists of a housing with an inlet at the top and a discharge at the bottom, two gates and two seats for the gates to close up

Figure 1

The double-flapgate airlock valve

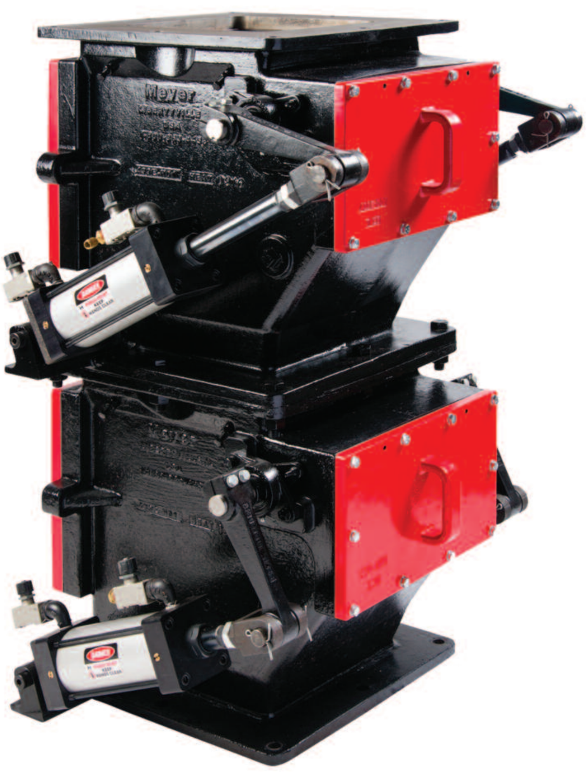
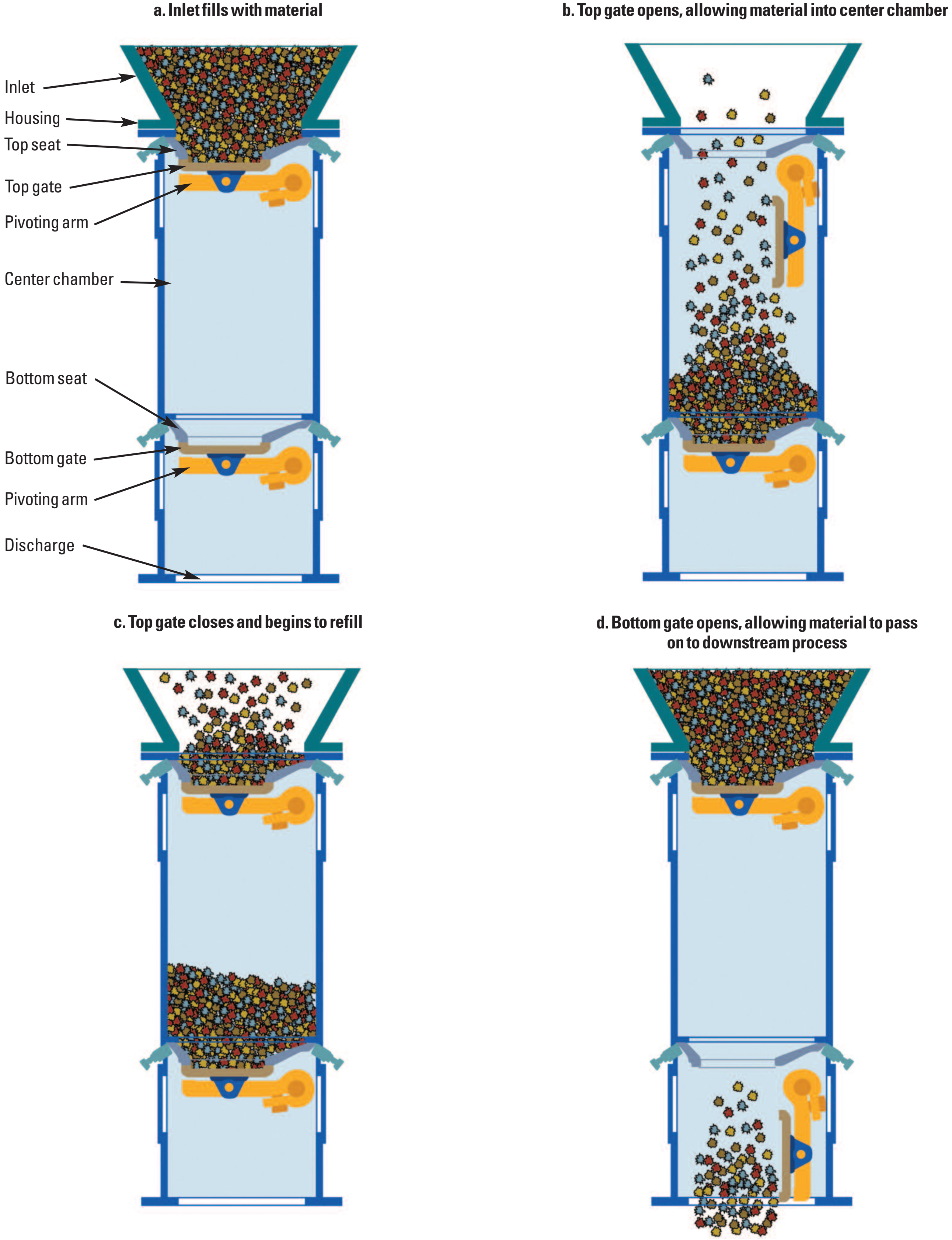


Figure 2

How the double-flapgate airlock valve operates



against (one at the top and one at the bottom), a center chamber between the gates, one or two pivoting arms for each gate, and one or two either pneumatic actuators or counterweights (not pictured) to open and close each gate. The valve is available in various construction materials depending on the application. Typically, the valve's housing is made of cast iron, and the valve's gates and seats are made of either stainless steel or high-chrome white iron, depending on the application.

In operation, the inlet fills with material (Figure 2a). Once the inlet is full, the top gate swings down to open, allowing material to flow into the center chamber between the two gates (Figure 2b). The top gate then shuts against the seat to provide a seal that keeps the system's pressure stable (Figure 2c). Once the top gate is closed, the bottom gate opens, and the material flows out through the valve's discharge to the next stage of the process (Figure 2d). The sequential opening and closing of the gates provides a consistent seal for the pressurized system and prevents air leakage between upstream and downstream equipment.

Typically, a pneumatic actuator attached to each arm (or arms) provides a power-open and power-close. A solenoid valve controlled by a timer or a central PLC triggers the actuator to pivot the arm, opening and closing each gate on a preset schedule that provides a consistent material flowrate to the downstream process.

When consistent material flow is less crucial or when electricity is unavailable, a counterweight can be attached to each arm to open and close the gates. The counterweight holds the top gate closed until enough material is sitting on the gate to open it by gravity, allowing the material to flow into the center chamber. Once the material has fallen from the top gate, the counterweight forces the gate to close again, and the process then repeats for the bottom gate. Because the counterweight is gravity-operated, the gate opens and closes much more slowly than a pneumatically operated gate, which can result in an uneven flowrate.

Applications to avoid. The double-flapgate valve's operation can limit its use in certain applications. Avoid using the valve below a column of material, such as the outlet of a bin or hopper, because once the top gate opens to let material through, the material's weight prevents the valve from closing. A rotary or other airlock valve is much better suited to this application. The double-flapgate valve's operation also limits its maximum flowrate, making it unsuitable for some applications. The valve's flowrate is generally 2 to 5 times slower than that of a rotary airlock valve.

Benefits for tough applications

While the double-flapgate valve has a higher initial cost than a rotary valve, in a tough application the double-flapgate provides a much better return on investment in terms of reduced maintenance downtime and labor costs and far less frequent valve replacement. Let's take a closer look at the benefits the double-flapgate valve can provide in handling your abrasive material or your process's high-pressure or high-temperature conditions.

Abrasive materials. In a pneumatic conveying system handling an abrasive material, a rotary valve constructed out of stainless steel, cast iron, carbon steel, or a variety of other materials, depending on the application, may need to be replaced four or five times a year due to abrasive wear effects. This can result in lost production time and increased equipment costs. With a rotary valve, the internal rotor rotates 360 degrees — completely through the housing — to move the material through the valve to the next stage, exposing the entire rotor and housing to wear. With the double-flapgate valve, the gate only drops down between 60 and 90 degrees, isolating the wear to the gate and the seat. In an abrasive application, a double-flapgate valve can outlast the rotary valve, typically requiring only gate and seat replacement within 1 year of installation. When dealing with abrasive materials, the double-flapgate valve uses gates and seats constructed of high-chrome white iron to better handle the materials.

High pressure. For a high-pressure application, the valve's housing is constructed of cast iron or stainless steel, providing longer service life. Under extreme conditions, a second arm with an additional actuator can be added on each gate. This provides a more uniform gate-to-seat seal and enables the gates to close against high pressure differentials. This is especially important in pneumatic conveying applications with differential pressures over 7 psi.

High temperature. Just as with a high-pressure situation, in a high-temperature application, over 700°F, the double-flapgate valve's housing, gates, and seats can be made of stainless steel to provide a longer service life. While thermal expansion and contraction can weaken the seal between a rotary airlock valve's rotating metal parts, a double-flapgate valve's few moving parts ensure a strong seal at any temperature.

Other advantages. The double-flapgate valve can also handle large material chunks without jamming. In rotary and other airlock valves, large chunks can jam or plug the valve openings, causing system downtime and costly valve repair or replacement. To prevent this, the double-flapgate airlock valve's openings are typically 8 to 12 inches square, allowing large particles to pass through without jamming.

Maintenance

Because of the small number of internal moving parts, the double-flapgate valve requires minimal maintenance, making it well-suited for handling abrasive materials and extreme operating conditions. The valve's housing can typically last 20 years or more without requiring replacement. Wear from an abrasive material will typically affect only the valve's gates and seats, which are typically easy and relatively cheap to replace. When the gates and seats are replaced, the valve can again operate like new. The frequency of replacement depends largely on the characteristics of the material. Check the valve once a year, especially in a pneumatic conveying application, to ensure the valve is providing a strong seal. A change in system pressure will likely be noticeable as the valve starts to leak due to gate and seat wear. If a pneumatic actuator is used, the cylinders will need to be replaced periodically depending on the workload. **PBE**

For further reading

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