AODD pumps gain energy efficiency and reduce maintenance costs with innovative technology.

Air-operated double-diaphragm (AODD) pumps are known for their positive attributes of handling fluids that are heavily laden with solids, abrasive materials, shear sensitive liquids (paints and coatings) and the ability to pump soft solids without damaging the product. They are also popular because they are lightweight, portable and easy to use due to their pneumatic power.

With the increasing awareness of energy costs and government and corporate goals to conserve energy, the pumping efficiency of AODD pumps has become a topic of discussion and a challenge for AODD pump end users. Recent technology has been developed that increases the pumping efficiency of AODD pumps and reduces energy costs by up to 50 percent, which equates to millions of dollars in annual savings. Also because the pumps operate only as much as necessary for each application, routine maintenance and downtime are reduced.

OPERATION:

The current standard configurations for AODD pumps use compressed air to drive the diaphragms to the end of stroke. Compressed air management is performed by a mechanical system typically consisting of a pilot valve mechanism that provides a small flow of compressed air to actuate a larger valve that changes the flow path of the supply pressure, which in turn changes the diaphragm movement's direction. This reciprocation of motion creates the pumping action of the AODD pump.

By design, standard AODD pumps change direction at the end of stroke. The compressed air is supplied to the inner chamber until the pilot valve is actuated at the end of stroke, and then the main valve shifts, and the compressed air is exhausted from one inner chamber while the opposite inner chamber is pressurized. This end of stroke exhaust sequence creates a scenario in which excess compressed air energy is exhausted without doing work before being exhausted to the atmosphere if the pump discharge pressure is lower than the air pressure supplied to actuate the pump. This is typically the case in most AODD pump applications.

AODD Pump Up-Sizing:

One method to reduce energy consumed by AODD pumps is to increase the size of the pump for the same desired flow. This increases the pump efficiency of volume of liquid pumped per amount of compressed air consumed. In many situations, the total cost of ownership of an AODD pump will be reduced by up-sizing the pump for the application.

AODD Pump Quick Exhaust Valves:

Another way to reduce the energy consumed by AODD pumps is with quick exhaust valves. By adding quick exhaust valves to the inner chambers, the actuation of the next pump stroke is made more efficient. This is accomplished by a change in the diaphragm deformation and in the amount of force required to begin the pump stroke.

AODD Pump Air Supply Restriction:

Restricting the air supply to an AODD pump can also improve pumping efficiencies in certain applications. Many AODD pumps have been equipped with adjustable restrictors in the past, but that practice has been discontinued in recent years. Some pumps still contain fixed restrictors to increase efficiency. Adjustable air supply restriction can be applied if the air supply pressure, the flow and discharge pressure requirements remain relatively constant in the application, and the restrictor can be adjusted to optimize pump performance.

Adjustable air supply restrictors will not work for pump applications in which the application parameters are subject to change. When the application changes, then the restrictor must be adjusted again to optimize performance. Most pump applications have changing performance requirements throughout the pumping cycle and/or changing air supply pressure throughout the pump's life.

Energy-Saving Technology:

New, technology is available that optimizes pump efficiency and uses adaptive optimization as pump application parameters change. This method maintains all the positive attributes of AODD pumps while employing the latest control technology. The devices are electromechanically controlled using a micro-processor and linear feedback system to monitor pump actuation and adjust the air supply according to the required performance, thus optimizing energy efficiency.

The technology still allows for simple installation by integrating electrical power generation into the system, eliminating the need to provide electrical power to the AODD pump. Ease of installation for the end user is, therefore, maintained. An optional power supply is available if preferred by the end user. This new technology is also fail-safe in the event of any failures within the device. The pump will operate as a standard AODD pump and will maintain the end user's processing objectives without interruption. By maintaining the robust characteristics of standard AODD pumps, this technology eliminates the risk of any increase in process downtime for the end user due to the integration of this type of solution.

The new energy reduction technology manipulates the air supply to obtain the same geometrical characteristics of pump operation and efficiency gains with respect to diaphragm deformation and force reduction at the beginning of the pump stroke, which is the same as what occurred with the earlier methods. One of the key differences is that this new technology automatically adjusts to maintain optimum efficiency for different and changing pump application parameters. This is made possible through the application of a patented feedback technology that monitors the full range of motion of the diaphragm movement including position, velocity and acceleration. This information is read by the microprocessor. Then associated algorithms are applied to control a valve system that manipulates the flow of air supplied to the pump.

The air flow is manipulated in a way that allows for full air supply flow at the beginning of the pump stroke and then reduces the air supply flow at different points during the stroke that are dependent on the specific application parameters. This flexible supply flow reduction enables increased pump efficiency regardless of differing pump applications. As the pump discharges pressure, the air supply pressure and fluid viscosity changes, and the system automatically adapts and optimizes the pump efficiency. This allows the pump to operate based on each application, helping reduce maintenance and downtime in addition to increasing efficiency.

The end user does not need to supply the operating parameters to the processor. The system contains a learning algorithm that learns the pump's operation without air manipulation, as standard pump operation and then starts the optimization process. The feedback and control systems continually servos about the diaphragm velocity and enable continuous optimization for maximum energy savings across a real-world pump application. The system will relearn as the application parameters change or the pump is placed into a new application, providing utmost ease of use for the end user.

The combination of adaptive optimization, self-learning capability and integrated power generation advantages found in this technology enables end users to enjoy all the positive attributes of traditional AODD pumps while reducing energy costs.

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