Innovation Through Necessity

By Walter Bonnett, Director of Marketing for Pump Solutions Group

None other than the ancient Greek philosopher Plato is credited with coining the phrase, “Necessity is the mother of invention,” meaning that “a need or problem encourages creative efforts to meet the need or solve the problem.” It’s unknown whether that phrase was going through Jim Wilden’s head as he watched water from a ruptured pipe gush into a shop at a steel factory in San Bernardino County, CA, some 50 years ago. Legend has it, however, that a foreman who was trying to plug the leak and, using Mr. Wilden’s nickname, yelled to him, “Hey, Slim, you would make a million dollars if you could invent a pump to get this stuff out of here.”

From that simple tongue-in-cheek exclamation an entire industry would blossom, as Wilden went to work doing just that, and in 1955 he had the solution—the air-operated double-diaphragm (AODD) pump, a technology that was said to have been “conceived out of necessity, born in the arms of innovation, and inspired by sheer will and determination.” After several years of trial and error, Wilden—who would call his nascent operation the Wilden Pump & Engineering Company—developed a pump that had the right air valve and diaphragms needed, and was tough and versatile enough, to meet the stringent demands of the mining and heavy-construction industries, where the need to pump water, slurry or any finely divided substance such as cement is an ongoing requirement. As the company continued to improve on the original design, Wilden introduced numerous AODD pumps that are ideal in applications for many additional industries such as food, pharmaceutical, chemical, oil & gas, waste treatment, etc.

How It Works Wilden® AODD pumps are classified as reciprocating, positive-displacement-style pumps. The pump operates by displacing fluid from one of its two liquid chambers upon each stroke completion. To operate correctly, AODD pumps require a precise amount of pressure (measured in pounds per square inch) and air (measured in cubic feet per minute) to deliver the proper amount of fluid.

The simple genius of the Wilden AODD pump design means that there are only a few wetted parts that are dynamic: the two diaphragms, which are connected by a common shaft, the two inlet valve balls and the two outlet valve balls. The diaphragms act as a separation membrane between the compressed air supply and the liquid. Driving the diaphragms with compressed air instead of the shaft balances the load on the diaphragm, which removes mechanical stress from the operation and extends diaphragm life. This also allows the valve balls to open and close on the valve seats, which direct liquid flow. This simple design and operation makes it easy for the operator to find the correct pressures and flows to optimize its operation.

More specifically, the pump begins operation when the air distribution system directs the air supply to the right air chamber and back side of the diaphragm. This moves the diaphragm away from the center block and toward the liquid chamber, in the process pulling the opposite diaphragm inward. This means the opposite diaphragm is now on its suction stroke. At the same time, atmospheric pressure forces fluid into the inlet manifold, forcing the inlet valve ball off its seat. This allows liquid to move past the inlet valve ball and into the liquid chamber.

When the pressurized right liquid chamber reaches its liquid capacity, the air valve redirects compressed air to the back side of the opposite diaphragm. This forces that diaphragm away from the center block while pulling the right diaphragm toward the center block. This closes the inlet valve ball on the opposite side while lifting the discharge valve ball off its seat and forcing the liquid to flow through the discharge manifold. The process is repeated for the opposite side, with the liquid chamber filling, the forced air redirecting the diaphragms and the created pressure forcing the discharge valve ball off its seat as the liquid moves through the discharge manifold.

As the pump reaches its original starting point, each diaphragm has gone through one suction and one discharge stroke, which constitutes one pumping cycle.

Maintenance The AODD pump’s design also means that maintenance is easily and efficiently performed. When performing routine maintenance checks, there are three main areas of concern:

• **Air Valve Piston/Spool and Casing.** Ensure that the piston/spool can move freely and remove any debris • **Diaphragms.** Make sure there is no swelling, cracking or other damage to the diaphragm surface • **Balls/Seats/O-rings.** Make sure no swelling, cracking or other damager is apparent

Another top-of-mind maintenance concern is seal replacement as proper seal installation is critical to pump performance. Care must be taken to ensure that seals are placed in the proper grooves and not damaged during installation. Incorrect seal location will render the pump inoperable, while damaged seals may cause decreased performance and shorter seal life.

Troubleshooting Due to the superior design of Wilden AODD pumps, only a few rare complications can surface during their operation. Fixing these problems can be a simple process in many cases. Below you will find a list of potential problems and solutions that pump users might find in the field.

Problem: Pump will not run or runs slowly **Solutions:** Check for obstructions in the air passageways or objects which would obstruct the movement of internal parts.

Problem: Pump runs but little or no product flows. **Solutions:** Check for pump cavitation, slow pump speed down to allow material to enter pumping chambers then increase speed accordingly. Check for sticking ball checks and, if necessary, replace checks with proper elastomers. Check to make sure all suction connections are air tight.

Problem: Air bubbles in pump discharge. **Solutions:** Check for ruptured diaphragm. Check tightness of clamp bands, especially at the intake manifold.

Problem: Product comes out air exhaust. **Solutions:** Check for ruptured diaphragm. Check tightness of large clamp bands. Check tightness of piston plates to shaft, if applicable.

Problem: Pump rattles. **Solutions:** Create false head or suction lift.

Conclusion Jim Wilden designed his first AODD pump to handle demanding applications that required a robust design, and more than a half century later, the time-tested operation of Wilden air-operated double-diaphragm pumps is still setting the standard for a wide range of industries that require the efficient, timely, cost-effective and maintenance-friendly pumping of a wide variety of liquids and other substances.

While Wilden could have had no idea at the time that the doggedness of will that sprang from that pipe leak would continue to reverberate around the globe in an innumerable of industries all these many years later, he did know that a good idea followed by the proper execution could have far-reaching positive effects, and there's no doubt that his air-operated double-diaphragm pumps have certainly met those parameters for innovative excellence—and will continue to do so in the future.

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Sidebar: Inside An AODD Pump

The uncomplicated design of AODD pumps features few moving parts, and those that do move have very simple, specific tasks:

1. **Air Chamber.** Houses the air that powers the diaphragms
2. **Air Distribution System.** The heart of the pump, it is the mechanism that shifts the pump in order to create suction and discharge strokes
3. **Outer Diaphragm Piston.** Connects the diaphragms to the reciprocating common shaft and seals the liquid side from the air side of the diaphragm
4. **Inner Diaphragm Piston.** Located on the air side of the pump, it does not come in contact with the process fluid
5. **Valve Ball.** Seal and release on the check-valve seats, allowing for discharge and suction of process fluids to occur
6. **Valve Seat.** Provide the ball valves a place to check

7. **Discharge Manifold.** Allows fluid to exit the pump through the discharge port which is typically located at the top of the pump
8. **Liquid Chamber.** Separated from the compressed air by the diaphragms, it fills with process fluid during the suction stroke and is emptied during the discharge stroke
9. **Diaphragm.** Acts as a separation membrane between the process fluid and the compressed air that is the driving force of the pump. To perform adequately, diaphragms should be of sufficient thickness and of appropriate material to prevent degradation or permeation in specific process-fluid applications.
10. **Inlet Manifold.** Allows fluid to enter the pump through the intake port located at the bottom of the pump

Links:
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