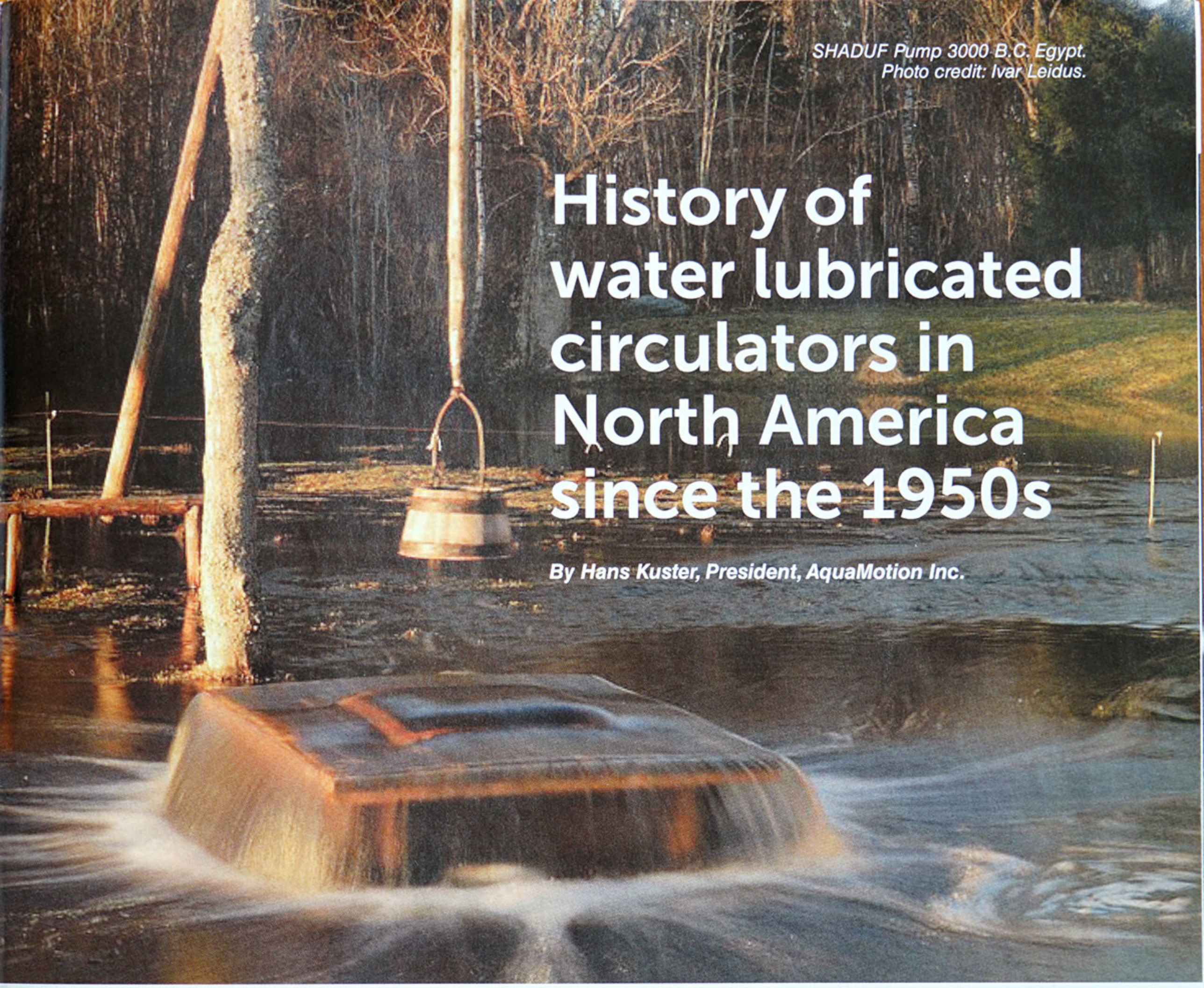

SHADUF Pump 3000 B.C. Egypt.
Photo credit: Ivar Leidus.

# History of water lubricated circulators in North America since the 1950s

By Hans Kuster, President, AquaMotion Inc.

I joined a U.S. manufacturer of hydronic heating products and pumps in 1962. Over the last 53 years, I have witnessed the startup, evolution and improvements of water lubricated circulators as vice president of manufacturing for a major pump company and president of Sparco Inc. and AquaMotion Inc.

In 1955, the U.S. pump companies used a three-piece circulator to move water through their domestic heating systems. It consisted of a separate motor and base, a bracket that included the bearing, a steel shaft, mechanical seals and impeller plus the pump casing. The bearing was lubricated with oil. The motor was connected to the shaft by a spring coupler.

The horsepower of the motor was about 1/12th HP. It required this power to overcome the resistance of the mechanical seal. A residential circulator drew 1.75 amps. This old technology is still in use today by some U.S. pump manufacturers.

In 1946, a Swiss Company, Ruetschi, adapted the canned motor pumps for successful use in the hydronic market. They were named the Perfecta. The revolutionary idea behind the Perfecta, placed a thin stainless steel sleeve between the stator winding of the motor and the rotor. The correct air gap between the sleeve and the rotor is of utmost importance for the efficiency of the motor. The sleeve was filled with water (water/glycol) and the rotor was fixed to a stainless steel shaft and the two bearings were lubricated with the system fluid. The impeller was fixed to the shaft and moved the water through the pump casing. This concept eliminated the friction losses of the mechanical seals and the horsepower requirement of such a residential circulator was reduced from 1.75 amp draw for a three piece circulator to .60 to .75 amp on a properly designed pump. This resulted in a 60 percent reduction in power consumption and a tremendous saving in electricity cost for the homeowner.

There were many more inventions that perfected the performance of the water lubricated circulator such as the invention of the cartridge. Initially, the pumps had a sight glass in the back where you could observe the rotation of the shaft. This design caused many leaks. Later on a slot was added to the shaft to kick start the pump after the shaft seizes during the summer month.

This design is still used in Europe in older models where, every fall, the contractor starts the pump with a turn on the

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# Circulators

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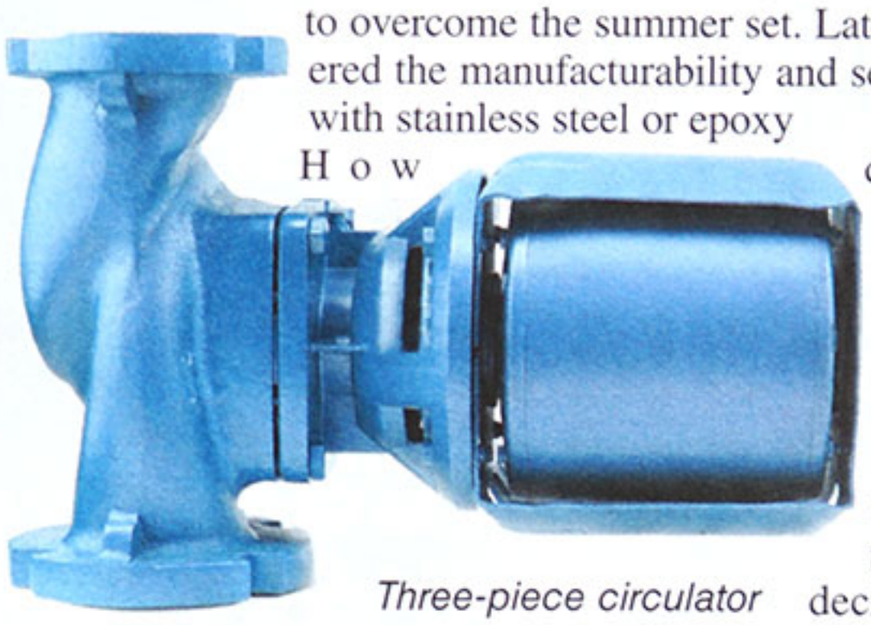
screw driver slot. Newer motors have better starting torque to overcome the summer set. Later inventions covered the manufacturability and sealing of the rotor with stainless steel or epoxy



*Three-piece circulator*

How did these inventions come to North America? Ruetschi, instead of trying to sell this product all over the world themselves, made the decision to go to market with over 20 licensees, all of which were major pump companies worldwide, to manufacture the pumps. The royalty was 5 percent, which equated to one dollar per pump when the selling price was about $20. In the mid-1950s, one U.S. pump manufacturer gambled on the new concept and bought the license for North America. Sales took off fairly quickly growing to over 100,000 units. But then,

Murphy's Law kicked in, "If anything can go wrong, it will go wrong."

So, many came back that it seemed more were returned than were sold. The reason was that what worked in Europe did not necessarily work in the U.S. In the U.S., we use cast iron and steel boilers and copper piping. The galvanic action between the dissimilar metals caused black iron oxide, a very hard particle that entered the space between the shaft and the bearing and scored the shaft and embedded in the bearings causing pump seizures. All new entrants to this market experienced the same initial problems until they adapted their designs with improvements for the North American markets.

The invention of the Cartridge design was another big step forward. Instead of a fixed tube sleeve, the back end of the tube is closed and the bearings are secured inside the cartridge. This way all moving parts were in the cartridge and could easily be removed and replaced to recondition the pump.

The invention of the ceramic hollow shaft and dirt block seal addressed these issues. The hardness of the ceramic versus stainless shafts eliminated scoring of the shaft. Some manufacturers use ceramic shafts and ceramic bearings. This combination results in no wear in the bearings or on the shaft as long as they are fully lubricated. If the electrician tests his hookups before the plumber fills the system, you will have a pump failure. The ceramic shaft and carbon or carbon impregnated sintered bronze bearing produces a more forgiving combination and allows for a dry run without seizing up.

The dirt block prevents black iron oxide from entering the bearings and limits the circulation of system fluid through the sleeve. The dirt block also only allows for the initial fill of a few ounces through the hollow shaft into the sleeve. Once the sleeve is filled, no additional fluid with dirt or black iron oxide will enter the sleeve. The fluid in the sleeve expands or contracts due to changes in system temperature. A feature of the hollow shaft is that it is sized to allow for this expansion] and contraction within the shaft. A very small amount of fluid exits the shaft when the fluid heats up due to expansion and is refilled as the system cools down. Once these design features were successfully implement, they secured the success for water lubricated circulators in North America.

The invention of the Cartridge design was another big step forward. Instead of a fixed tube sleeve, the back end of the tube is closed and the bearings are secured inside the cartridge. This way all moving parts were in the cartridge and could easily be removed and replaced to recondition the pump. The cartridge design along with the shaft and seal changes addressed many of the problems and propelled the U.S. licensee to the market leader position. The previous market leader, who did not accept the wet motor pump for many years and bet against it, lost out and lost their market dominance.


*ECM circulator*

The latest invention is the flushable cartridge and new bearing system which allows users to remove the cartridge, pull it apart, and flush out calcium or impurities in canned pumps which is especially helpful in hard water areas. The life of a $300 to $400 stainless pump can be extended by flushing or replacing it with a $50 replacement cartridge. This makes the canned pump even more sustainable and an eco-friendly, green product.

Electronically commutated canned motor (ECM) pumps give further efficiency improvement to the wet rotor circulators. ECMs have been promoted primarily by European competitors because it costs $75 a year in electricity to run a circulator in Germany as compared to $18 for a good PSC conventional pump in the U.S. The ECM use a permanent magnet in the rotor with a controller which is a more efficient motor and which adapts the motor output to the system demand and saves a few more dollars in electricity cost per year. ECMs are now included in the European building codes. The cost/benefit payback rewards for ECMs are in larger sizes, over ½ hp. The payback on small ECM residential circulators is as much as 10 years.

There is always a risk when moving from a known design to a new invention. A well-executed and tested invention brings success. In this case, additional inventions and improvements that were added to the original idea secured the future and position of the wet motor circulator in North America. ■