SERVICE CLINIC

Effective trapping in absorption chiller systems

EDITOR'S NOTE: This Service Clinic was prepared exclusively for CONTRACTING BUSINESS readers by John Kremers, manager, applications engineering, at Armstrong Machine Works, a division of Armstrong International.

Absorption refrigeration machines are ideal in commercial applications where large quantities of low cost, low pressure steam are available. You'll find such equipment in hospitals, hotels, universities, apartment buildings, offices and wherever plenty of comfort conditioning is needed.

Absorption units are also applicable in other environments, including the rubber and textile industries, which require process cooling or must maintain a controlled environment.

In these types of systems, proper drainage is crucial in order to avoid corrosion, damaging water hammer and reduced capacity. This is accomplished through the proper selection, installation and maintenance of steam traps.

These chiller machines function on water refrigerant and lithium bromide absorbent or ammonia refrigerant and water absorbent. Their four basic components include the evaporator, absorber, generator and condenser.

Observing the refrigeration cycle

In a lithium bromide machine (figure 1), 55F chilled water from the air conditioning system circulates through a coil in the evaporator. Pressure on the evaporator's shell side is about .15 pounds per square inch absolute (psia). Meanwhile, the coil's exterior is sprayed with 40F water.

Water within the coil enters the evaporator at about 55F, releasing sensible heat to the 40F water before returning to the air conditioning system at about 45F. The low evaporator pressure, combined with the heat given up by the coil, causes the 40F water to boil.

This water vapor then moves to the absorber, which contains a concentrated lithium bromide solution. The lithium bromide absorbs the water vapor, causing it to condense and give off its latent heat. A coil containing condensing water keeps the absorber cooled to about 105F.

The water vapor mixing with the lithium bromide dilutes the solution, reducing its absorption ability. A pump takes the dilute solution from the system's low pressure side. (.15 psia) to the generator on the high pressure side (1.5 psia).

At this stage, a submerged steam coil in the generator raises the temperature of the dilute lithium bromide solution from 105F to 210F. This steam coil provides the heat of vaporization to drive the water out of this solution. The re-concentrated lithium bromide then returns to the absorber to repeat that part of the cycle.

Water vapor driven off from the generator passes to the condenser, which is also at 1.5 psia. At the condenser, another coil containing cooling water at about 100F condenses this vapor. The condensed water vapor, now at about 115F, flows to the evaporator where the low pressure causes it to boil, starting the water portion of the cycle again.

Choosing the best steam trap

Steam traps drain the coil in the generator. So the trap size is determined by the maximum condensate load it must handle.

On the average, about 20 lb of steam are required each hour per ton of refrigeration. The pressure on a single stage machine is about 12 psi maximum, and the trap must be able to fit these conditions.

A trap capable of functioning at the maximum differential pressure is essential. The capacity at .5 psi differential must equal twice the maximum anticipated load, regardless of what pressure the maximum anticipated load occurs.

An 800-ton, single-stage absorption machine with a 0 psig return line has about 16,000 lb of conden-

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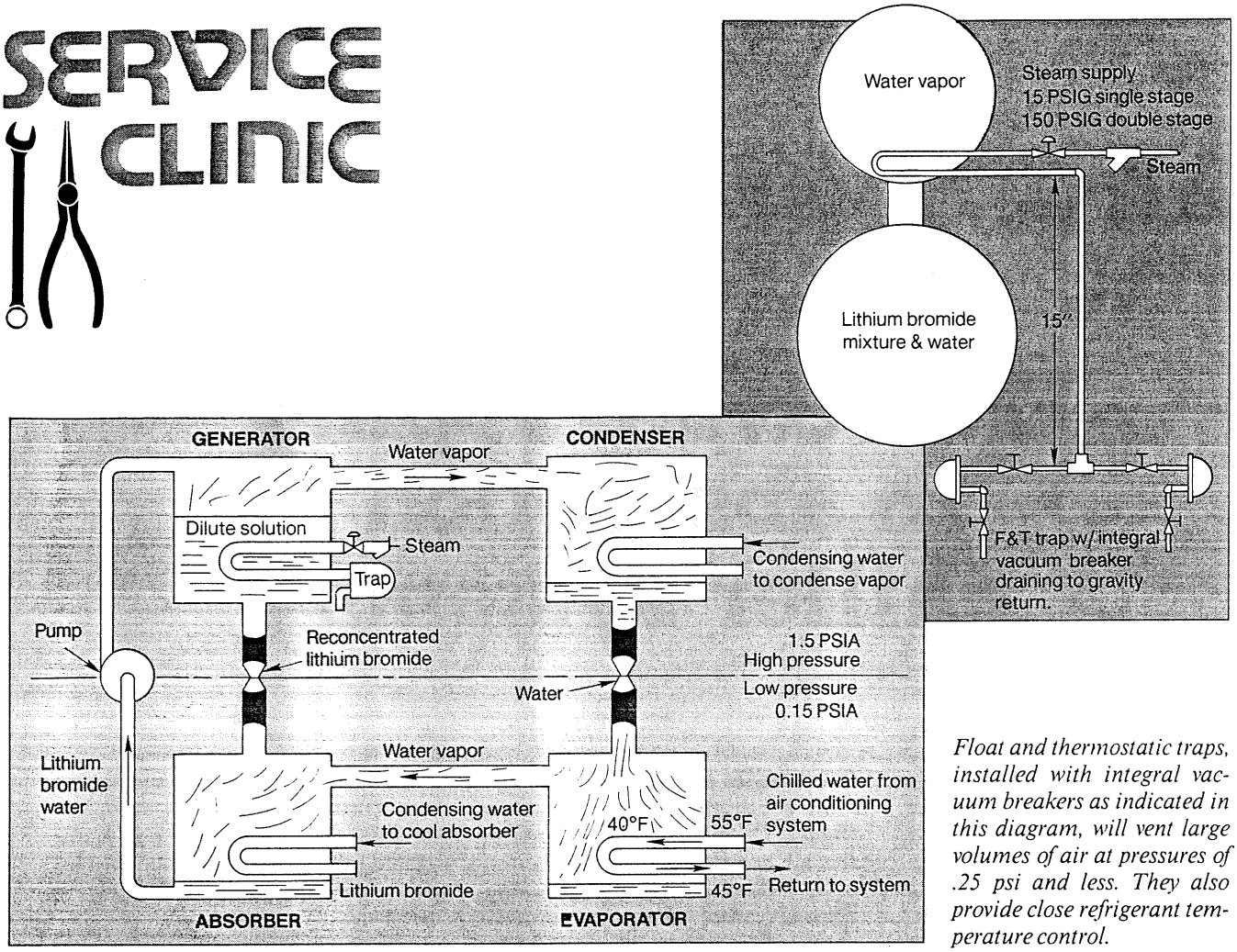

Float and thermostatic traps, installed with integral vacuum breakers as indicated in this diagram, will vent large volumes of air at pressures of .25 psi and less. They also provide close refrigerant temperature control.

sate/hr to be removed (800 tons × 20 lb/ton-hr). The correct trap functions at a 15 psi maximum differential and has a capacity at .5 psi differential of 32,000 lb/hr.

Steam traps on absorption machines must handle condensate loads and purge air at low pressure modulated conditions. Float and thermostatic (F & T) traps with integral vacuum breakers are well suited to this type of application (figure 2). F & T traps provide continuous modulating discharge and close temperature control. They are ideal for venting large volumes of air at pressures of .25 psi and less.

The integral vacuum breaker permits condensate drainage even when sub-atmospheric steam temperatures are required. Instead of vacuum forming, atmospheric pressure replaces that of steam so gravity drainage can occur. When higher than atmospheric steam temperatures are again required, the large capacity air vent in the F & T trap evacuates air from the heating coil to ensure that it contains steam.

An alternative for trapping absorption machines is an inverted bucket trap with a thermic air vent and vacuum breaker. The intermittent action of the inverted bucket can produce slight variations in temperature, but it assures maximum efficiency and is suitable for comfort air conditioning.

Mount the trap below the steam coil with a drip leg height of at least 15 in. The piping assures a minimum differential pressure across the trap of .5 psi. Two traps are often installed in parallel, each capable of handling the load. One of the traps acts as a standby unit. Should the one in service require maintenance, it can be repaired while the other carries the load.

Two-stage chillers

Two-stage absorption chillers use less steam per ton of refrigeration than single-stage units but require higher pressure steam (150 psig). However, in most cases, they still use only one steam trap.

Choose a trap capable of functioning at maximum anticipated differential. The capacity at half the maximum possible differential across the trap should equal three times the maximum anticipated load, no matter at what pressure the maximum anticipated load occurs.

In an application using an 800-ton, two-stage chiller with a 0 psig return line, the appropriate trap would have to remove 9,760 lb condensate/hr (800 ton × 12.2 lb/ton-hr). The correct trap functions at 150 psi maximum differential and has a capacity at 75 psi differential of 29,300 lb/hr.

When servicing, if one trap is insufficient to handle a single or two-stage machine, two or more traps can be mounted in parallel to share the load.

The role of the service mechanic in servicing these large machines is to ensure that the correct traps are being used and that they are properly working. With the right traps, absorption machines will perform satisfactorily, ensuring efficient operation and long life. **B**

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