

Basic Operational Description

for

Elliott Cycle Refrigerated Compressed Air Dryers

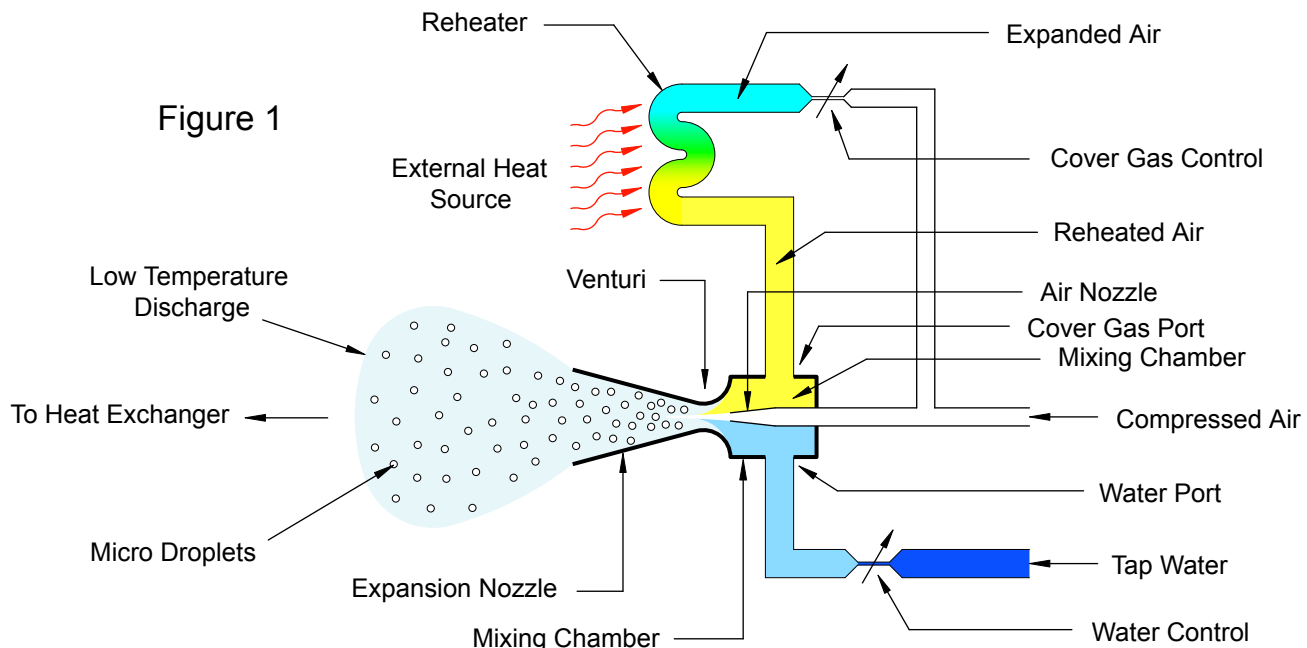
by

Air Options, Inc.

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Air Options, Inc. refrigerated dryers use a different refrigeration technology than typical refrigerated dryers. Most dryers on the market use Freon-based systems to generate the required cooling temperatures. Air Options uses a process based on water evaporation. The evaporative process is most commonly used in air conditioning large buildings or in cooling for large equipment. Petrochemical plants commonly use evaporative cooling. This is highly evident by the large white vapor clouds that are visible when traveling on adjacent roads. Evaporative cooling is not normally efficient enough for smaller applications and thus is not used for homes, light equipment and lesser processes. Air Options has developed a high efficiency evaporative refrigeration process that is particularly applicable for small industrial cooling requirements. Because compressed air is utilized, the Air Options process is not preferred for applications such as home air conditioners, but it is an ideal process for refrigerated compressed air dryers. The compressors that the Air Options dryers service have an abundance of compressed air to power the evaporative process.

The Air Options refrigerators are quite simple in operation. (Fig. 1) The body is a mixing chamber attached to a venturi tube. Compressed air is injected through venturi and a partial vacuum is formed within the mixing chamber. Tap water is introduced into the mixing chamber and is entrained by the venturi, atomized and ejected out the expansion nozzle. A portion of the water evaporates during this process producing a temperature shift which is based on the volumetric change of the water expanding from a liquid to a gas state and, to a lesser extent, the air expanding back to atmospheric pressure. To aid in evaporation a cover gas is generated and introduced into the mixing chamber. The gas is generated by feeding compressed air through a dropping orifice (cover gas control) and allowing its pressure to normalize to the pressure within mixing chamber. As the air expands its temperature drops and it sheds moisture to match. The air is then passed through a re-heater and its temperature is elevated. The re-heated air, or cover gas, now has a low relative humidity and therefore, a high affinity for water. The cover gas is introduced into the mixing chamber where it mingles with the atomized water and forces a higher evaporation rate. This has the effect of producing a lower discharge temperature. The micro droplets within the discharge serve to provide a high efficiency thermal transfer. The temperature of these micro-droplets normalize to the low temperature gas which surrounds them. The low temperature gas/droplet mixture is then introduced to the shell of a heat exchanger. When the gas/droplet mixture comes in contact with the outside of the heat exchanger tubes, a high efficiency thermal transfer occurs.



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Operational Description (cont.)

The refrigerator (Fig. 2) is a single assembly. It is constructed from a single piece of PVC plastic. A brass air nozzle is inserted into the back of the body so that it is in alignment with the venturi throat. Standard brass compression fittings are used to provide all of the air and water connections. The compressed air is introduced into the center of the body and is injected through the venturi throat via the air nozzle. The water is introduced through the lower fitting and subsequently the mixing chamber. The water is controlled via the water control valve. The mixing chamber is a cylindrical cavity that surrounds the air nozzle. The reheated air, or cover gas, is introduced through the top fitting and subsequently the mixing chamber. The water and gas mixture is atomized as it passes through the venturi. The venturi output is expanded via the expansion nozzle so as to provide some focusing of the low temperature discharge. The nose of the body carries a female NPT thread for mounting into the exchanger body. The design provides for a very simple, low cost and reliable component, that will provide many years of reliable service.

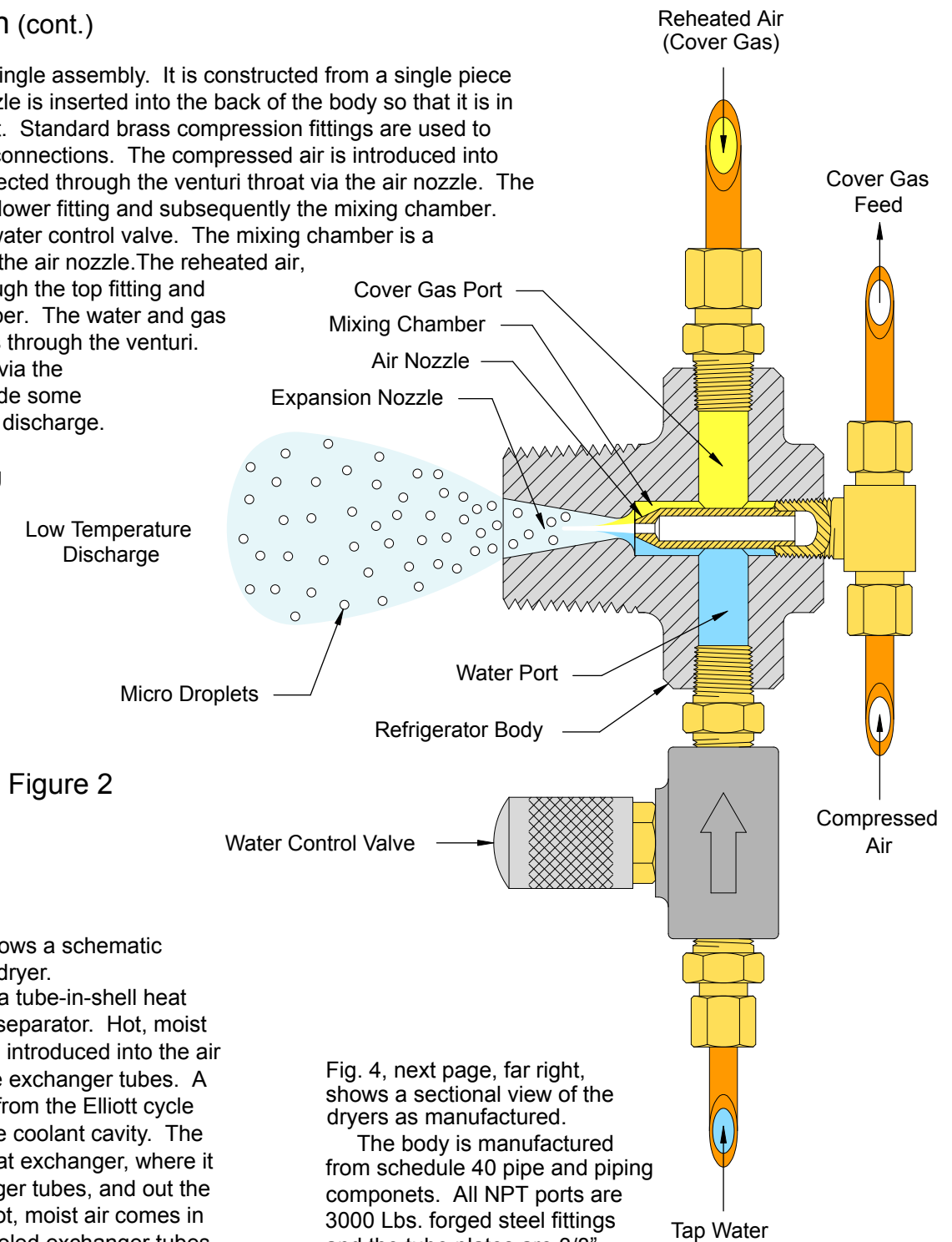


Figure 2

Fig. 3, next page, near right, shows a schematic representation of the complete dryer.

The dryer body consists of a tube-in-shell heat exchanger with a built-in water separator. Hot, moist air from the compressor head is introduced into the air input, where it flows through the exchanger tubes. A cooled vapor cloud discharged from the Elliott cycle refrigerator is introduced into the coolant cavity. The cloud then flows through the heat exchanger, where it cools the outside of the exchanger tubes, and out the coolant discharge. When the hot, moist air comes in contact with the inside of the cooled exchanger tubes, the water vapor condenses onto the inside walls of the tubes. The condensed water runs down the inside of the tubes along with the air flow and drips into the water reservoir. The dried air flows around the lower end of the air baffle, through the coalescing filter, and out the dry air output. The trapped water is periodically vented through the drain valve.

Fig. 4, next page, far right, shows a sectional view of the dryers as manufactured.

The body is manufactured from schedule 40 pipe and piping components. All NPT ports are 3000 Lbs. forged steel fittings and the tube plates are 3/8" thick carbon steel. The exchanger tubes are 300 series stainless steel which are fuse welded into the tube plates. The coalescing plates are 300 series stainless steel. The re-heater is sch 80 steel pipe that is welded to the upper plenum cap. This assures excellent heat transfer from the dryer input. The pilot valve is made from a block of navel brass. All control and feed connections are standard brass compression fittings and the tubing is ordinary refrigeration grade copper tube.

Operational Description (cont.)

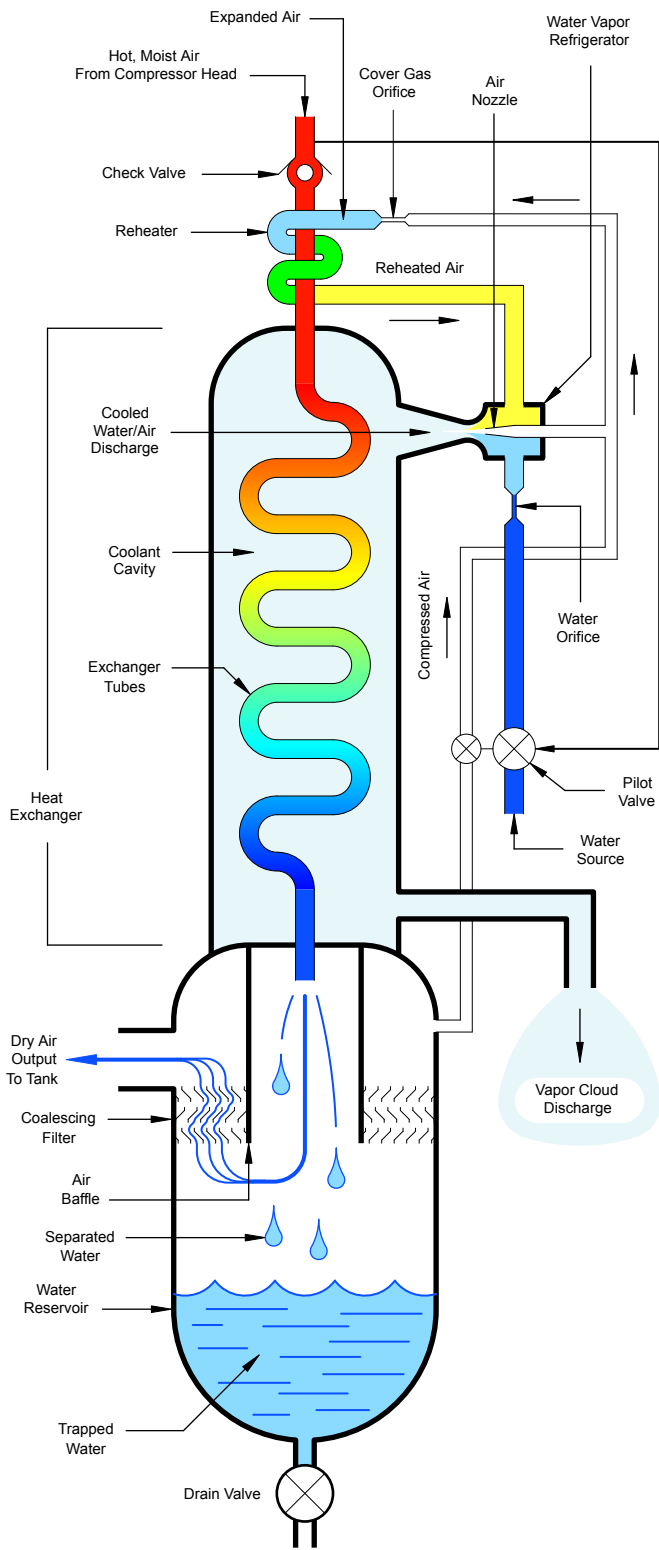


Figure 3

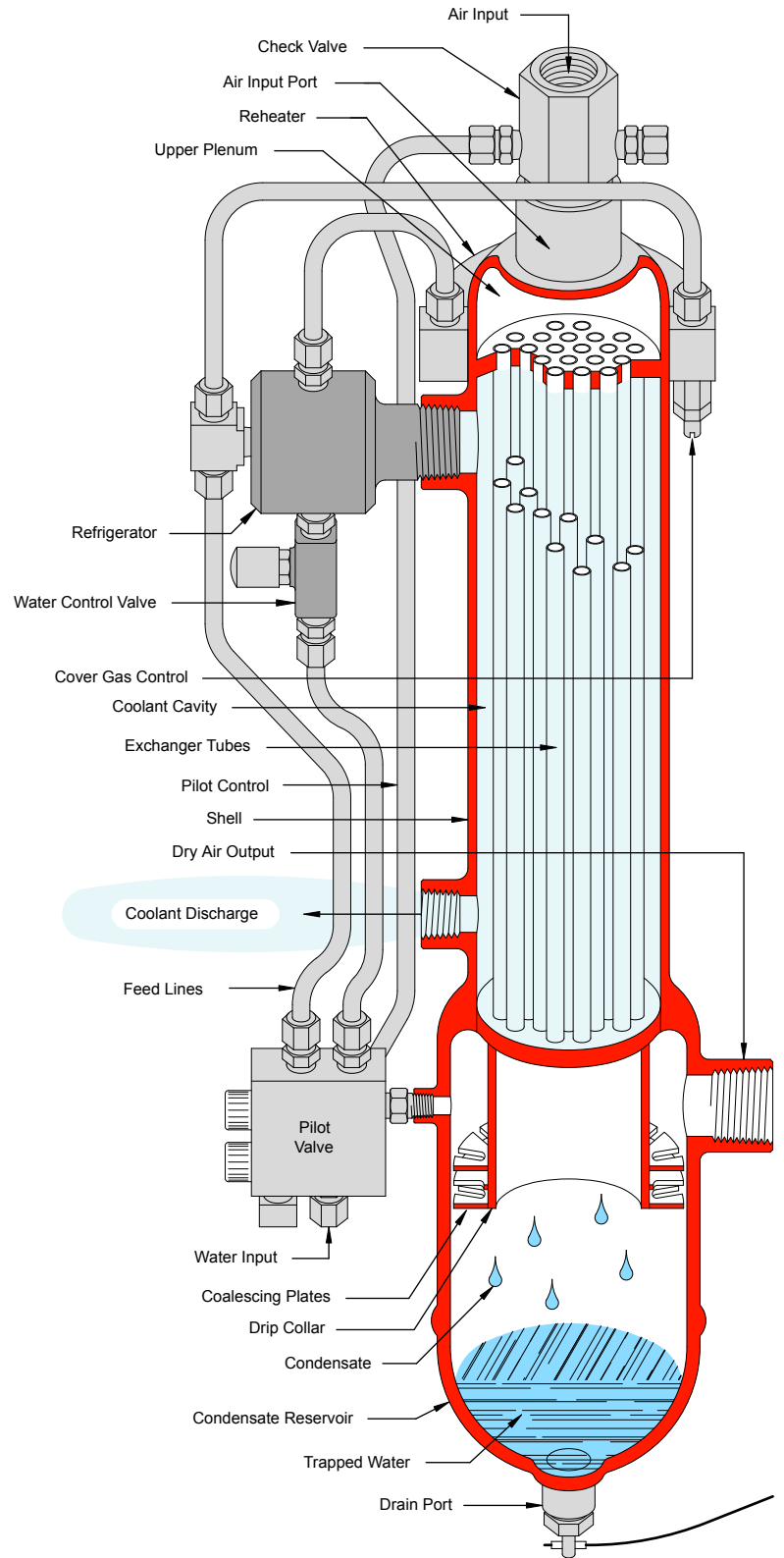


Figure 4

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Affordable Solutions for Compressed Air

Operational Description(cont.)

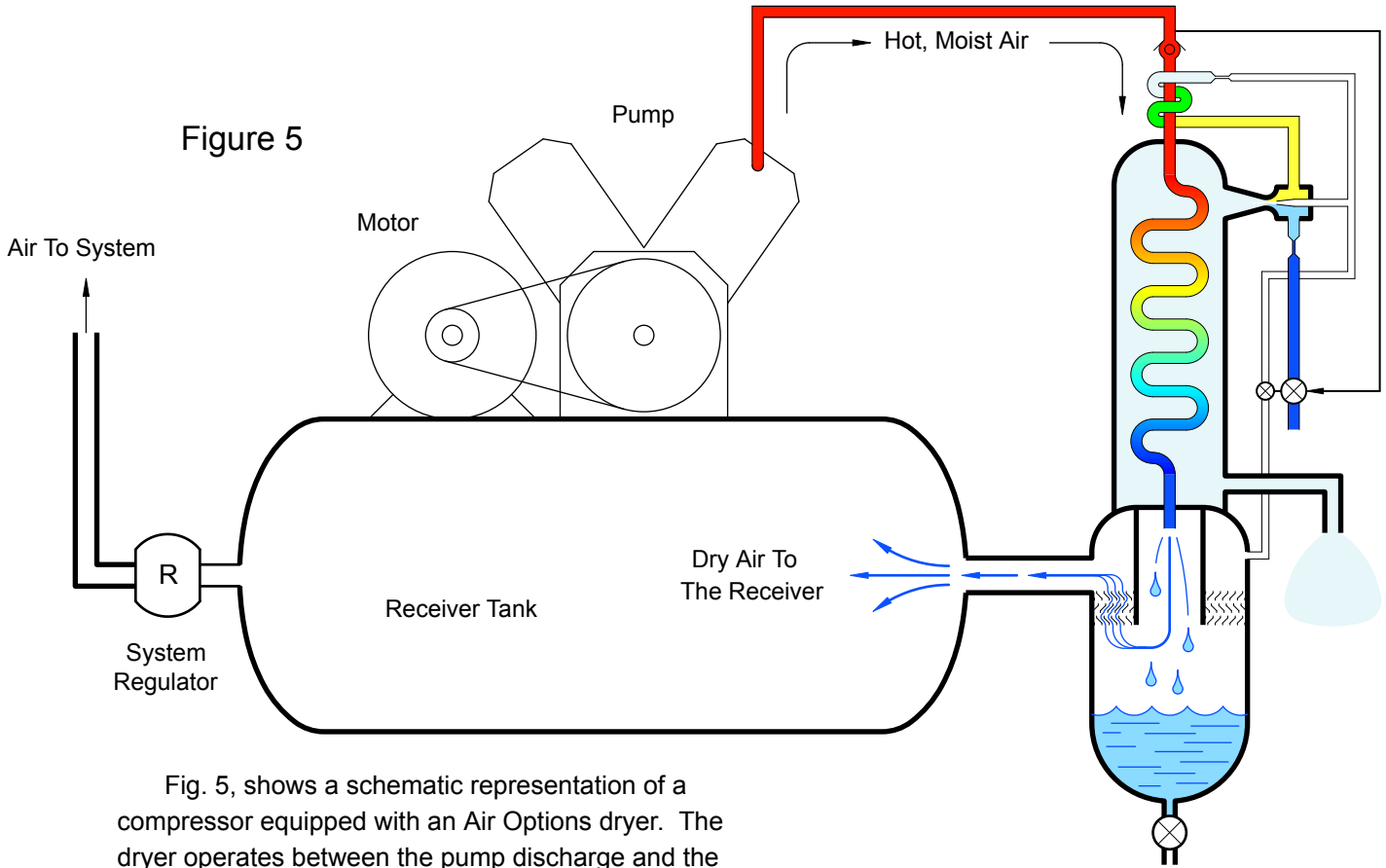
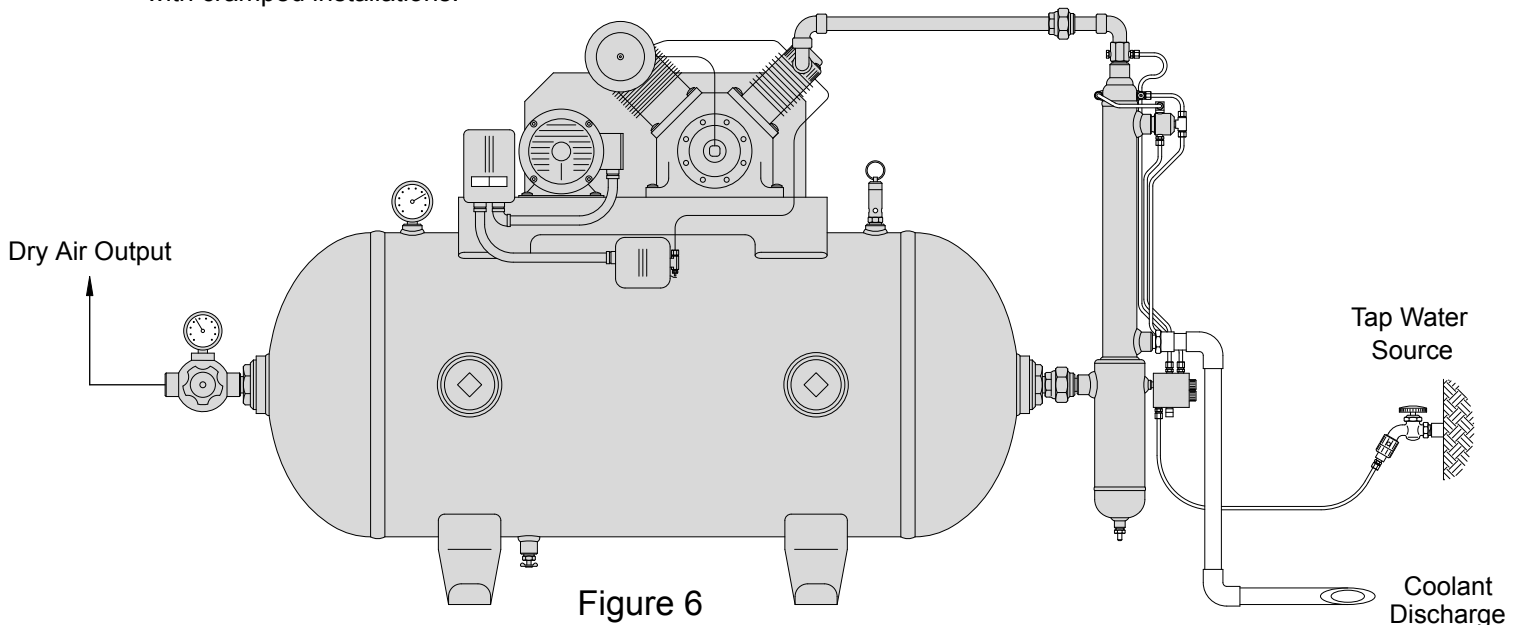


Fig. 5, shows a schematic representation of a compressor equipped with an Air Options dryer. The dryer operates between the pump discharge and the receiver, thus drying the air before it can condense in the tank.

Fig. 6, shows a typical setup on a reciprocating compressor. The dryer mounts directly to the compressor package which eliminates the need for any further floor space. This is particularly helpful when dealing with cramped installations.



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