4-Way Reversing Valves

Fitters Notes (Part 12)

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In the last issue, we took a closer look at filter driers and sight glasses. These two components are found in almost every commercial refrigeration system above a certain capacity. This is not the case with 4-way reversing valves. This type of valve is used to completely reverse the flow in a reversible system. Such valves may be used when both heating and cooling modes are required, or to provide an effective, energy-efficient defrosting method.

4-Way Reversing Valves

Construction
A 4-way reversing valve has four ports for tube connections. Three of these ports are on one side, and the fourth is on the opposite side. The three copper tube ports have a larger diameter than the single port on the opposite side.

The middle of the three large ports is permanently connected to the suction line, and the single small port is permanently connected to the pressure line. As the two remaining ports can be connected to the suction line or the pressure line depending on the valve position, because of pressure drops they have the same dimensions as the permanent suction line port.

A 4-way valve also has a solenoid pilot valve with a coil, which changes the direction of refrigerant flow when it is energised.

There are also small pilot lines running from the small valve port to the solenoid pilot valve and back to the middle large port.

Operation
In the following description, we assume that the small (pressure) port is facing up and the other three ports are facing down. With this orientation, you can also see the small solenoid pilot valve with its coil. A standard 4-way valve has only two positions; there are no intermediate positions. In the first position, the coil of the solenoid pilot valve is not energised. As a result, hot gas under high pressure is fed from the small port’s pilot line (permanent pressure connection) from the right into the slider mechanism’s chamber.

At the same time, the pressure on the left side of the slider chamber is relieved as the gas flows out to the low-pressure side via the connection to the permanent suction port. As a result, the slider moves to the left and opens the main paths from the top to the bottom right and from the left to the middle. In the second position, hot gas can flow from the top to the left, while suction gas can flow from the right to the middle and down.

This is achieved by energising the coil of the solenoid pilot valve, which causes high-pressure gas to be fed from the left into the slider mechanism’s chamber. This also allows the pressure on the right to be relieved via the middle main port at the bottom, which causes the slider to move to the right.

Pressure Drops and Dimensioning
Pressure drops are of fundamental importance for valve dimensioning. Excessively large pressure drops usually have a negative effect on the energy efficiency of a refrigeration system, while excessively small pressure drops can have undesirable effects, such as disturbing the stable operation of a servo solenoid valve. Both of these aspects can be regarded as less critical with 4-way valves.

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**Positioning**

This type of valve is connected to the hot-gas line as well as the suction line of the refrigeration system. The connections for the two “permanent” lines, which means the line that is always the hot-gas line and the line that is always the suction line, regardless of the position of the valve, are very easy to identify during installation.

The hot-gas line coming from the compressor is routed to the small port of the 4-way valve. The suction line leading to the compressor is connected to the middle of the three large ports. These two lines between the valve and the compressor always serve the same function. In this regard, you must ensure that the external pressure compensation of an expansion valve is always connected to the permanent suction line, i.e. to the line leading away from the middle large port of the 4-way valve.

If you ignore this rule, excessively high pressure will be applied to the external pressure compensation port, which will not only prevent the expansion valve from operating properly (it will be kept closed with great force), but may even cause permanent damage to the expansion valve. All that's left now is the two outer large ports. Both of these ports can temporarily be on the high-pressure or the low-pressure side.

**Application**

4-way valves are used to reverse the circulation in reversible refrigeration systems.

With this reversal, the evaporator becomes a condenser and the condenser becomes an evaporator. This switchover is often used in systems such as split-unit air conditioners that are used for cooling in the summer and heating in the transitional period. In heating mode, these units operate as air-to-air heat pumps.

Another application arises from the desire for efficient defrosting. When the circulation is reversed in a reversible system, the evaporator becomes a condenser and can be defrosted by internal heating. This means that the necessary heat is provided by hot gas pumped directly through the tubing system where the frost has formed, instead of being provided by electric heaters in the evaporator module.

This yields excellent defrosting results and is practically unbeatable as regards defrosting time, energy consumption, and effective heat transfer.

**Outlook**

This completes our discussion about 4-way valves. In the next article, you can read about another interesting family of components that are used specifically in water-cooled condensers: Temperature and pressure controlled water valves used for condensing pressure regulation.