

Jan. 6, 1959

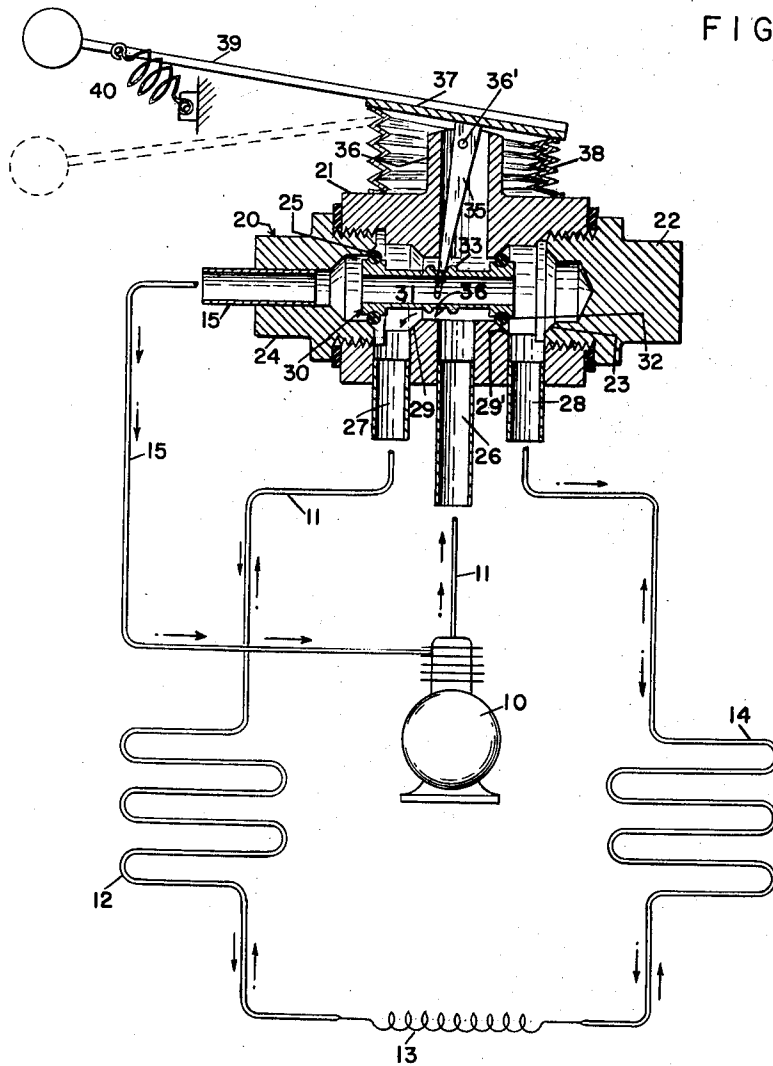
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VALVE CONSTRUCTIONS

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2 Sheets-Sheet 1

FIG. 1



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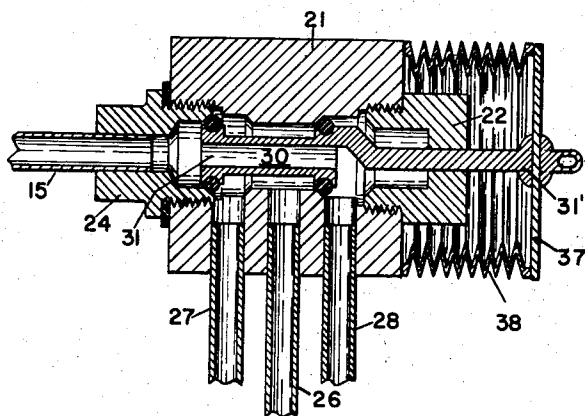


FIG. 3

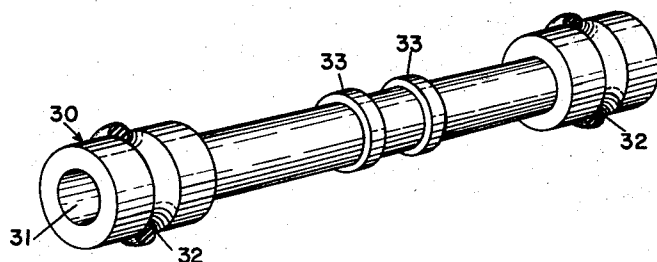


FIG. 2

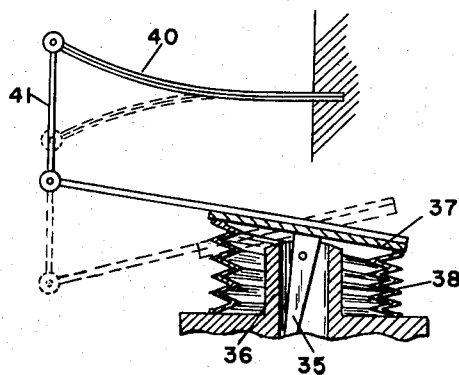


FIG. 4

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## VALVE CONSTRUCTIONS

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2 Claims. (Cl. 137—625.29)

This invention relates to an improved valve construction, more particularly to a valve adapted to permit reversal of the flow of the refrigerant through a refrigeration system, thus making the system useful for either heating or cooling.

Any refrigeration system is made in accordance with conventional thermo-dynamic heat pump principles, employing a refrigerant circulating in a closed system to transfer heat from one point to another. Where it is desired to cool a given area, the aforementioned closed system is arranged so that the refrigerant in flowing through said system will remove heat from this area to be cooled and convey the heat to another portion of the system where the heat is removed from the refrigerant. The system is provided with a compressor, at least two heat exchange coils, and some sort of expansion means. The refrigerant in gaseous form is compressed by the compressor and forwarded to a heat exchange condenser coil where heat is removed from the refrigerant to liquefy the same. At this point, obviously, heat is given off by the system. Liquid refrigerant is thereafter passed through the expansion means into the evaporator where the liquid refrigerant becomes a gas and in the process absorbs heat from the ambient surroundings to be cooled. The gaseous refrigerant is then forwarded to the compressor and the cycle repeated. The physical structure of both the evaporator and condenser coils may be generally the same; it has been found that if the flow of refrigerant through certain portions of the aforescribed system is reversed, the function of the coils may be reversed so that heat will be given off at the point where refrigeration previously took place.

It is often found desirable to employ this reversal in operation of the system to provide heat in areas previously cooled. Thus, air conditioning units may be employed reversibly to either heat or cool any given area. Reversal of refrigerant flow through portions of the refrigeration system employed in said air conditioning unit may be readily achieved by provision of a reversing valve which constrains the refrigerant flowing from the compressor to flow in one or the other direction through said system. As in the case of all valving, it is desirable that the valve be relatively simple in construction, easily operable, and requiring minimal maintenance.

It is with the above problems in mind that the present construction has been evolved which provides a reversing valve for use in conjunction with refrigeration systems permitting reversal of the flow of refrigerant through portions of the system thereby permitting use of the system either for heating or cooling of any given area. The valve here provided is simply controlled either manually or automatically, and is so constructed as to substantially eliminate any locking action in any one position.

It is accordingly a primary object of this invention to provide a hermetically sealed, mechanically operated valve construction.

An object of the invention is to provide a novel valve construction particularly adapted for use in conjunction

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with conventional refrigeration systems to reverse the flow of refrigerant through portions of the system, thus permitting said systems to be used for either heating or cooling a desired area.

These and other objects of the invention which will become apparent from the following detailed disclosure and claims are achieved by provision of valve housing with four coupling apertures to permit connection of said housing to four points of the refrigeration system. A sliding, hollow valve member is supported within said housing to be moved so as to provide independent passageways through the housing dependent upon its movement from a first position to a second position. A control rod connected to a bellows seal is arranged in connection with said sliding valve member to control the movement thereof within the housing. The bellows seal permits motion of the sliding valve member while maintaining a hermetic seal.

The specific constructional details of several preferred embodiments of this invention and their mode of operation will be made most manifest and particularly pointed out in conjunction with the accompanying drawings, wherein:

Figure 1 is a diagrammatic view of a refrigeration system equipped with a reversing valve embodying the novel features of this invention, with the valve shown in cross section;

Figure 2 is a perspective view of the sliding valve member employed in the valve embodied in the system of Figure 1;

Figure 3 illustrates a cross sectional view of an alternative valve construction embodying the novel concepts of this invention; and

Figure 4 illustrates diagrammatically a suitable thermostatic arrangement for controlling the operation of the reversing valve.

Referring to the drawings, like numerals in the various figures will be taken to designate like parts. Figure 1, illustrates a refrigeration system including a compressor 10, compressor discharge line 11, a heat exchange coil 12 such as a condenser, expansion means 13, which may be of a reversibly operable type such, for example, as the illustrated capillary tube, a heat exchange coil 14 such as an evaporator, and compressor suction line 15, all interconnected into a continuous circuit containing a reversible valve 20 connected in said circuit in a manner to be made hereinafter more explicit. Direction of refrigeration flow through the system during a cooling cycle is illustrated by the solid arrows; direction of refrigerant flow through the system during a heating cycle is illustrated by the dot and dash arrows.

The valve 20, as shown in Figure 1, comprises a valve housing 21 closed off at one end by plug 22 having valve seat 23 formed thereon. At its other end, the housing 21 is provided with union 24 for connection to suction line 15 of the above disclosed refrigeration system. The inner face of the union 24 has a valve seat 25 thereon. An intake port 26 is arranged in the valve housing connected to the discharge outlet of the compressor and two axially spaced ports 27 and 28 are provided one on each side of inlet port 26. Valve seats 29 and 29' are provided adjacent ports 27 and 28 as seen in the drawing. A sealed valve body 30 having an axially extending cylindrical bore 31 therethrough is provided for sliding within the valve housing 21.

The cylindrical valve body 30, as best seen in Figure 2, has a peripherally extending recess 32, at each end thereof. Within this recess 32, resilient members, such as rubber O-rings, are provided to serve as sealing members cooperating with the valve seats of the valve housing 21. Other suitable sealing means may, of course, be pro-

vided. A central portion of the valve body is provided with circumferentially spaced rings or flanges 33.

In the preferred embodiment of the invention, illustrated in Figure 1, means for moving the valve body 30 between its limiting positions as defined by valve seats 23, 25 comprises a control arm 35 pivotally mounted in hollow boss 36 as shown at 36'. The control arm 35 may terminate in a yoke which engages between the spaced flanges or rings 33 on the valve member 30. At the upper extremity of control arm 35, plate 37, preferably of a circular configuration, is attached. A non-porous sealing bellows 38 extends from the periphery of plate 37 into sealed engagement with valve housing 21, thus maintaining a hermetic seal while permitting movement of arm 35 to move slidable valve member 30 from a first position to a second position. An operating arm 39 extends from plate 37 and has fastened thereto a conventional off-center spring device 40, as seen in Figure 1. This off-center spring device serves to maintain arm 39 in either of two limiting positions to permit valve member 30 to be maintained in either of its limiting positions.

The arm 39 may be actuated manually as shown in Figure 1 or, if desired, it may be actuated automatically, for example, by means of a thermostatic arrangement as shown in Figure 4 in which a bimetallic strip 40 is linked through link 41 to the end of operating arm 39.

The alternative construction illustrated in Figure 3 is essentially the same as the valve illustrated in Figure 1 except that valve member 30 is provided with an extension or rod 31' extending outwardly through valve housing 21 through an aperture formed in plug 22. Boss 36 is thus eliminated. In this construction, a horizontal, sliding, operating rod is shown to move valve 30 from a first position to a second position.

The above disclosed construction permits control of the passage of the refrigerant as discharged from the compressor alternatively to one or the other of coils 12 or 14 whereby these coils will function alternatively as condenser or evaporator coils respectively, thus permitting the warming of the ambient atmosphere surrounding the coil functioning as the condenser or the cooling of the area surrounding the coil functioning as an evaporator. As is apparent, this will permit positioning of the heat exchanger in a fixed location, and at the same time permit either cooling or heating of any area where said system is located.

With the valve body 30 in a first position as shown in Figure 1, the compressor forwards compressed gaseous refrigerant through discharge line 11 to intake port 26 of valve 20, gaseous refrigerant passing through a first passageway in the housing 21 to port 27, which functions alternatively as an intake or discharge port, and in the instant situation is shown functioning as a discharge port. The compressed gaseous refrigerant passes to heat exchanger 12 which in this situation functions as a condenser, condensing refrigerant by the discharge of heat to the ambient surroundings. The liquid refrigerant passes through expansion means 13 to heat exchanger 14 which functions as an evaporator, the refrigerant removing heat from the ambient surroundings to cool the area in which it is placed. Evaporated refrigerant then passes to port 28 of valve 20, through a second passageway in the housing 21 formed in part by the bore 31 through sliding member 30 and out through union 24 coupled to suction line 15 of the compressor.

When it is desired to exchange the functions of coils 12 and 14, arm 35 (Figure 1) or extension 31' (Figure 3) is actuated to move or slide valve member 30 to a second position, to a right hand position referring to Figures 1 and 3. With valve member 30 in its second position, the hot compressed gas from the compressor enters valve housing 21 through port 26 and follows a passageway therethrough to port 28 which now serves as

an outlet or discharge port, the hot gaseous refrigerant passing to heat exchange member 14, which now functions as a condenser discharging heat to the area in which it is placed, the liquid refrigerant passing through expansion means 13 to heat exchanger 12, which now functions as an evaporator removing heat from the area in which it is placed. Gaseous refrigerant from heat exchanger 12 passes to port 27 of valve 20, through a passageway in housing 21 to union 24 and returns to the compressor through suction line 15.

It will be appreciated under some circumstances during a heating operation, it may be desirable to provide supplemental means for heating the refrigerant to assure that only gaseous refrigerant returns to the compressor as well as to provide additional heating capacity for the area being treated.

The positioning of the valve body as above disclosed, may be accomplished either manually or by means of a thermostatic control. It is thus seen that, dependent on the positioning of the valve body 30, a fixedly positioned refrigeration unit may be used, as desired, to either heat or cool a given area. The present invention provides a simple, economical reversing valve for use in a refrigeration system to permit the functions of the condenser and evaporator to be exchanged to coil or to heat the areas in which they are placed. The valve includes a sliding member having an opening therethrough which depending upon the position of the member forms a portion of a passageway for refrigerant through the valve. Simple seal means are provided for the valve which hermetically seals the valve without interference with its mechanical operation. The valve may be actuated mechanically or automatically as desired.

The above disclosure has been given by way of illustration and elucidation, and not by way of limitation, and it is desired to protect all embodiments of the hereindisclosed inventive concept within the scope of the appended claims.

I claim:

1. In valve construction, the combination of a housing having an inlet, an outlet and two ports which function interchangeably as inlet or outlet ports placed on opposite sides of the inlet, a first valve seat placed on one side of the inlet between the inlet and one of the two interchangeable ports, a second valve seat placed on the opposite side of the inlet between the inlet and the other of the two interchangeable ports, a third valve seat placed adjacent the opposite side of one of the two interchangeable ports, a fourth valve seat placed adjacent the opposite side of the other of the two interchangeable ports, a valve member slidable in said housing having an opening therethrough which functions as a portion of a passageway connecting the first interchangeable port and the outlet port when the valve is in a first position seating on the second valve seat and on the third valve seat, and means to move said valve to a second position to seat on the first valve seat and on the fourth valve seat to connect the second interchangeable port with the outlet and to connect the inlet with the first interchangeable port.

2. Valve construction according to claim 1 in which the valve body is provided with peripherally extending recesses, and O-rings are placed in the recesses to serve as sealing members cooperating with the valve seats.

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