

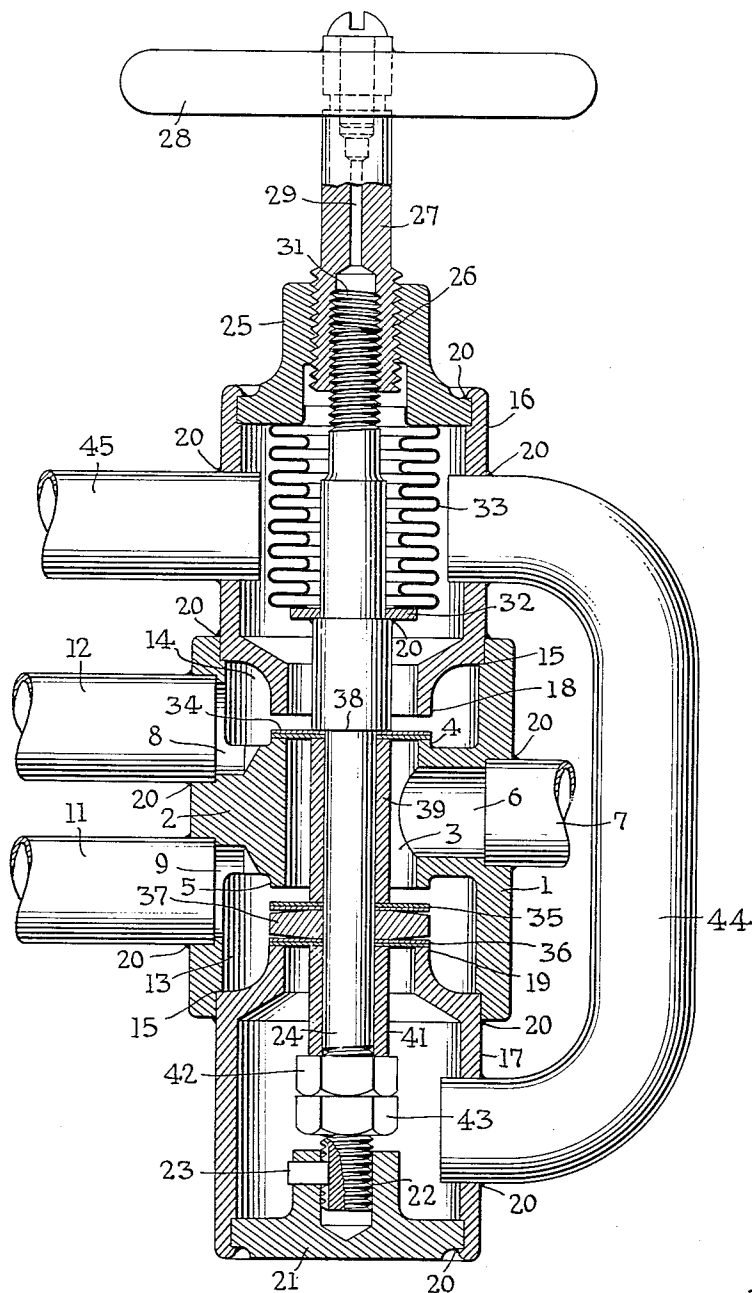
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REVERSING VALVES

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1

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REVERSING VALVES

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1 Claim. (Cl. 137—625.5)

Heat pumps of the reversible type can be used interchangeably for summer cooling and for winter heating of enclosed spaces.

The availability of a single piece of apparatus for two independent seasonal services is architecturally and economically attractive. When electric current must be used for heating, and provided outdoor temperatures are not unduly low, the high performance factor of the heat pump makes it more economical than a resistance heater.

Since it is usually not conveniently practicable to reverse the unit bodily the commercial trend is toward use of two heat exchangers either of which may perform the functions of an evaporator while the other performs those of a condenser. These exchangers must be interchangeably connected with the compressor by a reversing valve and the troublesome factor in the art is this valve.

It is to the provision of a satisfactory reversing valve that the invention is directed. A valve of this type has two functional positions, in each of which it must form two tight seals against the pressure differential between compressor suction and discharge. Volatile refrigerants commonly impair non-metallic substances so metals must be used even for sealing surfaces. The valve cannot readily be inspected, and leaks internal to the system, and great enough to cause serious energy losses, are not readily observable. Hence precise construction and reliably maintained performance over a long life is needed. Leakage from the system cannot be tolerated.

A valve meeting the stated requirements and capable of manufacture at reasonable cost is shown in the accompanying drawing in which the single figure is a view in axial section of the complete valve. Portions of its connections are shown.

It is characteristic of the invention that two flexible double-beat valves are mounted on a single stem and each valve seats selectively on one or the other of two opposed parallel seats. While the ideal condition would be offered by seats which are truly parallel, precisely spaced and accurately centered on the axis of the valve stem, one of the valuable attributes of the flexible metal disc valves is that they will accommodate themselves without impairment of function to minor inaccuracies in seat location and so permit the use of commercial tolerances in the manufacture of the valve body. To permit attainment of reasonable accuracy at moderate cost the valve body is constructed in three separately machined parts so contrived as to favor accurate assembly.

The middle portion 1 of the body is in the form of a generally cylindrical sleeve having a cross partition 2 at its middle, bored to afford an axial passage 3 which terminates in outward presented seat rims 4 and 5. A side passage 6 leads to passage 3 between seats 4 and 5, and receives a connection 7 to one of the heat exchangers (not shown) which is converted by the valve between evaporator and condenser functions. Two side passages 8 and 9 receive connections 11 and 12 one connected to

2

the discharge and the other to the suction of the compressor (not shown).

The passages 8 and 9 enter chambers 13 and 14 in the ends of portion 1 between the seat 4 or 5 and the opposed seat.

The ends of portion 1 are counterbored to shoulders 15 and each counterbore confines circumferentially and its shoulder 15 definitely positions a corresponding end portion 16 or 17 as the case may be.

Portion 16 has a ported end which terminates in a seat rim 18 and portion 17 has a similar ported end which terminates in seat rim 19. The seats 4 and 18 are opposed to each other in chamber 14 and the seats 5 and 19 are opposed to each other in chamber 13. All seats are centered with a good degree of accuracy on the axis of the valve stem hereinafter described and said axis is normal to each, at least within good commercial tolerances.

Throughout the drawing, fused metal joints (whether they be brazed, soldered or welded) are indicated by the numeral 20 and need not be further described.

The outer end of portion 17 is closed by a head 21 with a blind guide way 22 and spline 23 intended to guide the lower end of valve stem 24 and prevent it from rotating. The head 21 is mounted against a shoulder in a counterbore. The metal of the portion 17 is beaded over and welded as indicated.

The outer end of portion 16 is closed by a head 25, sealed in place in the manner already described as to head 21. It has an extension with a threaded axial bore 26 in which it mounted the threaded actuating stem 27. This may be turned by handwheel 28. An oil port is shown at 29.

The lower end of stem 27, within threaded portion 26, is bored and threaded as indicated at 31 to engage the upper threaded end of stem 24. The threads at 26 and 31 are differentiated so that turning of stem 27 will cause valve stem 24 to shift axially. If one thread is right and the other left handed, rapid motion of the valve stem may be had.

A metal disc 32 is sealed to a shoulder on stem 24, and corrugated metal bellows 33 connect disc 32 and head 25, affording a reliable seal without the use of packing around the stem 24.

The upper double-beat valve 34, which seats alternately against seats 4 and 18 is a flexible annulus of elastic sheet metal. Lamination increases initial flexibility. Two laminae are shown, since two are ordinarily sufficient. The lower double-beat valve is really two flexible annuli 35 and 36 (each shown as comprising two laminae of elastic sheet metal) separated by a double convex lenticular spacer 37. This is used to limit only the extreme flexure of the valve annuli, and consequently is essentially rigid. The upper valve seats against a shoulder 38 on stem 24. Between annuli 34 and 35 is a spacing sleeve 39 and below annuli 36 is a second spacing sleeve 41. The parts are held in assembled relation by nut 42 and check nut 43 threaded upon the lower end of stem 24.

The chambers within portions 16 and 17 freely communicate with each other through connection 44 and with the other heat exchanger (not shown) through connection 45.

While definite connections have been suggested, valves of this type can be variously connected. The invention resides in the valve structure, and this may be used for any purpose to which it is adaptable.

So far as is material, the valve in its lower position (as shown) closes the passages controlled by seats 4 and 19 and opens those controlled by seats 5 and 18. In the upper position the passages controlled by 5 and 18 are closed and those controlled by 4 and 19 are open.

The valve has the advantage of all metal construction,

3

and tight seals afforded by adequately loaded elastic metal discs.

What is claimed is:

In a four-way valve, the combination of a valve housing having a first pair of opposed coaxial annular valve seats, and having coaxial therewith a second pair of more widely spaced opposed coaxial annular valve seats; said seats being interposed between flow connections; a valve stem; means for shifting said stem in a path coincident with the axes of the stem and seat, said stem extending through said valve seats all of which are substantially normal to said axes; a first flexible double-beat valve comprising a flat annulus of elastic sheet metal positioned between the seats of the first pair, adapted to seat selectively against said seats as the stem is shifted, and attached to the stem in an annular area materially smaller than the openings through the first pair of valve seats; a second double-beat valve comprising two flat annuli of elastic sheet metal separated by a double convex lenticular spacer, and positioned between the seats of the second pair, the annuli being adapted to seat selectively against the seats of the second pair and being clamped to the

4

spacer in annular areas smaller than the openings through the second pair of seats, the spacer being of such outside diameter relatively to the openings through the seats of the second pair and of such thickness adjacent its center relatively to the differential between the spacings of the seats of the two pairs, as to arrest motion of the stem in each direction after both double-beat valves are seated.

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