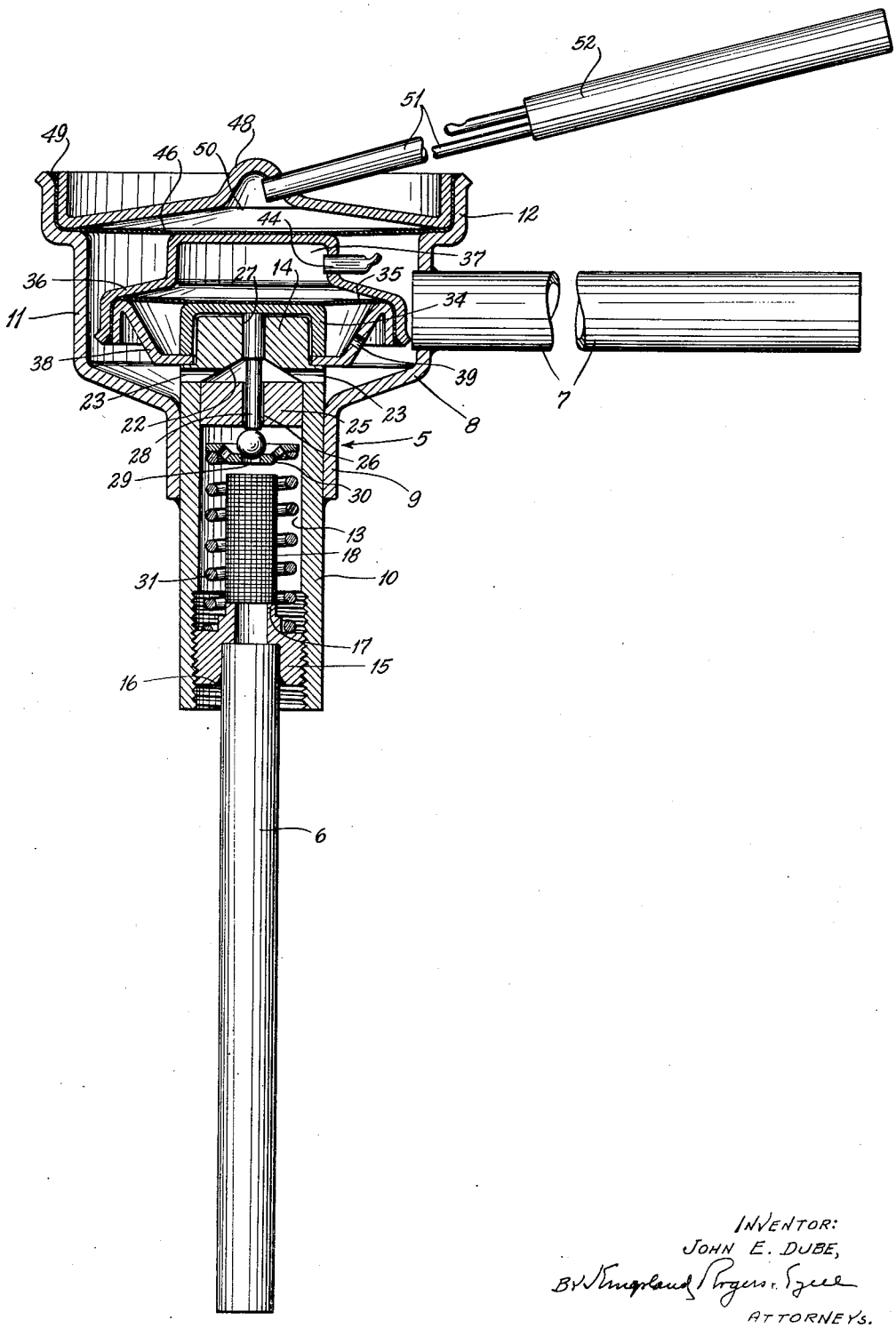
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THERMAL VALVE

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THERMAL VALVE

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The present invention relates to a thermal valve, and more particularly to an evaporator pressure limiting thermal valve.

It is an object of the invention to provide a valve of the foregoing type which can be made of stampings and standard parts to a maximum degree. It is a further object of the invention to provide a valve of this type that is compact in construction and readily assembled. It is a further object of the invention to provide a valve of this type that is rugged and durable in service.

The drawing represents a transverse section through the valve.

The valve includes a housing, generally indicated at 5. This housing is connected with an inlet pipe 6 and an outlet pipe 7.

The housing 5 includes a cup-shaped member 8 having a smaller tubular section 9 that receives a tubular inlet means 10. The upper stamping 8 also has an enlarged section 11, generally cylindrical and forming an outlet pressure chamber, and an upper circular diaphragm containing portion 12, the last being largest in diameter of any part of the particular piece.

The tube 10 projects into the housing 8. It may be drilled to provide its inner bore 13, the bore terminating short of the end of the tube 10 to provide a closed end 14. The outer surface of the inner end of the tubular member is reduced in size, in the manner shown, for a purpose to appear.

The bore 13, at its outer end, is internally threaded to receive a ported plug 15, externally threaded, and adjustable inward or outward, as will be evident. The inlet pipe 6 is rigidly fastened to the plug 15, as by induction brazing 16, or the like. The plug has inwardly extending reduced portions 17 to support a strainer 18.

The tubular member 10 may have the bore 13 cut by a conventional drill, so that the upper end of this opening is tapered as shown at 22. At this tapered portion, there are a plurality of outlet ports 23 extending laterally and opening into the enlarged portion 11 of the housing member 8. Immediately below these ports 23, there is fixed a valve partition 25 having a port 26 therethrough. The plug 14 has a corresponding opening 27 extending through it in axial alignment with the opening 26. A valve stem 28 has an enlarged portion that slides easily in the opening 27 in the end 14, and a smaller portion that passes through the port 26 in the plug 25 with clearance.

A valve ball 29 is adapted to be engaged by the lower end of the valve stem 28. This valve ball

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seats in a washer 30 that is urged upwardly by a coil spring 31, the lower end of which engages against the plug 15.

The upper end of the stem 28 engages an inverted cup-shaped cap 34, the top surface of which is, in turn, engaged by a diaphragm 35. This cap 34 acts as a combined buffer plate and spacer. The diaphragm 35 is sealed to an inverted cup-shaped member 36, to form a collapsible pressure chamber or capsule 37 adapted to be charged with gas under pressure. A rigid annular guide 38 is flanged, as shown, to be secured to the diaphragm and cup-shaped capsule member 36. The guide 38 slopes downwardly at its middle part and has an opening to receive the reduced inner end of the tube 10 and to be engaged by the open edges of the inverted buffer cup 34. It will be seen that the fit of the guide 38 over the end of the tube 10 stabilizes movement of the collapsible chamber formed by the diaphragm 35 and the cup-shaped member 36, and limits the downward movement thereof. Also, the guide 38, cooperating with the inverted cup 34, limits expansion of the diaphragm 35 away from the cupped member 36. The guide 38 has port means such as 39 to conduct fluid under pressure from the outlet chamber of the valve to the diaphragm.

As shown, the chamber 37 may be charged through the tube 44 that may thereafter be sealed off.

The closed end of the cupped member 36 engages the lower surface of a main diaphragm 46. The main diaphragm is sealed to the portion 12 of the member 8. A head 48 is interfitted with the diaphragm and the enlarged portion 12, to clamp the diaphragm in position, and is sealed therewith. This seal, generally indicated at 49, may be made by induction brazing. This arrangement provides an upper diaphragm chamber 50. A tube 51 is connected into the chamber 50 through the head 48, and has a bulb 52 at its outer end. This bulb is adapted to be located at a point the temperature of which is to effect a control of the valve, and is adapted to contain a suitable thermal liquid.

Operation

The inlet tube 6 may be connected to a source of fluid under pressure. In a typical installation, the inlet 6 will be connected to the compressor of a refrigerating system. The outlet 7 will be connected to the evaporator coils. The bulb 52 may be disposed at some point, such as at the outlet end of the evaporator coil, so as to respond to the

temperature of the refrigerant within the coil at that point.

It will be observed that the outlet fluid acts against the lower end of the main diaphragm 46, whereas the upper end receives the pressure of the thermal fluid from the bulb 52. As a result of this, the diaphragm 46 will take positions that are functions of the superheat of the refrigerant. When the temperature at the outlet of the evaporator increases, without excessive outlet pressure in the valve, the diaphragm 46 will move downwardly. When the superheat decreases, the diaphragm 46 will move upwardly. As shown, the valve is open, so that there is excess superheat at the critical point. In this position, the diaphragm 46 is down, having forced the collapsible chamber, including the upper member 36, and the diaphragm 35 down with it. The diaphragm 35 acts upon the upper end of the valve stem 28, and, as shown, has displaced the valve ball 29 downwardly against the spring 31 to an open position. In this position, the refrigerant can flow past the valve 29 and through the port 26, and thence outwardly through the radial ports 23, and finally into the outlet 7. It expands in this passage, and may absorb heat of evaporation from the evaporator coils.

When the superheat is lowered, as by increased outlet pressure in the valve, or by reduced temperature at the bulb 52, or a combination of these, the diaphragm 46 may be displaced upwardly. The spring 31 will act upon the ball 29 with an upward force, and this force will be transmitted through the stem 28 to the collapsible chamber. The collapsible chamber follows the contracting movement of the diaphragm 46. Thus, the valve 29 may be throttled or closed in accordance with the superheat conditions.

The valve is adapted to close when outlet pressure conditions exceed a predetermined maximum value, regardless of the condition of the main diaphragm 46. It will be seen that outlet pressure is admitted to the bottom side of the inner diaphragm 35 through the port 33. The upper side of this diaphragm is subjected to a predetermined gas pressure sealed within the chamber 37. When the force exerted by the outlet pressure below the diaphragm 35 exceeds the force of the pressure within the chamber 37, the inner diaphragm will be moved upwardly without displacing the member 36 or the diaphragm 46. In this section, the collapse of the diaphragm 35 permits the spring 31 to move the valve 29 upwardly with attendant upward movement of the stem 28 and the inverted cup member 34. Sufficient movement can occur so that the valve will close.

It may be seen that a compact, durable valve of this type is herein provided. It is also a construction that may be made inexpensively by line production methods employing principally stampings and standard parts.

The valve may be used as a conventional thermo-valve by the substitution of a fixed connector between the diaphragm 46 and the valve stem 27. The collapsible chamber is formed as a separate unit, complete in itself, readily removable. This makes easy a choice of collapsing pressures for it, or, in other words, a choice of maximum outlet pressures for the valve.

The superheat operating valve may be adjusted by moving the plug 15. Where the inlet pipe 6 is united firmly with the plug, this adjustment may be easily made by rotating the pipe 6.

The assembly of the valve is easy. The housing 5, including the portion 8 and the tube 10, is first formed, with the partition 25 in the tube. The collapsible chamber unit is applied from the top over the inwardly projecting end of the tube 10. The main diaphragm elements are then attached.

The valve stem 28 may be inserted from the bottom. Then the valve 29, the washer 30, and the spring 31 are installed, and held by the plug 15 with the strainer 18.

What is claimed is:

1. In a valve, a housing, tubular inlet means attached to the housing and projecting inwardly thereinto, a partition across said tubular inlet means having an opening therethrough, a valve on the outward side of the partition, means urging said valve yieldably toward the opening, a power means on the housing including a movable element, means for transmitting movements of the movable element to the valve including a collapsible pressure chamber having a rigid cupped member and a diaphragm thereacross adapted to be charged with gas at predetermined pressure, forming a pressure chamber, a rigid guide means on the cupped member engageable over the inwardly projecting part of the inlet means to be guided thereon, and connecting means between the diaphragm and the valve, outlet means from the housing, and means to conduct fluid under pressure to the diaphragm to act oppositely to the gas pressure charge in the chamber.

2. A valve having a housing, a tubular inlet means connected through the housing, projecting thereinto, and closed across its inner end, lateral openings through the housing below said closure, and discharging into the housing, an axial opening through the closure, a partition below the lateral openings, an opening axially therethrough, a ball valve below said opening, and adjustable tubular plug across the tubular inlet means below the valve, and adjustably movable toward and from the valve, a coil spring between the plug and the valve ball yieldably urging it toward the partition opening, a main pressure chamber including a diaphragm across the housing on the outlet side of the partition and movable with the valve, a collapsible chamber including a cupped member having its closed end abutting the main diaphragm, a second diaphragm across its open end and forming a pressure chamber to contain gas at predetermined pressure tending to move the second diaphragm toward the valve, a rigid member across the open end of the cupped member outside the diaphragm, said rigid member having an opening, a reduced portion on the inlet means terminating in a shoulder, the reduced portion receiving the opening in the rigid member and limiting its movement toward the valve, an inner cupped member applied over the end of the projection on the inlet means, with its ends in engagement with the rigid member and its closed end against the second diaphragm to limit movement of the second diaphragm away from its cupped member, a pin guided in the axial opening in the closure of the tubular inlet means, and passing through the partition opening without closing the same, to engage the valve, and an outlet from the housing.

3. In a valve, a valve casing, a main expansible wall in the casing for movement back and forth in a predetermined direction, a valve stem in the casing movable in said direction, a valve operated by the stem, a projection in the casing having external guide means parallel to the valve stem, the valve stem having its end spaced from the expansible wall, and a connecting means between

the wall and the valve stem, said connecting means being separable from both, and having internal guide means complementary to said first named guide means, and embracing the same for guided movement thereon, whereby to transmit movements of the wall to the valve stem.

4. In a valve, a valve casing, a main expansible wall in the casing for movement back and forth in a predetermined direction, a valve stem in the casing movable in said direction, a valve operated by the stem, a projection in the casing having external guide means parallel to the valve stem, the valve stem having its end spaced from the expansible wall, and a connecting means between the wall and the valve stem, said connecting means being separable from both, and having internal guide means complementary to said first named guide means, and embracing the same for guided movement thereon, whereby to transmit movements of the wall to the valve stem, said connecting means including a normally expanded collapsible capsule having a displaceable wall collapsible to reduce the size of the connecting means and permit the valve to operate in response to collapse of the capsule regardless of the main expansible wall.

5. In a valve, a valve casing, a main expansible wall in the casing for movement back and forth in a predetermined direction, a valve stem in the casing movable in said direction, a valve operated by the stem, a projection in the casing having external guide means parallel to the valve stem, the valve stem having its end spaced from the expansible wall, and a connecting means between the wall and the valve stem, said connecting means being separable from both, and having internal guide means complementary to said first named guide means, and embracing the same for guided movement thereon, whereby to transmit movements of the wall to the valve stem, said connecting means including rigid members arranged between the main expansible wall and the projection, a displaceable wall connected with the rigid members and forming a normally pressure-expanded collapsible chamber, said wall being disposed across the valve stem, a rigid element between the displaceable wall and the valve stem, and abutment means between the rigid element and said rigid members to limit expansion of the collapsible chamber.

6. In a valve construction, a housing including a cup-like outer member with an open upper end and having an opening in its lower end, a pipe-like member attached in said opening and projecting into the outer member, a valve stem slidably operable in said pipe-like member and extending through the same to inside the casing, a main diaphragm closing the open upper end of the cup-like member; a collapsible capsule comprising rigid parts including a rigid second cup element having its closed wall engageable with the main diaphragm and its open end toward the valve stem, rigid guide means from said second cup element embracing the projecting pipe-like member for guided movement thereon, a second diaphragm across the open end of the second cup element, transmitting movements to the valve stem, and a rigid limiting means between the second diaphragm and the rigid parts of the collapsible capsule for limiting movements of the second diaphragm.

7. In a valve construction, a housing including a cup-like outer member with an open upper end and having an opening in its lower end, a pipe-like member attached in said opening and projecting into the outer member, a valve stem slidably operable in said pipe-like member and extending through the same to inside the casing, a main diaphragm closing the open upper end of the cup-like member; a collapsible capsule comprising rigid parts including a rigid second cup element having its closed wall engageable with the main diaphragm and its open end toward the valve stem, rigid guide means from said second cup element embracing the projecting pipe-like member for guided movement thereon, a second diaphragm across the open end of the second cup element, transmitting movements to the valve stem, and a rigid limiting means between the second diaphragm and the rigid parts of the collapsible capsule for limiting movements of the second diaphragm, a valve in the pipe-like member operated by the valve stem, a spring in the pipe-like member urging the valve, stem, and collapsible capsule toward the main diaphragm.

8. A collapsible capsule unit for use in valves and the like and removable as a unit therefrom, comprising a rigid cup-shaped element, a diaphragm across the open end of the element of a size to be contained within the limits of the element and having its peripheral edges attached in sealing relation to the element, a rigid guide member attached to the open end of the cup-shaped element, and extending inwardly in spaced relation to the diaphragm, said guide member providing an opening for access to the diaphragm, and a rigid cup-like buffer element having its closed end engageable with the diaphragm and having its side wall portions extending toward the rigid guide member around the edges of the opening therein for abutting engagement therewith to limit movement of the diaphragm in one direction, the open end of the cup-like buffer element being at least as large as the opening in the guide member.

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