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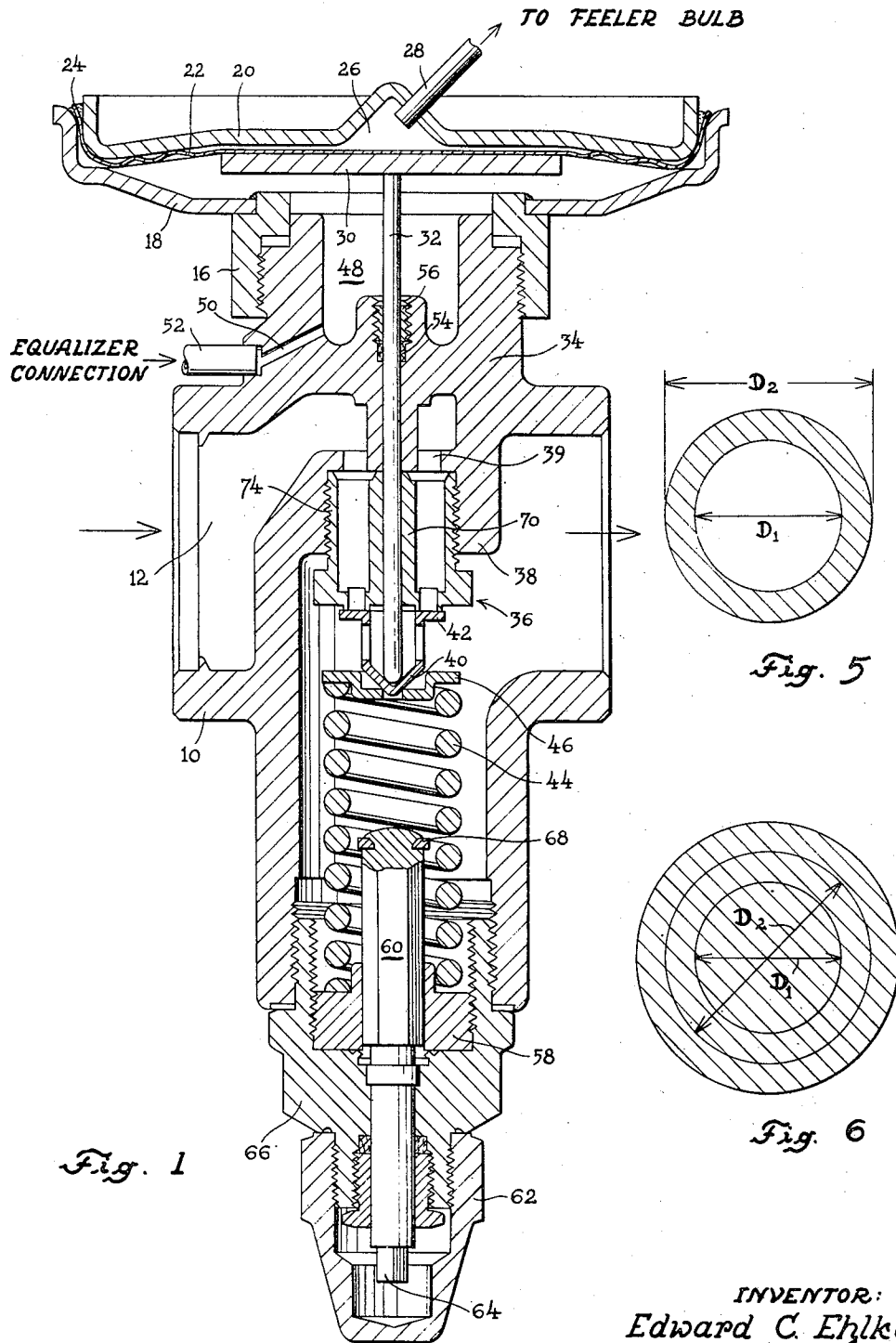
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HIGH CAPACITY THERMOSTATIC EXPANSION VALVE

Filed Jan. 19, 1955

2 Sheets-Sheet 1



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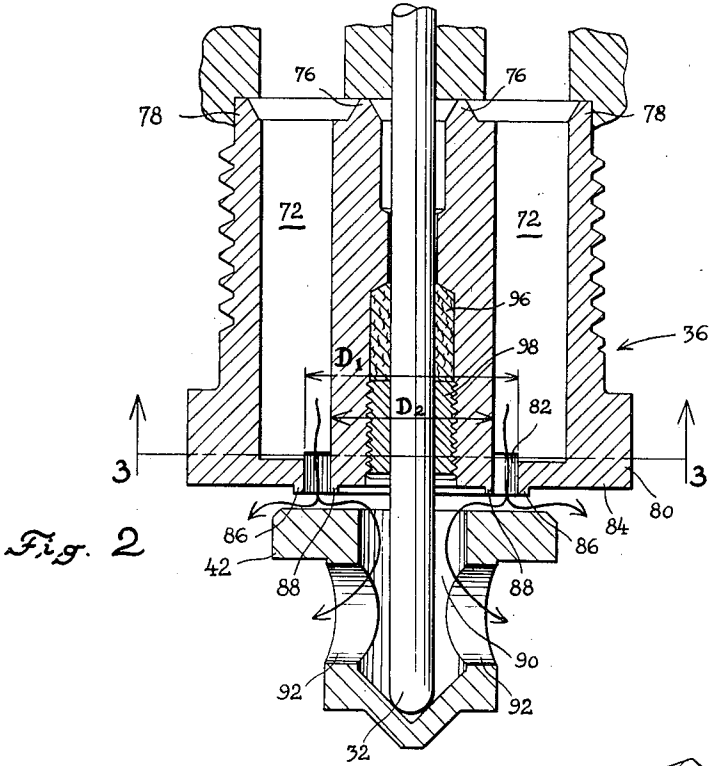
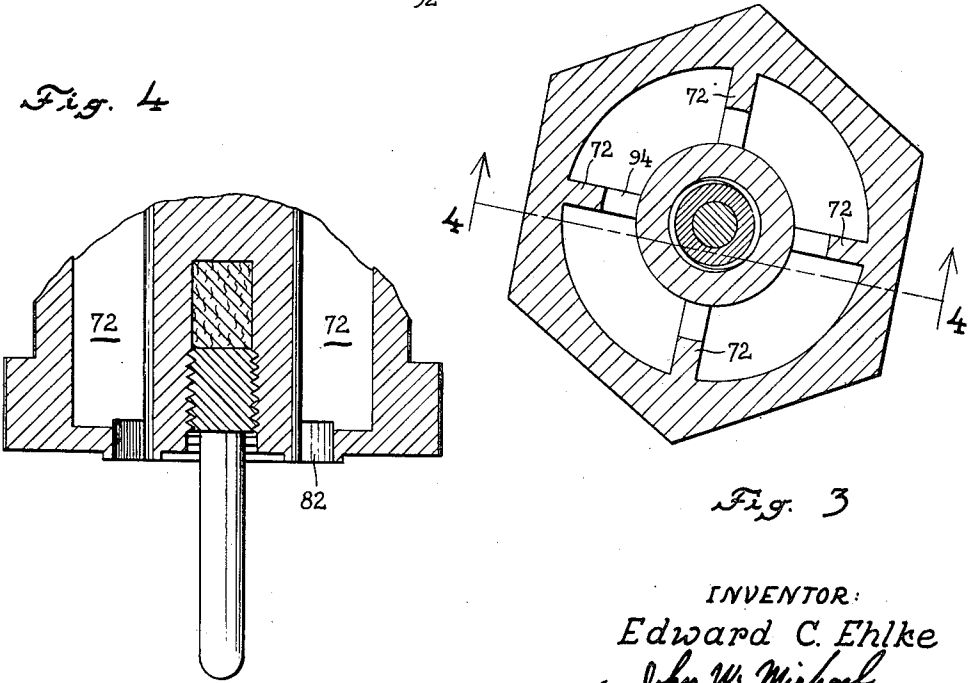
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HIGH CAPACITY THERMOSTATIC EXPANSION VALVE

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7 Claims. (Cl. 236—92)

This invention relates to a thermostatic expansion valve in which the head pressure variations have a minimum effect on the superheat setting and general operating characteristics.

The principal object of this invention is to provide a thermostatic expansion valve in which the head pressure variations have little effect on the valve operation.

Another object is to accomplish the principal object without resorting to multiple or balanced valves which result in costly construction.

Other objects and advantages will be pointed out in, or be apparent from, the specification and claims, as will obvious modifications of the embodiment shown in the drawings in which:

Fig. 1 is a vertical section through the valve;

Fig. 2 is a slightly modified construction similar to a fragment of Fig. 1;

Fig. 3 is a section taken as indicated by line 3—3 in Fig. 2;

Fig. 4 is a view taken as indicated by line 4—4 (note that the line is off-center) in Fig. 3;

Fig. 5 shows the valve area (on an enlarged scale) acted on by head pressure; and

Fig. 6 shows the equivalent area of a single port type valve having the same capacity as the illustrated valve.

Referring to the drawings in detail, the thermostatic expansion valve has a main body casting 10 having inlet 12 and outlet 14. The top of the body is threaded to receive fitting 16 to which the bottom 18 of the diaphragm housing is secured. The periphery of bottom 18 is turned up to receive top 20 and diaphragm 22. The assembly is hermetically sealed with silver solder at 24, and chamber 26 above the diaphragm is connected by capillary tube 28 to a feeler bulb, not shown. The underside of diaphragm 22 is provided with the usual pad 30 against which push pin 32 acts. The pin extends through the partition 34 and through the center of the valve seat casting 36 threadably mounted in partition 38 to align the passages in the casting with annular spring 39 in the partition. The lower end of the rod acts on the generally conical seat 40 of valve member 42. The valve member is urged towards the closed position by compressed spring 44 acting on plate 46 which is apertured to receive the point of the conical portion 40 of valve 42.

Chamber 48 on the underside of the diaphragm 22 is provided with an external equalizer connection through conduit 50 and capillary tube 52. When the valve is externally equalized packing 54 is provided around the push pin 32 and held in place by the hollow threaded plug 56. If the valve is not to be used with an external equalizer, the packing 54 would not be employed and the conduit 50 would be sealed.

The degree of compression of spring 44 (and thus, the superheat setting of the valve) is determined by the position of member 58 which is provided with a hex aperture to allow the member to slide on the hex shaft 60, while being effectively keyed thereto. Therefore, the cap 62 may be removed to permit the end 64 of the shaft 60

2

to be turned to rotate the member 58 and cause it to be moved up or down in its threaded connection to member 66 threadably secured in body 10. As shown in the drawings, the member 58 can be adjusted only to increase the spring force acting on the valve 42 since the member is at the lower limit of its travel. It will be noted that stem 60 is provided with a lock ring 68 which prevents turning member 58 off the stem 60.

Turning now to a detailed consideration of the annular valve seat assembly 36, it is to be noted that this is a cast or forged member having central portion 70 connected by four ribs 72 to the outer annular portion 74 which is threaded for mounting in the valve body. The upper end of the seat assembly is machined to provide two generally circular seats 76, 78 which are preferably machined simultaneously so as to result in all seating surfaces being coplanar. Thus, when the assembly is turned into the valve body by means of hex 80 at the lower end of the assembly, the casting will seat and seal with respect to the body at the desired locations. It is to be noted that the ribs 72 extend almost the entire length of the assembly 36. This is done to obtain great strength to resist the tendency to warp when the unit is threaded into the valve body. The annular opening 82 at the lower end of the casting 36 constitutes the actual port area. Thus, as may be seen in Fig. 2, the port 82 is the difference between D-1 and D-2. The exposed face 84 of the valve seat assembly is machined to provide the seats 86, 88. Here again, the machining is preferably done simultaneously to result in coplanar seating surfaces. Then, when the valve 42 is mounted in the body, it can be lapped, if necessary, to secure perfect seating.

It will be noted that the valve assembly 42 is provided with a central aperture 90 which communicates with the diametrically opposed apertures 92, 92. Therefore, when the valve opens as in Fig. 2, the flow can split into two paths shown by the arrows. Therefore, a small valve opening will open a considerable flow path as compared with a simple single port type valve which only opens a flow path about its periphery. As a result, a large flow can be obtained with this valve while exposing the valve 42 to the head pressure over a very small area. The size of this area is illustrated on an exaggerated scale in Fig. 5 wherein the shaded area represents the area over which the head pressure acts. Fig. 6 shows the area over which head pressure would act on a single port type valve having the same capacity. It will be appreciated that this difference is marked. The present construction allows head pressure to act on only one-sixth the area the head pressure would act on a single port type valve having the same capacity.

Referring to Figs. 2, 3 and 4 in particular, it will be noted that the ribs 72 are undercut at 94 immediately above the annular port 82 in order to minimize the interference to flow occasioned by the ribs at the port 82. While the undercutting is very slight, it has been found that the capacity of the valve is increased by undercutting in this manner. These figures also show an alternative construction for the location of the packing sealing the push rod 32 (employed with external equalizer). Thus, the packing 96 is contained within the seat assembly 36 and the degree of compression of the packing is adjusted by turning threaded member 98.

It will be noted in both constructions, the valve 42 can easily adjust to the seating areas 86, 88 to insure flat seating. This construction coupled with passing the push pin 32 through the center of the seat assembly 36 results in an easily fabricated assembly having very large capacity. In the past thermostatic expansion valves of similar capacity have generally resorted to series valve arrangements where the head pressure acted on the valves in opposite directions so as to cancel out the head pres-

sure effects as much as possible. This type of construction results in costly fabrication since the simultaneous seating of both valves is extremely difficult to obtain.

It is to be noted that should it be desired to reduce the capacity of the valve, the same basic construction can be employed except that the diametrically opposed ports 92, 92 would not be provided and, therefore, one flow path from the annular port 82 would be cut off. While this would reduce the capacity of the valve, the valve would then act in much the same manner as a single port type valve having an external diameter of D-1. Thus, the head pressure would act over the entire area D-1 rather than the difference between D-1 and D-2. This is true since the leakage past the valve even when the valve is seated and the seats are well lapped etc. would be enough to shortly elevate the pressure around the push pin 32 in the valve assembly 42 to the head pressure. Therefore, while the present construction can be readily modified to reduce the capacity of the valve, the desirable operating characteristic of the present construction is adversely effected.

The ease with which the present valve can be assembled or serviced should be appreciated. Removal of the fitting 16 carrying the diaphragm housing exposes the upper end of the rod. Removal of member 66 takes with it the entire superheat adjusting apparatus and the spring and valve to expose the valve seat assembly 36 for service or removal. Access to the seat is easy since the diameter of the bore from the lower end of the valve is larger than the seat casting diameter.

Although but one main embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. A thermostatic expansion valve of large capacity in which the head pressure has little effect on the operating characteristics of the valve comprising, a valve body having an inlet and an outlet and a partition wall therebetween, an annular port in said partition wall, coplanar annular valve seats inside and outside the annular port on the outlet side of the port, a push pin passing centrally of the annular port through said partition, means including a diaphragm defining a variable volume chamber, means connecting said chamber to a feeler bulb subjected to temperature variations, a flat annular valve assembly on the outlet side of the port and adapted to seat on said annular surfaces, said push pin being operatively connected to said diaphragm and to said valve assembly, spring means acting on the valve assembly urging the valve assembly towards the annular seats, and means allowing communication between the center of the valve assembly and the outlet so that flow through the port when the valve is open can flow to the outlet either externally or internally of the valve assembly.

2. A thermostatic expansion valve according to claim 1 in which the annular port is located within a valve seat assembly threadably mounted in said partition, said valve seat assembly comprising coaxial generally tubular members interconnected by webbing and having an annular port on the downstream end of the assembly, said valve assembly comprising a generally cuplike member having a flanged end which acts as the valve, the center of the cuplike member being ported to the outlet.

3. A thermostatic expansion valve according to claim 2 in which the valve seat assembly has the annular port located in a generally flat wall on the downstream side of the assembly, said ribs extending from the upstream end of the assembly to the wall being undercut slightly where the ribs pass over the annular port.

4. A thermostatic expansion valve comprising, a body having an inlet and an outlet with a partition therebetween, an annular port in said partition having annular seats surrounding the port on the downstream side of the partition, a diaphragm chamber mounted on said body and connected to a temperature responsive bulb to flex the diaphragm in accordance with temperature at the bulb, a push rod connected to said diaphragm and passing through said partition generally on the axis of said port, a valve member connected to said rod on the outlet side of the partition and including an annular valve adapted to close on said seats, and a spring urging said valve member toward the seats.

5. A thermostatic expansion valve according to claim 4 in which the valve member has an open flow path from the inside of the annular valve to the outlet so flow through the port can flow to the outlet either between the outer annular seat and the valve or the inner annular seat and the valve.

6. A thermostatic expansion valve according to claim 5 in which said annular port is contained in a separate seat assembly threaded into the partition and having an inner annulus through which the rod passes and an outer annulus connected to the inner annulus by ribs said assembly being threadably mounted in the partition.

7. A thermostatic expansion valve according to claim 6 in which the spring is a coil spring adjustably mounted in alignment with the rod and said seat assembly, means for adjusting the compression of the spring and including a fitting threaded into the body, the bore of the body having a greater diameter than the seat assembly and being aligned therewith to permit access to the seat assembly by removal of the fitting.

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