Feb. 18, 1964 J. M. MURPHY ETAL 3,121,373

FLUID MOTOR AND ADJUSTABLE BIASING MEANS

Filed Sept. 7, 1961 2 Sheets-Sheet 1

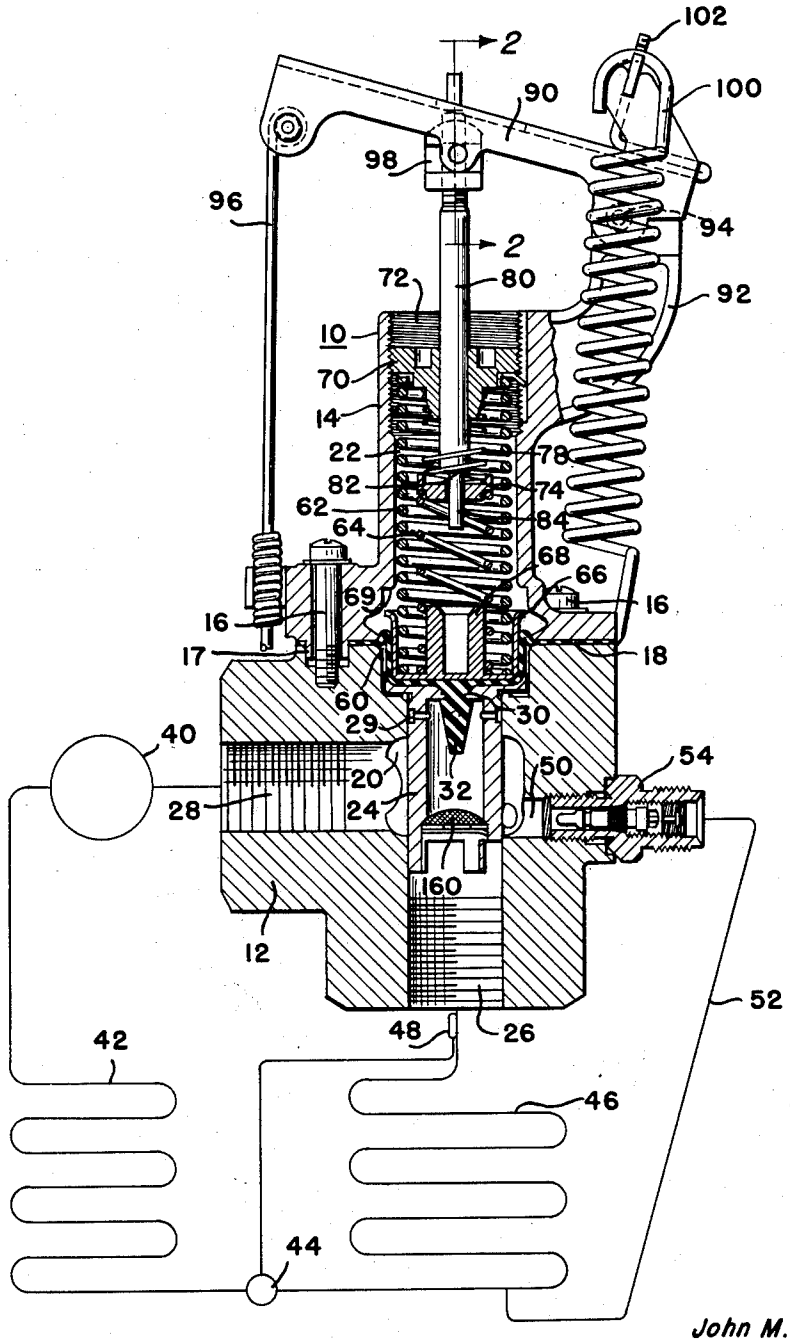


Fig. 1

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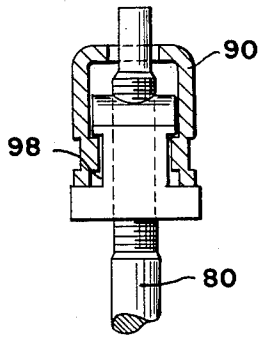


Fig. 2

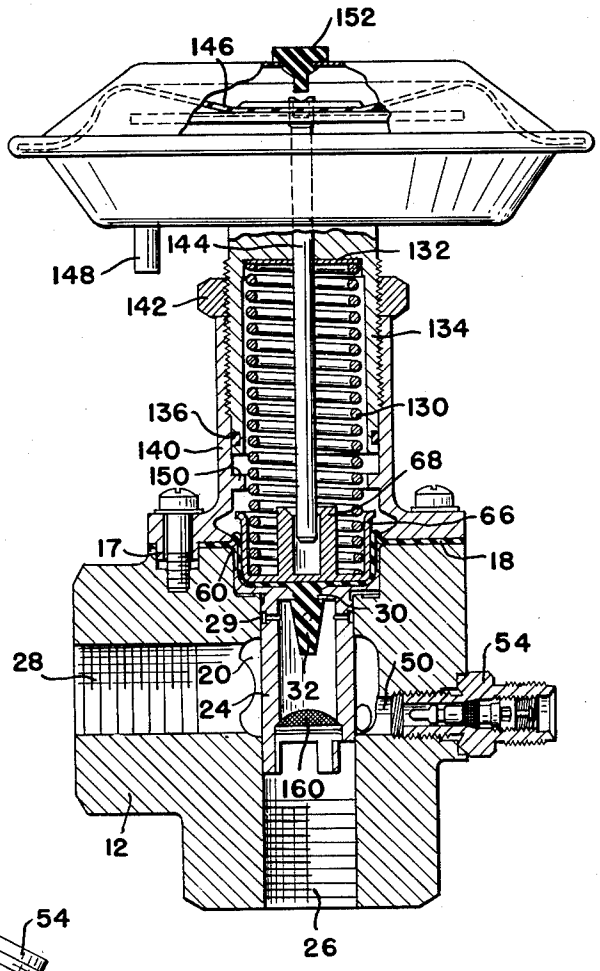


Fig. 4

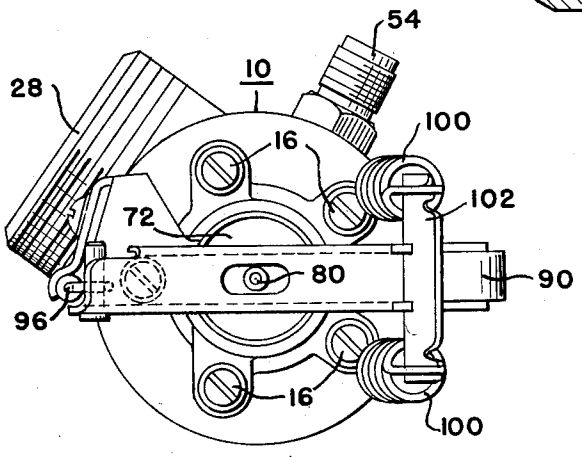


Fig. 3

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FLUID MOTOR AND ADJUSTABLE BIASING MEANS

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This invention relates to refrigerating apparatus and more particularly to a suction throttling valve for use in automobile air conditioning systems and the like.

It is an object of this invention to provide an improved low cost control valve which lends itself to mass production and which accurately maintains the evaporator pressure in a refrigerating system at a preselectable value.

Still another object of this invention is to provide an improved arrangement for varying the pressure maintained in the evaporator and for preventing that pressure from falling below evaporator freeze up pressure.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a sectional view of a valve embodying the invention and includes a schematic showing of the refrigerant circuit in which the valve is used.

FIGURE 2 is a fragmentary view taken substantially on line 2—2 of FIGURE 1.

FIGURE 3 is a plan view of the valve.

FIGURE 4 is similar to FIGURE 1 but shows a modified form of valve.

Referring now to the drawings wherein preferred embodiments of the invention have been shown, reference numeral 10 generally designates a suction throttling valve having a two-part casing consisting of a lower valve body 12 and an upper valve body or cover 14 which is secured to the lower valve body 12 by means of a plurality of cap screws 16. The upper valve body 14 has integrally formed locating bosses 17 which extend into recesses in the lower valve body 12 as shown in FIGURE 1. This insures proper concentricity of the cover 14 and main valve body 12 to give proper clearance for the diaphragm 18 on all sides of the follower 66.

A flexible diaphragm element 18 separates the valve body into a first compartment 20 and a second compartment 22. A flow control member 24 is secured to the diaphragm 18 so as to be actuated in response to changes in the pressures to which the diaphragm is subjected. The flow control member 24 is in the form of a reciprocating piston which serves to control the flow of refrigerant from the inlet 26 to the outlet 28. The upper side of the diaphragm is subjected to and responsive to atmospheric pressure and the lower side to the refrigerant pressure at the inlet 26 so as to form a fluid motor. A plurality of passages 29 connects the inlets 26 to the space 60 around the bottom side of the diaphragm. A very slight clearance is provided between the upper end of the member 24 and the side walls of the valve body 12 so that the pressure in the space 60 will be substantially the same as the pressure at the inlet 26 but will not be adversely affected by sudden fluctuations in the pressure at 26. The restriction to the flow between the inlet 26 and the space 60 serves to prevent a hunting action or chattering of the valve and consequently prevents the valve from being noisy. The piston element 24 is provided with a central aperture 30 which frictionally grips an integrally formed projection 32 on the one side of the diaphragm 18. It will be noted that the projection 32 is tapered and that

the bottom end thereof is sufficiently small to allow it to pass through the aperture 30 so that it may be forced through the aperture 30 until the end of the piston abuts against the bottom wall of the diaphragm 18.

The outlet passage 28 is connected to the inlet of a refrigerant compressor 40 and the compressed refrigerant leaving the compressor 40 flows into a conventional condenser 42 wherein the refrigerant is liquefied. The liquid refrigerant is then fed into a thermostatic expansion valve 44 arranged adjacent the inlet of the evaporator 46 and the outlet of the evaporator connects to the inlet 26 of the suction throttling valve 10. The expansion valve 44 is provided with the usual thermostatic bulb 48 located adjacent the outlet of the evaporator 46. For purposes of illustration, an evaporator of the type having a single series passage has been shown, whereas any type of evaporator could be used including those provided with a plurality of parallel passage and those known as flooded evaporators.

The suction throttling valve 10 is provided with an auxiliary inlet 50 which is connected by means of a line 52 to the bottom portion of the evaporator so as to provide for the return of lubricant from the bottom of the evaporator even when the suction throttling valve has closed off the inlet port 26. A pressure responsive valve 54 is provided in the oil return line 52 and serves to prevent flow through the line 52 when maximum refrigeration is required. In the event the refrigerant charge is partially depleted, the evaporator pressure will be pulled down and the suction throttling valve closed and under such conditions the valve 54 will open and allow lubricant to return to the compressor.

The flow control piston 24 is biased into the position in which it is shown in FIGURE 1 by means of a first relatively large coil spring 62. A second but smaller coil spring 64 can be brought into play as an additional diaphragm loading device when it is desired to increase the evaporator pressure. Both springs 62 and 64 are designed to press downwardly against the diaphragm through the cup-shaped diaphragm follower 66 which is constructed and arranged as shown. It will be noted that the cup-shaped follower 66 includes a central hollow post 68 which serves to position the spring 64 substantially centrally within the spring 62. A shoulder 69 is formed on the upper valve body element 14 and limits the upward movement of the diaphragm so as to prevent stretching of the diaphragm at the upper limit of movement thereof. The upper end of the spring 62 is limited in its movement by means of the adjustable spring retaining abutment 70 which is screw threaded into an aperture 72 provided in the upper end of the valve body member 14. By rotating the abutment element 70 it is possible to preset the loading of the spring 62 so as to operate the refrigerating system at maximum capacity without freeze up of the evaporator. Once the abutment 70 has been set at the factory, it normally would not be changed. By using a rolling type diaphragm operating in a cavity shaped like that shown, the effective area of the diaphragm varies so as to compensate for the change in the rate of the spring 62 as the spring is compressed.

The upper end of the spring 64 contacts a spring retaining thrust member or abutment 74 which is arranged as shown. A third spring 78 is arranged between the fixed abutment 70 and the thrust member 74 and serves to prevent rattle or chatter when no pressure is being applied to the thrust member 74. A plunger 80 is slidably supported in the abutment element 70 and is provided with a shoulder 82 for engaging the thrust member 74 so as to press down on the thrust member 74 and thereby compress the spring 64 when it is desired to provide additional spring loading for the diaphragm 18. The plunger 80 is provided with a reduced lower end portion 84 which

passes through the central aperture in the thrust washer 74 and thereby serves to guide and align the abutment 74 and the upper end of spring 64.

A spring pressure adjusting lever 90 has its one end pivotally secured to the bracket 92 by means of a pivot pin 94. The bracket 92 is formed as an integral part of the valve housing element 14. A control wire actuator 95 engages the free end of the lever 90 and serves to depress the plunger 80 upon a pull on the control wire 96. The midpoint of the lever 90 serves to pivotally engage a yoke-like member 98 which is secured to the plunger 80. The member 98 is threaded onto the member 80 and can be preset at the factory whereby it is possible to position the shoulder 82 on the lower end of the member 80 at the desired height above the thrust member 74 so as to avoid having the spring 64 press against the diaphragm 18 with any appreciable force when it is desired to operate the evaporator at its minimum pressure. A pair of overcenter springs 100 have their lower ends secured to the main valve housing and have their upper ends arranged to hook over projections 102 formed on the lever 90. It will be noted that the arrangement of the springs 100 relative to the pivot point 94 is such that an overcenter toggle action is provided. Thus, the springs 100, as shown in FIGURE 1, are slightly to the right of the dead center position and the pivot pin 94, and therefore actually bias the free end of the lever 90 upwardly when the lever occupies the position in which it is shown in FIGURE 1 but once the control wire 96 moves the free end of the lever 90 down a small amount, the center line of the springs 100 will move past the dead center position and the pivot point 94 of the lever 90 and when this takes place, the springs 100 tend to pull the free end of the lever 90 downwardly and thereby reduce the amount of pull the user has to exert on the control wire 96 in order to compress the inner spring 64.

The valve construction shown in FIGURE 4 of the drawings is similar in most all respects to the valve construction shown in FIGURE 1 except in lieu of using a control wire actuator for varying the spring loading, there is provided a pneumatically operated means for pressing downwardly against the upper side of the diaphragm 18. In this modified arrangement a single spring 130 is provided between the diaphragm follower 66 and an abutment surface 132 formed on the inner surface of the adjustable sleeve 134 which is arranged as shown. The sleeve 134 is provided with a sealing gasket 136 disposed in a peripheral groove formed on the outer surface of the sleeve 134. By rotating the sleeve 134 relative to the upper casing element 140, it is possible to adjust the spring loading. Once the proper spring loading has been obtained, a locking nut 142 will be tightened down and will serve to hold the sleeve 34 in the desired relationship to the valve housing 140. In this modification, the pressure to be maintained in the evaporator is adjusted by movement of the plunger 144 secured to a diaphragm 146. The upper side of the diaphragm 146 is subjected to atmospheric pressure and the lower side of the diaphragm may be subjected to a reduced pressure when it is desired to cause further throttling of the suction valve. The reduced pressure is preferably provided by connecting the suction line 148 to the intake manifold of the car engine which drives the compressor 40. The user would adjust the manifold suction pressure applied by any conventional means (not shown). An abutment 150 is provided within the valve housing element 140 so as to limit the maximum upward travel of the diaphragm follower 66 and an abutment 152 limits the upward travel of the plunger 144 so as to prevent the lower end of plunger 144 from moving out beyond the upper end of the recess in the hollow post 68 at any time.

In each of the devices shown, a screen 160 is provided in the flow control element 24 so as to prevent any foreign particles from entering the passage 29 and possibly interfering with free sliding movement of the element 24 within the valve body 12.

While the embodiments of the present invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. In combination, a fluid motor, first spring means continuously acting upon said fluid motor, means for adjusting said first spring means, a second spring means positioned for acting upon said fluid motor, a lever having means effective in one position for applying force to said second spring means to cause said second spring means to act upon and apply force to said fluid motor and effective in a second position to remove a major portion of the force from said second spring means, toggle over center spring means operably connected to said lever and oriented to provide substantially a dead center position in said second position and in said first position to apply a spring force to said lever opposing the force of the second spring means upon the lever, means for stopping said lever substantially in said second position, and means for operating said lever independently of said fluid motor.

2. In combination, a fluid motor, first spring means continuously acting upon said fluid motor, means for adjusting said first spring means, a second spring means positioned for acting upon said fluid motor, a lever, an adjustable connecting means operably connecting said lever and said second spring means for applying a force to said second spring means, toggle over center spring means operably connected to said lever, means for controlling said lever to operate substantially entirely on one side of the dead center position of said over center spring means for applying an increasing spring force to said lever as the opposition of said second spring means to the movement of said lever increases, and means for operating said lever independently of said fluid motor.

3. In combination, a fluid motor, a first coil spring having one end acting upon said fluid motor, a second coil spring located within said first coil spring having one end acting upon said fluid motor, an adjustable spring retainer associated with the other end of said first coil spring, said spring retainer having an aperture therein, a rod slidably mounted in said aperture and having one end provided with a second spring retainer associated with the other end of said second coil spring, a lever operably connected to the other end of said rod, and means for operating said lever to operate said rod to adjust said second coil spring.

4. In combination, a housing provided with a cylindrical portion, a fluid motor in said housing aligned with said cylindrical portion, a first coil spring located within said cylindrical portion and having one end operably connected to said fluid motor, an adjustable spring retainer threaded into said cylindrical portion associated with the other end of said first spring, a second coil spring located within said first coil spring and having one end operably connected to said fluid motor, said adjustable spring retainer having an aperture therein, a rod extending through said aperture and having a second spring retainer thereon associated with the other end of said second spring, and a lever pivotally connected to said housing and having an operative connection with said rod for moving the other end of said second spring.

5. In combination, a housing provided with a cylindrical portion, a fluid motor in said housing aligned with said cylindrical portion, a first coil spring located within said cylindrical portion and having one end operably connected to said fluid motor, an adjustable spring retainer threaded into said cylindrical portion associated with the other end of said first spring, a second coil spring located within said first coil spring and having one end operably connected to said fluid motor, said adjustable spring retainer having an aperture therein, a rod extending through said aperture and having a second spring

retainer thereon associated with the other end of said second spring, a lever pivotally connected to said housing and having an operative connection with said rod for moving the other end of said second spring, and toggle over center spring means connected at opposite ends to said lever and to said housing.

6. In combination, a housing provided with a cylindrical portion, a fluid motor in said housing aligned with said cylindrical portion, a first coil spring located within said cylindrical portion and having one end operably connected to said fluid motor, an adjustable spring retainer threaded into said cylindrical portion associated with the other end of said first spring, a second coil spring located within said first coil spring and having one end connected to said fluid motor, said adjustable spring retainer having an aperture therein, a rod extending through said aperture and having a second spring retainer thereon associated with the other end of said second spring, a third coil spring surrounding said rod between said first and second spring retainers, and toggle over center spring means connected at opposite ends to said lever and to said housing.

7. In combination, a housing provided with a cylindrical portion, a fluid motor in said housing aligned with said cylindrical portion, a first coil spring located within

said cylindrical portion and having one end operably connected to said fluid motor, an adjustable spring retainer threaded into said cylindrical portion associated with the other end of said first spring, a second coil spring located within said first coil spring and having one end connected to said fluid motor, said adjustable spring retainer having an aperture therein, a rod extending through said aperture and having a second spring retainer thereon associated with the other end of said second spring, and a lever pivotally connected to said housing and having a threaded adjustable operating connection with said rod for moving the other end of said second spring.

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