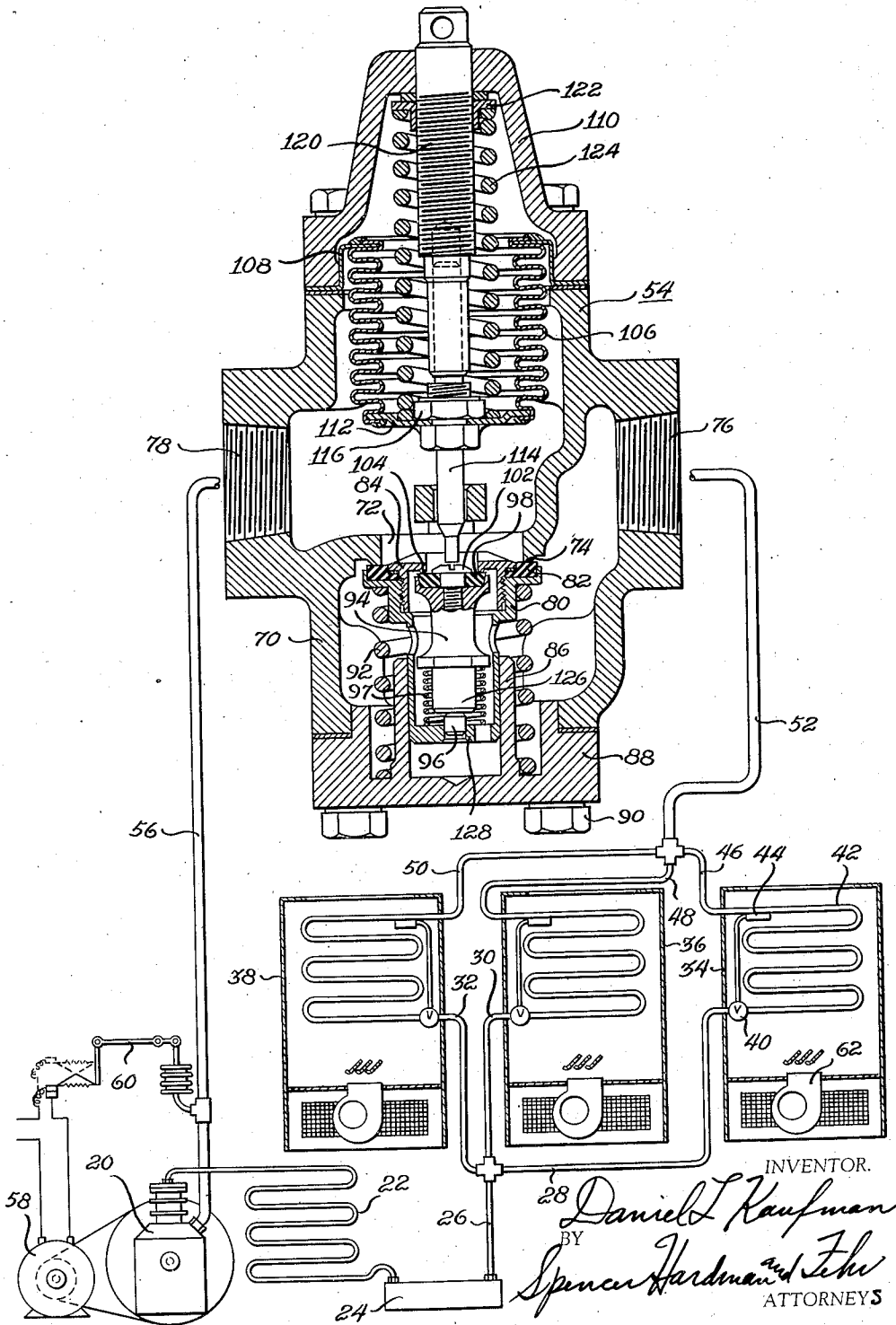


Sept. 8, 1936.

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REFRIGERATING APPARATUS
Filed Feb. 9, 1935

2,053,290



UNITED STATES PATENT OFFICE

2,053,290

REFRIGERATING APPARATUS

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Application February 9, 1935, Serial No. 5,789

3 Claims. (Cl. 62—3)

This invention relates to refrigerating apparatus and more particularly to means for preventing high starting loads upon the refrigerant compressor.

5 When refrigerating systems are shut down the refrigerant pressure within the low pressure portion of the system becomes much higher than during normal operation because of the rise in temperature of the evaporating means and the environment of the evaporating means. This imposes a much greater load than even the normal starting load and the normal starting load is of course considerably greater than the normal running load. Thus, it will be realized that upon
10 starting a refrigerating system which has been shut down for a considerable period of time, a very heavy load is placed upon the compressor and its driving motor. Attempts have been made to place throttling valves in the suction line of
15 refrigerating systems in order to take care of this particular situation. However, unless such valves are made exceedingly large they throttle the gas during the entire running period of the compressor and so cause the efficiency of the system to
20 be reduced considerably. Also, the use of large valves requires a very large bellows for operating the valve since large valves usually require a rather large amount of force in order to move them to open position.

30 It is an object of my invention to provide a refrigerating system with a valve means for reducing the load on the compressor during the starting of the refrigerating system after a shut down which valve means requires only a small
35 actuating means and which will not appreciably throttle the flow of refrigerant during the normal running period of the compressor.

It is a further object of my invention to provide a refrigerating system with a compound
40 valve in the suction line thereof having a comparatively small bellows responsive to the pressure in the inlet of the compressor for opening the valve when the pressure has been reduced to a predetermined amount to prevent overloading the compressor.

45 Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form
50 of the present invention is clearly shown.

In the drawing:

The figure is a diagrammatic view of a refrigerating system including an enlarged section of my improved valve means.

55 Referring to the drawing, there is shown a

compressor 20 for compressing the refrigerant and for forwarding the compressed refrigerant to a condenser 22 where the compressed refrigerant is liquefied and collected in the receiver 24. From the receiver 24 the liquid refrigerant is forwarded
5 through a common supply conduit 26 and branch supply conduits 28, 30 and 32 to the air conditioning units 34, 36 and 38. Each of these air conditioners is provided with an expansion valve 40 which controls the supply of liquid refrigerant to an evaporating means 42. The valve 40 is controlled by a thermostat 44 located in heat exchange relation with the outlet of the evaporator 42. From the air conditioning units the evaporated refrigerant is conducted by the individual
10 supply conduits 46, 48, and 50 to the common supply conduit 52 which connects to my improved throttle control valve 54 for controlling the flow of evaporated refrigerant through the return
15 conduit 56 to the inlet of the compressor 20. The compressor 20 is driven by an electric motor 58 under the control of a snap acting switch means 60 provided with a bellows responsive to the pressure within the return conduit 56. Each of the
20 air conditioning units are provided with a motor 25 driven fan preferably of the centrifugal type designated by the reference character 62 which draws in air from the room and circulates the air over the evaporator 42. Although the invention is shown as applied to a multiple air conditioning system, it should be understood that
30 this invention is applicable also to single and multiple refrigerating systems for other purposes.

Normally the pressure within the refrigerant evaporator, the return conduit and the inlet of
35 the compressor is kept between predetermined limits. However, when the system is shut down for any reason whatever, especially in warm weather, the refrigerant pressure rises in these evaporators and in the return conduit and inlet
40 of the compressor. The hotter the day and the hotter the environment temperature of the evaporators and compressor, the higher the pressure is in the evaporators and the return conduit. It will thus be seen should the system be required
45 to start on a very hot day after a shut down, there will be a tremendous load imposed upon the compressor which may be several times greater than the normal load.

Prior to my invention, so far as I am aware, 50 no one has been able to successfully provide a valve for throttling the suction line under such conditions which does not have the disadvantage of either throttling the flow of refrigerant during the running period or the disadvantage of 55

being exceedingly large and having expensive parts and expensive construction. On the other hand, I, by my invention have provided a small rather simple compound valve which overcomes these objections and permits the use of a relatively small actuating bellows and a relatively small valve structure which, through the use of the compound valve members, provides a relatively simple means for throttling the flow of evaporated refrigerant to the compressor during high pressure conditions but which permits the free flow of refrigerant under normal conditions.

This valve comprises a valve body 70 having a valve opening 72 provided with a valve seat 74. The valve opening connects to the inlet 76 of the valve on one side and to the outlet of the valve 78 on the other side. Beneath the valve seat there is provided a large valve member 80 having an annular rubber-like gasket member 82 of some suitable rubber-like material such as a form of chloroprene which is commonly known under the trade name "duprene". This rubber-like annular member has an inner flange which is fastened to the valve member 80 by a flanged member 84 threaded into the top of the valve and whose flanges grip the inner flange of the annular rubber-like member 82. The valve member 80 is guided within a boss 86 extending upwardly from the removable bottom portion 88 of the valve body which is fastened to the middle portion of the valve body by cap screws 90. The valve member 80 is urged against the valve seat 74 by a compression type of coil spring 92 which is seated within an annular groove surrounding the valve guide 86. Within the valve member 80 is a smaller pilot or primary valve 94. This valve is guided by a pin 96 extending from the lower portion of this pilot valve into an aperture formed in the bottom valve member 80. The pilot or primary valve is resiliently urged in an upward direction by a rather weak coil spring 97. The upper portion of this pilot valve is provided with a rubber-like gasket member 98 preferably of a form of chloroprene commonly known under the trade name of "duprene". This rubber-like member is fastened to the body of the pilot or primary valve by a screw 102. This pilot or primary valve cooperates with a seat 104 formed on the threaded member 84.

In order to open these two valves there is provided a flexible metal bellows 106 in the upper portion of the valve body which has its upper fixed end connected to a flange member 108 having its flange portion held between the bonnet 110 and the main portion of the valve body. The lower movable portion of the metal bellows is connected to a plate 112 fastened to the valve stem 114 by a nut 116 which holds the plate 112 tightly against a hexagonal shoulder on the valve stem. The upper end of this valve stem slides within the hollow lower end of an adjusting screw 120. Threaded upon the adjusting screw 120 is a spring retainer 122 which holds the upper end of a compression coil spring 124 while the lower end of the spring is held by the plate 112.

When the pressure in the crankcase or inlet of a compressor is relatively high the bellows 106 is partially collapsed and the valve stem remains in its upper position. When the compressor starts, for example, after a shut down, both the large secondary valve 80 and the pilot or primary valve 94 are closed. At this time the pressure of the refrigerant in the evaporators as well as in the compressor acts upon the two valves and

holds them tightly closed with the help of the springs 92 and 97. As the compressor begins operation the pressure within the return line 56 and the inlet of the compressor is gradually lowered. This reduces the pressure upon the closed end of the metal bellows 106 and permits the spring 124 to move the valve stem 114 downwardly. When the pressure within the crank case has been reduced a sufficient amount, the lower end of the valve stem 114 comes into contact with the screw 102 on the top of the pilot or primary valve 94 and begins to move the pilot valve downwardly. This permits the evaporated refrigerant to flow through the valve at a relatively slow rate and prevents a sudden load from being imposed upon the compressor. By this means the pressure upon the suction side is made rather constant and pressure on the two sides of the valve gradually approach equalization. As the pressure is still further reduced the bottom portion 126 of the pilot valve 94 comes into contact with the bottom portion 128 of the valve 80 and moves the secondary valve 80 to open position. As the pressure is further reduced, the valve 80 is moved to its fully open position and the evaporated refrigerant is then permitted to freely move from the evaporators through the valve member 84 to the compressor and the system is therefore permitted to operate at maximum efficiency.

Thus in my valve the bellows and its spring are merely required first to open the small pilot or primary valve which is backed by a rather weak spring. The pressure of the refrigerant in the evaporators exerts considerable pressure upon the valves tending to hold them closed and lighter valve springs may therefore be used. After the pressure has been reduced by the compressor the bellows acquires sufficient power to open the large valve. This enables this valve to have sufficient sensitivity to properly throttle the refrigerant during the starting period of the compressor and also provide sufficient power both in the initial stages of opening and in the final stages of opening. Thus by the use of this compound valve structure in the suction line the objections to this form of control have been overcome.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Refrigerating apparatus including an evaporating means, a compressor, and a condenser connected in operative circuit relation, said evaporating means being connected to said compressor and condenser, a compound valve comprising a small pilot valve and a large main valve for controlling the flow of fluid between the evaporating means and the compressor, and pressure responsive means for first opening the small pilot valve to reduce the pressure differential upon the main valve and then opening the large main valve.

2. Refrigerating apparatus including an evaporating means, a compressor, and a condenser connected in operative circuit relation, said evaporating means being connected to said compressor and condenser, a compound valve comprising a small pilot valve and a large main valve for controlling the flow of fluid between the evaporating means and the compressor, and pressure responsive means responsive to pressure at the

inlet of the compressor for first opening the small pilot valve and then opening the large main valve.

3. Refrigerating apparatus including an evaporating means, a compressor, and a condenser connected in operative circuit relation, said evaporating means being connected to said compressor and condenser, a compound valve comprising a small pilot valve and a large main valve for controlling the flow of fluid through said operative circuit, and pressure responsive means for first opening the small pilot valve to reduce the pressure differential upon the main valve and then opening the large main valve.

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