

Feb. 5, 1946.

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2,394,166

REFRIGERATING APPARATUS

Filed June 30, 1943

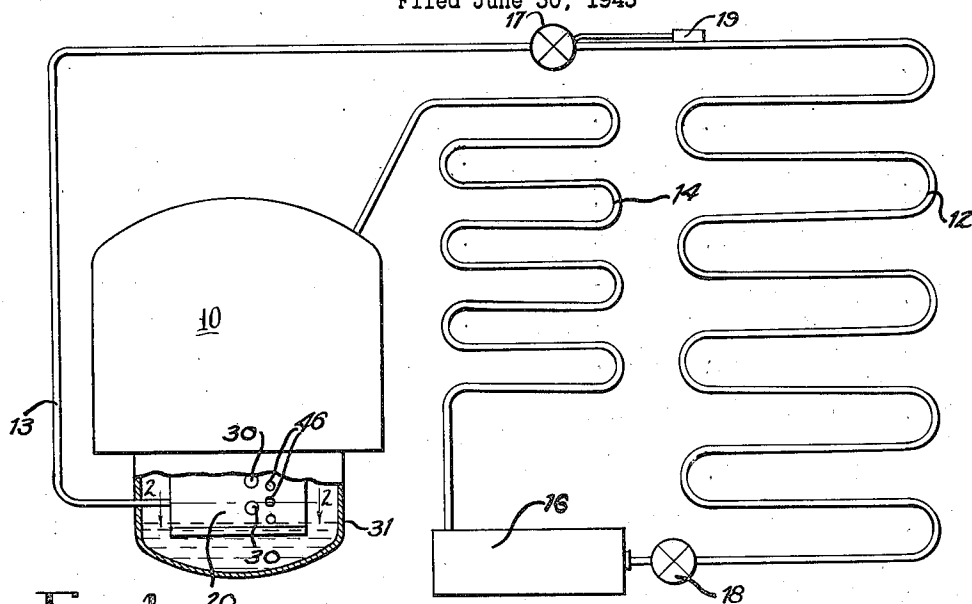


Fig. 1

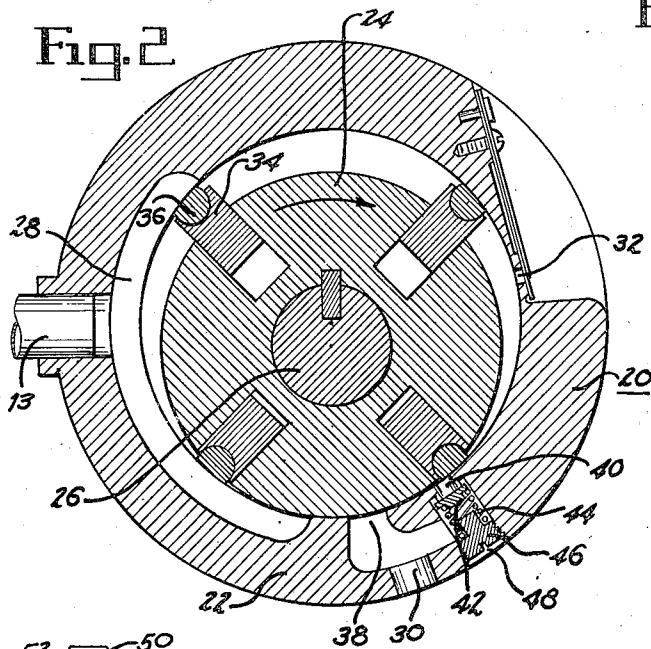
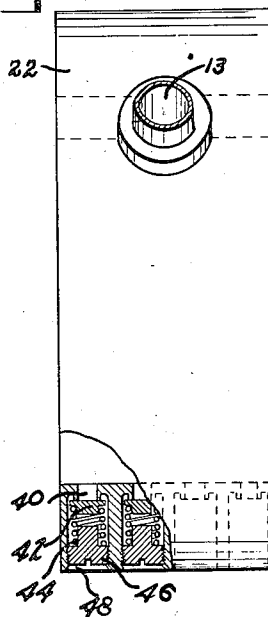


Fig. 4

Fig. 3



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UNITED STATES PATENT OFFICE

2,394,166

REFRIGERATING APPARATUS

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Application June 30, 1943, Serial No. 492,848

3 Claims. (Cl. 62—115)

This invention relates to refrigerating apparatus and more particularly to an improved arrangement which makes it possible to operate a refrigerating system efficiently over a wide range of pressure differentials.

One object of this invention is to make it practical to use the same 4-vane rotary compressor design for use in air conditioning systems as used on cold storage systems and the like.

Another object of this invention is to provide a compressor with two parallel discharge ports one of which remains open at all times and the other of which opens only at lower compression ratios.

It has been found that the usual form of pressure operated outlet valves are not practical in 4-vane rotary compressors wherein compressed gas is discharged from the compressor 4 times for every revolution of the compressor since the noise produced by such a valve is objectionable and the wear and tear on the valve is very great. It is one object of this invention, therefore, to provide a valving arrangement in which a pressure operated outlet valve is used but is not required to open and close each time a vane passes thereby.

A further object of this invention is to provide a valve having a natural period of vibration such that the valve does not have time to close between successive discharges from the compressor.

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 of the present invention is clearly shown.

In the drawing:

Fig. 1 is a diagrammatic view of a refrigerating system incorporating my invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is an elevational view with parts broken away showing the compressor cylinder; and

Fig. 4 is a plan view of the valve disc.

Referring now to the drawing in which I have disclosed a preferred embodiment of my invention, reference numeral 10 designates generally a sealed motor compressor unit which withdraws refrigerant vapor from the evaporator 12 through the suction line 13 and discharges compressed refrigerant into the condenser 14. The refrigerant condensed in the condenser 14 collects in the receiver 16 from whence it flows through a conventional expansion valve 18 into the evaporator 12. In the system shown, the flow of refrigerant from the evaporator to the compressor is controlled by the back pressure regulating valve 17 which in turn is controlled by the thermostat 19. The valve 17 selects the pressure

maintained in the evaporator in accordance with well known practice. The element 18 may be a fixed restrictor, a thermostatic expansion valve or any other type of control. The type of controls used would of course depend upon the particular application and the temperatures desired.

Reference numeral 20 designates generally a 4-vane rotary compressor having a main cylinder 22, a rotor 24, a drive shaft 26, an inlet port 28, outlet means 30 through which compressed refrigerant is discharged into the compressor casing 31, an oil relief port 32, and vanes 34 provided with shoes 36. For purposes of illustration, the outlet means has been shown in Fig. 1 as comprising two holes in the wall of the compressor 20 whereas in actual practice any number of holes may be used so long as they do not weaken the wall of the compressor too much or offer too much restriction to the flow of refrigerant. The compressor shown herein is conventional except for the construction and arrangement of the outlet ports. Two separate outlet ports 38 and 40 are provided which communicate with the main outlet means 30 as shown in Fig. 2. The outlet port 38 is of conventional construction and remains open at all times and functions much the same as any outlet port in a 4-vane compressor. For purposes of illustration, the outlet port 40 which serves as an auxiliary port has been shown as comprising four openings which are displaced from the port means 38 as shown in Fig. 2. The number of openings which make up the auxiliary port is broadly immaterial. Since all of the valves for the openings forming the auxiliary port 40 are identical in construction and operation and since a single valve could be used, reference will be made to only one of the valves in the following description. Thus each of the openings forming the port 40 is provided with a pressure operated valve plate 42 which is biased to the closed position by means of a spring 44 which abuts against a stop 46 threaded into an aperture 48 as best shown in Figs. 2 and 3. This valve never opens except at low compression ratios when the pressure of the gas in the compression chamber exceeds the outlet pressure before the outlet port 38 is uncovered.

As shown in Fig. 4 the valve plate 42 includes a hexagonal plate portion 50 and a central boss 52. The one end of the spring 44 surrounds the boss 52 so as to properly position the parts. By making the plate portion 50 of the valve plate 42 hexagonal, more clearance is provided for the escape of the gas.

The spring 44 and the valve plate 42 are purposely designed so that the valve plate 42 has a natural period of vibration which in effect prevents the valve plate from moving into fully closed position each time compressed gas is discharged

from the compressor at the low compression ratios. The primary purpose of the spring 44 is to hold the valve plate 42 in valve closing position whenever the pressure within the compression chamber does not exceed the pressure on the high side of the refrigerating system.

By virtue of the above described construction and arrangement the only outlet port which operates as a port at high compression ratios is the port 38. When the compressor is connected to a refrigerating system in which the compression ratios fall below a predetermined ratio preferably $3\frac{1}{2}$ to 1 or thereabouts, the auxiliary port 40 will also function since at these compression ratios the pressure within the compression chamber will exceed the outlet pressure before the port 38 becomes uncovered. At these low compression ratios the valve plate 42 will remain in the open position continuously while the compressor is operating. There will be certain transition periods when the compression ratio is such that very little of the gas is required to pass through the outlet port 40 in which case the valve 42 will not move far off from its seat and may have a chance to close between each discharge from the compressor. Under these conditions the valve does not have far to move and will not be noisy and will not be injured by the frequent opening and closing since under such conditions it cannot gain enough momentum in the short distance through which it travels to become noisy or do any damage to the parts. As shown in Fig. 2 the ports 40 and 38 both communicate with the main discharge openings 30. The above described valving arrangement makes it possible to use the same type of compressor design for those refrigerating systems having a high compression ratio as in those refrigerating systems having a low compression ratio. Furthermore a compressor incorporating my invention may be used efficiently in systems of the type wherein the compression ratio is high throughout certain periods of operation and is low throughout other periods of operation. Thus in the refrigerating system shown herein, the controls are such that the compressor is required to operate at high compression ratios for a portion of the time and then required to operate at low compression ratios at other times. As shown in Fig. 1, a pressure regulating valve 17 is placed in the suction line and is controlled by means of a thermostat 19. In the modification shown, the thermostat 19 responds to the temperature of the refrigerant vapor at the outlet of the evaporator. The thermostat 19 could, for example, be arranged so as to respond to the temperature, the relative humidity, or some other condition of the air either inside or outside the space to be conditioned.

While I have shown the equivalent of only one auxiliary valve port, it is obvious that additional auxiliary ports may be provided ahead of the main outlet 38 and ahead of the port 40. The location of the oil relief port 32 may also be varied depending upon the number and location of auxiliary ports 40 and depending upon the type of oiling system employed. The exact location of the oil relief port 32 does not form a part of my invention as oil relief ports of this type are commonly used in 4-vane rotary compressors so as to provide means of escape for lubricant in the event that the compression chamber becomes filled or partially filled with lubricant during the idle period of the compressor.

While the form of embodiment of the inven-

tion as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. In a refrigerating system; evaporator means; condenser means; compressor means; and means connecting said evaporator means, condenser means, and compressor means in refrigerant flow relationship; said connecting means including a pressure regulating means connected between said condenser means and said evaporator means for controlling the flow of refrigerant to said evaporator means; said compressor means comprising a casing forming an oil reservoir, a multiple vane compressor within said casing having a first outlet port and a second outlet port, one of said ports comprising a permanently open port and the other of said ports comprising a pressure operated valve, and means for discharging the compressed refrigerant leaving one of said ports into said oil reservoir so as to drop out oil entrained by the refrigerant into said oil reservoir.

2. In a refrigerating system; evaporator means; condenser means; compressor means; and means connecting said evaporator means, condenser means, and compressor means in refrigerant flow relationship; said connecting means including a pressure regulating means connected between said condenser means and said evaporator means for controlling the flow of refrigerant to said evaporator means; said compressor means comprising a casing forming an oil reservoir, a multiple vane compressor within said casing having an inlet port, a first outlet port, and a second outlet port, one of said outlet ports comprising a permanently open port and the other of said outlet ports comprising pressure operated valve means, and means for discharging the compressed refrigerant leaving said outlet ports into said casing so as to drop out oil entrained by the refrigerant into said oil reservoir; said connecting means including first connecting means connecting said evaporator means with said inlet port and second connecting means connecting the interior of said casing with said condenser means.

3. In a refrigerating system; evaporator means; condenser means; compressor means; and means connecting said evaporator means, condenser means, and compressor means in refrigerant flow relationship; said connecting means including a pressure regulating means connected between said condenser means and said evaporator means for controlling the flow of refrigerant to said evaporator means; said compressor means comprising a casing forming an oil reservoir, a multiple vane compressor within said casing having an inlet port, a first outlet port, and a second outlet port, one of said outlet ports comprising a permanently open port and the other of said outlet ports comprising pressure operated valve means, and means for discharging the compressed refrigerant leaving said outlet ports into said casing so as to drop out oil entrained by the refrigerant into said oil reservoir; said connecting means including first connecting means connecting said evaporator means with said inlet port and second connecting means connecting the interior of said casing with said condenser means; and valve means provided in said first connecting means for controlling the pressure at the inlet of said compressor.

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