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Weatherston

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[54] **REFRIGERANT HANDLING APPARATUS EMPLOYING ROOTS TYPE COMPRESSOR**

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[52] **U.S. Cl.** **62/510,** 62/196

[51] **Int. Cl.** **F25b 1/10**

[58] **Field of Search** 62/196, 510, 498

[56] **References Cited**

UNITED STATES PATENTS

3,568,466 3/1971 Brandin 62/510

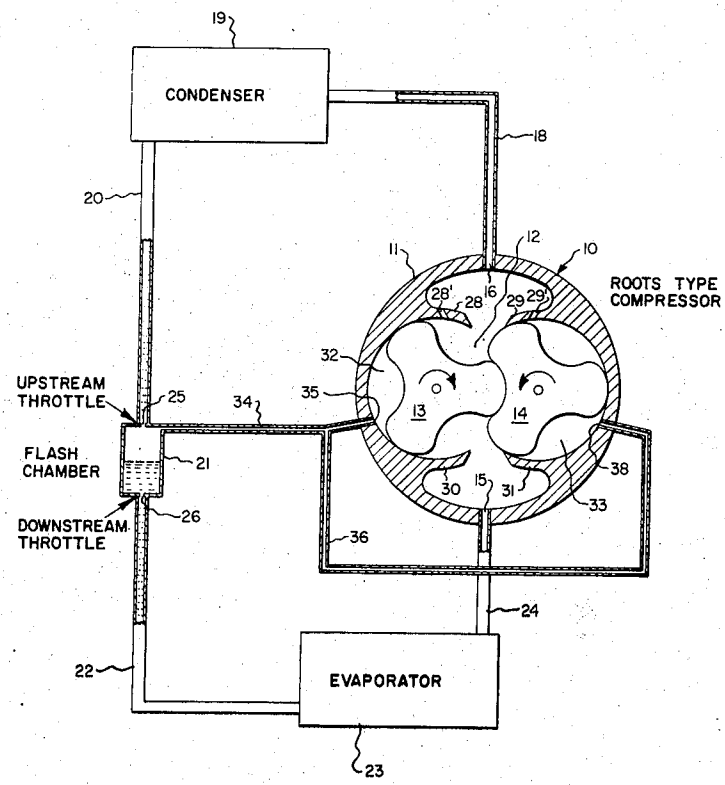
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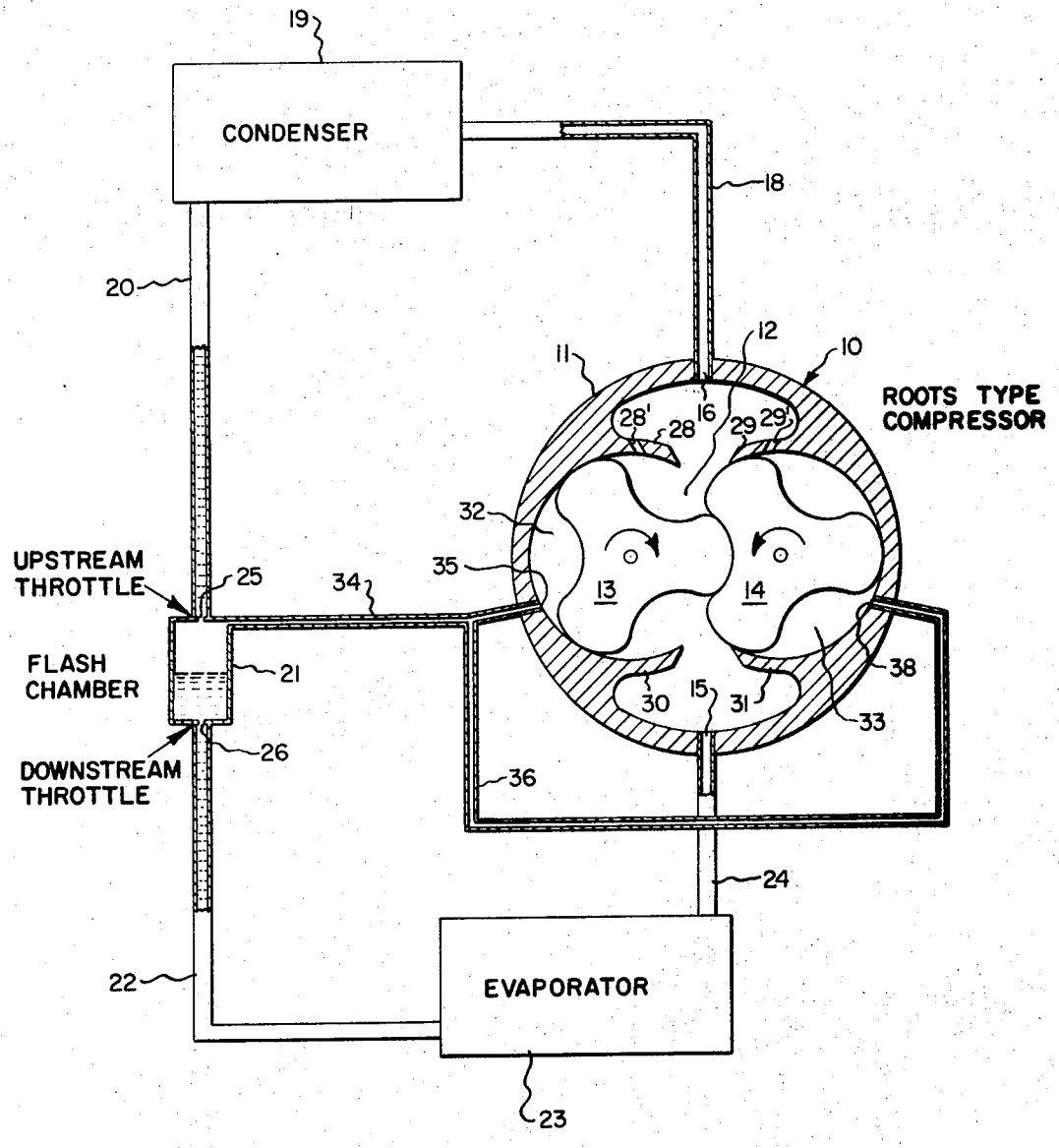
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[57] **ABSTRACT**

In an air-conditioning or refrigeration system, the expansive energy of the refrigerant itself is utilized to force some of the vapor formed in the throttling process into a closed volume chamber or well pocket of a Roots type compressor, one of the components of the system, facilitating a reduction in the required inlet volume and power of the compressor for a given cooling effect.

1 Claim, 1 Drawing Figure




19
CONDENSER
18
20
12
10
11
ROOTS TYPE
COMPRESSOR
28'
28
16
29
29'
32
35
34
UPSTREAM
THROTTLE
25
13
14
FLASH
CHAMBER
21
38
30
15
31
33
26
DOWNSTREAM
THROTTLE
36
24
EVAPORATOR
22
23

REFRIGERANT HANDLING APPARATUS EMPLOYING ROOTS TYPE COMPRESSOR

BACKGROUND OF THE INVENTION

In some compression air-conditioning or refrigeration systems a throttling device is located in the refrigerant conduit between the condenser and expander for dropping the refrigerant pressure from the condenser pressure to the evaporator pressure preferably in at least two steps for better control. Such throttling device expands the liquid refrigerant to a low temperature liquid and vapor mixture, typically 30 percent vapor, which enters the evaporator wherein the remaining liquid refrigerant absorbs heat and is vaporized. The vapor entering the evaporator does not materially contribute to the cooling which occurs there, but since it must pass through the compressor this vapor constitutes about 30 percent of the total inlet flow volume and work requirement of the compressor.

SUMMARY OF THE INVENTION

The foregoing disadvantage, as well as others, are overcome according to the present invention which provides refrigerant handling apparatus employing a Roots type compressor wherein the inlet to this compressor is not burdened to handle a significant amount of the vapor existing prior to the evaporator. In accordance with the present invention, refrigerant vapor produced as the result of at least a two step reduction in pressure and having a pressure intermediate the inlet and outlet pressures of the compressor is delivered directly in the closed volume chambers or well pockets of the compressor formed by its rotary coacting multilobed impellers, thereby increasing the amount of vapor compressed without affecting the work requirement of the compressor.

Basically, then, the present invention provides apparatus handling a vaporizable refrigerant and including in series an evaporator, a Roots type compressor having a low pressure inlet, a high pressure outlet and a closed volume chamber intermediate said inlet and outlet, upstream throttling means for dropping the pressure of the refrigerant from condenser pressure, downstream throttling means for dropping the pressure of the refrigerant to evaporator pressure, a flash chamber intermediate the two throttles in which the refrigerant vaporizes at a pressure intermediate the condenser and evaporator pressures, and a conduit feeding the separated vapor at such intermediate pressure into said closed volume chamber of the compressor.

For a fuller understanding of the present invention reference is made to the following detailed description of the same taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single FIGURE of the drawing depicts schematically apparatus providing a refrigeration cycle embodying the concept of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the accompanying drawing, the numeral **10** represents generally a Roots type compressor including a housing **11** defining a working compartment **12** in which a pair of rotary coacting multilobed impellers **13** and **14** is arranged. Housing **11** has a low pressure inlet **15** and a high pressure outlet **16**.

Outlet **16** is shown as communicatively connected via conduit **18** to a condenser **19** of any suitable construction. The outlet of this condenser is shown as communicatively connected via conduit **20** to the upper end of an enlarged flash chamber **21**, the lower end of which is shown as communicatively connected via conduit **22** to the inlet of an evaporator **23** of any suitable construction. The outlet of this evaporator is shown as communicatively connected via conduit **24** to compressor inlet **15**.

In this series arrangement of components to produce a refrigeration cycle, there is also provided an upstream throttle **25**, specifically in the form of a restricted orifice arranged at the juncture of conduit **20** with flash chamber **21**. A downstream throttle **26**, also in the form of a restricted orifice, is shown arranged at the juncture of conduit **22** with flash chamber **21**. Other forms of throttling devices may be employed, the simple restricted orifices shown being schematic and illustrative.

Adverting again to the Roots type compressor **10**, the housing **11** thereof is preferably formed to provide a pair of ledges **28** and **29** adjacent outlet **16** in each of which is provided a feedback passage **28'** or **29'** for directing a fluid jet at high outlet pressure against a lobe of the corresponding impeller **13** or **14**, in the manner and for the purpose disclosed in U.S. Pat. No. 3,531,227. Adjacent inlet **15**, housing **11** is shown as formed to provide a pair of ledges **30** and **31** as definitive extensions of working chamber **12**. Left impeller **13** is shown as arranged to rotate in a clockwise direction about a central axis. Right impeller **14** is shown as arranged to rotate in a counterclockwise direction about a central axis. Any suitable means, known to those skilled in the art, may be provided to effect the described rotation and coaction of impellers **13** and **14**.

While each of the impellers **13** and **14** is shown as having three lobes, this is for illustrative purposes only, and they may have more lobes. It will be noted that the salients of two adjacent lobes on each of the impellers **13** and **14** can have concurrently a substantially sealed wiping contact on the circular wall portion of the working compartment **12** partially surrounding each impeller. Such concurrent contact between the two lobes provides jointly with the wall of the working compartment **12** a closed volume chamber or well pocket, indicated at **32** for left impeller **13** and at **33** for right impeller **14**. This is a moving chamber or pocket, specifically of constant volume. It is first closed when the trailing one of an adjacent pair of lobes sealingly contacts the edge of shelf **30** or **31**, and first opened when the other or leading one of such pair uncovers feedback passage **28'** or **29'**.

An important feature of the present invention is to conduct refrigerant vapor which has separated from liquid in flash chamber **21**, and which is at a pressure intermediate the pressures obtaining in the compressor inlet **15** and outlet **16**, into the closed volume or well pockets **32** and **33**. This is shown as achieved by a conduit **34** communicatively connected at one end to the upper portion of flash chamber **21** and at its other end to an inlet **35** in the wall of housing and leading to chamber **32**, and a branch conduit **36** communicatively connected at one end to conduit **34** and at its other end

to an inlet **38** in the wall of housing and leading to chamber **33.**

Refrigerant in conduit **20** is essentially liquid, as it is also in conduit **22.** However, refrigerant at the pressure obtaining intermediate throttling orifices **25** and **26** causes some refrigerant to vaporize at this intermediate pressure, collecting adjacent the upper end of flash chamber **21** above the level of liquid refrigerant maintained therein. It is this refrigerant vapor at such intermediate pressure level, above that obtaining at compressor inlet **15** but below that obtaining at compressor outlet **16,** which will cause such vapor to flow into and fill chambers or pockets **32** and **33.**

Since the refrigerant in conduit **22** admitted into evaporator **23** is essentially all in liquid form, it is almost all available for vaporization to produce a cooling effect, so that the vapor reaching compressor inlet **15** has been efficiently utilized.

With the arrangement of components as described herein part of the refrigerant that would normally enter the compressor inlet in a conventional refrigeration system is diverted into the well pockets **32, 33** of the compressor at **35** and **38.** Since the power requirement of a Root's type compressor for a given size and speed is only a function of the pressure difference between the discharge and inlet, the vapor takeoff of the refrigerant in flash chamber **21** to pockets **32** and **33** does not in any way increase the loading on or work requirements of the compressor. Hence, contrasted to a conventional system for a given cooling capacity and refrigerant flow rate the size and power requirements of the compressor according to the present invention may be reduced.

Although a preferred embodiment of the present invention has been described, changes will occur to those skilled in the art; therefore, it is intended that the scope of the present invention is to be limited only by the scope of the appended claims.

I claim:

1. In apparatus handling a vaporizable refrigerant and including in series an evaporator, a Roots type compressor having a low pressure inlet, a high pressure outlet, and a closed constant volume chamber intermediate said inlet and outlet, upstream throttling means for dropping the pressure of the refrigerant from condenser pressure, and downstream throttling means for dropping the pressure of the refrigerant to evaporator pressure, wherein the improvement comprises flash chamber means arranged between said upstream and downstream throttling means in which refrigerant vaporizes at a pressure intermediate said condenser and evaporator pressures, and conduit means establishing communication between said flash chamber means and said closed volume chamber for introducing refrigerant vapor at such intermediate pressure into said closed volume chamber.

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