

July 12, 1966

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3,260,067

REFRIGERATION MACHINE

Filed May 4, 1964

5 Sheets-Sheet 1

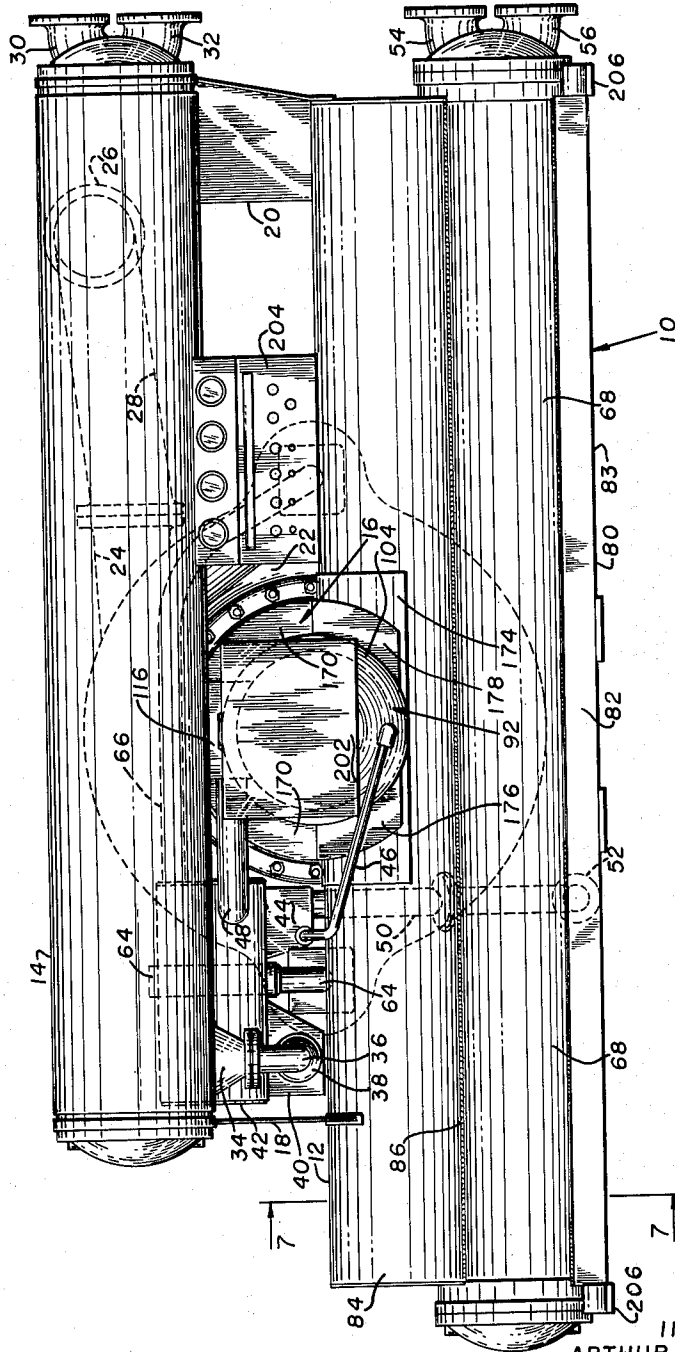


FIG. 1

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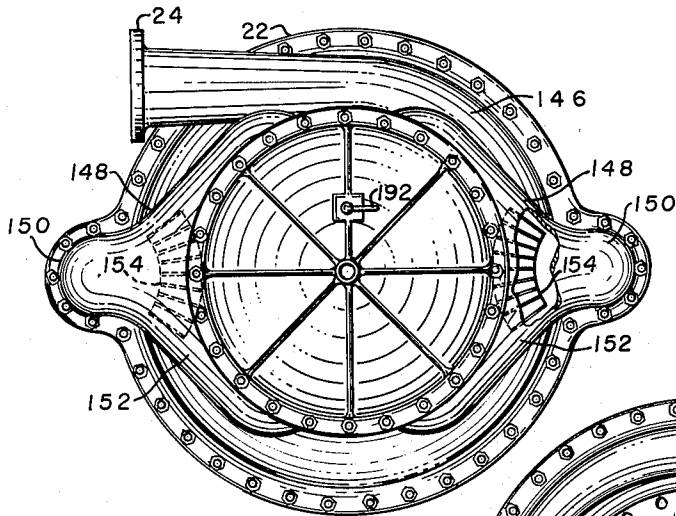


FIG. 5

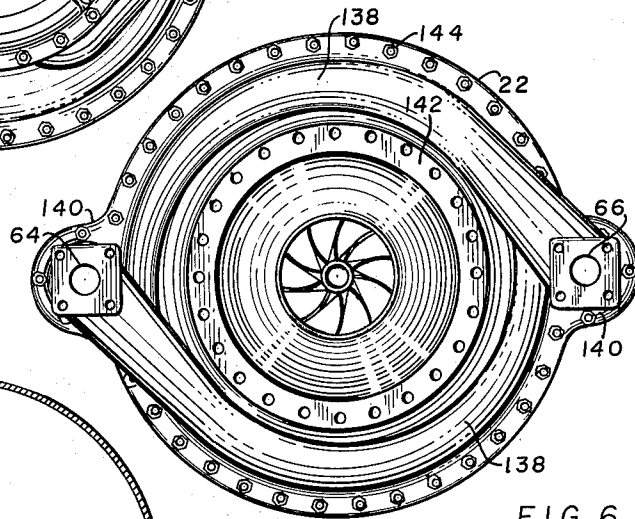


FIG. 6

FIG. 7

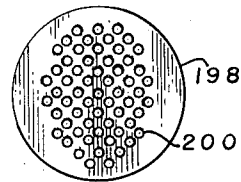
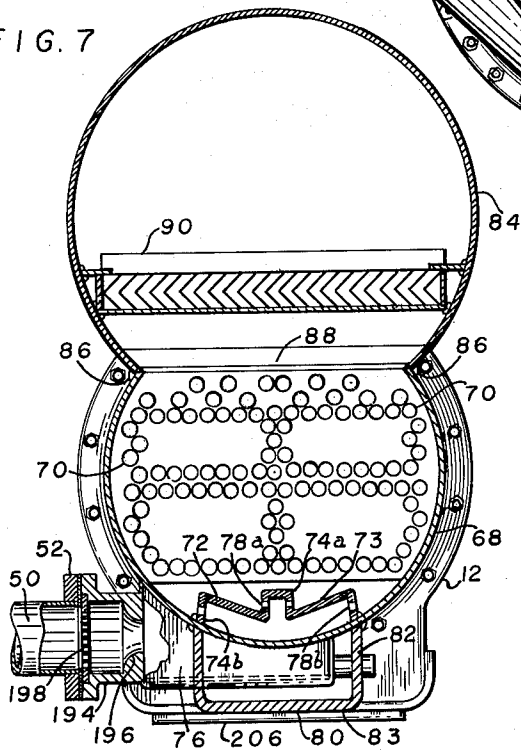


FIG. 8

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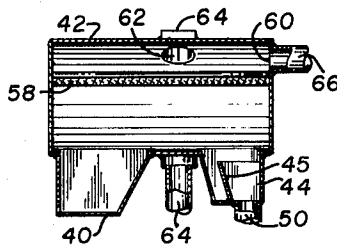


FIG. 9

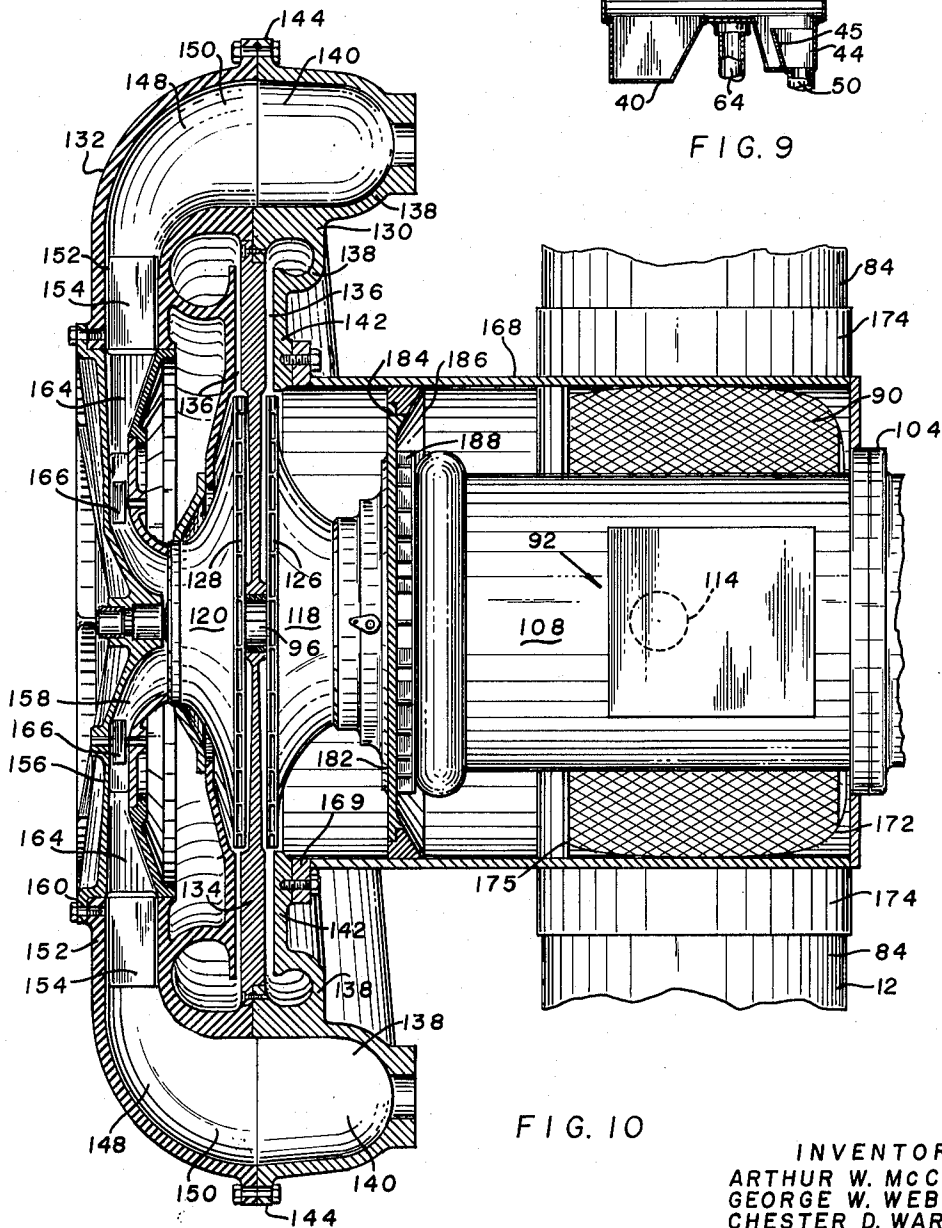


FIG. 10

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3,260,067

## REFRIGERATION MACHINE

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Filed May 4, 1964, Ser. No. 364,369

18 Claims. (Cl. 62-505)

This invention relates to refrigeration apparatus and more particularly to a hermetic refrigeration machine employing a refrigerant compression, condensation and evaporation cycle.

It is an object of this invention to provide a refrigeration machine wherein the compressor motor thereof is nested or merged with the shell of the evaporator.

Another object of the invention is the provision of refrigeration apparatus wherein the compressor-motor axis thereof is disposed in a direction normal to the evaporator thereof and wherein said motor is merged with the shell of the evaporator.

A further object of the invention is to provide a refrigeration machine with a compressor-motor unit having a central axis extending transversely to the evaporator and condenser.

It is another object of the invention to provide a refrigeration machine including a compressor motor transversely arranged relative to the evaporator, with a cylindrical shell circumscribing the motor for conveying refrigerant gas from the evaporator to the compressor.

A further object of this invention is to provide a refrigeration machine with a two stage centrifugal compressor having a pair of impellers arranged back-to-back on a shaft extending normally to the evaporator thereof and wherein the first stage impeller arranged closest to the evaporator is provided with a pair of collection volutes connected to the inlet of the second stage impeller by a pair of cross-over passages.

Another objective of the invention is the provision of a refrigeration machine having a two stage compressor and an economizer with means for returning refrigerant gas from a motor cooling jacket through the economizer liquid eliminator or filter to the second stage of the compressor.

A further object of the invention is the provision in a refrigeration machine of dual conduits from the economizer to the second stage of a two stage compressor employing a double volute collection means at the first stage thereof.

A still further object of our invention is to provide a refrigeration machine with a novel fixed double orifice flow control valve for normally maintaining a liquid seal between the condenser and evaporator.

Still another object of this invention is to provide a refrigerant evaporator having a condenser supported thereon, with a first channel member for distributing refrigerant liquid in the evaporator and a second channel member for skidding the refrigeration machine thereon and wherein the first and second channels are arranged to form a box beam for supporting the evaporator and portions of the refrigeration machine carried thereby.

Other objects and advantages will become apparent as this specification proceeds to describe the invention with reference to the accompanying drawings in which like reference numerals have been used to identify like parts wherein:

FIGURE 1 is a front view of our novel refrigeration machine;

FIGURE 2 is a top or plan view of the refrigeration machine of FIGURE 1;

FIGURE 3 is a side view of the refrigeration machine of FIGURE 1 taken from the left side thereof;

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FIGURE 4 is an enlarged vertical section taken through the center of the motor-compressor unit of the refrigeration machine as viewed from the left side;

FIGURE 5 is a back view of the compressor;

FIGURE 6 is a vertical section of the motor-compressor unit taken at 6-6 of FIGURE 4;

FIGURE 7 is an enlarged section of the evaporator taken at 7-7 of FIGURE 1 and having the fixed orifice valve thereof sectioned to show the interior detail structure;

FIGURE 8 is a further enlarged elevational view of an orifice forming member of the fixed orifice valve shown in FIGURE 7;

FIGURE 9 is a section of the economizer taken at 9-9 of FIGURE 3; and

FIGURE 10 is a horizontal section of the motor-compressor unit taken at 10-10 of FIGURE 4.

Now with reference to the drawings it will be seen that refrigeration machine 10 is comprised of an elongated horizontally extending shell-and-tube type heat exchanger 12 forming a refrigerant evaporator, a second elongated shell-and-tube type heat exchanger 14 forming a refrigerant condenser, and a motor-compressor unit 16. Condenser 14 is mounted and in spaced parallel relation above evaporator 12 by condenser end supports 18 and 20 extending between the condenser and evaporator. Motor-compressor unit 16 is interposed vertically between the condenser and evaporator and has a central axis extending normal to vertical planes containing the longitudinal axes of the condenser and evaporator.

The compressor condenser and evaporator are connected in a closed refrigerant circuit which will briefly be described before a detailed discussion of the various elements of the refrigeration machine. The motor-compressor unit 16 includes a two-stage centrifugal compressor 22 which delivers compressed refrigerant from a second stage outlet 24 to condenser refrigerant inlet 26 via discharge elbow conduit 28. Condenser 14 is cooled by a cooling medium such as water which may be introduced thereto and discharged therefrom by headers 30 and 32. Refrigerant condensate which is condensed by the cooling medium is collected by a condensate sump 34 at the end of condenser 14 remote from inlet 26. From sump 34 the liquid refrigerant flows downwardly in vertically extending conduit 36, through a fixed orifice flow control valve 38 into inlet 40 of an economizer chamber 42 in the bottom of which a portion of the liquid refrigerant is flashed into a gas. The remaining sub-cooled liquid portion is collected by the economizer sump 44.

From sump 44 a portion of the liquid refrigerant flows through conduit 46 to a motor cooling jacket 110 from whence the evaporated refrigerant is returned to the lower portion of the economizer 42 via conduit 48.

The liquid refrigerant in sump 44 may also flow downwardly through a vertically extending portion of conduit 50 through a second fixed orifice flow control valve 52 into the bottom of evaporator 12 where it is distributed lengthwise thereof. It should be noted that sump 44 contains a partition 45 which starts to supply liquid refrigerant for motor cooling before any is directed to the evaporator. The refrigerant liquid which is vaporized in the evaporator is returned to the first stage of compressor 22. The evaporation of the refrigerant in evaporator 12 may chill a secondary refrigerant such as water which may be introduced thereto and discharged therefrom by headers 54 and 56.

The refrigerant gas which is formed by the flashing of liquid refrigerant in the lower portion of economizer chamber 42 and the refrigerant gas which is returned to the economizer chamber from the motor cooling jacket,

passes upward through a liquid eliminator 58 (FIGURE 9) from whence it egresses chamber 42 via outlets 60 and 62 and is delivered in approximately equal amounts to the second stage of compressor 22 via conduits 64 and 66 connected to the compressor at the outlets 140 of the first stage described hereinafter.

Now looking to the specific details of the refrigeration machine it will be noted that evaporator 12 includes a lower cylindrical shell 68 nesting a plurality of tubes 70 for conducting the secondary refrigerant. Below tubes 70 and extending substantially the full length within shell 68 within the concave upward lower portion thereof is an elongated distributor channel member 72 having a pair of downwardly extending first leg portions 74a each of which is provided with a plurality of horizontally extending apertures 78a spaced longitudinally with respect to said channel, a deflector portion 73 connected to the longitudinally extending lower edge of each of said first leg portions and extending upward therefrom and horizontally away from both of leg portions 74a, and a downwardly directed second leg portion 74b depending from the longitudinally extending free upper edge of each of portions 73 to welded connection with shell 68, each second leg portion being provided with a plurality of horizontally extending apertures 78b spaced longitudinally with respect to said distributor whereby fluid discharged from apertures 78a is deflected upward by deflector portions 73 and fluid discharged from apertures 78b is deflected upward by generally concave upward portion of shell 68. A fluid inlet chamber 76 is disposed below shell 68 and provides fluid communication between valve 52 and the space encompassed by channel member 72 which functions to distribute the liquid refrigerant lengthwise of the evaporator 12 from whence the refrigerant is discharged through apertures 78a and 78b in the vertically extending leg portions 74a and 74b thereof. It will thus be seen that the refrigerant fluid is discharged from the distributor in four widely diffused streams spaced uniformly from front to rear thereby substantially preventing downward circulation of fluid among tubes 70 which would be detrimental to heat transfer efficiency.

A second channel member 80 extending under and longitudinally with respect to shell 68 and having upwardly extending leg portions 82 welded thereto presents an even surface 83 upon which the refrigeration machine 10 may be skidded into place as for example with rollers.

The leg portions 74b of channel 72 and the leg portions 82 of channel 80 are disposed generally in vertical alignment whereby the channel members 72 and 80 in combination function as a box beam supporting evaporator 12.

Evaporator 12 further includes upper cylindrical shell 84 welded to lower shell 68 at 86 on each side thereof. A plurality of transversely extending tie rods 88 may be spaced longitudinally within the shells as viewed in FIGURE 7. Disposed within the lower portion of the upper shell is a liquid eliminator 90 upwardly through which refrigerant evaporated in the lower shell passes from whence it is collected and conducted longitudinally within the upper portion of shell 84 toward the center thereof where it is delivered to the motor-compressor unit 16.

Motor-compressor unit 16 (FIGURES 4 and 10) includes an electric motor 92 having a rotor 94 mounted on shaft 96 which is mounted for rotation in bearings 98 and 100 disposed in motor end bells 102 and 104 respectively. Motor 92 includes a stator 106 circumscribing rotor 94 in spaced relation therewith and interposed between end bells 102 and 104.

A cylindrical shroud 108 extends between the end bells and circumscribes stator 106 in spaced relation thereby defining an annular space or motor cooling jacket 110 which is in fluid communication with conduit 46 via passage 112 in end bell 104. Liquid refrigerant in relatively small amounts from conduit 46 passes into the cooling jacket where it is vaporized by motor heat and dis-

charged through aperture 114 in the upper portion of shroud 108 from whence it passes to conduit 48 by way of rectangular conduit 116.

Disposed on shaft 96 adjacent the end remote from motor 92 are first and second stage centrifugal impellers 118 and 120 having inlets 122 and 124 and outlets 126 and 128 respectively. Impellers 118 and 120 are arranged with their outlets at adjacent ends and inlets at remote ends, i.e. in a back-to-back relation.

Compressor 22 includes a housing comprised of two main castings 130 and 132 in which gas collection volutes are formed for collecting the refrigerant gas compressed by and discharged from the impellers. An annular partition or diaphragm 134 is disposed between impellers 118 and 120 concentrically in sealing relation with shaft 96 and extends radially outward to the compressor housing and sealingly separates the two stages of compressor 22. Each planar surface of partition 134 in the area radially outward of the impellers defines one side of a vaneless radially extending diffuser passage 136 between an impeller and a collection volute. While identical compressor housings may be used for compressors of several different capacities, it is necessary to select the proper width diffuser passage for each size compressor. In the compressor herein described, this may be accomplished for both stages of compression simply by selecting the proper width of a single member, namely partition 134. Casting 130 which is disposed radially outward of and in radial alignment with impeller 118 includes two first stage collection volutes 138 each having a discharge outlet 140 diametrically opposed from the other in the horizontal plane.

Disposed radially inward of volutes 138 on the side of casting 130 facing motor 92 is a circular bolt flange 142 for connection of the compressor housing to the motor structure hereinafter described. Casting 130 includes a second annular bolt flange 144 radially outward of volutes 138 facing away from motor 92 for connection to casting 132.

Casting 132 contains a single second stage collection volute 146 discharging at outlet 24 disposed outwardly of and in radial alignment with second stage impeller 120. Casting 132 further includes two cross-over passages 148 each of which has an inlet 150 disposed radially outward of volute 146 in face-to-face relation with one of outlets 140 for receiving refrigerant gas discharged from the first stage of compression. Each passage 148 further includes a distributor portion 152 which may be provided with diffusing vanes 154 to distribute refrigerant gas circumferentially about annular inlet duct member 156.

Annular duct member 156 defines an annular passage 158 for conducting refrigerant gas from the distributor portions 152 radially inward to inlet 124 of impeller 120. Annular duct member 156 may be bolted at circular bolt flange 160 thereof to circular bolt flange 162 of casting 132. Annular duct member 156 may include a plurality of radially-extending fixed guide vanes 164 disposed in an annular pattern in passage 158 for guiding gas radially inward from distributor portions 152 in a non-rotational manner. Also disposed within annular passage 158 radially inward of vanes 154 are a plurality of prerotational second stage inlet guide vanes 166 arranged in an annular pattern and each mounted for pivotal adjustment about an axis extending parallel to shaft 96. Guide vanes 166 in passage 158 impart the proper rotational movement to the gas passing therethrough thereby controlling the angle of approach to the impeller inlet 124 and thus the capacity of the second stage of compression with minimum power loss by gas turbulence. The pivots of guide vanes 166 may be interconnected for common movement by any suitable mechanism.

Now looking more particularly to the manner in which refrigerant gas is delivered from evaporator 12 to inlet 122 of the first stage impeller 118, it will be seen that mo-

tor 92 is nestled with and extends into the cylindrical profile of the upper shell 84 of evaporator 12. Motor 92 extends into shell 84 a distance equal to about one-half the motor diameter. A right circular cylindrical shell 168 of substantially greater diameter than motor 92 is disposed concentrically of shaft 96 and extends from compressor casting 130 toward the end of motor 92 remote from compressor 22. Cylindrical shell 168 is provided with a circular bolt flange 169 for connection to bolt flange 142 of casting 130.

Cylindrical shell 168 is truncated by a first vertical plane extending in tangential relation to the front edge of the upper shell 84 of evaporator 12, and by a second plane extending upwardly at about a 45 degree angle toward the compressor from a horizontal line in said first plane extending through the axis of shaft 96. A flat plate 170 of arcuate configuration extends in said second plane and is sealingly welded to cylindrical shell 168 and shroud 108 of motor 92. Plate 170 may be appropriately notched to accommodate rectangular conduit 116.

Cylindrical shell 168 is notched out at its intersection with the cylindrical shell 84 as at 172 (FIGURE 10). Cylindrical shell 84 is similarly notched out at its intersection with cylindrical shell 168 thus leaving a fluid passage at 172. This aperture or fluid passage may be provided with a flange 174 extending from shell 168 and contoured to the profile of shell 84. Flange 174 includes a partial partition 175 which extends in the annular space between motor 92 and shell 168 over which the gas from the evaporator must flow on its way to the compressor thus further assuring that no liquid is delivered to the compressor. Flange 174 is sealingly welded to shell 168 which is formed as part of the motor-compressor subassembly. Upon assembling the motor-compressor unit to the evaporator, flange 174 is sealingly welded to shell 84 of the evaporator thus providing fluid communication between the interior of shell 84 and shell 168.

A pair of flat plates 176 and 178 (FIGURE 1) extends in the vertical plane aforementioned in connection with cylindrical shell 168 and are sealingly welded to plate 170, flange 174 and cylindrical shell 168 thereby providing in combination with plate 170 an end closure to seal the truncated portions of shell 168. A flat arcuate plate 180 may also extend rearwardly and downwardly from the rear edge of flange 170 (FIGURE 4). The annular space between shell 168 and motor shroud 108 provides an annular fluid passage from the aperture at 172 to the inlet 122 of first stage impeller 118.

A first stage annular inlet duct member 182 disposed concentrically with shaft 96 between impeller 118 and motor 92 is supportingly connected to motor end bell 102 as by bolts or other suitable means. Member 182 is provided with an annular flange portion 184 which is sealingly and supportingly connected to the internal wall of shell 168. The flange 184 provides a seal for the suction side of the compressor and may also be contoured to direct fluid into annular passage 186 of member 182 extending radially inwardly and toward inlet 122. Passage 186 may be provided with a plurality of prerotational first stage inlet guide vanes 188 arranged in an annular pattern, each mounted for pivotal adjustment about an axis extending parallel to shaft 96. The pivots of guide vanes 188 may be interconnected for common movement in any suitable manner. Vanes 188 function in the same manner as vanes 166 of the second stage. Vanes 166 and 188 may be actuated by a common load responsive motor 190 operatively connected thereto by suitable mechanism 192.

Now looking again to valves 38 and 52, it will be understood that these valves are similar in form and operation and a discussion of valve 52 alone, shown most clearly in FIGURES 7 and 8, will suffice. Valve 52 is comprised of a member 194 defining therein a single well rounded orifice 196 disposed in flow restricting relation with conduit 50 adjacent fluid inlet chamber 76 of evap-

orator 12. Valve 52 also includes a second orifice defining thin plate member 198 defining therein a plurality of orifices 200 disposed in flow restricting relation with conduit 50 upstream of orifice 196. Orifices 200 are formed with sharp leading edges and are responsible for between about 5 and about 25 percent of the total pressure drop imparted to the fluid by valve 52. The significance of this relationship will be more apparent from the discussion of the operation of our refrigeration machine.

The refrigeration machine may also include an electrical terminal box 202 mounted directly on motor 92 and a control panel 204. Further, resilient vibration dampening pads 206 may be placed under each end of the evaporator and under a central foot 208 arranged under the center of gravity of the motor compressor unit. Suitable seals may be placed throughout the machine where needed.

### Operation

During operation of our refrigeration machine refrigerant gas formed in the evaporator 12 passes upward through eliminator 90, moves in the upper portion of shell 84 toward the motor-compressor unit where it emerges through the aperture at 172 (FIGURE 10) into the space between shell 168 and motor shroud 108 thence into annular inlet duct member 182 past guide vanes 188 through annular passage 186 into inlet 122 of the first stage impeller 118. Gas discharged from outlet 126 of impeller 118 passes through one of the radially extending vaneless diffuser passages 136 between partition 134 and casting 130 to the pair of first stage gas collection volutes 138. From the outlets 140 of collection volutes 138 the partially compressed gas is delivered to the second stage annular inlet duct member 156 via the pair of cross-over passages 148 thence to inlet 124 of second stage impeller 120. Refrigerant gas having been compressed by the second stage impeller is delivered from outlet 128 through another radially extending vaneless diffuser passage 136 between partition 134 and casting 132 to the second stage gas collection volute 146 from whence it is discharged at outlet 24. The refrigerant flow in the remainder of the machine has already been described.

Normally while the machine is operating over a wide range of load conditions, fixed orifice flow control valves 38 and 52 function respectively to prevent refrigerant condenser gas from passing to the economizer and to prevent economizer flash gas from passing to the evaporator as the passage of such gas would require added space in the economizer and evaporator respectively without providing cooling effect. Each valve functions, it is believed, by maintaining a liquid seal in the vertically extending portion of the conduit preceding the valve. Under different load conditions there will, of course, be variations in the pressure difference between condenser and evaporator and the rate of refrigerant flow from the condenser to the evaporator. It will be understood that evaporator pressure decreases and condenser pressure increases with increasing load in a typically controlled system. Of course the converse is true upon decreasing load. These variations make it difficult to maintain a liquid seal in conduits 36 and 50. Should a single orifice flow control valve be employed, conduits 36 and 50 would have to be excessively long to accommodate variations in the liquid column to maintain a liquid seal.

The fixed double orifice flow control valve herein disclosed functions with extreme flexibility of control, thus permitting the vertically extending conduits preceding the valve to be relatively short. The downstream orifice 196 is designed to operate in the critical flow pressure range where variations in pressure downstream of the orifice are not substantially transmitted upstream of the orifice because of the critical velocity of fluid passing there-through. The rounded leading edge facilitates dependable and stable operation of this orifice in the critical flow pres-

sure range. Orifice 196 under many conditions is thought to function with little relation to variations in evaporator pressure. However, it is evident that an increase or decrease in upstream pressure will respectively increase or decrease the flow through the orifice 196 assembly over a wide range of load conditions without substantial loss of a liquid seal.

On the other hand the orifices 200 in plate member 198 are provided with sharp leading edges and do not function in the critical flow pressure range. Orifices 200 impart a small pressure drop to the liquid flowing therethrough thus causing a portion to flash into gas just downstream of orifice 200. Since this gas and the remaining liquid must pass via member 194 through orifice 196 it will be evident that the greater the flashing of gas just downstream of orifices 200, the smaller the amount of liquid that can flow through orifice 196. As the load increases, the liquid level begins to rise in the conduit preceding the valve and the liquid at the valve is subcooled by reason of being placed under a greater pressure head. Since the liquid is subcooled, a smaller amount of liquid will flash to a gas at orifices 200 thus permitting a larger proportion of liquid to pass orifice 196. The total flow through orifice 196 also increases with the increased pressure drop. If the liquid level in the conduit falls, the liquid at the valve is brought closer to saturation and greater quantities of gas are formed at orifices 200 thus reducing the proportion of liquid to orifice 196. Total flow through orifice 196 also decreases with the decreased pressure drop. Should the liquid level temporarily fall sufficiently to break the liquid seal, the uppermost orifice or orifices 200 will pass a small quantity of gas which will tend to choke the liquid flow at orifice 196 thus causing the liquid trap to be re-established. In order to obtain accurate control we have found that the first orifice means must account for between about 5 and about 25 percent of the total pressure drop attributed to the valve.

Since this flow control means is so versatile, the orifice size selected for a particular machine functions extremely well over a wide range of load conditions. In fact tests have shown that the liquid seal, so necessary to prevent the parasitic power loss due to gas bypass, is effectively maintained throughout the normal operating range. When unusual conditions are encountered, the double-orifice control has an inherent restrictive flow characteristic that minimizes to a near negligible quantity any gas bypass. However, this small quantity of gas may be of some benefit under certain unusual operating conditions which cause the compressor to operate near the surge or unstable region.

Although we have described in detail a specific embodiment of our invention, it is contemplated that various changes may be made without departing from the scope or spirit of our invention, and we desire to be limited only by the claims.

We claim:

1. A refrigeration machine comprising in combination a refrigerant evaporator; a refrigerant compressor; a refrigerant condenser; means connecting said refrigerant evaporator, compressor and condenser respectively in series; said evaporator including a plurality of tubes for conducting therein a fluid to be cooled by refrigerant and an elongated cylindrical shell disposed above said tubes for collecting evaporated refrigerant; an electric motor having at least a portion thereof in vertical alignment between said tubes and the profile of said cylindrical shell and having an axis of rotation transverse to said elongated cylindrical shell; and means drivingly connecting said motor to said compressor.

2. A refrigeration machine comprising in combination an elongated horizontally extending refrigerant evaporator; an elongated horizontally extending refrigerant condenser disposed in generally parallel relation with said

evaporator; one of said evaporator and condenser being spaced above the other; a centrifugal compressor disposed adjacent said evaporator and condenser and having a central axis arranged in a direction transverse to the longitudinal axes of said evaporator and condenser; an electric motor mounted in axial alignment with said compressor and having a portion thereof aligned between said evaporator and condenser; and means connecting said evaporator, compressor and condenser in a closed refrigerant circuit.

3. A refrigeration machine comprising in combination an elongated refrigerant evaporator having an elongated gas collecting shell extending along the length thereof; a centrifugal compressor for compressing refrigerant evaporated in said evaporator; an electric motor disposed in axial alignment with said compressor and drivingly connected thereto; said electric motor being partially merged into the profile of said gas collecting shell and having its axis of rotation extending generally normally to a vertical plane passing through and substantially parallel with the longitudinal axis of said evaporator.

4. The device as defined in claim 3 including a cylindrical shell of greater diameter than said motor and extending from said compressor axially toward said motor and partially encompassing said motor forming an annular fluid passage between said motor and said cylindrical shell; and means connecting said annular passage with said elongated gas collecting shell.

5. The device as defined by claim 4 wherein an annular inlet duct is mounted in said cylindrical shell; said annular inlet duct including an annular passage extending radially inward and toward the inlet of said compressor.

6. The device as defined by claim 5 wherein a plurality of vanes are mounted in said annular passage for pivotal movement about axes extending in substantially parallel relation to the axis of said electric motor and compressor.

7. A refrigeration machine comprising in combination a refrigerant condenser; elongated refrigerant evaporator; a two stage centrifugal compressor; said compressor including a shaft mounted for rotation about an axis extending in generally nonparallel relation to the longitudinal axis of said evaporator, a first impeller mounted for rotation with said shaft having a first inlet facing said evaporator and a first outlet radially outward of said inlet, a compressor housing having first and second gas collecting volute passages disposed radially outward of said first outlet for collecting gas discharged therefrom, a second impeller mounted for rotation with said shaft in a position more remote from said evaporator than said first impeller and having a second inlet facing away from said evaporator and a second outlet disposed radially outward of said second inlet, said compressor housing further including a third gas collecting volute passage disposed radially outward of said second outlet for collecting refrigerant gas therefrom and first and second cross-over passages each extending from one of said first and second volute passages and crossing radially outward over said second impeller toward said second inlet; first passage means connecting said third volute passage to said condenser; second passage means for connecting said condenser to said evaporator; and third passage means for connecting said evaporator to said inlet of said first impeller.

8. The device as defined by claim 7 including a first annular diffuser passage extending radially outward from said first outlet to said first and second volute passages; a second annular diffuser passage extending radially outward from said second outlet to said third volute passage; and a single annular partition mounted between said first and second impellers having a first face defining a wall of said first annular diffuser passage and a second face defining a wall of said second annular diffuser passage.

9. A refrigeration machine comprising in combination two-stage refrigerant compression means; a refrigerant condenser; means for conducting refrigerant gas from said compression means to said condenser; a refrigerant evaporator; means for conducting refrigerant condensate from said condenser to said evaporator; said last named means including an economizer means for flashing a portion of said condensate from said condenser; means for conducting refrigerant gas from said evaporator to the first stage of said refrigerant compression means; said economizer means including means for conducting flash gas to said compression means intermediate the two stages thereof; liquid eliminator means disposed in said last named flash gas conducting means for eliminating the passage of liquid refrigerant to said compression means; an electric motor drivably connected to said compression means; means for cooling said motor with refrigerant; and means for conducting refrigerant gas from said last named cooling means to said means for conducting flash gas upstream of said liquid eliminator means.

10. A refrigeration machine comprising in combination first impeller means for compressing a refrigerant gas; a second impeller means for compressing a refrigerant gas; a first means for collecting a first portion of refrigerant gas from said first impeller and conducting it to said second impeller; second means for collecting a second portion of refrigerant gas from said first impeller and conducting it to said second impeller; a refrigerant condenser; third means for collecting refrigerant gas from said second impeller and conducting it to said condenser; a refrigerant evaporator; fourth means for conducting refrigerant condensate from said condenser to said evaporator; said fourth means including economizer means for flashing a portion of the refrigerant condensate from said condenser; fifth means for conducting a first portion of flash gas from said economizer means to said first means; sixth means for conducting a second portion of flash gas from said economizer means to said second means and seventh means for conducting refrigerant gas from said evaporator to said first impeller means.

11. A refrigeration machine comprising in combination a refrigerant evaporator; a refrigerant condenser; a compressor means for compressing refrigerant from said evaporator and discharging it into said condenser; and conduit means for connecting said condenser to said evaporator; said conduit means including a vertically extending portion and a flow control means disposed below and downstream of said vertically extending portion; said flow control means including a first means for defining a flow restricting fixed orifice, second means for defining a flow restricting fixed orifice for flashing a portion of the liquid refrigerant passing therethrough into a gas and disposed upstream of said first mentioned orifice, and means for conducting at least a major portion of the gas formed at said second mentioned orifice through said first mentioned orifice.

12. A refrigeration machine comprising in combination a refrigerant evaporator; a refrigerant condenser; a compressor means for compressing refrigerant from said evaporator and discharging it into said condenser; and conduit means for connecting said condenser to said evaporator; said conduit means including a vertically extending portion and a flow restricting means disposed below and downstream of said vertically extending portion for restricting the flow of refrigerant thereby imparting a pressure drop to the refrigerant flowing therethrough; said flow restricting means being comprised of means forming a flow restricting orifice and means spaced upstream of said flow restricting orifice for reducing the pressure between about 5 percent and about 25 percent of the total pressure drop of said flow restricting means.

13. A refrigeration machine comprising in combination a refrigerant evaporator; a refrigerant condenser; a compressor means for compressing refrigerant from said

evaporator and discharging it into said condenser; conduit means for connecting said condenser to said evaporator; said conduit means including a vertically extending portion and a flow restricting means disposed below and downstream of said vertically extending portion for restricting the flow of refrigerant thereby imparting a pressure drop to the refrigerant flowing therethrough; said flow restricting means being comprised of means forming a first flow restricting orifice means and a second flow restricting orifice means spaced upstream of said first flow restricting orifice means; and means for simultaneously operating said first flow restricting orifice means at substantially critical flow conditions and said second flow restricting orifice means outside of the critical flow range.

14. A refrigeration machine comprising in combination an elongated horizontally extending evaporator; means for compressing refrigerant; an elongated condenser supported on said evaporator; conduit means for connecting said evaporator, said compression means and said condenser respectively in series; said evaporator including a horizontally extending elongated cylindrical shell; an elongated first channel member disposed at the bottom of said shell extending substantially in parallel relation therewith and having leg portions extending downward and connected to said shell; means for connecting said condenser to the zone beneath said first channel member between the legs thereof for distribution of liquid refrigerant along the length of said evaporator by said channel member; a second elongated channel member disposed beneath said shell extending in parallel relation therewith and having leg portions extending upwardly in generally vertical alignment with the downwardly extending leg portions of said first channel member and connected to said shell whereby the lower surface of said second channel member presents an even surface for rolling or otherwise skidding the refrigeration machine to its place of installation and whereby said first and second channel members in combination define a box beam for establishing a relatively rigid underframe for said evaporator and condenser.

15. A refrigerant evaporator comprising an elongated generally cylindrical shell having a generally concave upward lower portion; an elongated liquid refrigerant distributor disposed within said concave lower portion extending generally in parallel relation with said shell, said distributor including an elongated channel having a pair of downwardly extending first leg portions, each leg portion being provided with a plurality of horizontally extending apertures spaced longitudinally with respect to said distributor, a deflector portion connected to the longitudinally extending lower edge of each of said first leg portions and extending upwardly therefrom and horizontally away from both of said first leg portions, and a downwardly directed second leg portion depending from the longitudinally extending free upper edge of each of said deflector portions sealingly connected to said shell; each of said second leg portions being provided with a plurality of horizontally extending apertures spaced longitudinally with respect to said distributor whereby fluid discharged from the apertures in each of said first leg portions is deflected upward by a deflector portion and fluid discharged from said apertures in each of said second leg portions is deflected upward by the generally concave portion of said shell.

16. A refrigeration machine comprising in combination a refrigerant evaporator; a refrigerant condenser; a compressor means for compressing refrigerant from said evaporator and discharging it into said condenser; and conduit means for connecting said condenser to said evaporator; said conduit means including a vertically extending portion and a flow control means disposed below and downstream of said vertically extending portion; said flow control means including a first means for defining a flow restricting orifice, and second means for defining

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a flow restricting orifice upstream of said first mentioned orifice, said second means for defining a flow restricting orifice being a vertically extending plate provided with a plurality of vertically spaced throughgoing apertures.

17. A refrigeration machine comprising in combination a refrigerant evaporator; a refrigerant condenser; a compressor means for compressing refrigerant from said evaporator and discharging it to said condenser; and conduit means for connecting said condenser to said evaporator; said conduit means including a vertically extending portion and a flow control means disposed below and downstream of said vertically extending portion; said flow control means including a first means for defining a flow restricting fixed orifice, and second means for defining a flow restricting fixed orifice upstream of said first mentioned orifice; said compressor means being provided with two stages of compression; said conduit means further including an economizer flash chamber above and upstream of said vertically extending portion, a second vertically extending portion above and upstream of said economizer flash chamber and a second flow control means disposed below and downstream of said last mentioned vertically extending portion; said second flow control means including third means for defining a flow restricting fixed orifice and fourth means for defining a flow restricting fixed orifice upstream of said economizer flash chamber and downstream of the orifice defined by said third means; and means for connecting the upper portion of said economizer flash chamber to a point intermediate the stages of compression of said compression means.

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18. A refrigeration machine comprising in combination a refrigerant evaporator; a refrigerant condenser; a compressor means for compressing refrigerant from said evaporator and discharging it into said condenser; and conduit means for connecting said condenser to said evaporator; said conduit means including a vertically extending portion and a flow restricting means disposed below and downstream of said vertically extending portion for restricting the flow of refrigerant thereby imparting a pressure drop to the refrigerant flowing there-through; said flow restricting means being comprised of means forming a flow restricting orifice and means spaced upstream of said flow restricting orifice for reducing the pressure between about 5 percent and about 25 percent of the total pressure drop of said flow restricting means, said orifice formed by said means forming a flow restricting orifice having a well rounded leading edge and said means spaced upstream of said flow restricting orifice for reducing the pressure being a plate having a plurality of orifices with sharp leading edges.

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