Jan. 3, 1967 M. R. BUTTS ETAL 3,295,753

REFRIGERATING APPARATUS

Filed Jan. 4, 1965 2 Sheets-Sheet 1

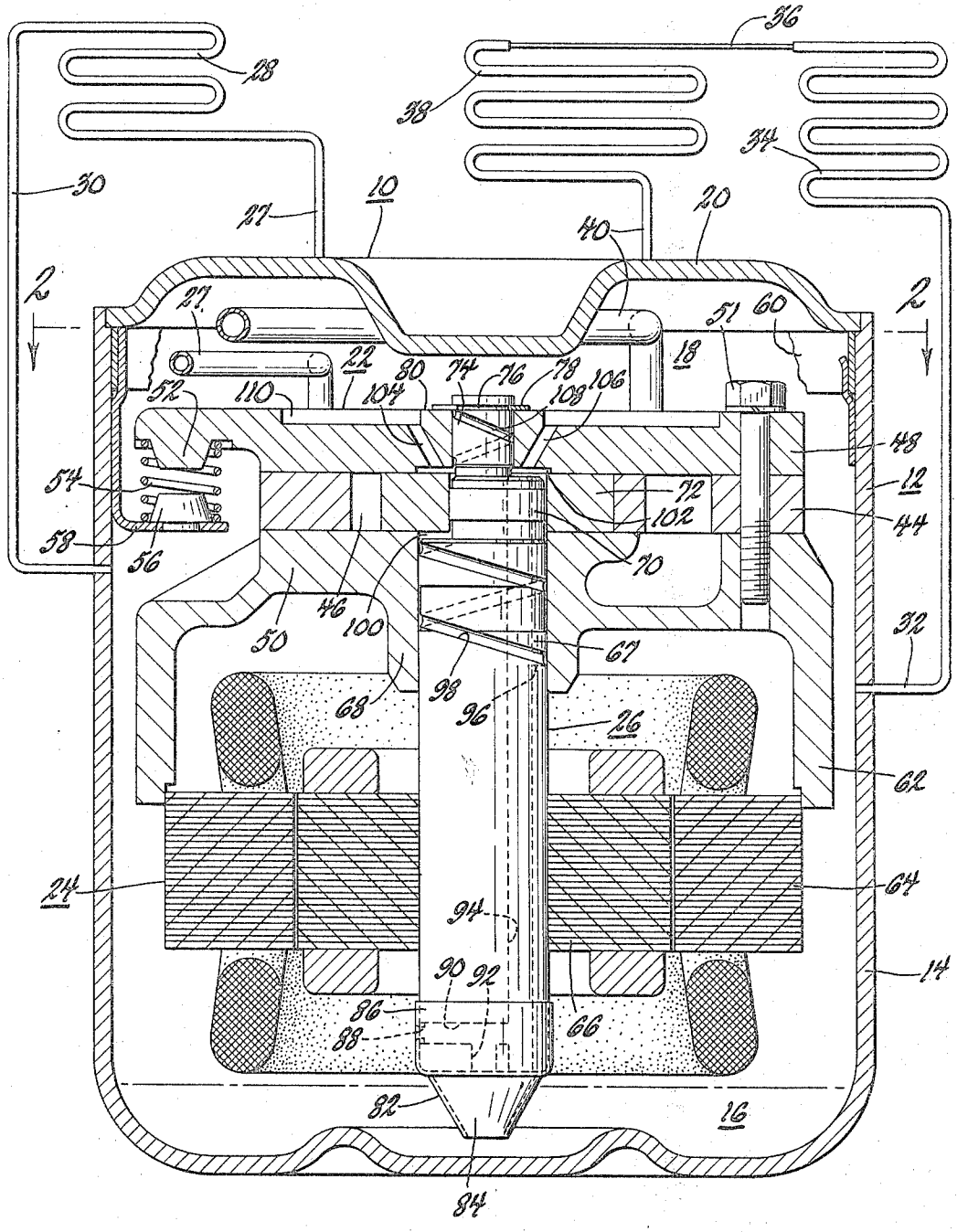


Fig. 1

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Filed Jan. 4, 1965 2 Sheets-Sheet 2

Fig. 2

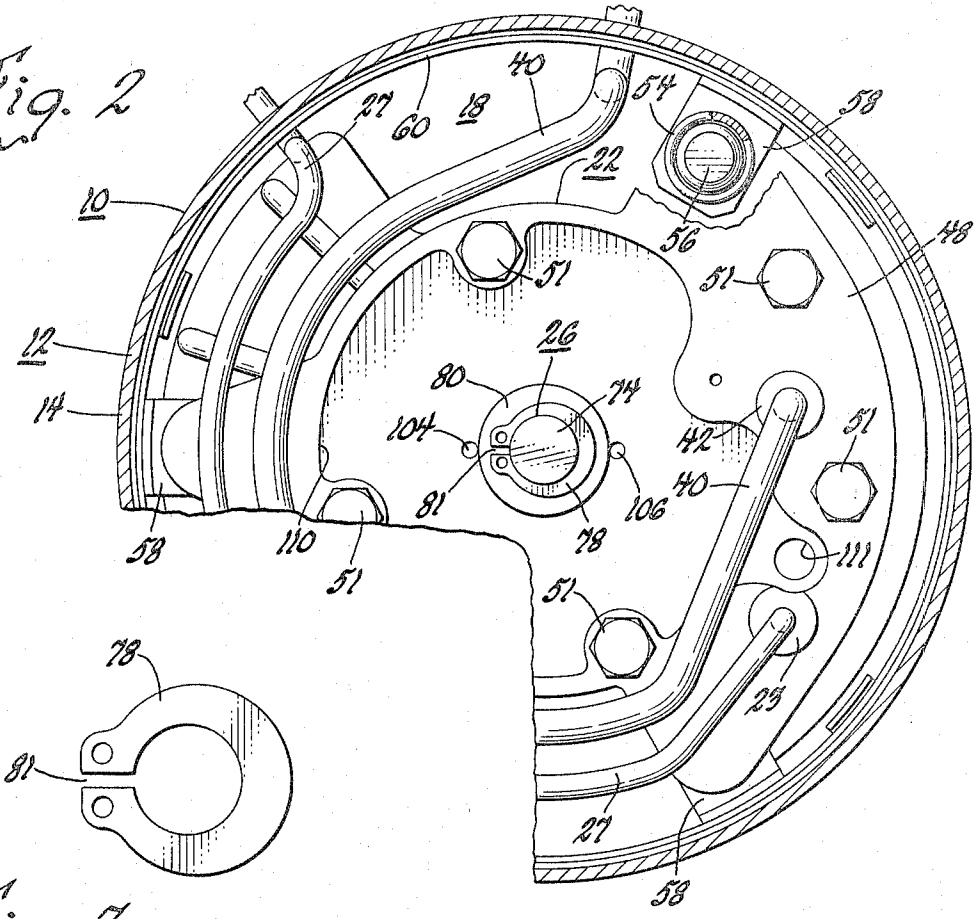
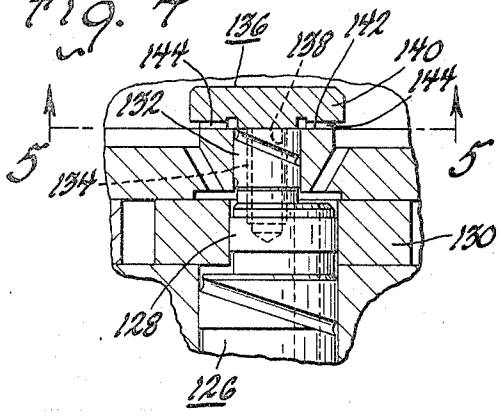


Fig. 3

Fig. 4



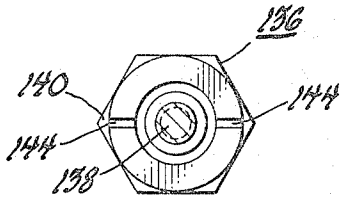


Fig. 5

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United States Patent Office 3,295,753 Patented Jan. 3, 1967

3,295,753

REFRIGERATING APPARATUS

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Filed Jan. 4, 1965, Ser. No. 423,215
12 Claims. (Cl. 230—139)

This invention is directed to refrigerating apparatus and more particularly to hermetically sealed refrigerant compressor units.

One problem in many hermetically sealed refrigerant compressors is that of noise transmission therefrom. The problem is particularly manifested in compressor arrangements wherein the compressor component of the assembly is partially or totally submerged in a liquid lubricant sump region at the bottom of the compressor. Consequently, an attempt has been made to remove the compressor and drive motor from this region by locating them within the gas space above the pump region. While such an arrangement solves noise problems, it tends to create lubrication problems by locating the main bearing points in the apparatus remotely of the lubricant in the sump region.

An object of the present invention, therefore, is to improve hermetically sealed refrigerant compressors having an inverted arrangement of the compressor and drive motor within the hermetically sealed shell in spaced relationship with respect to a lower liquid sump region by the provision of an improved liquid lubricant distributing system including plural discharge passageways.

A further object of the present invention is to improve hermetically sealed compressors having such an inverted arrangement of compressor and drive motor by the provision of improved means for circulating oil to the bearing points therein including low-cost means for slinging the circulated oil against the inner surface of the hermetically sealed shell for cooling.

A further object of the present invention is to improve hermetically sealed compressor units by arranging the compressor and drive motor thereof in an inverted manner with respect to the lower liquid sump region therein and including an oil pickup and distributing system for selectively directing a portion of the circulated oil into an oil collecting recess on top of the compressor unit to serve as a heat sink for the compressor and for selectively directing another portion of the oil against a rotatable shaft thrust element that directs the oil against the inner surface of the compressor shell for cooling.

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 view in vertical section of one embodiment of the present invention shown in operative relationship with a schematic refrigerant system;

FIGURE 2 is a view partially broken away and in horizontal section taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a view in elevation of a combination thrust and slinger element of the present invention;

FIGURE 4 is a fragmentary view of a modification of the shaft thrust element and oil distributing system of FIGURE 1; and

FIGURE 5 is a view in horizontal section taken along the line 5—5 of FIGURE 4.

In the embodiment of FIGURES 1 through 3 a compressor assembly 10 is illustrated including an outer hermetically sealed shell 12 having a lower portion 14 forming a lower liquid sump region 16 and an upper gas space 18. The portion 14 has an upper open end therein closed

by an upper closure member 20 suitably fastened therein by welding or the like. Within the gas space 18 is located a compressor 22 drivingly connected to an electric drive motor 24 by a shaft 26.

Upon energization of the motor 24, gas is compressed within the compressor 22 and discharged through an outlet fitting 23 to a line or conduit 27 which is directed exteriorly of the shell 12 where it fluidly connects through a superheat coil 28 that connects to a refrigerant return line 30 that discharges into the gas space 18. Refrigerant flowing from line 30 as it passes through the gas space 18 is separated from lubricant present therein. The refrigerant gas then passes through an outlet line or conduit 32 from the shell 12 to pass through a condenser coil 34 thence through a suitable refrigerant restrictor 36 representatively shown as being an elongated capillary tube and into an evaporator coil 38. From the evaporator coil, refrigerant flows through an inlet line or conduit 40 interiorly of the casing 12 through an inlet fitting 42 of the compressor 22.

Referring now more particularly to the compressor 22 in FIGURE 1, it can be seen that the unit is more or less centrally located within the upper gas space 18 a substantial distance above the sump region 16. Thus, the compressor 22 is surrounded by a gas space that, in accordance with certain of the principles of the present invention, serves as a fairly effective noise muffling media to limit transmissibility of noise from the compressor to a point exteriorly of the shell 12.

The compressor 22 includes a cylinder plate 44 that forms a pumping chamber 46 closed at one end by an upper end plate 48 and at the other end by a lower end plate 50. The plates 44, 48, 50 are suitably joined by means such as a plurality of circumferentially located tie bolts 51 directed therethrough and into threaded engagement with plate 50. The upper end plate 48 has a plurality of depending lugs 52 thereon each of which receives one end of a coil spring 54 having its opposite end received about a retaining button 56 supported on an L-shaped bracket 58 that is secured to a circumferential band or split ring 60 fastened within the inner surface of the shell portion 14 at the upper open end thereof. The spring carrying brackets 58 are located at circumferentially spaced points on the split ring 60, as best seen in FIGURE 2, to form a plural point resilient support for the compressor unit 22 to effectively damp vibration transfer from the compressor 22 to the shell 12.

The lower end plate 50 includes a depending circumferential flange 62 having a lower open end which receives a stator 64 of the motor 24 which is fastened thereto. Within the stator 64 is located a rotor 66 fastened to the shaft 26 at the inner periphery thereof.

Above the rotor 66 the shaft 26 is directed interiorly of the lower end plate and includes a bearing portion 67 thereon journalled within a depending hub portion 68 of the plate 50. The shaft further includes an eccentric portion 70 above the bearing portion 67 directed through an opening in a rotary pumping piston 72 in driving engagement therewith. Above the eccentric portion 70 is a smaller diameter shaft extension 74 directed through the upper end plate 48 exteriorly thereof.

The end of the extension 74 includes a groove 76 therein in which is fixedly received a snap ring thrust element 78 having the lower surface thereof in engagement with a raised surface 80 on the upper surface of the upper end plate 48 whereby the shaft 26 and rotor 66 are secured against downward vertical movement with respect to the compressor 22.

By virtue of the illustrated arrangement, upon energization of the motor 24, the shaft 26 will rotate causing the eccentric 70 to drive the piston 72 within the pump cham-

ber 46 for directing refrigerant through the associated refrigerant system as discussed above. Internal valving details, vanes and other compressor components form no part of the present invention and are therefore omitted. For an understanding of the operation of a rotary compressor of the type partially illustrated herein, however, reference can be made to United States Patent No. 3,016,183, issued January 9, 1962. While a rotary compressor is illustrated, it will be apparent to one skilled in the art that an eccentric shaft portion such as that illustrated is equally suited for association with a piston rod for driving a piston within a cylinder to effect the refrigerant compressing operation.

In accordance with certain other of the principles of the present invention, the illustrated embodiment includes improved means for circulating liquid lubricant from the lower liquid sump region 16 to the bearing points within the compressor. More particularly, the oil distributing system includes a centrifugal lubricant pickup element 82 secured on the lower end of the shart 26. The pickup element 82 is illustrated as being sheet metal member including a conically-shaped nose 84 disposed beneath the liquid level within the sump region 16 and a tubular upper portion 86 fitted over the end of the shaft 26 and secured thereto by directing a portion 88 of the sleeve 86 into a transverse passageway 90 in the shaft 26. The transverse passageway communicates with a first central opening 92 in the end of the shaft 26 which communicates with the central interior opening of the nose 84 and it also communicates with a longitudinally directed passageway 94 through the shaft 26 offset from opening 92 to have an open end overlying the inner surface of the nose portion 84. Thus, when the shaft rotates liquid lubricant is centrifuged up the interior walls of nose 84 into opening 94 and gas within the nose 84 is separated from the lubricant to pass through passageways 90, 88 into space 18.

The longitudinal opening 94 runs throughout the length of the shaft 26 and intercepts a transverse passageway 96 at the shaft bearing portion 67. The opening 96 communicates with an inclined, helically formed groove 98 which serves to lubricate the interface between bearing portion 67 and hub portion 68. At the upper end of groove 98 is formed a first oil collecting chamber 100 for lubricating the piston 72. Oil from the collecting chamber 100 flows across the bearing surface between eccentric 70 and piston 72 into an upper oil collecting chamber 102 within the compressor 22. The collecting chamber 102 also communicates with an upper open end of the passageway 94 for receiving the liquid lubricant that does not pass through the groove 98.

From the upper collecting chamber 102 lubricant is selectively passed through inclined passageways 104, 106 in the upper end plate or through another helical groove 108 in the shaft extension 74 serving to lubricate the bearing surface formed thereby.

The lubricant flowing through the inclined passageways 104, 106 is received within a recess 110 formed in the upper surface of the end plate 48 and the liquid from the groove 108 strikes the underside of the snap ring thrust element 78. The recess 110 communicates with a drain hole 111 in plate 48 for returning lubricant back to the sump region. As best seen in FIGURE 3, the snap ring 78 includes spaced end portions forming an opening 81 and by virtue of this construction, when the shaft and snap rotate, oil directed through the groove 108 is slung radially outwardly of the rotating assembly to strike the inner surface of the shell 12 which thereby serves as a heat exchange surface for cooling the oil.

The oil received within the recess 110 produces a heat sink in close proximity to the operating piston 72 whereby the operating temperature of the compressor 22 is maintained within a desired range.

Another embodiment of the combination thrust and slinger element is illustrated in FIGURES 4 and 5 which shows a shaft 126 equivalent to shaft 26 including an eccentric portion 128 directed through a pumping piston 130 in driving relationship therewith. The piston 130 is equivalent to piston 72 in the first mebodiment. Above the eccentric 128 is located a smaller diameter shaft extension 132 forming an upper bearing surface. In this embodiment the extension 132 includes internal threads 134 which are directed therebelow into a portion of the eccentric 128. Threadably received within the internal threaded opening 134 is a thrust element 136 including a threaded screw portion 138 and an upper head 140 having the underside thereof supportingly received by a raised surface 142 of an upper end plate like the end plate 48 of the first embodiment. In this embodiment a plurality of passageways identical to those in the first embodiment receive fluid directed thereto by an oil pickup of the type shown in the first embodiment for selectively directing liquid lubricant into a recess on the upper surface of the end plate and against the underside of the thrust element 136. The underside of the head 104 of the thrust element includes grooves 144 thereon that sling the oil directed against the underside radially outwardly of the rotating thrust member 136 against the inner surface of the shell 12 for cooling.

The head of the thrust element 136 is representatively shown as being hexagonally shaped, with it being understood that any other suitable geometry would be equally useful in practicing the present invention.

In view of the above-described embodiments of the invention, it will be appreciated that an improved oil distributing system is shown for associattion with an inverted type compressor incorporating the desirable features of selectively distributing oil from a liquid sump region into an oil receiving recess serving as a heat sink for the compressor and against a slinging element for distribution against the shell for cooling. A further feature of the invention is that the slinging element serves as an economical, low-cost retaining or shaft thrust element for connecting the drive shaft and rotor to the inverted compressor unit.

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 a refrigeration compressor, the combination of, a hermetically sealed shell including a lower liquid sump region and an upper gas space, a compressor including an outer housing wholly located within said gas space in spaced relationship to said shell whereby said gas space serves to muffle noises from said compressor, motor means for driving said compressor including a stator and a rotor located above said liquid sump region at a point spaced inwardly of said shell and between said sump region and said compressor, a shaft having a portion thereof rotatably supported by said compressor housing and a portion thereof secured to said rotor for driving said compressor upon energization of said motor means, said shaft having an extension thereon located on the upper side of said compressor housing, a thrust element secured to said shaft extension, said thrust element having a portion thereon engaging said compressor housing for suspending said shaft therefrom, means for resiliently supporting said compressor housing on said shell, and lubricant supply means for directing liquid from said sump region upwardly through said shaft against said thrust element whereby said thrust element upon rotation of said shaft serves to sling lubricant radially outwardly against the inside surface of said shell thereby to flow downwardly across substantially the full extent of the inside surface of said shell in cooling relationship therewith.

2. In a refrigerant compressor, the combination of, a hermetically sealed shell having a lower liquid sump region and an upper gas space, a compressor including an outer housing, means for resiliently supporting said compressor housing wholly within said upper gas space and in spaced relationship with liquid in said sump region, a

motor for driving said compressor including a stator and a rotor, a shaft secured to said rotor being directed vertically of said hermetically sealed shell through said compressor housing for driving said compressor upon energization of said motor, said shaft having an extension thereon directed through the upper side of said compressor housing a thrust element secured for rotation with said shaft extension and engaging said compressor housing to suspend said shaft and rotor with respect to said compressor housing out of supported relationship with said shell, and liquid supply means including passageway means within said shaft for drawing liquid from the sump region against said thrust element, and means on said thrust element for slinging said liquid radially outwardly thereof and against the interior surface of said shell thereby to flow downwardly across substantially the full extent of said shell in cooling relationship therewith.

3. In a refrigerant compressor, the combination of, a hermetically sealed shell forming a lower liquid sump region and an upper gas space, a compressor located within said gas space in spaced relationship with said liquid sump region, said compressor including an outer housing having an upper and a lower surface, means for resiliently supporting said compressor within said gas space, motor means located between said sump region and the lower surface of said compressor housing including a stator and a rotor, a shaft directed vertically of said shaft and having a portion thereon fixed to said rotor and another portion thereof directed through said lower housing surface for operating said compressor upon energization of said motor means, said shaft including an extension directed through said upper housing surface exteriorly thereof, a thrust element fixed to said shaft extension for rotation therewith, said thrust element engaging said upper compressor surface to suspend said shaft from said compressor housing, said thrust element constituting the sole support for said suspended shaft.

4. In the combination of claim 2, said shaft extension having a groove formed in the outer periphery thereof for directing liquid against said thrust element, said thrust element comprising a snap ring having a pair of end portions separated by an opening, said opening serving as means for slinging lubricant radially outwardly of said thrust element.

5. In the combination of claim 2, said shaft extension having an internally threaded portion, said thrust element comprising a screw having a threaded portion and a head portion, said threaded portion being threadably received within said shaft extension and said head portion including grooves on the underside thereof serving as said means for slinging lubricant radially outwardly of said thrust element.

6. In a refrigerant compressor, the combination of, a hermetically sealed shell forming a lower liquid sump region and an upper gas space, a rotary compressor located in spaced relationship with said sump region in said gas space for muffling noises from said compressor, said compressor including an upper end plate, a cylinder forming plate and a lower end plate, means for joining said plates, means including a depending portion on said upper end plate for resiliently supporting said compressor within said gas space, motor means located between said sump region and said compressor including a stator fixedly secured to said lower end plate and a rotor, a shaft having a portion thereof fixed to said rotor and a portion thereof directed interiorly of said compressor through said lower end plate, said shaft including an upper extension directed through said upper end plate exteriorly thereof, a thrust element fixed to said shaft extension including a portion in engagement with the outer surface of said upper end plate for suspending said shaft from said compressor out of supported relationship with said shell, lubricant supply means including passageway means in said shaft for drawing liquid from the sump region upwardly through said shaft against said thrust element, and means on said thrust element for receiving said lubricant and directing it radially outwardly against the inside surface of said shell.

7. In the combination of claim 6, said shaft extension having a groove formed in the outer periphery thereof for directing liquid against said thrust element, said thrust element comprising a snap ring having a pair of end portions separated by an opening, said opening serving as means for slinging lubricant radially outwardly of said thrust element.

8. In the combination of claim 6, said shaft extension having an internally threaded portion, said thrust element comprising, a screw having a threaded portion and a head portion, said threaded portion being threadably received within said shaft extension and said head portion including grooves on the underside thereof serving as said means for slinging lubricant radially outwardly of said thrust element.

9. In a refrigerant compressor, the combination of, a hermetically sealed shell having a lower liquid sump and an upper gas space, a compressor located within said gas space out of contact with said liquid sump region and in spaced relationship to said shell whereby said gas space muffles noises from said compressor, said compressor including an outer housing having an upper surface and a lower surface, means secured to said upper surface for resiliently supporting said compressor within said gas space, motor means located above said sump region and between said sump region and said compressor including a stator fixed to said lower surface of said housing, a rotor, a shaft having a portion thereof fixed to said rotor and another portion directed interiorly of said housing for operating said compressor upon energization of said motor, a shaft extension directed through said upper housing surface, a thrust element fixed to said shaft extension to suspend said shaft from said housing out of supported relationship with said shell, means forming a lubricant receiving recess within said upper compressor housing surface, lubricant pickup means for drawing liquid from said sump including first passageway means in said shaft for directing lubricant interiorly of said compressor, second passageway means in said shaft for directing oil from interiorly of said compressor against said thrust element, means on said thrust element for slinging lubricant radially outwardly thereof against the interior of said shell, and passageway means formed in said upper housing surface for directing oil exteriorly of said compressor into said oil receiving recess whereby said oil receiving recess serves as a heat sink for dissipating heat built up in said compressor.

10. In a refrigerant compressor, the combination of, a hermetically sealed shell forming a lower liquid sump region and an upper gas space, a compressor located in spaced relationship with said sump region within said gas space, said compressor including an upper end plate, a cylinder forming plate and a lower end plate, a piston within said cylinder, means including a depending portion on said upper end plate for resiliently supporting said compressor within said gas space so that noise from said compressor is muffled, a motor located between said compressor and said liquid sump region including a stator and a rotor, a shaft having a first portion fixedly secured to said rotor, said shaft being directed interiorly of said compressor through its lower end plate, a first bearing portion on said shaft rotatably supported by said lower end plate, an eccentric portion on said shaft for drivingly engaging the piston of said compressor for operating said compressor upon energization of said motor, a small diameter bearing portion on said shaft rotatably received within said upper end plate, said small diameter bearing portion extending exteriorly of said upper end plate, a thrust element secured to said small diameter portion for suspending said shaft from said compressor out of supported relationship with said shell, means forming a lubricant collecting chamber within said compressor, passageway means in said small diameter shaft portion for directing lubricant against said thrust element, means on said thrust

element for slinging said lubricant against the inner surface of said shell, means forming a recess in the upper surface of said upper end plate in surrounding relationship with said thrust element, and passageway means in said upper end plate for directing lubricant from said internal collection chamber exteriorly of said compressor into said liquid receiving recess to serve as a heat sink for heat from said compressor.

11. In the combination of claim **10**, said shaft extension having a groove formed in the outer periphery thereof for directing liquid against said thrust element, said thrust element comprising a snap ring having a pair of end portions separated by an opening, said opening serving as means for slinging lubricant radially outwardly of said thrust element.

12. In the combination of claim **10**, said shaft extension having an internally threaded portion, said thrust

element comprising a screw having a threaded portion and a head portion, said threaded portion being threadably received within said shaft extension and said head portion including grooves on the underside thereof serving as said means for slinging lubricant radially outwardly of said thrust element.

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