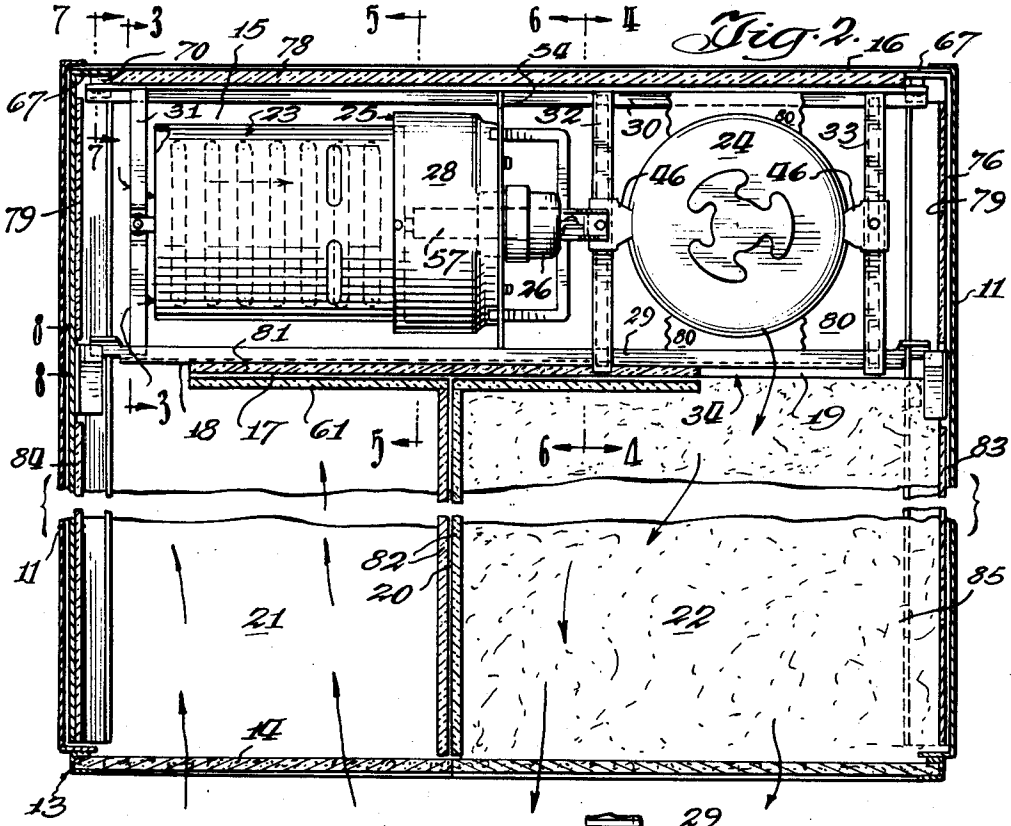
July 28, 1964 W. B. HERNDON, JR., ETAL 3,142,162

REFRIGERATION DEVICE

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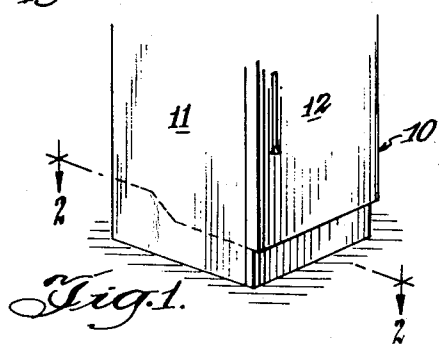


Fig. 1.

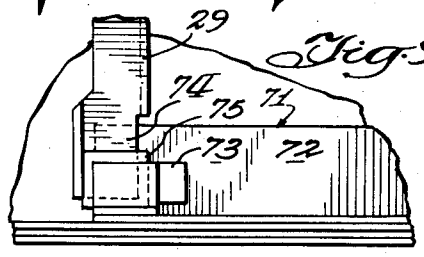


Fig. 9.

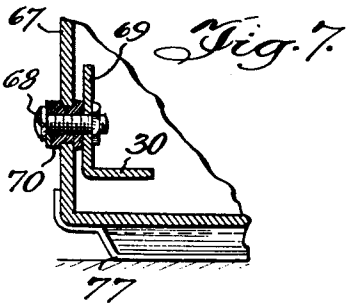


Fig. 7.

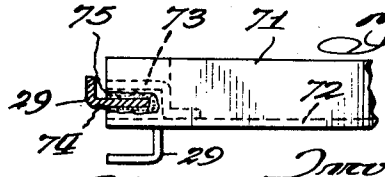


Fig. 8.

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REFRIGERATION DEVICE

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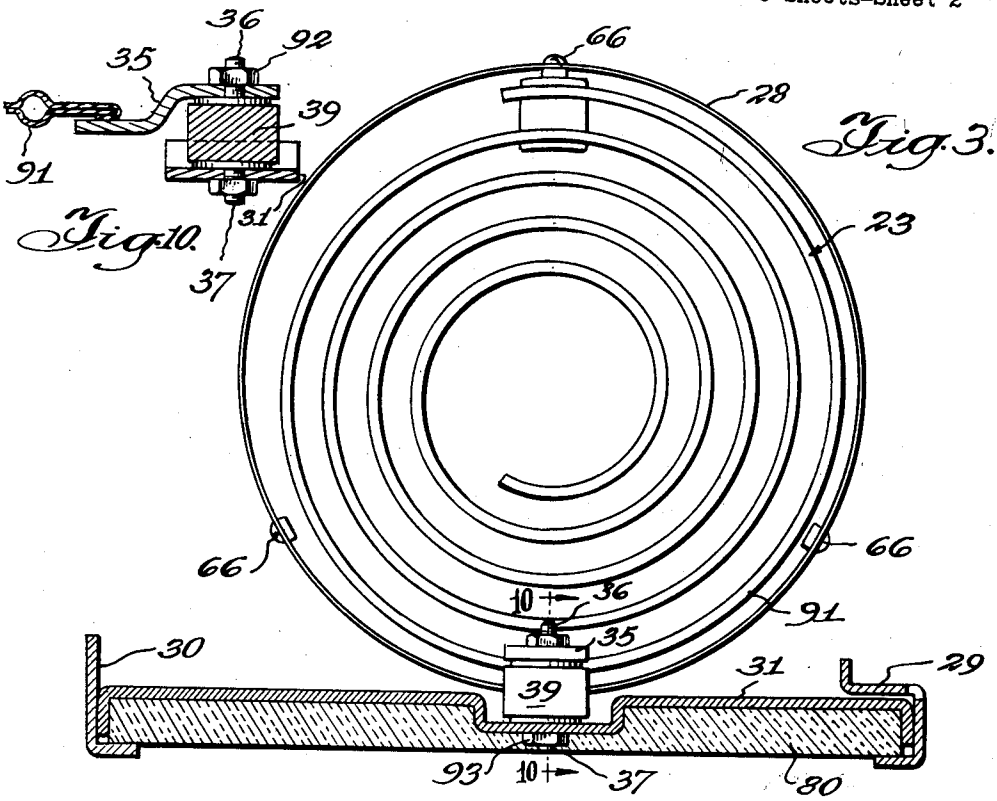


Fig. 10.

Fig. 3.

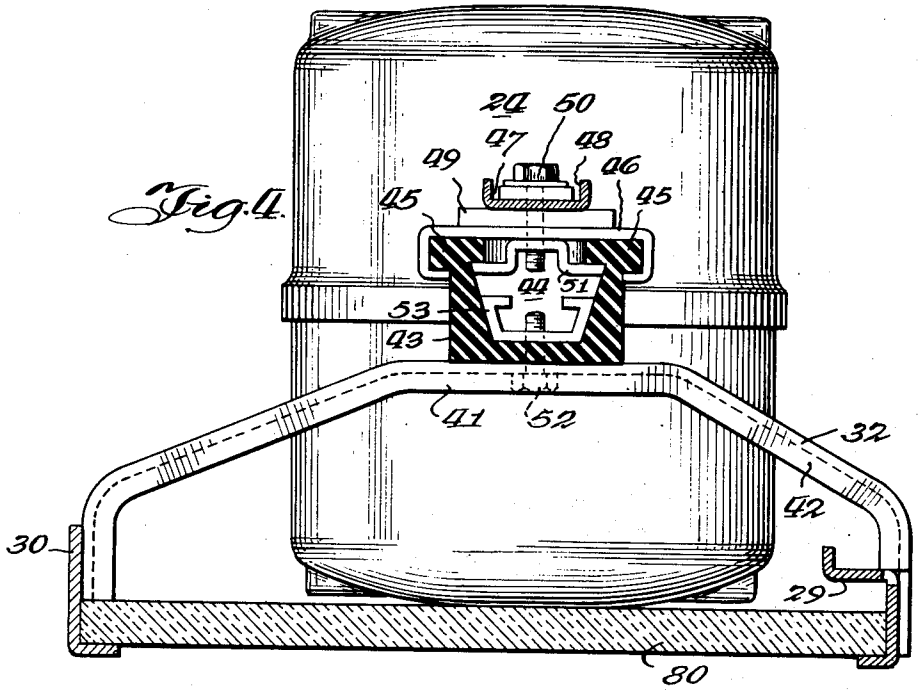


Fig. 4.

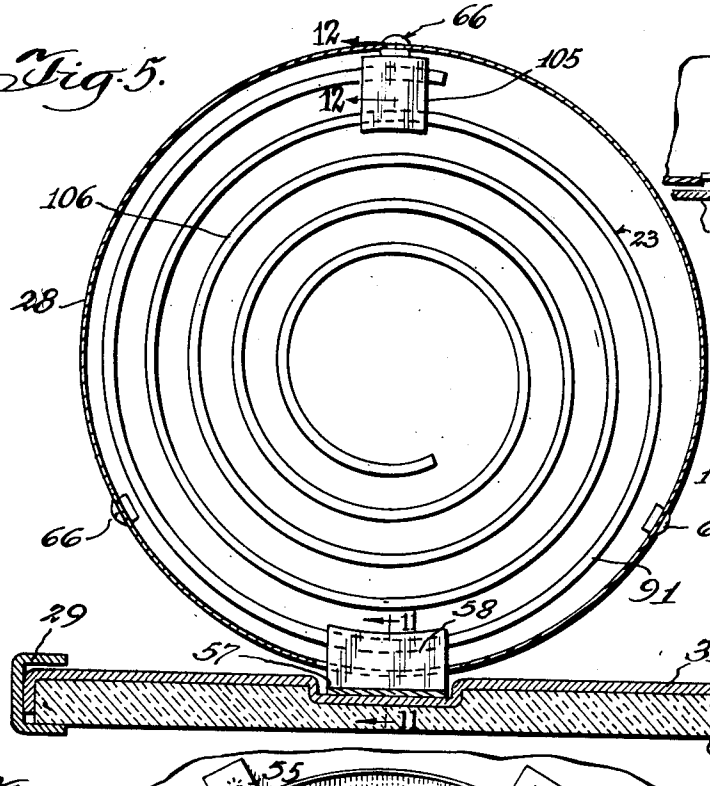
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REFRIGERATION DEVICE

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3 Sheets-Sheet 3

Fig. 5.



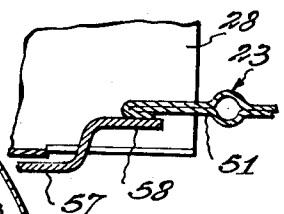


Fig. 11.

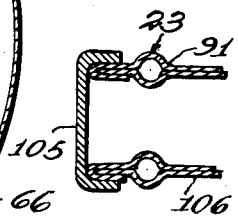
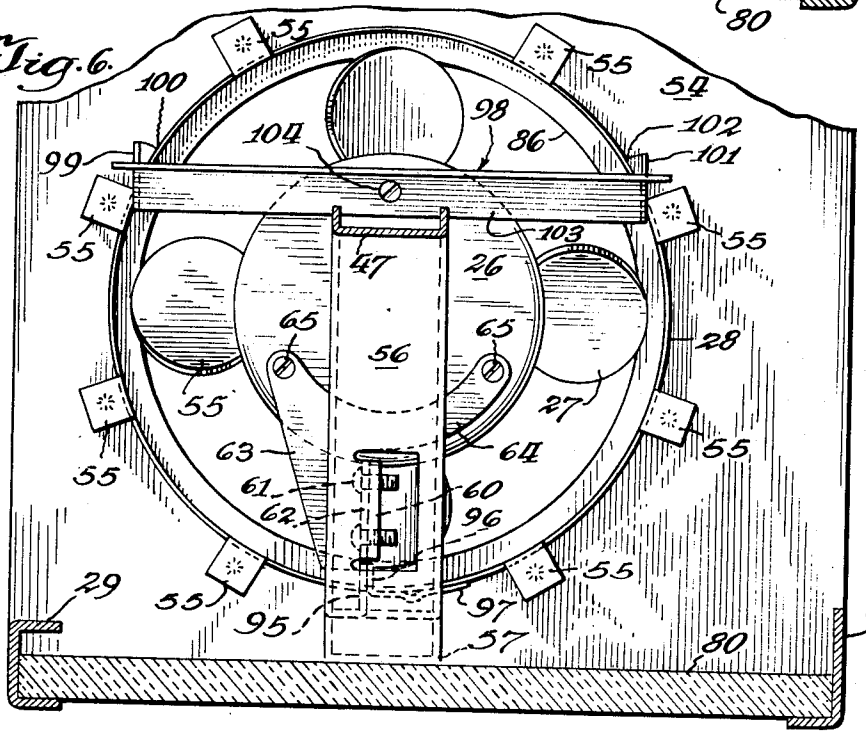


Fig. 12.

Fig. 6.



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3,142,162

REFRIGERATION DEVICE

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Filed Mar. 22, 1962, Ser. No. 181,521
8 Claims. (Cl. 62—295)

This invention relates to a refrigeration device.

It has been proposed that the condenser of a refrigeration device using a liquefiable refrigerant be cooled by air moving means such as a blower or fan so that the condenser can occupy smaller space and so that more efficient liquefying of the gaseous refrigerant will occur. It has also been proposed to use this same air moving means for cooling the compressor of the refrigeration system. With such air moving means it has been found, however, that the noise level is often excessively high, particularly where the condenser is made compact to occupy a relatively small space so that the air movement is relatively rapid in order to secure adequate cooling.

The present invention provides for air cooling of the condenser with means for suppressing the sound that is generated. In addition, the device of this invention locates the refrigeration unit including the condenser and air moving means and preferably the compressor in a machine compartment that is located at a relatively remote part of a cabinet of the refrigeration device and then provides a structure in which sound deadening materials are used efficiently for suppressing the sound. In addition, the refrigeration device of this invention provides a compact refrigeration unit for locating in the machine compartment with this unit being constructed so that it can be efficiently cooled by the air moving means included as a part of the unit and so that it can occupy only a relatively small space yet provide efficient cooling of the condenser and preferably also of the compressor.

One of the features of this invention therefore is to provide an improved refrigeration device as described above.

Another feature of the refrigeration device of this invention is the provision of a three chamber machinery compartment including a first forwardly disposed air inlet chamber and second forwardly disposed air outlet chamber and a third rearwardly disposed chamber containing the refrigeration unit. The chamber walls are lined with sound deadening material wherein this lining together with the rear disposition of the noise producing elements provide for quiet operation of the refrigeration device.

A further feature of this invention is the provision of a refrigeration unit wherein the condenser, the fan and the compressor are all resiliently mounted horizontally in line on a framework which gives a compact unit having noise suppressed operation. In addition, the invention provides for resilient support of the framework within the cabinet thus giving additional noise suppression.

Another feature of this invention is a refrigeration unit resiliently mounted on a framework wherein the compressor and the fan and condenser assembly are caused to move essentially as a single system when under the influence of certain planes of vibration. For example, vibrations of the compressor in the vertical plane are transmitted through resilient mountings to the fan and condenser assembly which assist in dampening out these undesirable vibrations. Further provisions of this mounting arrangement include resilient support of the compressor and the fan and condenser assembly on the framework in such a manner as to allow essentially independent

movement of the components under certain other planes of vibration. For instance, the torsional vibration of the compressor is dissipated through rubber mounts and independently of the fan and condenser assembly.

A further feature of the invention is the provision of a refrigeration unit including a helical condenser which vibrates due to the pulsations of the gas passing through it wherein these pulsations are essentially self-dissipating because of the mounting scheme employed. In addition, means are provided which can change the natural frequency of the helical condenser to thereby prevent the condenser from being driven by the dominant frequency of any residual pulsations.

Other features and advantages of the invention will be apparent from the following description of one embodiment thereof taken in conjunction with the accompanying drawings. Of the drawings:

FIGURE 1 is a fragmentary perspective view of a refrigeration device, specifically a refrigerator, embodying the invention.

FIGURE 2 is a broken horizontal sectional view taken substantially along the line 2—2 of FIGURE 1.

FIGURE 3 is a fragmentary vertical sectional view taken substantially along line 3—3 of FIGURE 2.

FIGURE 4 is a fragmentary vertical sectional view taken substantially along line 4—4 of FIGURE 2.

FIGURE 5 is a fragmentary vertical sectional view taken substantially along line 5—5 of FIGURE 2.

FIGURE 6 is a fragmentary vertical sectional view taken substantially along line 6—6 of FIGURE 2.

FIGURE 7 is a fragmentary vertical sectional view taken substantially along line 7—7 of FIGURE 2.

FIGURE 8 is a fragmentary vertical section view taken substantially along line 8—8 of FIGURE 2.

FIGURE 9 is a fragmentary plan view of the structure of FIGURE 8 and associated parts.

FIGURE 10 is a fragmentary vertical sectional view taken substantially along line 10—10 of FIGURE 3.

FIGURE 11 is a fragmentary vertical sectional view taken substantially along line 11—11 of FIGURE 5.

FIGURE 12 is a fragmentary vertical sectional view taken substantially along line 12—12 of FIGURE 5.

The embodiment of the invention shown in the accompanying drawings comprises a refrigerator 10 including a cabinet 11 closed by a door 12. Located in the bottom of the cabinet 11 is a section 13 having a front closed by an air directing grille 14. The cabinet section 13 is provided with a rear machine compartment 15 extending across the width of the cabinet 11 and defined at the rear by a wall 16 and at the front by a wall 17 whose ends are spaced inwardly of the sides of the cabinet 11 so as to provide passages 18 and 19. Extending forwardly of the wall 17 to the front of the cabinet is a dividing wall 20 which divides the space forwardly of the wall 17 into side passages 21 and 22.

Located within the machine compartment 15 is a refrigeration unit including a condenser 23 at one end of the compartment, a compressor 24 at the other end of the compartment and an intermediate air moving means 25. This air moving means comprises an electric motor 26 for rotating a fan 27 that is positioned within a cylindrical shroud 28.

The refrigeration unit is mounted on substantially parallel front 29 and rear 30 rails that are located at the front and rear of the compartment 15 when the unit is in position. Transversely to the rails 29 and 30 and extending therebetween, are structural members 31, 32 and 33 which cooperate with the rails to constitute the supporting framework for the refrigeration unit in the compartment 15. This refrigeration unit 34 made up of the supporting

framework of rails 29 and 30 and structural members 31–33 and the condenser 23, compressor 24 and air moving means 25 mounted on this framework may be easily moved into and removed from the compartment 15 through the rear of the cabinet 11.

The refrigeration unit 34 will of course include connecting piping as well as auxiliary elements common to such a unit. These, however, are omitted from the illustrated embodiment for clarity of illustration. Similarly, a complete refrigeration unit would of course include an evaporator apparatus. This is not shown as it is located in another part of the cabinet 11 and forms no part of the present invention.

As is illustrated most clearly in FIGURE 3, the condenser 23, which is of the well known roll bonded or brazed sheet metal type, is formed by arranging the sheet metal structure in a helix with the adjacent convolutions separated from each other so as to provide air passage spaces. As can be seen in FIGURE 3, the end structural member 31 is located adjacent the bottom of the cabinet. One end of the condenser 23 is supported by structural member 31 as best seen in FIGURES 3 and 10. A support leg 35 is welded or otherwise attached to the outer convolution 91 of the condenser 23. The free end of leg 35 is mounted to member 31 through a block of resilient rubber 39, this block includes a first molded in flat headed bolt 36 and a nut 92 for securing leg 35 to the block and a second molded in flat headed bolt 37 and nut 93 for securing the block to the member 31.

FIGURE 4 illustrates the support for the side of the compressor 24 that is adjacent the air moving means 25 with this support also supporting the air moving means as well as the end of the condenser 23 that is opposite the support 31. The support 33 on the other side of the compressor 24 is the same as support 32.

As illustrated in FIGURE 4, structural member 32 is formed of a metal channel of generally arched construction having a center 41 and ends attached to the rails 29 and 30. The structural member 32 is provided with side flanges 42 for added strength.

Mounted at the center 41 of the structural member 32 is a block of rubber 43 or similar resilient material havin a central opening 44 and upper side flanges 45. The rubber block 43 and the similar block on the opposite similar structural member 33 provide resilient support for the compressor 24. Attached to the compressor on opposite sides thereof are mounted brackets 46 which have sides embracing the rubber block flanges 45. Located on top of the mounting bracket 46 that is adjacent the intermediate support 32 is one end of a support channel 47 provided with side flanges 48 for rigidity. Between the end of the channel 47 and the bracket 46 is a rubber gasket 49 to isolate the bracket 46 from the channel 47. The assembly of bracket 46, channel 47 and rubber grommet 49 is tied together by means of a bolt 50 which extends through these parts into the opening 44 in the rubber block 43 to engage a tap plate 51. The bottom of the rubber block 43 is attached to the center 41 of the support 32 by a similar bolt 52 that extends into the opening 44 and engages a bottom tap plate 53. Both of the tap plates 51 and 53 are located within the opening 44 and bear against the inner surfaces of the rubber block 43 that forms a portion of this opening. The opposite bracket 46 on the end structural member 33 is exactly the same as the structural member 32 and the bracket 46 at this end is connected in a similar manner to the top of the member 33.

The support channel 47 whose one end is attached to the compressor bracket 46 in the manner previously described extends to the left as viewed in FIGURE 2 and is then provided with a downwardly extending portion 56 immediately behind the motor 26 and a bottom portion 57 that extends forwardly beneath the shroud 28. The forward end 58 terminates adjacent the outer convolution 91 of condenser 23 and is welded or otherwise attached to condenser 23 as is shown in FIGURE 11.

The upwardly extending channel portion 56 also serves as a support for the motor 26. This is accomplished by providing a flange 60 struck from the portion 56 and extending toward the motor 26. A similar flange 62 forms a part of one end of a mounting bracket 63, this flange 62 being attached to flange 60 as by screws 61. Mounting bracket 63 has its opposite and arcuate end 64 attached to the lower portion of the motor 26 by screws 65.

As seen in FIGURE 6, an upright flange 95 struck from portion 57 of support channel 47, has a portion 96 of a bracket 97 secured to it. A horizontal portion of bracket 97 is in turn welded or otherwise secured to the lower portion of shroud 28. Additional support is given shroud 28 by shroud support member 98, one end 99 of which is secured at an upper left-hand point 100 of the shroud and an opposite end 101 which is secured at an upper right hand point 102 of the shroud as seen in FIGURE 6. Support member 98 is secured midway along its transverse portion 103 to the motor 26 by screw 104. Thus bracket 47 serves to directly support the motor 26, one end of the condenser 23 and the lower portion of the shroud 28 and further serves to indirectly support the upper portion of the shroud 28 through its connection with the motor.

In order to prevent contact between the shroud 28 and the condenser 23, the shroud is provided with three equally spaced resilient rubber bumpers 66 spaced therearound. As most clearly seen in FIGURE 6, an insulating barrier block 54 is held in position against the shroud 28 by means of small ears 55 that are struck from the shroud. This block 54 is provided to prevent recirculation of air from the exhaust side of the fan which is the right-hand side of FIGURE 2 to the suction side which is the left-hand side of FIGURE 2.

As described previously, the condenser 23 is supported at two points, that is, the lowermost point at each of its ends. As seen in FIGURE 12, a tie clip 105 is attached to the outer convolutions 91 and 106 on the end of the condenser 23 opposite member 31. The helical condenser mounted in this manner is essentially a free spiral spring which is driven by the pressure pulsations of the gas as it flows through the condenser circuit. Thus the spiral spring like condenser causes these pressure pulsations to be dissipated in part by a partial winding and unwinding of the helix. Any residual pulsation which is not entirely dissipated by the winding and unwinding motion will drive the condenser at some natural frequency. If the frequency of the pulsations coincide with the natural frequency of the condenser, the vibration and hence the noise is multiplied. Thus it is desirable to change the natural frequency of the condenser to some value that does not coincide with the dominant pulsation frequency or any of its harmonics. This change in frequency is accomplished by selective placement of the tie clip 105 which changes the effective length of the helix.

The opposite ends of the rear rail 30 are attached to a mounting angle 67 by means of bolts 68 or the like extending through the mounting angle 67 and the rear flange 69 of the rail 30. The bolt 68 is isolated from the mounting angle 67 by means of a flexible rubber or the like grommet 70. The other end of the rail 30 is provided with a similar flange 69 and is attached to a mounting angle similar to the angle 67 with a bolt and grommet similar to the bolt 68 and grommet 70.

The front rail 29 engages a mounting angle 71 when in position. On top of the horizontal flange 72 of this angle 71 there is provided a rail stop 73 under which an upper horizontal portion 74 of the front rail 29 slides. A resilient rubber isolating member 75 is arranged between this portion 74 and the stop 73. The other end of the front rail 29 is provided with a similar construction.

As is shown in FIGURE 7, the bottom of the machine

compartment housing **76** is distorted downwardly to provide a plurality of cabinet supporting feet **77**.

The machine compartment **15** is lined with sound deadening material in the form of fiberglass sheets at the back as illustrated at **78**, at the sides as illustrated at **79** and at the bottom **80** as well as the top (not shown). Similarly, both sides of the vertical transverse front wall **17** of the compartment **15** are lined with fiberglass sound deadening sheets **81**. The opposite sides of the center wall **20** are also provided with sheets **82** of sound deadening material while similar sheets **83** and **84** are provided on the opposite side walls of the passages **21** and **22**. In the same manner, the bottom of the passage **22** is provided with a sheet **85** while the top of this passage is provided with a similar sheet (not shown).

In operation, air flows as indicated by the arrows in FIGURE 2 into the left-hand side of the grille **14** as viewed in this figure and into the entrance passage **18** to the left-hand side of the compartment **15**. From this left-hand side the air passes longitudinally between the convolutions of the condenser **23**. From the condenser **23** the air, which of course is moved by the fan **27**, passes through the fan shroud **28**, through the opening **86** in the insulating barrier plate **54**, around the compressor **24**, out the compartment **15** through the other passage **19**, forwardly through the side pasasge **22** and through the right-hand side of grille **14** into the room. The various sheets of sound deadening material make the operation of the unit extremely quiet. Additional sound reduction is obtained by the unique structural arrangement of having the refrigeration unit located in a separate compartment **15** which is disposed to the rear of the cabinet and as far as possible from the grille **14**.

As previously described, the condenser, the fan and the compressor are resiliently mounted horizontally in line on the framework. This arrangement provides a very compact assembly and permits placement of the unit in an area remote from the user whereby the noise level is substantially reduced.

Further noise reduction is obtained by rubber isolating the condenser and fan assembly **23**, **26** and the compressor **24** from their respective support members **31**, **32** and **33** by use of resilient mounts and, in addition, likewise isolating rails **29** and **30** on which members **31**, **32** and **33** are mounted from the cabinet **11**. Thus, any unwanted vibration emanating from the noise producing elements are interrupted and dampened twice before they have a chance to reach the cabinet.

The three point support arrangement of the condenser and fan assembly and the compressor necessitates the use of one common support point. Thus channel **47**, which supports one end of the condenser and fan assembly, and the bracket **46** located on one side of the compressor are mounted at a common point on structural member **32**. Channel **47** is isolated from bracket **46** by grommet **49** and bracket **46** is in turn isolated from member **32** by rubber block **43**. This common point arrangement permits two things to happen. First, it allows the condenser, fan and compressor to have essentially unitary movement in the several planes of vibration. Thus, vibration emanating from either the compressor or the condenser and fan assembly is transmitted from one to the other thus allowing the other component to assist in dampening the vibration prior to its interception by the resilient mounts. Secondly, because of the discontinuity between channel **47** and bracket **46** at grommet **49**, the condenser and fan assembly and the compressor can move independently of one another. For example, torsional vibration of the compressor during start up is not transferred to the condenser and fan assembly but is dissipated instead in rubber blocks **43** and grommet **49**. Further compactness and sound reduced operation is obtained by this in line, three point mounting system.

Having described our invention as related to the embodiment shown in the accompanying drawings, it is our intention that the invention be not limited by any of the

details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

We claim:

1. A refrigeration device including a cabinet, having a front and a back, means in said cabinet forming a machine compartment adjacent said back, and a refrigeration unit in said compartment, said refrigeration unit comprising: a condenser; an air moving means; a compressor; a supporting framework resiliently mounted within said compartment; and spaced mounting means for resiliently supporting said condenser, said air moving means and said compressor horizontally in line on said framework.

2. A refrigeration device including a cabinet having a front and a back, means in said cabinet forming a machine compartment adjacent said back and having a horizontal axis parallel to said back, and a refrigeration unit in said compartment, said refrigeration unit comprising: a supporting framework within said compartment including a first support member, a second support intermediate member and a third support member all transverse to said axis; a condenser; an air moving means, said condenser and said air moving means resiliently supported by said first and second members; and a compressor resiliently supported by said second and third members, said condenser, said air moving means and said compressor all being mounted horizontally in line on said supporting framework.

3. In a refrigeration device, apparatus comprising: a cabinet; means in said cabinet forming a machine compartment; a refrigeration unit within said compartment including a condenser and fan assembly having first and second ends, and a compressor having first and second mounting brackets; a first mounting member for resiliently supporting said first end of said condenser and fan assembly; a second mounting member for resiliently supporting said first mounting bracket of said compressor; and a third mounting member for resiliently supporting both said second end of said condenser and fan assembly and said second bracket of said compressor, said first, second and third mounting members co-acting to permit essentially unitary vibration of said compressor and said condenser and fan assembly.

4. The refrigeration device of claim 3 wherein said third mounting member includes a resilient mount between said second end and said second bracket thereby providing discontinuity of juncture and precluding transmission of torsional forces between said compressor and said condenser and fan assembly.

5. A refrigeration device including a cabinet, means in said cabinet forming a machine compartment, and a refrigeration unit within said compartment including a helical condenser plate, said condenser plate comprising: a first outer convolution terminating in a free end portion; a second inner convolution connected to and spaced inwardly from said first convolution; support means on said condenser plate for mounting said condenser plate within said compartment; and tie means connecting said free end portion of said outer convolution to said second convolution.

6. A refrigeration device including a cabinet, means in said cabinet forming a machine compartment, and a refrigeration unit within said compartment including a helical condenser plate, said condenser plate comprising: a first outer convolution; a plurality of inner convolutions serially connected to said first convolution and spaced inwardly therefrom; means for supporting said condenser plate within said compartment; and tie means for connecting said outer convolution to one of said plurality of inner convolutions.

7. A refrigeration device including a cabinet, means in said cabinet forming a machine compartment, and a refrigeration unit within said compartment including a helical condenser plate having first and second ends,

said condenser plate comprising: a first outer convolution; a plurality of inner convolutions serially connected to said first convolution and spaced inwardly therefrom; first mounting means for supporting the first end of said condenser at said outer convolution; and second mounting means for supporting the second end of said condenser at said outer convolution.

8. The refrigeration device of claim 7 wherein said outer convolution includes a bottom portion, said first and second mounting means supporting the outer convolution at said bottom portion.

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