Jan. 21, 1936. H. H. BIXLER 2,028,584

REFRIGERATING MACHINE

Filed Jan. 11, 1935

Fig. 2.

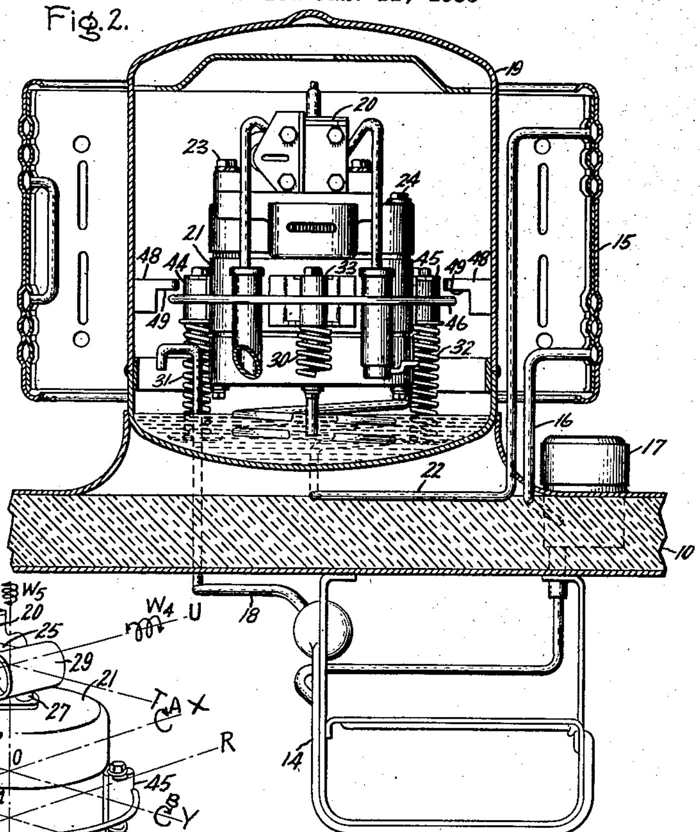


Fig. 3.

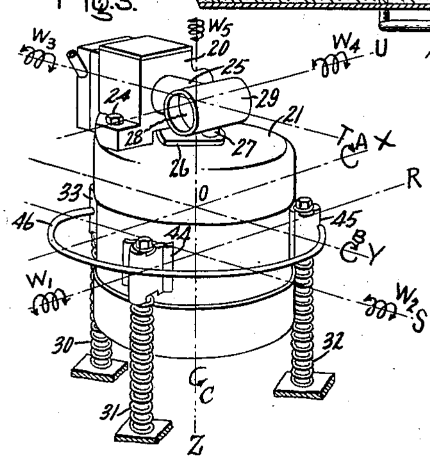


Fig. 1.

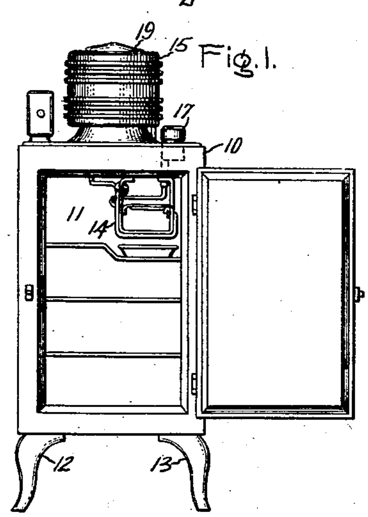


Fig. 5.

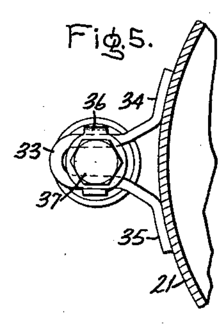
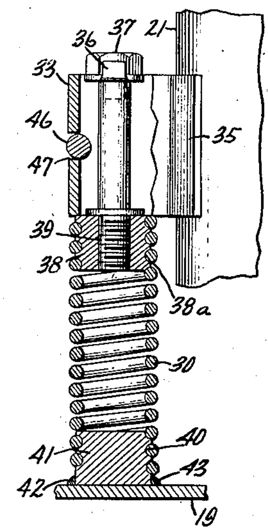


Fig. 4.



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His Attorney.

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2,028,584

REFRIGERATING MACHINE

Harley H. Bixler, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application January 11, 1935, Serial No. 1,338

14 Claims. (Cl. 230—235)

My invention relates to refrigerating machines.

In many refrigerating machines, and particularly in those designed for domestic use, a cabinet is provided having a cooling compartment therein for the preservation of foods or the like. The machine also includes a compressor for compressing gaseous refrigerant and an electric motor or the like for driving the compressor. The compressed refrigerant is liquefied by a suitable condenser and is supplied to an expansion type cooling unit within the cooling compartment. It is desirable that the compressor, motor and condenser all be mounted on the cabinet in order that a portable self-contained machine may be had. It will be understood that the motor driven compressor unit may be mounted either on top of the cabinet, in a machinery compartment in the lower part thereof, or in any other suitable location therein. The mounting of the motor and compressor on the cabinet presents special difficulties in connection with the minimizing of vibrations produced thereby. The parts of the motor and compressor moving at relatively high speeds set up vibrations therein and it is necessary that the cabinet should not be similarly vibrated both because of the undesirable noise entailed and because of possible damage to the cabinet and its contents. Since the cabinet is ordinarily quite heavy, as well as comparatively rigid in a vertical direction, vertical forces applied thereto due to the vibration of the motor and compressor are of little or no consequence but special precautions must be taken to avoid the application of horizontal vibrational forces to the cabinet. The transmission of horizontal forces is particularly undesirable since the cabinet is usually mounted on a smooth or even slippery floor surface and lateral vibration of the cabinet might cause it to "walk" about the floor.

It is frequently desirable to combine the motor and compressor into a unitary structure in order to simplify the connections therebetween and to otherwise reduce the number of parts required for their construction. Such a unitary structural arrangement introduces peculiar difficulties, however, in the matter of transmission of vibrations since there are several reciprocatory, as well as rotary, parts contained in the same structure and the weight distribution is also usually unsymmetrical.

It is an object of my invention to provide a refrigerating machine of the type described having a motor and a compressor mounted as a unitary structure thereon in such a manner that a minimum amount of horizontal vibration is transmitted therefrom to the remainder of the machine.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawing in which Fig. 1 is a front elevation of a refrigerating machine embodying my invention; Fig. 2 is a sectional view of a portion of the refrigerating machine shown in Fig. 1; Fig. 3 is a schematic representation of the unitary compressor and motor and the mounting therefor, included in the refrigerating machine shown in Fig. 2; Fig. 4 is a fragmentary view, partly in section, of one of the resilient supports included in the refrigerating machine shown in Fig. 2, and Fig. 5 is a plan view of the resilient support shown in Fig. 4.

Referring to the drawing, in Fig. 1 I have shown a refrigerating machine having a cabinet 10 provided with a cooling compartment 11, the cabinet 10 being supported on legs 12 and 13. The cabinet 10 is preferably provided with an outer steel shell and an inner steel shell lining for the cooling compartment 11, the inner and outer shells being separated by heat insulating material in the usual manner. A comparatively heavy structure is thus provided which is rigid in a vertical direction. The comparatively light legs 12 and 13 cause it to be less rigid in a horizontal direction. The cooling compartment 11 is cooled by an evaporator 14 which is supplied with liquid refrigerant from a condenser 15 through a conduit 16 and a flow controlling float valve 17. The liquid refrigerant supplied to the evaporator 14 is vaporized therein by the absorption of heat from articles contained in the compartment 11 and the vaporized refrigerant is returned therefrom through a suction conduit 18 to the interior of an hermetically sealed casing 10. The gaseous refrigerant in the casing 19 is compressed by a compressor 20 of the Scotch yoke type which is driven by an electric motor 21. Although a compressor of this type has many advantages adapting it for use in refrigerating machines, the inherent unbalance of its moving parts makes it particularly difficult to mount in such a manner that undesirable vibrations will not be transmitted therefrom. The compressed gaseous refrigerant passes from the compressor 20 through a conduit 22 to the air-cooled condenser 15. The operation of the refrigerating system need not be described in detail here since it forms no part of my present invention.

I have provided an arrangement for supporting the compressor 20 and motor 21 in such manner that a minimum amount of average horizontal force will be transmitted therefrom to the cabinet 10. In the preferred form of my invention, the compressor 20 is mounted on top of the motor 21 being secured thereto as a unitary structure by bolts 23 and 24. Since the cabinet 10 forms a heavy base for the motor 21 and compressor 20 which is relatively rigid in a vertical direction, we may neglect the effect of any vertical forces which may be transmitted to the cabinet 10 as they will have relatively little effect thereon in any case. The mounting for the unitary compressor and motor structure must be so arranged, however, that a minimum amount of horizontal force will be transmitted therefrom to the cabinet 10.

Any body which is capable of unrestrained movement in all directions, whether the body be symmetrical or unsymmetrical, has six normal modes of vibration. By "mode of vibration" is meant a pattern or path of movement through which the body vibrates at a natural frequency, there being a natural frequency for each mode. The frequency for each mode is dependent upon the distribution of mass in the body and upon the characteristics of its mounting as is the mode of vibration itself. Each of these modes of vibration is independent of every other mode of vibration in that the body will vibrate freely in any one particular mode, the exactly appropriate initial displacing force having been applied thereto to initiate such vibration, and while so vibrating will have no tendency to vibrate in any of the other modes. For purposes of analysis, these modes of vibration may conveniently be referred to a series of coordinates illustrated in Fig. 3. As will be seen from an inspection of Fig. 3, these coordinates include the three axes X, Y and Z, each of which is located at right angles with respect to the others at an arbitrary point of origin "o" which in the present instance is at approximately the center of gravity of the unitary structure. The other three coordinates are the arrows A, B and C which indicate rotary movement about the axes X, Y and Z, respectively. Any movement of the motor and compressor shown in Fig. 3 can be analyzed in terms of rectilinear movement along the axes X, Y and Z and in an angular movement about the same axes, the six coordinates thus entailed being the minimum number of coordinates to which any general movement of the compressor and motor can be reduced. Consequently, the six normal modes of vibration of the compressor and motor can be expressed in terms of the coordinates shown in Fig. 3.

In the case of a symmetrical body each normal mode of vibration thereof is either a rotational movement in a plane about some single axis (not necessarily one of the arbitrary reference axes chosen, of course) or reciprocatory movement along some straight line axis. In the case of an unsymmetrical body, however, the normal modes of vibration are more complicated in that each one consists of simultaneous rotary movement about, as well as rectilinear movement along, some fixed axis, that is, a screw motion along an axis.

In the case of the motor 21 and compressor 20 shown in Fig. 3, the axes of five of its normal modes of vibration are indicated by R, S, T, U and Z, respectively, the reference axis Z having been chosen coincident with the axis of one mode of vibration. The vibratory screw motion of the unitary compressor and motor structure in five of its modes of vibration about the axes R, S, T, U and Z, is indicated by the arrows ω_1, ω_2, ω_3, ω_4, and ω_5, respectively. The axis of the sixth mode of vibration of the unitary structure illustrated is approximately in the plane of the axis R and is displaced a relatively long distance to one side thereof. In the case of a symmetrical body, the axis of the sixth mode of vibration would be at an infinite distance from the body; that is, the motion in the sixth mode would be purely rectilinear along a vertical axis through the body. It will be understood that in a practical case, the motion of any body which is resiliently mounted is in part determined by the position and form of the resilient mounting itself, that is the motion is in part determined by the point or points at which the resilient mounting acts on the body and the elastic characteristics of the mounting itself. The modes of vibration which are illustrated in Fig. 3 are the modes of vibration of the unitary structure which are in part determined by the resilient mounting therefor which is illustrated, the terms being so used hereinafter. The natural frequency of vibration of the unitary structure about the axes R, S, T, U, Z, and a remote sixth axis may be designated as f_1, f_2, f_3, f_4, f_5, and f_6, respectively. For the particular machine illustrated, f_1 and f_2 are approximately equal and are of about four cycles per second; f_3 and f_4 are approximately equal and are about twelve cycles per second; f_5 is about eight cycles per second and f_6 is about nine cycles per second.

It is important to consider the normal modes of vibration of a body in determining its movement when subjected to forced vibration due to some applied exciting force since its movement as a result of such forced vibration will be in all of the normal modes simultaneously in the general case. The excitation of the body in any particular mode may, however, be modified by varying the relation of the exciting force and the axis of the mode. That is, if the force is applied at the axis it will create no couple about it and hence induce no vibration about it. In the machine illustrated the frequency of the applied force is approximately 30 cycles per second.

In order to determine the proper arrangement of the compressor 20 and motor 21 and its resilient mounting and thus to minimize the horizontal forces transmitted to the cabinet 10, consideration must be given to the ratio of the forces applied to the unitary motor and compressor structure to the forces transmitted to the base. In the case of any resiliently mounted body the ratio of the force transmitted to the base on which the body is mounted to the forces applied thereto may be expressed by the equation:

$$\frac{F_1}{F_2}=\frac{1}{\left(\frac{f_o}{f_a}\right)^2-1}$$

In the above equation F_1 is the force transmitted to the base and F_2 is the force applied to the body; f_o is the frequency of the applied force and f_a is the natural frequency of the mode considered. It will be apparent from an examination of this equation that for any given applied force having a fixed frequency that as the natural frequency of the mode which it excites is decreased the amount of force transmitted to the base is also decreased. Although the natural frequency of the mode of the body may, to some extent, be decreased by changing the resilient characteristic of the mounting, definite limitations are imposed on this method by the resulting lack of stability of the machine if too light a spring is used. A second method, and the one which I prefer, is to design the body and mounting in such manner that the couples causing vibration of the body in the modes having the highest natural frequency are minimized.

The motor 21 and compressor 20 are each subjected to vibratory or periodic displacing forces during their normal operation. That is, the movement of the moving parts of the compressor subject it to certain vibrational forces while the rotation of the rotor and the magnetic forces in the electric circuit of the motor subject it to certain other vibratory forces. Since the compressor 20 and motor 21 are combined in a unitary structure all of these forces act simultaneously on this unitary structure and cause it to vibrate to a greater or lesser degree in all of its six modes simultaneously, that is, to move in all of six paths or patterns of movement at the same time. Since this unitary structure is subjected to such a variety of forces and is so unsymmetrical insofar as weight distribution is concerned, it should be apparent that great care must be exercised in analyzing the complicated resultant vibratory movement of the unitary structure as a whole.

As pointed out above, the use of a relatively heavy and rigid cabinet 10 which forms the base of the unitary motor and compressor structure makes it unnecessary to design the mounting to minimize vertical vibratory forces. Since the motor 21 is arranged with its driving shaft extending in a vertical direction, if its rotor is properly balanced by making it symmetrical the motor will impart very small, if any, horizontal vibratory forces to the structure about the axis Z. The principal sources of horizontal force occurring during the operation of the machine are the reciprocatory piston which moves in the cylinder 25 of the compressor 20 and the counterweight 26 which rotates with the crank shaft 27 of the compressor 20. The crank shaft 27 is driven by the motor 21 and reciprocates the slide 28 in the yoke 29 of the compressor 20. Such compressors of the Scotch yoke type are well known in the art and need not be described here in further detail. In accordance with my invention I position the resilient mounting at a sufficient vertical distance from the moving parts of the compressor 20 that the axes of the normal modes of vibration of said unitary structure on said resilient mounting having relatively high natural frequencies lie in the region of the displacing forces exerted by said moving parts. That is, the points or region of attachment of the vertical helical compression springs 30, 31 and 32 are positioned at such a distance from the piston and counterweight of the compressor 20 that the axes T and U are in the region of the lines of movement of piston and counterweight. Also, in the preferred form of my invention the resilient mounting for the unitary compressor and motor structure is so positioned with respect to the latter that the axes R and S will be approximately in the plane of attachment of the resilient mounting, this plane being below the moving parts of compressor 20 in the illustrative form of my invention. It will be understood that as the points or region of attachment of the springs 30, 31 and 32 are varied the axes of the several modes of vibration will also be displaced in different directions. The advantages of the mounting, which I have provided, which causes the axes of the several modes of vibration to fall in the positions noted will be apparent from an analysis of the effects of the forces caused by the various moving parts of the machine during its normal operation, particularly the piston and counterweight.

Since the piston in the cylinder 20 and the counterweight 26 are closely adjacent to the axes T and U, the forces set up by the piston and counterweight will cause very small, if any, couples to be set up about these axes, the lever arms between the forces and the axes being small. As a consequence, the excitation of the unitary structure in the modes ω_3 and ω_4 is very small. As was pointed out above, this condition is desirable since the ratio of forces applied to the forces transmitted to the base increases as the natural frequency of the mode increases. Since the excitation of the modes ω_3 and ω_4 which have a relatively high frequency has been minimized, the forces transmitted to the base 10, due to the vibration of the unitary structure will also be minimized. Although the forces set up by the movement of the piston in the cylinder 20 and the counterweight 26 will set up couples about the axes R and S causing the unitary structure to vibrate at the modes ω_1 and ω_2, the latter modes are of relatively low frequency and hence only a small proportion of the force applied will be transmitted to the cabinet 10 due to vibration of the unitary structure in these modes. Also since the springs 30, 31 and 32 are attached to the periphery of the motor 21 in approximately the plane of the axes R and S, the amplitude of horizontal vibration of the unitary structure in this plane will be a minimum in so far as the modes ω_1 and ω_2 are concerned and thus the horizontal force exerted on the mounting due to vibration in the modes ω_1 and ω_2 will also be a minimum.

The details of the construction by means of which the vertical helical compression spring 30 is attached to the side of the frame of a motor 21 are best shown in Figs. 4 and 5. A V-shaped foot 33 is welded along the surface 34 and 35 to the side of the motor 21. A bridging piece 36 extends across the top of foot 33 and a bolt 37 passing downwardly through an aperture in the bridging piece 36 is in threaded engagement with a block 38. The spring 30 is secured to the block 38 by a helical groove 38*a* formed in the surface of the block 38. The block 38 is of a greater diameter than the width of the opening in the foot 33, and as a consequence when the bolt 37 is screwed tightly into the threaded aperture 39 in the block 38, the top of the spring 30 is held firmly against the bottom of the foot 33. The lower end of the spring 30 is placed in a helical groove 40 formed in the surface of a lower supporting block 41, the block 41 being welded to the casing 19 as indicated at points 42 and 43. The supporting springs 31 and 32 are similarly secured to feet 44 and 45, respectively. The springs 30, 31 and 32 are equally spaced about the periphery of the motor 21 at intervals of approximately 120° in order to provide a symmetrical three point mounting. I prefer to use a three point mounting because of its inherent stability.

A bumper ring 46 surrounds the feet 33, 44 and 45. As shown in Fig. 4, the ring 46 fits in a notch 47 cut in the outer end of the foot 33. The ring 46 is snapped into similar notches provided in the outer sides of the feet 44 and 45. A series of stops 48 are provided in the casing 19, which are welded to the inner side wall of the casing 19. As shown in Fig. 2, a notch 49 is cut in the lower side of each of the stops 48. These stops 48 serve to limit the vertical movement of the unitary compressor and motor structure beyond a predetermined limit. This arrangement is also particularly useful in limiting the movement of the motor 21 and compressor 20 within the casing 19 when the machine is being shipped from one place to another.

While I have shown a particular embodiment of my invention in connection with a compression refrigerating machine, I do not desire my invention to be limited to the particular construction shown and described, and I intend in the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A refrigerating machine comprising a heavy, rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a motor and a compressor assembled as a unitary structure, said unitary structure including a plurality of moving parts exerting horizontal displacing forces thereon during the normal operation of said machine, and resilient means attached to said unitary structure for supporting the same on said base, the region of attachment of said resilient means to said unitary structure being positioned at a sufficient vertical distance below said moving parts and said resilient means having such elastic characteristics that the horizontal axes of the normal modes of vibration of said unitary structure on said resilient means having relatively high natural frequencies lie in the region of said displacing forces in order to minimize the horizontal force transmitted to said base.

2. A refrigerating machine comprising a heavy, rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a motor and a compressor assembled as a unitary structure, said unitary structure including a plurality of moving parts exerting horizontal displacing forces thereon during the normal operation of said machine, and resilient means attached to said unitary structure for supporting the same on said base, said unitary structure having a plurality of normal modes of vibration on said resilient means about a plurality of horizontal axes, the region of attachment of said resilient means to said unitary structure being located in the region of the horizontal axes of the normal modes of vibration having relatively low natural frequencies and at a sufficient vertical distance below said moving parts and said resilient means having such elastic characteristics that the horizontal axes of the modes of vibration having relatively high natural frequencies lie in the region of said displacing forces.

3. A refrigerating machine comprising a heavy, rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a motor and a compressor assembled as a unitary structure, said unitary structure including a plurality of moving parts exerting horizontal displacing forces thereon during the normal operation of said machine, and resilient means including a plurality of compression springs attached to said unitary structure for supporting the same on said base, the region of attachment of said resilient means to said unitary structure being positioned at a sufficient vertical distance below said moving parts and said resilient means having such elastic characteristics that the horizontal axes of the normal modes of vibration of said unitary structure on said resilient means having relatively high natural frequencies lie in the region of said displacing forces in order to minimize the horizontal force transmitted to said base.

4. A refrigerating machine comprising a heavy, rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a motor and a compressor assembled as a unitary structure, said unitary structure including a plurality of moving parts exerting horizontal displacing forces thereon during the normal operation of said machine, and resilient means including three helical compression springs attached at spaced intervals to said unitary structure for supporting the same on said base, said unitary structure having a plurality of modes of vibration on said resilient means about a plurality of horizontal axes, said resilient means being attached to said unitary structure in the region of the horizontal axes of the normal modes of vibration having relatively low natural frequencies and at a sufficient vertical distance below said moving parts and said compression springs having such elastic characteristics that the horizontal axes of the modes of vibration having relatively high natural frequencies lie in the region of said displacing forces.

5. A refrigerating machine comprising a heavy, rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a compressor, a motor for driving said compressor, said compressor being mounted on the top of said motor as a unitary structure, and resilient means attached to said unitary structure for supporting the same on said base, the region of attachment of said resilient means to said unitary structure being positioned at a sufficient vertical distance from said moving parts and said resilient means having such elastic characteristics that the horizontal axes of the normal modes of vibration of said unitary structure on said resilient means having relatively high natural frequencies lie in the region of said displacing forces in order to minimize the horizontal force transmitted to said base.

6. A refrigerating machine comprising a heavy, rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a motor having a vertically extending shaft, a compressor of the Scotch yoke type mounted on the top of said motor as a unitary structure and driven by said shaft, said compressor including a plurality of moving parts exerting horizontal displacing forces in said unitary structure during the normal operation of said machine, and resilient means attached to said unitary structure for supporting the same on said base, the region of attachment of said resilient means to said unitary structure being positioned at a sufficient vertical distance below said moving parts and said resilient means having such elastic characteristics that the horizontal axes of the normal modes of vibration of said unitary structure on said resilient means having relatively high natural frequencies lie in the region of said displacing forces in order to minimize the horizontal force transmitted to said base.

7. A refrigerating machine comprising a heavy,

rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a motor having a vertically extending shaft, a compressor of the Scotch yoke type mounted on the top of said motor as a unitary structure and driven by said shaft, said compressor including a plurality of moving parts exerting horizontal displacing forces on said unitary structure during the normal operation of said machine, and resilient means including three helical compression springs attached to said unitary structure for supporting the same on said base, said unitary structure having a plurality of modes of vibration on said resilient means about a plurality of horizontal axes, the points of attachment of said resilient means to said unitary structure being positioned in the region of the horizontal axes of the normal modes of vibration having relatively low natural frequencies and at a sufficient vertical distance below said moving parts and said compression springs having such elastic characteristics that the horizontal axes of the modes of vibration having relatively high natural frequencies lie in the region of said displacing forces.

8. A refrigerating machine comprising a heavy, rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a motor having a vertically extending shaft, a compressor mounted as a unitary structure on the top of said motor, said compressor being provided with a horizontally reciprocating piston and a counterweight rotating about a vertical axis, said piston and said counterweight being driven by said shaft, said piston and said counterweight exerting horizontal displacing forces on said unitary structure during normal operation of said machine, and resilient means attached to said unitary structure for supporting the same on said base, the region of attachment of said resilient means to said unitary structure being positioned at a sufficient vertical distance below said piston and counterweight and said resilient means having such elastic characteristics that the horizontal axes of the normal modes of vibration of said unitary structure on said resilient means having relatively high natural frequencies lie in the region of said displacing forces in order to minimize the horizontal force transmitted to said base.

9. A refrigerating machine comprising a heavy, rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a motor having a vertically extending shaft, a compressor mounted as a unitary structure on the top of said motor, said compressor being provided with a horizontally reciprocating piston and a counterweight rotating about a vertical axis, said piston and said counterweight being driven by said shaft, said piston and counterweight exerting horizontal displacing forces on said unitary structure during the normal operation of said machine, and resilient means attached to said unitary structure for supporting the same on said base, said unitary structure having a plurality of modes of vibration on said resilient means about a plurality of horizontal axes, the region of attachment of said resilient means to said unitary structure being positioned in the region of the horizontal axes of the normal modes of vibration having relatively low natural frequencies and at a sufficient vertical distance below said piston and counterweight and said resilient means having such elastic characteristics that the horizontal axes of the modes of vibration having relatively high natural frequencies lie in the region of said displacing forces.

10. A refrigerating machine comprising a heavy, rigid cabinet containing a cooling compartment, said cabinet being relatively unresponsive to vertical forces tending to move said cabinet in a vertical direction, a motor and a compressor assembled as a unitary structure, said unitary structure including a plurality of moving parts exerting horizontal displacing forces thereon during the normal operation of said machine, and resilient means attached to said unitary structure for supporting the same on said cabinet, said unitary structure having a plurality of modes of vibration on said resilient means about a plurality of horizontal axes, the region of attachment of said resilient means to said unitary structure being positioned in the region of the horizontal axes of the normal modes of vibration having relatively low natural frequencies and at a sufficient vertical distance below said moving parts and said resilient means having such elastic characteristics that the horizontal axes of the modes of vibration having relatively high natural frequencies lie in the region of said displacing forces.

11. A refrigerating machine comprising a heavy, rigid cabinet containing a cooling compartment, said cabinet being relatively unresponsive to vertical forces tending to move said cabinet in a vertical direction, a motor having a vertically extending shaft, a compressor mounted as a unitary structure on the top of said motor, said compressor being provided with a horizontally reciprocating piston and a counterweight being driven by said shaft, said piston and counterweight exerting horizontal displacing forces on said unitary structure during the normal operation of said machine, and resilient means including three vertical helical compression springs attached to said unitary structure for supporting the same on said cabinet, the region of attachment of said resilient means to said unitary structure being positioned at a sufficient vertical distance from said piston and counterweight and said compression springs having such elastic characteristics that the horizontal axes of the normal modes of vibration of said unitary structure on said resilient means having relatively high natural frequencies lie in the region of said displacing forces in order to minimize the horizontal force transmitted to said cabinet.

12. A refrigerating machine comprising a heavy, rigid base which is relatively unresponsive to vertical forces tending to move said base in a vertical direction, a motor having a vertically extending shaft, a compressor mounted as a unitary structure on the top of said motor, said compressor including a plurality of moving parts exerting horizontal displacing forces on said unitary structure during the normal operation of said machine, and means including a plurality of vertical compression springs secured at spaced intervals to the periphery of said motor for supporting said unitary structure on said base, the tops of said springs lying in a plane slightly below the center of gravity of said unitary structure.

13. A refrigerating machine comprising a motor and a compressor assembled as a unitary structure, a casing surrounding said unitary structure, a bumper ring secured to and surrounding said unitary structure in a horizontal plane, and means including a plurality of stops secured to

the inner side walls of said casing for engaging said bumper ring to limit the vertical movement of said unitary structure in said casing.

14. A motor having a vertically extending frame, a vertical helical compression spring, a block secured to the top of said spring, and means for mounting said motor on said spring, said means including a V-shaped foot secured to the side of said frame and a bolt passing downwardly through the open portion of said foot and engaging said block.

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