June 8, 1965 K. KJELDSEN 3,187,995

CAPSULE FOR REFRIGERATING MACHINES

Filed Aug. 27, 1962

FIG. 1

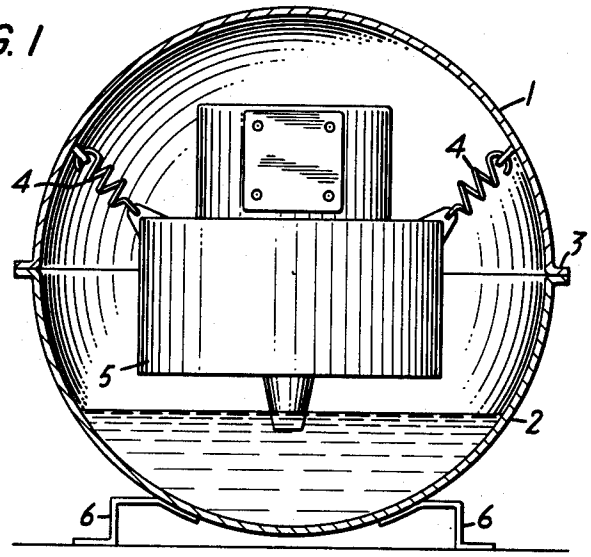
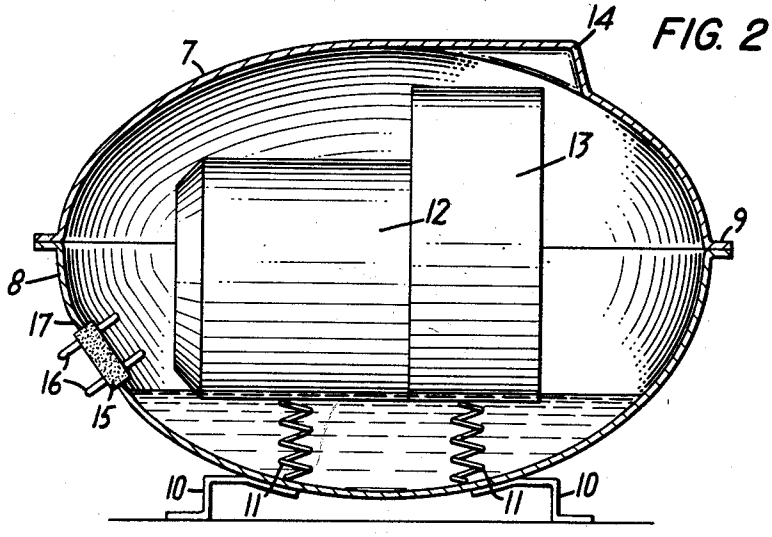


FIG. 2



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CAPSULE FOR REFRIGERATING MACHINES

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This invention relates to capsule-enclosed refrigerating machines and is more particularly concerned with machines of the character indicated which are constructed for increased noise reduction.

In constructing modern refrigerating machines, one of the most important objects of the builder is to achieve an effective noise reduction. In order to achieve this object, it has been proposed to control the noise at its point of origin, for example by using suction- and pressure-mufflers for reduction of the noise originating in the gaseous refrigerant, by using the largest possible stationary core in the electric motor in order to reduce motor noise, by balancing the driving shaft which is acted upon by an eccentric crank, and the like.

It has been assumed that the capsule, necessary for a hermeticaly-sealed refrigerating machine, contributes in reducing the noise because it surrounds completely the noise source. In order to avoid transfer of vibrations by direct transmission to the capsule and then emitted from the capsule to the surrounding air as noise, the compressor aggregates have been spring mounted inside the capsule, thus making it possible to reduce the proportion of vibrations which reach the capsule.

The capsules of hermetically-sealed refrigerating machines have heretofore been generally formed from cylindrical bodies having flattened bottoms and tops or covers. In most cases, the capsule has been provided with various bulged portions in order to accommodate the machine aggregate inside the capsule.

It is an object of this invention to provide a capsule construction for a hermetically-sealed refrigerating machine which is effective to reduce noise transmission.

The basic idea of the invention is that a supplemental noise repression is obtained by adapting the capsule acoustically to the working conditions. According to the invention, this is possible because the noise frequency of the capsule proper is outside the noise frequency of the internal machine aggregate. In this sense, I mean by noise frequencies not only distinct noise frequencies but also their alien frequencies, as well as intermodulation frequencies which may have an influence on the vibrating conditions of the capsule.

According to the invention, the capsule is considered as a noise transmitter which, however, is largely mistuned in relation to the vibration source located inside the capsule, viz. the internal machine aggregate. Although the desire for a low noise level in the case of refrigerating machine has existed for a long time, persons skilled in this art have not heretofore considered the possibilities of the acoustical adaption of the capsule proper.

It is possible to achieve this result by using a well-known technique in which the frequency resonant through a reinforcement of the capsule is diverted to such a high level that it is above all possible audible noise frequencies. The usual means for employing this technique, viz. the use of a thicker material or the insertion of reinforcement pieces, however, cannot normally be used commercially owing to substantially increased cost and production difficulties. In accordance with the invention, the desired result is achieved by providing the major portion, and generally substantially all, of the capsule wall with a double curvature.

In particular, bodies having a double curvature and the fewest natural or resonant frequencies are advantageous.

In bodies having only a few, or perhaps only one single resonant frequency, it is easy to establish this frequency outside the noise frequency. Known capsules, on the contrary, normally have two or more resonant frequencies, viz. the basic frequency and its alien frequencies or harmonics.

One of the preferred capsule constructions in accordance with this invention, is a ball or sphere, which will only "breath" or "pulsate." Furthermore, the ball has a large damping of its own, thus considerably reducing noise transmission to the surrounding air.

Another advantageous construction is the ellipsoid which has almost all of the advantages of the ball or sphere and, because of its ellipticail form, has a more useful volume for a given refrigerator design. In practice, slight deviations from a pure mathematical sphere or ellipsoid structure are permissible, for example by flattening slightly the area where the pressure-tight insulation and the electrical terminals are located. These slight deviations have been found not to adversely affect the result because it has been established that even radical deviations from the pure mathematical form, for instance ovoid- or walnut-shaped forms, give in actual practice good results. Also, minor bulges, for example for the adaption of the cylinder head, or the replacement of the double curved areas by many plane areas touching each other still give the desired advantages and, therefore, do not deviate from the basic principles of this invention.

Further characteristics of the invention will appear from the following detailed description of two illustrative embodiments, taken in connection with the drawing embodiments, taken in connection with the drawing wherein,

FIG. 1 is a cross-sectional view of a sphere-shaped capsule containing a refrigerating machine aggregate and embodying features of the present invention; and

FIG. 2 is a longitudinal-sectional view of a modified form having an elliptical capsule.

In FIG. 1, the capsule comprises two hemispheres 1 and 2 connected to each other by means of a circular welded seam 3. Inside the capsule, the motor compressor is mounted in conventional manner by means of springs 4. The lower portion of hemisphere 2 is provided with supports 6.

In FIG. 2, the upper and the lower portions of the capsule each consists of two elliptical halves 7 and 8 welded together along the elliptical edge 9. As in the case of the construction of FIG. 1, the lower half of the capsule is provided with supports 10. Inside the capsule, the motor 12, onto which the compressor 13 is fixed, rests on the springs 11. The upper half 7 of the capsule deviates from a pure elliptical form by having a flattening 14 to ensure the free movements of the compressor 13.

The lower half is flattened slightly at 17 in order to accommodate the pressure-tightening insulation 15 containing the electrical terminal device 16.

Various materials of construction can be used for making the capsule of this invention, as will be apparent to persons skilled in the art, and known manufacturing techniques, e.g. pressing or stamping, are suitably employed. Typical materials of construction include iron plates or sheets.

Although shown diagrammatically in the drawing, the motor and the compressor, and the spring suspension, per se are not part of the present invention and they can be of conventional construction. A typical motor compressor in connection with which the capsule of the present invention can be used is described, for example, in U.S. Patent No. 2,312,596. The motor and compressor can also be, for example, of the construction shown in co-pending application, Serial No. 173,847 filed November

13, 1961, and in co-pending application, Serial No. 176,464 filed November 27, 1961.

It will also be understood that various changes and modifications may be made in the embodiments described above and illustrated in the drawing without departing from the scope of the invention as defined in the appended claims.

It is intended, therefore, that all matter contained in the foregoing description and in the drawing shall be interpreted as illustrative only and not as limiative of the invention.

I claim:

1. A hermetic refrigeration unit comprising, a refrigeration compressor, a capsule completely enclosing said compressor for reducing noise transmitted from said compressor to its surroundings, said capsule having a double curvature wall configuration effective for said capsule to have a natural resonant frequency different than audio frequencies and harmonic frequencies transmitted from said compressor, said capsule having an ellipsoid configuration, and elastic means mounting said compressor internally of said capsule, whereby noise transmission from said compressor is reduced.

2. A hermetic refrigeration unit comprising, a refrigeration compressor, a capsule completely enclosing said compressor for reducing noise transmitted from said compressor to its surroundings, said capsule having a double curvature wall configuration effective for said capsule to have a natural resonant frequency different than audio frequencies and harmonic frequencies transmitted from said compressor, said capsule having a spherical configuration, and elastic means mounting said compressor internally of said capsule for vibratory movement relative to the interior of said capsule, whereby noise transmission from said compressor is reduced.

3. A hermetic refrigeration unit comprising, a refrigeration compressor, a capsule completely enclosing said compressor for reducing noise transmitted from said compressor to its surroundings, said capsule having a double curvature wall configuration effective for said capsule to have a natural resonant frequency different than audio frequencies and harmonic frequencies emitted from said compressor, said capsule having an elliptical configuration, and elastic means mounting said compressor internally of said capsule for vibratory movement relative to the interior of said capsule, whereby noise transmission from said compressor is reduced.

4. A hermetic refrigeration unit comprising, a refrigeration compressor, a capsule completely enclosing said compressor for reducing noise transmitted from said compressor to its surroundings, said capsule having a double curvature wall configuration effective for said capsule to have a natural resonant frequency lower than noise-making audio frequencies and harmonic frequencies thereof transmitted from said compressor in operation, said capsule having an ellipsoid configuration, and elastic means mounting said compressor internally of said capsule, whereby noise transmission from said compressor is damped.

5. A hermetic refrigeration unit comprising, a refrigeration compressor, a capsule completely enclosing said compressor for reducing noise transmitted from said compressor to its surroundings, said capsule having a natural resonant frequency different than audio frequencies and harmonic frequencies transmitted from said compressor, said capsule having an ellipsoidal configuration, and elastic means mounting said compressor internally of said capsule, whereby said capsule is detuned relative to said compressor and noise transmission from said compressor is reduced.

References Cited by the Examiner

UNITED STATES PATENTS

2,297,475	9/42	Hintze et al.	62—296 X
2,581,902	1/52	Bodine.	
2,690,652	10/54	Teeter et al.	230—232 X
2,772,047	11/56	Sonnberger	230—235

FOREIGN PATENTS

992,706	7/51	France.
543,791	3/56	Italy.

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