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(54) NOISE ABSORBING COMPOSITE FOR THE SUSPENSION SYSTEM OF COMPRESSORS, MOTORS AND SIMILAR APPARATUS

GERÄUSCHABSORBIERENDE ZUSAMMENSETZUNG FÜR DAS AUFHÄNGUNGSSYSTEM VON KOMPRESSOREN, MOTOREN UND ÄHNLICHEM

MATERIAU COMPOSITE AMORTISSEUR DE BRUIT POUR LE SYSTEME DE SUSPENSION DE COMPRESSEURS, MOTEURS ET APPAREILS SIMILAIRES

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Description

Technical Field

The present invention refers to a noise absorbing composite, which is chemically and physically resistant, for a suspension system usually employed in compressors, motors or any other similar apparatus of hermetic construction, which functioning causes vibrations, associated with undesirable high frequency noises. Said material is particularly applied in reciprocating hermetic compressors used in refrigerating units.

Background of the Invention

Reciprocating hermetic compressors are conventionally provided with a suspension system, which uses springs or other adequate means to insulate the vibrations of the motor-pump assembly from its hermetic case. In the known constructions, the hermetic compressor presents its motor-pump assembly fastened through suspension metallic springs, which are attached to the upper portion of the compressor case and which functions under tension, or through supporting springs, which are attached under compression to the base of the case.

In both conditions, though in different intensities, vibrations are transmitted from the motor-pump assembly to the compressor case, longitudinally through the springs, the latter presenting resonant frequencies of longitudinal propagation which, when excited, cause high frequency noises that are extremely uncomfortable to the human ear.

In order to eliminate such noises, sound-absorbing systems were developed, by applying elastomeric materials to the suspension springs, said materials substantially reducing such resonances of the suspension elements, as described, for example, in the German Patent Application DE 1.813.622 of Robert Bosch Hausgerate GmbH.

It should be observed that, due to the fact that the compressor presents very high internal temperatures, usually higher than 120°C (248°F); due to the fact that the suspension springs experiment temperatures higher than 200°C (392°F), due to heat absortion/transmission during the welding of the compressor cover to the case; and also due to the presence of lubricant oil of the compressor, associated with vapors of products existing in such temperatures, it is necessary that the applied sound-absorbing material presents physical and chemical resistance, in order to maintain its dimensional, mechanical and chemical characteristics during all the useful life of the compressor, since the hermetic construction of said compressor does not justify its opening for eventual repairs or replacement of components, such as the sound-absorbing material. However, the sound-absorbing elastomeric systems of the state of the art do not present such characteristics of physical and chemical resistance, and undesirable high frequency noises are often present substantially soon in their useful lives, due to thermal and/or chemical decomposition and/or deformations in the noise absorbing means which are used.

Besides having low physical and chemical resistance, the known elastomeric systems present limited sound-absorbing capacity, according to assays carried out by the inventor of the present invention with several known products, such as: acrylic-ethylene copolymers, halogenated hydrocarbons, butadienes and acrylonitrilebutadienes in suspension components having the same geometry, in which the values obtained for the total reduction of noise in the compressor were of about 1-3 decibels.

Disclosure of the Invention

Thus, it is the general object of the present invention to provide a noise absorbing composite for the suspension system of compressors, motors and other similar devices which present undesirable high frequency noises under operation.

It is a particular object of the present invention to provide a noise absorbing composite for the suspension system of reciprocating hermetic compressors used in refrigerating units, presenting high physical and chemical resistance and maintaining adequate mechanical and dimensional characteristics, even in chemically aggressive environment and at high temperatures.

It is still an object of the present invention to provide a noise absorbing composite, as described above, which maintains its sound-absorbing properties during the whole useful life of the compressor.

It is a further object of the present invention to provide a noise absorbing composite, as described above, which presents a high level of sound-absorbing capacity.

These and other objectives and advantages of the present invention are achieved through the provision of a noise absorbing composite for the suspension system of a reciprocating hermetic compressor, said suspension system being of the type defined by metallic helical springs, which interconnect the fixed case of a hermetic compressor with its motor-pump assembly, usually with undesirable high frequency noises, said noise-absorbing composite being defined by a portion of a viscoelastic material, in close and permanent contact with a substantial portion of said spring surface, said viscoelastic material at least comprising:

- a main elastomeric portion, defined by 100 parts of a compound, which is selected from the group consisting of: polysiloxanes, tetracyclosiloxanes, pentacyclosiloxanes or mixtures thereof;
- a portion of vulcanization, defined from 0.2 to 6.0 phr of a compound selected from the group consisting of: di-cumile peroxide; 2.5-bis (ter-butyl) peroxide; 2.5 dimethylhexane, or mixtures thereof.

In practical terms, the utilization of the proposed ma-

terial is a resource for considerably improving the quality of a refrigerating unit, in a low cost, as well as contributing to improve the environmental conditions, by eliminating undesirable noises.

Brief Description of the Drawings

The application of the invention will be illustrated below, in a non-restrictive way, through the attached drawings, in which:

Fig. 1 illustrates, schematically, a lateral elevational view of a reciprocating hermetic compressor, in which the motor-pump assembly is attached to the case through suspension metallic springs under tension;

Fig. 2 shows a similar view of fig.1, but with the motor-pump assembly attached to the case through supporting metallic springs under compression;

Fig. 3 is a diametral longitudinal section view of an absorbing element in the form of an elongated plug of cylindrical shape, which can be fitted within a suspension or a supporting spring and which is provided with an axial bore, in order to receive an expander, thereby increasing its radial compression against the spring; and

Fig. 4 illustrates a diametral longitudinal section view of a suspension or supporting metallic helical spring, whose coils are all internally covered with an absorbing element, which is substantially cylindrical and adapted within the spring.

Best Mode of Carrying out the Invention

According to figures 1 and 2, the suspension system of the motor-pump assembly 1 in the case 2 of a reciprocating hermetic compressor may present two basic constructive dispositions: suspension metallic springs 3A, which are attached to the upper part of the case 2 of the compressor and which operate under tension; and supporting metallic springs 3B, which are attached under compression to the base of the case 2. In figure 1, i.e., in the first type of construction, it can be observed that the suspension springs 3A are attached to the case 2, through supporting means 5 welded to the upper part of said case. When a cover 4 is being welded to the case 2, heat is transmitted to the inside of the compressor, in such an amount that the suspension springs 3A reach temperatures up to 200°C (392°F), during a period of time approximately the same as that of the welding operation, i.e., of about 15 seconds.

In figure 2, which corresponds to the second type of construction, it can be seen that a predominant portion of the supporting springs 3B is permanently immersed in lubricant oil 6, which can be mineral or synthetic and whose chemical material usually presents highly aggressive components for most elastomeric materials in the form of organic compounds, whether they are hydrogenated or non-hydrogenated, and/or sulphonated or non-sulphonated, or others.

Besides what has been mentioned above, and further considering that the reciprocating hermetic compressor for refrigerating units operate, in some applications, under temperatures up to 120°C (248°F), when vapors resulting from the decomposition of the lubricant oil are produced, we learn that the material of the sound-absorbing material for the suspension of the motor-pump assembly should present high thermal and physical resistance, as well as maintain a substantial dimensional constancy, notwithstanding the adversities to which said material will be subjected during the whole useful life of the compressor.

The characteristics established above as necessary, are not however sufficient to adjust the material to the purpose to which it is designated, since said material should present good sound-absorbing capacity of high frequency vibration as a fundamental characteristic.

Experiments have been carried out with elastomers, which are available in the market and which can be useful in the proposed material, such as: acryloethylene copolymers, modified chlorinated and/or fluorinated polyethylenes, butadienes, acrylonitrilebutadienes, among others. Such experiments produced some materials presenting satisfactory thermal resistance and reasonable dimensional constancy. Some materials presenting acceptable chemical resistance were also produced. The reduction of the total noise level in the compressor with such materials were of about 1 to 2 decibels.

The proposed material, besides having remarkable chemical and thermal resistance, under temperatures up to 200°C (392°F), associated with a unique dimensional constancy, allows a reduction in the noise amplitude in the frequency with of 400 to 8,000 Hz, and a total noise reduction in the compressor of about 4 decibels, such characteristics lasting during the whole useful life of the compressor.

According to figure 4, a noise absorbing composite for a suspension system of reciprocating hermetic compressors of the present invention can be applied to a spring, which interconnects the motor-pump assembly 1 of the compressor with the case 2 thereof, said composite having the form of a cylindrical plug 10, which is attached internally to said spring 3, by the simultaneous radial action of the partial fitting of the internal surface of the wire of the spring 3 against the external contact surface of said plug of the sound-absorbing material 10 of the invention, together with a resilient compression of said plug against said spring 3, in order to allow a permanent contact between both surfaces, thus assuring the mutual retention of said spring 3 and plug 10.

In another preferred embodiment, according to figure 3, the noise absorbing composite of the present invention presents the form of an elongated plug 20, of a substantially cylindrical shape, dimensioned to be fitted within the spring 3, with its lateral wall exerting a certain radial compression over the coils of said spring. Such

compression is achieved by the own elasticity of the plug 20, and by the level of compression thereof inside the spring and/or by introducing an expander in an axial bore 21, which is provided on at least one of the ends of said plug 20.

In another non-illustrated embodiment, the noise absorbing composite can present the following alternative forms:

- a tubular element, which externally surrounds the spring coils;
- a split tubular sleeve, which is compressable around said spring;
- a coating, individually surrounding the spring coils; or
- any other form, provided that the material of the proposed material can absorb the high frequency vibrations of the spring coils, thereby minimizing the propagation resonance in this range of frequencies.

The noise absorbing composite for the suspension system of reciprocating hermetic compressors of this invention, which has a substantially viscoelastic consistency, which presents the aforementioned advantages and which can be applied as described above, comprises a main elastomeric portion, defined by 100 parts of a compound consisting of: polysiloxanes, tetracyclosiloxanes, pentacyclosiloxanes or mixtures thereof, said main elastomeric portion preferably comprising 100 parts of a fluorinated polysiloxane. If any alternative compound is used, it will be incorporated in the same amount.

In order to promote the hardening of the main elastomeric portion, a portion of vulcanization is incorporated, defined by 0.2 to 6.0 phr (parts by 100 parts of elastomer) and, preferably, from 0.8 to 1.3 phr of a compound selected from the group consisting of di-cumile, 2.5-bis (ter-butyl) peroxide, 2.5-dimethylhexane, or mixture thereof. In the preferred formulation, the vulcanization portion comprises from 0.8 to 1.3 phr of di-cumile peroxide, with 93 to 99% purity, preferably 99% purity.

A basic viscoelastic material, such as that obtained above, presents a hardness between 20 and 50 shore A, preferably between 30 and 40 shore A, where the maximum hardness corresponds to a maximum specified incorporation of the vulcanization portion in the basic viscoelastic material, and vice-versa. Said basic viscoelastic material actually has the advantages required for the material in question, except for its thermal resistance, which is still unsatisfactory in extreme operational conditions.

In order to be able to support more severe thermal conditions, a thermo-resistant portion shall be incorporated in the basic viscoelastic material, said portion being defined from 0.8 to 1.3 phr of polysiloxanes, whose maximum amount imparts maximum resistance, under high temperatures, to the noise absorbing composite of the present invention, and vice-versa, within the preestablished limits.

As evidenced from the description above, the proposed absorbing composite depends on a specific mixture, within the limits established for each component, for each application of the compressor, being thus determined case by case, due to the range of requirements.

It should also be emphasized that the proposed composite has been described and applied to a reciprocating hermetic compressor, since this is the specific application developed by the inventor. Nevertheless, such application can be employed in motors or any other apparatus requiring the incorporation of a sound-absorbing material with the qualities of the present invention.

Claims

1. Noise absorbing composite for the suspension system of compressors, motors and similar apparatus, which can be used in a suspension system of the type defined by metallic helical springs (3A, 3B), which interconnect a fixed case (2) of an hermetic compressor with its motor-pump assembly (1), the latter being provided with a high frequency vibratory movement, said noise absorbing composite (10) being defined by a portion of viscoelastic material, disposed in close and permanent contact with a substantial portion of the surface of said springs (3A, 3B), characterized in that said viscoelastic material (10) comprises:

   - a main elastomeric portion, defined by 100 parts of a compound, which is selected from the group consisting of:polysiloxanes, tetracyclosiloxanes, pentacyclosiloxane s or mixtures thereof;
   - a portion of vulcanization, defined from 0.2 to 6.0 phr of a compound selected from the group consisting of: di-cumile peroxide; 2.5-bis (ter-butyl) peroxide; 2.5 dimethylhexane, or mixtures thereof;
   - a thermo-resistant portion, defined from 0.8 to 1.3 phr of a polysiloxane compound.

2. Composite, according to claim 1, characterized in that the compound of the main elastomeric portion is halogenated.

3. Composite, according to claim 2, characterized in that the main elastomeric portion comprises fluorinated polysiloxane.

4. Composite, according to claim 1, characterized in that the portion of vulcanization comprises 99% purity di-cumile peroxide.

5. composite, according to claim 1, characterized in that it comprises hardness between 30 and 40 shore A.

6. composite, according to claim 1, characterized in that it presents thermal decomposition temperature above 200°C (392°F).

Patentansprüche

1. Geräuschabsorbierende Zusammensetzung für das Aufhängungssystem von Kompressoren, Motoren und ähnlichen Geräten, die in einem Aufhängungssystem des Typs mit metallischen Schraubenfedern (3A, 3B) eingesetzt werden kann, wobei die Federn ein feststehendes Gehäuse (2) eines hermetisch geschlossenen Kompressors mit dessen Motor-Pumpen-Anordnung (1) verbinden und letztere einer Vibrationsbewegung hoher Frequenz unterliegt und wobei die geräuschabsorbierende Zusammensetzung (10) durch einen Abschnitt aus viskoelastischem Material festgelegt wird, der in engem und dauerndem Kontakt mit einem erheblichen Teil der Oberfläche der Federn (3A, 3B) steht, **dadurch gekennzeichnet**, daß das viskoelastische Material (10) umfaßt:

   - einen elastomeren Hauptabschnitt, der aus 100 Teilen einer Verbindung besteht, die aus der Gruppe ausgewählt ist, welche aus folgenden Stoffen besteht: Polysiloxan, Tetracyclosiloxan, Pentacyclosiloxan oder Mischungen derselben;
   - einen aus Vulkanisat bestehenden Abschnitt, der 0,2 bis 6,0 phr (parts per 100 rubber) einer Verbindung aufweist, die aus der Gruppe ausgewählt ist, welche aus folgenden Stoffen besteht: Dicumylperoxid, 2,5-Bis-(tert.-butyl)peroxid, 2,5 Dimethylhexan oder Mischungen derselben;
   - einen wärmebeständigen Abschnitt, der 0,8 bis 1,3 phr einer Polysiloxan-Verbindung aufweist.

2. Zusammensetzung nach Anspruch 1, dadurch gekennziechnet, daß die Verbindung des elastomeren Hauptabschnitts halogeniert ist.

3. Zusammensetzung nach Anspruch 2, dadurch gekennzeichnet, daß der elastomere Hauptabschnitt fluoriertes Polysiloxan enthält.

4. Zusammensetzung nach Anspruch 1, dadurch gekennzeichnet, daß der aus Vulkanisat bestehende Abschnitt 99% reines Dicumylperoxid enthält.

5. Zusammensetzung nach Anspurch 1, dadurch gekennzeichnet, daß ihre Härte zwischen 30 und 40 Shore A liegt.

6. Zusammensetzung nach Anspruch 1, dadurch gekennzeichnet, daß sie eine thermische Zersetzungstemperatur über 200°C (392°F) aufweist.

Revendications

1. Matériau composite amortisseur de bruit pour le système de suspension de compresseurs, moteurs et appareils similaires pouvant utiliser dans un système de suspension du type défini par des ressorts hélicoïdaux métalliques (3A, 3B), assurant l'interconnexion d'un premier carter (2) d'un compresseur hermétique avec son ensemble moteur-pompe (1), ce dernier étant soumis à un mouvement vibratoire à haute fréquence, ledit matériau composite amortisseur de bruit (10) étant défini par une partie de matériau visco-élastique, disposée en contact intime et permanent avec une partie substantielle de la surface desdits ressorts (3A, 3B), caractérisé en ce que ledit matériau visco-élastique (10) comprend:

   - une partie élastomère principale, définie par 100 parties d'un composé qui est sélectionné dans le groupe composé des polysiloxanes, tétracyclosiloxanes, pentacyclosiloxanes ou de leurs mélanges;
   - une partie vulcanisation définie par un rapport (phr) de 0,2 à 6,0 d'un composé sélectionné dans le groupe composé de : peroxyde de di-cumile; de peroxyde de 2,5-bis (ter-butyl); 2,5 diméthylhexane, ou leurs mélanges;
   - une partie thermorésistante, définie de 0,8 à 1,3 d'un composite polysiloxane.

2. Composite selon la revendication 1, caractérisé en ce que le composé de la partie élastomère est halogéné.

3. Composite selon la revendication 2, caractérisé en ce que la partie élastomère principale comprend du polysiloxane floriné.

4. Composite selon la revendication 1, caractérisé en ce que la partie vulcanisation comprend un peroxyde de di-cumile ayant un taux de pureté de 99 %.

5. Composite selon la revendication 1, caractérisé en ce qu'il présente une dureté comprise entre 30 et 40 shore A.

6. Composite selon la revendication 1, caractérisé en ce qu'il présente une température de décomposition thermique supérieure à 200°C (392°F).

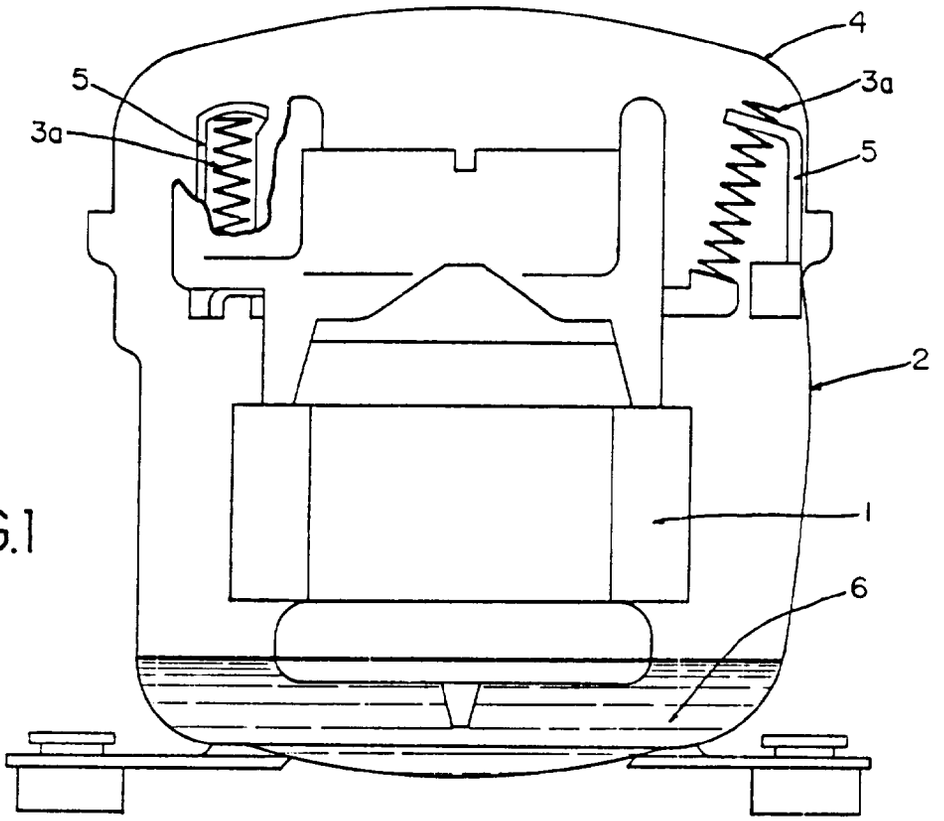

FIG.1

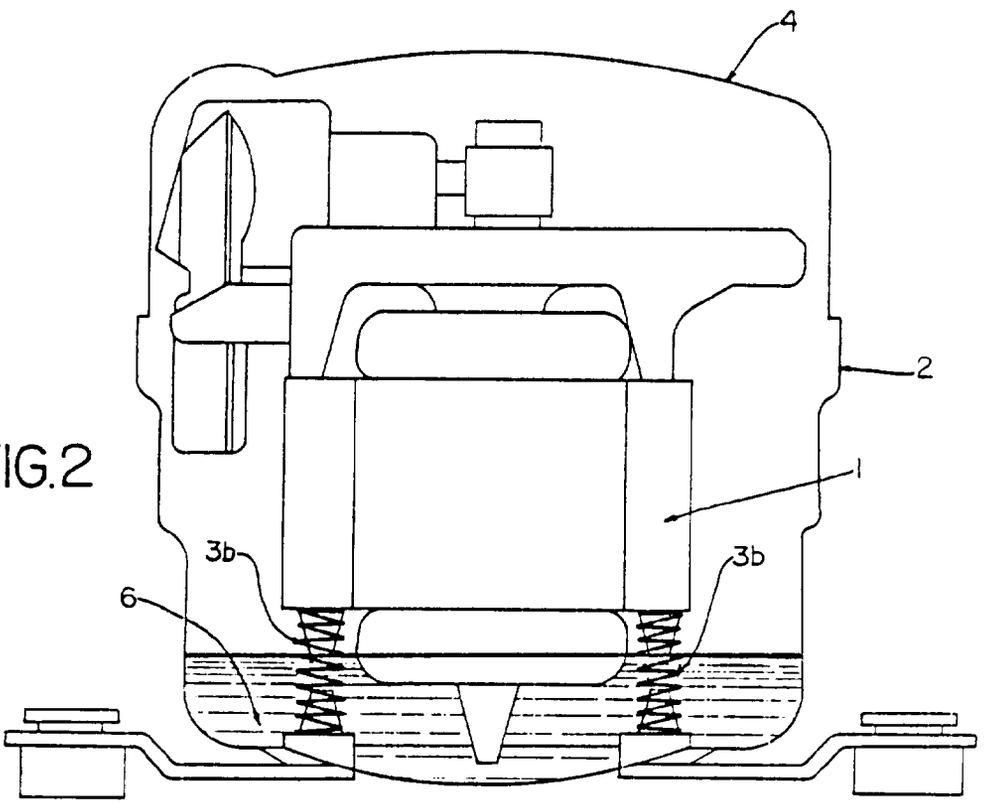

FIG.2

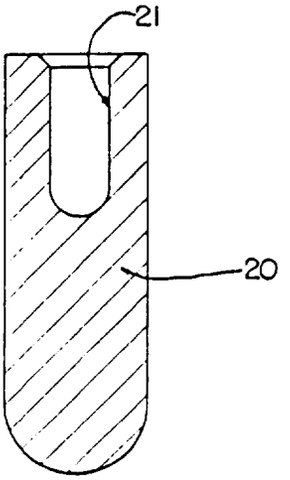

FIG. 3

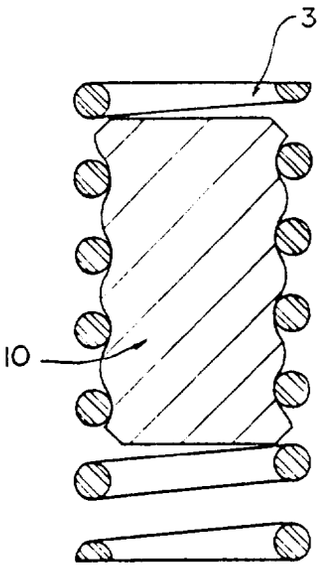

FIG. 4