

## DESCRIPTION

### VIBRATION DAMPING RUBBER AND MOTOR FIXING MOUNT

#### Technical Field

5 [0001] The present invention relates to vibration-damping rubbers and motor-fixing mounts, and more particularly to a vibration-damping rubber and a motor-fixing mount which exhibit good processability, and exhibit improved heat dissipation properties (thermal conductivity) while maintaining a low compression set even at high temperatures.

#### Background Art

15 [0002] Motor-fixing mounts which typically comprise, between a motor and a support member for supporting the motor, a vibration-damping rubber interposed between plates, are used in order to reduce vibrations and noise caused by motors in office automation equipment and the like.

20 [0003] The use of materials with good thermal conductivity for vibration-damping rubber has previously been proposed, in order to dissipate heat generated when driving a motor (patent documents 1 and 2).

[0004] Patent documents 1 and 2 use silicon rubber, other synthetic rubbers, or the like as rubber materials.

25 [0005] However, silicon rubber is disadvantageous in that it has low strength and cannot support motors stably for a long period of time. Other synthetic rubbers such as

polymers containing chlorine or the like may also pose the problem of outgassing.

[0006] For this reason, the use of NBR rubber, which is inexpensive and has relatively superior strength stability, as a rubber material that do not have above-

[Patent document 1] JP H6-143485 A

[Patent document 2] JP H5-168193 A

## 10 Disclosure of the Invention

### Problems to be Solved by the Invention

[0007] However, when a generally known thermally conductive filler such as, for example, graphite, acetylene black or the like is blended into NBR in an attempt to improve thermal conductivity, problems arise such as a deterioration in the compression set of the rubber composition caused by an increase in temperature during use, and hence the tendency for the rubber to flatten.

[0008] For example, when graphite or acetylene black is used alone as a thermally conductive filler, the use of, for example, acetylene black alone results in poor processability (Comparative Example 1), and the use of graphite alone results in poor heat dissipation properties (Comparative Examples 2 and 3).

25 [0009] When graphite and acetylene black are used together, the use of, for example, graphite in a range of 10 to 120 parts by weight and acetylene black in a range of

less than 10 parts by weight does not result in sufficient heat dissipation properties (Comparative Example 7); and the use of more than 80 parts by weight of acetylene black causes the hardness of the molded article to be excessively high, or causes the moldability to deteriorate. Furthermore, the use of acetylene black in a range of 10 to 80 parts by weight and graphite in a range of less than 10 parts by weight does not result in sufficient heat dissipation properties (Comparative Example 8), and the use of more than 120 parts by weight of graphite also causes the hardness of the molded article to be excessively high, and causes the compression set to deteriorate.

[0010] Good processability is also demanded to mass-produce the vibration-damping rubber and motor-fixing mount of the present invention.

[0011] It is an object of the invention to provide, by blending specific amounts of acetylene black and graphite into NBR rubber, a vibration-damping rubber and a motor-fixing mount which exhibit good processability, and exhibit improved heat dissipation properties (thermal conductivity) while maintaining a low compression set even at high temperatures.

[0012] Other objects of the invention will become apparent from the following description.

#### Means for Solving the Problems

[0013] The above-described object can be solved by the

inventions set forth below.

[0014]

(Claim 1)

5 A vibration-damping rubber comprising a NBR composition containing 10 to 120 parts by weight of graphite and 10 to 80 parts by weight of acetylene black per 100 parts by weight of NRB rubber.

[0015]

(Claim 2)

10 The vibration-damping rubber according to claim 1, wherein the NBR composition has a hardness of 75 or less as measured according to JIS K6253 (using a durometer A), has a compression set of 36% or less as measured after an aging and heat resistance test at 100°C for 70 hours according to  
15 JIS K6262 (using a large test piece), has a  $\tan \delta$  (10 Hz) of 0.3 or more, and has heat dissipation properties such that the measured value of a thermal conductivity test is 60°C or more.

[0016]

20 (Claim 3)

A motor-fixing mount comprising the vibration-damping rubber as defined in claim 1 or 2 interposed between plates.

## 25 Effects of the Invention

[0017] The present invention provides a vibration-damping rubber and a motor-fixing mount which exhibit good

processability (roll-processability and kneadability), and exhibit improved heat dissipation properties (thermal conductivity) while maintaining a low compression set even at high temperatures, by blending graphite and acetylene black, which are thermally conductive fillers, into NBR, according to a unique blending method.

[0018] The present invention also allows the heat dissipation properties (the thermal conductivity) to improve while maintaining a low compression set, and also allows the material strength and vibration-damping performance to improve simultaneously.

#### Brief Description of the Drawings

[0083]

FIG. 1 is a diagram illustrating the state in which a mount according to one embodiment of the invention is fixed to a motor and a bracket;

FIG. 2 is a cross section of the mount of FIG. 1; and

FIG. 3 is a diagram illustrating a method for measuring the thermal conductivity.

#### Explanation of Reference Numerals

[0084]

1: Motor

2: Motor-fixing mount

3: Bracket

4: Vibration-damping rubber

5: Plates

5a: Screw holes

6: Actuating shaft

5 7: Through-hole

20: Hot plate

21: Hot plate apparatus

22: Large test piece

23: Thermocouple

10

#### Best Mode for Carrying Out the Invention

[0019] Embodiments of the present invention will be described below.

[0020] The NBR composition for use in the invention  
15 contains 10 to 120 parts by weight of graphite and 10 to 80 parts by weight of acetylene black as thermally conductive fillers per 100 parts by weight of NBR rubber.

[0021] To provide good moldability, roll-processability, and the like, the NBR rubber preferably has a minimum  
20 Mooney viscosity of 60 M or less as measured in a Mooney scorch test (at 125°C, a preheating time of 1 minute, an L rotor) in accordance with JIS K6300.

[0022] The NBR rubber for use in the invention is obtainable as a commercially available product, and Nipol  
25 DN3350 manufactured by Zeon Corporation can be mentioned as such a commercially available product.

[0023] The graphite preferably has an average particle

size of 20  $\mu\text{m}$  or less. The average particle size herein is measured according to the centrifugal sedimentation method. An average particle size of 20  $\mu\text{m}$  or less is preferable because the graphite can be charged into rubber in a high proportion. More preferably, the graphite has an average particle size of 5 to 15  $\mu\text{m}$ .

[0024] In the invention, two or more graphites with different average particle diameters may also be used.

[0025] The graphite for use in the invention is obtainable as a commercially available product, and examples of such commercially available products include "Graphite A-0", "Graphite G-6S", and "Graphite CPS-3S", manufactured by Chuetsu Graphite Works Co., Ltd., and the like.

[0026] The amount of graphite blended into 100 parts by weight of NBR rubber is from 10 to 120 parts by weight, preferably from 30 to 100 parts by weight, and more preferably from 50 to 80 parts by weight. If the amount of graphite is less than 10 parts by weight, sufficient heat dissipation properties will not be obtained, whereas if the amount exceeds 120 parts by weight, the hardness of the molded article will be excessively high, and the compression set will also deteriorate.

[0027] Acetylene black with an average particle size of 50 nm or less is preferably used. The average particle size is measured according to the dynamic light scattering method. An average particle size of 50 nm or less is

preferable because the acetylene black can be charged into rubber in a high proportion.

[0028] The acetylene black for use in the invention is obtainable as a commercially available product, and for example, "Denka Black" manufactured by Denki Kagaku Kogyo can be mentioned as such a commercially available product.

[0029] The amount of acetylene black blended into 100 parts by weight of NBR rubber is from 10 to 80 parts by weight, preferably from 20 to 50 parts by weight, and more preferably from 30 to 40 parts by weight.

[0030] If the amount of acetylene black is less than 10 parts by weight, the heat dissipation properties will be poor, whereas if the amount exceeds 80 parts by weight, the hardness will be excessively high, and problems with roll-processability such as floating of the rubber from a roll mill during manufacturing will occur, and problems with rubber kneadability will also occur.

[0031] In the invention, the use of acetylene black, in particular, among carbon blacks enables high heat dissipation properties to be achieved, and enables the compression set to be improved.

[0032] The composition of the invention may comprise, as needed, other components such as various reinforcing agents, antioxidants, fillers, cross-linking agents, cross-linking accelerators, and the like within a range such that the effects of the invention are not impaired.

[0033] Examples of cross-linking agents include sulfur,

organic sulfur-containing compounds, oximes and like organic cross-linking agents (for example, quinone dioxide compound), organic peroxides, metal oxides, organic multivalent amine compounds, modified phenolic resins, and  
5 the like.

[0034] These cross-linking agents are preferably used in a range of about 0.2 to about 10 parts by weight, and more preferably about 0.5 to about 8 parts by weight, per 100 parts by weight of rubber.

10 [0035] Examples of sulfur include powder sulfur, precipitated sulfur, colloidal sulfur, and the like.  
Examples of organic sulfur-containing compounds include tetramethylthiuram, disulfide, selenium dimethyldithiocarbamate, and the like.

15 [0036] Examples of organic peroxides include dicumyl peroxide, di-tert-butyl peroxide, 2,5-dimethyl-2,5-di-(tert-butylperoxy)hexane, benzoyl peroxide, cumyl peroxide, 1,3-di(tert-butylperoxy)isopropylbenzene, 2,5-dimethyl-2,5-di(tert-butylperoxy)hexane, m-toluoylperoxide, dipropionyl  
20 peroxide, and the like.

[0037] Examples of metal oxides include zinc white, magnesium oxide, and the like.

[0038] In the invention, various additives such as, for example, stabilizers, tackifiers, release agents, pigments,  
25 flame retardants, lubricants, and the like can also be added. A small amount of a thermoplastic resin or a rubber can also be added to improve the wear resistance,

moldability, and the like. Moreover, short fibers and the like can also be added in a range such that the effects of the invention are not impaired, to improve the strength and stiffness.

5 [0039] The NBR composition for use in the invention can be manufactured by melt-kneading, for example, the above-mentioned components, using a heating kneader such as, for example, a single screw extruder, a twin screw extruder, a roll mill, a Banbury mixer, a brabender, a kneader, a high-  
10 shear mixer, or the like, and then by adding a cross-linking agent, a cross-linking aid, and the like to mix these necessary components simultaneously and melt-kneading them.

[0040] Molding (vulcanization) is performed according to  
15 a known method by heating at about 150 to about 200°C for about 3 to about 60 minutes, using, for example, an injection molding machine, a compression molding machine, a vulcanizing press, or the like, and, if necessary, secondary cross-linking is also performed by heating at  
20 about 150 to about 250°C for about 1 to about 24 hours.

[0041] An example of the vibration-damping rubber of the present invention and an example of a motor-fixing mount using the rubber are explained with reference to the drawings.

25 [0042] FIG. 1 is a cross section illustrating the state in which a motor-fixing mount according to the invention is fixed to a motor and a bracket; and FIG. 2 is a cross

section illustrating the motor-fixing mount 2 of FIG. 1.

[0043] As illustrated in FIG. 1, the motor 1 is supported by the bracket 3, which is a support member, via the motor-fixing mount 2.

5 [0044] Reference numeral 4 denotes a vibration-damping rubber, which is made from the above-described NBR composition. While the vibration-damping rubber 4 may also contain other components, it is preferably obtained using the above-described NBR composition as it is. The rubber  
10 may be composed of a single layer or a plurality of layers.

[0045] Reference numeral 5 denotes plates, numeral 5a denotes screw holes, numeral 6 denotes an actuating shaft, and numeral 7 denotes a through-hole.

[0046] The NBR composition for use in the invention has  
15 a hardness of 75 or less as measured according to JIS K6253 (using a durometer A), and therefore can easily produce a thin article for use as a vibration-damping rubber or for use in a motor-fixing mount.

[0047] Moreover, the NBR composition for use in the  
20 invention has a compression set of 36% or less as measured after an aging and heat resistance test at 100°C for 70 hours according to JIS K6262 (using a large test piece), and therefore is unlikely to flatten.

[0048] In addition, the NRB composition for use in the  
25 invention has a  $\tan \delta$  (10 Hz) of 0.3 or more, and therefore exhibits excellent vibration-damping performance.

Furthermore, the NBR composition has a measured value of a

thermal conductivity test of 60°C or more, and therefore also exhibits excellent heat dissipation properties.

[0049] The NBR composition with these properties contains 10 to 120 parts by weight of graphite and 10 to 80 parts by weight of acetylene black as thermally conductive fillers per 100 parts by weight of NBR rubber, and accordingly, even though it is blended with the thermally conductive fillers, it exhibits good processability (roll-processability and kneadability), exhibits improved heat dissipation properties while maintaining a low compression set without causing the rubber to flatten even during use at high temperatures, and exhibits improved material strength and vibration-damping performance simultaneously.

[0050] The motor-fixing mount of the invention is also capable of exhibiting good heat dissipation properties while supporting a motor stably for a long period of time, even when used in a position to which heat is particularly applied.

## 20 EXAMPLES

[0051] The present invention will be described below with reference to Examples; however, the invention is not limited by these Examples.

[0052]

### 25 Example 1

<Blending Components and Amounts Thereof>

Polymer:

NBR rubber (Nipol DN3350, manufactured by Nippon Zeon; amount of bonded AN: 33%, ML central value: 50) ... 100 parts by weight

Reinforcing agents:

5           Precipitated silica (Nipsil VN3, manufactured by Tosoh Silica Corporation) ... 14 parts by weight

          Graphite (particle size: 5  $\mu\text{m}$ ) (Graphite A-0, manufactured by Nichiden Carbon Co.) ... 35 parts by weight

          Graphite (particle size: 10  $\mu\text{m}$ ) (Graphite G-65,  
10   manufactured by Chuetsu Graphite Works Co., Ltd.) ... 35 parts by weight

          Acetylene black (Denka Black particles, manufactured by Denki Kagaku Kogyo) ... 35 parts by weight

Cross-linking accelerator aids:

15           Zinc white (first-class zinc oxide, manufactured by Sakai Chemical Industry) ... 5 parts by weight

          Stearic acid (Stearic acid TST, manufactured by Miyoshi Oil & Fat) ... 1 part by weight

Antioxidants:

20           TMDQ           (2,2,4-trimethyl-1,2-dihydroquinoline polymer) (NONFLEX RD, manufactured by Seiko Chemical) ... 2 parts by weight

          IPPD   (N-isopropyl-N'-phenyl-p-phenylenediamine) (Antage 3C, manufactured by Kawaguchi Chemical Industry) ...  
25   2 parts by weight

Processing aid:

          A wax (Suntight R, manufactured by Seiko

Chemical) ... 1.5 parts by weight

Plasticizers:

Alkylsulfonic acid phenylester (Mesamoll, manufactured by LANXESS) ... 15 parts by weight

5 Liquid nitrile rubber (NBR) (Nipol 1312, manufactured by Nippon Zeon) ... 30 parts by weight

Cross-linking agent:

Sulfur (colloidal sulfur, manufactured by Tsurumi Chemical Industry) ... 1 part by weight

10 Cross-linking accelerators:

TMTM (tetramethylthiuram monosulfide) (Accel TS, manufactured by Kawaguchi Chemical Industry) ... 1.65 parts by weight

15 MBTS (dibenzothiazyl disulfide) (Nocceler DM, manufactured by Ouchi Shinko Chemical industrial) ... 2.2 parts by weight

[0053] All of the above-listed raw materials except for the cross-linking agent and cross-linking accelerators were kneaded in a kneader to prepare a master batch at a discharge temperature of 100°C, and then the cross-linking agent and cross-linking accelerators were added to the master batch during kneading in a roll mill, thereby preparing a target rubber composition. The resulting rubber composition was press-cured at a curing temperature of 180°C for 6 minutes, thereby yielding a test sample.

[0054]

<Evaluation Method>

## 1. Processability

Kneadability in a kneader and roll-processability were evaluated.

[0055] Good kneadability in a kneader was evaluated as "A", and poor kneadability in a kneader was evaluated as "B". Very good roll-processability was evaluated as "A", appropriate (practically not problematic) processability was evaluated as "B", and very poor roll-processability, which caused significant floating, tack, and the like, was evaluated as "C". The notation "(Floating)" indicates that floating of the rubber from a roll mill was significant, and the notation "(tack)" indicates that the adhesion of the rubber to the roll mill was significant.

[0056]

## 2. Mooney Scorch Tests

Tests were performed in accordance with JIS K6300 at a test temperature of 125°C, using a preheating time of 1 minute and an L rotor, and the minimum Mooney viscosity  $V_m$  and the scorch times  $t_5$ ,  $t_{35}$  were determined.

[0057]

## 3. Tensile Test and Hardness Test

Tensile tests were performed in accordance with JIS K6251, and hardness test were performed in accordance with JIS K6253.

[0058]

## 4. Compression Set Test

Compression set was measured after an aging and

heat resistance test at 100°C for 70 hours in accordance with JIS K6262, using a large test piece.

[0059]

#### 5. Dynamic Viscoelasticity Measurement

5           Dynamic viscoelasticity was measured using a viscoelasticity spectrometer at an initial strain of 10%, a frequency of 10 Hz, a dynamic strain of 7%, and a temperature of 25°C.

[0060]

#### 10 6. Heat Dissipation Test

          The method for testing heat dissipation properties is explained with reference to FIG. 3.

[0061]   A large test piece 22 was allowed to stand on a hot plate 20 at 80°C (a hot plate apparatus 21: a rotorless  
15 Mooney viscometer RLM-1, manufactured by Toyo Seiki Seisaku-sho, LTD.), and the temperature of the compressed ball that reached after 1 hour was measured using a thermocouple 23 (a multi-input data collection system, manufactured by KEYENCE) installed above the compressed  
20 ball. In actual measurement, the temperature of the rubber becomes constant after about 30 minutes, so the average of the temperatures of the rubber from 30 minutes to 1 hour after the beginning of the measurement was determined as the temperature of the rubber after 1 hour. The ambient  
25 temperature and the temperature of the hot plate were also measured simultaneously to correct the rubber temperature.

[0062]   Assuming that A is the rubber temperature, B is

the measured hot plate temperature, and C is the measured ambient temperature, the corrected rubber temperature was determined according to the equation: corrected rubber temperature =  $A + (80 - B) - (C - \text{average ambient temperature of all the measurements})$ .

[0063]

#### Example 2

A rubber sample was prepared in the same manner as Example 1, except that, instead of using both of the graphites A-0 and G-6S, 70 parts by weight of only graphite G-6S were added, and the resulting sample was subjected to evaluation tests.

[0064]

#### Example 3

A rubber sample was prepared in the same manner as Example 1, except that, instead of using both of the graphites A-0 and G-6S, 70 parts by weight of only graphite G-6S were added, and 65 parts by weight of acetylene black were added, and the resulting sample was subjected to evaluation tests.

[0065]

#### Example 4

A rubber sample was prepared in the same manner as Example 1, except that, instead of using both of the graphites A-0 and G-6S, 105 parts by weight of only graphite G-6S were added, and the resulting sample was

subjected to evaluation tests.

[0066]

#### Comparative Example 1

5 A rubber sample was prepared in the same manner as Example 1, except that graphite was not used, and 105 parts by weight of acetylene black were added, and the resulting sample was subjected to evaluation tests.

[0067]

#### Comparative Example 2

10 A rubber sample was prepared in the same manner as Example 1, except that, instead of using both of the graphites A-0 and G-6S, 105 parts by weight of only graphite A-0 were added, and acetylene black was not used, and the resulting sample was subjected to evaluation tests.

15 [0068]

#### Comparative Example 3

A rubber sample was prepared in the same manner as Example 1, except that, instead of using both of the graphites A-0 and G-6S, 105 parts by weight of only graphite G-6S were added, and acetylene black was not used, and the resulting sample was subjected to evaluation tests.

[0069]

#### Comparative Example 4

25 A rubber sample was prepared in the same manner as Example 1, except that graphite and acetylene black were not used, and 105 parts by weight of carbon black (ShoBlack N330, manufactured by Cabot Japan) were added, and the

resulting sample was subjected to evaluation tests.

[0070]

#### Comparative Example 5

A rubber sample was prepared in the same manner  
5 as Example 1, except that graphite and acetylene black were  
not used, and 105 parts by weight of magnesium oxide  
(PYROKISUMA 5301, manufactured by Kyowa Chemical Industry)  
were added, and the resulting sample was subjected to  
evaluation tests.

10 [0071]

#### Comparative Example 6

A rubber sample was prepared in the same manner  
as Example 1, except that graphite and precipitated silica  
were not used, and 350 parts by weight of magnesium oxide  
15 (PYROKISUMA 5301, manufactured by Kyowa Chemical Industry)  
were added, and the resulting sample was subjected to  
evaluation tests.

[0072]

#### Comparative Example 7

20 A rubber sample was prepared in the same manner  
as Example 1, except that, instead of using both of the  
graphites A-0 and G-6S, 70 parts by weight of only graphite  
G-6S were added, and 5 parts by weight of acetylene black  
were added, and the resulting sample was subjected to  
25 evaluation tests.

[0073]

#### Comparative Example 8

A rubber sample was prepared in the same manner as Example 1, except that, instead of using both of the graphites A-0 and G-6S, 5 parts by weight of only graphite G-6S were added, and 35 parts by weight of acetylene black were added, and the resulting sample was subjected to evaluation tests.

[0074] Table 1 shows the formulation and evaluation results of each of the rubber samples of the Examples and Comparative Examples.

10 [0075]

[Table 1]

|                                                          | Ex.1   | Ex.2   | Ex.3   | Ex.4   | Comp. Ex.1   | Comp. Ex.2 | Comp. Ex.3 | Comp. Ex.4 | Comp. Ex.5 | Comp. Ex.6 | Comp. Ex.7 | Comp. Ex.8 |
|----------------------------------------------------------|--------|--------|--------|--------|--------------|------------|------------|------------|------------|------------|------------|------------|
| Nipol DN3350                                             | 100    | 100    | 100    | 100    | 100          | 100        | 100        | 100        | 100        | 100        | 100        | 100        |
| Shoblack N330                                            |        |        |        |        |              |            |            | 105        |            |            |            |            |
| Nipsil VN3                                               | 14     | 14     | 14     | 14     | 14           | 14         | 14         | 14         | 14         | 14         | 14         | 14         |
| Graphite A-0 (5 µm)                                      | 35     |        |        |        |              | 105        |            |            |            |            |            |            |
| Graphite G-6S (10 µm)                                    | 35     | 70     | 70     | 105    |              |            | 105        |            |            | 70         | 5          | 5          |
| PYROKISUMA 5301 (2 µm)                                   |        |        |        |        |              |            |            |            | 105        | 350        |            |            |
| Denka Black particles                                    | 35     | 35     | 65     | 35     | 105          |            |            |            |            | 35         | 5          | 35         |
| ZnO                                                      | 5      | 5      | 5      | 5      | 5            | 5          | 5          | 5          | 5          | 5          | 5          | 5          |
| Stearic acid TST                                         | 1      | 1      | 1      | 1      | 1            | 1          | 1          | 1          | 1          | 1          | 1          | 1          |
| NONFLEX RD                                               | 2      | 2      | 2      | 2      | 2            | 2          | 2          | 2          | 2          | 2          | 2          | 2          |
| Antage 3C                                                | 2      | 2      | 2      | 2      | 2            | 2          | 2          | 2          | 2          | 2          | 2          | 2          |
| Suntight R                                               | 1.5    | 1.5    | 1.5    | 1.5    | 1.5          | 1.5        | 1.5        | 1.5        | 1.5        | 1.5        | 1.5        | 1.5        |
| Mesamoll                                                 | 15     | 15     | 15     | 15     | 15           | 15         | 15         | 15         | 15         | 15         | 15         | 15         |
| Nipol 1312                                               | 30     | 30     | 30     | 30     | 30           | 30         | 30         | 30         | 30         | 30         | 30         | 30         |
| S                                                        | 1      | 1      | 1      | 1      | 1            | 1          | 1          | 1          | 1          | 1          | 1          | 1          |
| Accel TS                                                 | 1.65   | 1.65   | 1.65   | 1.65   | 1.65         | 1.65       | 1.65       | 1.65       | 1.65       | 1.65       | 1.65       | 1.65       |
| Nocceler DM                                              | 2.2    | 2.2    | 2.2    | 2.2    | 2.2          | 2.2        | 2.2        | 2.2        | 2.2        | 2.2        | 2.2        | 2.2        |
| Total                                                    | 280.35 | 280.35 | 310.35 | 315.35 | 280.35       | 280.35     | 280.35     | 280.35     | 280.35     | 546.35     | 250.35     | 215.35     |
| Processability                                           |        |        |        |        |              |            |            |            |            |            |            |            |
| Kneadability in a kneader (ease of discharge)            | A      | A      | A      | A      | A            | A          | A          | A          | A          | B          | A          | A          |
| Roll-processability (tack or not tack)                   | A      | A      | B      | A      | C (Floating) | A          | A          | A          | A          | C (tack)   | A          | A          |
| Mooney scorch at 125°C                                   |        |        |        |        |              |            |            |            |            |            |            |            |
| Vm (M)                                                   | 28.0   | 25.3   | 45.6   | 33.1   | 79.7         | 38.5       | 36.0       | 48.3       | 11.2       | 68.7       | 21.5       | 33.7       |
| t5 (min)                                                 | 8.6    | 10.0   | 8.2    | 8.8    | 7.1          | 6.3        | 9.4        | 6.4        | 16.6       | 9.1        | 10.5       | 11.3       |
| t35 (min)                                                | 10.2   | 11.9   | 10.1   | 10.8   | 8.9          | 7.3        | 11.5       | 7.8        | 19.5       | 11.2       | 12.0       | 12.9       |
| Normal physical properties                               |        |        |        |        |              |            |            |            |            |            |            |            |
| Hardness (durometer A)                                   | 63     | 63     | 72     | 71     | 76           | 60         | 64         | 73         | 39         | 72         | 61         | 53         |
| Tensile strength (MPa)                                   | 9.2    | 9.0    | 11.5   | 9.5    | 13.8         | 7.9        | 6.8        | 17.8       | 5.5        | 3.8        | 7.0        | 8.0        |
| Elongation at break (%)                                  | 640    | 670    | 570    | 650    | 450          | 640        | 720        | 380        | 960        | 520        | 740        | 670        |
| Compression set test                                     |        |        |        |        |              |            |            |            |            |            |            |            |
| Compression set (%) 100°C x 70 hrs                       | 29     | 33     | 34     | 36     | 30           | 35         | 34         | 33         | 55         | 66         | 33         | 31         |
| Dynamic characteristics; pulling direction: RT           |        |        |        |        |              |            |            |            |            |            |            |            |
| tan δ 10 Hz                                              | 0.334  | 0.326  | 0.341  | 0.325  | 0.356        | 0.267      | 0.220      | 0.426      | 0.245      | 0.336      | 0.325      | 0.323      |
| tan δ 50 Hz                                              | 0.365  | 0.363  | 0.368  | 0.367  | 0.326        | 0.319      | 0.280      | 0.360      | 0.300      | 0.380      | 0.359      | 0.353      |
| tan δ 100 Hz                                             | 0.369  | 0.368  | 0.371  | 0.373  | 0.266        | 0.358      | 0.325      | 0.287      | 0.342      | 0.402      | 0.361      | 0.356      |
| Thermal conductivity                                     |        |        |        |        |              |            |            |            |            |            |            |            |
| Temperature (°C) after being left on a hot plate at 80°C | 60.0   | 60.5   | 60.6   | 61.3   | 60.7         | 58.6       | 58.8       | 55.5       | 55.4       | 63.5       | 57.5       | 58.7       |

[0076]

<Evaluation>

A preferable value for each evaluation test is as follows.

- 5           2. Mooney viscosity: 60 M or less
3. Hardness: 75 or less
4. Compression set: 36% or less
5. Dynamic viscoelasticity  $\tan \delta$ : 0.3 or more
6. Heat dissipation properties: 60°C or more

10 [0077]    It is seen from Table 1 that the rubber samples of Examples 1, 2, 3, and 4 had preferable values in terms of heat dissipation properties, as well as other physical properties and processability.

15 [0078]    The rubber sample of Comparative Example 1 showed increases in rubber hardness and Mooney viscosity, and also showed a deterioration in processability.

[0079]    The rubber samples of Comparative Examples 2, 3, 7, and 8 had heat dissipation properties slightly below the expected value.

20 [0080]    The rubber sample of Comparative Example 4 had heat dissipation properties considerably below the expected value.

25 [0081]    The rubber sample of Comparative Example 5 had a significant deterioration in compression set, and did not also show an improvement in heat dissipation properties.

[0082]    The rubber sample of Comparative Example 6 exhibited very good heat dissipation properties, but had

difficulty in maintaining a low compression set, and showed deteriorations in the values of physical properties.

## CLAIMS

1.           A vibration-damping rubber comprising a NBR composition containing 10 to 120 parts by weight of graphite and 10 to 80 parts by weight of acetylene black per 100 parts by weight of NRB rubber.
2.           The vibration-damping rubber according to claim 1, wherein the NBR composition has a hardness of 75 or less as measured according to JIS K6253 (using a durometer A), has a compression set of 36% or less as measured after an aging and heat resistance test at 100°C for 70 hours according to JIS K6262 (using a large test piece), has a  $\tan \delta$  (10 Hz) of 0.3 or more, and has heat dissipation properties such that the measured value of a thermal conductivity test is 60°C or more.
3.           A motor-fixing mount comprising the vibration-damping rubber as defined in claim 1 or 2 interposed between plates.