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ELECTRIC CONTACT GREASE

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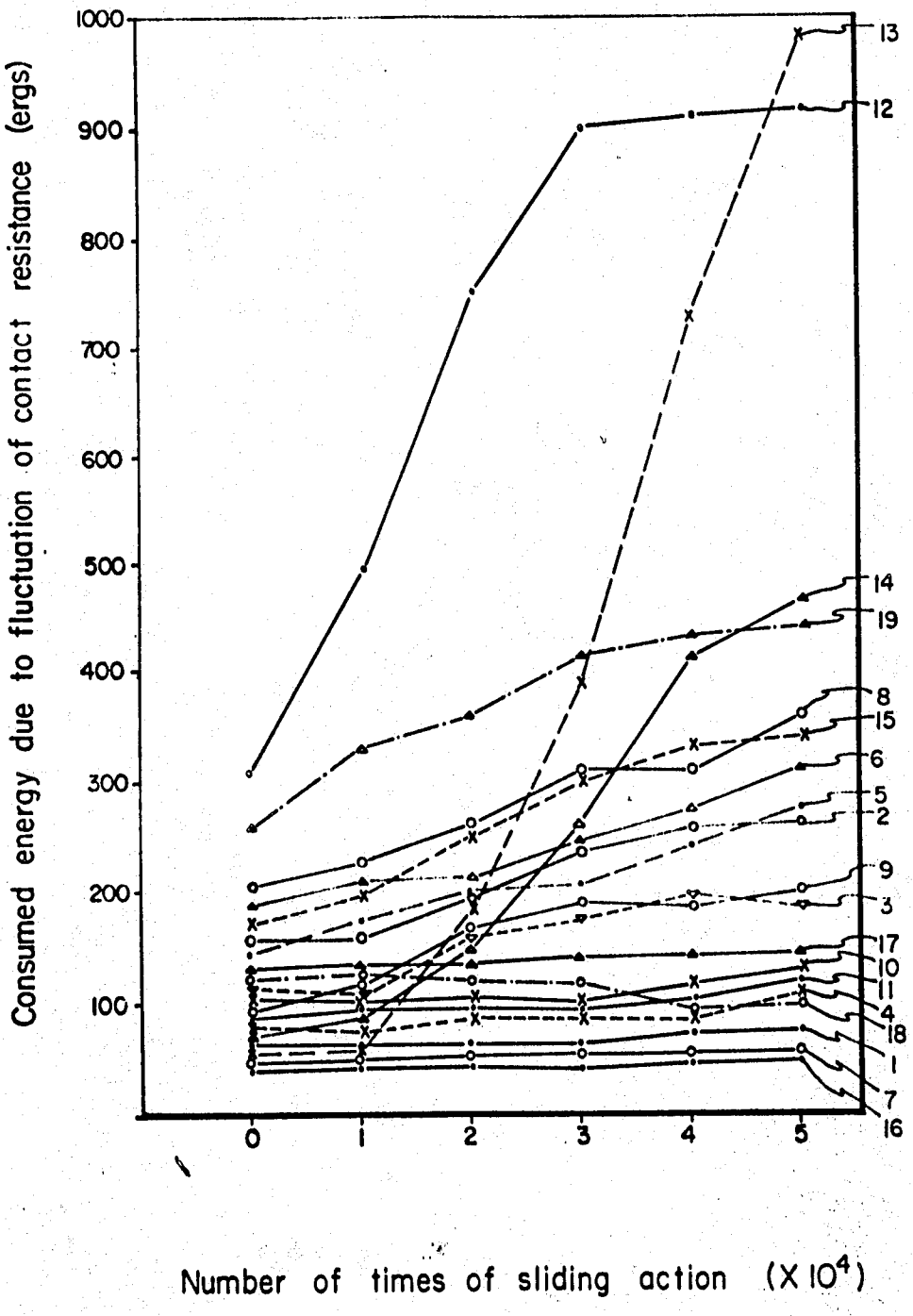

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ELECTRIC CONTACT GREASE

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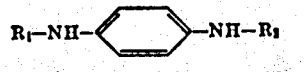
Int. Cl. C10m 5/20, 5/26
U.S. Cl. 252—11 4 Claims

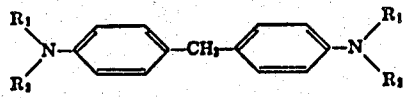
ABSTRACT OF THE DISCLOSURE

An electric contact grease consisting essentially of:

(a) a major amount of paraffinic mineral oil,
(b) 2 to 15 percent by weight of chlorinated diphenyls and triphenyls,
(c) 7 to 12 percent by weight of colloidal silica, and
(d) 0.1 to 3.0 percent by weight of at least one member selected from the group consisting of (i) amino compounds having the following formula:



wherein R_1 is alkyl containing 3 to 10 carbon atoms, and R_2 is a member selected from the group consisting of alkyl containing 3 to 10 carbon atoms, cycloalkyl and aryl, and (ii) amino compounds having the following formula:



wherein R_1 and R_2 are alkyl containing 1 to 10 carbon atoms, respectively.

FIELD OF THE INVENTION

The present invention relates to an electric contact grease which has particular application in sliding contacts of electrical machines and apparatuses.

DESCRIPTION OF THE PRIOR ART

Conventional electric contacts in, for example, television and radio are subjected to contact failure and are responsible for troubles such as sound noise, picture failure and the like.

These troubles are prevented to some extent by using electric contact greases. However, conventional grease for an electric contact has not been completely satisfactory due to the complicated nature of the phenomenon of the electric contact.

Contact failure is usually caused by oxidation, sulphurization and wear of contact metal surfaces and sludge formed by oxidation and polymerization of grease itself used for the contact. Therefore, the role of contact grease is to prevent oxidation, sulphurization and wear of contact metals so as to stabilize the electric contact resistance, to prevent noise and to lengthen the life of the electric contact.

BRIEF SUMMARY OF THE INVENTION

An object of the present invention is to provide a contact grease capable of preventing wear of the electric sliding contact.

Another object of the present invention is to provide a contact grease which stabilizes contact resistance and thereby prevents noise in the electric contact.

A further object of the present invention is to provide a contact grease which prevents damage to electric contacts, due to variable circumstances. These and other objects of the present invention will be apparent upon consideration of the following detailed description.

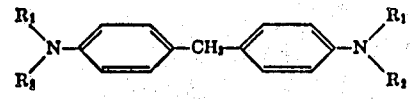
BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 shows the relationship between the number of times of sliding action and the stability of electrical contact resistance.

DETAILED DESCRIPTION

A contact grease according to the present invention consists essentially of a major amount of a paraffinic mineral oil, 2 to 15 percent by weight of chlorinated aromatic hydrocarbon, 7 to 12 percent by weight of colloidal silica and 0.1 to 3.0 percent by weight of at least one member selected from the group consisting of (i) amino compounds having the following formula:

wherein R_1 is alkyl containing 3 to 10 carbon atoms, and R_2 is a member selected from the group consisting of alkyl containing 3 to 10 carbon atoms, cycloalkyl and aryl, and (ii) amino compounds having the following formula:



wherein R_1 and R_2 are alkyl containing 1 to 10 carbon atoms, respectively.

Anti-rust agent or anti-sulphurizing agents are preferably added to the composition of the grease.

The novel contact grease according to the present invention prevents an electric contact from failing, and ensures satisfactory contacting action for a longer time period especially when applied to an electric contact which is composed with a combination of a contact rivet made of a metal selected from the group consisting of platinum, gold, silver, copper and their alloys, and the other contact plate made of nickel or nickel silver.

Nickel is often used for plating a printed circuit or a contact metal because of its good chemical stability and mechanical characteristics though its electric resistivity is comparably higher.

Paraffinic mineral oil defined herein includes pure paraffinic mineral oil having a small amount, for example, up to 20 percent by weight of aromatic and/or naphthenic mineral oil incorporated therein. It is preferable that the paraffinic mineral oil has a viscosity of 50 to 140 centistokes (at 37.8° C.) and an aniline point higher than 95 in the ASTM 0611–55T (American Society for Testing Materials).

A paraffinic mineral oil having a viscosity lower than 50 cst. results in a contact grease which has poor antiwearing property, and higher than 140 cst. results in contact grease which has poor stability of contact resistance. Paraffinic mineral oil which has aniline point lower than about 95 results in contact grease which has a tendency towards noise occurrence at comparably high temperature. A contact grease according to the present invention com-

prises chlorinated aromatic hydrocarbon, i.e., at least one member selected from the group consisting of tetrachlorodiphenyl, pentachlorodiphenyl, hexachlorodiphenyl and polychlorotriphenyl. When the chlorinated aromatic hydrocarbon is present in an amount higher than about 15 percent by weight, the electric contact resistance is difficult to stabilize. At an amount of the chlorinated aromatic hydrocarbon lower than 2 percent by weight, the anti-wearing property of the grease becomes smaller.

The contact grease according to the present invention, also comprises colloidal silica having a BET-surface area (surface area measured by BET method) of from 180 to 330 m.²/g.

When the amount of colloidal silica is lower than about 7 percent by weight, the life of the contact becomes shorter. When that amount is higher than 12 percent by weight, the wear of the contact metal becomes larger.

In the present invention, the amino compound as anti-oxidant not only serves to prevent mineral oil from oxidation and polymerization, but at the same time decreases the wear of the contact metal and stabilizes the contact resistance.

On the other hand, in the case of other antioxidants, for example, 4,4'-methylene-bis-(2,6-di-tert-butyl phenol) or, 2,6-di-tert-butyl para-cresol, the contact resistance is low in the first stage of sliding action, but the wear advances rapidly with the progress of sliding action. Consequently, the contact resistance becomes larger and noise is generated.

The contact grease using silicone oil as base oil is inferior to the grease according to the present invention in the anti-wearing property.

According to the present invention, a mixture of the paraffinic mineral oil, the chlorinated diphenyl, and the amino compound with or without rust inhibitor and anti-sulphurizing agent is heated at 120 to 150° C. to make a homogeneous liquid, and then the colloidal silica is added thereto under stirring to make a homogeneous paste. The cooled mixture is milled by a usual method, e.g. employing three roll mills, and is subjected to a reduced pressure so as to remove air and foam. The resulting greases are smooth and buttery in texture and have excellently mechanical and thermal stability. The invention is described in the following examples, which are for the purpose of illustration and are not considered to be limitative with respect to scope or conditions. In the example, "g." represents grams.

Example 1

A mixture of 81.5 g. of paraffinic mineral oil having viscosity of 65 cst. at 37.8° C. and aniline point of 98.2° C., 70 g. of tetrachloro diphenyl and 2.0 g. of N,N,N',N-tetramethyl-4,4'-diamino-diphenyl methane (tetra base) is heated at about 130° C.

After being homogenized, 9.5 g. of Aerosil-300 (trade name of colloidal silica having BET surface area of about 300 m.²/g., which is manufactured by Japan Aerosil Company Ltd.) is added to the mixture under stirring.

After being homogenized, the mixture is cooled to room temperature and milled with three roll mill. Then the foam remaining in the grease is removed under reduced pressure. The resulting grease is stable and has a pour point of higher than 230° C. The grease is applied to an electric contact.

The grease action is shown in Example No. 1 of Table 1 and FIG. 1.

Example 2

A mixture of 74.5 g. of paraffinic mineral oil having viscosity of 110.2 cst. at 37.8° C. and aniline point of 113.0° C., 12.5 g. of hexachlorodiphenyl and 1.8 g. of N,N'-di-sec-butyl-paraphenylene diamine is heated at about 150° C.

After being homogenized, 11.2 g. of Aerosil-300 is added to the mixture under stirring.

The resulting mixture is treated in a way similar to that of Example 1. The test is carried out similarly to Example 1 and the result is shown in Table 1 and FIG. 1.

Example 3

A mixture of 83.4 g. of paraffinic mineral oil having viscosity of 95.2 cst. at 37.8° C. and aniline point of 101.2° C., 6.5 g. of heptachlorodiphenyl and 1.6 g. of N,N,N',N'-tetradecyl-4,4'-diamino diphenyl methane is heated at about 140° C. After being homogenized, 8.5 g. of Aerosil-200 (having BET surface area of about 200 m.²/g.) is added thereto and the mixture is treated in a way similar to Example 1.

The test is carried out similarly to Example 1 and the result is shown in Table 1 and FIG. 1.

Example 4

The mixture of 85.6 g. of paraffinic mineral oil having viscosity of 104.3 cst. at 37.8° C. and aniline point of 105.2° C., 2.0 g. of tetrachlorodiphenyl and 1.9 g. of N,N'-di-sec-hexyl-paraphenylene diamine is heated at 130° C.

After being homogenized, 10.5 g. of Aerosil-300 is added thereto and the mixture is treated in a way similar to Example 1.

The resting result is shown in Table 1 and FIG. 1.

Example 5

The mixture of 78.2 g. of paraffinic mineral oil having viscosity of 110.1 cst. at 37.8° C. and aniline point of 112.1° C., 12.0 g. of heptachlorodiphenyl and 0.2 g. of N,N'-di-sec-hexyl-para-phenylene diamine is heated at 145° C.

After being homogenized, 9.7 g. of Aerosil-200 is added thereto and the mixture is treated in a way similar to Example 1. The testing result is shown in Table 1 and FIG. 1.

Example 6

The mixture of 76.7 g. of paraffinic mineral oil having viscosity of 134.2 cst. at 37.8° C., 10.0 g. of hexachlorodiphenyl, and 3.0 g. of N,N'-dimethyl-N,N'-dioctyl-4,4'-diamino diphenyl methane is heated at 135° C. After being homogenized, 10.3 g. of Aerosil-300 is added hereto and the mixture is treated in a way similar to Example 1.

The testing result is shown in Table 1 and FIG. 1.

Example 7

The mixture of 85.2 g. of paraffinic mineral oil having viscosity of 55.2 cst. and aniline point of 96.3° C, 4.5 g. of tetrachlorodiphenyl and 0.5 g. of N-isopropyl-N'-phenyl-para-phenylene-diamine is heated at 140° C.

After being homogenized, 9.8 g. of Aerosil-300 is added thereto and the mixture is treated in a way similar to Example 1.

The testing result is shown in Table 1 and FIG. 1.

Example 8

The mixture of 75.8 g. paraffinic mineral oil having viscosity of 136.5 cst. and aniline point of 115.6° C., 14.5 g. of heptachlorodiphenyl, 1.5 g. of N,N,N',N-tetraethyl-4,4-diamino diphenyl methane and 1.1 g. of N,N'-di-sec-butyl-para-phenylene diamine is heated at 150° C.

After being homogenized, 7.1 g. of Aerosil-200 is added thereto and the mixture is treated in a way similar to Example 1.

The testing result is shown in Table 1 and FIG. 1.

Example 9

The mixture of 80.8 g. of paraffinic mineral oil having viscosity of 82.5 cst. at 37.8° C. and aniline point of

102.5° C., 8.5 g. of hexachlorodiphenyl and 2.0 g. of tetra base is heated at 140° C.

After being homogenized, 8.7 g. of Aerosil-200 is added thereto and the mixture is treated in a way similar to Example 1.

The testing result is shown in Table 1 and FIG. 1.

Example 10

The mixture of 83.1 g. of paraffinic mineral oil having viscosity of 98.5 cst. and aniline point of 112.0° C., 4.5 g. of heptachlorodiphenyl, and 2.2 g. of tetra base is heated at 135° C.

After being homogenized, 10.2 g. of Aerosil-2491 [the trade name of the product (BET surface area of about 300 m.²/g.) of Degussa Co. Ltd.] is added thereto and the mixture is treated in a way similar to Example 1.

The testing result is shown in Table 1 and FIG. 1.

Example 11

The mixture of 80.8 g. of paraffinic mineral oil having viscosity of 77.5 cst. and aniline point of 108.2° C., 7.3 g. of hexachlorodiphenyl and 2.5 g. of N,N'-di-sec-butyl-para-phenylene diamine is heated at 140° C.

After being homogenized, 9.4 g. of Aerosil-2491 is added thereto and the mixture is treated in a way similar to Example 1.

The testing result is shown in Table 1 and FIG. 1.

Table 1 shows the test results of antiwearing property of the greases of from Example 1 to 11 and commercially available conventional greases for comparison.

The test was carried out as follows.

The greases were applied to the sliding contact which comprises a combination of a movable contact rivet and fixed contact plate. The material used for the fixed contact plate is nickel.

The radius of curvature of the top of the movable contact rivet is 2 mm. The rivet is made of at least one member selected from the group consisting of platinum, gold, silver, copper and their alloys. The wear of the contact rivet was measured as decreased thickness of the top of the rivet after 50 thousand times of sliding action with sliding speed of 8 cm./sec. and sliding distance of 4 cm.

As the value of the electrical contact resistance fluctuates with sliding action, the peak value of contact resistance has little meaning.

Therefore, the energy E that was consumed at the contact in a given time was counted.

Energy E is expressed as follows.

$$E=\int_0^t i^2 Rc\,dt \qquad (1)$$

i: contact current measured

t: time measured

Rc: Electric contact resistance

In the present case, the condition is as follows.

i=50 ma.

t=1 sec.

The reference numbers 1 to 19 in FIG. 1 correspond to the test number in Table 1, respectively.

Generally speaking, the difference between the contact resistance before and after sliding action should not be large in order to be used effectively for electric contact.

It is clear from FIG. 1 that the grease according to the present invention has little difference between the contact resistance at the beginning and after 50 thousand times of sliding action.

Consequently, the grease according to the present invention provides an electric contact having a stable contact resistivity, with prevention of noise generation completely and lengthening the life of the electric contact.

TABLE 1

Test No.	Sample of grease	Compressive load of contact (g.)	Material of contact rivet	Wear of contact rivet (thickness) (mm.)
1	Example 1	100	Ag	0.036
2	Example 2	100	Ag	0.022
3	Example 3	100	Ag	0.025
4	Example 4	100	Ag	0.032
5	Example 5	100	Ag	0.027
6	Example 6	100	Ag	0.015
7	Example 7	100	Ag	0.043
8	Example 8	100	Ag	0.010
9	Example 9	100	Ag	0.024
10	Example 10	100	Ag	0.023
11	Example 11	100	Ag	0.020
12	Li-soap grease	100	Ag	0.018
13	Silicone grease	100	Ag	0.070
14	Grease containing MBP [1] instead of tetra base [2] in Ex. 1.	100	Ag	0.048
15	Example 9	20	Ag	0.008
16	do	400	Ag	0.058
17	do	100	Ag-Cu (90-10)	0.018
18	do	100	Au-Ag-Pt (60-21-6)	0.016
19	do	100	Nickel silver	0.012

[1] MBP=4,4'-methylene bis (2,6-di-tert. butyl phenol).
[2] Tetra base=4,4'-tetramethyldiaminodiphenylmethane.

We claim:

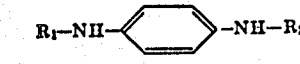
1. A contact grease consisting essentially of

(a) a major amount of paraffinic mineral oil,

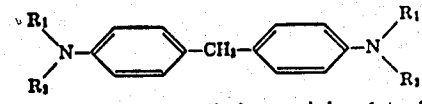
(b) 2 to 15 percent by weight of at least one chlorinated aromatic hydrocarbon selected from the group consisting of chlorinated diphenyl and chlorinated triphenyl,

(c) 7 to 12 percent by weight of colloidal silica, and

(d) 0.1 to 3.0 percent by weight of at least one member selected from the group consisting of (i) amino compounds having the following formula:



wherein R_1 is alkyl containing 3 to 10 carbon atoms, and R_2 is a member selected from the group consisting of alkyl containing 3 to 10 carbon atoms, cycloalkyl and phenyl and (ii) amino compounds having the following formula:



wherein R_1 and R_2 are alkyl containing 1 to 10 carbon atoms, respectively.

2. A contact grease of claim 1, wherein said paraffinic mineral oil has viscosity of 50 to 140 centistokes at a temperature of 37.8° C. and aniline point of higher than 95.

3. A contact grease of claim 1, wherein said chlorinated aromatic hydrocarbon is a member selected from the group consisting of tetrachlorodiphenyl, pentachlorodiphenyl, hexachlorodiphenyl and polychlorotriphenyl.

4. A contact grease of claim 1, wherein said colloidal silica has BET surface area of from 180 to 330 m.²/g.

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