A resin coupling connected to a resin fuel hose is provided. An O-ring is fitted in the inner cylindrical wall of the pipe inserting section of a coupling body. The electrical resistance of the coupling body meets $10^6$ to $10^{10}$ $\Omega$·cm in volume resistivity, or $10^6$ to $10^{10}$ $\Omega$ in surface resistivity.
FUEL HOSE RESIN COUPLING

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to a fuel hose coupling connected to a fuel hose, and more particularly to a fuel coupling which is so designed that an O-ring is fitted in the inner wall of the pipe inserting section of the coupling body.


[0004] 2. Description of the Related Art

[0005] In this specification, the term “electrical deterioration of resin” is intended to mean that current flows in the contact part of different kinds of members, so that the resin is deteriorated. The resin electrical deterioration may includes electrolytic deterioration and thermal (Joule heat) deterioration.

[0006] For instance, Japanese Patent Publication No. Hei. 4-224394 is not a literature which does not particularly relates to the invention, but a literature which shows a general technical level and is herein incorporated by reference.

[0007] A resin fuel hole generally requires compound characteristics such as gasoline resistance, gasohol resistance, gasoline permeability resistance, and moisture permeability resistance. Therefore, generally, a hose body 12 is of a multi-layer structure as shown in FIG. 1.

[0008] For instance, the resin fuel hole is designed as follows: A body layer 14 is formed of polyamide such as nylon 11, nylon 12, or the like, excellent in gasohol resistance and moisture permeability resistance, and having flexibility. And an inner layer (the innermost layer) 16 of fluoro-resin material is formed which is much higher in characteristics such as gasoline resistance and gasoline permeability resistance than the nylon 11 or nylon 12 inside the body layer 14 (cf. U.S. Pat. No. 5,383,087).

[0009] The inner surface of the resin fuel hole is liable to be electrostatically charged by the flow of fuel. Therefore, it is necessary that the amount of electrostatic charge is suppressed to a predetermined value, whereby to prevent the occurrence of electrostatic trouble.

[0010] For this purpose, generally, the inner layer 16 is formed with a material whose electrical resistance is lower than a predetermined value (usually 1x10^8 Ω) to make static electricity generate easily, so that the static electricity (charge) is allowed to leak to other electrically conductive members.

[0011] That is, the static electricity generated in the inner layer 16 is removed through a nipple 20 of an electrically conductive quick connector and through a metal pipe 22 which is connected to the quick connector 18 and grounded (cf. FIG. 2).

[0012] The structure of the quick connector 18 is such that an O-rings are fitted in the inner cylindrical wall of the pipe inserting section 26 of the coupling body 24. This is to connect the metal pipe to the coupling 18 in one action.

[0013] On the other hand, the electrically conductive quick connector is mainly made of resin in view of assembling work, productivity (injection molding can be utilized) and the reduction of weight.

[0014] In order to discharge the static electricity (charge), the quick connector is generally made of a resin which is lower than volume resistivity 10^7 Ω·cm or lower or surface resistivity 10^6 Ω.

[0015] It has been found that the resin quick connector having electrical resistance is accelerated in electrical deterioration.

SUMMARY OF THE INVENTION

[0016] In view of the foregoing, an object of the invention is to provide a fuel hose resin coupling in which the coupling body is scarcely electrically deteriorated.

[0017] The inventors have conducted intensive research on the solution of the above-described problem, and found that the cause for the electrical deterioration of the resin coupling is as follows:

[0018] In the discharge path (or charge leak path) of the inner layer 16, the coupling body 24, and the metal pipe 22, a gap which is for the assembling of the metal pipe 22 and the coupling 18 is provided between the metal pipe 22 and the pipe inserting section 26 of the coupling body 24. The gap between the metal pipe 22 and the pipe inserting section 26 is sealed with O-rings 28. Because of the function of the O-ring 28, it is not permitted that its electrical resistance is low to the extent that static electricity can leak. In order to make the electrical resistance low, it is necessary that a large quantity of carbon black is employed to reduce the electrical resistance of the O-ring; however, in order to seal the gap well, it is not suitable to employ a large quantity of carbon black.

[0019] Therefore, the charge moved from the inner layer 16 to the coupling body 24 behaviors as follows: that is, when the metal pipe 22 is brought into point-contact with the coupling body because of the vibration of the traveling vehicle, current flows in the contact part of the coupling body 24 and the metal pipe 22. This current is a factor which expedites the deterioration (or dissolution) of the coupling body 24 of resin.

[0020] In this connection, it has been found that, if the electrical resistance of the coupling body is in a predetermined range, then the current which expedites the deterioration of the coupling body 24 does not flow in the contact part of the coupling body 24 and the metal pipe 22. As a result, the following fuel hose resin coupling has been thought of.

[0021] The fuel hose resin coupling according to the present invention has an O-ring fitted in the inner cylindrical wall of the pipe inserting section of a coupling body. A specific feature of the resin coupling resides in that the electrical resistance of the coupling body meets 10^7 to 10^10 Ω·cm in volume resistivity or 10^6 to 10^10 · in surface resistivity.

[0022] In this connection, it is preferable that the coupling body has an electrically conductive film, because the surface resistivity of the coupling body can be readily set in the above-described range.
In addition, it is preferable that an electrically conductive elastic member is arranged on the bottomed step of the pipe inserting section. In this case, it is preferable that each of the volume and surface resistivities of the elastic member is smaller than those of the coupling body, because the discharge path is maintained well.

Features and advantages of the invention will be evident from the following detailed description of the preferred embodiments described in conjunction with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross sectional view of an example of a fuel hose;

FIG. 2 is a sectional view of an example of a resin coupling, which constitutes an embodiment of the invention;

FIG. 3 is a sectional view showing another assembling example of the resin coupling; and

FIG. 4 is a sectional view of the resin coupling on which an electrically conductive film is formed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A resin coupling of the invention will be described mainly with reference to FIG. 2.

The resin coupling of the invention is connected to a resin fuel hose (or a hose body) 12, and O-rings 28 are fitted in the inner cylindrical wall of the pipe inserting section 26 of the coupling body 24. That is, it is a quick connector.

In the embodiment shown, the hose body 12 is of a double-layer structure having a body layer 14 and an innermost pipe layer, namely, an inner layer 16; however, it may be of a single layer structure, or a multi-layer structure consisting of three through six layers. In FIG. 2, reference numeral 25 designates a hose protector of elastomer.

An insulating resin forming the body layer 14 may be any resin which meets characteristics required by the fuel hose; however, it is preferable to employ nylon 11 or nylon 12 which is excellent in gasohol resistance, small in water absorption coefficient, flexible, and high in low temperature resistance.

Furthermore, it is preferable that the inner layer 16 inside the hose body layer 14 is made of an electrically conductive fluoro-resin material.

In the case where the body layer 14 is of nylon, and the inner layer 16 is of fluoro-resin, since those materials cannot be connected together by welding, usually an adhesive layer is interposed between the body layer 14 and the inner layer 16.

In the resin coupling of the invention, it is a specific essential feature that the electrical resistance of the coupling body 14 meets $10^4$ to $10^{10}$ $\Omega$ cm (preferably $10^7$ to $10^9$ $\Omega$ cm) in volume resistivity or $10^6$ to $10^{10}$ $\Omega$ (preferably $10^7$ to $10^8$ $\Omega$) in surface resistivity.

If the electrical resistance of the quick connector exceeds the upper limit value, then the electrical resistance is too high to move the static electricity generated inside the hose through the quick connector 18 to the metal pipe 22. On the other hand, the electrical resistance is lower than the lower limit value, then a great current flows in the discharge path; that is, the contact of the coupling body 24 and the metal pipe 22, so that, in the quick connector, the resin may be electrically deteriorated.

The quick connector may have the above-described range of electrical resistance as follows: That is, it may be formed with a hard resin material which is obtained by mixing electrically conductive filler with hard resin material. Alternatively, as shown in FIG. 4, an electrically conductive film 30 may be formed on the surface of the coupling body 24 which is formed with hard resin material.

Preferably, the hard resin material is polyacetal (POM), polyamide (PA), poly vinyl chloride (PVC), poly-ester, or polypropylene.

Preferably, the electrically conductive filler is carbon black, graphite, or stainless steel, and high electrically conductive metal material such as copper, silver and gold.

Means for forming the electrically conductive film 30 may be electrically conductive painting coating, electrically conductive ink printing, electrically plating, vacuum evaporating, flame coating, sputtering, or ion plating. However, in view of the productivity, it is preferably to employ the electrically conductive paint coating or electrically conductive ink printing.

The electrically conductive paint/ink is the mixture of electrically conductive filler, and binder such as synthetic resin, solvent and additive which is hardened to form an electrically conductive paint. The electrically conductive filler may be those which have been described above. However, in the case of electrically conductive film, it is preferable that it is carbon black or graphite which is not expensive, because it is not required that the electrically conductive film is high in electrical conductivity.

In addition, it is preferable that the binder, namely, the synthetic resin is high in adhesion with the body layer 14. For instance, in the case where the body layer is made of nylon 11 and nylon 12, it is preferable that the synthetic resin is polyurethane, acrylic resin (including ultraviolet-hardened type), and alkyd resin because they are high in weather resistance.

The surface of the coupling body 24 has the electrically conductive film. Therefore, the coupling body which has an electrical resistance of $10^4$ to $10^{10}$ $\Omega$ in surface resistivity, can be readily prepared.

As shown in FIG. 3, an electrically conductive elastic member 32 is arranged on the bottomed step 27 of the pipe inserting section 26. Each of the volume and surface resistivities of the elastic member 32 is made smaller than those of the coupling body 24, whereby a direct and stable discharge path can be formed by electrical conduction (including charge movement). Preferably, each of the volume and surface resistivities of the elastic member 32 is set not less than 0.1% and less than 10% of those of the coupling body 24. Therefore, electrical conduction is smoothly carried out from the coupling body 24 to the metal pipe 22; that
is no charge is stored in the coupling body 24, and the flow of large current through the contact part of the coupling body 24 and the metal pipe 22 is more positively prevented.

[0046] In the embodiment, the elastic member 32 is of electrically conductive rubber; however, the invention is not limited thereto or thereby; that is, it may be a coil spring or leaf spring which is made of metal or electrically conductive hard plastic material.

[0047] In the fuel hose resin coupling of the invention, the electrical resistance of the coupling body meets $10^0$ to $10^{10}$ $\Omega \cdot cm$ in volume resistivity or $10^0$ to $10^{10}$ $\Omega$ in surface resistivity. Therefore, the resin coupling of the invention has the following functions and effects or merits:

[0048] If the electrical resistance of the quick connector 18 exceeds the upper limit value, then the electrical resistance becomes excessively high, so that it becomes difficult for the static electricity generated inside the hose to move to the metal pipe 22 through the quick connector 18. On the other hand, if the electrical resistance is lower than the lower limit value, a large current flows in the coupling body 24 and the metal pipe 22 in the discharge path, so that the quick connector 18 may be electrically deteriorated.

[0049] Hence, in the fuel hose resin coupling of the invention, the resin body is scarcely electrically deteriorated.

[0050] Furthermore, since the surface of the coupling body has the electrically conductive film, it is readily possible to allow the coupling body to have the above-described surface resistivity.

[0051] In the fuel hose resin coupling of the invention, the electrically conductive elastic member is arranged on the bottomed step of the pipe inserting section. This feature makes it possible to form a direct and stable discharge path by discharge movement.

[0052] Hence, electrical conduction is smoothly carried out from the coupling body to the metal pipe. Furthermore, the coupling body is not charged. The difficulty can be prevented more positively that a large current flows in the contact part of the coupling body 24 and the metal pipe 22. Therefore, the electrical deterioration of the resin coupling body can be prevented more positively.

[0053] Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form can be changed in the details of construction and in the combination and arrangement of parts without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. A fuel hose resin coupling for connecting a resin fuel hose with a metal pipe, comprising:
   a coupling body to be inserted into the resin fuel hose and having a pipe inserting section into which the metal pipe is to be inserted; and
   an O-ring fitted in said pipe inserting section and disposed between said coupling body and the metal pipe, wherein an electrical resistance of said coupling body meets $10^0$ to $10^{10}$ $\Omega$ in surface resistivity.

2. A fuel hose resin coupling according to claim 1, wherein said coupling body has an electrically conductive film on a surface thereof, and has the electrical resistance of $10^0$ to $10^{10}$ $\Omega$ in the surface resistivity.

3. A fuel hose resin coupling according to claim 1, further comprising an electrically conductive elastic member being arranged on a bottom of said pipe inserting section.

4. A fuel hose resin coupling according to claim 3, wherein surface resistivity of said elastic member is smaller than that of said coupling body.

5. A fuel hose resin coupling according to claim 1, wherein the electrical resistance of said coupling body meets $10^0$ to $10^{6}$ $\Omega$ in the surface resistivity.

6. A fuel hose resin coupling according to claim 3, wherein volume resistivity of said elastic member is smaller than that of said coupling body.

7. A fuel hose resin coupling for connecting a resin fuel hose with a metal pipe, comprising:
   a coupling body to be inserted into the resin fuel hose and having a pipe inserting section into which the metal pipe is to be inserted; and
   an O-ring fitted in said pipe inserting section and disposed between said coupling body and the metal pipe, wherein an electrical resistance of said coupling body meets $10^0$ to $10^{10}$ $\Omega \cdot cm$ in volume resistivity.

8. A fuel hose resin coupling according to claim 7, further comprising an electrically conductive elastic member being arranged on a bottom of said pipe inserting section.

9. A fuel hose resin coupling according to claim 8, wherein volume resistivity of said elastic member is smaller than that of said coupling body.

10. A fuel hose resin coupling according to claim 7, wherein the electrical resistance of said coupling body meets $10^7$ to $10^{10}$ $\Omega \cdot cm$ in the volume resistivity.

11. A fuel hose resin coupling according to claim 8, wherein surface resistivity of said elastic member is smaller than that of said coupling body.

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