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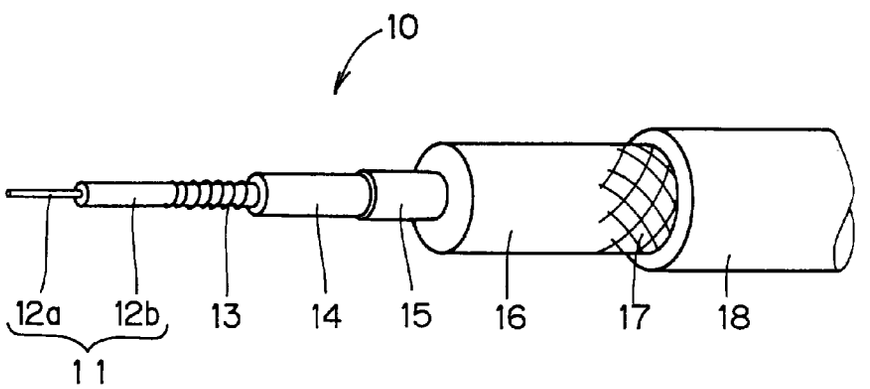
(54) Winding-type noise-suppressing high-tension resistive cord

(57) There is disclosed a winding-type noise-suppressing high-tension resistive cord which includes a core (11) having a reinforcing string (12a) and a coating layer (12b) made of fluororubber for extrusion-coating the reinforcing string (12a), a resistance wire (13) coiled around the core (11), an internal semi-conductive layer (14) having a flat surface and made of semi-conductive fluororubber for extrusion-coating the core (11) around which the resistance wire (13) is coiled, a release layer (15) formed on the internal semi-conductive layer (14), an insulating layer (16) for coating the release layer (15), a reinforcing braid (17) for coating the insulating layer (16), and a sheath (18) for coating the reinforcing braid (17), thereby establishing stable electrical connection to a terminal without the need to cause the resistance wire to resiliently dent the surface of the core and without reduction in withstand voltage if a conductor diameter is reduced for decrease in electrostatic capacity of the cord.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a winding-type noise-suppressing high-tension resistive cord to be used as an ignition cable for an internal combustion engine of an automotive vehicle and the like.

Description of the Prior Art

High-tension resistive cords for transmitting a high voltage generated at an ignition coil to a spark plug directly or through a distributer have been required to have a low electric transmission loss, a good noise suppressing effect, and high resistance to heat and voltage. In general, currently used high-tension resistive cords are of two types: a string-type high-tension resistive cord which includes fibers impregnated with carbon; and a winding-type high-tension resistive cord which includes a metal small-gage wire having a high specific resistance and wound about a core made of a magnetic material or the like.

As shown in Fig. 5 is disclosed the winding-type high-tension resistive cord which comprises a reinforcing string 51 of aramid fibers, glass fibers or the like; a core 52 formed by extrusion-coating the reinforcing string 51 with a base polymer including ferrite powder mixed therein; a resistance wire 53 coiled around the core 52; an insulating layer 54 for extrusion-coating the core 52 and the resistance wire 53; a braid 55 for coating the insulating layer 54; and an outermost sheath 56 for coating the braid 55 (Japanese Utility Model Publication No. 1-32253 (1989)).

However, the above described winding-type high-tension resistive cord, wherein the resistance wire coiled around the core is loosened or unwound when the insulating layer is cut and stripped, requires a purpose-built cutting and stripping machine, and it is hence impractical to put the winding-type high-tension resistive cords alone on the market. To solve such a problem, the resistance wire is required to resiliently dent the surface of the core when it is coiled around the core (Japanese Patent Publication No. 5-42084 (1993)).

When the winding-type high-tension resistive cord is used as an ignition cable for an automotive vehicle, conductive materials such as salt and sludge deposited on the outer periphery of the cable increase the electrostatic capacity of the cord to reduce voltage supplied to a spark plug. Thus a need arises to reduce the electrostatic capacity of the cord itself. To reduce the electrostatic capacity of the cord having a constant outer diameter, it is necessary to reduce a conductor diameter. However, the reduction in diameter of the conductor (the core around which the resistance wire is coiled) in the above described winding-type high-tension resistive cord increases a field strength, and an uneven conductor surface formed by winding the resistance wire around the core causes a dielectric breakdown, resulting in lowered withstand voltage.

For electrical connection between the winding-type high-tension resistive cord and a metal terminal, as shown in Fig. 6, a conductor portion (the core 52 and the resistance wire 53) exposed by stripping the insulating layer is bent along the outer surface of the cord in its longitudinal direction, and a tubular metal terminal A is fitted on the cord, with the conductor portion bent. Thus, the reduction in conductor diameter decreases a contact area between the conductor portion and the metal terminal A, resulting in unstable electrical connection.

The core made of inexpensive ethylene propylene rubber (EP rubber) for reduction in fabrication cost of the cord presents a problem. That is, since the EP rubber is not heat-resistant, the core subjected to heat deterioration is softened to cause the resistance wire to be embedded more deeply than necessary in the core. This produces a clearance between the resistance wire and the metal terminal to establish unstable electrical connection.

SUMMARY OF THE INVENTION

According to the present invention, a winding-type noise-suppressing high-tension resistive cord comprises: a core; a resistance wire coiled around the core; an internal semi-conductive layer having a flat surface and made of semi-conductive fluororubber for extrusion-coating the core around which the resistance wire is coiled; a release layer for coating the internal semi-conductive layer; and an insulating layer for coating the release layer.

Preferably, the release layer is formed of graphite-containing silicone oil.

Preferably, the core includes a reinforcing string of aramid fiber, and a coating layer composed mainly of rubber for coating the reinforcing string.

According to the winding-type noise-suppressing high-tension resistive cord as above constructed, the presence of the release layer facilitates the stripping of the insulating layer, and the presence of the internal semi-conductive layer made of the semi-conductive fluororubber prevents the direct application of the force acting to strip the insulating layer to the resistance wire, thereby preventing the resistance wire from being loosened or unwound when the resistance wire is not caused to resiliently dent the surface of the core.

The flat surface of the internal semi-conductive layer alleviates the increase in field strength to prevent remarkable deterioration of the withstand voltage characteristic if the conductor diameter is reduced. Electrical connection between the metal terminal and the resistance wire through the internal semi-conductive layer does not decrease the contact area between the terminal and the conductor if the conductor diameter is reduced.

Further, if the core made of an inexpensive material which is not heat-resistant is subjected to heat deterio-

ration to cause the resistance wire to be fully embedded in the core, the presence of the internal semi-conductive layer does not produce a clearance between the metal terminal and the resistance wire. This provides stable electrical connection.

It is therefore an object of the present invention to provide a winding-type noise-suppressing high-tension resistive cord which establishes stable electrical connection to a terminal without the need to cause a resistance wire to resiliently dent a surface of a core and without reduction in withstand voltage if a conductor diameter is reduced to decrease the electrostatic capacity of the cord.

These and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a winding-type noise-suppressing high-tension resistive cord according to a first preferred embodiment of the present invention;

Fig. 2 is a sectional view of the winding-type noise-suppressing high-tension resistive cord connected to a metal terminal;

Fig. 3 is a perspective view of the winding-type noise-suppressing high-tension resistive cord according to a second preferred embodiment of the present invention;

Fig. 4 is a perspective view of the winding-type noise-suppressing high-tension resistive cord according to a third preferred embodiment of the present invention;

Fig. 5 is a perspective view of a conventional winding-type noise-suppressing high-tension resistive cord; and

Fig. 6 is a sectional view of the conventional winding-type noise-suppressing high-tension resistive cord connected to a metal terminal.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments will now be described according to the present invention with reference to the drawings. Referring to Fig. 1, a winding-type noise-suppressing high-tension resistive cord 10 comprises a semi-conductive core 11 of a 1.3 mm outer diameter including a reinforcing string 12a of three twisted 1000-denier aramid yams and a coating layer 12b made of fluororubber including ferrite powder mixed therein for extrusion-coating the reinforcing string 12a. A 50 μm Ni-Cr resistance wire 13 is coiled 7200 times per meter around the core 11. The coating layer 12b includes 100 parts by weight of the fluororubber and 400 parts by weight of the ferrite powder. The core 11 around which the resistance wire 13 is coiled is extrusion-coated with semi-conductive fluororubber having an electrical conductivity of about 1000 to 10000 Ω·cm which forms an internal semi-conductive layer 14 of a 1.5 mm outer diameter and having a flat surface.

On the internal semi-conductive layer 14 is formed a release layer 15 of graphite-containing silicone oil. On the release layer 15 is formed an insulating layer 16 of a 4.6 mm outer diameter by extrusion coating of ethylene propylene rubber. The insulating layer 16 is coated with a reinforcing braid 17 of glass yarn which in turn is coated with a sheath 18 made of ethylene propylene rubber.

In the winding-type noise-suppressing high-tension resistive cord 10 constructed as above stated, the presence of the release layer 15 facilitates the stripping of the insulating layer 16, and the presence of the internal semi-conductive layer 14 prevents the direct application of a force acting to strip the insulating layer 16 to the resistance wire 13 to prevent the resistance wire 13 from being loosened or unwound during the stripping of the insulating layer 16 if the resistance wire 13 coiled around the core 11 is not, in particular, caused to resiliently dent the surface of the core 11. Further, if the outer diameter of the conductor portion is reduced for decrease in electrostatic capacity of the cord 10, the presence of the flat-surface internal semi-conductive layer 14 through which the connection is made between the resistance wire 13 and a metal terminal A as shown in Fig. 2 alleviates the increase in field strength to prevent reduction in withstand voltage characteristic and extreme decrease in contact area between the metal terminal A and the conductor portion. This provides stable electrical connection between the resistance wire 13 and the metal terminal A.

Fig. 3 illustrates a second preferred embodiment according to the present invention. A winding-type noise-suppressing high-tension resistive cord 20 according to the second preferred embodiment comprises a core 21 including a reinforcing string 22a and a coating layer 22b, a resistance wire 23, an internal semi-conductive layer 24, a release layer 25, an insulating layer 26, a reinforcing braid 27, and a sheath 28, similar to the first preferred embodiment. The winding-type noise-suppressing high-tension resistive cord 20 of the second preferred embodiment differs from that of the first preferred embodiment in material and outer diameter of some of the constituents. Specifically, the coating layer 22b includes 500 parts by weight of ferrite powder and 100 parts by weight of EP rubber, and has an outer diameter of 1.1 mm. The resistance wire 23 is a Ni-Cr resistance wire having an outer diameter of 40 μm and coiled 6000 times per meter around the core 21. The internal semi-conductive layer 24 is made of semi-conductive fluororubber, similar to that of the first preferred embodiment, but has an outer diameter of 1.3 mm. Other constructions of the second preferred embodiment are identical with those of the first preferred embodiment.

The winding-type noise-suppressing high-tension resistive cord 20 employs EP rubber which is inexpensive but not heat-resistant as a base polymer of the coat-

ing layer 22b. When the EP rubber is subjected to heat deterioration to cause the resistance wire 23 to be fully embedded in the core 21, the presence of the internal semi-conductive layer 24 which covers the core 21 and the resistance wire 23 provides stable electrical contact without a clearance between the resistance wire 23 and the metal terminal A.

Fig. 4 illustrates a third preferred embodiment according to the present invention. A winding-type noise-suppressing high-tension resistive cord 30 comprises a core 31 including a reinforcing string 32a and a coating layer 32b, a resistance wire 33, an internal semi-conductive layer 34, a release layer 35, an insulating layer 36, a reinforcing braid 37, and a sheath 38, similar to the first and second preferred embodiments. The winding-type noise-suppressing high-tension resistive cord 30 of the third preferred embodiment differs from those of the first and second preferred embodiments in material and outer diameter of some of the constituents. Specifically, the reinforcing string 32a includes three twisted 400-denier aramid yarns. The coating layer 32b is formed of a fluororubber coating applied over the reinforcing string 32a and has an outer diameter of 0.6 mm. The resistance wire 33 is a Ni-Cr resistance wire having an outer diameter of 40 μm, similar to that of the second preferred embodiment, but coiled 10000 times per meter around the core 31. The internal semi-conductive layer 34 is made of semi-conductive fluororubber, similar to those of the first and second preferred embodiments, but has an outer diameter of 0.8 mm. Other constructions of the third preferred embodiment are identical with those of the first and second preferred embodiments.

In the winding-type noise-suppressing high-tension resistive cord 30, the resistance wire 33 is not permitted to resiliently dent the surface of the core 31 when it is coiled since the coating layer 32b is made of the fluororubber coating applied over the reinforcing string 32a as above described. However, the presence of the internal semi-conductive layer 34 which covers the resistance wire 33 and the core 31 prevents the direct application of a force acting to strip the insulating layer 36 to the resistance wire 33, thereby preventing the resistance wire 33 from being loosened or unwound.

While the invention has been shown and described in detail, the foregoing description is in all aspects illustrative and not restrictive. It is therefore understood that numerous modifications and variations can be devised without departing from the scope of the invention.

Claims

1. A winding-type noise-suppressing high-tension resistive cord comprising:
   a core;
   a resistance wire coiled around said core;
   an internal semi-conductive layer having a flat surface and made of semi-conductive fluororubber for extrusion-coating said core around which said resistance wire is coiled;
   a release layer for coating said internal semi-conductive layer; and
   an insulating layer for coating said release layer.

2. The winding-type noise-suppressing high-tension resistive cord of claim 1, wherein
   said internal semi-conductive layer has an electrical conductivity of 1000 to 10000 Ω·cm.

3. The winding-type noise-suppressing high-tension resistive cord of claim 1, wherein
   said release layer is formed of graphite-containing silicone oil.

4. The winding-type noise-suppressing high-tension resistive cord of claim 1, further comprising:
   a reinforcing braid for coating said insulating layer; and
   a sheath for coating said reinforcing braid.

5. The winding-type noise-suppressing high-tension resistive cord of claim 1, 2, 3, or 4, wherein
   said core includes a reinforcing string of aramid fiber, and a coating layer composed mainly of rubber for coating said reinforcing string.

6. The winding-type noise-suppressing high-tension resistive cord of claim 5, wherein
   said coating layer is formed of fluororubber including ferrite powder mixed therein for extrusion-coating said reinforcing string, and
   said coating layer includes 400 parts by weight of said ferrite powder and 100 parts by weight of said fluororubber.

7. The winding-type noise-suppressing high-tension resistive cord of claim 5, wherein
   said coating layer is formed of ethylene propylene rubber including ferrite powder mixed therein for extrusion-coating said reinforcing string, and
   said coating layer includes 500 parts by weight of said ferrite powder and 100 parts by weight of said ethylene propylene rubber.

8. The winding-type noise-suppressing high-tension resistive cord of claim 5, wherein
   said coating layer is formed of a fluororubber coating applied over said reinforcing string.

FIG. 1

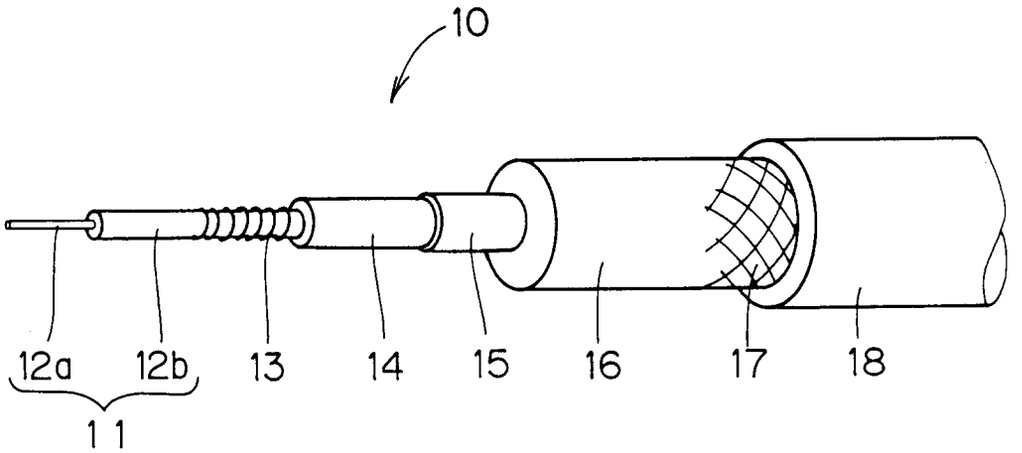

FIG. 2

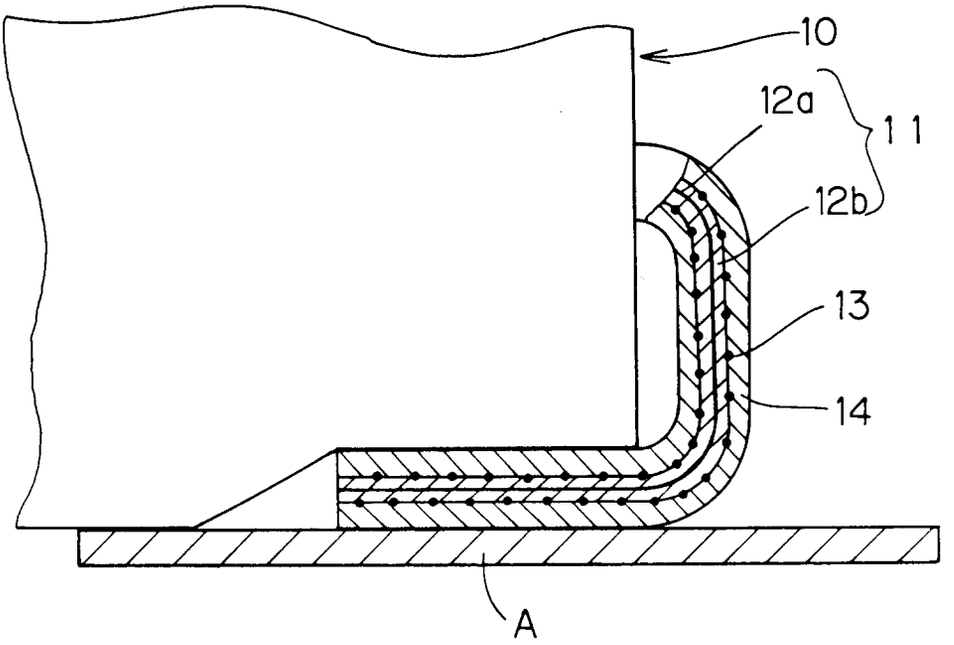

FIG. 3

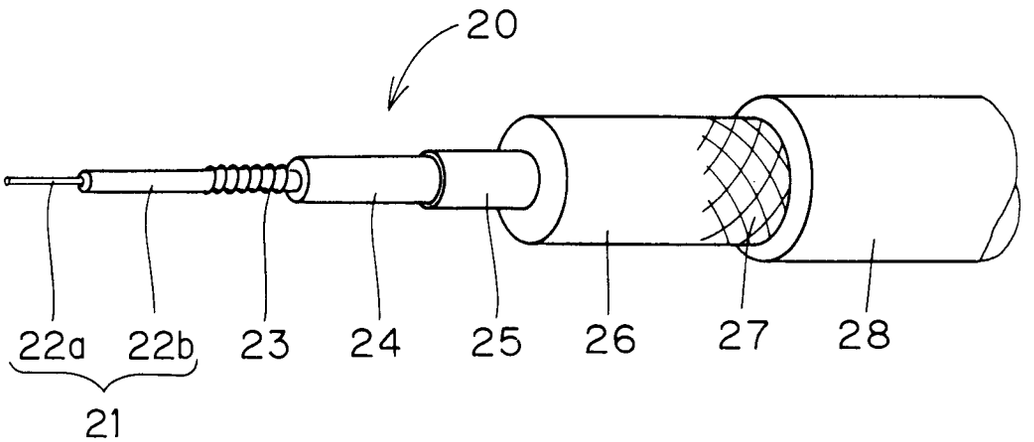

FIG. 4

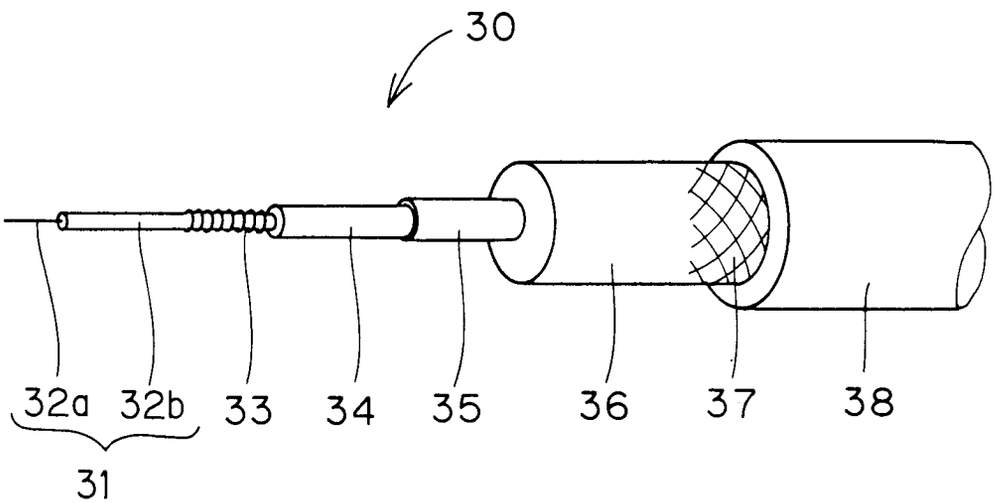

FIG. 5

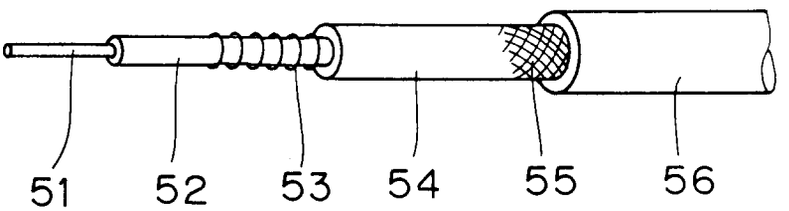

FIG. 6