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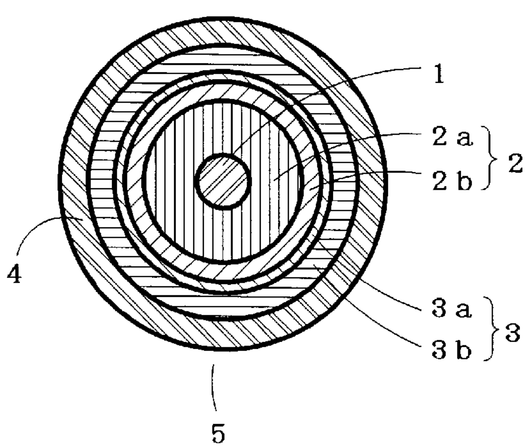
(54) **Semirigid coaxial cable and its method of manufacture.**

(57) The semirigid coaxial cable 5 comprises a center conductor 1, an insulating layer 2, outer conductor 3 and protective covering layer 4 in order. The insulating layer 2 comprises a first insulating layer 2a made of material having a low permittivity and a second insulating layer 2b made of a resin that can be more easily electroless-plated than the material of the first insulating layer 2a. The outer conductor 3 further comprises a electroless-plated anchoring metal layer 3a and electro-plated conductive metal layer 3b. The conductive metal layer 3b further comprises a copper-plated layer 3c, a glossy copper-plated layer 3d, and a strike plated nickel layer or tin-plated layer 3e.

F I G. 1




EP 0 675 507 A2

This invention relates to a semirigid coaxial cable and its method of manufacture, and more particularly to a semirigid coaxial cable used in high frequency circuit boards of electronic equipments such as telecommunication equipments and data processing equipments, and in signal transmission circuits of high frequency components, and to a method for manufacturing of said semirigid coaxial cable.

FIG. 11 shows an example of a conventional coaxial cable. In this coaxial cable 10, outer surface of a center conductor 1 is covered by an insulating layer 72 having a low permittivity. Said insulating layer 72 is further surrounded by an outer conductor 73 formed by braiding or by transversely winding a plurality of fine metallic wires, or by winding metal foil around said insulating layer 72. An external surface of said outer conductor 73 is covered by a protective cover layer 4 formed by hot extrusion of a material such as polyvinyl chloride (PVC) plastic.

FIG. 12 shows an example of a conventional semirigid coaxial cable.

In this semirigid coaxial cable 9, on the outer surface of a center conductor 1 made of copper or some other metal is covered by an insulating layer 62 having a low permittivity. Said insulating layer 62 may be formed by hot extrusion of perfluoro alkyl (PFA) vinyl ether-tetrafluorethylene copolymer resin. A metal pipe, such as a copper pipe, is provided closely to said insulating layer 62 to act as an outer conductor 63.

The conventional coaxial cable 10 mentioned above has openings in the outer conductor 73, due to which, its shielding characteristics become unsatisfactory.

On the other hand, the shielding characteristics of the conventional semirigid coaxial cable 9 are satisfactory, however, it has other problem which are described below.

While manufacturing the semirigid coaxial cable 9, insulated wire 60 is produced first and then inserted in a copper pipe with a comparatively large thickness. Next, the copper pipe is drawn using a die, to form an outer conductor 63, so that the insulated wire 60 and the copper pipe press firmly against each other. To improve the close contact, the outside diameter of the insulated wire 60 and inside diameter of the copper pipe must be approximately same. This results in increased friction and insertion of the insulated wire 60 into the copper pipe becomes difficult. For this reason, the semirigid coaxial cable can only be manufactured in short (for example, about 30 meters) lengths.

Furthermore, the copper pipe has to be manufactured in a separate, independent process and needs to have perfect circularity, necessitating a large thickness (for example, about 0.30 mm). This thickness changes very slightly (for example, about 0.26 mm) even when the pipe is drawn, and the pipe is difficult to bend and difficult to wind up. Even for this reason, the semirigid coaxial cable can only be manufactured in short length. And by this short length, a protective cover layer cannot be formed efficiently. Therefore, there is generally no protective cover layer, and hence, the applications of the conventional semirigid coaxial cable are restricted.

Also, the cable is subjected to very high stresses during drawing, which is likely to reduce dimensional accuracy. This leads to a problem of instability in high frequency transmission characteristics such as the characteristic impedance and the voltage standing wave ratio (VSWR). Moreover, since the cable is manufactured by drawing, at the mass production stage, the lower limit of its finished diameter is restricted to about 0.6 mm. In other words, there is another problem that the manufacture of smaller diameter cables is difficult.

Coaxial cable, in which the outer conductor of the conventional coaxial cable 10 is formed by electroplating, have been described in the unexamined Japanese patent publication no. 81938/1993. It has also been mentioned that, if fluororesin is used for the insulating layer in this cable, then, roughing the surface beforehand using Tetraetch (brand name, Junkosha Co.,Ltd.) is recommended for improving the adhesion with the copper plating. A method of roughing the surface of an insulating material by chemically etching with sodium metal has been described in the unexamined Japanese utility model publication no. 20014/1968. However, the etching solutions mentioned above are not practically usable because of their high cost and the high risk involved in handling them. Furthermore, since a high degree of adhesion is obtained between the insulating material and the plated layer by the treatment methods mentioned above, the separation becomes difficult. Due to this, stripping the ends of the cable for making terminal connections becomes troublesome.

An aim of the present invention is to provide a semirigid coaxial cable which has good shielding characteristics, is possible to manufactured in long lengths, is possible to form a protective cover layer, has stable high frequency transmission characteristics, is possible to manufactured in small diameters, is possible to do electroless plating easier than doing electroless plating directly on the insulating material having a low permittivity and is possible to do ends stripping easily. It is an another aim of the present invention to offer a satisfactory method for manufacturing said semirigid coaxial cable.

In order to accomplish the above mentioned aims, this invention provides a semirigid coaxial cable comprises a center conductor, a first insulating layer, on the outer surface of said center conductor, formed of a material having a low permittivity, a second insulating layer, on the outer surface of said first insulating layer, formed of a resin which can be easily electroless-plated as compared to the material of said first insulating layer, and an outer conductor, surrounding said center conductor, said first and second insulating layers, formed by a electroless-plated anchoring metal layer and a electro-plated conductive metal layer.

Furthermore, this invention provides a semirigid coaxial cable wherein the outer conductor is provided with a protective cover layer on the outer surface conductor.

This invention provides a semirigid coaxial cable wherein said conductive metal layer is comprised of a copper-plated layer, a glossy copper-plated layer, and a strike plated nickel layer or a tin-plated layer.

This invention provides a semirigid coaxial cable wherein said first insulating layer is formed of fluororesin-based or polyolefine-based resins having a low permittivity.

This invention provides a semirigid coaxial cable wherein said second insulating layer is formed by hot-extruding a resin or by winding an insulating tape.

This invention provides a semirigid coaxial cable wherein thickness of said second insulating layer is 5 μm or more and less than 20% the thickness of said first insulating layer.

This invention provides a semirigid coaxial cable wherein diameter of said center conductor is 0.20 mm or less, and finished diameter of said semirigid coaxial cable is 0.90 mm or less.

This invention provides a method for manufacturing a semirigid coaxial cable comprising a covering process for first insulating layer, wherein outer surface of a center conductor is covered by insulating material having a low permittivity, a covering process for second insulating layer, wherein outer surface of said first insulating layer is covered by a resin which can be easily electroless-plated as compared to the material of said first insulating layer, an electroless plating process, wherein outer surface of said second insulating layer is covered by a electroless-plated anchoring metal layer, and an electroplating process, wherein outer surface of said electroless-plated anchoring metal layer is covered by a conductive metal layer.

Furthermore, this invention provides a method for manufacturing a semirigid coaxial cable comprising a covering process, wherein outer surface of said conductive metal layer is covered by a protective cover layer.

This invention provides a method for manufacturing a semirigid coaxial cable comprising a copper plating process for forming a copper-plated layer, a glossy copper plating process for forming a glossy copper-plated layer, and a strike plating process for forming a strike plated nickel layer or a tin plating process for forming a tin-plated layer.

This invention provides a method for manufacturing a semirigid coaxial cable comprising a heat treatment process after carrying out said electroplating process.

The reason for restricting the thickness of the second insulating layer to 5 μm or more is basically due to the fact that, 5 μm is almost the lowest limit of thickness achievable with the existing engineering techniques, moreover, for this thickness electroplating is possible and end stripping is easy. Furthermore, the thickness is restricted to less than 20% of the thickness of the first insulating layer to maintain the various characteristics of the coaxial cable which uses a low permittivity first insulating layer.

In the semirigid coaxial cable of the present invention, after the outer surface of a first insulating layer is covered by a second insulating layer, an outer conductor, comprising successively of a electroless-plated anchoring metal layer and electro-plated conductive metal layer, is formed on outer surface of said second insulating layer. Since there are no openings in the outer conductor, the shielding characteristics are good. Furthermore, since the outer conductor is formed by electroless plating and electroplating, the insulated wire need not be inserted in a copper pipe. Moreover, since an outer conductor with a small (for instance, 0.10 mm) diameter is utilized, the semirigid coaxial cable can be easily bent and wound. And a large length of over 1,000 m can be manufactured. Since products of long length can be manufactured, a protective cover layer can be formed efficiently. As a result, the semirigid coaxial cable can be used in a wide range of applications. In addition, since the wire is not drawn, and only a liquid pressure is applied during the plating process, dimensional accuracy is not compromised, and stable high frequency transmission characteristics, such as characteristic impedance and voltage standing wave ratio are achieved. Furthermore, manufacturing of semirigid coaxial cables having finished diameters of under 0.90 mm becomes possible.

In the above mentioned structure, if said electroplated conductive metal layer is made up of a copper-plated layer, a glossy copper-plated layer and a strike plated nickel layer or a tin-plated layer, adhesion of the outer conductor to the second insulating layer is enhanced because of the copper-plated layer and the anchoring metal layer, conductivity is improved because of the glossy copper-plated layer, corrosion resistance and solderability are enhanced because of the strike plated nickel layer or tin-plated layer. Therefore the mentioned composition is particularly preferable.

Furthermore, the first insulating layer is made of fluororesins having a low permittivity such as polytetrafluoroethylene (PTFE) resin, perfluoro alkyl (PFA) vinyl ether-tetrafluoroethylene copolymer resin, fluorinated ethylene propylene (FEP) copolymer resin, ethylene tetrafluoroethylene (ETFE) copolymer resin, or polyolefine-based resins such as polyethylene (PE) resin or polypropylene (PP) resin. In addition, it is preferred that said second insulating layer is made of hot-extruded or tape wound layer of polyester resin, polyamide resin, etc., to enable formation of outer conductor by electroless plating and electroplating without roughing the surface. PVC resin can also be used, however, since PVC is a water repellent, surface treatment using a strong acid is desirable.

If the outside diameter of the center conductor is below 0.20 mm and the finished diameter of the semirigid coaxial cable is below 0.90 mm, the semirigid coaxial cable becomes a good wire for use in the electronic equipments.

Furthermore, since the second insulating layer is either formed by a thin tubing or winding a tape over the outer surface of the first insulating layer, the adhesion between the first and the second insulating layers is weak. In comparison, the adhesion between the second insulating layer and the electroless-plated anchoring metal layer, the adhesion between the electroless-plated anchoring metal layer and the electroplated conductive metal layer, and the adhesion between the electro-plated conductive metal layer and the protective cover layer are much stronger. Consequently, while stripping the ends of the semirigid coaxial cable using a stripper, an integral assembly of second insulating layer, outer conductor and protective cover layer can be stripped off easily from the first insulating layer.

According to the method for manufacturing the semirigid coaxial cable in the present invention, the second insulating layer is formed of a resin that can be electroless-plated easily than the material of the first insulating layer. Because of this, an anchoring metal layer can be formed by electroless plating without roughing the surface of said second insulating layer. Furthermore, a conductive metal layer can be easily formed by electroplating over said anchoring metal layer to make the outer conductor. Consequently, said outer conductor has good adhesiveness, adequate thickness, and no stresses. Whereby a semirigid coaxial cable of good characteristics mentioned above can be manufactured.

Furthermore, according to the method for manufacturing the semirigid coaxial cable in the present invention, because the material of the second insulating layer is easier to elelectroless-plate than the first insulating layer, chemical etching of the surface using metallic sodium or the like becomes unnecessary.

Moreover, according to the method for manufacturing the semirigid coaxial cable in the present invention, if the coaxial cable is subjected to heat treatment after said conductive metal layer is provided, the flexibility of the semirigid coaxial cable can be enhanced.

Embodiments of the invention will now be described in detail, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a cross section view of a semirigid coaxial cable according to the first embodiment of the present invention.

FIG. 2 is the flow chart showing the method of manufacture of the semirigid coaxial cable of the present invention.

FIG. 3 to FIG. 8 are explanatory drawings of the processes for forming the outer conductor of the semirigid coaxial cable.

FIG. 9 is a sketch for explaining the stripping the end of the semirigid coaxial cable of the present invention.

FIG. 10 is a cross section view of a semirigid coaxial cable according to the second embodiment of the present invention.

FIG. 11 is an elevational view of an example of a conventional coaxial cable with a partial cutaway.

FIG. 12 is a cross section view of an example of a conventional semirigid coaxial cable.

The present invention will be described in more detail with embodiments shown in the accompanying drawings. However, it must be understood that all matter contained in the embodiments and drawings shall be interpreted as illustrative and not in a limiting sense.

FIG. 1 is a cross section view of a semirigid coaxial cable according to the first embodiment of the present invention.

This semirigid coaxial cable 5 comprises of a center conductor 1, a insulating layer 2, an outer conductor 3 and a protective cover layer 4 arranged in order, with an outside diameter of 0.93 mm, and has a length of greater than 1000 m.

The center conductor 1, is a silver-plated copper wire with an outside diameter of 0.20 mm.

The insulating layer 2 comprises of a 0.20 mm thick first insulating layer 2a made of calcined polytetrafluoroethylene (PTFE) resin, and a 0.015 mm thick second insulating layer 2b made of hot-extruded polyamide resin.

The outer conductor 3 comprises of a 2 μm thick anchoring metal layer 3a formed by electroless plating of Ni-P, and a 107 μm thick conductive metal layer 3b formed by electroplating. As shown in FIG. 8, the conductive metal layer 3b further comprises of a copper-plated layer 3c having a thickness of 5 μm, a glossy copper-plated layer 3d having a thickness of 100 μm, and a strike plated nickel layer 3e having a thickness of 2 μm.

The protective covering layer 4 is made of PVC resin and has a thickness of 0.041 mm.

FIG. 2 is a flow chart showing in detail the steps involved in the method for manufacturing a semirigid coaxial cable. The method of manufacture will be described by taking an example of manufacture of the above mentioned semirigid coaxial cable 5.

In the covering process F1 for first insulating layer 2a, PTFE in paste form is extruded over the outer surface of the center conductor 1 made of silver plated copper wire with 0.20 mm diameter and calcinated, to provide the first insulating layer 2a of thickness 0.20 mm. Next, in the covering process F2 for the second insulating layer 2b, outer surface of said first insulating 2a is covered with a polyamide resin of thickness 0.015 mm by hot extrusion to form the second insulating layer 2b. Subsequently, as shown in FIG. 3, surface of the second insulating layer 2b is cleaned with alcohol in order to remove any foreign matter 30, such as oil, from said surface.

In the electroless plating process F3, first, the surface of the second insulating layer 2b is washed in hot and ordinary water, then, stannous chloride ($SnCl_2$) is adsorbed (for sensitizing) on said surface and the wire is immersed in a solution of palladium chloride ($PdCl_2$), and further, as shown in FIG. 4, palladium (Pd) 31 is deposited on said surface by deoxidation (activating). Next, electroless plating is carried out for 5 minutes using electroless plating nickel-phosphorous (Ni-P) solution (P=3%) at 80° C, and as shown in FIG. 5, Ni-P is deposited to form the anchoring metal layer 3a having a thickness of 2 μm. This is followed by ultrasonic cleaning.

In the electroplating process F4, copper electroplating is carried out at a current density of 1 A/dm$^2$ for 20 minutes using a copper sulfate plating solution at 25° C, to form the copper-plated layer 3c, as shown in FIG. 6, having a thickness of 5 μm. Next, electroplating is carried out at a current density of 5 A/dm$^2$ for 90 minutes using a glossy copper sulfate plating solution at 25° C to form the glossy copper-plated layer 3d, as shown in FIG. 7, having a thickness of 100 μm. Subsequently, electroplating is carried out at a current density of 5 A/dm$^2$ for 5 minutes using a strike plating nickel solution at 20° C, to form the strike plated nickel layer 3e, as shown in FIG. 8, having a thickness of 2 μm. When the conductive metal layer 3b comprising of the copper-plated layer 3c, the glossy copper-plated layer 3d and the strike plated nickel layer 3e is formed, the semirigid coaxial cable is ultrasonically cleaned and dried.

Next, a heat treatment, which is not essential, is carried out for 10 minutes at 150° C. Due to such a heat treatment, flexibility of small diameter semirigid coaxial cable will be improved.

In the covering process F5, the protective covering layer 4 of thickness 0.041 mm is provided by extrusion of PVC resin.

Consequently, while stripping the ends of the semirigid coaxial cable 5 using a stripper, as shown in FIG. 9, an integral assembly of second insulating layer 2b, outer conductor 3 and protective cover layer 4 can be stripped off easily from the first insulating layer 2a.

FIG. 10 is a cross section view of a semirigid coaxial cable according to the second embodiment of the present invention.

This semirigid coaxial cable 6 comprises of a center conductor 1, a insulating layer 2 consisting of a first insulating layer 20a and a second insulating layer 20b, an outer conductor 3 and a protective covering layer 4 arranged in order, with an outside diameter of 0.72 mm, and has a length of greater than 1000 m.

The center conductor 1, is a silver-plated copper wire with an outside diameter of 0.10 mm.

The first insulating layer 20a is made of perfluoro alkyl vinyl (PFA) ether-tetrafluoroethylene copolymer resin, and has a thickness 0.10 mm.

The second insulating layer 20b is a tape-wound layer of 0.01 mm thickness formed by double-winding polyester tape of thickness 0.005 mm and width 3 mm spirally over the first insulating layer 20a.

The outer conductor 3 comprises of a 1 μm thick anchoring metal layer 3a formed by electroless plating of Ni-P, and a 80 μm thick conductive metal layer 3b formed by electroplating. The conductive metal layer 3b further comprises of a copper-plated layer 3c having a thickness of 5 μm, a glossy copper-plated layer 3d having a thickness of 73 μm, and a tin plated layer 3e having a thickness of 2 μm.

The protective covering layer 4 is made of PVC resin and has a thickness of 0.119 mm.

The method of manufacture of the semirigid coaxial cable 6 is described below with a reference to the flow chart of FIG. 2.

In the covering process F1 for first insulating layer 20a, perfluoro alkyl vinyl (PFA) ether-tetrafluoroethylene copolymer resin in paste form is extruded over the outer surface of the center conductor 1, to provide the first insulating layer 20a of thickness 0.010 mm.

Next, in the covering process F2 for the second insulating layer 20b, outer surface of said first insulating 20a is covered with a polyester tape of 0.005 mm thickness and 3 mm width by spirally winding the polyester tape two times to form the second insulating layer 20b.

In the electroless plating process F3, first, the surface of the second insulating layer 20b is washed in hot and ordinary water, stannous chloride ($SnCl_2$) is adsorbed on said surface and the wire is immersed in a solutibn of palladium chloride ($PdCl_2$), and then palladium (Pd) is deposited on said surface by deoxidation. Next, electroless plating is carried out using electroless plating nickel-phosphorous (Ni-P) solution at 80 ° C, and Ni-P is deposited to form the anchoring metal layer 3a having a thickness of 1 μm. This is followed by ultrasonic cleaning.

In the electroplating process F4, copper electroplating is carried out using a copper sulfate plating solution at 25° C, to form the copper-plated layer 3c having a thickness of 5 μm. Next, electroplating is carried out using a glossy copper sulfate plating solution at 25° C to form the glossy copper-plated layer 3d having a thickness of 73 μm. Subsequently, electroplating is carried out at a current density of 5 A/dm$^2$ for 5 minutes using acid tin plating solution at 25° C, to form the tin-plated layer 3e having a thickness of 2 μm. When the conductive metal layer 3b comprising of the copper-plated layer 3c, the glossy copper-plated layer 3d and the tin-plated nickel layer 3e is formed, the semirigid coaxial cable is ultrasonically cleaned and dried.

In the covering process F5, the protective cover layer 4 of thickness 0.119 mm is provided by extrusion of PVC resin.

In the semirigid coaxial cable 6 described above, while stripping the ends of the cable using a stripper, an integral assembly of second insulating layer 20b, outer conductor 3 and protective cover layer 4 can be stripped off from the first insulating layer 20a easily.

Instead of the electroless nickel-phosphorous (Ni-P) plating described in the first and second embodiments, other electroless plating, such as copper or nickel-boron (Ni-B) may be used to form the anchoring metal layer 3a. Furthermore, instead of copper electroplating, silver electroplating may be substituted to form the conductive metal layer 3b.

By the semirigid coaxial cable and its method of manufacture of the present invention, because the semirigid coaxial cable has a thin outer conductor without opening, the shielding characteristics of the semirigid coaxial cable are good. Furthermore, the coaxial cable can be easily bent or wound, and a length of cable exceeding 1,000 m can be manufactured. Since the semirigid coaxial cable has a protective covering layer which can be formed efficiently, it can be used in a wide range of applications. The dimensional accuracy is great, and high frequency transmission characteristics are stable. Manufacture of small diameter semirigid cables with a finished diameter of lower than 0.90 mm is possible. Electroless-plating on the first insulating layer can be effortlessly accomplished. Stripping of terminals becomes easy. In view of the advantages mentioned above, the semirigid coaxial cable can be effectively used in high frequency circuit boards of electronic equipments such as telecommunication equipments and data processing equipments, and in signal transmission circuits of high frequency components.

In particular, if the outer conductor is made of a electroless-plated anchoring metal layer and a electro-plated conductive metal layer, and if said conductive metal layer is formed of a copper-plated layer, a glossy copper-plated layer and a strike plated nickel layer or a tin-plated layer, then the adhesiveness, conductivity, corrosion resistance, and solderability can be enhanced significantly.

## Claims

1. A semirigid coaxial cable (5) having a center conductor (1), an insulating layer (2) on the outer surface of said center conductor (1) and an outer conductor (3) on the outer surface of said insulating layer (2), characterized in that;

   said insulating layer (2) is comprised of a first insulating layer (2a) formed of a material having a low permittivity, and a second insulating layer (2b), on the outer surface of said first insulating layer (2a), formed of a resin which can be easily electroless-plated as compared to the material of said first insulating layer (2a), and

   said outer conductor (3) is comprised of a electroless-plated anchoring metal layer (3a) and a electro-plated conductive metal layer (3b).

2. The semirigid coaxial cable (5) according to claim 1, characterized in that;

   said outer conductor (3) is provided with a protective cover layer (4) on the outer surface.

3. The semirigid coaxial cable (5) according to claim 1 or claim 2, characterized in that;

   said conductive metal layer (3b) is comprised of a copper-plated layer (3c), a glossy copper-plated layer (3d), and a strike plated nickel layer or a tin-plated layer (3e).

4. The semirigid coaxial cable (5) according to claim 1, claim 2 or claim 3, characterized in that;

   said first insulating layer (2a) is formed of fluororesin-based or polyolefine-based resins having a low permittivity.

5. The semirigid coaxial cable (5) according to claim 1, claim 2, claim 3, or claim 4, characterized in that;

   said second insulating layer (2b) is formed by hot-extruding a resin or by winding an insulating tape over said first insulating layer (2a).

6. The semirigid coaxial cable (5) according to claim 1, claim 2, claim 3, claim 4, or claim 5, characterized in that;

   thickness of said second insulating layer (2b) is 5 μm or more and less than 20% the thickness of said first insulating layer (2a).

7. The semirigid coaxial cable 5 according to claim 1, claim 2, claim 3, claim 4, claim 5, or claim 6, characterized in that;

   diameter of said center conductor (1) is 0.20 mm or less, and finished diameter of said semirigid coaxial cable (5) is 0.90 mm or less.

8. A method for manufacturing a semirigid coaxial cable (5) comprising of a insulating material covering process for forming a insulating layer (2) on the outer surface of a center conductor (1), and conductive material covering process for forming of a outer conductor (3) material on the outer surface of said insulating layer (2), characterized in that;

said insulating material covering process is comprised of a covering process (F1) for first insulating layer, wherein outer surface of said center conductor (1) is covered by material having a low permittivity to form a first insulating layer (2a), and a covering process (F2) for second insulating layer, wherein outer surface of said first insulating layer (2a) is covered by a resin which can be easily electroless-plated as compared to the material of said first insulating layer (2a) to form a second insulating layer (2b), and

said conductive material covering process comprises of a electroless plating process (F3), wherein outer surface of said second insulating layer (2b) is covered by a electroless-plated anchoring metal layer (3a), and a electroplating process (F4), wherein outer surface of said electroless-plated anchoring metal layer (3a) is covered by a conductive metal layer (3b).

**9.** The method for manufacturing a semirigid coaxial cable (5) according to claim 8 characterized in that;

said electroplating process (F4) is followed by a outer covering process (F5), wherein outer surface of said conductive metal layer (3b) is covered by a protective cover layer (4).

**10.** The method for manufacturing a semirigid coaxial cable (5) according to claim 8 or claim 9 characterized in that;

said electroplating process (F4) is comprised of a copper plating process for forming a copper-plated layer (3c),

a glossy copper plating process for forming a glossy copper-plated layer (3d), and

a strike plating process for forming a strike plated nickel layer or a tin plating process for forming a tin-plated layer (3e).

**11.** The method for manufacturing a semirigid coaxial cable (5) according to claim 8, claim 9 or claim 10, characterized in that;

said electroplating process (F4) is followed by a heat treatment process.

FIG. 1

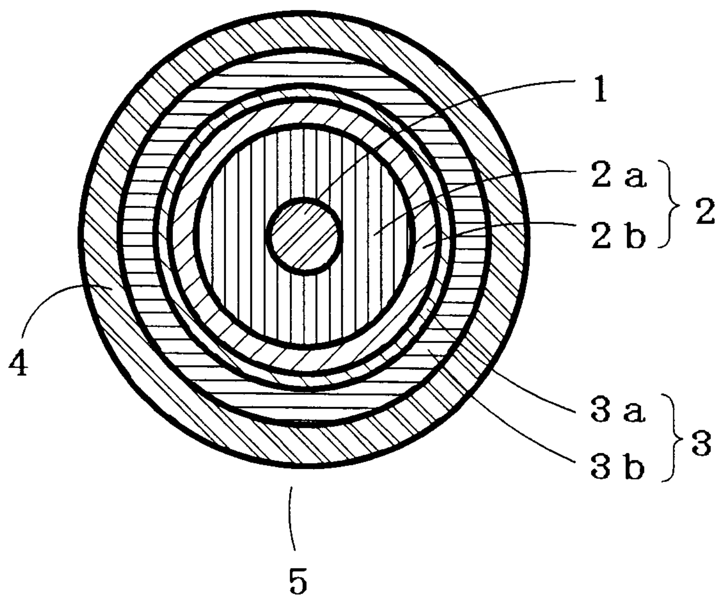


FIG. 2

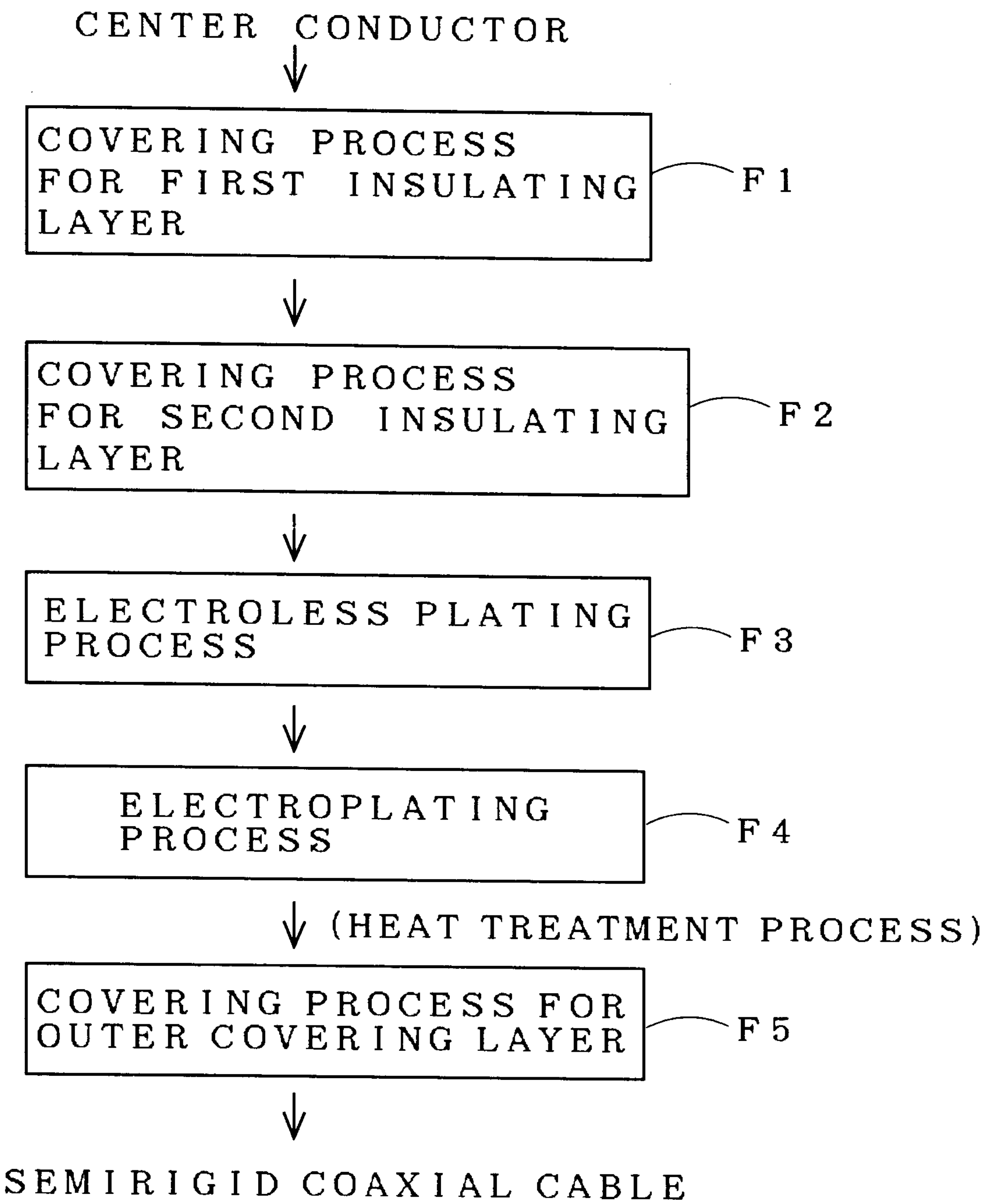

CENTER CONDUCTOR
COVERING PROCESS FOR FIRST INSULATING LAYER
F1
COVERING PROCESS FOR SECOND INSULATING LAYER
F2
ELECTROLESS PLATING PROCESS
F3
ELECTROPLATING PROCESS
F4
(HEAT TREATMENT PROCESS)
COVERING PROCESS FOR OUTER COVERING LAYER
F5
SEMIRIGID COAXIAL CABLE

FIG. 3

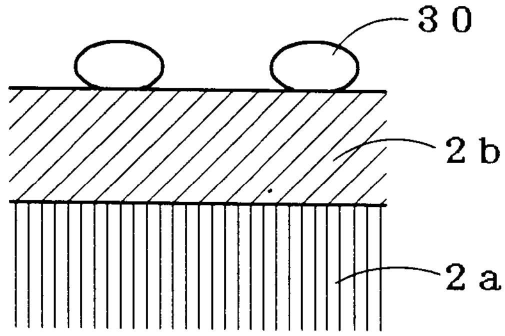



FIG. 4

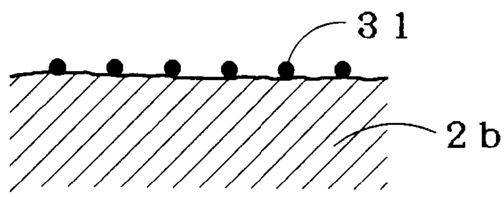



FIG. 5

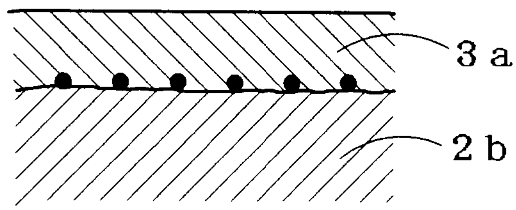


FIG. 6

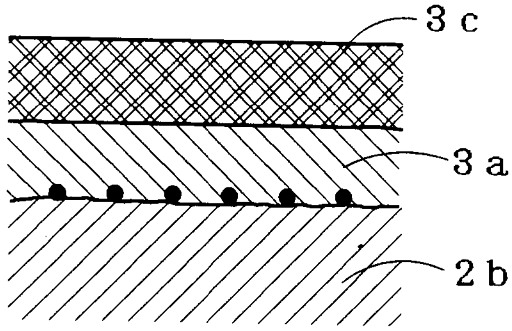



FIG. 7

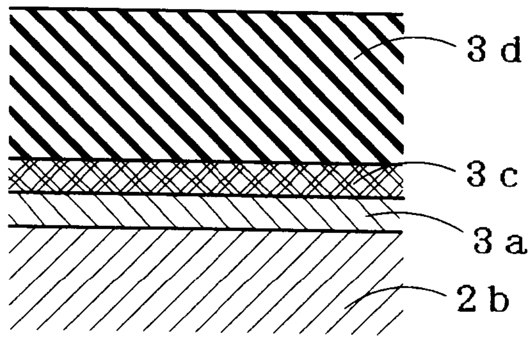



FIG. 8

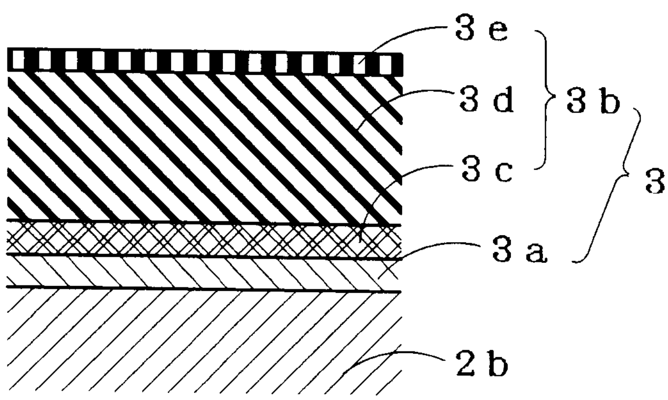


FIG. 9

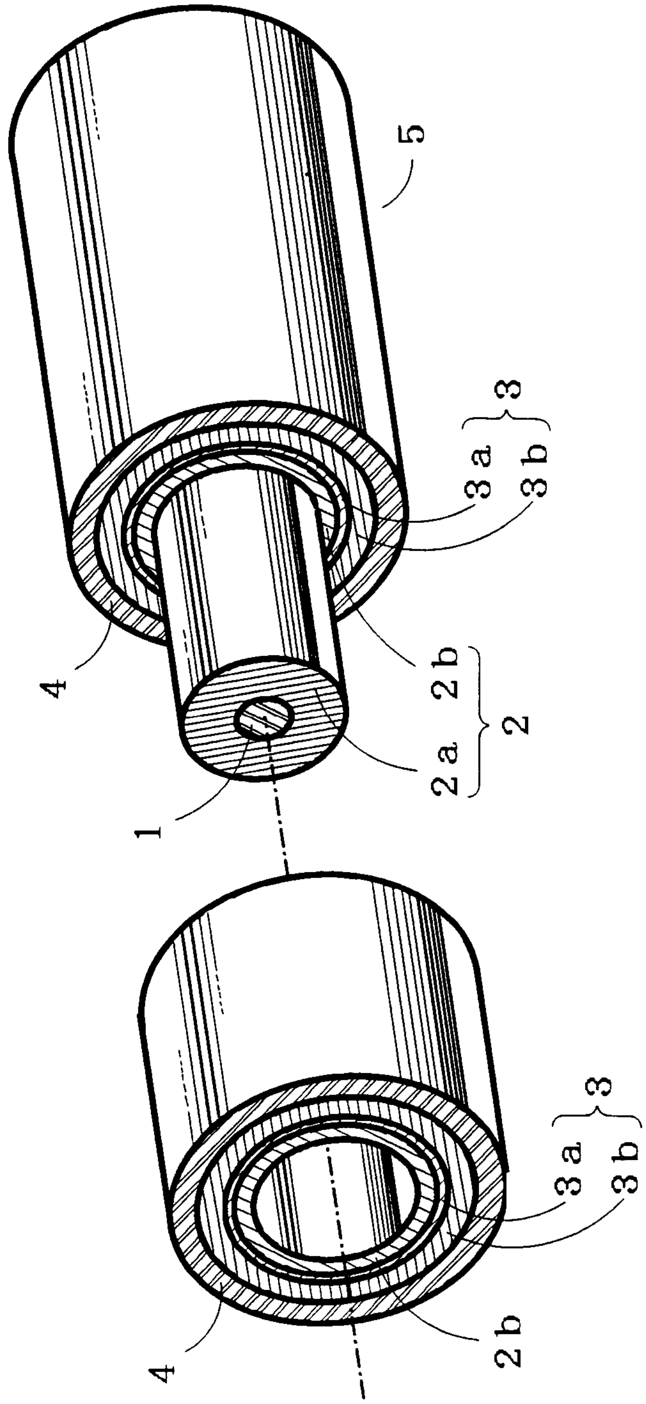


FIG. 10

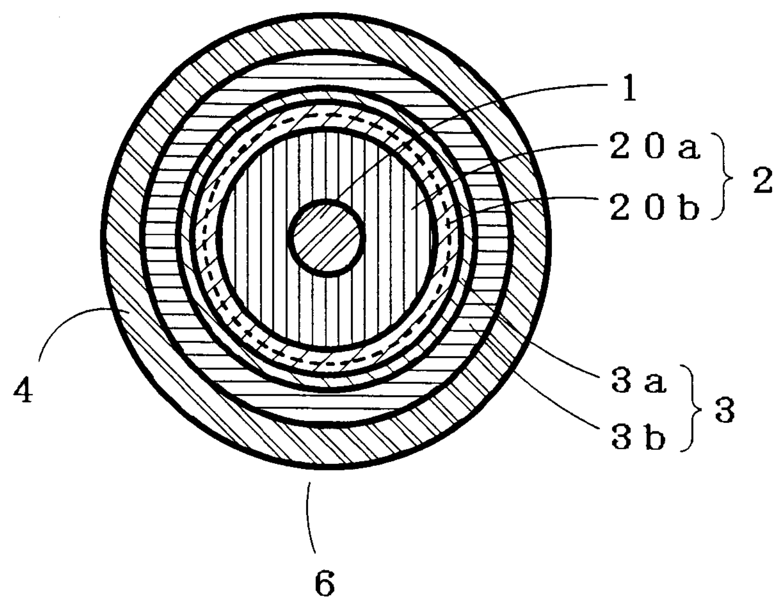


FIG. 11

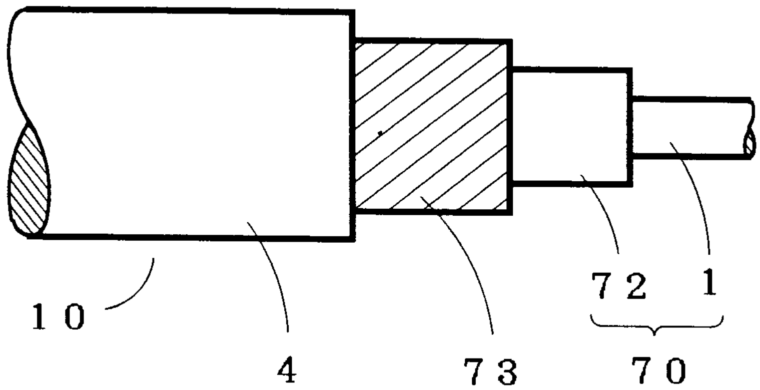



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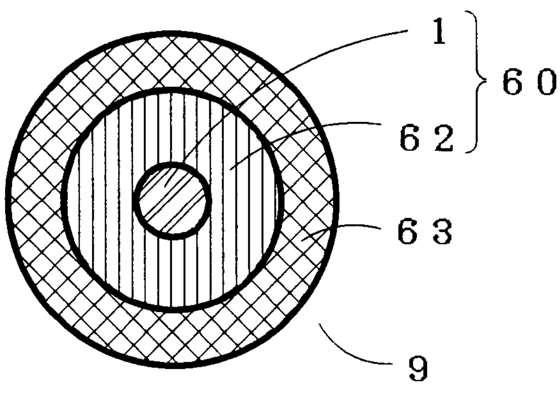
FIG. 12

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