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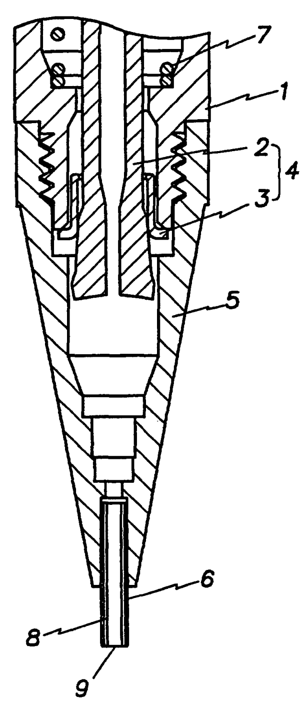
(54) MECHANICAL PENCIL AND PRODUCTION METHOD FOR ITS LEAD PROTECTION MEMBER

(57) A lead protective member according to the present invention is formed by removing a part of resin filled in the lead protective member by laser beam to thereby form a hole in a longitudinal direction, by coating metal at least on the outside of a resin tube or pipe, or by forming an electrically conductive film at least on the outside of a resin tube or pipe and coating metal on the electrically conductive film, and variance in manufacture is small. Moreover, by making smaller in inscribed circular diameter of a front end part of the lead protective member, the resin layer is compressed to increase the feeling of resistance with respect to the lead and shaking of the lead does not occur during the time of writing. Moreover, since the resin layer is increased in thickness by partly removing the resin layer on the front end part of lead protective member, the factor of compression of the resin layer is reduced, thus enabling to eliminate shaking of the refill more completely.

FIG. 3



EP 1 151 874 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a mechanical pencil in which a lead is fed from a lead protective mechanism disposed at a tip part of a tubular shaft by advancing/retracting a lead feed mechanism disposed within the tubular shaft, and a method for manufacturing the lead protective member.

BACKGROUND OF THE INVENTION

[0002] The above-mentioned mechanical pencil will be described with reference to FIG. 1.

[0003] A mechanical pencil of this type has a lead feed mechanism 4 comprising a chuck 2 such as a three-piece split chuck and a ball chuck and a chuck clamping member 3. And a lead is fed by using this lead feed mechanism 4. At the time for feeding the lead, the chuck 2 is advanced against an elastic force of an elastic member (not shown) with the lead L clamped by the chuck clamping member 3. After the shuck 2 is advanced a certain distance, the movement of the chuck clamping member 3 is prohibited (by a step portion 5a of a tip member 5 fixed to a tubular shaft 1 as shown in FIG. 1). Thereafter, when the chuck 2 is further advanced, the chuck 2 is brought into an open state. In that state, when the movement of the chuck 2 is released, the chuck 2 is retracted until it is caused to engage the chuck clamping member 3 by elastic force of the elastic member. During that time, however, the lead L is retained by a return stopper member S (that is, a lead retainer which prevents the lead from moving rearward) composed of rubber or the like so as not to retract and the feeding operation of the lead is carried out. By repeating this procedure, the lead L is protruded from a lead protective member 6 disposed at a tip part of the tubular shaft 1 (tip member 5).

[0004] In the case where the lead is caused to become short by writing, the shortened lead cannot be clamped by the chuck 2. And, the shortened lead is remained between the tip part of the chuck 2 and the lead protective member 6. Since this remaining lead (hereinafter referred to as the "residual lead") L is merely loosely retained by the return stopper member S, the feeling of writing becomes bad. Therefore, it is customary that the residual lead is pushed by a following lead and discharged or the residual lead is pulled out using a finger(s) or the like and discarded. Moreover, in the case where the residual lead is displaced from the return stopper member S, the above-mentioned phenomenon appears conspicuously and the residual lead is likely to fall down by its dead weight.

[0005] In order to utilize this residual lead effectively, one proposal was made with respect to the lead protective member. One known example is that an elastic film composed of rubber or the like is integrally laminated on an inner surface of the lead protective member and a frictional resistance with the residual lead is increased by the elastic film, thereby preventing the fallen-down of the residual lead by the dead weight (Japanese Utility Model Publication No. S58-32959). There is also known another example in which a projection is formed on an inner surface of the lead protective member and the projection is made to bite into a surface of the residual lead in order to prevent drop of the residual lead by its dead weight (Japanese Patent Application Laid-Open Nos. S56-118898 and S58-203099).

[0006] The lead protective members of those conventional techniques had various problems.

[0007] In the former, since a molten synthetic resin, rubber or the like is press filled in a mold and then cooled to form an elastic film on an inner surface of the lead protective member, there occurs such a problem of variance in manufacture that when a gap between the lead protective member and the mold is reduced, the molten synthetic resin, rubber or the like becomes unable to be press filled in the mold.

[0008] Moreover, there is such an additional problem that in the case where writing operation is performed on the surface of a paper sheet or the like using a mechanical pencil which is provided with a lead protective member whose inner surface is integrally laminated with an elastic film and which is currently in a residual lead state, shaking of the lead occurs at the tip part of the lead protective member and the user is likely to get a sense of disorder at the time of writing.

[0009] This is attributable to the elastic force of the elastic film for retaining the residual lead. That is to say, the inner surface of the lead protective member is made of an elastic film. Even in the case where a lead is loaded, a sufficient elastic force of the film is maintained in order to prevent the lead from falling down by its dead weight and therefore, the elastic film is compressed by the writing pressure at the time of writing and the user gets a feeling of shaking of the lead. This problem of an occurrence of shaking of the lead cannot be solved even if the pressure for retaining the lead (hereinafter referred to as the "lead retaining force") is increased by enlarging the thickness of the tip part of the lead protective member of the elastic film.

[0010] The elastic film is composed of resin such as silicon or rubber. Although the elastic film is excellent in chemical resistance, heat resistance and cold resistance, it has a poor resistance to such organic nonpolar compounds as gasoline, toluene and liquid paraffin. The elastic film is swollen when it absorbs those solvents. On the other hand, the refill of the mechanical pencil is impregnated with oil such as liquid paraffin, mineral oil, animal oil, vegetable oil or the like. When the organic nonpolar compound contained in such oil is absorbed in the elastic film, swelling of the elastic film is taken place. It gives rise to another problem in that the lead retaining force is increased, thus making it difficult to feed the lead.

[0011] In the latter, there is encountered with such a problem that since the projection is made to bite into the residual lead in order to prevent the residual lead from falling down at the time of writing with a residual lead, the surface of the lead gets hurt by the projection and as a result, the fine lead is badly degraded in strength.

SUMMARY OF THE INVENTION

[0012] It is an object of the present invention to provide a mechanical pencil in which a residual lead can be used effectively without degrading the strength of the lead. Another object of the present invention is to provide a method for manufacturing a lead protective member of a mechanical pencil in which the user does not get a feeling of shaking of the residual lead at the time of writing and the lead retaining force is not increased.

[0013] The present invention has been made in view of the above-mentioned problems.

[0014] A first subject matter of the present invention resides in a mechanical pencil in which a lead feed mechanism disposed in a tubular shaft is advanced/retracted to feed a lead from a lead protective member disposed at a tip part of the tubular shaft, wherein the lead protective member is formed by removing a part of resin filled in the lead protective member by laser beam to thereby form a hole in a longitudinal direction, and the lead is loosely retained by an inner surface of the hole formed in the longitudinal direction.

[0015] A second subject matter of the present invention resides in a mechanical pencil in which a lead feed mechanism disposed in a tubular shaft is advanced/retracted to feed a lead from a lead protective member disposed at a tip part of the tubular shaft, wherein the lead protective member is formed by coating metal at least on the outside of a resin tube, and the lead is loosely retained by an inner surface of the resin tube.

[0016] A third subject matter of the present invention resides in a mechanical pencil in which a lead feed mechanism disposed in a tubular shaft is advanced/retracted to feed a lead from a lead protective member disposed at a tip part of the tubular shaft, wherein the lead protective member is formed by forming an electrically conductive film at least on the outside of a resin tube and coating metal on the electrically conductive film, and the lead is loosely retained by an inner surface of the resin tube.

[0017] A fourth subject matter of the present invention resides in a mechanical pencil in which a lead feed mechanism is disposed in a tubular shaft and a lead protective member having at least a resin layer on an inner surface thereof is disposed at a tip part of the tubular shaft, wherein the lead protective member is made smaller in inscribed circular diameter of a front end part than that of a rear end part by plastically deforming the lead protective member by applying external force thereto from outside.

[0018] A fifth subject matter of the present invention resides in a method for manufacturing a lead protective member of a mechanical pencil having at least a resin layer on an inner surface of the lead protective member, the method comprising at least the step of plastic deformation for plastically deforming a tip part of the lead protective member by applying an external force thereto from outside and setting an inscribed circular diameter of the tip part of the lead protective member to be smaller than that of a non-deformed part.

[0019] According to the present invention, in the lead protective member disposed at the tip part of the tubular shaft, there is employed the lead retaining member for retaining the lead at least by the inner surface of the lead protective member. Accordingly, there can be obtained a mechanical pencil in which, in the case where the lead is long, the same function as in the conventional devices can be obtained, and in the case the lead is short (i.e., residual lead), the residual lead can be used effectively without degrading the strength of the lead. Moreover, the lead protective member is formed by removing a part of the resin filled in the lead protective member by laser beam and forming hole in a longitudinal direction, or the lead protective member is formed by coating metal at least on the outside of the resin pipe, or the lead protective member is formed by forming an electrically conductive film at least on the outside of a resin pipe and coating metal on the electrically conductive film. Accordingly, variance in manufacture is small. Moreover, by reducing an inscribed diameter of a tip portion, the resin layer is compressed to increase the feeling of resistance with respect to the lead. Accordingly, there is no occurrence of shaking of the residual lead at the time of writing. Moreover, a part of the resin layer on the front end part is reduced to make the thickness of the resin layer thinner. Accordingly, the factor of compression of the resin layer becomes small, thus enabling to eliminate shaking of the refill more completely. Moreover, since the front end part of the lead protective member is made narrower, visibility of the front end part of the lead can be enhanced. Moreover, by using resin excellent in oil resistance for the elastic resin layer, swelling of the elastic resin layer due to absorption of the organic nonpolar compound contained in the lead can be restrained. This makes it possible to prevent such an occurrence that the lead is difficult to be fed due to increase of the force for retaining the lead.

[0020] It should be noted that the terms " resin tube" used herein includes resin pipe.

BRIF DESCRIPTION OF THE DRAWINGS

[0021] FIG. 1 is an explanatory view of the prior art.

[0022] FIG. 2 is a vertical sectional view of a mechanical pencil of the present invention.

[0023] FIG. 3 is a vertical sectional view of an important part of the mechanical pencil of the present invention.

[0024] FIG. 4. is a vertical sectional view of a lead protective member of the present invention.

[0025] FIG. 5 is a vertical sectional view of the lead protective member of the present invention.

[0026] FIG. 6 is a vertical sectional view of the lead protective member of the present invention.

[0027] FIG. 7 is a vertical sectional view of the lead protective member of the present member invention.

[0028] FIG. 8 is a vertical sectional view of the lead protective member of the present member invention.

[0029] FIG. 9 is a vertical sectional view of the lead protective member of the present member invention.

[0030] FIG. 10 is a vertical sectional view of the lead protective member of the present member invention.

[0031] FIG. 11 is a vertical sectional view of the lead protective member of the present member invention.

[0032] FIG. 12 is a vertical sectional view of the lead protective member of the present member invention.

[0033] FIG. 13 is a vertical sectional view of the lead protective member of the present member invention.

[0034] FIG. 14 is a vertical sectional view of the lead protective member of the present member invention.

[0035] FIG. 15 is a vertical sectional view of the lead protective member of the present member invention.

[0036] FIG. 16 is a vertical sectional view of the lead protective member of the present member invention.

[0037] FIG. 17 is a vertical sectional view of the lead protective member of the present member invention.

[0038] FIG. 18 is a vertical sectional view of the lead protective member of the present member invention.

[0039] FIG. 19 is a vertical sectional view of the lead protective member of the present member invention.

[0040] FIG. 20 is a vertical sectional view of the lead protective member of the present member invention.

[0041] FIG. 21 is a vertical sectional view of the lead protective member of the present member invention.

[0042] FIG. 22 is a vertical sectional view of the lead protective member of the present member invention.

[0043] FIG. 23 is a vertical sectional view of the lead protective member of the present member invention.

[0044] FIG. 24 is a vertical sectional view of the lead protective member of the present member invention.

[0045] FIG. 25 is a vertical sectional view of the lead protective member of the present member invention.

[0046] FIG. 26 is a vertical sectional view of the lead protective member of the present member invention.

[0047] FIG. 27 is a vertical sectional view of the lead protective member of the present member invention.

[0048] FIG. 28 is a vertical sectional view of the lead protective member of the present member invention.

[0049] FIG. 29 is a vertical sectional view of the lead protective member of the present member invention.

[0050] FIG. 30 is a vertical sectional view of the lead protective member of the present member invention.

[0051] FIG. 31 is a vertical sectional view showing a manufacturing process of the lead protective member of the present invention.

[0052] FIG. 32 is a vertical sectional view showing a manufacturing process of the lead protective member of the present invention.

[0053] FIG. 33 is a vertical sectional view showing a manufacturing process of the lead protective member of the present invention.

[0054] FIG. 34 is a vertical sectional view showing a manufacturing process of the lead protective member of the present invention.

[0055] FIG. 35 is a vertical sectional view showing a manufacturing process of the lead protective member of the present invention.

[0056] FIG. 36 is a vertical sectional view showing a manufacturing process of the lead protective member of the present invention.

[0057] FIG. 37 is a vertical sectional view showing a manufacturing process of the lead protective member of the present invention.

[0058] FIG. 38 is a vertical sectional view showing a manufacturing process of the lead protective member of the present invention.

[0059] FIG. 39 is a perspective view of the lead protective member of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Embodiment 1:

[0060] FIG. 2 is one example of a vertical sectional view of a mechanical pencil of the present invention and FIG. 3 is one example of a vertical sectional view of an important part of the mechanical pencil.

[0061] In FIGS. 2 and 3, reference numeral 1 denotes a tubular shaft of the mechanical pencil. Within the tubular shaft 1, a lead feed mechanism 4 is disposed which comprises a chuck 2 such as a three-piece split chuck, a ball chuck and the like (the chuck shown is a three-piece split chuck) and a chuck clamping member 3 (a ring is shown. In a case of a ball chuck, a ball is used). A tip member 5 is fixed to the tubular shaft 1. If desired, the tip member 5 may be formed integral with the tubular shaft 1. Moreover, the tip member 5 has a lead protective member 6 fixed to a tip part of the tip member 5.

[0062] Reference numeral 7 is a spring member such as a coiled spring and the like for biasing the lead feed mechanism 4 backward (upward in FIGS. 2 and 3). Thus, the feed mechanism 4 can advance and retract in a longitudinal direction. In FIGS. 2 and 3, although there is shown one example in which a lead return stopper member (or, a lead retainer for preventing the lead from moving backward) used in a conventional mechanical pencil is removed, the lead return stopper member may be disposed behind the lead protective member as in the conventional device.

[0063] The above-mentioned construction is basically the same as the typical conventional rear end knock-type mechanical pencil.

[0064] The present invention is likewise applicable to various types of a mechanical pencil having a known conventional construction such as a front end knock-type, a rotary knock-type, a side slide-type and a middle-part bending knock-type.

[0065] The features of the present invention reside in a construction of the lead protective member 6 in a mechanical pencil and a method for manufacturing the same.

[0066] A lead retaining member 8 for retaining a lead is formed at the inside of the lead protective member 6. By virtue of a provision of the lead retaining member 8, not only a long lead but also such a short lead as a residual lead can be retained.

[0067] The lead protective member 6 is formed by removing a part of resin filled in therein by laser beam so that a hole is formed in the longitudinal direction.

[0068] Specific examples of resins used for the lead retaining member 8 may include a reaction curing type resin, a thermosetting type resin and a thermoplastic resin. More specifically, they are an epoxy resin, an urethane resin, an acryl melamine resin, an acryl-silicone resin, an acryl-urethane resin, an unsaturated polyester resin, an alkyd resin, a silicon resin, a polyvinyl chloride, a polyvinyl acetate, a vinyl chloride-vinyl acetate copolymer, a vinyl butyral resin, a silicone rubber, an urethane rubber, an ethylene acryl rubber, an epichlorohydrin rubber, an acryl rubber, an ethylene propylene rubber, a chloroprene rubber, a natural rubber, an isoprene rubber, polyethylene chloride, a nitrile rubber, styrene-based elastomer, olefin-based elastomer, ester-based elastomer, urethane-based elastomer and the like. Moreover, ultraviolet curing type resins can also be used. Specific examples of them may include a monofunctional monomer and a multifunctional monomer of acrylic ester and methacrylic ester having an acryloyl group at a terminal as a functional group, and polyester acrylate, epoxy acrylate, polyurethane acrylate, polyester acrylate, melamine acrylate and alkyd acrylate as a photopolymerizable prepolymer. The monomer cannot be used alone but it is always used in combination with the photopolymerizable prepolymer. The photopolymerizable prepolymer materials are used in admixture of one or two or more kinds of them.

[0069] Furthermore, by using a resin material excellent in oil resistance, the lead retaining member 8 becomes difficult to absorb the organic nonpolar compound even when a refill containing an organic nonpolar compound is slidingly moved within a through-hole. Thus, the lead retaining member 8 becomes small in swelling. As a result, increase in lead retaining force is restrained and the mechanical pencil can be used for a long period of time. Especially, in the case where a resin material is used having a weight variation factor of 10 % or less when it is immersed in a liquid paraffin (Cas No. 8012-95-1) of a temperature of 70 °C for two days, the lead retaining member 8 is hardly swelled and its lead retaining force is hardly changed. Therefore, this resin is preferred.

[0070] In the case where a resin material is used having a weight variation factor of more than 10 % when it is immersed in a liquid paraffin of a temperature of 70 °C for two days, absorption of the organic nonpolar compound contained in the refill into the lead retaining member 8 is increased and the swelling of the lead retaining member 8 becomes difficult to restrain. Therefore, the lead retaining force is increased. When the lead retaining force exceeds 200 g, the lead becomes difficult to be advanced by the lead feed mechanism. As a result, it may occur that the lead is broken at the inside and the lead cannot be fed.

[0071] Those resins may contain a blowing agent, powders, etc.

[0072] As the blowing agent, there can be used a chemical blowing agent, a physical blowing agent, a heat-expanding microcapsule or the like. Specific examples of the chemical blowing agents may include an organic decomposition type blowing agent such as azo compounds, nitroso compounds, hydrazine derivatives, semicarbazide compounds, azide compounds, triazole compounds and the like, and an organic reaction type blowing agent such as isocyanate compounds and the like, an inorganic decomposition type blowing agent such as bicarbonate, carbonate, sulfite, hydride and the like, a mixture of sodium carbonate and acid, a mixture of hydrogen peroxide and yeast plant, and an inorganic reaction type blowing agent such as a mixture of zinc powder and acid and the like. Specific examples of the physical blowing agents may include such as butane, pentane, hexane, dichloroethane, dichloromethane, fleon, air, carbon dioxide, gaseous nitrogen and the like. Specific examples of heat-expanding microcapsule may include, among others, a microcapsule containing a low boiling point hydrocarbon such as isobutane, pentane, petroleum ether, hexane and the like serves as a core substance and a thermoplastic resin composed of a copolymer of vinylidene chloride, acrylonitrile, acrylic ester, methacrylic ester and the like serves as a shell. Those foamed bodies may be added one or two or more kinds.

[0073] FIG. 4 shows one example in which the resin contains a foamed agent.

[0074] In FIG. 4, reference numeral 12 denotes voids formed by foaming.

[0075] Specific examples of the powders may include resin powders such as styrene, nylon, polyolefine, silicon, epoxy, polymethacrylate methyl and the like, and inorganic powders such as silica, alumina, zirconia and the like. They may further include composite powders obtained by coating, for example, an acryl-based, urethane-based, or epoxy-based powder coating film on those powders, and those obtained by absorbing or placing inorganic powders, which are smaller than the resin powders, in the resin powders using an automatic mortar, a ball mill, a jet mill, an atomizer, a hybridizer or the like. The shape of the powders is not particularly limited but it may be in the form of sphere, plate, needle and the like. Those powders may be added one or two or more kinds. By adding powders having a melting point higher than that of the resin, bumps and valleys are formed by the powders when a part of the resin is removed by laser beam. Thus, unevenness of the diameter of the lead can be absorbed more completely.

[0076] FIG. 5 shows one example in which the resin contains powders 13.

[0077] The materials of the lead protective member 6 are not particularly limited inasmuch as they can form a tubular shape. Examples of such materials may include metallic materials such as aluminum and its alloy, copper and its alloy, iron or its alloy, zinc or its alloy, magnesium or its alloy and the like, thermoplastic resins such as acrylonitrile-butadiene-styrene copolymer (ABS), acrylonitrile-styrene copolymer (AS), acrylic resin, polycarbonate, polypropylene, polyethylene, polyester, polystyrene, and the like, ceramic materials such as alumina, zirconia, porcelain clay and the like, natural materials such as wood and the like, and so on. It is also acceptable that nickel and chrome, or valuable metal, coating film, printing pattern or the like is preliminarily formed on an inner and/or outer wall of the lead protective member 6 by an electrical plating method, electroless plating, painting, or printing.

[0078] A method of formation will be described. A method for filling the above resin to the lead protective member 6 may be performed under the conditions of a normal temperature, a normal pressure, heating, pressuring, vacuum, etc. and is not particularly limited. Then, a part of the resin thus filled is removed by laser beam to form a hole 9 in the longitudinal direction. The laser mediums of the laser beam to be used may be any mediums inasmuch as they can thermally melt or chemically destroy (decompose) the resin and remove it and are not particularly limited. Specific examples of the laser mediums may include solid laser such as ruby laser, YAG laser, glass laser, tungstic calcium laser and the like, gas laser such as He-Ne laser, Ar laser, Kr laser, CO_2 laser and the like, liquid laser such as oxychlorinated selenium laser and the like, semiconductor laser such as Ga-As laser, Ga-Sb laser, Cd-S laser, Zn-S laser and the like, excimer laser, etc. The hole may be formed by a laser beam machine, a laser marker or the like using the above laser mediums.

[0079] As for the configuration of the lead retaining member 8, a wide variety of configurations may be employed such as, a configuration having a uniform thickness as shown in FIG. 6, a tapered configuration form a rear end towards a front end as shown in FIG. 7, a step-like configuration from a rear end towards a front end as shown in FIG. 8 and a configuration in which the lead retaining member 8 is formed only on an inner surface of a front part of the lead protective member 6 as shown in FIG. 9.

[0080] As previously mentioned, in this method of formation, after the resin to be served as the lead retaining member 8 is filled in the lead protective member 6, a part of the resin is removed by laser bean to form the hole 9 in the longitudinal direction. In the case where the tip member 5 is separately formed from the tubular shaft 1, it is also accepted that after the lead protective member 6 is attached to the tip part of the tip member 5 by press-fit or insert-molding, the resin is filled in the lead protective member 6 and a part of the resin is removed by laser beam.

[0081] The lead, which has been fed by the lead feed mechanism, is disposed at the inner surface of the hole 9 of the lead retaining member 8. Since it is necessary that the lead is loosely retained by the inner surface of the hole 9 of the lead protective member 8 at that time, the lead retaining member 8 is required to have elasticity in the radial direction. Therefore, if the resin used for the lead retaining member 8 has no elasticity in the radial direction, it is necessary to add an additive to the resin so that the resin may have sufficient elasticity. As for the lead retaining force of the lead retaining member 8, it is just enough if the lead retaining member 8 has a lead retaining force enough to prevent the residual lead from falling down by its dead weight. Preferably, the required elasticity is set in a range from 10 g to 100 g against a passing direction of the lead. When the lead retaining force is in the range of from 35 g to 100 g, it can also be expected such an effect that rotation of the lead occurrable at the time of writing with the residual lead can be restrained.

[0082] As for the cross sectional configuration of the hole 9, a wide variety of configurations can be employed such as, a circular configuration, an elliptical configuration, a polygonal configuration, a configuration in which an inner surface thereof is in the shape of a pedal, a configuration in which an inner surface thereof is formed with a slit or a rib in a longitudinal direction, and the like.

Embodiment 1-1:

[0083] An example of a mechanical pencil in Embodiment 1 will be described in detail.

[0084] After a stainless pipe having an outside diameter of 1.07 mm, an inside diameter of 0.76 mm and a length of 6.0 mm was barrel-polished, the pipe was degreased with a solvent. Then, a silicone resin (TSE3221, manufactured by GE Toshiba Silicons Co., Ltd.) was filled under pressure into the stainless pipe. Thereafter, the same was cured for 30 minutes at a temperature of 150 °C. Then, a lead retaining member having a bore diameter of 0.54 mm was formed in the lead protective member by making a hole under the conditions of an output of 200 W and a processing time of 0.5 seconds using a CO_2 laser beam machine (manufactured by Mitsubishi Electric Corp.; oscillator ML5036D; machining table ML2512HD11; machining lens f 7.5 inches; processing nozzle Ø 2.0 inches). By doing so, a lead protective member as shown in FIG. 6 was formed. Then, a tip member of a mechanical pencil (PG305D, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A125, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 1-2:

[0085] Another example of a mechanical pencil in Embodiment 1 will be described in detail next.

[0086] After a stainless pipe having an outside diameter of 1.07 mm, an inside diameter of 0.76 mm and a length of 6.0 mm was barrel-polished, the pipe was degreased with a solvent. Then, a silicone resin (SE1701W/C, manufactured by Dow Corning Toray Silicone Co., Ltd.) was added with 10 wt. % of a special purpose catalyst and agitated. Then, the resultant resin was filled under pressure into the stainless pipe. Thereafter, the same was cured for 30 minutes at a temperature of 150 °C. Then, a lead retaining member having a rear end bore diameter of 0.54 mm and a frond end bore diameter of 0.52 mm was formed in the lead protective member by making a hole under the conditions of a spot diameter of 0.18 mm, an output of 6 W, a scan speed of 500 mm/s and a processing time of 1 second using a CO_2 laser marker (LP-200, SUNX Limited.). By doing so, a lead protective member as shown in FIG. 7 was formed. Then, a tip member of a mechanical pencil (A125, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A125, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 1-3:

[0087] A further example of a mechanical pencil in Embodiment 1 will be described in detail.

[0088] After an iron pipe having an outside diameter of 1.06 mm, an inside diameter of 0.77 mm and a length of 6.0 mm was barrel-polished, the pipe was degreased with a solvent. Then the pipe was degreased by a known plating pre-treatment method and an Ni plating film of 5 µm was formed by an electroless plating method. Then, an urethane resin (LF-105, manufactured by Asahi Glass Co., Ltd.) was filled under pressure into the iron pipe. Thereafter, the same was cured under the conditions of a normal temperature, a humidity of 90 % and 24 hours. Then, a lead retaining member having a rear end bore diameter of 0.54 mm, an intermediate bore diameter of 0.53 mm and a frond end bore diameter of 0.52 mm was formed in the lead protective member by making a hole under the conditions of a spot diameter of 0.18 mm, an output of 9 W, a scan speed of 500 mm/s and a processing time of 0.3 seconds and sequentially by making a holed under the conditions of a spot diameter of 0.18 mm, an output of 6W, a scan speed of 500 mm/s, and a processing time of 0.3 seconds using a CO_2 laser marker (LP-200, SUNX Limited.). By doing so, a lead protective member as shown in FIG. 8 was formed. Then, a tip member of a mechanical pencil (PG505-AD, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for PG505-AD, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 1-4:

[0089] Another example of a mechanical pencil in Embodiment 1 will be described in detail.

[0090] After a stainless pipe having an outside diameter of 1.07 mm, an inside diameter of 0.76 mm and a length of 6.0 mm was barrel-polished, the pipe was degreased with a solvent. Then, a silicone resin (TSE3221, manufactured by GE-Toshiba Silicone Co. Ltd.) added with 10 wt % of a blowing agent (EXPANCEL 091DU, manufactured by Japan Fillite Co., Ltd.)
was dispersed by a mortar and then, filled under pressure into the stainless pipe. Thereafter, the same was cured for 30 minutes at a temperature of 150 °C. Then, a lead retaining member having a bore diameter of 0.54 mm was formed in the lead protective member by making a hole under the conditions of an electric output of 200 W and a processing time of 0.3 seconds using a CO_2 laser beam machine (manufactured by Mitsubishi Electric Corp.; oscillator ML5036D; machining table ML2512HD11; machining lens f 7.5 inches; processing nozzle Ø 2.0 inches). By doing so, a lead protective member as shown in FIG. 4 was formed. Then, a tip member of a mechanical pencil (PG305D, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A125, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 1-5:

[0091] Another example of a mechanical pencil in Embodiment 1 will be described.

[0092] After a brass pipe having an outside diameter of 1.06 mm, an inside diameter of 0.77 mm and a length of 6.0 mm was barrel-polished, the pipe was degreased with a solvent. Then the pipe was degreased by a known plating pre-treatment method and an Ni plating film of 5 µm was formed by an electroless plating method. Thereafter, a Cr plating film of 0.01 µ m was formed by an electric plating method. Then, 3 wt % of silica powders 15 (SYLYSIA 770, manufactured by Fuji Silysia Chemical Ltd.) was added to a thermosetting acrylic coating (MAGICRON 1000, manufactured by Kansai Paint Co., Ltd.) and dispersed by three rolls. Then, the resultant was filled into the brass pipe in a vacuum condition. Thereafter, the same was cured for 20 minutes at a temperature of 180 °C. Then, the resultant was a lead retaining member having a bore diameter of 0.54 mm was formed in the lead protective member by making a hole under the conditions of an output of 300 W and a processing time of 1 second using a CO_2 laser beam machine (manufactured by Mitsubishi Electric Corp.; oscillator ML5036D; machining table ML2512HD11; machining lens f 7.5 inches; processing nozzle Ø 2.0 inches). By doing so, a lead protective member as shown in FIG. 9 was formed. Then, a tip member of a mechanical pencil (PG305D, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A125, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 2:

[0093] In this Embodiment 2, since the construction is same as the Embodiment 1 only excepting the construction of the lead protective member, description thereof is omitted.

[0094] Formation of a lead protective member in this Embodiment 2 is made by a method for coating metal at least on the outside of a resin tube.

[0095] In FIGS. 10 and 11, reference numeral 14 denotes a resin tube serving as a lead retaining member for retaining a lead, and 15, a coating metal serving as a lead protective member, respectively. The resin tube 14 can be formed by various methods such as a compression molding, a transfer molding, an injection molding, an extrusion molding, a vacuum casting and the like. Specific examples of the resin may include acrylic resin, silicon resin, fluororesin, polyvinyl chloride, polyurethane resin, polyethylene resin, a silicone rubber, an urethane rubber, an ethylene acryl rubber, an epichlorohydrin rubber, an acryl rubber, an ethylene propylene rubber, a chloroprene rubber, a natural rubber, an isoprene rubber, polyethylene chloride, a nitrile rubber, styrene-based elastomer, olefin-based elastomer, ester-based elastomer, urethane-based elastomer and the like. Moreover, by using a resin excellent in oil resistance, the same effect as in the Embodiment 1 can be obtained.

[0096] Those resins may contain the powders, the blowing agent or the electrically conductive fine particles as mentioned in the Embodiment 1.

[0097] A coating metal 15 formed on the outside of the resin tube 14 serving as the lead retaining member is formed in multilayer using any one or two or more kinds of an electroless plating method, a physical depositing method, an electroplating method and an electroforming method. Specific examples of the materials for forming the coating metal 15 may include aluminum, copper, iron, zinc, magnesium, chrome, nickel, tin, titanium, gold, silver, palladium, platinum, rhodium and ruthenium or alloy thereof. This coating metal 15 may be formed directly on the resin tube 14. Or otherwise, the coating metal 15 may be formed on the resin tube 14 after the surface of the coating metal 15 is subjected to activation treatment, hydration treatment, catalyst impartation treatment or the like.

[0098] In the case where the coating metal 15 is formed on the outside of the resin tube 14, a rod may be inserted in the resin tube.

[0099] By the same reason as mentioned in the Embodiment 1, the resin tube 4 is required to have elasticity in the radial direction. Therefore, if the resin used for the resin tube 14 has no elasticity in the radial direction, it is necessary to add an additive to the resin so that the resin may have sufficient elasticity. As for the lead retaining force of the resin tube 14, it is just enough if the resin tube 14 has a lead retaining force enough to prevent the residual lead from falling down by its dead weight. Preferably, the required elasticity is set in a range from 10 g to 100 g against a passing direction of the lead. When the lead retaining force is in the range of from 35 g to 100 g, it can also be expected such an effect that rotation of the lead occurrable at the time of writing with the residual lead can be restrained.

[0100] The cross sectional configuration of the resin tube 14 is not particularly limited but a wide variety of configurations can be employed such as, a circular configuration, an elliptical configuration, a polygonal configuration, a configuration in which an inner surface thereof is in the shape of a pedal as shown in FIG. 12, a configuration in which an inner surface thereof is formed with a slit or a rib in a longitudinal direction as shown in FIG. 13, a configuration in which an inner surface thereof is formed with a polygonal shape as shown in FIG. 14 or the like.

Embodiment 2-1:

[0101] One example of a mechanical pencil in the Embodiment 2 will be described.

[0102] An iron-made rod having an outside diameter of 0.50 mm and a length of 150 mm was inserted into a hole of a silicone tube of a circular shape having an outside diameter of 1.0 mm and an inside diameter of 0.55 mm and having a length of 150 mm. Then, the outside of the silicone tube was hydrated by means of corona discharge treatment. Then, a palladium catalyst was absorbed on the outside of the silicone tube by a known sensitizer method and an activator method. Then, the same was treated for 320 minutes at a liquid temperature of 90 degrees C using an electroless nickel-phosphorus plating solution (BLUE SUMER, manufactured by Japan Kanigen Co., Ltd.). By doing so, a metal layer (nickel-phosphorus layer) having a film thickness of 120 μm was formed by an electroless plating method. After drying, the iron-made core rod was removed and a nickel-phosphorus-made pipe having a silicone resin on its inner surface was obtained. Then, the nickel-phosphorus-made pipe was cut so as to have a length of 6 mm and a lead protective member was formed. Then, a tip member of a mechanical pencil (PG305D, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A125, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 2-2:

[0103] One example of a mechanical pencil in the Embodiment 2 will be described in detail.

[0104] An iron-made rod having an outside diameter of 0.54 mm and a length of 100 mm was inserted into a hole of a heat-contracting silicone rubber tube (St-3d4 (0.2), manufactured by Shin-Etsu Chemical Co., Ltd.) having a length of 100 mm. Then, a titanium nitride film of 80 μ m was formed by an ion-plating method. Then, the iron-made core rod was removed and a titanium nitride-made pipe having a silicone resin on its inner surface was obtained. Then, the titanium nitride-made pipe was cut so as to have a length of 6 mm and a lead protective member was formed. Then, a tip member of a mechanical pencil (A125, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A125, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 2-3:

[0105] One example of a mechanical pencil in the Embodiment 2 will be described in detail.

[0106] An iron-made rod having an outside diameter of 0.54 mm and a length of 100 mm was inserted into a hole of a silicone tube of a circular shape having an outside diameter of 1.0 mm and an inside diameter of 0.55 mm and having a length of 150 mm and containing electrically conductive fine particles. Then, the outside of the silicone tube was hydrated by means of corona discharge treatment. Then, 0.5 m 1/1 of a stress-free additive (NSF-E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (nickel sulfamate high-concentration bath, manufactured by Nihon Kagaku Sangyo Co., Ltd.) and treated for 60 minutes at a current density of $10A/dm^2$ in the form of a solution composition wherein the stress to the precipitation film becomes a compressive stress. By doing so, a metal layer (nickel layer) having a film thickness of 100 μm was formed by an electroforming method. After drying, the iron-made core rod was removed and a nickel-made pipe having a silicone resin on its inner surface was obtained. Then, the nickel-made pipe was cut so as to have a length of 6 mm and a lead protective member was formed. Then, a tip member of a mechanical pencil (PG305D, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A125, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 3:

[0107] In this Embodiment 3, since the construction is same as the Embodiment 1 only excepting the construction of the lead protective member, description thereof is omitted.

[0108] Formation of a lead protective member in this Embodiment 3 is made by a method for forming an electrically conductive film at least on the outside of a resin tube and coating metal on the electrically conductive film.

[0109] In FIGS. 15 and 16, reference numeral 14 denotes a resin tube serving as a lead retaining member for retaining a lead, and 15, a coating metal serving as a lead protective member, respectively. The resin tube 14 can be formed by various methods such as a compression molding, a transfer molding, an injection molding, an extrusion molding, a vacuum casting and the like. Specific examples of the resin may include acrylic resin, silicone resin, fluororesin, polyvinyl chloride, urethane resin, polyurethane resin, polyethylene resin, a silicon rubber, an urethane rubber, an ethylene acryl rubber, an epichlorohydrin rubber, an acryl rubber, an ethylene propylene rubber, a chloroprene rubber, a natural rubber, an isoprene rubber, polyethylene chloride, a nitrile rubber, styrene-based elastomer, olefin-based elastomer, ester-based elastomer, urethane-based elastomer and the like. Those resins may contain the powders, the blowing agent or the electrically conductive fine particles as mentioned in the Embodiment 1.

[0110] The electrically conductive film 16 formed on the outside of the resin tube 14 serving as the lead retaining member is formed in multilayer using any one or two or more kinds of an electroless plating method, a physical depositing method and a chemical depositing method. Specific examples of the materials for forming the electrically conductive film 16 may include aluminum, copper, iron, zinc, magnesium, chrome, nickel, tin, titanium, gold, silver, palladium, platinum, rhodium and ruthenium or alloy thereof. This electrically conductive film 16 may be formed directly on the resin tube 14. Or otherwise, the electrically conductive film 16 may be formed on the resin tube 14 after the surface of the resin tube 14 is subjected to activation treatment, hydration treatment, catalyst impartation treatment or the like.

[0111] In the case where the electrically conductive film 16 is formed on the outside of the resin tube 14, a rod may be inserted in the resin tube. The same is also applicable at the time for forming the coating metal 15.

[0112] The method for forming the coating metal 15 which is formed in the electrically conductive film 16 may be carried out as follows. The resin tube forming the electrically conductive film 16 is immersed in an aqueous solution containing metal ion for forming the metal layer and a negative potential is supplied to the resin tube on which the immersed electrically conductive film is formed, thus enabling to obtain the metal. A specific formation method thereof can properly selected from various kinds of methods such as, for example, an electroplating method and an electroforming method, depending on shape, length, thickness, etc. of the resin tube and is not particularly limited inasmuch as a metal layer can be formed.

[0113] By the same reason as mentioned in the Embodiment 1, the resin tube 14 is required to have elasticity in the radial direction. Therefore, if the resin used for the resin tube 14 has no elasticity in the radial direction, it is necessary to add an additive to the resin so that the resin may have sufficient elasticity. As for the lead retaining force of the resin tube 14, it is just enough if the resin tube 14 has a lead retaining force enough to prevent the residual lead from falling down by its dead weight. Preferably, the required elasticity is set in a range from 10 g to 100 g against a passing direction of the lead. When the lead retaining force is in the range of from 35 g to 100 g, it can also be expected such an effect that rotation of the lead occurrable at the time of writing with the residual lead can be restrained.

[0114] The cross sectional configuration of the resin tube 14 is not particularly limited but a wide variety of configurations can be employed such as, a circular configuration, an elliptical configuration, a polygonal configuration, a configuration in which an inner surface thereof is in the shape of a pedal as shown in FIG. 17, a configuration in which an inner surface thereof is formed with a slit or a rib in a longitudinal direction as shown in FIG. 18, a configuration in which an inner surface thereof is formed with a polygonal shape as shown in FIG. 19 or the like.

Embodiment 3-1:

[0115] One example of a mechanical pencil in the Embodiment 3 will be described in detail next.

[0116] An iron-made rod having an outside diameter of 0.54 mm and a length of 100 mm was inserted into a hole of a silicone tube of a circular shape having an outside diameter of 1.0 mm and an inside diameter of 0.55 mm and having a length of 100 mm. Then, the outside of the silicone tube was hydrated by means of corona discharge treatment. Then, a palladium catalyst was absorbed on the outside of the silicone tube by a known sensitizer method and an activator method. Then, the same was treated for 1 minute at a liquid temperature of 90 degrees C using an electroless nickel-phosphorus plating solution (BLUE SUMER, manufactured by Japan Kanigen Co., Ltd.). By doing so, an electrically conductive film having a film thickness of 0.3 μm was formed by an electroless plating method. Then, 0.5 m 1/1a stress-free additive (NSF-E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (nickel sulfamate high-concentration bath, manufactured by Nihon Kagaku Sangyo Co., Ltd.) and treated for 60 minutes at a current density of 10A/dm^2 in the form of a solution composition wherein the stress to the precipitation film becomes a compressive stress. By doing so, a metal layer (nickel layer) having a film thickness of 100 μm was formed by an electroforming method. After drying, the iron-made core rod was removed and a nickel-made pipe having a silicone resin on its inner surface was obtained. Then, the nickel-made pipe was cut so as to have a length of 6 mm and a lead protective member was formed. Then, a tip member of a mechanical pencil (PG305D, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A125, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 3-2:

[0117] One example of a mechanical pencil in the Embodiment 3 will be described in detail next.

[0118] An iron-made rod having an outside diameter of 0.54 mm and a length of 150 mm was inserted into a hole of a heat-contracting silicone rubber tube (St-3d4 (0.2), manufactured by Shin-Etsu Chemical Co., Ltd.) having a length of 150 mm. Then, the outside of the silicone rubber tube was hydrated by means of corona discharge treatment. Then, a palladium catalyst was absorbed on the outside of the silicone rubber tube by a known sensitizer method and an activator method. Then, the same was treated for 5 minutes at a liquid temperature of 90 degrees C using an electroless nickel-phosphorus plating solution (BLUE SUMER, manufactured by Japan Kanigen Co., Ltd.). By doing so, an electrically conductive film having a film thickness of 1.0 μm was formed by an electroless plating method. Then, the film was treated at a current density of 10A/dm^2 using an industrial chrome plating liquid. By doing so, a metal layer (hard chrome layer) having a film thickness of 80 μm was formed by an electroplating method. After drying, the iron-made core rod was removed and a hard chrome-made pipe having a silicone resin on its inner surface was obtained. Then, the hard chrome-made pipe was cut so as to have a length of 6 mm and a lead protective member was formed. Then, a tip member of a mechanical pencil (A125, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A127, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 3-3:

[0119] One example of a mechanical pencil in the Embodiment 3 will be described in detail next.

[0120] An iron-made rod having an outside diameter of 0.54 mm and a length of 100 mm was inserted into a hole of a heat-contracting silicone rubber tube (St-3d4 (0.2), manufactured by Shin-Etsu Chemical Co., Ltd.) having a length of 100 mm. Then, a copper-made film of 0.1 μm was formed as an electrically conductive film by an ion plating method. Thereafter, 0.5 m 1/1 of a stress-free additive (NSF-E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (nickel sulfamate high-concentration bath, manufactured by Nihon Kagaku Sangyo Co., Ltd.) and treated for 60 minutes at a current density of 10A/dm^2 in the form of a solution composition wherein the stress to the precipitation film becomes a tensile stress. By doing so, a metal layer (nickel layer) having a film thickness of 100 μm was formed by an electroforming method. After drying, the iron-made core rod was removed and a nickel-made pipe having a silicone resin on its inner surface was obtained. Then, the nickel-made pipe was cut so as to have a length of 6 mm and a lead protective member was formed. Then, a tip member of a mechanical pencil (A125, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A127, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 3-4:

[0121] One example of a mechanical pencil in the Embodiment 3 will be described in detail next.

[0122] An iron-made rod having an outside diameter of 0.54 mm and a length of 100 mm was inserted into a hole of a silicone tube of a circular shape having an outside diameter of 1.0 mm and an inside diameter of 0.55 mm and having a length of 100 mm. Then, the outside of the silicone tube was hydrated by means of corona discharge treatment. After immersing in an aminosilane treatment solution (1 wt % alcohol solution of A1100, manufactured by Nippon Unicar Co., Ltd.) for 10 minutes at a liquid temperature of 50 degrees C, the resultant resin was dried for 60 minutes at a temperature of 100 degrees C. Then, a palladium catalyst was absorbed on the outside of the silicone tube by a known sensitizer method and an activator method. Then, the same was treated for 1 minute at a liquid temperature of 90 °C using an electroless nickel-phosphorus plating solution (BLUE SUMER, manufactured by Japan Kanigen Co., Ltd.). By doing so, a metal layer (nickel-phosphorus layer) having a film thickness of 0.3 μm was formed by an electroless plating method. Thereafter, the same was treated for 120 minutes at a current density of 10A/dm^2 in the form of a solution composition wherein the stress to the precipitation film becomes a compressive stress, using a nickel electroforming solution (nickel sulfamate high-concentration bath, manufactured by Nihon Kagaku Sangyo Co., Ltd.). By doing so, a metal layer (nickel layer) having a film thickness of 150 μm was formed by an electroforming method. After drying, the iron-made core rod was removed and a nickel-made pipe having a silicone resin on its inner surface was obtained. Then, the nickel-made pipe was cut so as to have a length of 6 mm and a lead protective member was formed. Then, a tip member of a mechanical pencil (A125, manufactured by Pentel Co., Ltd.) was removed and this lead protective member was fixedly press-fitted to a separate tip member (tip member for A127, manufactured by Pentel Co., Ltd.). As a result, a mechanical pencil was obtained.

Embodiment 4:

[0123] A lead protective member of the present invention may have a deformed part formed by applying an external force thereto from outside so as to be plastically deformed.

[0124] FIGS. 20 and 21 show one example of a lead protective member.

[0125] The lead protective member has a resin layer 17 for retaining a lead and formed within the lead protective member and a metal layer 18 formed on the outside of the resin layer 17. A through-hole is formed in this resin layer 17. The lead L is slidingly moved through this through-hole. Owing to a provision of this resin layer 17, not only a long lead but also such a short lead as a residual lead can be retained.

[0126] This protective member is obtained by applying an external force to a front end part thereof from outside so as to be plastically deformed. Due to this plastic deformation, the diameter of the through-hole of the resin layer 17 is reduced.

[0127] Accordingly, by reducing the outside diameter of the front part of the lead protective member, the lead is compressed when it passes through the reduced part, thereby increasing the feeling of resistance. Thus, shaking of the residual lead can be eliminated.

[0128] Shaking of the residual lead can also be eliminated by reducing the outside diameter of the front end part of the lead protective member after a part of the resin layer 17 formed on the front end part of the lead protective member is removed.

[0129] It should be noted that an electrically conductive film 16 may be formed between the resin layer 17 and the metal layer 18.

Embodiment 5:

[0130] Reference is now made to FIG. 22.

[0131] This Embodiment 5 is obtained by removing a part of a resin layer formed within a lead protective member.

[0132] Examples of a method for removing a part 20 of the resin layer may include a method for removing the resin layer by laser beam (hereinafter referred to as the "removing method 1"), a method for cutting the resin layer (hereinafter referred to as the "removing method 2"), a method for removing the resin layer by melting (hereinafter referred to as the "removing method 3") and the like. A specific method may selectively be employed in accordance with the material and shape of the resin layer.

[0133] In the removing method 1, a laser medium is used which can thermally melt or chemically destroy (decompose) a part of the resin layer 17 by laser beam and remove it. The laser mediums employable in this Embodiment 5 are not particularly limited. They may include, for example, solid laser such as ruby laser, YAG laser, glass laser, tungstic calcium laser and the like, gas laser such as He-Ne laser, Ar laser, Kr laser, CO_2 laser and the like, liquid laser such as oxychlorinated selenium laser, semiconductor laser such as Ga-As laser, Ga-Sb laser, Cd-S laser, Zn-S laser and the like, excimer laser, etc.

[0134] In the removing method 2, the cutting means are not particularly limited. They may include, for example, lathe turning using a boring bar tool, drill machining using a twist drill or semi-circular turning tool, ream machining, grinding machining using a grinder and the like.

[0135] In the removing method 3, the melting means are not particularly limited. They may include, for example, a method for deforming the resin layer 17 by pressing a heated trowel against the resin layer 17, and the like.

[0136] Moreover, the removal shape of the partly removed part 20 is not particularly limited. It may chiefly include a cylindrical shape, a conical shape, a funnel-like shape, a polygonal shape and the like.

Embodiment 5-1:

[0137] FIGS. 23, 24 and 25 show one example.

[0138] Embodiment 5-1 is same as the Embodiment 4 only except that a part of a front end part of a resin layer 17 is removed before the front end part is machined.

[0139] In this Embodiment 5-1, since a part 20 of the front end part of the resin layer 17 is removed, the elastic force of the resin layer 17 formed on the front end part is smaller than that of the comparable part of the Embodiment 4. Accordingly, shaking of the lead at the front end part is less than that of the comparable part of the Embodiment 4.

[0140] At the time for removing a part of the front end part of the resin layer 17, other means may be employed. For example, it is also accepted that the resin layer is entirely removed as shown in FIG. 26 or the resin layer is partly removed in the form of a crown as shown in Fig. 27.

Embodiment 5-2:

[0141] FIG. 28 shows another example.

[0142] In this Embodiment 5-2, a lead protective member 5 and a front end part 5 are integrally formed with each other by a metal layer formed on the outside of the resin layer 17. That is to say, after the metal layer is formed so as to have a thick wall, its outer appearance and its rear part inner surface are machined so as to have various shapes. Moreover, the tip part of the lead protective member 6 is reduced in diameter by drawing.

Embodiment 5-3:

[0143] FIG. 29 shows one example.

[0144] In this Embodiment 5-3, the inside diameter of a front end part is reduced by deforming the front end part of a metal layer 18 of a lead protective member inward by pressing or the like. In this Embodiment 5-3, it is also accepted that first, the tip part of the metal pipe is machined by pressing and cutting so as to form a metal layer 18 and then, a resin layer 17 is formed within the metal layer 18.

Embodiment 5-4:

[0145] FIG. 30 shows one example.

[0146] This Embodiment 5-4 is same as the Embodiment 4 only except that the inside diameter (inscribed diameter in this example) of a front end part is reduced by deforming the front end part at several divided sections instead of deforming the front end part over the entire circumference. For machining the front end part at several divided sections, many methods may selectively be employed such as, for example, a press machining method, a punch machining method, a roll machining method using a die and the like.

Embodiment 6:

[0147] A method for forming a plastic deformation will be described in detail next.

[0148] The method for forming a plastic deformation employed in this Embodiment 6 is a method for draw machining (hereinafter referred to as the "plastic deformation method 1").

[0149] One example of the plastic deformation method 1 may include a pipe draw machining method using a die. This die is provided at an inner surface thereof with a contour corresponding to a counterpart contour which a front end part may have after it is deformed. The drawing configuration is not particularly limited.

[0150] A dimethyl-based silicone tube having an outside diameter of Ø 0.86 mm (circle), an inscribed diameter of Ø 0.52 mm (hexagon) and a length of 500 mm was formed by extrusion molding, and an iron-made core rod is inserted in a hole of the silicone tube.

[0151] Then, an electrically conductive film (copper film) having a film thickness of 0.2 μm was formed on the surface of the silicone tube through an ion plating method.

[0152] Thereafter, 10 mL/L of an additive (NSF H-3, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0153] Then, the silicone tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 70 minutes. As a result, a metal layer (nickel layer) having a film thickness of 120 μm was formed.

[0154] Then, the resultant was dried and then, the iron-made core rod was removed. Then, the resultant silicone tube was cut with a cutter.

[0155] The cutter used herein was a cutter (GC-320PB, manufactured by Disco Corporation) having a thickness of 0.5 mm or less. The speed of rotation of the cutter was 1500 to 4000 m/min at a circumferential speed of the cutter.

[0156] Since burrs were produced due to cutting on an end face of the lead protective member after cutting, the burrs produced at the outer peripheral part of the end face were removed by barrel polishing or the like.

[0157] As the barrel, a centrifugal fluid barrel working machine was used and the barrel polishing was carried out by a wet method. A titan chip was used as the barrel polishing stone and the end face of the lead protective member was polished together with a compound of water and surface active agent.

[0158] A method for removing a part of the resin layer 17 at a tip part of the lead protective member will be described next.

[0159] The removing operation is carried out using CO_2 laser beam.

[0160] The laser beam is irradiated for 1.5 seconds under the conditions of a focal length of 20 mm and a light output of 15 watts. By doing so, the resin layer 8 can be removed from 0.5 mm to 1.5 mm in depth (see reference numeral 9 of FIG. 22).

[0161] A manufacturing method capable of making a front end part inscribed diameter smaller than the rear part inscribed diameter by applying an external force to the silicone tube from outside so as to be plastically deformed will be described next with reference to FIGS. 31, 32 and 33.

[0162] Deformation is made by a drawing method using the die 21.

[0163] Material of the die 21 used herein is a cemented carbide. The inner surface contour 22 of the die 21 may have a contour capable of drawing with a gentle curve in the same way as the general pipe drawing contour or tapered contour.

[0164] A pipe 24 for feeding the core rod 23 is disposed within the die 23.

[0165] The core rod 23 is inserted in the lead retaining member at the time of drawing the front end part of the lead protective member. This serves to prevent the inside diameter of the front end part of the lead protective member from being drawn smaller than the inside diameter of the objective tip part hole due to adverse effect caused by the uneven thickness of the metal layer 18 (see FIG. 34).

[0166] The feed pipe 24 is adapted to separate the lead protective member from the die 21 when the lead protective member bites into the die after the drawing operation (see FIG. 33).

[0167] The die 21 is set on a press machine and the lead protective member 6 is set on a workpiece retaining table 25 which is disposed in an axial direction of the die 21 (see FIG. 31).

[0168] Then, a die set 26 is lowered to press the lead protective member 6 (see FIG. 32).

[0169] After lowering, the die set 26 is moved upward (see FIG. 33).

[0170] It should be noted that the positional relation between the workpiece retaining table 25 and the die set 26 is not limited to a vertical relation (up and down relation).

[0171] By drawing the end part of the lead protective member through the series of processes, the front end part of the metal layer 18 is deformed such that the inscribed diameter is reduced. By this, the residual lead is prevented from falling down by its dead weight. In addition, a lead protective member of a mechanical pencil is formed, in which the user gets no feeling of shaking of the residual lead at the time of writing. Thus, there can be obtained a lead protective member (see FIG. 33) which is provided at an inner surface thereof with a silicone resin layer and whose front end part is plastically deformed (see reference numeral 19 of FIG. 33).

Embodiment 7:

[0172] The method for forming a plastic deformation employed in this Embodiment 7 is a deformation method in which a deforming operation is carried out by pressing a bearing or the like (hereinafter referred to as the "plastic deformation method 2").

[0173] Examples of the plastic deformation method 2 may include a rolling method in which a plurality of bearings are radially arranged each having an outer peripheral surface whose contour corresponds to a counterpart contour which the front end part of the lead protective member may have after it is deformed and in which the front end part of the lead protective member is deformed by being gradually pressed against the central part of the bearings while rotating the lead protective member, a method in which the lead protective member is rotated and the front end part of the rotating lead protective member is deformed by gradually pressing a bearing or the like whose contour corresponds to a counterpart contour which the front end part of the lead protective member may have after it is deformed, against the side of the front end part of the lead protective member, and the like. The plastic deformation method 2 is, of course, not particularly limited to the above methods.

[0174] It is also accepted that the lead protective member is fixed and the bearing side is rotated.

[0175] A fluoro-dimethyle copolymerization silicone tube having an outside diameter of Ø 0.90 mm (circle), an inscribed diameter of Ø 0.53 mm (circle) and a length of 500 mm was formed by extrusion molding using a fluoro-dimethyle copolymerization silicone rubber (XE24-A1680, manufactured by GE-Toshiba Silicone Co. Ltd.), and an iron-made core rod is inserted in a hole of the silicone tube.

[0176] Then, an electrically conductive film (copper film) having a film thickness of 0.5 µm was formed on the surface of the silicone tube through an ion plating method.

[0177] Thereafter, 10 mL/L of an additive (NSF H-2, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0178] Thereafter, 5 mL/L of an additive (NSF-E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0179] Then, the silicone tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 70 minutes. As a result, a metal layer (nickel layer) having a film thickness of 120 µm was formed.

[0180] Then, the resultant was dried and then, the iron alloy-made core rod was removed. The cutting and burrs removing are carried out in the same manner as in Embodiment 6.

[0181] The partial removal of the silicone tube was carried out such that the lead protective member was fixed to the shaft of rotation and the partial removal was made by boring while rotating the shaft of rotation. It is also accepted that the boring bar tool is rotated and the lead protective member is fixed.

[0182] A manufacturing method capable of making a front end part inscribed diameter smaller than the rear part inscribed diameter by applying an external force to the silicone tube from outside so as to be plastically deformed will be described next with reference to FIGS. 34, 35 and 36.

[0183] Deformation is carried out by roll machining in which a bearing 27 having a deforming contour (see reference numeral 22 of FIG. 34) at a tip part is pressed against the objective part.

[0184] Two or three bearings 27 are radially arranged with respect to the axis of the shaft 28 of rotation and rotatably fixed by a bearing fixing member 29.

[0185] A bearing set 30 on which the bearings 27 are mounted is attached to a rotating spindle, motor or the like.

[0186] The core rod 23 is inserted into the lead protective member at the time of drawing the front end part of the lead protective member so that the inside diameter will be prevented from being drawn smaller than the inside diameter of the objective tip part hole due to adverse effect caused by the uneven thickness of the metal layer 18 as in the Embodiment 6.

[0187] The lead protective member is set on the workpiece retaining table 25 and the bearing set 30 is attached to a motor or the like for rotating the bearing set 30 on an extension of the axis of the lead protective member (see FIG. 34).

[0188] The front end part of the metal layer 18 is deformed by drawing the end part of the lead protective member by pressing the bearing set 30 against the lead protective member while rotating the bearing set 30 with the motor or the like (see FIG. 35).

[0189] After lowering, the bearing set 30 is moved upward (see FIG. 36).

[0190] The positional relation between the workpiece retaining table 25 and the bearing set 30 is not limited to the vertical direction (up and down direction).

[0191] By reducing the inscribed diameter through the series of processes, a lead protective member of a mechanical pencil is formed in which the residual lead is prevented from falling down by its dead weight and the user does not get a feeling of shaking of the lead at the time of writing. Thus, there can be obtained the lead protective member (see FIG. 36) which is provided at an inner surface thereof with a silicone resin layer and whose front end part is plastically deformed (see reference numeral 19 of FIG. 36).

Embodiment 8:

[0192] The method for forming a plastic deformation employed in this Embodiment 8 is a deformation method in which a part of the front end part is deformed by punching or the like (hereinafter referred to as the "plastic deformation method 3").

[0193] One example of the plastic deformation method 3 may include a method in which a part of an outer peripheral part from the side of the front end part of the lead protective member is deformed at several spots by punching or the like. The configuration of the tip part of the punch is not particularly limited.

[0194] An iron alloy-made core rod was inserted in a methylfluoroalkyl-based silicone tube (fluorosilicone tube) having an outside diameter of Ø 0.92 mm (circle), an inscribed diameter of Ø 0.51 mm (pentagon) and a length of 6 mm.

[0195] Then, an electrically conductive film (copper film) having a film thickness of 0.2 µm was formed on the surface of the silicone tube through an ion plating method.

[0196] Thereafter, 5 mL/L of an additive (NSF-E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0197] Then, the silicone tube (fluorosilicone tube) with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 60 minutes. As a result, a metal layer (nickel layer) having a film thickness of 120 μm was formed.

[0198] Then, the resultant was dried and then, the iron alloy-made core rod was removed.

[0199] The method for removing a part of the silicone tube employed here was a method in which a heated trowel having a removing contour was heated to a temperature for heat deforming the silicone and pressed against the part of the silicone tube so that the silicone is deformed in various ways.

[0200] A manufacturing method capable of making a front end part inscribed diameter smaller than the rear part inscribed diameter by applying an external force to the silicone tube from outside so as to be plastically deformed will be described next with reference to FIGS. 37, 38 and 39.

[0201] Deformation is made by punching several spots of the outer periphery of the front end part using a punch 31.

[0202] Deformation is made by roll machining in which the punch 31 having a contour (see reference numeral 22 of FIG. 37) capable of deforming the tip part is pressed against the tip part.

[0203] Punching operation may be carried out several times using only one punch 31. It is also accepted that a plurality of punches 31 are radially arranged and punching operation is carried out simultaneously by those punches 31.

[0204] The punching direction is not particularly limited.

[0205] FIG. 39 shows one example in which the inscribed diameter is reduced by deforming the tip part at several divided sections.

[0206] As in the Embodiments 6 and 7, punching operation may be carried out in a state in which the core rod is inserted in the hole, so that the inside diameter will be prevented from being drawn smaller than the inside diameter of the objective tip part hole due to adverse effect caused by the uneven thickness of the metal layer 18 and the accuracy of the inscribed hole diameter is enhanced at the front end part.

[0207] The deforming contour is not limited to the contour shown.

[0208] The deforming method is not limited to punching. Pressing and rolling using a die may also be employed.

Embodiment 9:

[0209] A fluoro-dimethyl-admixed silicone tube having an outside diameter of Ø 0.92 mm (circle), an inscribed diameter of Ø 0.51 mm (pentagon) and a length of 500 mm was formed by extrusion molding using a silicone rubber obtained by admixing a methylfluoroalkyl-based silicone rubber (fluorosilicone) and a dimethyl-based silicone rubber in a ratio of 1 : 1. An iron alloy-made rod was inserted into a hole of the silicone tube.

[0210] Then, an electrically conductive film (copper film) having a film thickness of 0.2 μm was formed on the surface of the silicone tube through an ion plating method.

[0211] Thereafter, 5 mL/L of an additive (NSF-E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0212] Then, the fluoro-dimethyl-admixed silicone tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 60 minutes. As a result, a metal layer (nickel layer) having a film thickness of 100 μm was formed.

[0213] Then, the resultant was dried and then, the iron alloy-made core rod was removed.

[0214] The procedure for cutting, removing burrs, removing silicone and drawing may be selectively employed from any one of the Embodiments 5 to 8. By means of this procedure, a lead protective member was obtained having a silicone resin layer on its inner surface and whose front end part is plastically deformed.

Embodiment 10:

[0215] A dimethyl-based silicone tube having an outside diameter of Ø 0.86 mm (circle), an inscribed diameter of Ø 0.5 mm (hexagon) and a length of 500 mm was formed by extrusion molding, and an iron-made rod was inserted into a hole of the silicone tube.

[0216] Then, the outside of the silicone tube was hydrated by means of corona discharge treatment. Then, a palladium catalyst was absorbed on the outside of the silicone tube by a known sensitizer method and an activator method.

[0217] Then, the resultant was immersed in an electroless nickel plating solution (obtained by diluting BLUE SUMER (manufactured by Japan Kanigen Co., Ltd.) with ion exchange water by 5 times) and treated for 1 minute at a liquid temperature of 90 degrees C. As a result, an electrically conductive film (Ni-P alloy film) having a film thickness of 0.2 μm was formed on the surface of the silicone tube.

[0218] Thereafter, 10 mL/L of an additive (NSF H-3, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of

60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0219] Then, the dimethyl-based silicone tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 70 minutes. As a result, a metal layer (nickel layer) having a film thickness of 120 μ m was formed.

[0220] Then, the resultant was dried and then, the iron alloy-made core rod was removed.

[0221] The procedure for cutting, removing burrs, removing silicone and drawing may be selectively employed from any one of the Embodiments 5 to 8. By means of this procedure, a lead protective member was obtained having a silicone resin layer on its inner surface and whose front end part is plastically deformed.

Embodiment 11:

[0222] A fluoro-dimethy copolymerization silicone tube having an outside diameter of Ø 0.90 mm (circle), an inscribed diameter of Ø 0.53 mm (circle) and a length of 500 mm was formed by extrusion molding using a fluoro-dimethyle copolymerization silicone rubber (XE24-A1680, manufactured by GE Toshiba Silicons Co., Ltd.), and an iron alloy-made rod was inserted into a hole of the silicone tube.

[0223] Then, the outside of the silicone tube was hydrated by means of plasma treatment. Then, a palladium catalyst was absorbed on the outside of the silicone tube by a known catalyst method.

[0224] Then, the resultant silicone tube was immersed in an electroless copper plating solution (a mixed solution of 125 mL/L of electroless copper solution 500A (manufactured by Okuno Chemical Industries Co., Ltd.) and 125 mL/L of electroless copper solution 500B (manufactured by Okuno Chemical Industries Co., Ltd.) and treated for 10 minutes at a liquid temperature of 25 °C. As a result, an electrically conductive film (copper film) having a film thickness of 0.5 μm was formed.

[0225] Thereafter, 10 mL/L of an additive (NSF H-2, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0226] Then, the fluoro-dimethyl copolymerization silicone tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 70 minutes. As a result, a metal layer (nickel layer) having a film thickness of 120 μm was formed.

[0227] Then, the resultant was dried and then, the iron alloy-made core rod was removed.

[0228] The procedure for cutting, removing burrs, removing silicone and drawing may be selectively employed from any one of the Embodiments 5 to 8. By means of this procedure, a lead protective member was obtained having a silicone resin layer on its inner surface and whose front end part is plastically deformed.

Embodiment 12:

[0229] An iron alloy-made rod was inserted into a hole of a heat-contracting silicone rubber tube (St-3d4 (0.2), manufactured by Shin-Etsu Chemical Co., Ltd.) having a length of 300 mm.

[0230] Then, an electrically conductive film (copper film) having a film thickness of 0.2 μm was formed on the surface of the heat contracting silicone tube by an ion-plating method.

[0231] Thereafter, 5 mL/L of an additive (NSF-E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0232] Then, the Fluoro-dimethyl copolymerization silicone tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 60 minutes. As a result, a metal layer (nickel layer) having a film thickness of 100 μm was formed.

[0233] Then, the resultant was dried and then, the iron alloy-made core rod was removed.

[0234] The procedure for cutting, removing burrs, removing silicone and drawing may be selectively employed from any one of the Embodiments 5 to 8. By means of this procedure, a lead protective member was obtained having a silicone resin layer on its inner surface and whose front end part is plastically deformed.

Embodiment 13:

[0235] An iron-made core rod was inserted into a hole of a fluororesin tube having an outside diameter of Ø 1.0 mm (circle), an inscribed diameter of Ø 0.5 mm (circle) and a length of 500 mm.

[0236] Then, an electrically conductive film (copper film) having a film thickness of 0.2 μm was formed on the surface of the heat contracting silicone tube by an ion-plating method.

[0237] Thereafter, 5 mL/L of an additive (NSF E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0238] Then, the fluororesin tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 60 minutes. As a result, a metal layer (nickel layer) having a film thickness of 100 µm was formed.

[0239] Then, the resultant tube was dried and then, the iron alloy-made core rod was removed.

[0240] The procedure for cutting, removing burrs, removing silicone and drawing may be selectively employed from any one of the Embodiments 5 to 8. By means of this procedure, a lead protective member was obtained having a fluororesin layer on its inner surface and whose front end part is plastically deformed.

Embodiment 14:

[0241] An acrylic pipe having an outside diameter of Ø 1.0 mm (circle), an inscribed diameter of Ø 0.58 mm (circle) and a length of 500 mm was formed by extrusion molding. Then, the outside of this acrylic pipe was hydrated by means of corona discharge treatment. Then, a palladium catalyst was absorbed on the outside of the acrylic pipe by a known sensitizer method and an activator method. Then, the palladium catalyst was absorbed on the outside of the acrylic pipe by a known catalyst method.

[0242] Then, this acrylic pipe was immersed in an electroless copper plating solution (a mixed solution of 125 mL/L of electroless copper solution 500A (manufactured by Okuno Chemical Industries Co., Ltd.) and 125 mL/L of electroless copper solution 500B (manufactured by Okuno Chemical Industries Co., Ltd.)) and treated for 10 minutes at a liquid temperature of 25 degrees C. As a result, an electrically conductive film (copper film) having a film thickness of 0.5 µm was formed.

[0243] Thereafter, the acrylic pipe with an electrically conductive film formed thereon was dipped into the copper electroforming solution (acid copper sulfate bath), and a negative potential was supplied thereto at a current density of 5 A/dm^2. As a result, a metal layer (copper layer) having a film thickness of 50 µm was formed.

[0244] The procedure for cutting, removing burrs, removing silicone and drawing may be selectively employed from any one of the Embodiments 5 to 8. By means of this procedure, a lead protective member was obtained having a acrylic resin layer on its inner surface and whose front end part is plastically deformed.

Embodiment 15:

[0245] A fluoro-dimethyl copolymerization silicone tube having an outside diameter of Ø 0.90 mm (circle), an inscribed diameter of Ø 0.52 mm (hexagon) and a length of 500 mm was formed by extrusion molding using a fluoro-dimethyl copolymerization silicone rubber (XE24-A1680; weight change rate: 2 % (when immersed in a fluid paraffin of a temperature of 70 °C for 20 days, the same shall apply hereinafter), manufactured by GE Toshiba Silicons Co., Ltd.), and an iron alloy-made rod was inserted into a hole of the silicone tube.

[0246] Then, an electrically conductive film (copper film) having a film thickness of 0.5 µm was formed on the surface of the silicone tube by an ion-plating method.

[0247] Thereafter, 10 mL/L of an additive (NSF H-3, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0248] Then, the silicone tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 70 minutes. As a result, a metal layer (nickel layer) having a film thickness of 120 µm was formed.

[0249] Then, the resultant tube was dried and then, the iron-made core rod was removed. Thereafter, the silicone tube was cut with a cutter to obtain a lead protective member.

[0250] A refill was passed through the lead protective member thus obtained and the lead retaining force was measured with a digital force gauge (manufactured by Imada Co., Ltd.: Model DPX-1). After 200 refills were passed through the lead protective member, the lead retaining force was measured again with the digital force gauge. No increase in lead retaining force was confirmed.

Embodiment 16:

[0251] A fluoro-dimethy copolymerization silicone tube having an outside diameter of Ø 0.90 mm (circle), an inscribed diameter of Ø 0.53 mm (circle) and a length of 500 mm was formed by extrusion molding using a fluoro-dimethyl copolymerization silicone rubber (XE24-A1680; weight change rate: 2 %, manufactured by GE Toshiba Silicons Co., Ltd.), and an iron alloy-made rod was inserted into a hole of the silicone tube.

[0252] Then, an electrically conductive film (copper film) having a film thickness of 0.5 µm was formed on the surface of the silicone tube by an ion-plating method.

[0253] Thereafter, 10 mL/L of an additive (NSF H-2, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0254] Then, the silicone tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 70 minutes. As a result, a metal layer (nickel layer) having a film thickness of 120 μ m was formed.

[0255] Then, the resultant tube was dried and then, the iron alloy-made core rod was removed. Thereafter, the silicone tube was cut with a cutter to obtain a lead protective member.

[0256] A refill was passed through the lead protective member thus obtained and the lead retaining force was measured with a digital force gauge. After 200 refills were passed through the lead protective member, the lead retaining force was measured again with the digital force gauge. No increase in lead retaining force was confirmed.

Embodiment 17:

[0257] An iron alloy-made core rod was inserted in a methylfluoroalkyl-based silicone tube (fluorosilicone tube: weight change rate 1 %) having an outside diameter of Ø 0.92 mm (circle), an inscribed diameter of Ø 0.51 mm (pentagon) and a length of 6 mm.

[0258] Then, an electrically conductive film (copper film) having a film thickness of 0.2 μm was formed on the surface of the silicone tube through an ion plating method.

[0259] Thereafter, 5 mL/L of an additive (NSF-E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0260] Then, the silicone tube (fluorosilicone tube) with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 60 minutes. As a result, a metal layer (nickel layer) having a film thickness of 10 μm was formed.

[0261] Then, the resultant tube was dried and then, the iron alloy-made core rod was removed. Thereafter, the silicone tube was cut with a cutter to obtain a lead protective member.

[0262] A refill was passed through the lead protective member thus obtained and the lead retaining force was measured with a digital force gauge. After 200 refills were passed through the lead protective member, the lead retaining force was measured again with the digital force gauge. No increase in lead retaining force was confirmed.

Embodiment 18

[0263] A fluoro-dimethyl-admixed silicone tube having an outside diameter of Ø 0.92 mm (circle), an inscribed diameter of Ø 0.51 mm (pentagon) and a length of 500 mm was formed by extrusion molding using a silicone rubber (weight change rate 8 %) obtained by admixing a methylfluoroalkyl-based silicone rubber (fluorosilicone) and a dimethyl-based silicone rubber in a ratio of 1 : 1. An iron alloy-made core rod was inserted into a hole of the silicone tube.

[0264] Then, an electrically conductive film (copper film) having a film thickness of 0.2 μm was formed on the surface of the silicone tube through an ion plating method.

[0265] Thereafter, 5 mL/L of an additive (NSF-E, manufactured by Nihon Kagaku Sangyo Co., Ltd.) was added to a nickel electroforming solution (1000 g/L of 60 % nickel sulfamate solution (manufactured by Nihon Kagaku Sangyo Co., Ltd.), 30 g/L of nickel chloride and 35 g/L of boric acid). By doing so, a nickel electroforming solution for forming a metal layer was prepared.

[0266] Then, the fluoro-dimethyl-admixed silicone tube with an electrically conductive film formed thereon was immersed into the nickel electroforming solution for forming a metal layer, and a negative potential was supplied thereto at a current density of 10 A/dm^2 and treated in that condition for 60 minutes. As a result, a metal layer (nickel layer) having a film thickness of 100 μm was formed.

[0267] Then, the resultant tube was dried and then, the iron alloy-made core rod was removed. Thereafter, the silicone tube was cut with a cutter to obtain a lead protective member.

[0268] A refill was passed through the lead protective member thus obtained and the lead retaining force was measured with a digital force gauge. After 200 refills were passed through the lead protective member, the lead retaining force was measured again with the digital force gauge. No increase in lead retaining force was confirmed.

Comparative Example:

[0269] A commercially available mechanical pencil (manufactured by Pentel Co., Ltd.: A125: a stainless pipe having an outside diameter of 0.9 mm, an inside diameter of 0.61 mm and a length of 6 mm was used as a lead protective member; it has a return stopper member) was used as a Comparative Example.

[0270] Tables 1 and 2 show the results of evaluation made with respect to the lead retaining force and yes/no of fallen-down by dead weight of each of the mechanical pencils obtained in the Embodiments 1-1 to 15, 2-1 to 2-3, 3-1 to 3-4 and the Comparative Example.

[0271] The "lead retaining force" in the lead retaining force evaluation was obtained as follows. A refill for a mechanical pencil (standardized diameter: 0.5 (JIS S

6005), HB (manufactured by Pentel Co., Ltd., Hi-POLYMER Ain (C255-HB)) was loaded to a lead protective member attached to a tip member and held in a vertical posture. Then, the tip member was pinchingly held and pressed downward to cause the lead to start moving backward. And a load (load of static friction) to be exerted at the starting time of the backward movement of the lead was measured as the retaining force. Evaluation was made with respect to 5 pieces for each sample (5 products for the Comparative Example), and average values, maximum values and minimum values were obtained for them.

[0272] In Table 2, "yes/no of fallen-down by dead weight" was determined as follows. The Hi-POLYMER Ain (C255-HB) was cut so as to have a length of 3 mm (residual lead) and inserted from the tip part of each lead protective member of the Embodiments and Comparative Example and the rear end of the residual lead was connected to the front end of the following lead. And the residual lead when held in a vertical posture was observed.

Table 1

	lead retaining force (g)		
	average	max.	min.
Embodiment 1-1	15	16	14
Embodiment 1-2	20	22	18
Embodiment 1-3	50	51	49
Embodiment 1-4	30	33	27
Embodiment 1-5	100	105	95
Embodiment 2-1	33	35	31
Embodiment 2-2	30	32	29
Embodiment 2-3	27	28	27
Embodiment 3-1	25	30	20
Embodiment 3-2	90	94	86
Embodiment 3-3	30	31	29
Embodiment 3-4	18	20	16
Comp. Example	25	30	20

Table 2

	Fallen-down by dead weight yes/no
Embodiment 1-1	no
Embodiment 1-2	no
Embodiment 1-3	no
Embodiment 1-4	no
Embodiment 1-5	no
Embodiment 2-1	no
Embodiment 2-2	no
Embodiment 2-3	no
Embodiment 3-1	no
Embodiment 3-2	no

Table 2 (continued)

	Fallen-down by dead weight yes/no
Embodiment 3-3	no
Embodiment 3-4	no
Comp. Example	yes

Claims

1. A mechanical pencil in which a lead feed mechanism disposed in a tubular shaft is advanced/retracted to feed a lead from a lead protective member disposed at a tip part of said tubular shaft, wherein said lead protective member is formed by removing a part of resin filled in said lead protective member by laser beam to thereby form a hole in a longitudinal direction, and said lead is loosely retained by an inner surface of said hole formed in the longitudinal direction.

2. A mechanical pencil in which a lead feed mechanism disposed in a tubular shaft is advanced/retracted to feed a lead from a lead protective member disposed at a tip part of said tubular shaft, wherein said lead protective member is formed by coating metal at least on the outside of a resin tube, and said lead is loosely retained by an inner surface of said resin tube.

3. A mechanical pencil in which a lead feed mechanism disposed in a tubular shaft is advanced/retracted to feed a lead from a lead protective member disposed at a tip part of said tubular shaft, wherein said lead protective member is formed by forming an electrically conductive film at least on the outside of a resin tube and coating metal on said electrically conductive film, and said lead is loosely retained by an inner surface of said resin tube.

4. A mechanical pencil according to any one of claims 1 to 3, wherein said resin is excellent in oil resistance.

5. A mechanical pencil according to any one of claims 1 to 3, wherein said resin is silicone rubber.

6. A mechanical pencil according to any one of claims 1 to 3, wherein said resin is fluoro-dimethyl copolymerization silicone rubber.

7. A mechanical pencil according to any one of claims 1 to 3, wherein said resin has a weight variation factor of 10 % or less when said resin is immersed in liquid paraffin (for twenty days at 70 degrees C).

8. A mechanical pencil in which a lead feed mecha-

nism is disposed in a tubular shaft and a lead protective member having at least a resin layer on an inner surface thereof is disposed at a tip part of said tubular shaft, wherein said lead protective member is made smaller in inscribed circular diameter of a front end part than that of a rear end part by plastically deforming said lead protective member by applying external force thereto from outside.

9. A mechanical pencil according to claim 8, wherein said lead protective member is formed by partly removing said resin layer on said front end part prior to plastic deformation.

10. A mechanical pencil according to claim 2 or 3, wherein said resin tube is deformed in a bore form in section.

11. A mechanical pencil according to any one of claims 1 to 10, wherein said refill is not fallen by dead weight.

12. A mechanical pencil according to any one of claims 1 to 11, wherein lead retaining force is set to 10 g to 100 g with respect to a lead passing direction.

13. A mechanical pencil according to any one of claims 1 to 11, wherein lead retaining force is set to 35 g to 100 g with respect to a lead passing direction.

14. A method for manufacturing a lead protective member of a mechanical pencil having at least a resin layer on an inner surface of said lead protective member, said method comprising at least the step'of plastic deformation for plastically deforming a tip part of said lead protective member by applying external force thereto from outside and setting an inscribed circular diameter of said tip part of said lead protective member to be smaller than that of a non-deformed part.

15. A method for manufacturing a lead protective member of a mechanical pencil according to claim 14, further comprising the step of partly removing the resin layer on said tip part of said lead protective member prior to the step of plastic deformation.

FIG.1

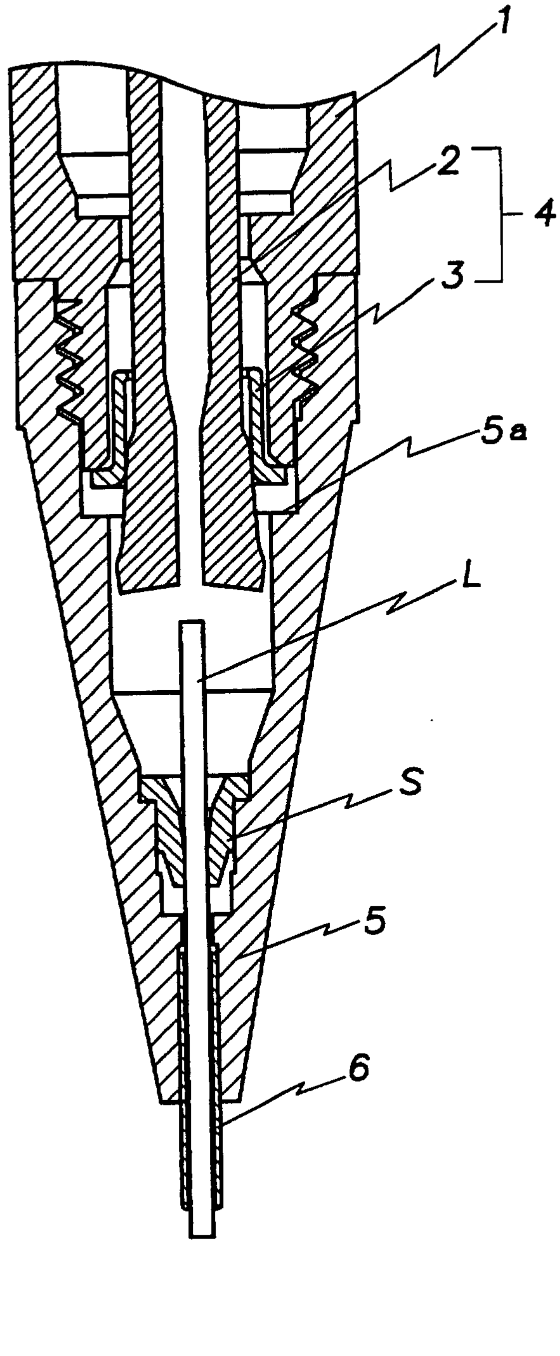


FIG.3

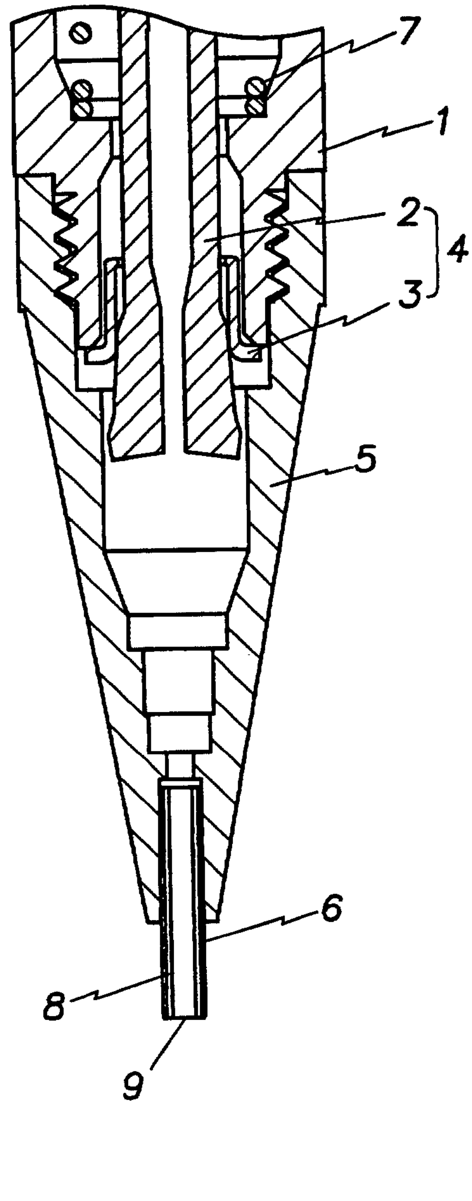


FIG. 2

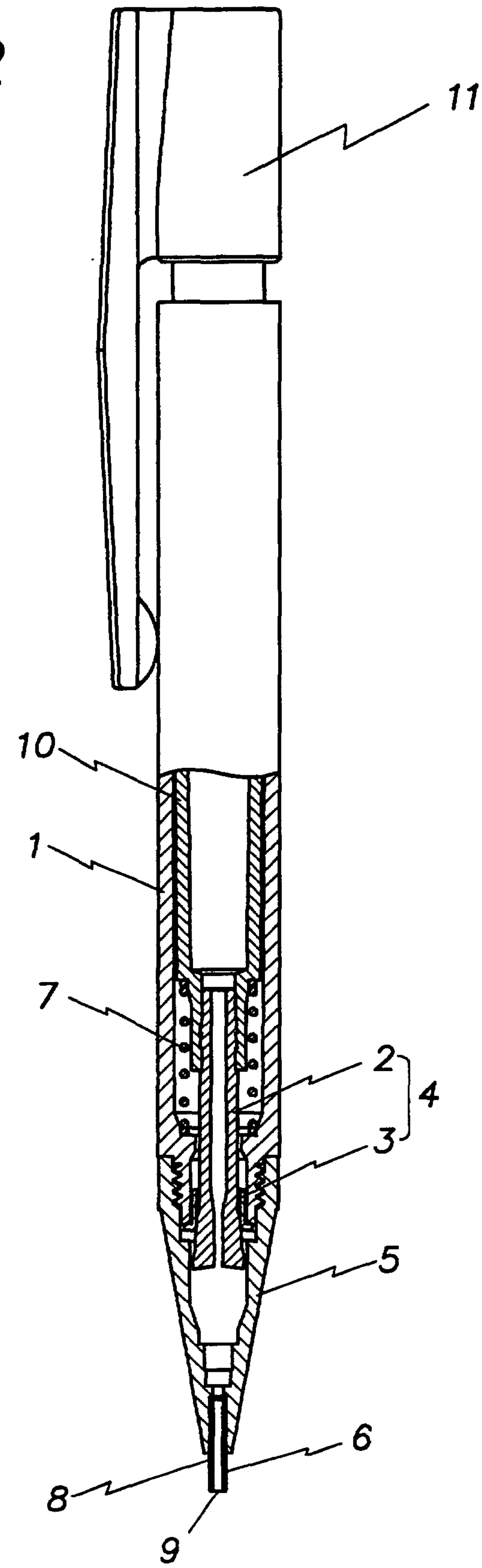


FIG.4

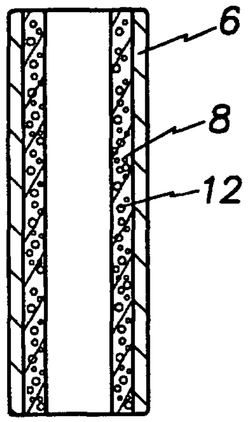


FIG.5

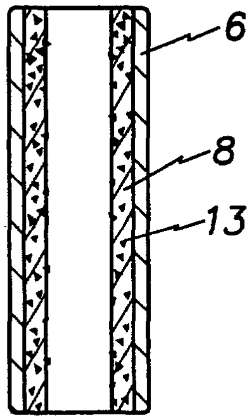


FIG.6

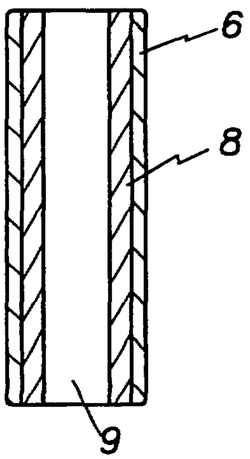


FIG.7

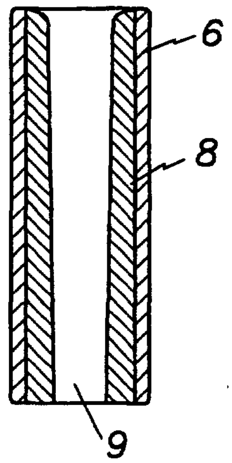


FIG.8

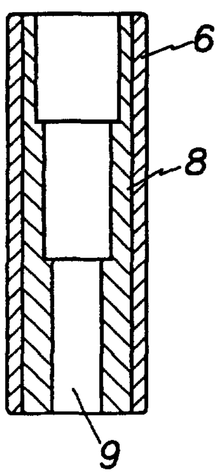


FIG.9

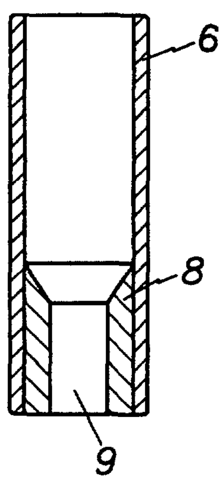


FIG.10

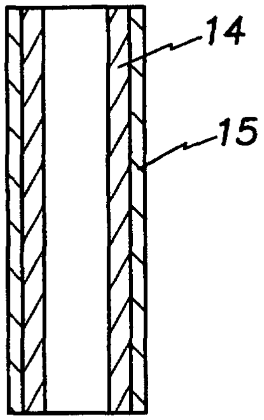


FIG.11

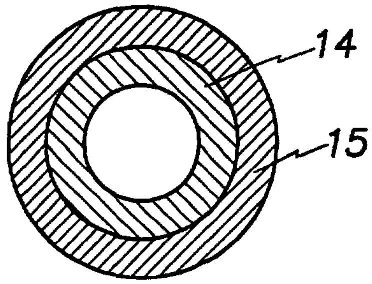


FIG.12

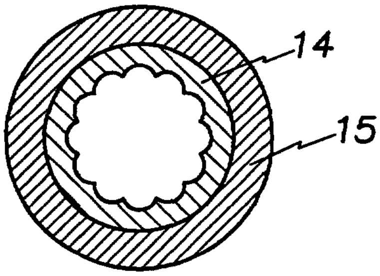


FIG.13

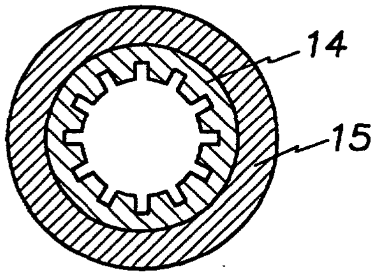


FIG.14

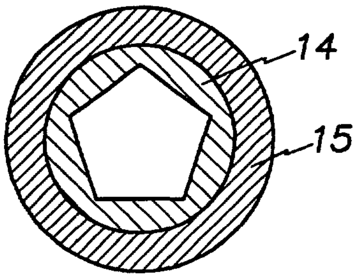


FIG.15

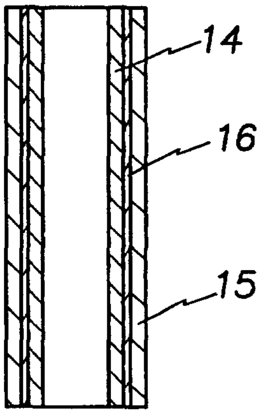


FIG.16

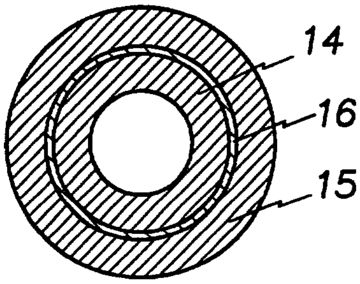


FIG.17

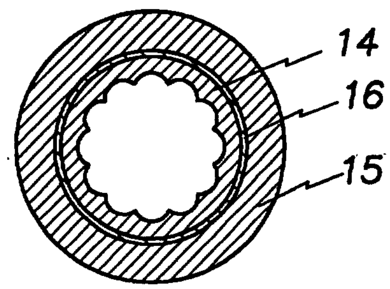


FIG.18

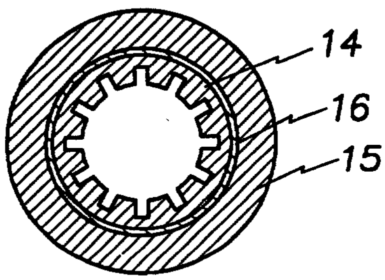


FIG.19

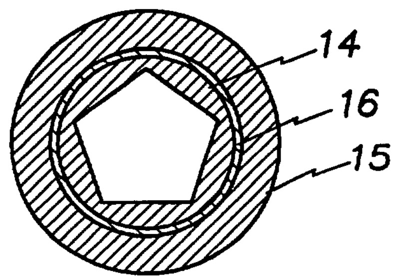


FIG.20

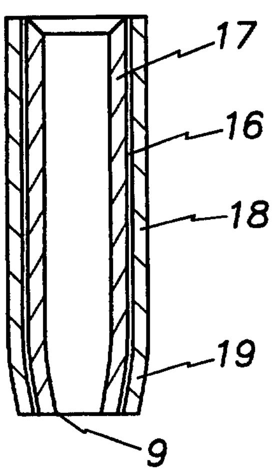


FIG.21

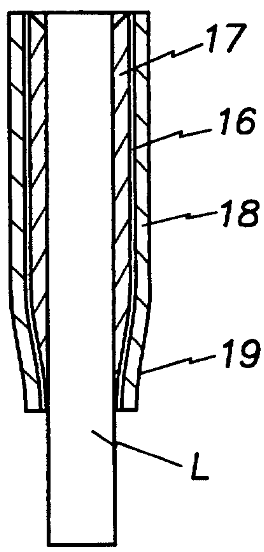


FIG.22

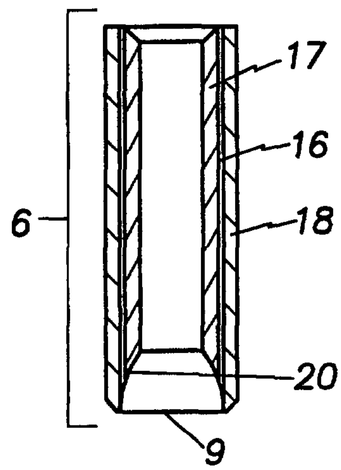


FIG.23

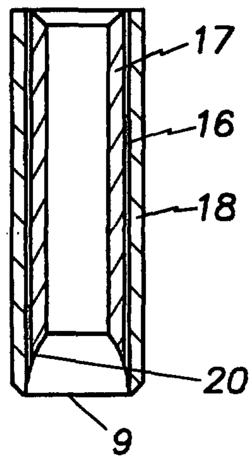


FIG.24

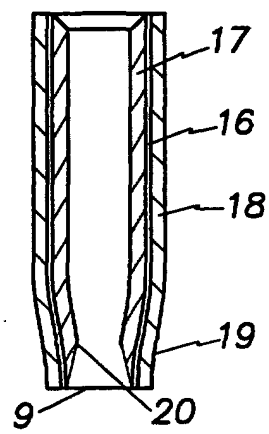


FIG.25

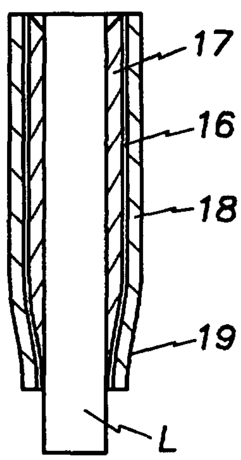


FIG.26

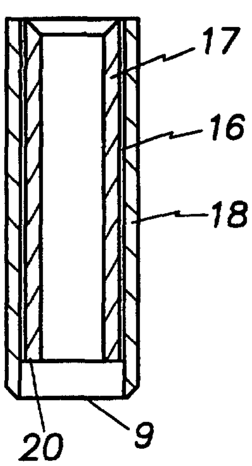


FIG.27

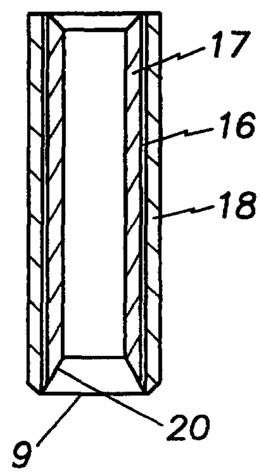


FIG.28

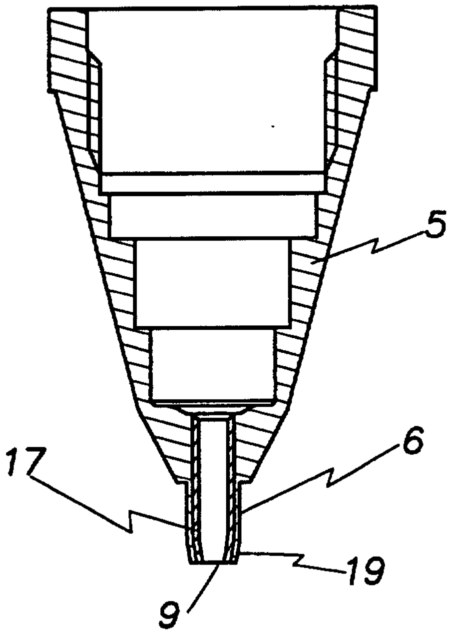


FIG.29

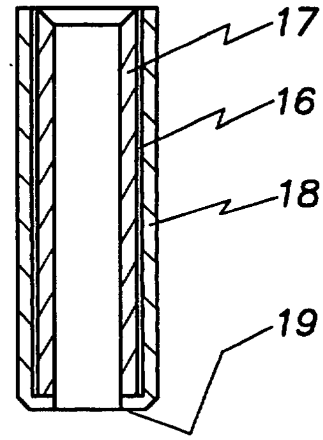


FIG.30

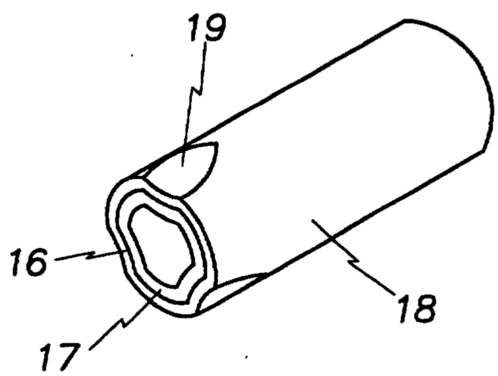


FIG.39

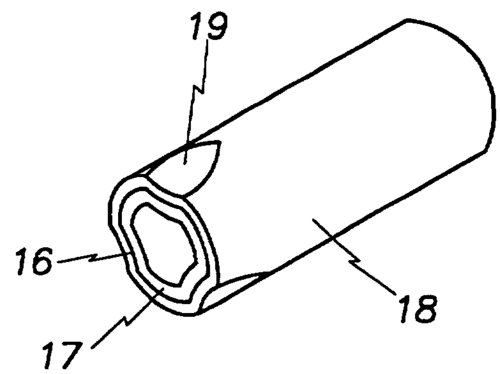


FIG.31

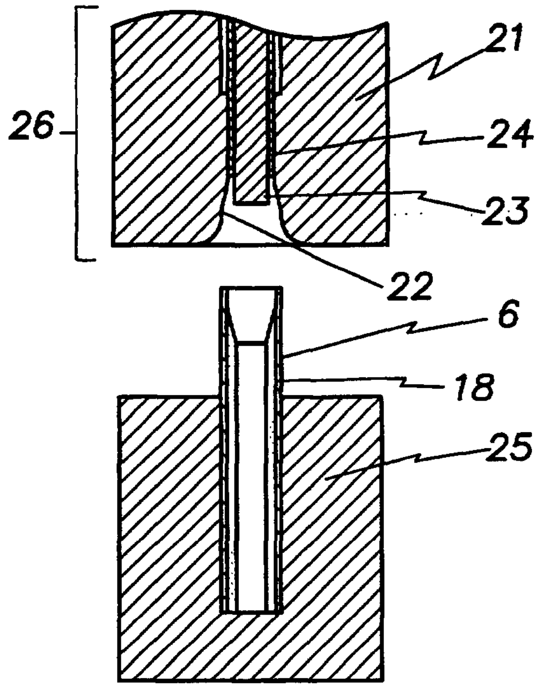


FIG.32

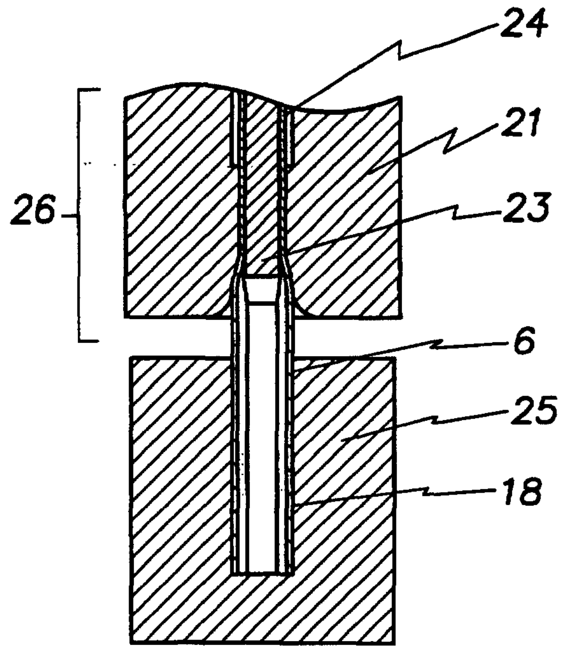


FIG.33

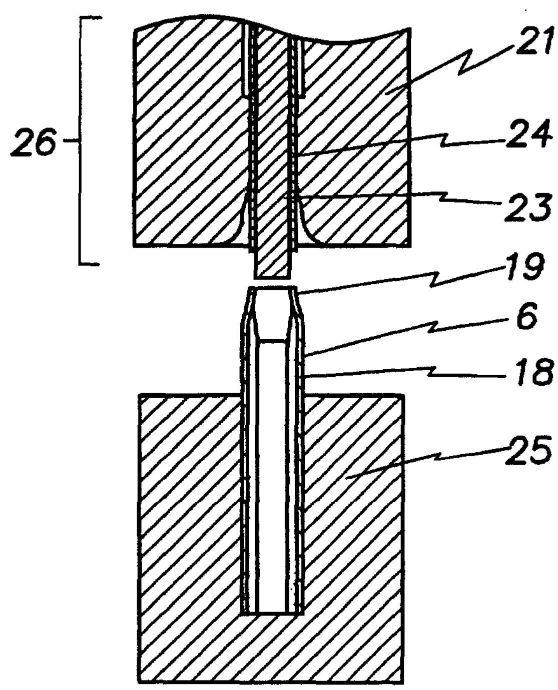


FIG.34

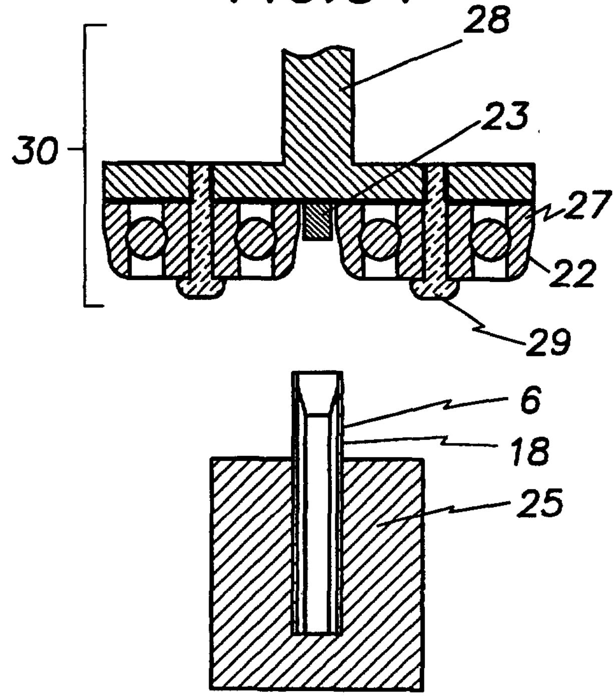


FIG. 35

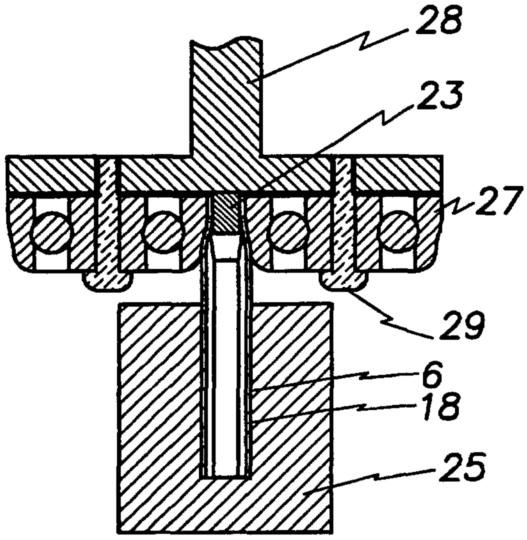


FIG. 36

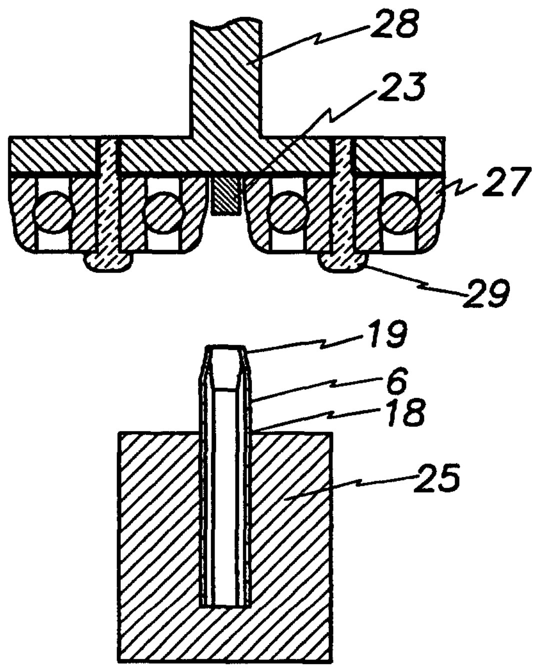


FIG. 37

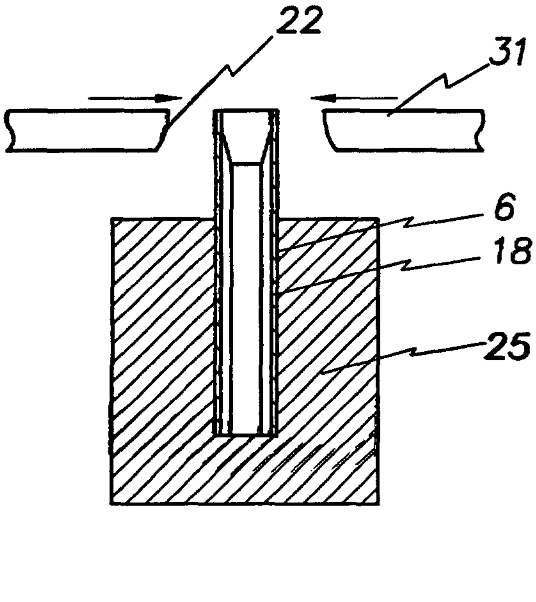
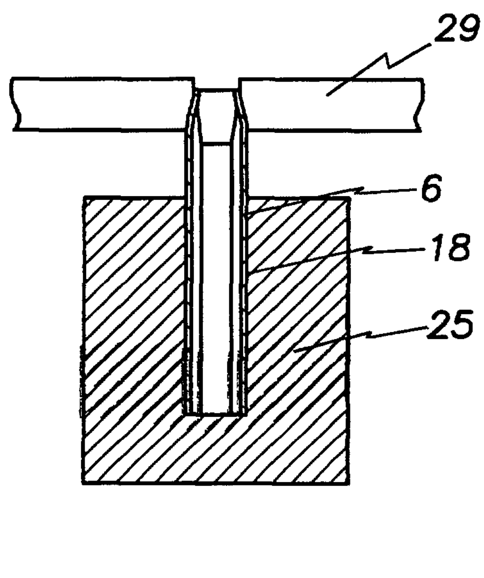


FIG. 38



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/07060

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B43K 21/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] B43K 21/00-21/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2001
Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X X	JP, 9-183294, A (Pentel Kabushiki Kaisha), 15 July, 1997 (15.07.97), Full text; all drawings; especially, Par. Nos. [0011] to [0012]; Figs. 4, 5 Full text; all drawings; especially, Par. Nos. [0007], [0011] to [0012]; Figs. 4, 5 (Family: none)	8 11-13,14
A	JP, 58-32959, Y2 (Sakura Color Prod. Corp.), 22 July, 1983 (22.07.83), Full text; all drawings (Family: none)	1-15
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 14564/1990 (Laid-open No.90992/1991) (Pentel Kabushiki Kaisha), 17 September, 1991 (17.09.91), Full text; all drawings (Family: none)	1-15
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No.9054/1989 (Laid-open No.99689/1990) (Pentel Kabushiki Kaisha),	1-15

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 January, 2001 (10.01.01)	23 January, 2001 (23.01.01)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/07060

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	08 August, 1990 (08.08.90), Full text; all drawings (Family: none)	
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No.21622/1989 (Laid-open No.112491/1990) (Pentel Kabushiki Kaisha), 07 September, 1990 (07.09.90), Full text; all drawings (Family: none)	1-15
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No.29997/1972 (Laid-open No.105627/1973) (Pilot Kiko K.K.), 08 December, 1973 (08.12.73), Full text; all drawings (Family: none)	8,9,11-15
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No.13112/1980 (Laid-open No.115284/1981) (Masasuke ITO), 04 September, 1981 (04.09.81), Full text; all drawings (Family: none)	8,9,11-15
A	JP, 2530089, Y2 (Pentel Kabushiki Kaisha), 26 March, 1997 (26.03.97), Full text; all drawings (Family: none)	8,9,11-15

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