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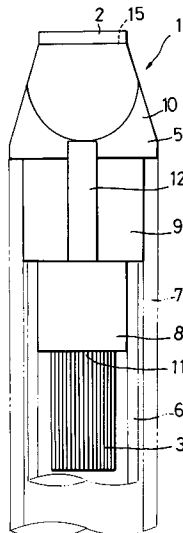
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(54) **Liquid applicator.**

(57) The invention provides an improved liquid applicator using a roller which is effectively prevented from being disengaged from the housing thereof. The improved liquid applicator provides very smooth flow of ink from the initial touch of drawing without generating scratchy effect. The improved liquid applicator introduces a roller in place of a conventional ball of a ball pen. The roller is of hollow structure. The roller-storing portion is tapered in double steps. The liquid applicator incorporates a relay core. Tip of the relay core comes into contact with the roller in the roller-storing portion to press the roller in the direction of the tip aperture of the roller-storing portion.

FIG. 1

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BACKGROUND OF THE INVENTION

Field of the Invention:

5 The present invention relates to a liquid applicator for writing letters or painting objective surface, more particularly, to a liquid applicator capable of transferring ink onto objective surface by rotation of a roller.

Description of the Related Art:

10 Today, ball pens have widely been popularized as convenient liquid applicator. However, since the writing (or painting) member for transferring ink onto objective surface literally comprises a ball coming into contact with objective surface at a point, any of those conventional ball pens is not suited for drawing thick lines or painting out broad surface.

Japanese Laid-Open Utility Model Publication No. SHO58-69479 (1988) proposes such a liquid
15 applicator for drawing broad lines with a roller introduced in place of a ball.

In response, referring to the above Japanese Laid-Open Utility Model Publication No. SHO58-69479, inventors of the present invention experimentally fabricated a liquid applicator by replacing a ball of an oily ball pen (loaded with oily ink) with a roller.

20 Although the above Japanese Utility Model Publication No. SHO58-69479 does not concretely specify numerical value of roller diameter, since ball of any conventional oily ball pen has about 0.6mm of diameter, the experimentally fabricated liquid applicator was also provided with 0.6mm of roller diameter.

Nevertheless, the roller of the experimentally fabricated liquid applicator could not properly rotate itself, thus failing to function as a liquid applicator,

25 Inventors again experimentally fabricated such a liquid applicator incorporating a roller having more than 6mm of diameter. In contrast with the initially fabricated liquid applicator incorporating a roller having 0.6mm of diameter, the roller of the newly fabricated liquid applicator smoothly rotated.

However, even the liquid applicator newly fabricated proved to be still defective in the following two aspects.

30 The first problem was that the experimentally fabricated liquid applicator could not withstand shock. Concretely, on receipt of shock from a drop test, the roller built in the newly fabricated liquid applicator dropped off from the roller holding portion.

Although inventors tried to prevent the roller from dropping off from the roller portion by applying a variety of techniques normally being performed in the ball-pen industry such as new way of caulking the tip of the roller retaining portion and adjustment of aperture of the roller retaining portion for example, neither of
35 the applied techniques turned out to be acceptable for use.

The secondary problem was that ink could not smoothly flow out of the roller on the way of writing letters. Probably, this symptom was caused by the following two reasons.

After finishing the writing with any conventional liquid applicator, when the liquid applicator is placed by setting the roller side atop, the roller falls itself onto the part of the holder.

40 When expanding the roller diameter, in order to expose circumferential surface of the roller, aperture of the roller must necessarily be expanded. Because of this, when the roller falls itself in the holder, clearance is generated between the roller and the holder. While laying the liquid applicator as of this condition, ink in the holder is exposed to air to be dried atmospherically. In consequence, when starting up writing, the liquid applicator is scratchy without making smooth flow of ink.

45 The above symptom was more significantly noticeable when the liquid applicator used aqueous ink in place of oily ink.

The other reason for causing the liquid applicator to become scratchy without smooth flow of ink at the start of writing was that ink stored in the holder was transferred to ink-pool. The reason is described below.

50 In any conventional ball pen using oily ink, oily ink is always pooled in clearance formed by a ball and the ball-retaining portion. When writing letters, relative to rotation of the ball, oily ink is transferred onto an objective paper surface, and yet, since such a conventional ball pen incorporates a ball having very narrow diameter, there is negligible clearance between the ball and the ball retaining portion.

55 When holding a ball pen by placing the ball atop, oily ink in the above clearance receives force in the direction of the ink pool by specific gravity. Since any conventional ball pen using oily ink has narrow clearance mentioned above, and yet, because of high viscosity of oily ink, oily ink is prevented from being dropped off in the direction of the ink pool by virtue of adhesion between the ball and side wall or by effect of capillary-tube force

However, as was done by inventors, as a result of provision of a substantial diameter for the roller of the experimentally fabricated liquid applicator, clearance between the side walls and the roller is expanded, and thus, specific gravity of ink overcomes adhesion between the roller and side walls or capillary-tube force to cause ink to drop onto the ink pool.

5 As was previously proven, this symptom was quite evident when storing aqueous ink in the ink pool.

SUMMARY OF THE INVENTION

10 It is an object of the invention to develop and provide an improved liquid applicator featuring improved shock resistant property and smooth flow of ink without incurring scratchy effect at the start of writing letters or figures.

The improved liquid applicator according to the invention incorporates a roller having hollow or porous structure. Because of this, the roller is of light weight and generates minimal inertia force even when receiving external shock, and thus, the roller built in the inventive liquid applicator is not disengageable from 15 the holder even when being subject to external shock.

Since the roller of the inventive liquid applicator has light weight, the roller can hardly fall itself into a roller-storing portion, and yet, unwanted clearance can hardly be generated between aperture of the roller-storing portion and the roller. Furthermore, the improved liquid applicator according to the invention is so structured that the roller is pressed in the direction of the aperture of the roller storing portion by a relay 20 core, and thus, unwanted clearance can hardly be generated between the aperture of the roller-storing portion and the roller. In consequence, the roller storing portion of the liquid applicator according to the invention retains tightly closed condition to prevent the interior from atmospherically being dried

According to the liquid applicator embodied by the invention, since sectional shape of the roller storing portion on the part of an ink passage hole is tapered by more than double steps and consists of circular-arc form, there is minimal clearance between the roller and the roller storing portion. Owing to this structural 25 arrangement, ink is stably held between the roller and the roller storing portion without flowing itself into the ink pool at all.

The above and further objects and features of the invention will more fully be understood from the following detailed description given in reference to the accompanying drawings which are shown below 30 solely by way of exemplification,

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front view of a roller-holding portion of the improved liquid applicator according to a concrete 35 embodiment of the invention;

Fig. 2 is a plan of the holder portion of the liquid applicator shown in Fig. 1;

Fig. 3 is a cross-sectional view of the holder portion across line A through A shown in Fig. 2;

Fig. 4 is an enlarged sectional view of main components of roller-storing portion of the holder while no roller is accommodated therein;

40 Fig. 5 is an enlarged view of main components of the holder shown in Fig. 3;

Fig. 6 is a cross-sectional view of the holder across line B through B shown in Fig. 2;

Fig. 7 is an enlarged sectional view of main components of the roller storing portion of the holder while no roller is accommodated therein;

Fig. 8 is an enlarged view of main components of the holder shown in Fig. 6;

45 Fig. 9 is a perspective view of disassembled components of the liquid applicator shown in Fig. 1 with a partial sectional view of one of them;

Fig. 10 is an enlarged sectional view of main components of the roller storing portion of the holder without accommodating the roller according to a variation of the embodiment of the invention;

50 Fig. 11 is an enlarged sectional view of main components of the liquid applicator according to another variation of the embodiment of the invention;

Fig. 12 is an enlarged view of main components of the painting according to another variation of the embodiment of the invention;

Fig. 13 is a perspective view of a roller used for another variation of the embodiment of the invention;

55 Fig. 14 is a front view of the holder of the liquid applicator according to another embodiment of the invention;

Fig. 15 is an enlarged sectional view of main components of the roller storing portion of the liquid applicator shown in Fig. 14 while no roller is accommodated therein;

Fig. 16 is an enlarged view of main components of the liquid applicator shown in Fig. 14;

Fig. 17 is a lateral sectional view of the liquid applicator shown in Fig. 14;

Fig. 18 is an enlarged view of main components of the liquid applicator shown in Fig. 17;

Fig. 19 is a perspective view of disassembled components of the liquid applicator shown in Fig. 14 with partial sectional view thereof;

5 Fig. 20 is an enlarged view of main components of the liquid applicator according to another variation of the embodiment of the invention; and

Fig. 21 is an enlarged sectional view of the liquid applicator according to a still further variation of the embodiment of the invention.

10 DESCRIPTION OF THE PREFERRED EMBODIMENTS

The reference numeral 1 shown in Figures 1 through 9 designates an improved liquid applicator according to a concrete embodiment of the invention. Basically, the liquid applicator 1 according to the invention comprises a holder unit 5 which is provided with a roller 2 and a relay core 3, an ink pool 6, and a pen shaft 7. The holder 5 is secured to the tip of the ink pool 6, still more the pen shaft 7 is secured to the outside of the ink pool 6.

The ink pool 6 and the pen shaft 7 are exactly identical to those which are used for any conventional ball pen, where the ink pool 6 and the pen shaft 7 are respectively made from synthetic resin and cylindrically formed.

20 The ink pool 6 internally stores water-soluble ink available for any conventional ball pen. More particularly, the ink pool 6 contains gelled water-soluble ink available for any conventional ball pen such as the one containing a maximum of 8000CPS of viscosity. Either of the gel led water-soluble ink and water-soluble ink uses water as the main solvent. Conventional oily ink uses organic solvent such as phenyl cellosolve or benzyl alcohol for example.

25 On the other hand, ink available for aqueous ball pen uses waters solvent.

Ink available for an oily ball pen contains 10000 through 30000CPS of high-grade viscosity, whereas ink of an aqueous ball pen contains viscosity lower than that of oily ink. Ink available for an aqueous ball pen is roughly classified into two groups according to the difference in the performance of viscosity. The one is such an ink capable of performing "Newton" fluxion (viscosity remains constant according to the degree of fluxion). Concretely, viscosity in the ink pool and the ball housing is identical. Normally, ink containing 5 through 2000CPS of viscosity is used.

35 The other group of ink contains viscosity having property to vary itself according to fluxion of ink. Concretely, ink belonging to the latter group contains 2000 through 8000CPS of viscosity in the ink pool. However, when the ink is led inside of the ball housing, viscosity is sharply reduced to a maximum of 10CPS. Conventionally, the latter ink is called "thixotropic ink", Such a water-soluble ink added with gelling agent containing thixotropic property is generally called "water-soluble gelled ink",

40 The liquid applicator 1 according to an embodiment of the invention incorporates a hollow roller 2 having a through-hole 4 in the center. In order to solely reduce weight of the roller 2, the invention has introduced such a hollow roller 2. More particularly, the light-weight roller 2 prevents unwanted clearance from being generated between a tip aperture 15 of a roller-storing portion 18 and the roller 2 itself otherwise caused by fall of the roller 2 into the roller-storing portion 18 when the roller 2 is laid atop.

Another important effect is to prevent the roller 2 from dropping off from the holder housing when the liquid applicator 1 receives shock.

45 The invention permits use of copper, nickel, zinc alloy, or copper alloy such as brass, stainless steel, or resin free of metamorphosis to be caused by ink, for composing the roller 2.

The through-hole 4 in the center of the roller 2 is generally formed by executing a cutting process. Ratio between the inner and outer diameters of the roller 2 approximately ranges from 0.5:1 to 0.8:1. Practical ratio is mainly selected according to rigidity of the roller 2. Concretely, as far as own rigidity is durable, it is desired that the roller 2 be provided with the through-hole 4 having as wide diameter as possible. Expansion of the size of the through-hole unavoidably causes mass of the roller to decrease. Based on this reason, the wider the diameter of the through-hole 4 of the roller 2, the less the inertia force generated in the roller when incurring shock thereto, and thus the roller 2 can hardly be disengaged from the liquid applicator.

55 For reference, ratio relationship between the inner and outer diameters and the weight of the roller 2 is shown in the following table.

Ratio of inner/outer diameters	Ratio of weight
0.5 : 1	0.75
0.7 : 1	0.51
0.75 : 1	0.44
0.8 : 1	0.36
Note: The table represents weight ratio when actual weight of a solid roller is 1.	

10 The relay core 3 consists of a bundle of polyacrylic or nylon fibers. The invention also permits use of a bundle of tubular resinous filaments, or a solid of polyacetal-resin or nylon-resin each having a fine through-hole in the axial direction, for composing the relay core 3. Structurally, the relay core 3 is of circular-cylindrical form, where only the tip portion is flatly chipped off.

15 The holder 5 holds the roller 2 and the relay core 3, which is formed by an injection molding of polypropylene resin or the like. External configuration of the holder 5 is sectioned into 3 parts including an ink supply unit 8, a pen shaft insert 9, and an exposed portion 10. The ink supply unit 8 has circular section whose external circumference is substantially equal to the inner diameter of the ink pool 6. An ink inlet hole 11 is formed through the bottom of the ink supply unit 8.

20 Although the pen-shaft insert 9 is also of circular section, the diameter is slightly wider than that of the ink supply unit 8. Outer diameter of the pen-shaft insert 9 is almost equal to the inner diameter of the pen shaft 7. A pair of grooves 12 are formed in the pen-shaft insert 9 in the axial direction thereof. The grooves 12 jointly function to equalize atmospheric pressure inside and outside of the pen-shaft insert 9 so that ink from the ink supply unit 8 can smoothly flow into the holder 5.

25 The exposed portion 10 of the holder 5 has circular section across the border of the pen-shaft insert 9. Structurally, the exposed portion 10 is tapered, where the tip portion is of ridge-like form. More particularly, the tip of the exposed portion 10 extends itself in the vertical direction against the center axis, where the tip surface has very narrow width. In addition, a rectangularly shaped aperture 15 is formed at the tip of the exposed portion 10. Width of the tip-aperture 15 is slightly narrower than the diameter of the roller 2.

30 As shown in Figures 3 through 9, the ink inlet hole 11 and the tip aperture 15 of the holder 5 are interlinked with each other via an ink passage hole 17 and a roller-storing portion 18. The ink passage hole 17 is cylindrically formed on the part of the ink inlet hole 11. Local portion of the ink passage hole 17 close to the roller storing portion 18 is gradually flattened (in other words, the interior of the holder 5 gradually becomes thick), whereas tip of the ink passage hole 17 opens to the roller-storing portion 18.

35 The roller-storing portion 18 itself is a portion for rotatably accommodating the roller 2 therein. As shown in Figures 4 and 7, the roller-storing portion 18 has polygonal section surrounded by vertically flat edge surfaces 22 and circumferential surface 24. Inner dimension of the edge surfaces 22 is greater than the total length of the roller 2 by approximately one 100th millimeter. Accordingly, even when the roller 2 is mounted, both edge surfaces 22 do not press the corresponding edge surfaces of the roller 2.

40 Circumferential surface 24 is composed of four continuous surfaces. Concretely, the circumferential surface 24 has a pair of surfaces 25 being in parallel with axial line and a pair of double-step tapered surfaces 28 and 29 being continuous to the axially parallel surfaces 25. Of these, the tapered surface 28 being continuous to the axially parallel surfaces 25 is acute angled, whereas the other tapered surface 29 being continuous to the tapered surface 28 is obtuse angled. The tapered surfaces 28 and 29 respectively converge themselves in the direction of the border between the roller-storing portion 18 and the ink inlet hole 17. A number of shallow grooves are formed on the tapered surface 29.

45 The roller 2 is pressedly inserted in the roller-storing portion 18 via the tip aperture 15 of the holder 5. On the other hand, the relay core 3 is pressedly inserted from the ink inlet hole 11 of the holder 5, where the tip of the relay core 3 projects itself inside of the roller-storing portion 18.

50 When the roller 2 and the relay core 3 are respectively secured to the holder 5, as shown in Fig. 8, the tip of the relay core 3 constantly remains in contact with circumferential surface of the roller 2 so that the roller 2 can be pressed in the direction of the tip aperture 15. In consequence, the circumferential surface 24 of the roller 2 closely adheres to longitudinal local domains of the aperture edge of the tip aperture 15, and thus, no clearance is formed in the aperture 15. In other words, while the inventive liquid applicator is out of use, the roller storing portion 18 is fully shielded from external atmosphere, thus maintaining airtightness.

55 Although there is negligible clearance between the edge surface of the roller 2 and the edge surfaces 22 of the roller storing portion 18, since there is substantial contactable area between both edge surfaces, external atmosphere can hardly permeate through them. The roller 2 itself is in such a state as though

being afloat by way of leaving the bottom surface of the roller-storing portion 18 (the surface on the part of the ink inlet hole 17) after being pressed by the relay core 3.

When drawing a line with the liquid applicator 1 embodied by the invention, the exposed portion of the roller 2 is pressed against a paper surface by downwardly holding the roller 2. When the roller 2 is held downward, ink flows into the holder 5 via the relay core 3, and then the roller-storing portion 18 is filled with ink,

When the exposed portion of the roller 2 is pressed against a paper surface, the roller 2 slightly sinks itself in the roller-storing portion 18 in resistance against pressure from the relay core 3, and then, the roller 2 slightly comes into contact with the tapered surfaces 28 and 29 of the roller-storing portion 18. When this condition is entered, minimal clearance is generated between the roller 2 and the tip aperture 15.

When shifting the liquid applicator 1 while the above condition is underway, the roller 2 rolls itself over the paper surface to permit outgoing ink to be transferred onto the paper surface.

According to the liquid applicator 1 embodied by the invention, even when the liquid applicator 1 is vertically placed in a pen stand after completing a drawing work by putting the roller 2 atop, ink can be prevented from flowing into the ink pool 6.

According to the inventive liquid applicator 1, since double-step tapered surfaces 28 and 29 are formed on the part of the ink inlet hole of the roller-storing portion 18, there is merely minimal clearance between the roller 2 and the roller-storing portion 18 in semi-spherical domain on the part of the ink inlet hole of the roller 2. In other words, the longest distance between the roller 2 and the circumferential surface 24 is by far shorter than that of conventional liquid applicators.

In terms of concrete numerical values, assuming that there is 2mm of diameter of the roller 2, if a single-step tapered surface were provided, then there is a maximum of 0.16mm of clearance between the roller 2 and the roller-storing portion 18. On the other hand, according to the structure embodied by the invention, there is merely 0.04mm of clearance between the roller 2 and the roller-storing portion 18. Owing to this structure, ink is retained by adhesion between the roller 2 and the roller-storing portion 18 or by capillary tube force, and thus, ink is prevented from flowing into the ink pool 6.

After completing a drawing work, the roller 2 is pressed in the direction of the tip aperture 15 by the relay core 3 to fully close the tip aperture 15. This in turn securely prevents air from the tip aperture 15 from permeating into the roller-storing portion 18 and also prevents air from being replaced inside of the roller-storing portion 18, thus eventually preventing ink from flowing into the ink pool 6 otherwise caused by effect of atmospheric pressure. Furthermore, since the tip aperture 15 is fully closed by the roller 2, ink inside of the roller-storing portion 18 cannot be dried. In consequence, whenever resuming the drawing with the inventive liquid applicator 1, ink flows out very smoothly from the initial touch against a paper surface.

Furthermore, according to the liquid applicator 1 embodied by the invention, since the relay core 3 is disposed inside of the ink passage hole 17, the ink passage hole 17 remains being closed by the relay core 3 functioning as a lid, and thus, ink pooled in the roller 2 and the roller-storing portion 18 cannot flow downwardly into the ink pool 6 in practical effect.

On the other hand, particular caution should be exercised when selecting such a relay core 3 containing strong capillary tube force in that the relay core 3 of this kind absorbs ink from the roller-storing portion 18 without properly functioning as a lid inside of the ink passage hole 17. Nevertheless, even when using such a relay core 3 exerting excessive capillary tube force, as is done for the liquid applicator 1 embodied by the invention, by way of minimizing clearance between the roller 2 and the roller-storing portion 18 based on formation of double-step tapered surfaces 28 and 29 of the roller-storing portion 18, capillary tube force between the roller 2 and the roller-storing portion 18 overcomes that of the relay core 3, thus preventing ink from flowing downward into the ink pool 6.

In particular, the liquid applicator 1 according to the invention strongly supports the roller 2 without causing the roller 2 to jump out of the holder 5 even when receiving strong shock.

Concretely, when the liquid applicator 1 embodied by the invention falls onto the ground for example, inertia force is generated in the roller 2, and then the inertia force is exerted in the direction to cause the roller 2 to drop off from the holder 5.

Nevertheless, since the roller 2 of the liquid applicator 1 related to the invention is hollow, it contains minimal mass, and thus, the roller 2 merely generates negligible inertia force. In consequence, even when receiving substantial shock, the roller 2 remains unaffected without being dropped off from the holder 5,

In order to check and confirm practical effect of the inventive liquid applicator 1, inventors experimentally fabricated a liquid applicator 1 by internally providing a roller made of stainless steel having 4mm of length, 2mm of diameter, and inner diameter being 75% against the outer diameter. For comparative example, inventors also experimentally fabricated a liquid applicator incorporating a solid roller having length and external configuration exactly identical to the hollow roller embodied by the invention. As a result

of drop test done by dropping down both samples from a 1 meter high position, the comparative solid roller was then disengaged from the liquid applicator prepared for the comparative test, whereas the hollow roller 2 of the inventive liquid applicator 1 remained unaffected as of the firmly secured condition.

According to the above embodiment, the roller 2 is secured to the holder 5 by arranging the tip aperture 15 of the roller storing portion 18 to be narrower than the width of the roller 2, and also by causing the circumferential surface of the roller 2 to come into contact with the back surface of the tip aperture 15 of the roller-storing portion 18.

When using a hollow roller 2 internally provided with a through-hole 4, instead of contracting the tip aperture 15 or in addition to the above-referred method, it is also possible for the invention to prevent the roller 2 from being disengaged from the holder 5 by way of utilizing the through-hole 4. Referring now to Figures 11 and 12, an inventive structure for preventing the roller 2 from disengagement from the holder 5 based on utilization of the through-hole 4 is described below. In the following description, those component members identical to the preceding embodiment are respectively designated by the identical reference numerals, and thus, detailed description of the duplicated component members is deleted.

According to an improved liquid applicator 40 shown in Figure 11, a pair of semispherical projections 43 are provided on both sides of the interior of the roller-storing portion 18 at positions at which the edge surfaces of the roller 2 respectively come into contact therewith. When the roller 2 is pressedly inserted, the above projections 43 respectively transform themselves, and then, when the roller 2 is set to the correct position, the projections 43 are respectively inserted in the through-hole 4.

According to the liquid applicator 40 based on the latter embodiment of the invention, even when receiving substantial shock, since the through-hole 4 of the roller 2 is securely coupled with the projections 43, the roller 2 is prevented from being disengaged from the liquid applicator 40.

It should be understood however that when engaging those projections 43 with the roller 2 as is done for the above embodiment, it is not always necessary for the invention to provide the roller 2 with a through-hole, but such a roller generally being hollow and having a partition in the intermediate portion may also be introduced for embodying the invention. In addition, it is also permissible for the invention to introduce such a hollow roller provided with sizable recesses on both sides.

The liquid applicator 50 shown in Figure 12 prevents the roller 2 from being disengaged from the holder 53 by applying a shaft 51 in place of the above-referred projections 43.

Concretely, the roller-storing portion 18 of the holder 53 introduced to this embodiment is provided with a through-hole 54. The roller 2 is disposed inside of the roller-storing portion 18. A shaft 51 extends itself between the through-hole 4 of the roller 2 and the roller storing portion 18. The shaft 51 is disposed solely for the purpose of preventing the roller 2 from being disengaged from the holder 53, and conversely, provision of the shaft 51 is not based on such an intent to have it serve as a shaft for rotating the roller 2. Accordingly, diameter of the shaft 51 is obviously narrower than that of the through-hole 4 of the roller 2.

The foregoing embodiments have respectively disclosed the cylindrical roller 2 used for the inventive liquid applicator 1. However, in order to exert identical function, it is possible for the invention to introduce a porous roller 60 shown in Figure 13 for example. Since the porous roller 60 contains mass being less than that of a solid roller, like the preceding embodiments, the porous roller 60 merely generates minimal inertia force from shock, and yet, even when receiving shock, the porous roller 60 is rarely disengaged from the liquid applicator 1.

Fine holes of the porous roller 60 may contain continuous foam or independent foam, and yet, the roller 60 may be provided with smooth surface or projections and recesses. When the roller 60 has smooth surface, seat surface of the roller-storing portion 18 smoothly slips in conjunction with the roller 2 while writing letters with the inventive liquid applicator 1, thus permitting the roller 2 to smoothly rotate itself. On the other hand, when there are projections and recesses on the surface of the roller 60, ink properly spreads over the roller 2.

Although not being illustrated in Figures 11 and 12, in the case of the liquid applicator 40 shown in Figure 11 and the liquid applicator 50 shown in Figure 12, like the preceding embodiments, the roller-storing portion is provided with double-step tapered surfaces. The roller 2 is pressed by the relay core 3, and yet, the tip aperture remains fully being closed.

The above embodiments have respectively exemplified double-step tapered surfaces of the roller-storing portion. It should be understood that identical effect can also be achieved by provision of triple or more than triple steps of tapered surfaces therefor. As shown in Figure 10, instead of forming tapered surfaces, such a structure having a pair of circular-arc surfaces 30 may also be introduced.

The above embodiments have respectively disclosed an improved liquid applicator incorporating a relay core 3 for properly guiding stored ink as the most desirable exemplification. It should be understood however that the inventive art to minimize weight of a roller 2 by providing a hollow or porous roller 2 and to

form double or more than double-step surfaces or circular-arc surfaces of the roller-storing portion can also be applied to such a liquid applicator devoid of the relay core 3.

Figures 14 through 21 respectively exemplify further embodiments of the invention by applying the above novel art to a liquid applicator devoid of the relay core 3.

5 Those component members provided for additional embodiments being identical to those of the preceding embodiments are respectively designated by identical reference numerals.

The liquid applicator 70 shown in Figures 14 through 19 differs from the liquid applicator 1 shown in Figures 1 through 9 in that no relay core is built in the liquid applicator 70. As another aspect of the difference from the liquid applicator 1, the liquid applicator 70 is provided with parallel grooves at the border
10 between the roller-storing portion 18 and the ink passage hole 17.

Except for the above difference, other structural details are exactly identical to those of the preceding embodiments. As was done for the preceding embodiments, double-step tapered surfaces 28 and 29 are provided for the roller-storing portion 18. Needless to say that the roller 2 is of hollow structure.

In the liquid applicator 80 shown in Figure 20, a pair of projections 43 are formed inside of the roller-storing portion 18 by way of engagement with a through-hole 4 of the roller 2.
15

In the liquid applicator 90 shown in Figure 21, a shaft 51 is inserted through a through-hole 4 of the roller 2 by way of being supported by a hole 54 formed in the roller-storing portion 18.

Any of the above-referred liquid applicators 70, 80, and 90 disclosed in Figures 14 through 21 is resistant against shock without causing the roller 2 to jump out of the roller-storing portion. Since stored ink rarely drops into the ink pool, any of the above liquid applicators according to the invention provides
20 satisfactory flow of writing from the initial touch on a paper surface.

Claims

- 25 1. A liquid applicator comprising;
an ink pool;
a holder which is secured to the tip of said ink pool and internally provided with a roller-storing portion and an ink passage hole; and
a hollow roller disposed in said roller-storing portion of said holder.
30
2. The liquid applicator according to Claim 1, wherein said roller-storing portion has an aperture at the tip thereof, wherein said roller-storing portion has a bottom surface on the part of said ink passage hole, wherein a relay core is disposed inside of said ink passage hole, wherein tip of said relay core comes into contact with said roller, and wherein said roller is pressed in the direction of said aperture of said roller-storing portion by said relay core.
35
3. The liquid applicator according to Claim 2, wherein said roller-storing portion has an aperture at the tip thereof, wherein said roller-storing portion has a bottom surface on the part of said ink passage hole, and wherein said bottom surface of said roller-storing portion has double-steps or more than double-steps of tapered form or a plurality of circular-arc forms in the sectional shape thereof.
40
4. The liquid applicator according to Claim 3, wherein said ink pool stores ink containing a maximum of 8000CPS of viscosity under normal temperature.
- 45 5. The liquid applicator according to Claim 1, wherein said roller is of hollow structure forming a through-hole in the core, wherein a shaft is inserted in said core hole, and wherein said shaft is supported by said holder.
6. The liquid applicator according to Claim 1, wherein said roller is of hollow structure having a through-hole or recessed domains in the core, where in a pair of projections are formed on internal edge surfaces of said roller-storing portion, and wherein said projections are coupled with said through-hole or recessed domains of said roller.
50
7. A liquid applicator comprising;
55 an ink pool;
a holder which is secured to the tip of said ink pool and internally provided with a roller-storing portion and an ink passage hole; and
a porous roller disposed in said roller-storing portion of said holder.

8. A liquid applicator comprising;
an ink pool;
a holder which is secured to the tip of said ink pool and internally provided with a roller-storing portion and an ink passage hole; and
5 a roller disposed in said roller-storing portion of said holder;
wherein sectional form of inner surface of said roller-storing portion on the part of said ink passage hole is tapered via double-steps or more than double-steps converging in the direction of said ink passage hole.
- 10 9. The liquid applicator according to Claim 8, wherein a relay core is disposed in said ink passage hole, wherein the tip of said relay core comes into contact with said roller, and where in said roller is pressed in the direction of an aperture of said roller-storing portion by said relay core.
- 15 10. The liquid applicator according to Claim 9, wherein said ink pool stores ink containing a maximum of 8000CPS of viscosity under normal temperature.
11. The liquid applicator according to Claim 8, wherein said roller is of hollow or porous structure.
- 20 12. The liquid applicator according to Claim 11, wherein said ink pool stores ink containing a maximum of 8000CPS of viscosity under normal temperature.
13. A liquid applicator comprising;
an ink pool;
a holder which is secured to the tip of said ink pool and internally provided with a roller-storing portion and an ink passage hole;
25 a roller disposed in said roller-storing portion of said holder; and
a relay core disposed in said ink passage hole of said holder;
wherein said roller is pressed in the direction of an aperture of said roller-storing portion by said relay core.
- 30 14. The liquid applicator according to Claim 13, wherein said roller is pressed by said relay core, and wherein, while said liquid applicator is out of drawing use, circumferential surface of said roller closely adheres to said aperture of said roller-storing portion.
- 35 15. The liquid applicator according to Claim 14, wherein said roller is afloat above surface of said roller-storing portion on the part of said ink passage hole.
16. The liquid applicator according to Claim 15, wherein said roller is of hollow or porous structure.
- 40 17. The liquid applicator according to Claim 16, wherein said ink pool is filled with aqueous ink.
18. The liquid applicator according to Claim 17, wherein sectional form of inner surface of said roller-storing portion on the part of said ink passage hole is tapered via double-steps or more than double-steps or in circular-arc form converging in the direction of said ink passage hole.
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FIG. 1

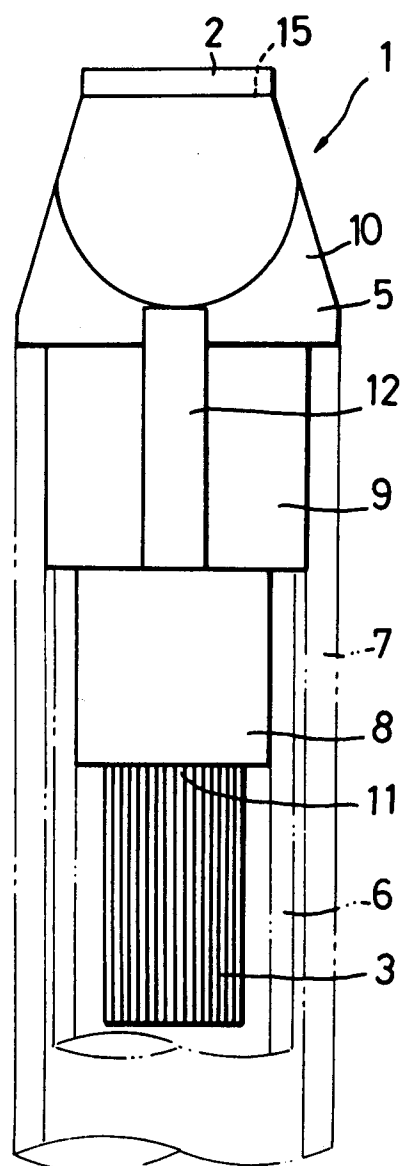


FIG. 2

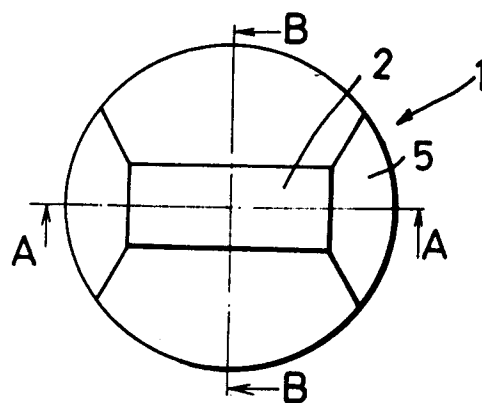


FIG. 3

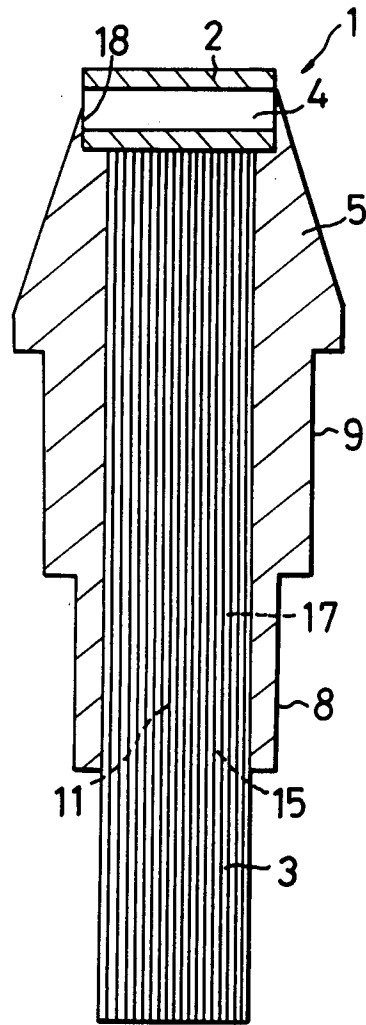


FIG. 4

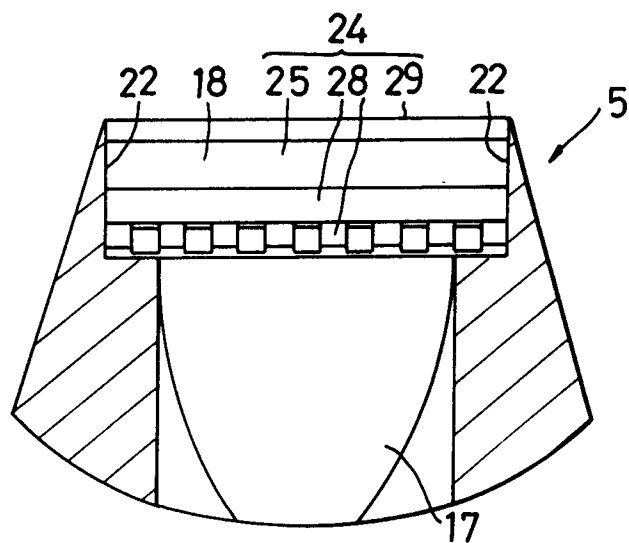


FIG.5

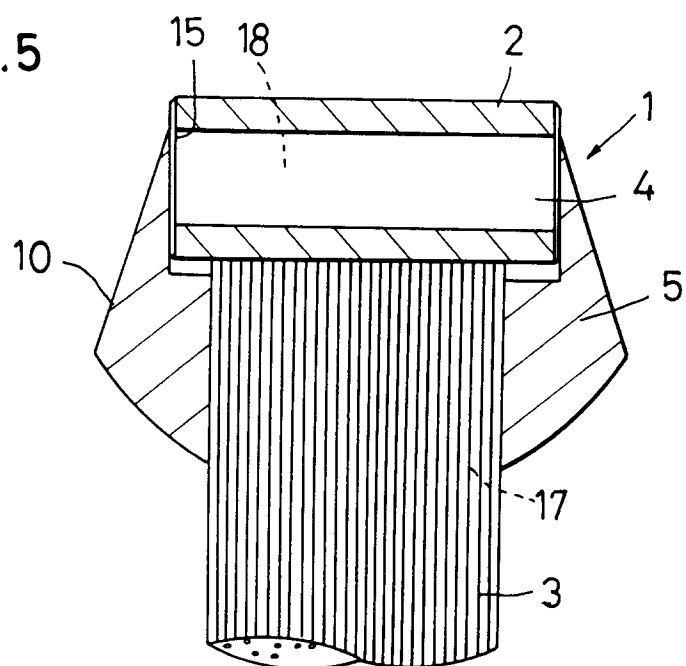


FIG.6

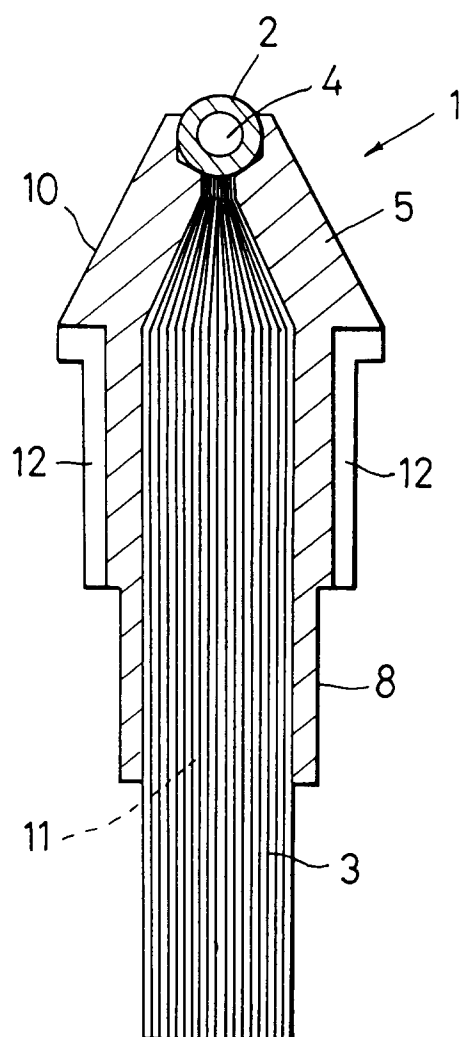


FIG.7

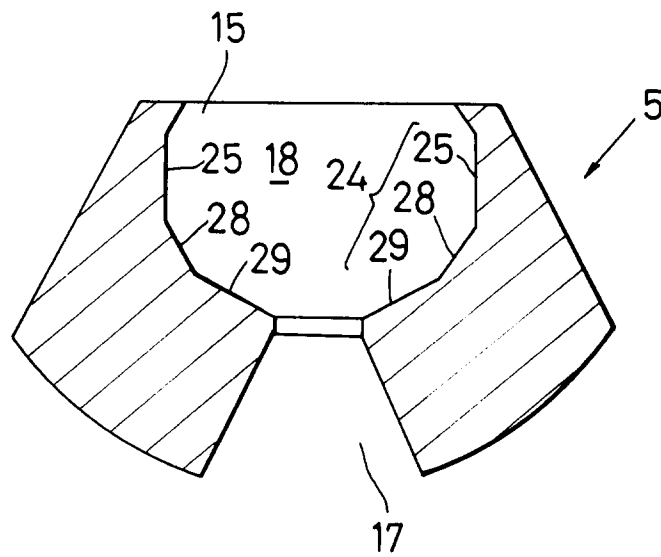


FIG.8

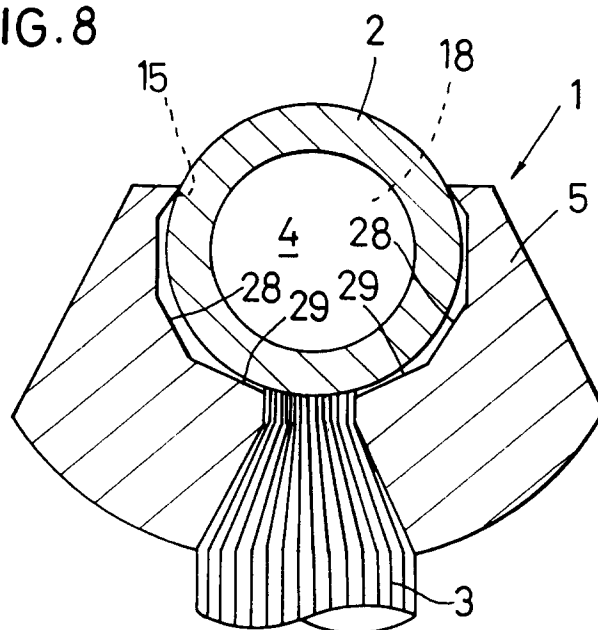


FIG.9

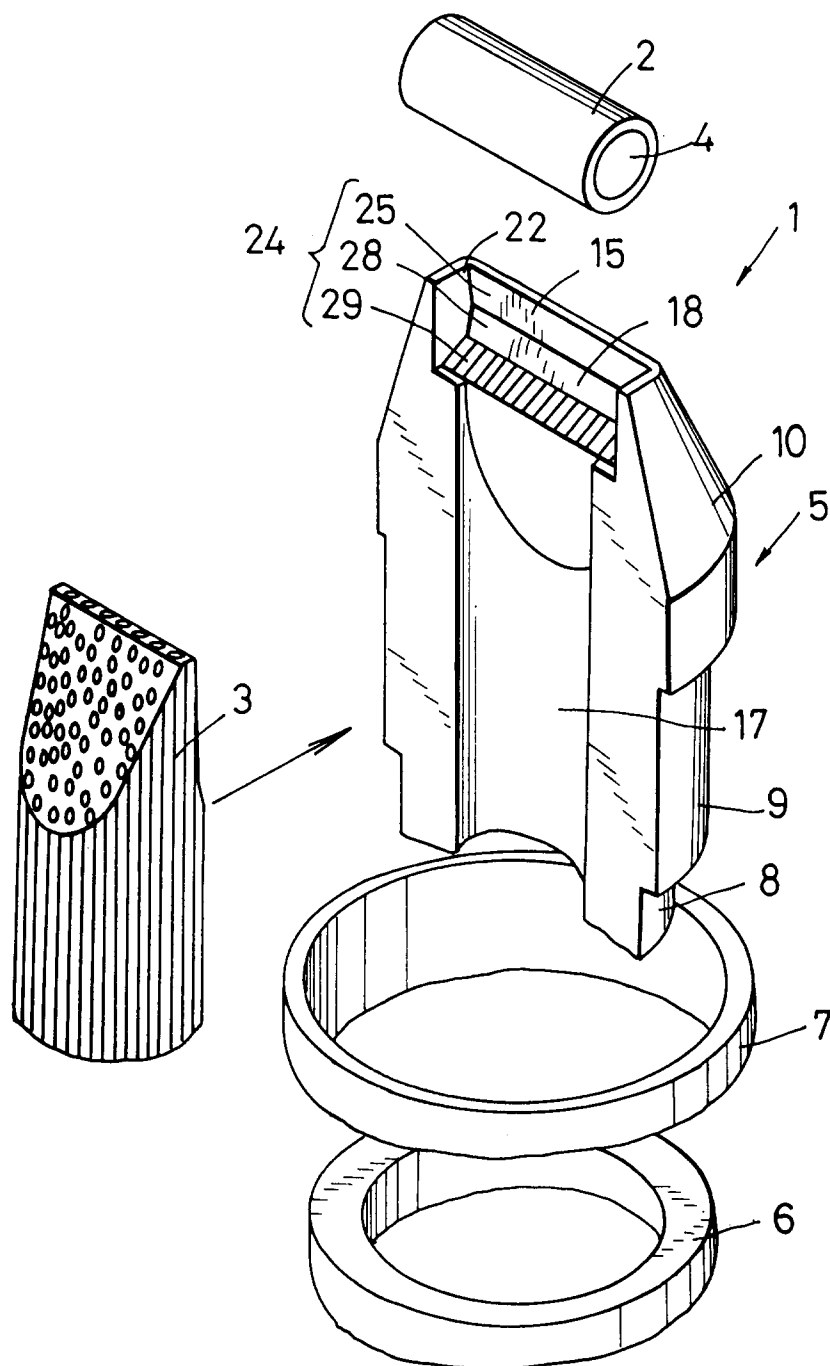


FIG.10

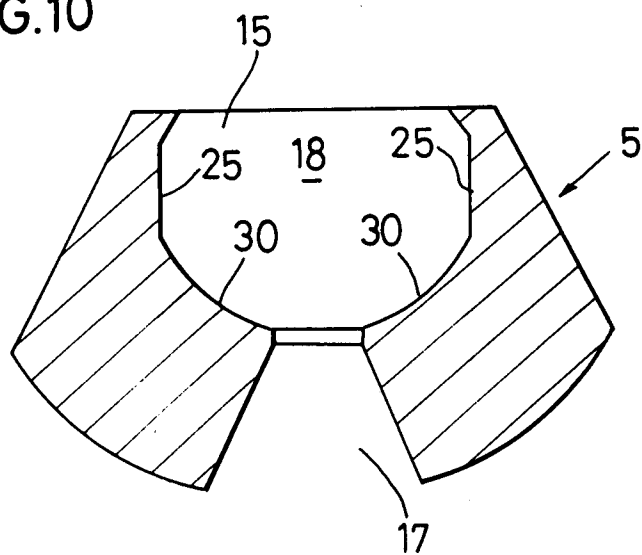


FIG.11

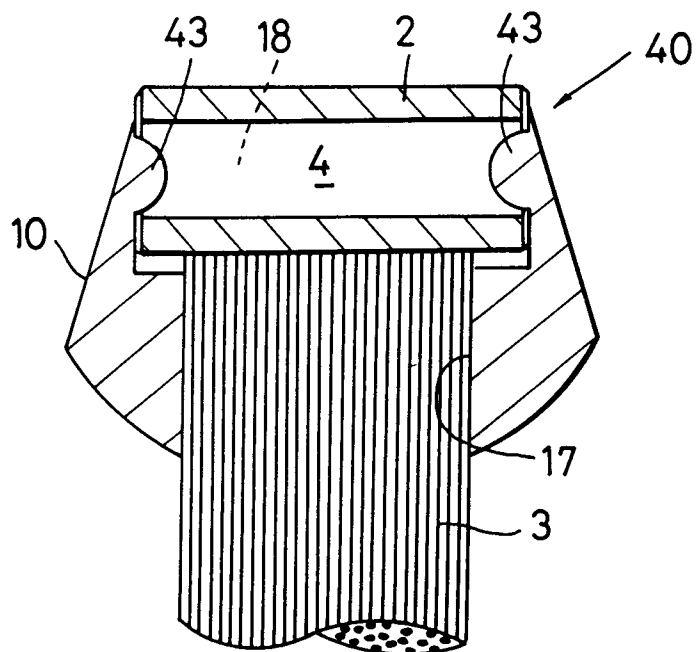


FIG. 12

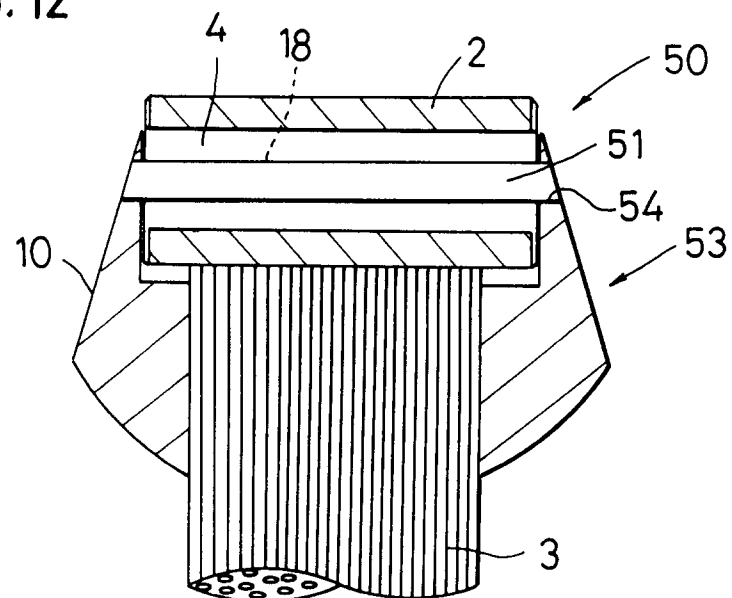


FIG. 13

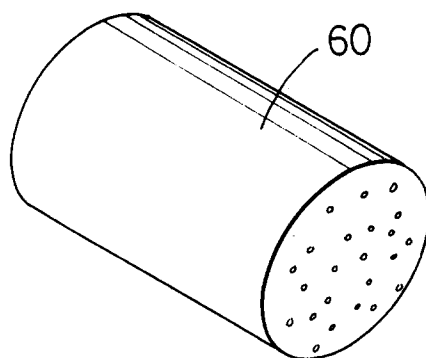


FIG. 14

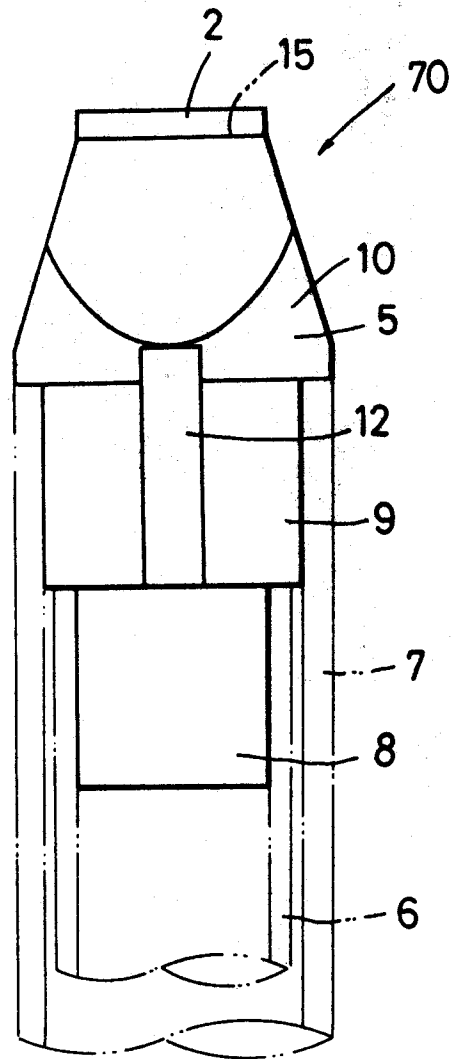


FIG. 15

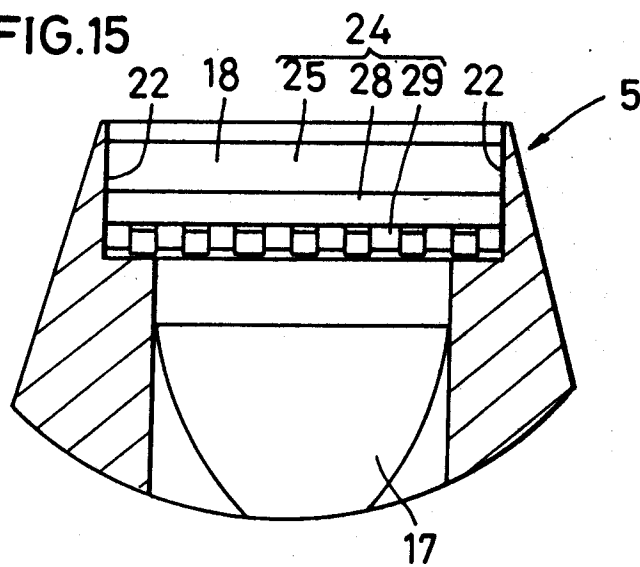


FIG.16

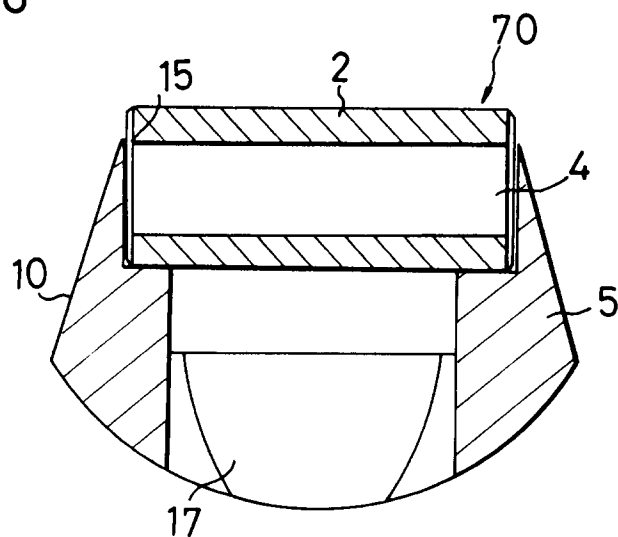


FIG.17

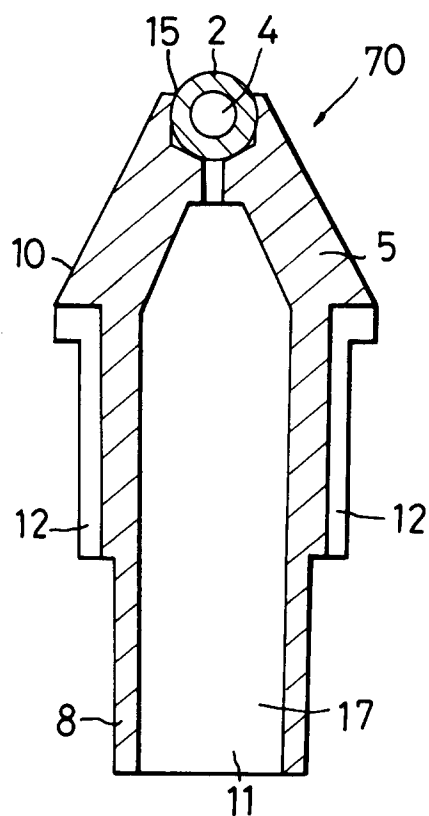


FIG.19

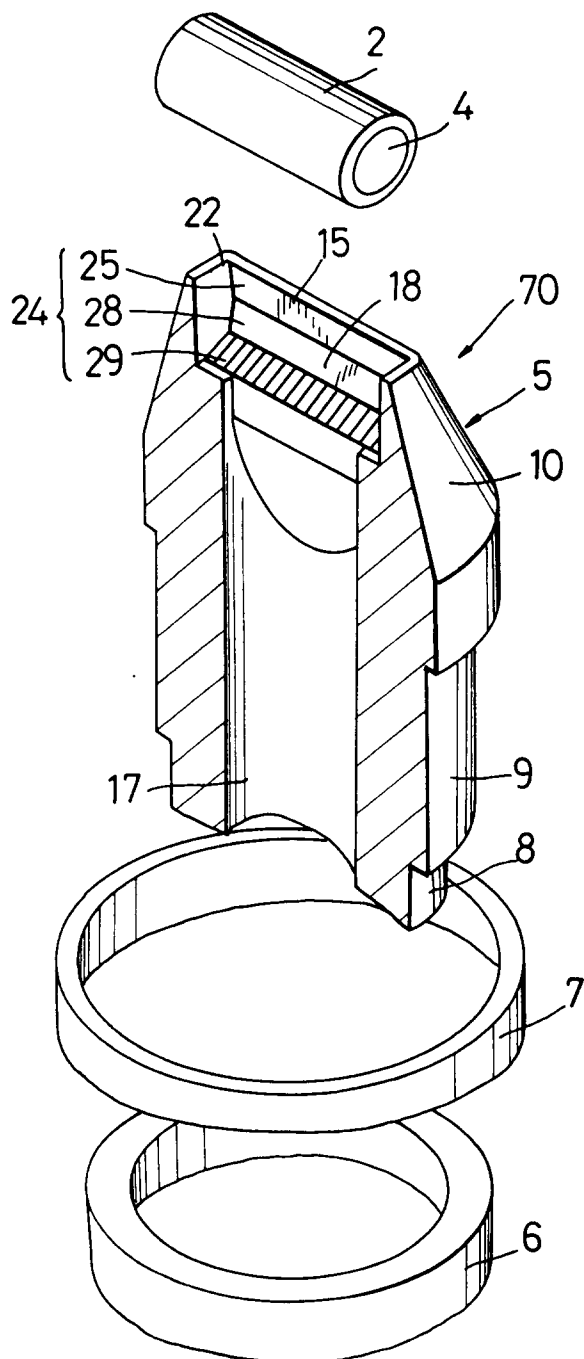


FIG.18

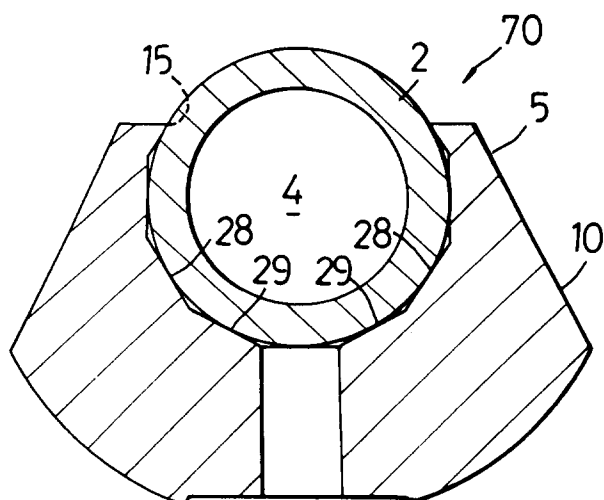


FIG. 20

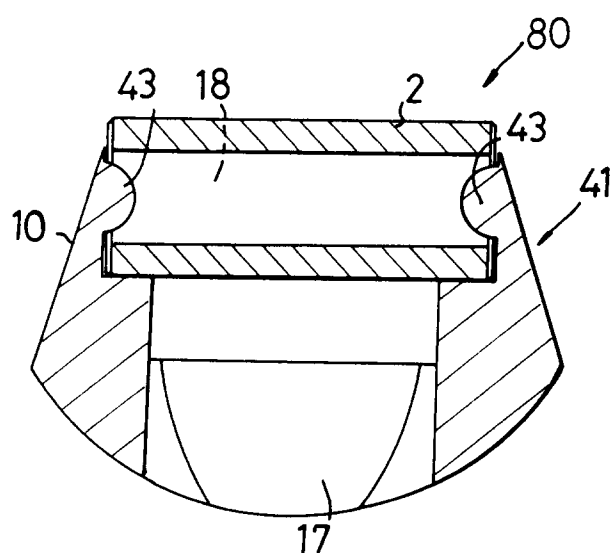


FIG. 21

