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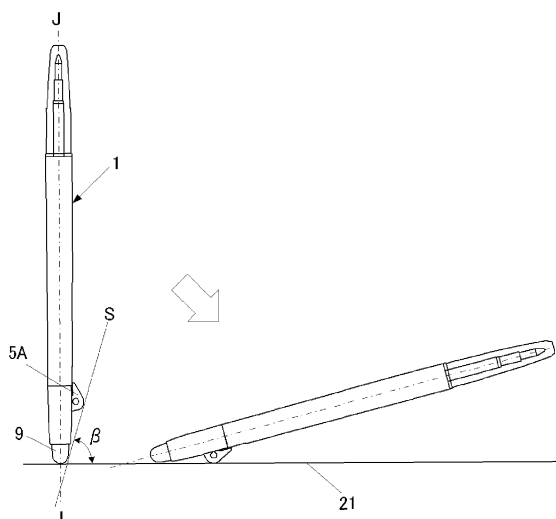
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(54) **RETRACTABLE BALLPOINT PEN**

(57) Provided is a thermochromic retractable ballpoint pen including a friction body at a rear end of a barrel for easy thermochromicity only in a desired area. A retractable ballpoint pen is characterized by that the pen includes a friction body, at a rear end of the barrel, used for friction of handwriting in the thermochromic ink, enabling thermochromism of the handwriting in the thermochromic ink with frictional heat produced at that time, and having rubber-like elasticity, a maximum outer diameter

of the rear end of the barrel is from 1.0 times to 1.5 times a maximum outer diameter of the friction body, a maximum width in a circumferential direction of the operating portion is less than the maximum outer diameter of the friction body, and an angle of a tangent to both the friction body and the operating portion from a writing surface is 60 degrees or more when the friction body is downward and an axial line of the barrel is in a vertical state relative to the writing surface.

Fig. 5



Description**TECHNICAL FIELD**

[0001] The present invention relates to a retractable ballpoint pen including a retraction mechanism that allows a front end of a ballpoint pen tip to be retracted from a front end opening of a barrel.

BACKGROUND ART

[0002] Conventionally, retractable ballpoint pens are well known that include a retraction mechanism mounting a ballpoint pen tip to rotatably hold a ball directly or via a tip holder at a front end of an ink storage cylinder, housing a ballpoint pen refill to directly store ink for a ballpoint pen in the ink storage cylinder in a barrel by biasing to a rear end of the barrel by a coil spring, and allowing a front end of the ballpoint pen tip to be retracted from a front end opening of the barrel.

[0003] In such retractable ballpoint pen, there are many proposals for retractable writing instruments, such as "thermochromic writing utensil" in Japanese Patent Application Kokai Publication No. 2012-91470, that allow handwriting in thermochromic ink to be thermochromic by a friction body equipped at a rear end of a barrel.

[0004] In addition, in such retractable ballpoint pen tip, there are many proposals for structures, such as "coating application implement" in Japanese Patent Application Kokai Publication No. Hei 07-204567, that include a coil spring behind the ball and prevent ink leakage from a front end of a tip and the like by pressing the ball against an inner wall of the front end of the tip.

[0005] Further, there are many proposals for enlargement of clearance in the longitudinal direction of a ball for the purpose of increasing ink consumption and the like, such as "method for manufacturing a coating tool" in Japanese Patent Application Kokai Publication No. Hei 06-15218.

PRIOR ART DOCUMENTS**Patent Documents****[0006]**

Patent Document 1: Japanese Patent Application Kokai Publication No. 2012-91470

Patent Document 2: Japanese Patent Application Kokai Publication No. Hei 07-204567

Patent Document 3: Japanese Patent Application Kokai Publication No. Hei 06-15218

DISCLOSURE OF THE INVENTION**Problems to be solved by the Invention****<First Problem>**

[0007] However, in conventional retractable writing instruments including a friction body at a rear end of a barrel, such as Patent Document 1 mentioned above, the angle of the tangent to both the friction body and an operating body relative to the axis of the barrel, so that the clip is prone to touch the writing surface while using the friction body and there used to be a problem of having limitation on the angle to use the friction body, which makes it difficult to use the friction body.

[0008] The present invention has made in view of these conventional techniques to provide a thermochromic retractable ballpoint pen including a friction body at a rear end of a barrel for easy thermochromism only in a desired area.

<Second Problem>

[0009] However, in a case of using a coil spring, such as Patent Document 2 mentioned above, for a retractable ballpoint pen, a dent is sometimes made at a front end of a tip due to an impact when dropping from a desk to a floor. When such dent is made a front end of a tip, there is a risk of ink leakage even by pressing the ball against the inner wall at the front end of the tip by the coil spring. As Patent Document 3 mentioned above, when the clearance in the vertical direction of the ball is enlarged for the purpose of increasing the amount of ink supply and the like, the ink is prone to leak due to the dent. In particular, as the diameter of the ball becomes as small as ϕ 0.4 mm or less, the inner diameter and the outer diameter of the caulking portion at the front end of the tip also becomes smaller and the influence given to the caulking portion by a dent of a same size also becomes greater.

[0010] Although it is considered to thicken the thickness at the front end of the tip in view of such problem, there used to be problems that, when the thickness at the front end of the tip becomes thicker, a paper touching phenomenon to touch the writing surface while writing is prone to occur, which reduces the writing comfort.

[0011] As reviewing the phenomenon that a writing instrument drops from a desk, although the writing instrument may sometimes slip from a hand holding it and drop, the phenomenon is often because the writing instrument placed horizontally on the desk is hit by a hand, an elbow, a book, a notebook, or the like to drop.

[0012] The present invention has made in view of these conventional techniques to provide a retractable ballpoint pen that has a front end of a tip at which a dent is not easily made due to an impact when the writing instrument placed horizontally on a desk drops by mistake and also that is capable of obtaining stable ink flow.

Means to solve the Problems

<First Embodiment of the Present Invention>

[0013] To solve the problems, a first embodiment of the present invention is a retractable ballpoint pen including a retraction mechanism to allow a front end of a ballpoint pen tip to be retracted from a front end opening of a barrel by mounting the ballpoint pen tip to rotatably hold a ball at a front end of an ink storage cylinder directly or via a tip holder, by housing a ballpoint pen refill, directly storing thermochromic ink in an ink storage cylinder, in the barrel by biasing by a coil spring to a rear end of the barrel, and by operating an operating portion of an operating body attached in outward projection from an outer circumferential surface of the barrel, wherein the pen includes a friction body, at a rear end of the barrel, used for friction of handwriting in the thermochromic ink, enabling thermochromism of the handwriting in the thermochromic ink with frictional heat produced at that time, and having rubber-like elasticity, a maximum outer diameter of the rear end of the barrel is from 1.0 times to 1.5 times a maximum outer diameter of the friction body, a maximum width in a circumferential direction of the operating portion is less than the maximum outer diameter of the friction body, and an angle of a tangent to both the friction body and the operating portion from a writing surface is 60 degrees or more when the friction body is downward and an axial line of the barrel is in a vertical state relative to the writing surface.

[0014] It should be noted that, in the first embodiment of the present invention, "front" indicates a ballpoint pen tip side in a longitudinal direction of the retractable writing instrument and "rear" indicates a friction body side.

[0015] It is also characterized by that the maximum outer diameter of the friction body is from 1.0 mm to 7.0 mm.

[0016] It is also characterized by that a distance in a longitudinal direction from the rear end of the friction body to the operating portion is twice or more a length in the longitudinal direction of the friction body exposed to outside from the rear end of the barrel.

[0017] It is furthermore characterized by that a position of a center of gravity in a state where the ballpoint pen tip projects is located in or behind an intermediate portion of an entire length of a writing instrument.

[0018] According to a first configuration of the first embodiment of the present invention, a retractable ballpoint pen is characterized by that the pen includes a friction body, at a rear end of the barrel, used for friction of handwriting in the thermochromic ink, enabling thermochromism of the handwriting in the thermochromic ink with frictional heat produced at that time, and having rubber-like elasticity, a maximum outer diameter of the rear end of the barrel is from 1.0 times to 1.5 times a maximum outer diameter of the friction body, a maximum width in a circumferential direction of the operating portion is less than the maximum outer diameter of the friction body,

and an angle of a tangent to both the friction body and the operating portion from a writing surface is 60 degrees or more when the friction body is downward and an axial line of the barrel is in a vertical state relative to the writing surface, thereby exhibiting effects of easy visibility of the handwriting in the thermochromic ink and easy thermochromism only in a desired area regardless of retractability of the ballpoint pen tip.

[0019] This is firstly because, since there is a risk that the rear end of the barrel obstructs visibility of handwriting while using the friction body when the maximum outer diameter of the rear end of the barrel exceeds 1.5 times the maximum outer diameter of the friction body and there is a risk that the operating body is not easily operated when the maximum outer diameter of the friction body is greater than the maximum outer diameter of the rear end of the barrel (less than 1.0 times), the maximum outer diameter of the rear end of the barrel is designed to be from 1.0 times to 1.5 times the maximum outer diameter of the friction body to suppress obstruction to handwriting by the rear end of the barrel while using the friction body for enhancement of the visibility of the handwriting. In addition, not only the rear end of the barrel, the maximum outer diameter of 1/3 or more of the entire length of the writing instrument, even more preferably 1/2 or more and most preferably the entire writing instrument, from the barrel rear end of the friction body is also set to be from 1.0 times to 1.5 times the maximum outer diameter of the friction body, thereby being capable of further enhancing the visibility of handwriting.

[0020] Next, as long as the angle of the tangent to both the friction body and the operating portion from the writing surface is 45 degrees or more when the friction body is downward and also the axial line of the barrel is in a vertical state relative to the writing surface, it is possible to use the friction body without worrying about the operating body itself when the writing instrument is gripped and the angle of using the friction body (angle of the writing instrument), specifically contact of the operating portion with the writing surface while a user uses it. However, for thermochromism only in a desired area, it is preferred that the tangent to both the friction body and the operating portion is designed to be 60 degrees or more, preferably 70 degrees or more when the friction body is downward and also the axial line of the barrel is in a vertical state relative to the writing surface for further enhancement of the visibility of the handwriting while using the friction body. Although it may also be considered to set the tangent to be 90 degrees or more when the friction body and the operating body are in a vertical state relative to the axial line of the barrel, it is preferred to be 80 degrees or less in view of the operability of the operating body. In addition, when using a ball having a ball diameter of less than ϕ 0.5 mm, the handwriting tends to be smaller and thus the effects of the present invention are significant.

[0021] According to a second configuration of the first embodiment of the present invention, the maximum outer diameter of the friction body is from 1.0 mm to 7.0 mm,

thereby exhibiting effects of easy visibility of the handwriting in the thermochromic ink and easy thermochromism only in a desired area. Many of general notebooks are provided with horizontal ruled lines at 7 mm pitch, and those having 8 mm and 10 mm pitches are also often commercially available. Therefore, the maximum outer diameter of the friction body is 7.0 mm or less, preferably 6.0 mm or less, thereby being capable of enhancing the visibility of the handwriting written between ruled lines while using the friction body, so that it is preferred that the maximum outer diameter of the friction body is 7.0 mm or less. In addition, since there is a risk of damaging the friction body while using the friction body when the maximum outer diameter of the friction body is less than 1.0 mm, it is preferred that the maximum outer diameter of the friction body 1.0 mm or more.

[0022] According to a third configuration of the first embodiment of the present invention, a distance in a longitudinal direction from the rear end of the friction body to the operating portion is twice or more a length in the longitudinal direction of the friction body exposed to outside from the rear end of the barrel, thereby exhibiting effects of easy visibility of handwriting in thermochromic ink without reducing the visibility of handwriting by the operating portion. Since the operating portion is not easily operated when the distance in a longitudinal direction from the rear end of the friction body to the operating portion, it is preferred to be three times or less the length in the longitudinal direction of the friction body exposed to outside from the rear end of the barrel.

[0023] According to a fourth configuration of the first embodiment of the present invention, by locating a position of a center of gravity in a state where the ballpoint pen tip projects in or behind an intermediate portion of an entire length of a writing instrument, it is possible to make it difficult to drop to the floor from the front end of the tip even when the writing instrument placed horizontally on a desk drops by mistake and thus it is possible to suppress damaging at the front end of the tip. In particular, even a dent is in the same size, an inner diameter of caulking tends to be smaller as the ball is as small as ϕ 0.5 mm or less and thus the influence of the dent relative to the inner diameter becomes greater, so that the effects of the present configuration are significant. In addition, the friction body equipped at the rear end of the barrel has rubber-like elasticity, thereby exhibiting effects of alleviating an impact when dropping down to the floor from the friction body, so that it is preferred to be located behind the intermediate portion. In the present invention, the intermediate portion is not limited to the position in at the same distance from both ends of the entire length of the writing instrument.

[0024] The friction body used for the first embodiment of the present invention may include a member having rubber-like elasticity, such as rubber and an elastomer having rubber-like elasticity, for example, silicone rubber, fluorine-based rubber, chloroprene rubber, nitrile rubber, polyester-based rubber, ethylene propylene diene rub-

ber (EPDM), a styrene-based elastomer, an ester-based elastomer, and an olefin-based elastomer, and they may be used by selecting appropriately. The friction body may be formed integrally with the rear end of the barrel and may also mount another member by fitting and the like. It is preferred that Shore A hardness is not less than 40 and not more than 100.

[0025] The thermochromic ink using for the first embodiment of the present invention is preferably reversible thermochromic ink. The reversible thermochromic ink may be configured by using various types, singly or in combination, such as a heating achromatic type to be achromatic by heating from a color developing state, a chromatic memory retention type to perform memory retention of a color developing state and an achromatic state interchangeably in a specific temperature range, and a heating color development type to develop color by heating from an achromatic state and to recover an achromatic state from a color developing state by cooling.

[0026] For a colorant to be contained in the reversible thermochromic ink, reversible thermochromic microcapsule pigment is used preferably that involves, in microcapsules, a reversible thermochromic composition at least including conventionally known essential three components of (a) an electron donor coloration organic compound, (b) an electron accepting compound, and (c) a reactive medium that determines a generation temperature of color reaction of both compounds.

<Second Embodiment of the Present Invention>

[0027] To solve the problems, a second embodiment of the present invention is a retractable ballpoint pen including a retraction mechanism to allow a front end of a ballpoint pen tip to be retracted from a front end opening of a barrel by mounting the ballpoint pen tip to rotatably hold a ball with ϕ 0.4 mm or less at a front end of an ink storage cylinder directly or via a tip holder by a caulking portion at a front end of the tip, by housing a ballpoint pen refill, directly storing thermochromic ink in an ink storage cylinder, in the barrel by biasing by a coil spring to a rear end of the barrel, and by operating an operating portion of an operating body equipped at the barrel, wherein the pen includes a friction body, at a rear end of the barrel, used for friction of handwriting in the thermochromic ink, enabling thermochromism of the handwriting in the thermochromic ink with frictional heat produced at that time, and having rubber-like elasticity, a coil spring to press the ball by a pressing force greater than a gross weight of the retractable ballpoint pen against an inner wall at the front end of the tip is disposed behind the ball, clearance in a vertical direction of the ball is from 30 to 40 μ m, an outer diameter of the caulking portion is from 1.0 times to 1.2 times a ball diameter, and a position of a center of gravity in a state where the ballpoint pen tip projects is located in or behind an intermediate portion of an entire length of a writing instrument.

[0028] It should be noted that, in the second embodi-

ment of the present invention, "front" indicates a ballpoint pen tip side in a longitudinal direction of the retractable writing instrument and "rear" indicates a friction body side. In addition, the intermediate portion of the entire length of the writing instrument is not limited to a position at the same distance from both ends of the entire length of the writing instrument but includes the vicinity.

[0029] In addition, it is characterized by that the gross weight of the retractable ballpoint pen is 10 g or less.

[0030] In addition, it is characterized by that the operating portion of the operating body is attached in outward projection from the outer circumferential surface of the barrel, a maximum width in a circumferential direction of the operating portion is less than a maximum width in a circumferential direction of the friction body, and a pressing force of the coil spring to bias the ballpoint pen refill to the rear end of the barrel is from 100 to 200 g.

[0031] According to a first configuration of the second embodiment of the present invention, a retractable ballpoint pen using a ball with ϕ 0.4 mm or less includes a friction body, at a rear end of the barrel, used for friction of handwriting in the thermochromic ink, enabling thermochromism of the handwriting in the thermochromic ink with frictional heat produced at that time, and having rubber-like elasticity, a coil spring to press the ball by a pressing force greater than a gross weight of the retractable ballpoint pen against an inner wall at the front end of the tip is disposed behind the ball, clearance in a vertical direction of the ball is from 30 to 40 μm , an outer diameter of the caulking portion is from 1.0 times to 1.2 times a ball diameter, and a position of a center of gravity in a state where the ballpoint pen tip projects is located in or behind an intermediate portion of an entire length of a writing instrument, thereby effectively alleviating drop impact.

[0032] This is because, by locating the position of the center of gravity in a state where the ballpoint pen tip projects in or behind an intermediate portion of the entire length of the writing instrument, it is possible to make it difficult to drop to the floor from the front end of the tip even when the writing instrument placed horizontally on a desk drops by mistake. Further, since the friction body attached to the rear end of the barrel has rubber-like elasticity, it is possible to alleviate the impact even when dropping down to the floor from the friction body, so that it is preferred to be located behind the intermediate portion.

[0033] When the clearance in the vertical direction of a ball is from 30 to 50 μm as described above using the ball having a diameter as small as ϕ 0.4 mm or less, the ball is prone to move by receiving the impact when retracting the front end of the tip and while using the friction body and thus there is a risk of swallowing air. Therefore, in the present invention, in addition to the configuration above, it is also an important configuration to suppress easy movement of the ball by pressing the ball against the inner wall of the front end of the tip by a pressing force greater than the gross weight of the retractable ballpoint pen and to prevent paper touching and ball fallout by making the outer diameter of the caulking portion to

be from 1.0 times to 1.2 times, preferably from 1.05 times to 1.1 times, the ball diameter. The ball retaining force is prone to decrease when the outer diameter of the caulking portion is less than 1.0 times the ball diameter and the paper touching phenomenon is prone to occur when more than 1.2 times because it becomes difficult to obtain the desired clearance.

[0034] In addition, even using a ball having a diameter as small as ϕ 0.4 mm or less, in a case of thermochromic ink, handwriting is prone to be light and the writing comfort is prone to decrease when an ink consumption per 100 m is less than 150 mg and drying property of the handwriting decreases when more than 300 mg, so that from 150 mg to 300 mg is preferred to obtain good handwriting and writing comfort. It is possible to obtain the ink consumption per 100 m by writing with a write testing machine in conditions of load of 100 g, writing speed at 4 m/min, writing angle at 70 degrees, and 20°C in accordance with JIS S 6054 and calculating an ink consumption (average value of ten) per 100 m.

[0035] In the second embodiment of the present invention, it is preferred that the thermochromic ink is reversible thermochromic ink. The reversible thermochromic ink may be configured by using various types, singly or in combination, such as a heating achromatic type to be achromatic by heating from a color developing state, a chromatic memory retention type to perform memory retention of a color developing state and an achromatic state interchangeably in a specific temperature range, and a heating color development type to develop color by heating from an achromatic state and to recover an achromatic state from a color developing state by cooling.

[0036] For a colorant to be contained in the reversible thermochromic ink, reversible thermochromic microcapsule pigment is used preferably that involves, in microcapsules, a reversible thermochromic composition at least including conventionally known essential three components of (a) an electron donor coloration organic compound, (b) an electron accepting compound, and (c) a reaction medium to determine a temperature to promote both of the above coloration reactions.

[0037] It is preferred that a particle size of the microcapsule pigment is from 0.1 μm to 30 μm . The particle size merely means an average size and it is possible to obtain on the basis of volume by centrifugal sedimentation or laser diffraction. The content of the pigment is preferably from 3 to 15 mass% based on the total amount of the ink composition.

[0038] The friction body used for the second embodiment of the present invention may include a member having rubber-like elasticity, such as rubber and an elastomer having rubber-like elasticity, for example, silicone rubber, fluorine-based rubber, chloroprene rubber, nitrile rubber, polyester-based rubber, ethylene propylene diene rubber (EPDM), a styrene-based elastomer, an ester-based elastomer, and an olefin-based elastomer, and they may be used by selecting appropriately. The friction body may be formed integrally with the rear end of the

barrel and may also mount another member by two-color forming, fitting, and the like. It is preferred that Shore A hardness is not less than 40 and not more than 100.

[0039] According to a second configuration of the second embodiment of the present invention, in addition to the position of the center of gravity, the product weight is designed to be 10 g or less, thereby alleviating the drop impact even more. This is because it is possible to be represented by $F = mV/t$ (impact force is F [N], mass of object is m [kg], and deceleration time is t [s], $V = \sqrt{2gh}$ (g denotes gravitational acceleration = 9.8 [m/s²] and h denotes height [m])). In particular, when using a ball having a diameter as small as $\phi 0.4$ mm or less, the thickness of the caulking portion at the front end of the tip becomes thin and a dent is prone to be made when dropping. It is thus preferred to suppress the drop impact by making the product weight to be 10 g or less. When the product weight is too light, the retractable writing instrument placed horizontally on a desk is prone to move by being hit by a hand, an elbow, a book, a notebook, or the like, and as a result, it is prone to drop, so that it is preferred that the product weight is 5 g or more.

[0040] According to a third configuration of the second embodiment of the present invention, the operating portion of the operating body is attached in outward projection from the outer circumferential surface of the barrel and the width in the circumferential direction of the operating portion is less than the width in the circumferential direction of the friction body, thereby exhibiting effects of easy visibility of the handwriting on the writing surface while using the friction body. Since it is not easily operated when the width of the operating portion becomes small, it is preferred that the pressing force of the coil spring to bias the ballpoint pen refill to the rear end of the barrel is from 100 to 200 g. This is because there is a risk that the front end of the tip projects casually when less than 100 g, and the operability decreases and also the knocking impact is prone to be great when more than 200 g, so that the pressing force of the coil spring is designed to be from 100 to 200 g, preferably from 120 g to 180 g.

Effects of the Invention

<First Effect>

[0041] The present invention is capable of providing a thermochromic retractable ballpoint pen including a friction body at a rear end of a barrel for easy thermochromism only in a desired area.

<Second Effect>

[0042] The present invention is capable of providing a retractable ballpoint pen that has a front end of a tip at which a dent is not easily made due to an impact, such as dropping, and also that is capable of obtaining stable ink flow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043]

- 5 Fig. 1 is a longitudinal cross-sectional view illustrating a retractable ballpoint pen in First Embodiment. Fig. 2 is a diagram illustrating a state where a ballpoint pen tip in Fig. 1 projects.
- 10 Fig. 3 is a partially omitted enlarged cross-sectional view of the main portion of the ballpoint pen tip in Fig. 1.
- 15 Fig. 4 is an external view taken from an upper surface direction in Fig. 1.
- 20 Fig. 5 is an external view illustrating one example of a state of using the friction body in Fig. 1.
- 25 Fig. 6 is an external view illustrating another example of a state of using the friction body in Fig. 1.

MODE FOR CARRYING OUT THE INVENTION

- 30 **[0044]** Fig. 1 through Fig. 6 illustrate a retractable ballpoint pen 1 in First Embodiment. In the retractable ballpoint pen 1, a front barrel 2 and an intermediate barrel 3 are screwed together and a ballpoint pen refill that is stored in a barrel main body obtained by slide-over fitting a rear barrel 4 to a rear end of the intermediate barrel 3 is slidably biased in a rear end direction of the rear barrel 4 by a coil spring 8 disposed between a spring receiving member 7 disposed at a rear end of the front barrel 2 and a rotating cam 6 to be stored therein. In the intermediate barrel 3, a retraction mechanism made with the rotating cam 6 is built. Although not shown, a cam groove is provided in an inner surface of the intermediate barrel 3.

- 35 **[0045]** In addition, in an outer circumferential surface of the rear barrel 4, an elongated window hole 4A extending in the longitudinal direction is protrudingly provided to radially communicate with inside and outside, and via the window hole 4A, a transparent operating body 5 is disposed so as to project radially outwardly from the outer circumferential surface of the rear barrel 4. The operating body 5 includes an operating portion 5A projecting outwardly from the window hole 4A and a shaft portion 5B having a cam portion (not shown) in a plurality of serrations formed at the front end so as to move the rotating cam 6 forward and also to induce rotation.

- 45 **[0046]** To use the retractable ballpoint pen 1, in a state where a front end of a ballpoint pen tip 12 is retracted into a front end opening 2A of the front barrel 2, the operating portion 5A of the operating body 5 disposed in outward projection from the radially outer circumferential surface of the rear barrel 4 is slidably operated in the direction of the front end opening 2A of the front barrel 2 along the window hole 4A provided in the rear barrel 4 against a biasing force of the coil spring 8. Consequently, the shaft portion 5B of the operating body 5 actuates the rotating cam 6. This maintains a state where the front end of the ballpoint pen tip 12 projects from the front end opening 2A of the front barrel 2, which enables writing

with the retractable ballpoint pen 1. The retraction mechanism mentioned above is a conventionally known retraction mechanism made with the rotating cam 6 and allows the ballpoint pen tip 12 to retract from the front end opening 2A of the front barrel 2. The biasing force of the coil spring 8 to bias the ballpoint pen refill to the rear end side of the rear barrel 4 is, as a result of measurement by a push-pull scale, 150 gf and the ink consumption for 100 m is 180 mg.

[0047] At the rear end of the rear barrel 4, a friction body 9 of a polyester-based elastomer is mounted by slide-over fitting. As illustrated in Fig. 5 and Fig. 6, the friction body 9 is put in pressure contact on handwriting written between horizontal rule lines P on a writing surface 21 of a notebook and the like and rubbed thereon to generate heat. The heat allows the handwriting in thermochromic ink to be thermally achromatic or thermochromic. In a state where the ballpoint pen tip 12 is retracted into the front barrel 2, an angle β of a tangent S to both the operating portion 5A of the operating body 5 and the friction body 9 is 78 degrees relative to an axial line J.

[0048] As illustrated in Fig. 2, an entire length L of the retractable ballpoint pen 1 in the present embodiment is 144.0 cm in a state where the front end of the ballpoint pen tip 12 projects from the front barrel 2. In addition, the center of gravity G of the retractable ballpoint pen 1 in a state where the front end of the ballpoint pen tip 12 projects from the front barrel 2 is located in a distance M from the front end of the ballpoint pen tip 12 and in a distance N from the rear end of the friction body 9. The retractable ballpoint pen 1 has the distance M of 71.5 cm and the distance N of 72.5 mm. To confirm the state of dropping from a desk, a drop test is performed in which the retractable ballpoint pen 1 is in a state parallel to the ground and dropped from a height of 1 m, and as a result, it does not drop from the tip side and a caulking portion 13A is not damaged.

[0049] As illustrated in Fig. 4, a maximum width (outer diameter) A of the friction body 9 is designed to be 6 mm and a maximum width E in the circumferential direction of the operating portion 5A to be 2 mm ($A > E$). In addition, the maximum width (outer diameter) A of the friction body 9 is designed to be smaller than a maximum width (outer diameter) B (7 mm) of the rear end of the rear barrel 4 ($A < B$). The retractable writing instrument 1 has the gross weight of 9.0 g, a maximum width D (outer diameter) of the front barrel 2 of 9.0 mm, a maximum width (outer diameter) of the intermediate barrel of 9.0 mm, and a maximum width C (outer diameter) of the rear barrel 4 of 8 mm. As illustrated in Fig. 1, a distance Q in the longitudinal direction from the rear end of the friction body 9 to the operating portion 5A is 2.7 times a length R in the longitudinal direction of the friction body 9 exposed to outside from rear end of the rear barrel 4.

[0050] As illustrated in Fig. 3, the ballpoint pen refill has a configuration of mounting the ballpoint pen tip 12 at a front end of an ink storage cylinder 10 via a tip holder 11. The ballpoint pen tip 12 has, in a tip main body 13

made with a stainless steel wire, a ball holding chamber 14, an ink distribution hole 17 located at the center of the ball holding chamber 14, and an ink distribution groove 16 to communicate with the ink distribution hole 17. The ink distribution groove 16 extends radially and has a depth of not reaching a tip rear hole 18. On a bottom wall 15 of the ball holding chamber 14, a ball 19 made of tungsten carbide with ϕ 0.38 mm is placed. The ball 19 is rotatably held by caulking the caulking portion 13A at the front end of the tip inside so as to have a part of it projects from a front end edge of the tip.

[0051] The ballpoint pen tip 12 is fabricated by firstly cutting a stainless steel wire with ϕ 2.3 mm having a hardness from 230 Hv to 280 Hv into a desired length and providing the ball holding chamber 14, the ink distribution groove 16, the ink distribution hole 17, and the rear hole 18 in the stainless steel wire, and then, placing the ball 19 on the bottom wall 15 of the ball holding chamber 14, and after that, forming a seal surface in a shape approximately same as the ball 19 on the inner wall of the caulking portion 13A at the front end of the tip by rearward hammering. In addition, a coil spring 20 is disposed behind the ball 19 and the ball 19 is pressed on the inner wall seal surface of the caulking portion 13A by the pressing force. The pressing force of the coil spring 20 to press the ball 19 is designed to be 20 gf.

[0052] In addition, in the state where the ball 19 is placed on the bottom wall 15, an amount H of ball projection to project from the front end of the tip is designed to be 30% of the ball diameter, a caulking angle α to be 110 degrees, clearance of the ball 19 in the vertical direction (left and right directions of the ball 19 in Fig. 3) to be 35 μ m, and an outer diameter K of the caulking portion to be 1.05 times the ball diameter. In addition, the coil spring 20 is disposed behind the ball 19, and the ball 19 is pressed on the inner wall seal surface side of the caulking portion 13A by the pressing force of the coil spring 20. The pressing force of the coil spring 20 to press the ball 19 is designed to be 20 gf.

[0053] By designing the pressing force of the coil spring 20 to press the ball 19 to be not less than the entire (product) weight of the retractable ballpoint pen 1 and also not more than 30 g, it is possible to obtain good writing and impact resistance performance. This is because, when the pressing force of the coil spring 20 to press the ball 19 is less than the product weight, it is difficult to suppress movement of the ball due to an impact and ink leakage is prone to occur. It is also because, when the pressing force of the coil spring 20 to press the ball 19 is more than 30 g, start writing performance and writing texture decrease.

[0054] When the amount H of ball projection to project from the front end of the tip is less than 25% of the ball diameter in the state where the ball 19 is placed on the bottom wall 15, the front end of the tip is prone to hit a writing surface, such as the writing surface 21, while writing and the front end of the tip is prone to be damaged. When it is more than 40% of the ball diameter, the ball

retaining force becomes weak, which reduces the impact resistance performance of dropping and the like. In addition, by forming the caulking angle α to be an obtuse angle, an effect of enhancing the ball retaining force of the caulking portion 13A is exhibited. When the caulking angle α exceeds 120 degrees, the front end of the tip is prone to hit a writing surface, such as the writing surface, while writing. The caulking angle α is preferably from 90 degrees to 120 degrees.

[0055] In the ink storage cylinder 10, thermochromic ink for a rollerball pen (not shown) is stored that contains reversible thermochromic microcapsule pigment having an average particle size of 0.5 μm and has an ink viscosity at 1 rpm in an EM rotational viscometer of 1020 mPa·s (25°C), has an ink viscosity at 100 rpm of 84 mPa·s (25°C), and has a shear-thinning index of 0.48. At a rear end of the ink in the ink storage cylinder 10, a grease-like ink follower (not shown) is stored directly. The ink viscosity at 100 rpm in an EM rotational viscometer is preferably from 40 to 200 mPa·s.

[0056] In addition, as illustrated in Fig. 5, the retractable ballpoint pen 1 in the present embodiment has a configuration in which, when the friction body 9 is downward and an axial line J of the barrel is vertical to the writing surface in a state where the ballpoint pen tip 12 is retracted into the front barrel 2, the tangent S to both the friction body 9 and the operating portion 5A becomes at degrees or more relative to the writing surface. With such configuration, when a user uses the friction body 9, it is possible to use without worrying about contact of the operating portion 5A with the writing surface. In particular, since handwriting formed with a ball with ϕ 0.4 mm or less becomes small, the tangent S to both the friction body 9 and the operating portion 5A when the friction body 9 is downward and the axial line J of the barrel is vertical to the a writing surface is preferably 60 degrees or more and most preferably 70 degrees or more.

[0057] Although the pressing force of the coil spring to press the ball is not particularly limited, it is possible to obtain good writing and impact resistance performance by making it more than the product weight and also not more than 30 g. This is because, when the pressing force of the coil spring to press the ball is less than the product weight, it is difficult to suppress the movement of the ball due to an impact and ink leakage is prone to occur. It is also because, when the pressing force of the coil spring to press the ball is more than 30 g, start writing performance and writing texture decrease.

[0058] Although a ball of 0.38 mm is used for convenience in the present embodiment, the ball diameter is not particularly limited. It is preferred because good handwriting and writing comfort is obtained by, as the embodiment, using a ball of ϕ 0.4 mm or less, having clearance in the vertical direction of the ball from 30 to 50 μm , and having an ink consumption per 100 m from 150 to 300 mg. This is because it becomes difficult to increase the ink consumption as much as the ink consumption per 100 m from 150 to 300 mg when the clearance in the

vertical direction of the ball is less than 30 μm . In contrast, when the clearance in the vertical direction of a ball exceeds 50 μm using a ball with not more than ϕ 0.4 mm, the thickness at the front end of the tip is thin and the ball retaining force decreases, so that from 30 to 50 μm is most preferred. The ball diameter is preferably from ϕ 0.3 mm to ϕ 0.4 mm. It is possible to obtain the ink consumption per 100 m by writing with a write testing machine in conditions of load of 100 g, writing speed at 4 m/min, writing angle at 70 degrees, and 20°C in accordance with JIS S 6054 and calculating an ink consumption (average value of ten) per 100 m.

[0059] In addition, although the gross weight (product weight) of the retractable ballpoint pen is not particularly limited, an impact due to dropping is greatly dependent on mass of an object (product weight) as it is possible to be represented by $F = mV/t$ (impact force is F [N], mass of object is m [kg], and deceleration time is t [s], $V = \sqrt{(2gh)}$ (g denotes gravitational acceleration = 9.8 [m/s²] and h denotes height [m])). In particular, when using a ball having a diameter as small as ϕ 0.5 mm or less, the thickness of the caulking portion at the front end of the tip becomes thin and a dent is prone to be made when dropping. It is thus preferred to suppress the drop impact by making the product weight to be 10 g or less. When the product weight is too light, the retractable writing instrument placed horizontally on a desk is prone to move by being hit by a hand, an elbow, a book, a notebook, or the like, and as a result, it is prone to drop, so that it is preferred that the product weight is 5 g or more.

[0060] Although, in the present embodiment, the operating portion 5A as a projecting area is a plate piece having a longitudinal cross-section in an arc shape that also work as a protrusion to prevent rolling when the writing instrument is placed horizontally on a desk and is provided with a hole portion 5C to attach a charm, it is also possible to integrally form or attach a clip.

[0061] In addition, although the barrel main body is configured with the front barrel, the middle barrel, and the rear barrel in the present embodiment, it is not particularly limited as such. In addition, although the barrel main body (front barrel, middle barrel, rear barrel) and the operating body are formed by a synthetic resin, such as polycarbonate, polyethylene, and ABS, and metal, it is preferred that the operating body at least is formed by a transparent or translucent synthetic resin. This is because, by making the operating body 5 to be transparent or translucent as illustrated in Fig. 6, it is possible to not easily reduce the visibility of handwriting even when the operating portion 5A comes into eyesight while using the friction body 9.

[0062] In addition, as in the present embodiment, the width of the operating portion of the operating body is less than the maximum width of the friction body, thereby exhibiting an effect of easy visibility of the handwriting on the writing surface while using the friction body. Since the operation becomes difficult when the width of the operating body becomes small, it is preferred that the press-

ing force of the coil spring to bias the ballpoint pen refill to the rear end of the barrel if from 100 to 200 g. This is because there is a risk that the front end of the tip projects casually when less than 100 g and the operability decreases when more than 200 g, so that it is preferred that the pressing force of the coil spring is from 100 to 200 g, preferably from 120 g to 180 g.

[0063] In addition, since there is a risk that the rear end of the barrel obstructs visibility of handwriting while using the friction body when the maximum outer diameter of the rear end of the rear barrel exceeds 1.5 times the maximum outer diameter of the friction body and there is a risk that the operating body is not easily operated when the maximum outer diameter of the friction body is greater than the maximum outer diameter of the rear end of the barrel (less than 1.0 times), it is preferred that the maximum outer diameter of the rear end of the barrel is designed to be from 1.0 times to 1.5 times the maximum outer diameter of the friction body to suppress obstruction to handwriting by the rear end of the barrel while using the friction body for enhancement of the visibility of the handwriting. In addition, not only the rear end of the rear barrel, the maximum outer diameter of 1/3 or more of the entire length of the writing instrument, even more preferably 1/2 or more and most preferably the entire writing instrument, from the barrel rear end of the friction body is also set to be from 1.0 times to 1.5 times the maximum outer diameter of the friction body, thereby being capable of further enhancing the visibility of handwriting. Many of general notebooks are provided with horizontal ruled lines at 7 mm pitch, and those having 8 mm and 10 mm pitches are also often commercially available. It is therefore preferred that the maximum outer diameter of the friction body is 7.0 mm or less.

[0064] Although the present embodiment exemplifies a retractable ballpoint pen including a retraction mechanism made with a rotating cam for convenience, the retraction mechanism is not particularly limited. Considering the operability and the like, it is preferred to use a retraction mechanism made with a rotating cam.

Industrial Applicability

[0065] Since the retractable ballpoint pen of the present invention has easy thermochromism only in a desired area, it is widely applicable to use with notebooks and pocketbooks.

[0066] Since the retractable ballpoint pen of the present invention may be used without limitation in the retraction mechanism, it is widely applicable as a retractable ballpoint pen.

Description of Reference Numerals

[0067]

- 1 retractable ballpoint pen
- 2 front barrel

- 2A front end opening
- 3 intermediate barrel
- 4 rear barrel
- 4A window hole
- 5 5 operating body
- 5A operating portion
- 5B shaft portion
- 5C hole portion
- 6 rotating cam
- 10 7 spring receiving member
- 8 coil spring
- 9 friction body
- 10 ink storage cylinder
- 11 tip holder
- 15 12 ballpoint pen tip
- 13 tip main body
- 13A caulking portion
- 14 ball holding chamber
- 15 bottom wall
- 20 16 ink distribution groove
- 17 ink distribution hole
- 18 rear hole
- 19 ball
- 20 coil spring
- 25 21 writing surface
- A maximum outer diameter of friction body
- B maximum outer diameter of rear end of rear barrel
- C maximum outer diameter of rear barrel
- D maximum outer diameter of front barrel and intermediate barrel
- 30 E width of operating portion
- G center of gravity
- H amount of ball projection
- J axis
- 35 K outer diameter of caulking portion
- L entire length in a state where front end of tip projects
- M distance from front end of tip to center of gravity
- N distance from rear end of friction body to center of gravity
- 40 Q distance from rear end of friction body to operating portion
- R length of friction body exposed to outside from rear end of rear barrel
- 45 S tangent
- α caulking angle
- β angle of tangent to both friction body and operating portion

Claims

1. A retractable ballpoint pen comprising a retraction mechanism to allow a front end of a ballpoint pen tip to be retracted from a front end opening of a barrel by mounting the ballpoint pen tip to rotatably hold a ball at a front end of an ink storage cylinder directly or via a tip holder, by housing a ballpoint

pen refill, directly storing thermochromic ink in an ink storage cylinder, in the barrel by biasing by a coil spring to a rear end of the barrel, and by operating an operating portion of an operating body attached in outward projection from an outer circumferential surface of the barrel, wherein

the pen includes a friction body, at a rear end of the barrel, used for friction of handwriting in the thermochromic ink, enabling thermochromism of the handwriting in the thermochromic ink with frictional heat produced at that time, and having rubber-like elasticity,

a maximum outer diameter of the rear end of the barrel is from 1.0 times to 1.5 times a maximum outer diameter of the friction body,

a maximum width in a circumferential direction of the operating portion is less than the maximum outer diameter of the friction body, and

an angle of a tangent to both the friction body and the operating portion from a writing surface is 60 degrees or more when the friction body is downward and an axial line of the barrel is in a vertical state relative to the writing surface.

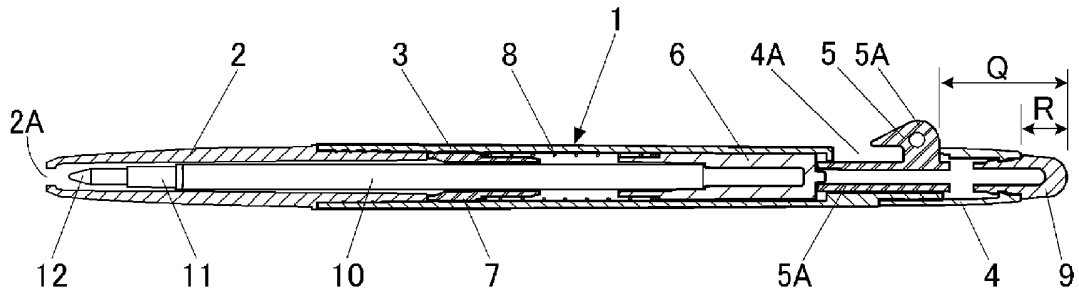
2. The retractable ballpoint pen according to claim 1, wherein the maximum outer diameter of the friction body is from 1.0 mm to 7.0 mm.
3. The retractable ballpoint pen according to claim 1 or 2, wherein a distance in a longitudinal direction from the rear end of the friction body to the operating portion is twice or more a length in the longitudinal direction of the friction body exposed to outside from the rear end of the barrel.
4. The retractable ballpoint pen according to any one of claims 1 through 3, wherein a position of a center of gravity in a state where the ballpoint pen tip projects is located in or behind an intermediate portion of an entire length of a writing instrument.

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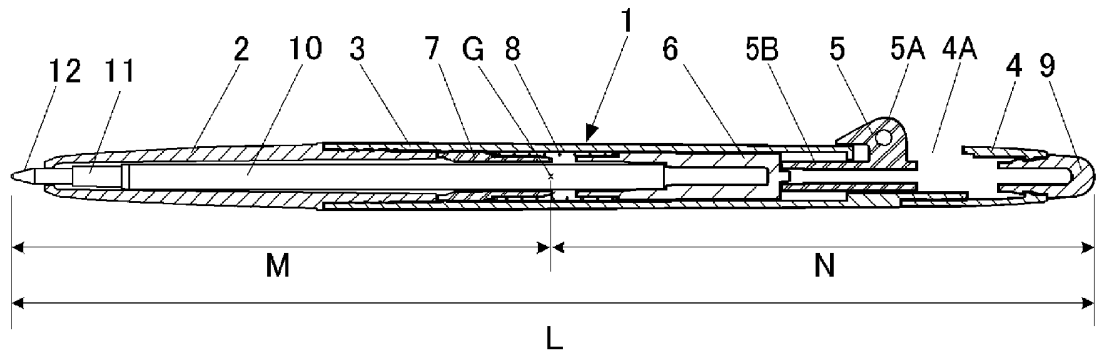
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【図1】



【図2】



【図3】

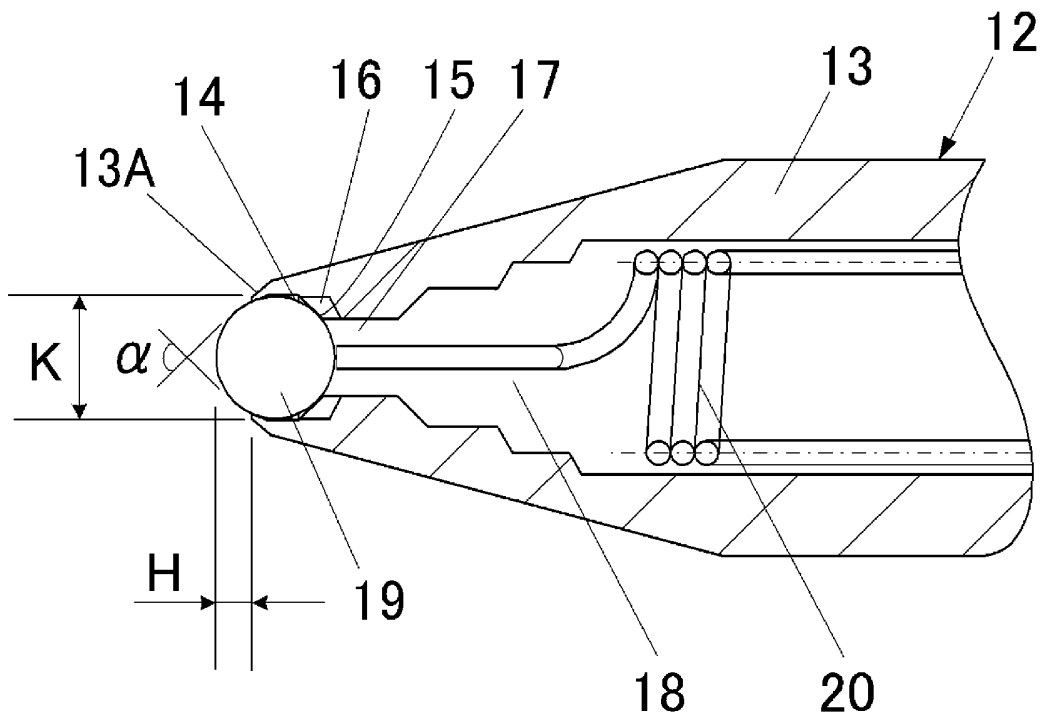


Fig. 4

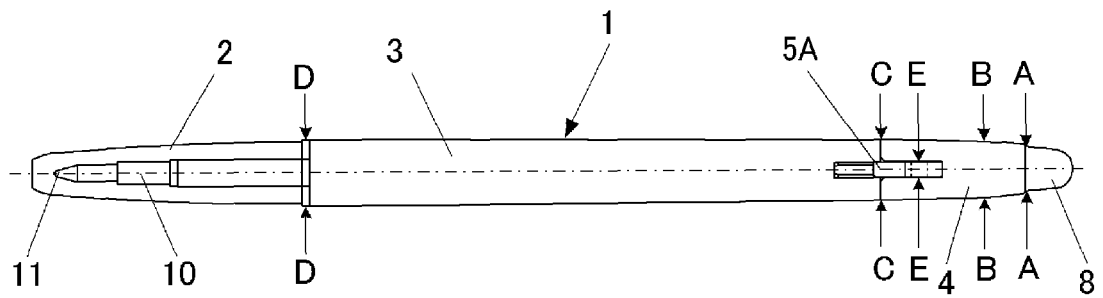


Fig. 5

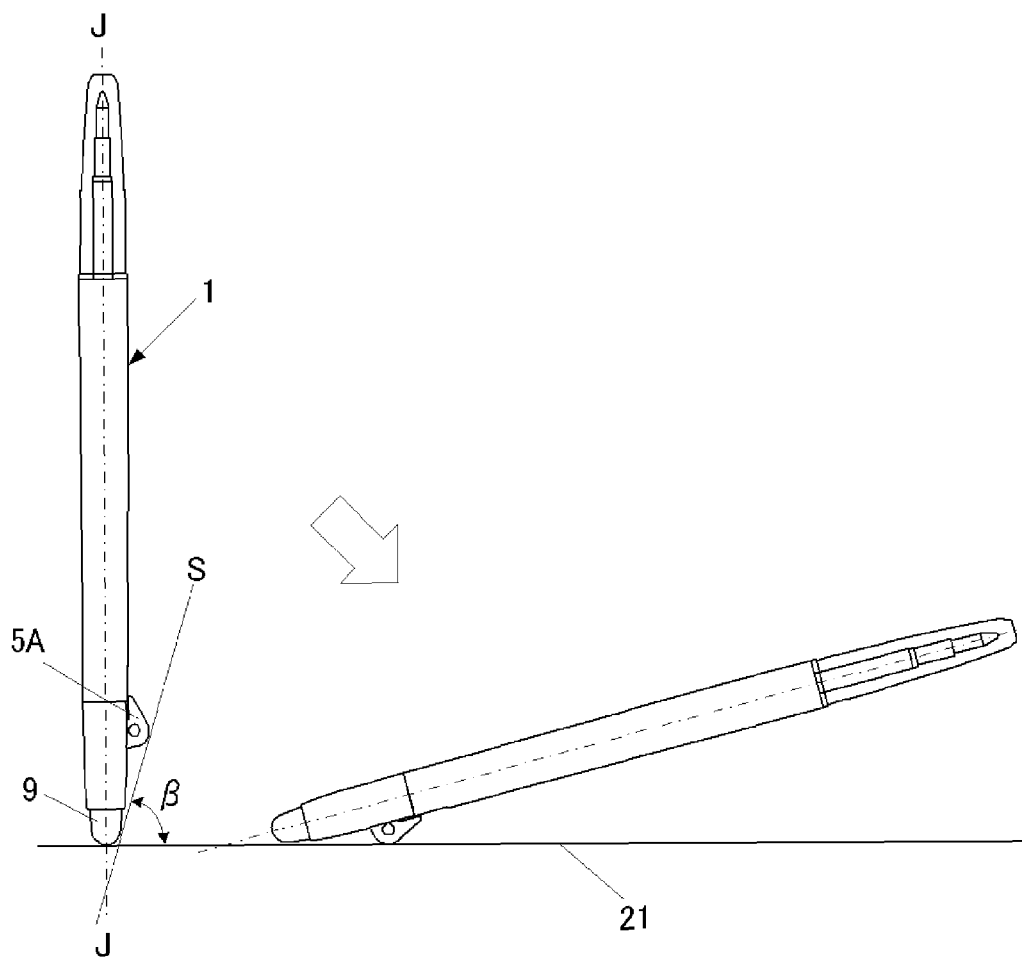
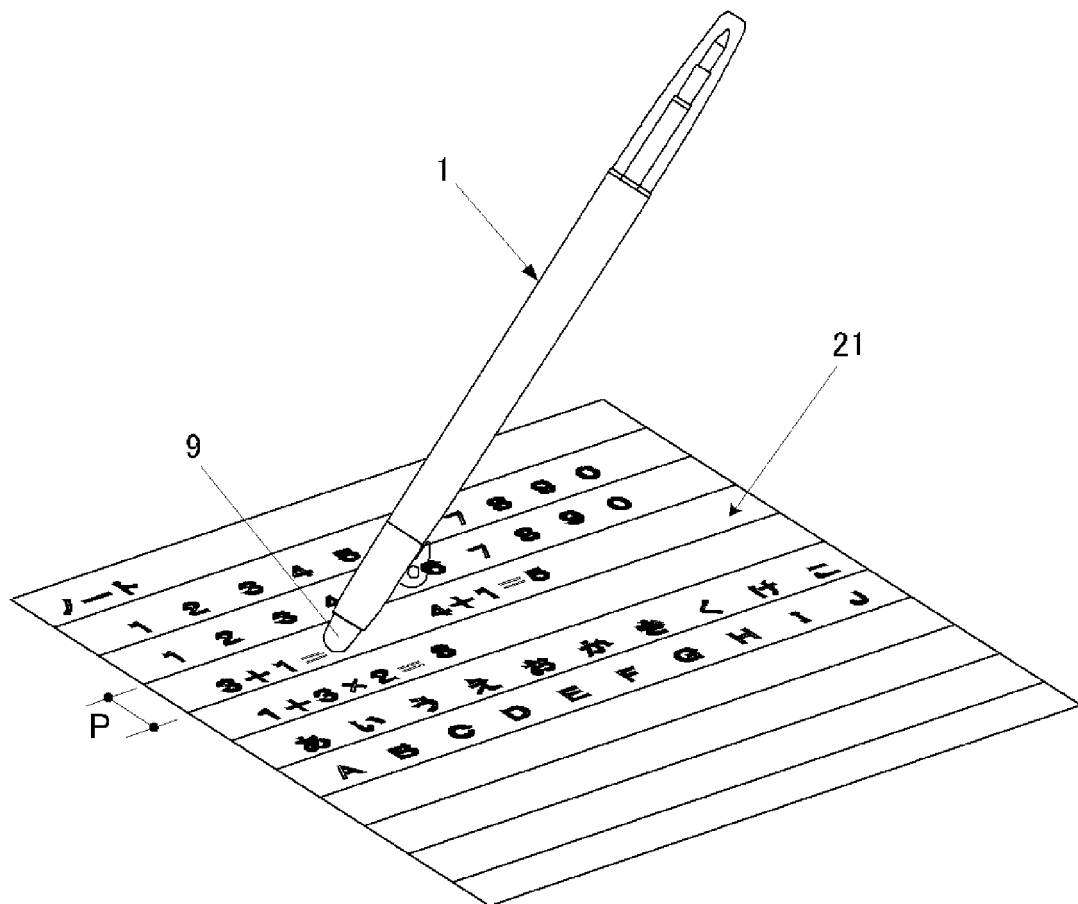


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/067613

A. CLASSIFICATION OF SUBJECT MATTER

B43K29/02(2006.01) i, B43K7/12(2006.01) i

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)

B43K1/00-31/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013
 Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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 Y	WO 2008/105227 A1 (The Pilot Ink Co., Ltd.), 04 September 2008 (04.09.2008), paragraphs [0008], [0081] to [0082], [0095] to [0097], [0125] to [0132]; fig. 14 to 15 & JP 2013-28176 A & JP 2013-39835 A & US 2010/0098476 A1 & US 2013/0121744 A1 & EP 2130684 A1 & CN 101622138 A & KR 10-2009-0123864 A & TW 200843967 A	1-3 4
Y	JP 9-39470 A (Pilot Precision Co., Ltd.), 10 February 1997 (10.02.1997), claim 1; paragraph [0011] (Family: none)	4

☐ 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
17 July, 2013 (17.07.13)Date of mailing of the international search report
30 July, 2013 (30.07.13)Name and mailing address of the ISA/
Japanese Patent Office

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Patent documents cited in the description

- JP 2012091470 A [0003] [0006]
- JP HEI07204567 B [0004] [0006]
- JP HEI0615218 B [0005] [0006]