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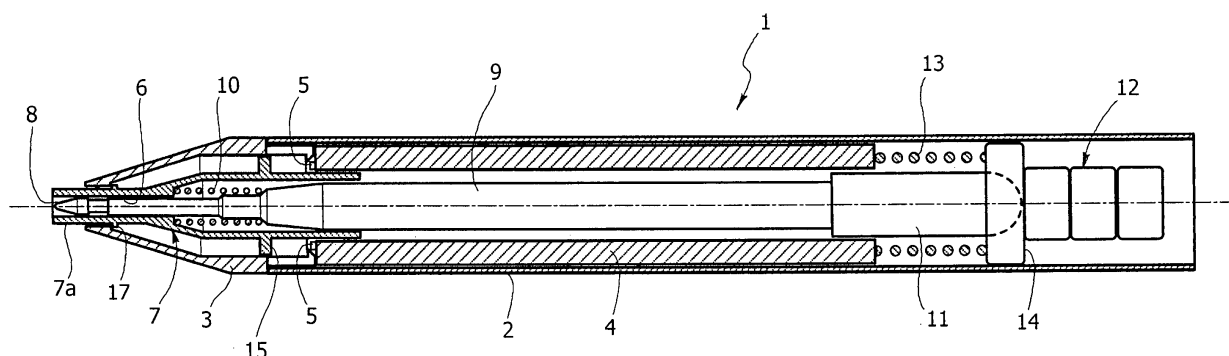
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(54) **Writing instrument with shape memory actuating means**

(57) A writing instrument comprises shape memory actuating means for switching from an inoperative con-

dition of the writing tip (8) to an operative condition, and vice versa.

FIG. 1



Description

[0001] The present invention relates to writing instruments, such as pens or pencils, in particular ball point pens, of the kind comprising a body bearing a writing tip and actuating means to control switching between an operative condition and an inoperative condition of the writing tip.

[0002] The object of the present invention is to obtain a writing instrument of the type indicated above which is provided with innovative actuating means, having advantages both from the viewpoint of efficiency and reliability, and from the viewpoint of constructive simplicity and cost reduction, as well as from the viewpoint of convenience of use.

[0003] In view of achieving these and further preferred objects, the invention relates to a writing instrument of the kind indicated above, characterised in that the aforesaid actuating means comprise at least one shape memory element.

[0004] Shape memory metal alloys have long been known and applied in several fields. Such materials have the characteristic of passing from a martensitic structure to an austenitic structure above a predetermined transition temperature, thereby being subject to a contraction when their temperature exceeds this transition value. The same Applicant is the holder of several patents on different applications of shape memory actuators. The heating necessary to activate the shape memory element is often obtained by making an electric current flow through the shape memory element, thereby heating it by Joule effect. In other applications, heating is obtained in another manner, e.g. even simply by sensing the temperature of the environment in which the shape memory element is positioned.

[0005] The idea constituting the basis of the present invention is fundamentally to apply shape memory actuating means to control switching between the inoperative condition and the operative condition of the writing tip of a writing instrument.

[0006] In the preferred embodiment of the invention, the shape memory element when activated causes switching from the inoperative condition of the writing tip to the operative condition. In this embodiment, engaging means are provided to maintain the operative condition of the writing tip even after a deactivation of the shape memory element. Preferably, the engaging means are magnetic means. Moreover, the writing instrument comprises releasing means, to cause a disengagement of the engaging means, and spring means that return the device to the inoperative condition of the writing tip when the releasing means are activated.

[0007] Also preferably, the releasing means comprise at least one additional shape memory element. Therefore, in the preferred embodiment, at least two shape memory elements are provided, one able to be activated to control switching of the device from the inoperative condition to the operative condition of the writing tip,

which is then maintained by the aforesaid engaging means even after the deactivation of the first shape memory element, and the other shape memory element being able to be activated to release the engaging means, in order to allow the device to return to the inoperative condition of the writing tip, under the effect of the aforesaid spring means.

[0008] Naturally, it would also be possible to reverse the functions of the elements described above. In particular, it would be possible to provide spring means that tend to maintain the device in the inoperative condition of the writing tip, so that the first shape memory element can be activated to make the writing tip operative, and the second shape memory element can be activated to release the engaging means and allow the return to the operative position.

[0009] Lastly, again with specific reference to the preferred embodiment of the invention, the writing tip is preferably supported in a fixed position in the body of the writing instrument, and it is surrounded by a tip-covering element which is slidably mounted in the body between a position where it covers the writing tip, corresponding to the inoperative condition thereof, and a position where it uncovers the writing tip, corresponding to the operative condition thereof. In the case of this specific embodiment, the first shape memory element causes the displacement of the tip-covering element from the covering position to the uncovering position of the writing tip, where the tip-covering element is maintained by magnetic means. Preferably, these magnetic means are permanent magnets carried by a magnet-holding member which is slidably mounted in the body of the writing instrument and biased to a resting position by spring means. In this case, the second shape memory element is connected to the magnet-holding element and can be activated to move it to a position in which the tip-covering element is forced to become disengaged from the magnets so as to return to its tip-covering position under the effect of the respective spring means.

[0010] Also preferably, the writing instrument of the invention can be additionally provided with a device for mechanical switching between the operative condition and the inoperative condition of the writing tip, which can be used alternatively to the shape memory control system.

[0011] The activation of each shape memory element is controlled by electric power supply means which comprise a battery included in the body of the writing instrument and a switch, e.g. of the kind which can be activated by a light touch, positioned on the body of the writing instrument and connected to the shape memory elements by means of an electronic control unit, which can be housed, for example, within the usual clip on the outside the body of the writing instrument.

[0012] For example, the electronic control means can be arranged such that each successive activation of the touch switch causes the activation of the first or of the second shape memory element, in order to cause on

each occasion the switching from the inoperative condition of the writing tip to the operative condition, or vice versa.

[0013] Thanks to the characteristics indicated above, the writing instrument of the invention is efficient and reliable in operation whilst having an extremely simple structure, with a relatively low cost of production. Use of the writing instrument is particularly convenient because the user does not have to perform any mechanical action to cause the writing tip to switch between the operative and inoperative conditions.

[0014] Additional advantages and characteristics of the invention shall become readily apparent from the description that follows with reference to the accompanying drawings, provided purely by way of non limiting example, in which:

- Figure 1 is a cross-sectional view at an enlarged scale of a writing instrument, specifically a ball point pen, according to the invention,
- Figure 2 is a perspective view of the parts housed inside the body of the pen shown in Figure 1,
- Figure 4 is an exploded view of the parts shown in Figure 2,
- Figures 5a and 5b show a cross-sectional view of the pen, in two different operative conditions.

[0015] With reference to the drawings, numeral 1 generally designates a ball point pen, comprising a tubular body 2 made of plastic material. On one end of the tubular body 2, a tubular end element 3 is snap-fitted, also made of plastic material and provided at its base with a circumferential series of elastically deformable fins.

[0016] Inside the tubular body 2, there is slidably mounted a cylindrical sleeve 4, which can be made for instance of plastic material, which has a front end, oriented towards the end element 3, bearing a plurality (four, in the illustrated example - see Figure 2) of permanent magnets 5.

[0017] Inside a front hole 6 of the end element 3 and inside the magnet-holding sleeve 4, there is slidably mounted a tubular element 7, having a portion whose diameter is dimensioned to be slidably guided inside the sleeve 4, and tapering in a front portion 7a of reduced diameter, which is slidably guided inside the front hole 6.

[0018] Inside the front portion 7a of the element 7 the writing tip 8 of a refill 9 is positioned. A helical spring 10 is mounted around a front portion of reduced diameter of the refill 9, and is axially interposed between the main portion of greater diameter of the body of the refill 9 and an abutment surface defined on the inner surface of the tip-covering element 7. At the rear end of the body of the refill 9 a closing element 11 is positioned against which a unit 12 constituted by one or more electric power supply batteries is located. The unit 12 is held in position inside the rear end of the tubular body 2 by means of a closing element (not shown in the drawings) of any known kind, mounted on the rear end of the tubular body 2 and preferably

incorporating on its outer surface a clip of any known type. Therefore, as a result of mounting the unit 12 at the rear end of the tubular body 2, the refill 9 is held in position against the spring 10 and is therefore stationary inside the body of the pen.

[0019] A helical spring 13 is axially interposed between the rear end of the magnet-holding sleeve 4 and a ring 14 integral with the closing element 11.

[0020] In the resting condition, the helical spring 10 tends to maintain the tip-covering element 7 in the position shown in Figure 1, corresponding to an inoperative condition of the writing tip, in which the tip is completely covered and made unusable by the frontal portion 7a of the tip-covering element 7. Starting from this inoperative condition, the tip-covering element 7 can be moved, by actuating means that will be described in detail below, rightwards (with reference to the drawings), against the action of the spring 10, to a position, shown in Figure 5a, in which the terminal portion 7a of the tip-covering element is retracted inside the end element 3, so that the writing tip 8 is in an operative condition.

[0021] As shall be described in detail below, the movement of the tip-covering element 7 from the position covering the tip 8 to the position uncovering the tip is actuated by one or more shape memory elements. However, once the position where the tip is uncovered, shown in Figure 5a, is reached, the tip-covering element 7 remains in this position even after the deactivation of the shape memory means, because in this condition a metal ring 15, fitted over the tip-covering element 7, is held by the magnets 5 carried by the magnet-holding element 4.

[0022] In order to bring the pen back to the inoperative condition, a movement to the right (with reference to the drawings) of the magnet-holding sleeve 4 is caused (as shown in Figure 5b) by actuating means to be described in detail below, so as to move the magnets 5 away from the ring 15, thus enabling the return of the tip-covering element 7 to the projecting position shown in Figure 1, under the action of the spring 10. Once the magnets 5 are disengaged from the ring 15, the magnet-holding sleeve 4 returns to the resting position shown in Figure 1 due to the spring 13.

[0023] In the illustrated embodiment, the actuating means to cause the tip-covering element 7 to move towards the position uncovering the writing tip 8 and the actuating means to cause the magnets 5 to move away from the ring 15, are shape memory actuating means. In the case of the specific example shown, the actuating means that control the movement of the tip-covering element 7 comprise two shape memory wires 16 that are arranged longitudinally along the outer surface of the tip-covering element 7 and of the refill 9 and inside the magnet-holding sleeve 4, at diametrically opposite positions. The ends of the shape memory wires 16 situated at the rear end of the pen are electrically connected to the battery 6, whilst the front ends are electrically connected to each other by a metal ring 17 mounted on the tip-cover 7 (Figure 3) or by any other electrical connection element.

The two shape memory wires 16 are then mutually connected in series and an electric current flows through them when the electrical connection with the battery 6 is established. This connection is controlled by on/off switching means of any known type (not shown) which the user can activate. According to a preferred characteristic, these switching means can be constituted by a capacitive touch sensor, positioned on the outer surface of the pen, able to establish the supply of current to the shape memory wires 16 every time the user touches the surface of the sensor with his/her fingers and the pen is in the inoperative condition. The electrical connection between battery and shape memory elements is also controlled by a controlling electronic unit, which can be positioned in any point of the body of the pen, or for example in the clip of the pen. The electronic unit deactivates the electrical power supply to the shape memory elements 16 after their activation, e.g. after a predetermined time which assures that the tip-covering element 7 has reached the retracted condition where it uncovers the writing tip. Once this position is reached, as stated, the electrical power supply can be deactivated, because the tip-covering element 7 is held by the magnets 5 in the position enabling use of the writing tip 8.

[0024] The arrangement of a pen in which switching between the inoperative condition and the operative condition of the writing tip is obtained by an axial movement of a tip-covering element, rather than a movement of the tip, provides the advantage of a reduced energy consumption, because the mass of the tip-covering element is markedly smaller than that of the entire body of the refill 9. Moreover, with this solution, switching can be obtained by a shorter axial stroke than that which would be necessary if the entire refill had to be actuated, which, among other advantages, improves the efficiency of the device in terms of rapidity of activation and deactivation. Additionally, a fixed refill assures a better writing quality.

[0025] As stated, in the case of the preferred embodiment, the displacement of the magnet-holding sleeve 4 to disengage the magnets 5 from the ring 15, to allow the return of the tip-covering element 7 in the condition covering the writing tip 8, is obtained by shape memory actuating means. In particular, in the example shown, two shape memory wires 17 are provided (see Figure 2) which are arranged longitudinally inside the sleeve 4 and on the exterior of the refill. The ends of the shape memory wires 17 oriented towards the tip of the pen are anchored to the sleeve 4 by crimping (as shown schematically in Figure 3) and are electrically connected to each other by any metallic connection, whilst the rear ends of the shape memory wires 17 are connected to the battery unit 12 by the interposition of switching means and the electronic control unit, and are naturally isolated relative to the wires 16. In this case, each successive activation of the touch sensor alternatively causes the activation of the wires 16 and the wires 17, to obtain in each case the passage of the pen from the inoperative condition to the operative condition and vice versa. In other words, a bi-stable con-

trol is obtained, able to cause switching from one condition to the other at each successive intervention, the condition reached each time being maintained until a new intervention is made on the device.

[0026] According to an additional preferred characteristic of the invention, the pen, in addition to the shape memory actuating means, also comprises a mechanical device for actuating switching between the operative condition and the inoperative condition. For this purpose, it is possible to provide for example a cursor slidably mounted on the outside of the pen and rigidly connected through a slit formed in the body of the pen to the tip-covering element 7. By pushing the cursor in the direction away from the tip of the pen, the tip-covering element 7 can be brought to the condition where it uncovers the writing tip 8, in contact with the magnets 5. From this condition, pushing the cursor towards the tip of the pen with a sufficient force to overcome the attraction of the magnets 5, the tip-covering element is returned to the condition where it disables the writing tip 8. In this way, the tip according to the invention in any case assures the possibility of use even if, for any reason, electrical power should not be available.

[0027] Naturally, without altering the principle of the invention, the construction details and the embodiments may be widely varied from what is described and illustrated purely by way of example herein, without thereby departing from the scope of the present invention.

[0028] For example, the means for maintaining the tip-covering element 7 in the position where it uncovers the tip 7 could also be mechanical latching means, instead of magnetic means, in which case the shape memory wires 17 would be arranged to disengage these latching means.

[0029] Alternatively, the passage of the pen between the operative condition and the inoperative condition could be obtained through a displacement of the refill 9. The electrical power supply means could also be different from those which have been illustrated. For example they could be constituted by one or more photovoltaic cells. The arrangement of the shape memory elements could also be entirely different from that illustrated purely by way of example herein.

Claims

1. A writing instrument (1), comprising a body (2) bearing a writing tip (8) and actuating means (16, 17) to control switching between an operative condition and an inoperative condition of the writing tip (8), **characterised in that** said actuating means comprise at least one shape memory element (16, 17).
2. Writing instrument as claimed in claim 1, **characterised in that** said shape memory element (16) when activated causes switching from the inoperative condition to the operative condition of the writing tip (8).

3. Writing instrument as claimed in claim 2, **characterised in that** engaging means (5) are provided to maintain the operative condition of the writing tip (8) even after a deactivation of the shape memory element (16). 5
4. Writing instrument as claimed in claim 3, **characterised in that** said engaging means are magnetic means (5).
5. Writing instrument as claimed in claim 3, **characterised in that** releasing means (17) are provided, for causing a disengagement of said engaging means (5). 10
6. Writing element as claimed in claim 5, **characterised in that** spring means (10) are provided, which tend to hold the aforesaid inoperative condition of the writing tip (8). 15
7. Writing instrument as claimed in claim 5, **characterised in that** said releasing means comprise at least one additional shape memory element (17). 20
8. Writing instrument as claimed in any of the previous claims, **characterised in that** means are provided for supplying an electrical current to the aforesaid shape memory element, or to the aforesaid shape memory elements (16, 17), in order to cause a heating by Joule effect beyond a respective transition temperature. 25
9. Writing instrument as claimed in claim 5, **characterised in that** the writing tip (8) is supported in a fixed position in the body (2) of the writing instrument, and **in that** said writing tip (8) is surrounded by a tip-covering element (7) slidably mounted in the body (2) between a position where it covers the writing tip, corresponding to the inoperative condition of the tip, and a position where it uncovers the writing tip (8), corresponding to the operative condition of the tip (8). 30
10. Writing instrument as claimed in claim 9, **characterised in that** the shape memory element (16) is constituted by a shape memory wire operatively connected at its ends to the tip-covering element (7) and to the body of the writing instrument. 35
11. Writing instrument as claimed in claim 10, **characterised in that** in the body of the writing instrument a helical spring (10) is housed which biases the tip-covering element (7) towards the position where it covers the writing tip (8). 40
12. Writing instrument as claimed in claim 9, **characterised in that** said engaging means comprise magnetic means for holding the tip-covering element (7) 45
- in the position where it uncovers the writing tip (8).
13. Writing instrument as claimed in claim 12, **characterised in that** the magnetic means comprise one or more permanent magnets (5) carried by a magnet-holding element (4) which is slidably mounted within the body (2) and biased by spring means towards a rest position. 50
14. Writing instrument as claimed in claim 13, **characterised in that** said releasing means are constituted by at least one shape memory element (17) for moving the magnet-holding element (4) away from its rest position, so as to disengage the magnets (5) from the tip-covering element (7). 55
15. Writing instrument as claimed in claim 8, **characterised in that** the electrical power supply means comprise one or more power supply batteries or one or more photovoltaic cells.
16. Writing instrument as claimed in claim 8, **characterised in that** the electrical power supply means include manually actuated on/off switching means.
17. Writing instrument as claimed in claim 16, **characterised in that** said switching means comprise a touch sensor positioned on the outer surface of the writing instrument.
18. Writing instrument as claimed in claim 8, **characterised in that** said electrical power supply means comprise an electronic control unit arranged to cause the passage from the operative condition to the inoperative condition or vice versa, at each successive intervention on the aforesaid switching means.
19. Writing instrument as claimed in any of the previous claims, **characterised in that** it further comprises means for the mechanical manual actuation of the switching between the inoperative condition and the operative condition of the writing instrument, and vice versa.

Amended claims in accordance with Rule 137(2) EPC.

1. A writing instrument (1), comprising a body (2) bearing a writing tip (8) and actuating means (16, 17) to control switching between an operative condition and an inoperative condition of the writing tip (8), **wherein** said actuating means comprise at least one shape memory element (16, 17), **characterised in that** the writing tip (8) is supported in a fixed position in the body (2) of the writing instrument, and **in that** said writing tip (8) is surrounded by a tip-covering element (7) slidably mounted in the body

(2) and displaceable by means of an activation of said actuating shape memory element (16,17) between a position where it covers the writing tip, corresponding to the inoperative condition of the tip, and a position where it uncovers the writing tip (8), corresponding to the operative condition of the tip (8).

2. Writing instrument as claimed in claim 1, **characterised in that** said shape memory element (16) when activated causes switching from the inoperative condition to the operative condition of the writing tip (8).

3. Writing instrument as claimed in claim 2, **characterised in that** engaging means (5) are provided to maintain the operative condition of the writing tip (8) even after a deactivation of the shape memory element (16).

4. Writing instrument as claimed in claim 3, **characterised in that** said engaging means are magnetic means (5).

5. Writing instrument as claimed in claim 3, **characterised in that** releasing means (17) are provided, for causing a disengagement of said engaging means (5).

6. Writing element as claimed in claim 5, **characterised in that** spring means (10) are provided, which tend to hold the aforesaid inoperative condition of the writing tip (8).

7. Writing instrument as claimed in claim 5, **characterised in that** said releasing means comprise at least one additional shape memory element (17).

8. Writing instrument as claimed in any of the previous claims, **characterised in that** means are provided for supplying an electrical current to the aforesaid shape memory element, or to the aforesaid shape memory elements (16, 17), in order to cause a heating by Joule effect beyond a respective transition temperature.

9. Writing instrument as claimed in claim 1, **characterised in that** the shape memory element (16) is constituted by a shape memory wire operatively connected at its ends to the tip-covering element (7) and to the body of the writing instrument.

10. Writing instrument as claimed in claim 9, **characterised in that** in the body of the writing instrument a helical spring (10) is housed which biases the tip-covering element (7) towards the position where it covers the writing tip (8).

11. Writing instrument as claimed in claim 1, **char-**

acterised in that engaging means are provided comprising magnetic means for holding the tip-covering element (7) in the position where it uncovers the writing tip (8).

12. Writing instrument as claimed in claim 11, **characterised in that** the magnetic means comprise one or more permanent magnets (5) carried by a magnet-holding element (4) which is slidably mounted within the body (2) and biased by spring means towards a rest position.

13. Writing instrument as claimed in claim 12, **characterised in that** releasing means are provided which are constituted by at least one shape memory element (17) for moving the magnet-holding element (4) away from its rest position, so as to disengage the magnets (5) from the tip-covering element (7).

14. Writing instrument as claimed in claim 8, **characterised in that** the electrical power supply means comprise one or more power supply batteries or one or more photovoltaic cells.

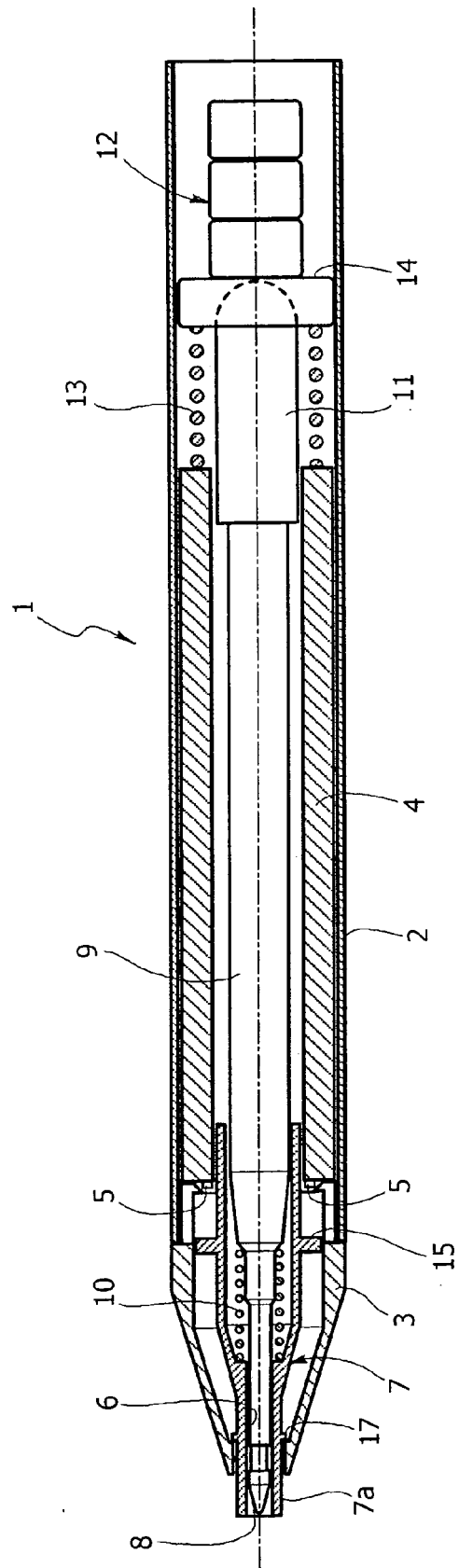
15. Writing instrument as claimed in claim 8, **characterised in that** the electrical power supply means include manually actuated on/off switching means.

16. Writing instrument as claimed in claim 15, **characterised in that** said switching means comprise a touch sensor positioned on the outer surface of the writing instrument.

17. Writing instrument as claimed in claim 8, **characterised in that** said electrical power supply means comprise an electronic control unit arranged to cause the passage from the operative condition to the inoperative condition or vice versa, at each successive intervention on the aforesaid switching means.

18. Writing instrument as claimed in any of the previous claims, **characterised in that** it further comprises means for the mechanical manual actuation of the switching between the inoperative condition and the operative condition of the writing instrument, and vice versa.

FIG. 1



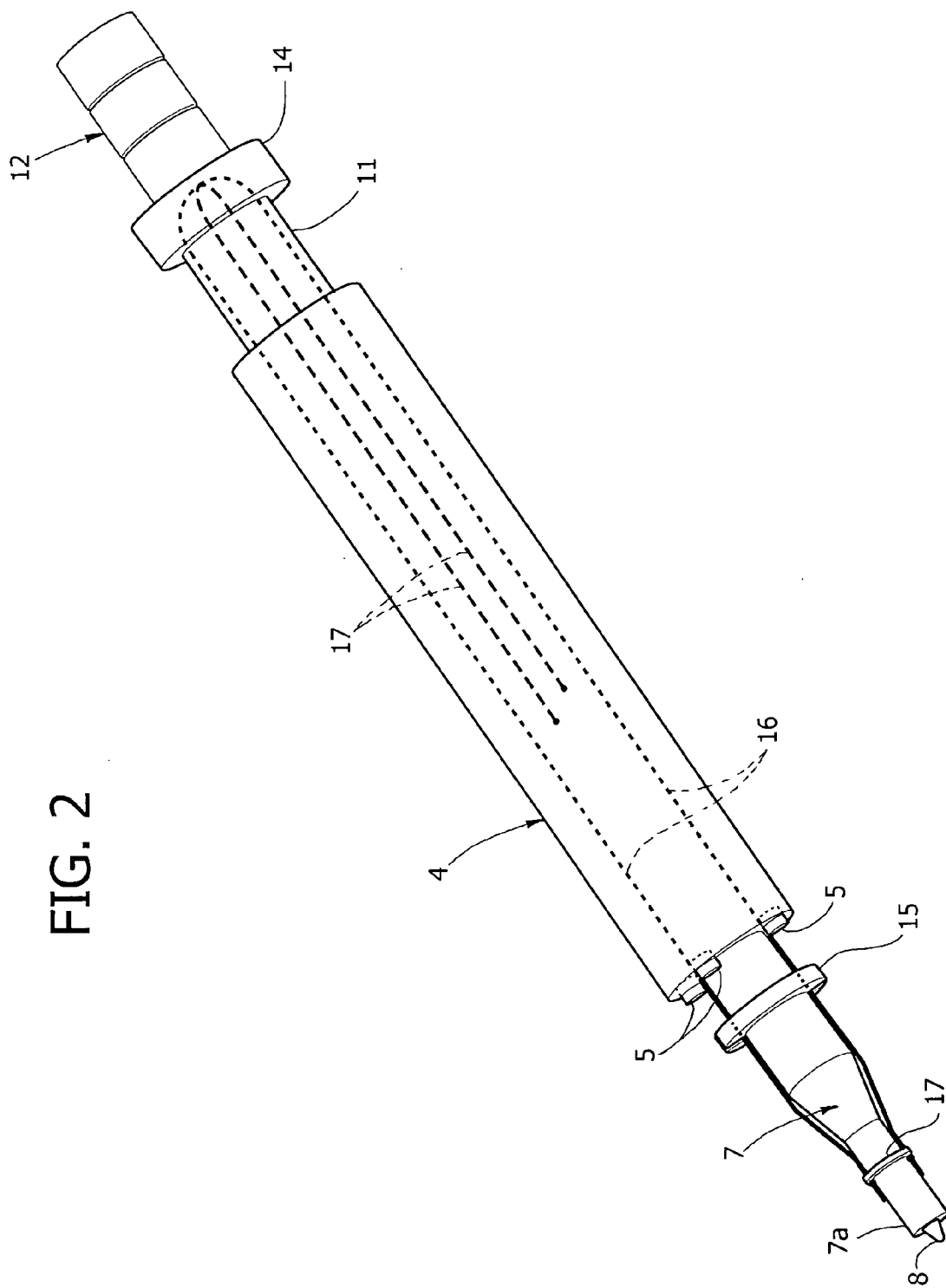


FIG. 3

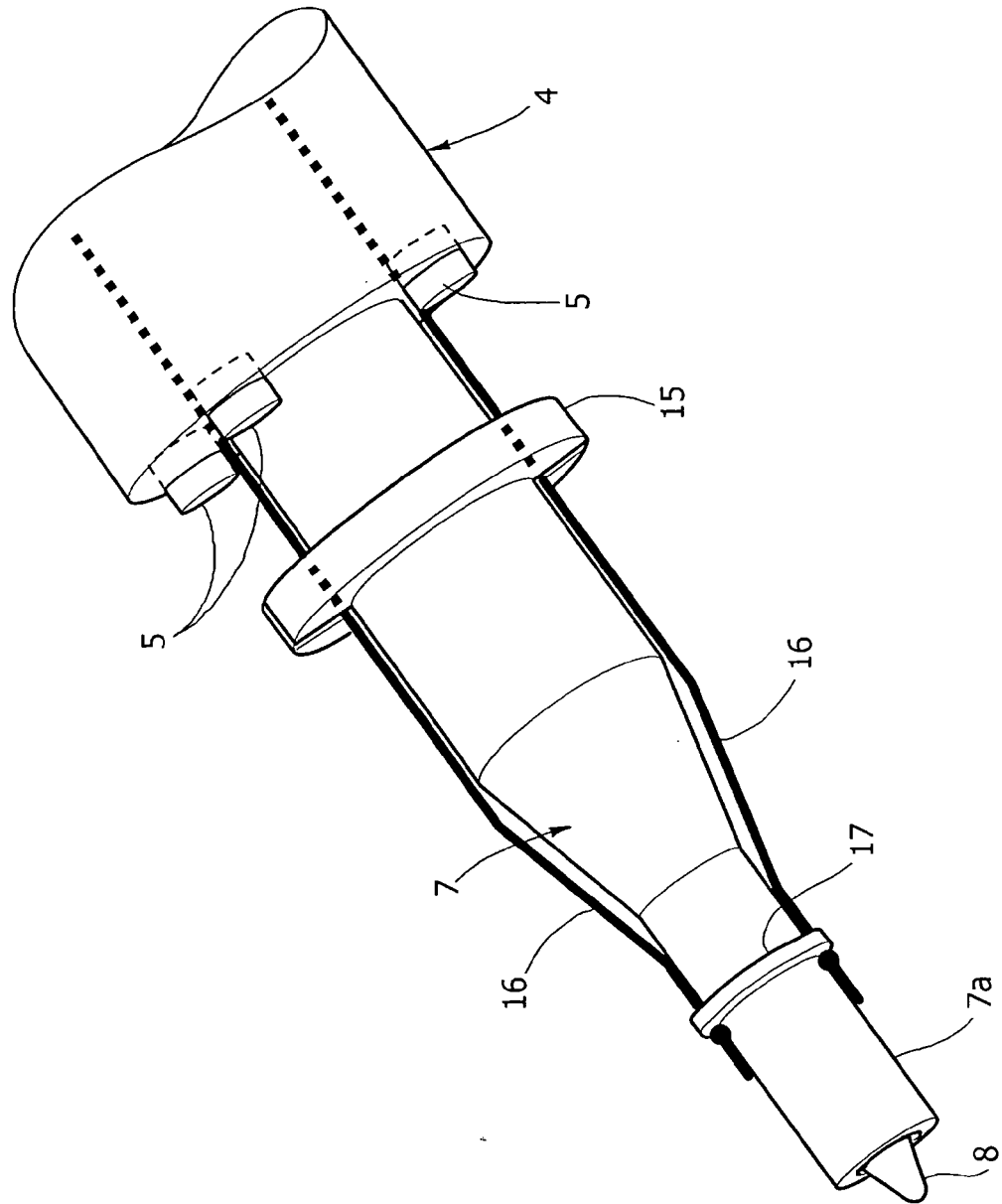


FIG. 4

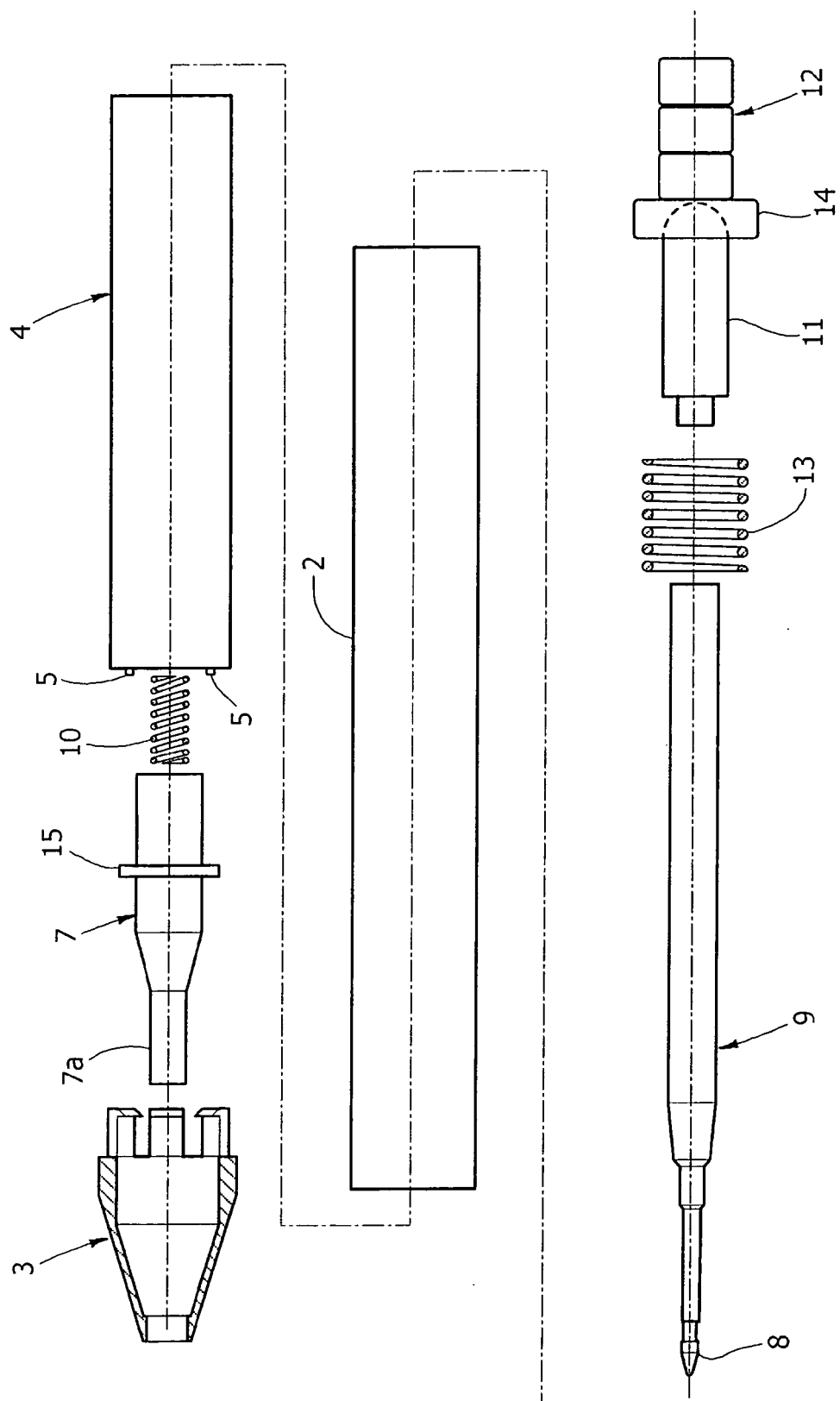


FIG. 5A

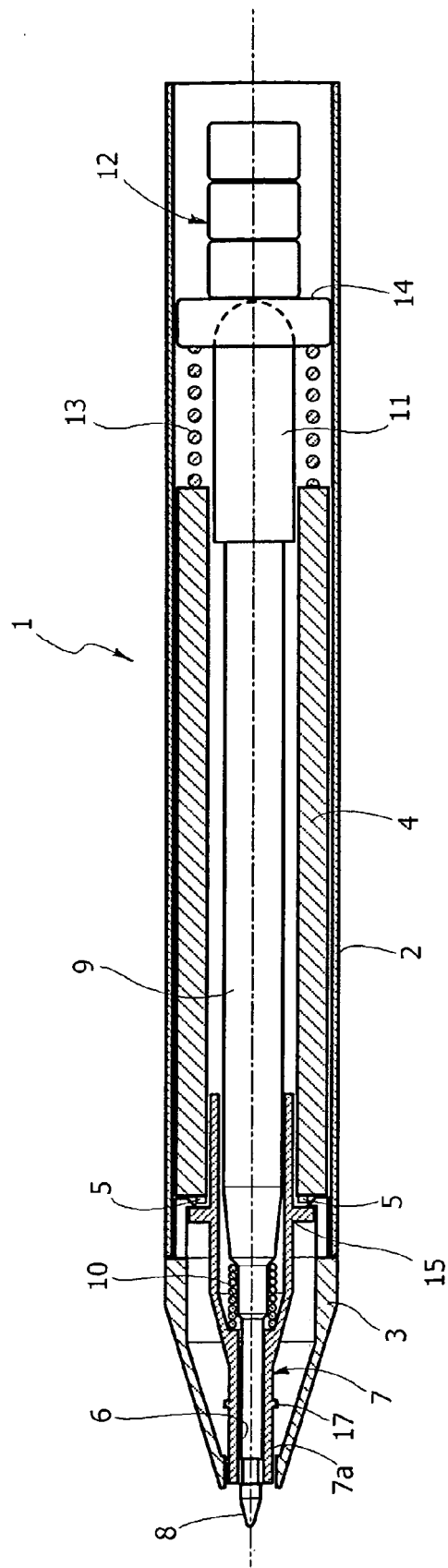
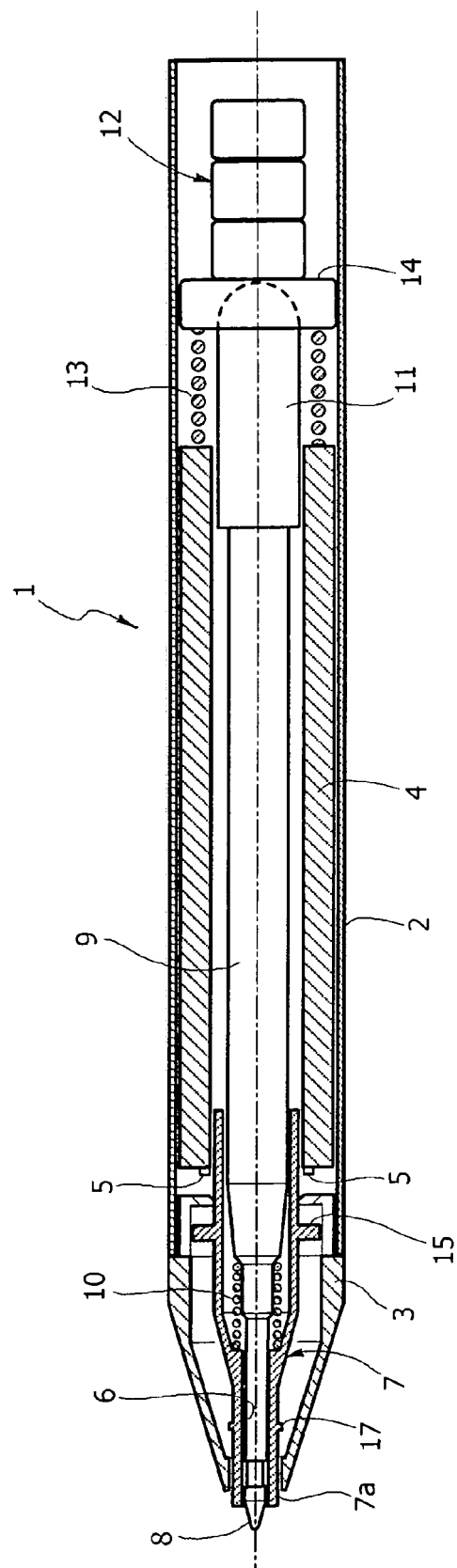


FIG. 5B





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 42 5454

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 December 2006	Examiner Koch, Jean-Marc
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 06 42 5454

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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