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(11) **EP 1 074 402 A1**

(12) **EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 158(3) EPC

(43) Date of publication:  
**07.02.2001 Bulletin 2001/06**

(21) Application number: **00903964.5**

(22) Date of filing: **16.02.2000**

(51) Int. Cl.<sup>7</sup>: **B43K 1/08**

(86) International application number:  
**PCT/JP00/00849**

(87) International publication number:  
**WO 00/48846 (24.08.2000 Gazette 2000/34)**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**

(30) Priority: **19.02.1999 JP 4092499**

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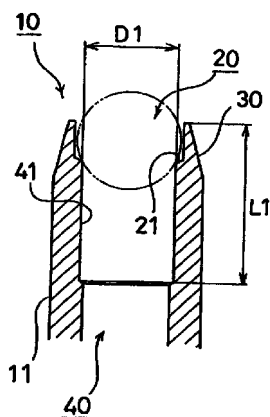
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(54) **METHOD OF MANUFACTURING A PIPE TYPE BALL-POINT PEN TIP**

(57) A method of manufacturing a tubular ballpoint pen tip (10) with not only a ball seat but also an ink hole (40) of constant sizes by cutting is provided. The inner wall of a steel tube (11) is cut in the same diameter as the finishing diameter (D1) of the ink hole (40) in order to eliminate the variations of the ink hole (40) caused by an error of the steel tube (11). Then, channels (50) are bored and the ink hole (40) is cut with a drill with a caliber (D2) slightly shorter than the above-mentioned finishing diameter (D1). In this way, burrs (51) produced by the boring of the channels (50) is removed.

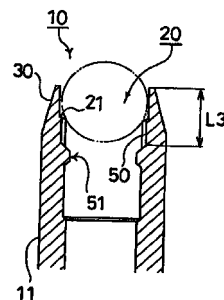
**FIG.3**

**A**



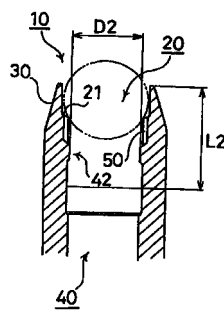
**FIG.3**

**B**



**FIG.3**

**C**



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## Description

### TECHNICAL FIELD

[0001] The present invention relates to a method of manufacturing a ballpoint pen tip from steel tube. 5

### BACKGROUND ART

[0002] Steel tubes have been heretofore used as material of ballpoint pen tips. In such a so-called tubular ballpoint pen tip, the intact inside cavity of the steel tube is usually used as an ink hole. Further, plural (usually three) sites near an end of the steel tube are radially punched to be deformed plastically so that the sites may protrude inward to be a ball seat. 10 15

[0003] Each of the sites at which the tube is punched should be located at an equal distance from the end of the tube and be deformed plastically to an equal extent. It is, however, actually difficult to punch the tube as described above. Therefore, since a ball may be partially seated on the ball seat, which is formed partially, there has been an inconvenience that the ink flow amount may be inconstant according to the direction of writing. 20 25

[0004] Furthermore, since the inner diameter of the material steel tube inevitably includes an error, the ink flow amount may be inconstant according to the variation of the ink hole diameter.

[0005] In order to eliminate above-mentioned drawbacks, the invention described in Japanese Patent Laid-Open No. 10-217665 by the present Applicant discloses a tubular ballpoint pen tip fabricated by cutting. 30

[0006] In the invention of the tubular ballpoint pen tip, the ball seat, which has been conventionally fabricated by plastic deformation, is formed by cutting in the same way as in a ballpoint pen tip made of solid cylindrical material. 35

[0007] More specifically, the inner surface of an end of a steel tube is cut to form a ball housing having a conical bottom surface. Then, channels are radially cut from this bottom surface. Thereafter, a ball is inserted in this ball housing. The end of the steel tube is caulked inwardly so that the ball may be held by the steel tube. Subsequently, the ball is struck from a tip end. In this way, the curved surface of the ball is transferred to the conical bottom surface. Namely, this transferred surface becomes a ball seat. 40 45

[0008] As described above, the ball seat can be formed uniformly even in a tubular ballpoint pen tip. 50

[0009] In the above-mentioned prior art, however, since the ink hole is formed from the intact inner cavity of the material steel tube, the ink hole diameter varies according to the errors in the inner diameter of the material. Consequently, the variation of the ink flow amount among individual ballpoint pen tips has not been eliminated yet. 55

[0010] In order to solve the above-mentioned prob-

lems, the present invention is intended to provide a method of fabricating a tubular ballpoint pen tip by cutting, wherein the size of the ink hole as well as the ball seat is constant.

### DISCLOSURE OF THE INVENTION

[0011] The present invention provides a method of manufacturing a tubular ballpoint pen tip by cutting a steel tube, comprising an ink-hole-finishing step in which an inner wall of the steel tube is cut up to a distance of L1 from a tip end with a drill with a caliber of D1, a following channel-boring step in which radial channels are bored against the ink hole up to a distance of L3 from the tip end, and a following cleaning step in which the inner wall of the steel tube is cut up to a distance of L2 from the tip end with a drill a caliber of D2; wherein the following relations are satisfied:

$$L1 \geq L2 > L3$$

and

$$D1 \geq D2.$$

[0012] One of the advantages of using a steel tube for material of the ballpoint pen tip is that its inside cavity can be used as an ink hole.

[0013] However, although the inner diameter of the material steel tube is made to be the size of the ink hole of a final product, it inevitably includes an error to a certain extent.

[0014] Accordingly, in the present invention, the ink-hole-finishing step, in which the inner wall of the steel tube is cut with a drill with a caliber of the ink hole in the final product (D1), is performed. Thus, the variation in the inner diameter caused by a material error can be eliminated. The distance (L1) through which this ink-hole-finishing step is carried out does not extend over the full length of the steel tube, but is sufficient to cover a part close to the tip end. An error in the latter portion of the ballpoint pen tip hardly affects the ink flow amount, and it is sufficient to improve the accuracy of the ink hole at the tip end portion.

[0015] Furthermore, in the present invention, channels are bored after the ink-hole-finishing is applied to the steel tube, and thereafter the cleaning step, in which the inner wall of the ink hole is cut with a drill with a caliber (D2) less than or equal to the inner diameter in the ink-hole-finishing. The cleaning step is carried out with the drill with a smaller caliber, because it is sufficient to eliminate burr produced in the channel-boring step. Namely, the cleaning step is not intended to enlarge the ink hole but to remove the burr protruding inward of the ink hole by the channel-boring step. Although the caliber D2 is referred to as being "less than" the inner diameter D1, the caliber D2 is preferably slightly less than the caliber D1 in order to remove the burr. If the cal-

iber D2 is too small, the burr cannot be removed. Since this cleaning step is not intended to enlarge the ink hole, the caliber of the drill used in this step may be the same as that used in the ink-hole-finishing step.

**[0016]** The distance (L2) for cutting in this cleaning step is less than or equal to the distance L1 and greater than the distance (L3) for boring in the channel-boring step because it is sufficient to eliminate the burr produced by the channel boring. Furthermore, since the distance L2 is less than or equal to the distance L1, the distance for cutting in the cleaning step may be equal to the distance for the ink-hole-finishing step.

**[0017]** In this way, the variation in the ink hole diameter caused by the material error can be eliminated, and the burr produced by the channel (50) boring can be removed.

**[0018]** In the description above, it is not limited when the ink-hole-finishing step should be performed. For example, a ball housing (20) may be formed after this step. However, the ink-hole-finishing step is preferably carried out after the ball housing is formed by cutting the inner wall of the tip end the steel tube, because the burr produced during formation of the ball housing can be eliminated in the ink-hole-finishing step.

**[0019]** In this way, an actual manufacturing process for a tubular ballpoint pen tip is carried out, for example, as follows.

**[0020]** First, an inner wall of a tip end of a steel tube is cut and enlarged to form a ball housing. Further, an outer wall of the tip end the steel tube is cut to taper off to form a tapering surface.

**[0021]** Thereafter, the inner wall of the steel tube is cut with a drill with a caliber of D1 up to the distance L1 from the tip end. Namely, the inner diameter of the ink hole at the tip end is cut to D1.

**[0022]** Then, plural radial channels are bored from the bottom surface of the ball housing to a distance L3 from the tip end using a channel tool. This step is referred to as the channel-boring step.

**[0023]** Thereafter, the inner wall of the steel tube is again cut with a drill with a caliber of D2 up to a distance of L2 from the tip end. Namely, burr produced in the channel-boring step is removed in the cleaning step. Since the caliber D2 is less than or equal to the caliber D1 as mentioned above, the inner diameter of the ink hole will not be enlarged.

**[0024]** Then, a ball is loaded in the ball housing as in an ordinary procedure. Subsequently, caulking is performed to form a caulked portion. Thereafter, the ball is struck from the tip end to form a ball seat on the bottom surface of the ball housing and also to form a clearance between the ball and the inner edge of the caulked portion.

## BRIEF DESCRIPTION OF THE DRAWINGS

### [0025]

Fig. 1 is a schema for some steps of a manufacturing process for a tubular ballpoint pen tip in accordance with the present invention, in which A, B and C are frontal sectional views. Fig. 2 is a schema for some steps of a manufacturing process for a tubular ballpoint pen tip in accordance with the present invention, in which A and B are frontal sectional views and C is a sectional view along an I-I plane in B. Fig. 3 is a schema for some steps of a manufacturing process for a tubular ballpoint pen tip in accordance with the present invention, in which A, B and C are frontal sectional views. Fig. 4 is a schema for some steps of a manufacturing process for a tubular ballpoint pen tip in accordance with the present invention, in which A and B are frontal sectional views.

## BEST MODE FOR CARRYING OUT THE INVENTION

**[0026]** An embodiment of the present invention is hereinafter described with reference to the attached drawings.

**[0027]** Note that each size given in the following description is shown only as an example and that the present invention is not limited by the description.

**[0028]** A steel tube 11 for material of a ballpoint pen tip 10 is made of a piece of fine tubular stainless steel with an outer diameter (a) 1.2 to 2.0 times as long as a ball diameter (e) and an inner diameter (b) 0.7 to 0.9 times as long as the ball diameter (e) (Fig. 1A). The material of the steel tube 11 is SUS304, SUS305, SUS316, SUS430, and so on.

**[0029]** First, a tip end of the steel tube 11 is cut and chamfered to form a tip end edge 81 (Fig. 1B).

**[0030]** Then, a burr 83 produced at the tip end edge portion 82 by the above-mentioned chamfering is cut and removed so that a temporary tapering surface 84 is formed slightly at the tip end (Fig. 1C).

**[0031]** After the burr is removed, a ball housing 20 is roughly cut from the tip end of the ballpoint pen tip 10 using a drill with a caliber (c) approximately equal to the ball diameter (e) (Fig. 2A).

**[0032]** Then, the inside of the ball housing 20 is cut to be finished with a drill with a caliber (d) 1.02 to 1.05 times as long as the ball diameter (e). Moreover, the outer surface of the tip end is cut to form a tapering surface 30 (Fig. 2B). In this way, the bottom surface 21 of the ball housing on which a ball seat will be subsequently transferred is formed.

**[0033]** Then, in the ink-hole-finishing step, an ink-hole-finished portion 41 is cut up to 0.8 mm (L1) from the tip end with a drill with a caliber (D1) longer than or equal to the inner diameter (b) of the steel tube (Fig. 3A). In this step, burrs 31 (cf. Figs. 2A, B, and C) pro-

duced during cutting of the ball housing 20 are removed and the variation caused by the error of the steel tube 11 are eliminated.

[0034] Further, in the channel-boring step, channels 50 are radially formed in the bottom surface 21 of the ball housing 20 up to 0.15 mm (L3) from the tip end toward the rear end with a channel tool (Fig. 3B).

[0035] Subsequently, in the cleaning step, a drill with a caliber (D2) less than or equal to D1 is inserted from the tip end up to 0.5 mm (L2) from the tip end in order to remove the burrs 51 produced by the cutting of the channels 50 and to form a cleaned portion 42 (Fig. 3C).

[0036] Then, a hard-metal ball 70 is inserted into the ball housing 20, and the tip end is caulked to be a caulked portion 60 which holds the ball 70 (Fig. 4A).

[0037] Finally, the tip end of the ball 70 is struck toward the rear end, giving a final ball exposure size, to form an appropriate clearance (f) and a ball seat (not shown) (Fig. 4B).

[0038] Subsequently, though not particularly illustrated, an ink guide wick (not shown) is inserted from the rear end of the ballpoint pen tip 10 and its tip end is made to bear against the rear end of the ball 70. This ink guide wick is formed by extrusion molding of resin such as polyacetal, and many grooves are formed in its outer surface along its axis. These grooves are capillary tubes to guide ink toward the tip end. Then, the ballpoint pen tip 10 is punched at in the midway thereof to fix the ink guide wick and, thus, the ballpoint pen tip 10 is completed.

#### INDUSTRIAL APPLICABILITY

[0039] As described thus far, the method of manufacturing a tubular ballpoint pen tip in accordance with the present invention provides a tubular ballpoint pen tip having a ball seat and an ink hole of stable sizes by cutting.

#### Claims

1. A method of manufacturing a tubular ballpoint pen tip (10) by cutting a steel tube (11), comprising:

an ink-hole-finishing step in which an inner wall of the steel tube (11) is cut up to a distance of L1 from a tip end with a drill with a caliber of D1,

a following channel-boring step in which radial channels (50) are bored against the ink hole (40) up to a distance of L3 from the tip end, and a following cleaning step in which the inner wall of the steel tube (11) is cut up to a distance of L2 from the tip end with a drill a caliber of D2; wherein the following relations are satisfied:

$$L1 \geq L2 > L3$$

and

$$D1 \geq D2.$$

2. A method of manufacturing a tubular ballpoint pen tip (10) according to claim 1, wherein said ink-hole-finishing step is carried out after the ball housing (20) is formed by cutting the inner wall of the tip end the steel tube (11).

FIG. 1

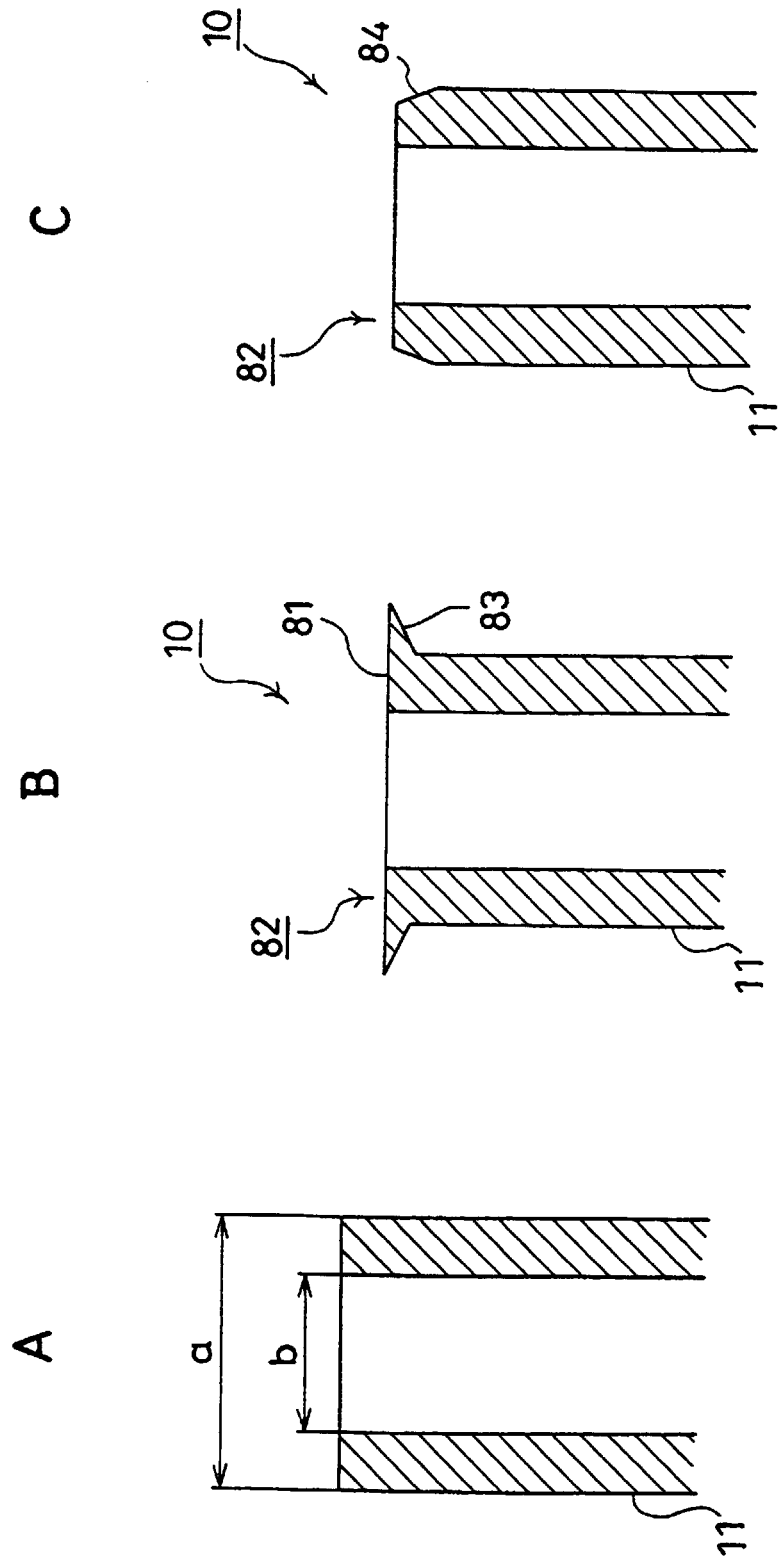


FIG. 2

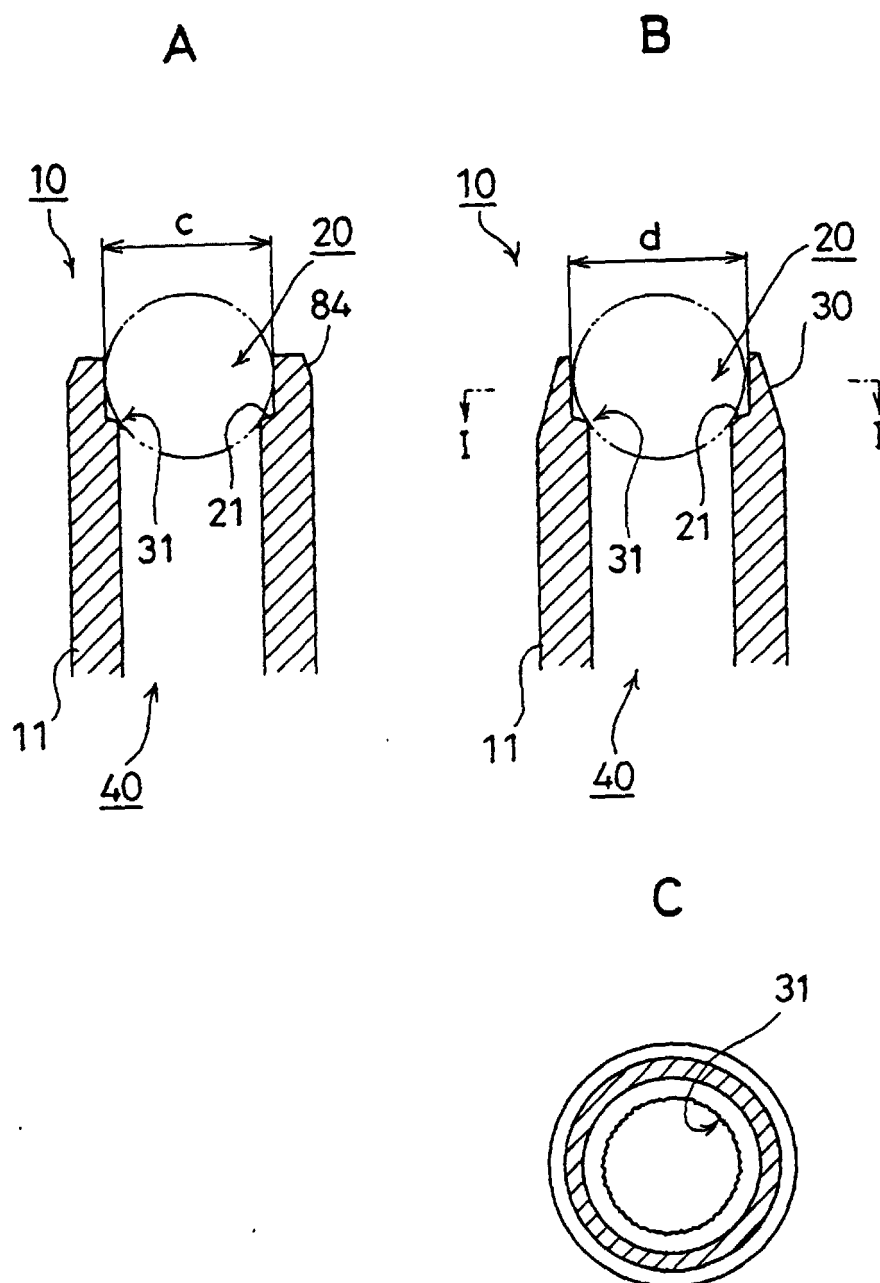


FIG. 3

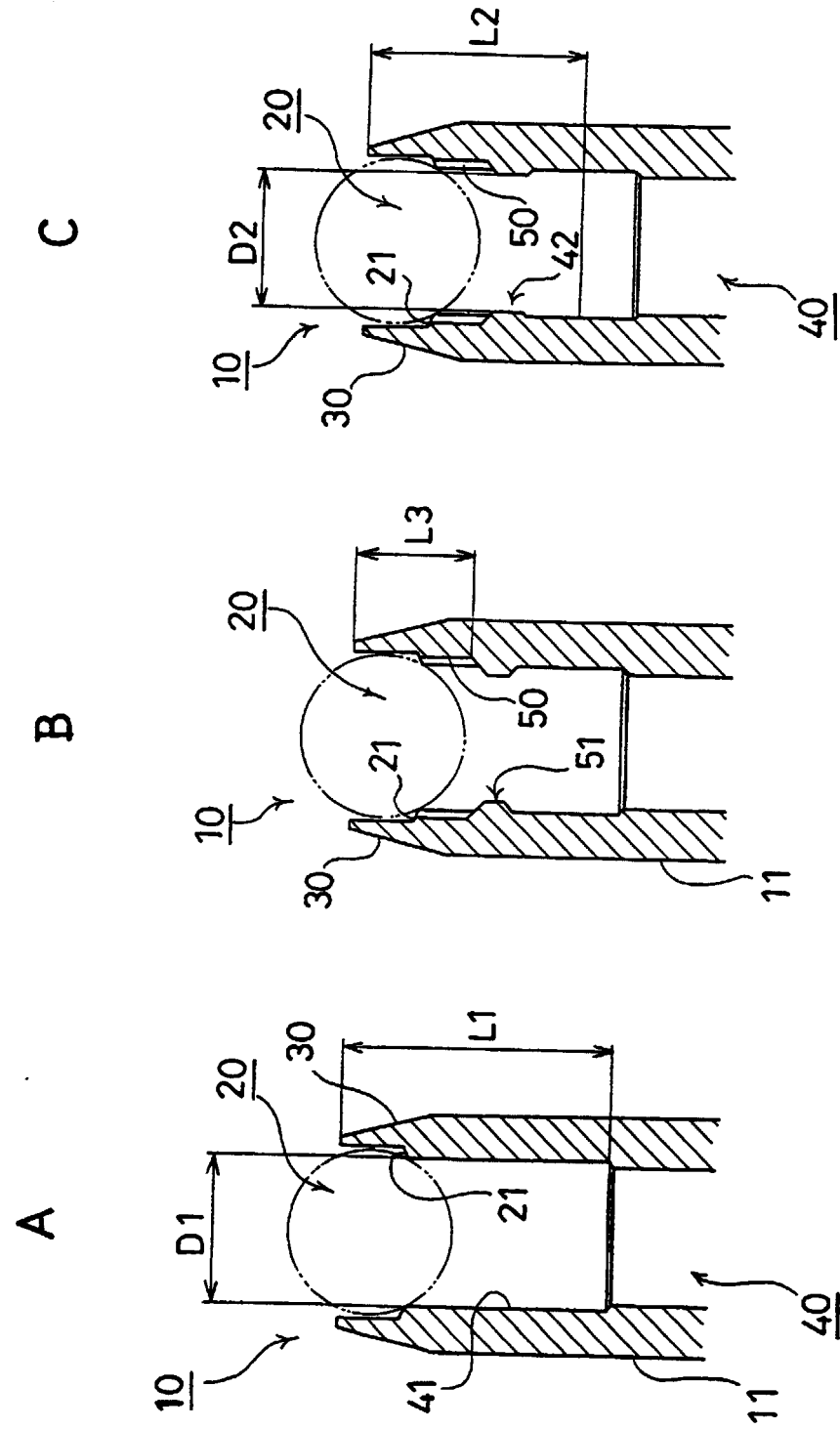
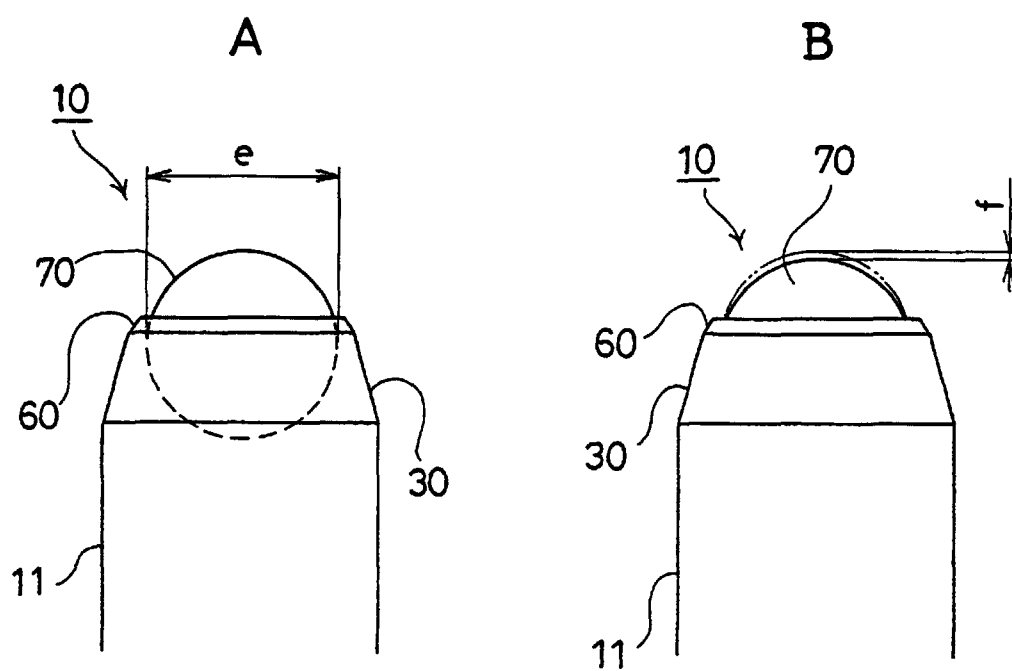


FIG. 4





## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/00849

A. CLASSIFICATION OF SUBJECT MATTER  
Int.Cl.<sup>7</sup> B43K 1/08

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl.<sup>7</sup> B43K 1/08Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2000  
Kokai Jitsuyo Shinan Koho 1971-2000 Jitsuyo Shinan Toroku Koho 1996-2000

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. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Y         | JP, 10-217665, A (Mitsubishi Pencil Co., Ltd.),<br>18 August, 1998 (18.08.98),<br>Full text; all drawings                                                                               | 1                     |
| A         | Full text; all drawings (Family: none)                                                                                                                                                  | 2                     |
| Y         | JP, 39-2679, B1 (Patent Ausuuerutsungusu, Ansyutaruto),<br>14 March, 1964 (14.03.64),<br>Full text; all drawings; Particularly, page 1, right<br>column, lines 31 to 39; Figs. 11 to 15 | 1                     |
| A         | Full text; all drawings (Family: none)                                                                                                                                                  | 2                     |
| A         | JP, 63-41755, B2 (The Pilot Pen Co., Ltd.)<br>18 August, 1988 (18.08.88)<br>Full text; all drawings (Family: none)                                                                      | 1-2                   |
| A         | JP, 3037168, U (ZEBRA K.K.),<br>06 May, 1997 (06.05.97),<br>Full text; all drawings (Family: none)                                                                                      | 1-2                   |

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

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Date of the actual completion of the international search  
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