United States Patent [19]

Linz et al.

[11] **3,781,123**

[45] **Dec. 25, 1973**

[54] **BALL-POINT PENS**

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[21] Appl. No.: **310,781**

Related U.S. Application Data

[63] Continuation of Ser. No. 17,018, March 9, 1970, abandoned, which is a continuation of Ser. No. 633,873, April 26, 1967, abandoned.

[30] **Foreign Application Priority Data**

Apr. 26, 1966 Germany ..... L 53,436

[52] **U.S. Cl.** **401/216,** 106/23

[51] **Int. Cl.** **B43k 7/10**

[58] **Field of Search** 106/23; 401/209–217, 59

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[57] **ABSTRACT**

In a ball-point pen having a ball housing including a support wall and a bearing surface for seating a ball, and means at one end of the ball housing for communicating into a reservoir containing a pasty writing medium, a plurality of open channels are formed in the bearing surface for conducting the pasty writing medium from the reservoir to the ball, the cross sectional area of each open channel being less than 1,000 square microns, so that the capillary attraction between the open channels and the writing medium is great enough to move the writing medium from the reservoir to the ball against the force of gravity. The support wall and bearing surface are preferably dimensioned to define an annular collecting groove communicating between the surface of the ball and each of the open channels.

11 Claims, 4 Drawing Figures

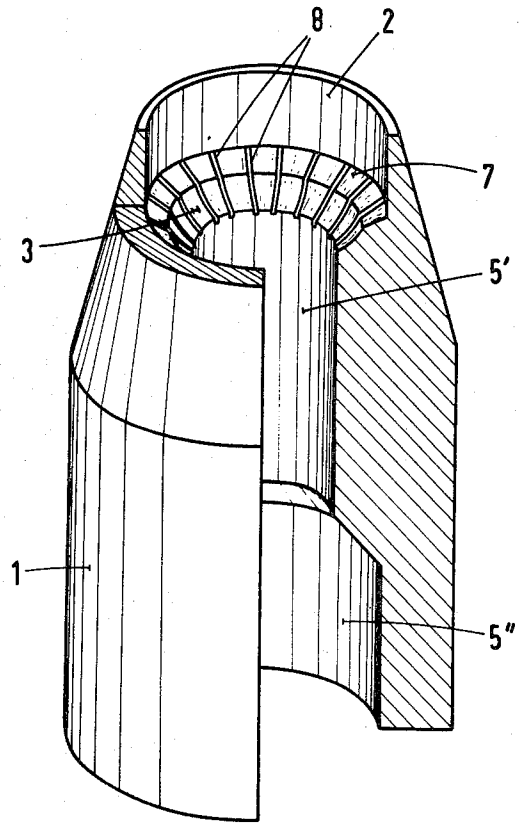

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FIG. 1

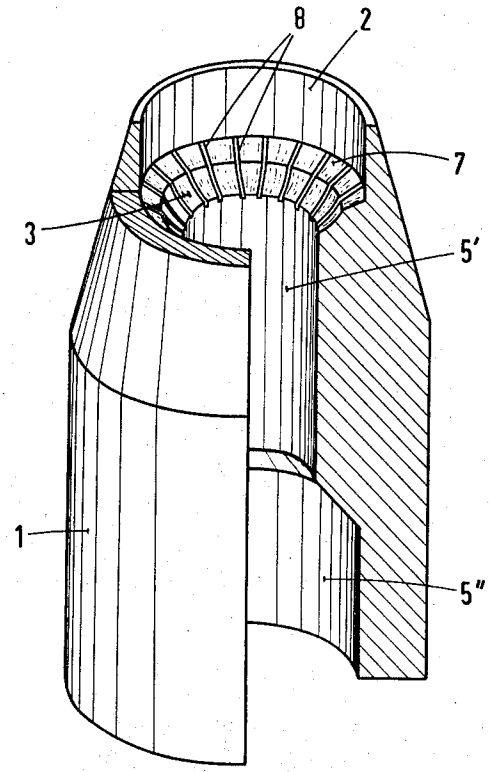
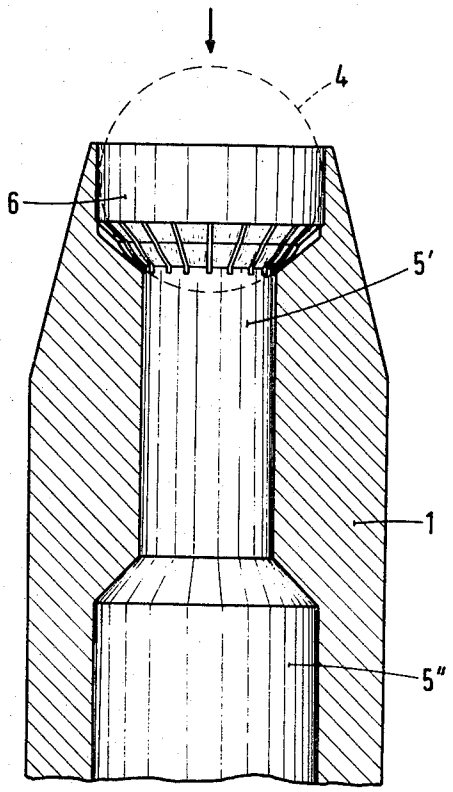


FIG. 2



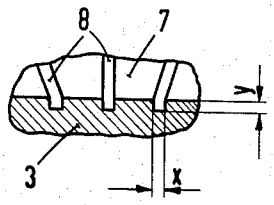


FIG. 4

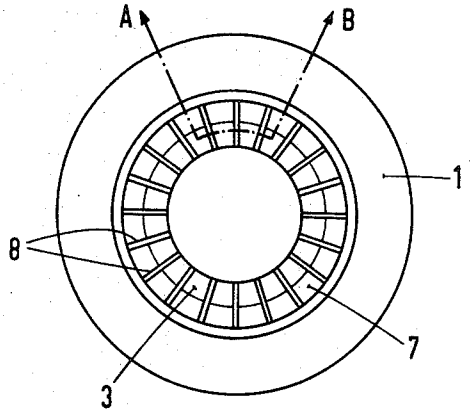


FIG. 3

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BALL-POINT PENS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of now abandoned application Ser. No. 17, 018 filed Mar. 9, 1970 which was a continuation of abandoned application Ser. No. 633, 873, filed Apr. 26, 1967.

BACKGROUND OF THE INVENTION

The present invention relates to ball-point pens. The term "ball-point pens" as used herein includes both a writing implement containing a cartridge and also a replaceable cartridge by itself. The invention relates preferably to ball-point pen cartridges having DIN standard dimensions and provided with a writing medium reservoir, the inner cross-section of which is less than 10 mm^2. The term "pasty writing medium" includes writing pastes having a viscosity at 37° C. of not less than 10 Poise and preferably not more than 250 Poise.

Ball-point pens wherein an aperture is formed at the rearward end of the supply reservoir have become extremely popular. With ball-point pens of this type, when the supply of writing medium decreases, i.e., when the column of writing medium gets shorter, continuous pressure compensation takes place via the aperture. This is essential for the flow of writing medium to the writing point, unless special steps are taken to ensure continuous flow, as for example, by including a pressurized gas above the writing medium column. Provisions of this kind, however, make the ball-point pen relatively expensive. For continuous flow of writing medium to the writing point during writing, an important factor is the capillary forces which, in known ball-point pens, are present substantially in the gap between the ball and the lateral bearing seating. These capillary forces are mainly responsible for the fact that, if the volume of the reservoir is small, no writing medium will flow out of the rearward aperture in the reservoir if the ball-point pen is held with its writing point upwards.

The known ball-point pens of the above-mentioned type have the disadvantage that it is impossible to write when the writing point is at a higher level than the rearward end of the reservoir. The reason for this is that when writing in this position, air penetrates into the gap between the ball and the ball seating, and from there into the channels formed in the base seating. This air displaces the writing medium out of the channels and enters the central feed duct which communicates with the reservoir. Consequently, after a short time, the connection between the writing medium column and the writing point is interrupted, so that the capillary force, which is necessary to make the pen work, is no longer effective. Only when the writing point is directed downwards will the writing medium begin to flow again under the influence of gravity, so that the writing point or, to be more precise, the space between the ball and the ball seating is again able to fill with writing medium.

Due to the above-mentioned disadvantage, it is, for example, very difficult to write with the prior art ball-point pens on drawing boards which extend almost vertically.

SUMMARY OF THE INVENTION

In the present invention, the channels formed in the bearing surface for the ball are so designed that their capillary effect is, relative to the writing medium contained in them, sufficiently large to move the writing medium from the reservoir to the ball against the force of gravity, so that no air bubble can form between the ink column and the ball. In accordance with this invention, it has been found that this can be accomplished by keeping the cross sectional area of the channels below 1,000 square microns. In known ball-point pens, the channels (whose cross-section was above 10,000 square microns) did not provide the effect achieved by the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially cut away perspective view of one embodiment of the invention.

FIG. 2 is a longitudinal cross sectional view of the embodiment shown in FIG. 1, with the position of the ball therefor being indicated by dashed lines.

FIG. 3 is a top view of the embodiment shown in FIGS. 1 and 2 taken in the direction of the arrow in FIG. 2.

FIG. 4 is an enlarged cross sectional view taken substantially along the plane defined by reference line 4—4 in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Before describing the illustrated embodiment in detail, the general design principles of the invention will first be discussed.

Tests have shown that good results can be achieved with channels having a maximum width of 20 microns and a maximum depth of 20 microns. If the spherical base seating is subjected to excessive frictional wear, a channel depth of 20 microns may, under certain circumstances, be insufficient for assuring adequate feeding of writing medium to the ball as the base seating becomes worn, thereby reducing the depth of the feed channels. If the ball "sinks in," during the working life of the pen, by for example, 30 microns, then the depth of the channels should be at least 50 microns but should not exceed 100 microns. In the case of those greater channel depths, the channel widths should be at most 10 microns.

In order to counteract the interruption of the flow of ink at the writing point, it is preferable to use a writing medium having a surface tension of above 40 dynes/cm.

In order to adequately feed the ball bed with writing medium, it is preferable to increase the number of channels (which, in the case of a cartridge corresponding otherwise to the DIN standard dimensions and with a 1 mm diameter ball, have a length of approximately 200 microns) relative to known designs, wherein as a rule three to five channels are provided. With a channel width of 20 microns, therefore, at least 10 channels and, with a channel width of 10 microns, at least 20 channels should preferably be machined into the bearing seating. Fine channels may be formed in the bearing surface, either in the conventional manner, i.e., by punching or, for example, by spark erosion or ultrasonic processing. In order to achieve satisfactory feeding of the ball bed with writing medium, grooves connecting adjacent channels together may be formed between the channels.

In order to achieve satisfactory lubrication of the ball bed, lubricants such as molybdenum disulphide may be added to the writing medium.

Referring to the drawings, the writing point 1 can be manufactured by the chip-removing machining of a cylindrical blank, for example made of brass. Adjacent to the end of the writing point 1 remote from the bearing surface for the ball is a reservoir (not shown) for the writing medium. The connection between the reservoir and the chamber surrounding the bearing surface faces 2, 3 for the ball 4 is provided by means of a central feed channel 5', 5'', the channel section 5' immediately adjacent the bearing surface having a smaller diameter than the section 5'' adjacent the reservoir.

Reference numeral 2 designates that one face of the recess formed from the front end-face side of the writing point which, after the beading-in of the ball 4, forms the spherical lateral ball seating. The basic seating 3, which is also spherical, after the hammering-in of the ball 4, is separated from the lateral seating via an annular collecting groove 6 for the writing medium (FIG. 2). The groove in formed by means of a step 7 (FIG. 1) formed on the end-face cavity in the writing point 1.

Machined into the surface 3 and the shoulder 7 are small open channels 8 having dimensions as discussed above to insure that the capillary attraction forces are adequate to move the writing medium to the ball against the force of gravity. In FIG. 4 the letters X and Y represent the width and the depth of the channels respectively, whose dimensions are preferably chosen within the ranges indicated above.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

We claim:

1. In a ball-point pen having a ball housing including a support wall and a bearing surface for seating a ball, a reservoir adjacent the housing and provided in the vicinity of its end remote from the housing with an air inlet opening, a mass of a pasty writing medium having a minimum viscosity of 10 poise at 37° C contained in said reservoir, and means at one end of said ball housing communicating with said pasty writing medium in said reservoir, the improvement comprising a plurality of open channels in said bearing surface for conducting such pasty writing medium from such reservoir to a ball seated on said bearing surface, the cross-sectional area of each of said open channels being no greater than 1,000 square microns, said channels constituting the sole ink flow path between said reservoir and said ball.

2. A ball-point pen as defined in claim 1, wherein said support wall and bearing surface are dimensioned to define an annular groove communicating with each of said open channels.

3. A ball-point pen as defined in claim 1, wherein each of said open channels is not more than 20 microns wide.

4. A ball-point pen as defined in claim 3, wherein each of said open channels is not more than 20 microns deep.

5. A ball-point pen as defined in claim 1, wherein the depth of each of said open channels is greater than 50 microns, and wherein the width of each of said open channels is less than 10 microns.

6. A ball-point pen as defined in claim 1, wherein the reservoir is filled with a pasty writing medium having a surface tension greater than 40 dynes/cm.

7. A ball-point pen as defined in claim 1, including at least ten of said open channels, each of said open channels being approximately 200 microns long and approximately 20 microns wide.

8. A ball-point pen as defined in claim 1, including at least twenty of said open channels, each of said open channels being approximately 200 microns long and approximately 10 microns wide.

9. A ball-point pen as defined in claim 1, and also including grooves communicating between adjacent pairs of said open channels.

10. In a ball-point pen having a ball housing including a support wall and a bearing surface for seating a ball, and means at one end of said housing for communicating into a reservoir containing a pasty medium, the improvement comprising a plurality of open channels in said bearing surface for conducting such pasty writing medium from such reservoir to a ball seated on said bearing surface, the cross-sectional area of each of said open channels being no greater than 1,000 square microns, and wherein the reservoir is filled with a pasty writing medium containing a lubricant.

11. A ball-point pen as defined in claim 10, in which said lubricant is molybdenum disulphide.

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