

[54] **PEN WITH INJECTION SYSTEM**
 [76] Inventor: **Edward Bok**, Burgemeester
 Amersfoordtlaan 82,
 Badhoevedorp, Netherlands

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Primary Examiner—Lawrence Charles

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 401/230

[51] Int. Cl.² **B43K 5/10**

[58] Field of Search 401/223, 230, 258-260,
 401/183-185, 245, 246, 160, 133, 198, 199;
 222/206, 207, 212

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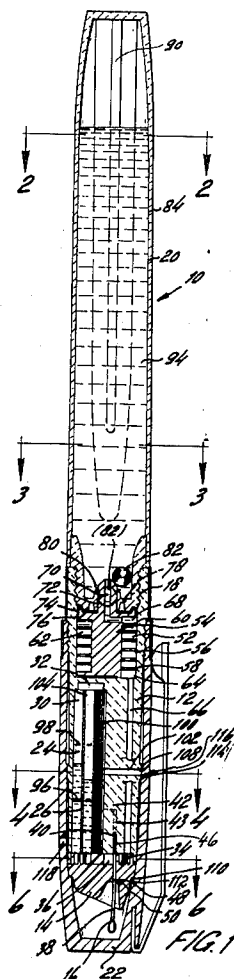
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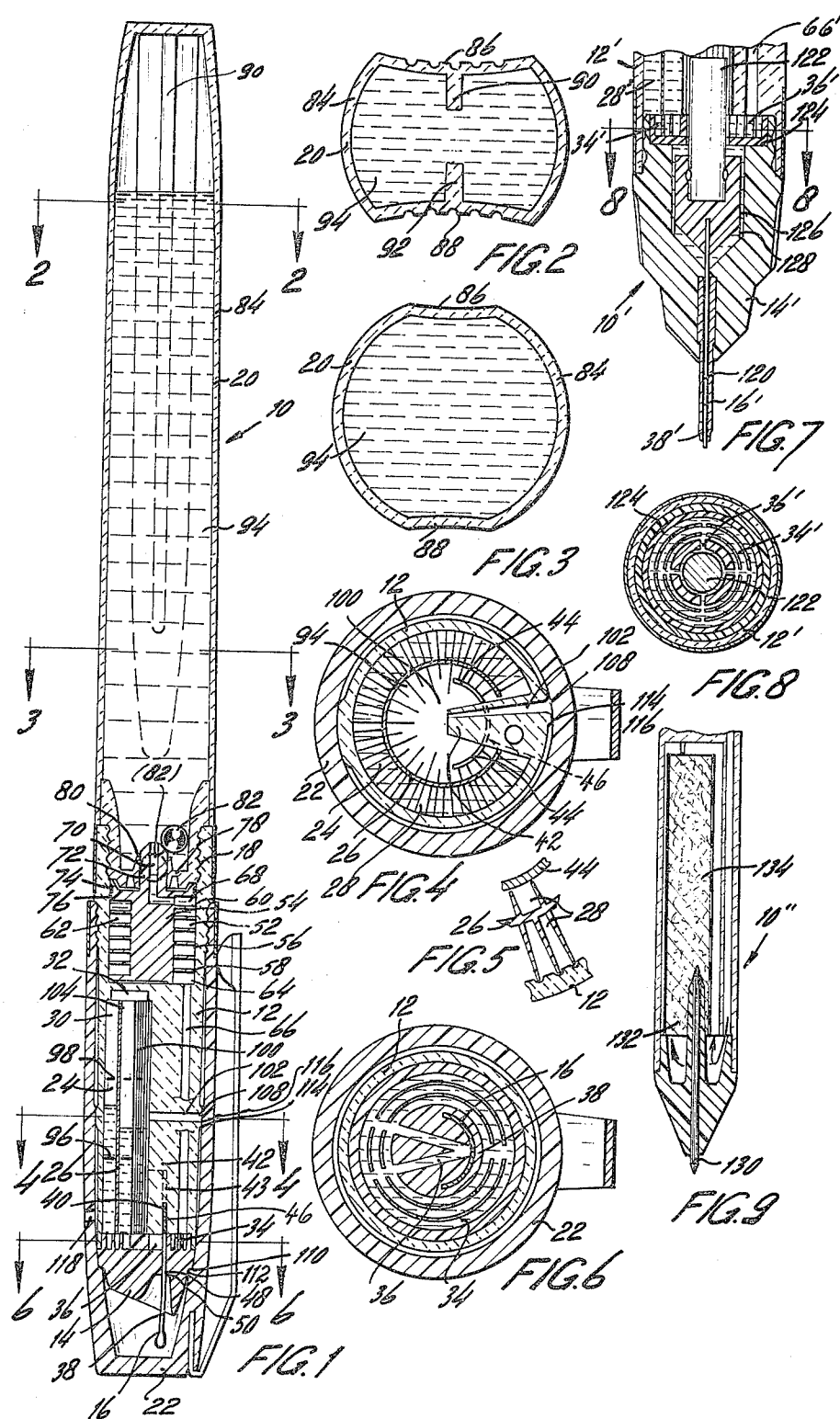
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ABSTRACT

The present invention relates to a pen having a compressible free ink reservoir, a contained ink reservoir, a writing tip in communication with the contained ink reservoir, a manually operable injection system for transferring ink from the free ink reservoir to the contained ink reservoir which includes at least one ink injection channel extending downwardly from the lower end of the free ink reservoir to a position near the bottom of the contained ink reservoir, and a venting system extending upwardly from the lower end of the contained ink reservoir to the top thereof and beyond a cross venting channel which extends from an opening in the side wall of the contained ink reservoir.

9 Claims, 9 Drawing Figures





PEN WITH INJECTION SYSTEM

BACKGROUND AND SUMMARY OF THE INVENTION

In the U.S. Pat. application Ser. No. 396,149, filed Sept. 11, 1973, of the inventor herein a pen is described wherein the pen holder is provided with a first ink reservoir, the pen nib chamber is formed as a second ink reservoir, and wherein a non-hydraulic injection channel operatively connects the lower portion of the first ink reservoir with the lower portion of the second ink reservoir. A venting system extends upwardly from the lower end of the second reservoir and is provided with a buffer for collecting ink, which buffer also acts as an ink locking structure to prevent the escape of ink from the venting system into the venting opening.

In the present invention, the pen holder is provided with a free ink reservoir while the lower end of the pen is formed as a contained ink reservoir. A pen tip is in communication with the contained ink reservoir. A non-hydraulic injection channel operatively connects the lower portion of the free ink reservoir with the lower portion of the contained ink reservoir such that the free ink reservoir is compressible to periodically transmit via the injection channel a limited amount of ink into the contained reservoir. The venting system extends upwardly to the top of the contained ink reservoir and beyond the cross venting channel, which connects the venting opening in the sidewall of the pen with the venting system. In the contained ink reservoir, capillary ink buffer channels are provided, which as part of the venting system are communicant with the venting passage of the venting system. The cross venting channel is connected with the venting channel. Part of the ink buffer channels can be more capillary with the possible use of a tampon and whereby these ink buffer channels are capillary connected with the ink passage of the pen tip. As the venting passage is less capillary than the ink buffer channels, this channel and especially near the cross venting channel, remains free of ink. During changes in position of the pen, ink does not flow via this channel, but is suctioned therefrom by means of the capillary action of the adjacent buffer channels. After each ink injection into the contained ink reservoir the buffer channels are provided with fresh ink, which mixes with the residue ink. In this way, the ink in the buffer channels remains in liquid form, is able to partly vaporize, and provides means to maintain vapor saturated air in the venting system, with under normal conditions no possible clogging of ink therein. This feature enables the venting system and ink injection channel to be part of the holder with no required periodic cleaning thereof, and the use of large, low priced disposable ink cartridges, which can be secured to such a pen holder. Moreover, the lower end of the ink injection channel is connected with the ink buffer channels, enabling after the injection of ink with the following automatic suctioning of ink and air, the return of not contained ink out of these channels into the free ink reservoir. As a result, the contained ink reservoir contains no free ink, with ideal structures for fountain pens and other pens with slitted pen tips, stylographic pens with large sized pen tips and pens with fibrous pen tips.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view of the pen of the present invention;

FIG. 2 is a cross-sectional view of the pen taken along line 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view of the pen taken along line 3—3 of FIG. 1;

FIG. 4 is a cross-sectional view of the pen taken along line 4—4 of FIG. 1;

FIG. 5 is an enlarged cross-sectional view of the ink buffer;

FIG. 6 is a cross-sectional view of the pen taken along line 6—6 of FIG. 1;

FIG. 7 is a vertical sectional view of a different embodiment of the lower end of the pen;

FIG. 8 is a cross-sectional view of the pen taken along line 8—8 of FIG. 7; and

FIG. 9 is a vertical sectional view of the lower end of an additional embodiment of the pen featuring a fibrous tip.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As illustrated in FIG. 1, the pen of the present invention is designated generally by the reference numeral 10 and consists of a holder 12 which is provided with a nib 14 and a tip 16 and to which by means of screw thread 18 the disposable ink cartridge 20 is attached, which serves as the free ink reservoir. Furthermore, the protective cap 22 is secured to the lower end of the holder 12.

In holder 12 a compartment 24 is located, as illustrated in FIGS. 1 and 4, wherein the buffer block 26 is secured. Buffer block 26 contains a large number of capillary ink buffer channels 28, as illustrated in detail in FIG. 5, which at their top portions 30 terminate in communication chamber 32.

Within the flexible pen nib 14 are located a plurality of ink grooves 34, as illustrated in FIG. 6, which via the central ink grooves 36 operatively connect the ink buffer channels 28 with the ink passage 38 of the metal pen tip 16.

Pen tip 16 is with its upper end pressed into the corresponding groove 40 of the inner notch 42 of holder 12, whereby the sides 44 of the pen tip are guided along the lower end 46 of the notch 42, as seen in FIG. 4. In this way and also by means of the passage 48 of the pen tip through the pen nib bottom 50 an excellent securing of the pen tip 16 to the holder 12 is obtained.

In the upper compartment 52 of holder 12 the injection block 54 is positioned. The injection block 54 is provided with the spiralled groove 56, while the separation walls 58 press against the inner sidewall 60 of the compartment 52, thus defining the injection channel-segment 62 which at its lower end 64 is operatively connected with the injection channel-segment 66 which is located in notch 42. The upper end of the channel-segment 66 is via a groove 56 connected to the central injection channel-segment 70, which is located in the upper extension 72 of the injection-block 54.

The leak free, sealing-off of the inside of the block 54 is accomplished by means of the flanges 74 and 76, which are urged against the inner sidewall 60 of the upper compartment 52.

In the bottom 78 of the ink cartridge 20 the central passage 80 is located and in the cartridge 20 the seal-

off ball 82 is pressed, which position is indicated with reference numeral 82. As the ink cartridge 20 is screwed on the holder 12, the extension 72 moves in upward direction in passage 80 with the resulting upward displacement of the ball 82 until this ball is removed from the passage 80.

As a result, the compartment or contained ink reservoir 24 is placed via injection channel 66, 56, 70 in operative connection with the inside of the ink cartridge or free ink reservoir 20.

Sidewall 84 of the ink cartridge 20 is flexible, and provided in such a way that two wall segments 86 and 88 are formed, as illustrated in FIGS. 2 and 3. The wall segments 86 and 88 are provided with wall limits 90 and 92, which determine the maximum depression of the wall segments 86 and 88 to each other.

The functioning of the pen will now be described. After securing the ink cartridge 20 to the holder 12, the sidewall segments 86 and 88 are pressed inwardly toward each other, resulting in diminishing the volume in the ink cartridge 20. Ink 90 is urged out of the ink cartridge 20 via injection channels 70, 56, 66 into the ink transport grooves 34 and from there by means of capillary action the ink is suctioned into the ink buffer channels 28.

Because the compression volume of the ink cartridge 20 is only slightly greater than the buffer volume of the injection-channel 66, 56, 70 the volume of the injected ink is also limited and amounts to approximately 150 mm³, whereas the total ink capacity of the channels 28 is approximately 400 mm³. Thus, after the first ink injection the ink level 96 is reached, whereas after a following ink injection, which however is not needed, the ink level 98 is obtained. After another ink injection the channels 28 are completely filled and some ink will enter the central venting passage 100. However, the maximum length of the ink column therein is limited to such an extent that the ink level cannot reach the cross venting channel 102. If in the ink injection position — which also is the normal pen-use position — after such ink injection the compression force on the sidewall segments 86 and 88 is released, due to its resilient characteristics, the wall 84 returns to its normal position. Thereby all free ink in the venting channel 100 is automatically removed under the force of suction and only thereafter the suctioning of venting air can take place into the free ink reservoir 20 to replace the injected ink. In this way, no free ink can remain in the contained ink reservoir 24.

The ink transport channel 38 in the pen tip 16 is to a greater extent more capillary than the greatest part of the ink buffer channels 28 and the ink transport grooves 34 and 36. This results during pen-use in the suctioning of ink out of the channels 28 via the channel 38 and ink transport grooves 36.

As the holder 12 is made of transparent material, the ink level in the outer channels 28 is clearly visible and in that way the correct amount of ink injection can be determined.

Because only one injection of ink is required for long lasting pen-use, the rest of the buffer capacity of the channels 28 can function as a buffer to collect ink, which during extreme rises in temperature or pressure is urged out of the ink cartridge 20.

The sealing off of the venting opening 108 in the sidewall of the holder 12 and the ink transport channel 38 of the pen tip 16 is achieved by means of the protective

cap 22, which in attached position has its flange 110 sealably urged against the flexible flange 112 of the pen nib 14 and its sidewall segment 114 urged against the flange 116 around venting opening 108.

After the attachment of the cap 22, the air therein can escape via the opening 118 in the sidewall of the cap 22.

Within the scope of the present invention other methods of attaching the cap and sealing off systems are contemplated.

Furthermore, part of the capillary channels 28 can be more capillary than the rest of these channels. Thereby such capillary channels 28, and possibly all of them, can be made of capillary fibrous material or tampon material. This is illustrated in FIG. 9, which shows the fibrous tip 130 which upwardly extends into the lower end 132 of the capillary tampon 134.

In FIG. 7 the lower end of stylographic drafting pen 10' is illustrated wherein the nib 14' with tip 16' is removably attached to holder 12' permitting the holder 12' to be replaced or cleaned.

The cleaning wire 120 is positioned in the ink passage 38' of the tip 16' and displaceable by means of a shaking motion of the needle weight 122. By means of plate 124 this needle weight 122 is enclosed in the pen nib chamber 126. In this plate 124 the ink transport grooves 34' and 36' are positioned as illustrated in FIG. 8 and connect the capillary channels 28' with the injection channel segment 66' and also channels 28' with the capillary chamber 128 around the needle weight 122.

Within the scope of the present invention it is contemplated that the holder 12' and the free ink reservoir 20 can be part of a disposable unit. Furthermore, the stylographic pen tip can be modified within the scope of the present invention, such as for instance a tip, whereby the needle is sidewardly displaceable and use can be made of flexible material for such a tip. Thereby the lower end of the needle can be provided with a ball to enable a light moving of the needle over the writing surface. Furthermore, the holder, tip and free ink reservoir can be contained in a disposable unit.

I claim:

1. A pen, comprising:

a free ink reservoir,

a contained ink reservoir beneath said free ink reservoir and provided with a pen tip in communication therewith,

at least one ink injection channel positioned between said free ink reservoir and said contained ink reservoir,

manually operable injection means for transferring ink from said free ink reservoir to said contained ink reservoir along said channel, and

a venting system provided with venting passage means comprising a plurality of capillary ink buffer channels and a main venting channel of less capillarity than said ink buffer channels and in communication with a portion of said ink buffer channels, an opening within the wall of said contained ink reservoir and exposed to the atmosphere, and a cross venting channel connecting said opening to said venting passage means at a position intermediate the ends thereof such that a portion of said venting passage means extends upwardly beyond said cross venting channel.

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2. A pen as in claim 1, wherein said ink injection channel extends downwardly from the lower end of said free ink reservoir to a position near the bottom of said contained ink reservoir, and wherein said pen tip is provided with a capillary ink feed in communication with said capillary ink buffer channels.

3. A pen as in claim 1, wherein said ink buffer channels extend upwardly from the lower end of said contained ink reservoir beyond said opening of said cross venting channel into said main venting channel.

4. A pen as in claim 3, wherein said ink buffer channels and said venting channel and said opening are located in different portions of said contained ink reservoir.

5. A pen as in claim 4, wherein a plurality of ink buffer channels are positioned in the side wall of said main venting channel and whereby said cross venting channel opens into that part of said side wall of said venting channel that is not occupied by said ink buffer channels.

6. A pen as in claim 5, whereby part of said ink buffer means is more capillary than the remainder thereof.

7. a pen as in claim 5, including a tampon structure,

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said buffer channels forming a part of said tampon structure, said capillary ink feed of said pen tip extending upwardly into said tampon structure, and wherein said ink injection channel is separated therefrom so as to introduce ink to said buffer channels at the lowermost portion of said contained ink reservoir.

8. A pen as in claim 7, wherein said upper ink feed extension is enclosed with an inlet opening in its top in capillary connection with said tampon buffer channels.

9. A pen as in claim 1, whereby said contained ink reservoir is part of a holder, and wherein an ink injection block is positioned in the upper compartment of said holder and by means of separation wall means is divided from said contained ink reservoir, said separation wall means urging against the inner side wall of said compartment, the upper end of said injection block connected with said free ink reservoir, the lower end of said injection block connected with the lower end of said contained ink reservoir, and wherein said free ink reservoir comprises a disposable ink cartridge secured to said holder.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,905,709 Dated September 16, 1975

Inventor(s) Edward Bok

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the Title Page, the following should be added:

-- [30] Foreign Application Priority Data

Feb. 19, 1973	Holland	-----7302248
June 25, 1973	Holland	-----7308787
Sept. 24, 1970	Holland	-----7311065

Signed and Sealed this

tenth Day of February 1976

[SEAL]

Attest:

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