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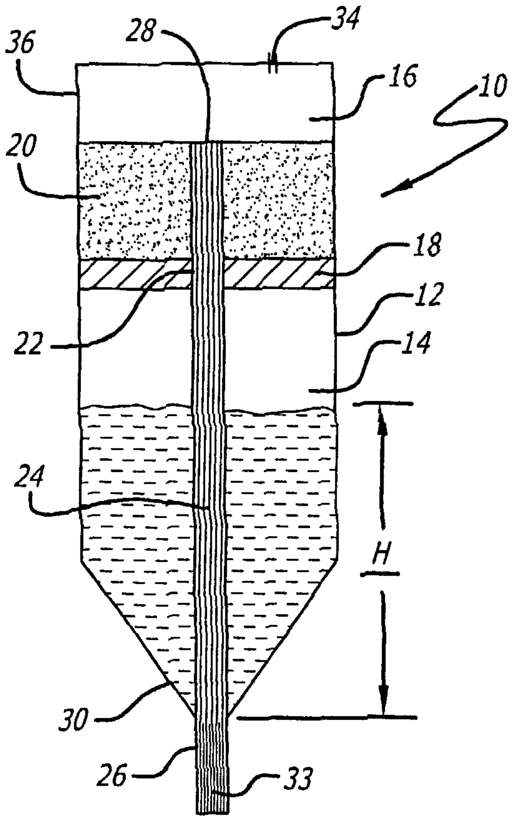
(54) Title: WRITING INSTRUMENT HAVING A RESERVOIR BETWEEN A TIP AND A CAPILLARY STORAGE



(57) Abstract: The present invention provides a capillary wick (24) running through the reservoir so that at least a portion of the capillary wick (24) along the longitudinal axis is in direct contact with the liquid within the reservoir. This allows liquid in the reservoir to convey to a tip (33) with minimal flow resistance. As such, a sufficient amount of liquid is provided to the tip (33), even when the writing instrument is used in quick strokes or for a long duration of time. In a writing position, a capillary storage (20) is above the reservoir so that the capillary storage (20) remains substantially dry without the head pressure affecting the capillary storage (20). The present invention is also directed to providing a porous divider wall (18) between a reservoir that is below the storage, but without a capillary wick. Here, the porous divider wall (18) is used to regulate air flow into the reservoir. Without the capillary wick, the unit costs and the manufacturing costs are substantially reduced.

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WRITING INSTRUMENT HAVING A RESERVOIR BETWEEN A TIP AND A CAPILLARY STORAGE

BACKGROUND OF THE INVENTION

[0001] 1. **Field of the Invention:**

[0002] The present invention relates generally to a fluid dispensing utensil and, more particularly, to a writing instrument having a reservoir between a tip and a capillary storage.

[0003] 2. **General Background and State of the Art:**

[0004] Writing instruments are commonly used for dispensing liquids such as ink, paint, adhesive, shoe polish, lotion, medicine, perfume, makeup, Whiteout®, and food to a surface. One type of liquid dispensing utensil stores relatively a large volume of liquid in a reservoir (or container) where the liquid is allowed to move freely. Pens incorporating such a reservoir may be referred to as "free ink" pens or markers. U.S. Patent No. 6,095,707 issued to Kaufmann discloses such a pen where the ink in the reservoir is usually in a liquid state and is free to move about as the pen is moved. One of the nice features of free ink markers is that they may be visually appealing to users as the liquid moves around within the reservoir. Moreover, free ink markers tend to last longer than other markers.

[0005] Liquid in these writing instruments is transferred from the reservoir to the delivery end (often referred to as a tip or a nib) through a capillary wick that is in contact with the liquid so that capillary action of wick draws the liquid from the reservoir to the tip. A slight vacuum (underpressure) relative to the atmosphere is maintained within the reservoir to prevent the liquid in the wick from escaping from the writing instrument until the tip is brought into contact with the surface onto which the liquid is to be dispensed. The liquid dispenses when the attraction force from the surface draws the liquid to flow from the tip to the surface. As the liquid dispenses, air enters the reservoir in a controlled manner through an air inlet formed to the reservoir. Replacing the liquid with air allows the slight vacuum to be maintained in the reservoir at a relatively constant level.

[0006] As surrounding air around the pen rises or when the pen is used in a higher elevation, the air in the reservoir may expand such that the pressure within the reservoir may rise. Rising pressure in the reservoir may forces excess liquid to flow through the wick and leak through the tip. To handle the excess liquid, some ink pens or markers include an overflow chamber having a capillary storage that will absorb the excess ink.

[0007] The capillary storage is located in the front section of the writing instrument next to the tip or below the reservoir when the writing instrument is held in a writing position. With the reservoir above the capillary storage, the head pressure from the liquid in the reservoir may keep at least a portion of the capillaries in the capillary storage wet. This means that when there is a rise in temperature or pressure within the reservoir, only the unwetted or dry capillaries in the capillary storage can absorb the excess liquid from the reservoir. As such, the capillary storage may need to be oversized to account for the fact that at least some portion of the capillaries will not be able to absorb the excess liquid because they are already wet. However, a larger capillary storage means that the circumference of the writing instrument, which is housing the capillary storage, needs to be bigger as well. This is one of the reasons why a free ink writing instrument is generally thicker than a ballpoint pen, for example, and therefore may not be as comfortable for the user to use.

[0008] Still further, with the capillary storage between the tip and the reservoir, it means that the capillary wick needs to extend between the reservoir and the tip. With longer capillary wick, however, there is greater resistance to flow liquid through the wick. This means that if a user writes quickly or for a long period of time, liquid from the reservoir may not flow through the capillary wick fast enough so that the tip may dry out and therefore not write properly.

[0009] With regard to manufacturing, most free ink writing instruments are assembled from several pieces including a capillary wick, capillary storage, a divider separating the reservoir and a storage area, all enclosed in a reservoir. All of the above pieces add cost and manufacturing time to producing a writing instrument. To minimize the cost of the writing instrument, there is a need to manufacture a writing instrument with fewer pieces. Moreover, there is a need to keep most if not all of the capillaries in a capillary storage dry so that most, if not all, of the capillaries in a capillary storage may absorb excess ink from the reservoir. Even further, there is a need to minimize the flow resistance in the conveying line so that a sufficient amount of ink is delivered to the tip of the writing instrument under most, if not all, writing conditions.

BRIEF SUMMARY OF THE INVENTION

[00010] One of the features of the present invention is to provide a writing instrument having a relatively small circumference so that it may be comfortably held in a user's hand for writing. Another feature of the present invention is to minimize the flow resistance in a

conveying line so that a sufficient amount of ink or liquid may be delivered to a tip of the writing instrument. Still another feature is to provide a writing instrument that is easier to manufacture at a lower cost.

[00011] The present invention accomplishes the above features by providing a reservoir for holding liquid or ink between a capillary storage and a tip. When the writing instrument is in a writing position, the capillary storage is located above the reservoir so that head pressure in the reservoir due to the column of liquid does not force liquid into the capillary storage. This means that the capillary storage may remain substantially dry so that most, if not all, of the capillaries in the capillary storage may absorb the excess ink in the reservoir due to a rise in temperature or pressure within the reservoir.

[00012] Still another feature of the present invention is to have a capillary wick (or conveying line) running through the reservoir so that at least a portion of the capillary wick along its longitudinal access is in direct contact with the liquid within the reservoir. This allows the liquid in the reservoir to convey through the side of the wick and then to the tip with minimal flow resistance. As such, a sufficient amount of liquid may be provided to the tip, even when the writing instrument is used in quick strokes or for a long duration of time.

[00013] Yet another embodiment of the present invention is to provide a reservoir between the storage and the tip, but without a conveying line. Without the conveying line, the unit costs and the manufacturing costs may be substantially reduced. In this embodiment, the reservoir may be below the capillary storage that are divided by a porous or a capillary divider wall. Here, the porous divider wall may be used to regulate air flow into the reservoir. As the temperature or pressure in the reservoir rises, air may displace the liquid in the largest pore in the porous divider wall to equalize the pressure in the reservoir. The displaced liquid from the divider wall may be temporarily stored in the capillary storage that is in direct contact with the porous divider wall. On the other hand, as the temperature or pressure within the reservoir drops, air may flow back into the reservoir through the largest pore size in the porous divider wall.

[00014] In situations where the tip is facing upward or in an inverted position, the porous divider wall may be fully saturated and, if there is a rise in temperature or pressure within the reservoir, the excess liquid from the reservoir may be temporarily stored in the capillary storage. With the capillary storage above the reservoir in a normal writing position, a smaller

capillary storage may be used because under normal conditions, most if not all the capillaries in the capillary storage will be empty of liquid.

[00015] The above described and many other features and attendant advantages of the present invention will become apparent from a consideration of the following detailed description when considered in conjunction with the accompanying drawings.

Brief Description of the Drawings

[00016] FIG. 1 is an exemplary cross-sectional view of a writing instrument showing a reservoir between a capillary storage and a tip;

[00017] FIG. 2 is an exemplary distribution of pore sizes or capillarity between a capillary wick, a capillary storage, and a tip;

[00018] FIG. 3 is an exemplary cross-sectional view of a writing instrument in accordance with another embodiment showing a capillary conveying line partially through a capillary storage;

[00019] FIG. 4 is an exemplary cross-sectional view of yet another embodiment of the present invention showing a capillary conveying line adjacent a capillary storage;

[00020] FIG. 5 is an exemplary cross-sectional view of still another embodiment of the present invention showing a tube partially sealing a capillary conveying line within a reservoir;

[00021] FIG. 6 is an exemplary cross-sectional view of another embodiment of the present invention showing a reservoir between a capillary storage and a nib, but without a capillary conveying line;

[00022] FIG. 7 is an exemplary distribution of pore sizes or capillarity between a capillary storage, a porous divider wall, and a tip; and

[00023] FIG. 8 is an exemplary cross-sectional view of yet another embodiment of the present invention showing a capillary storage being adjacent a hole.

Detailed Description of the Preferred Embodiments

[00024] This description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention. The section titles and overall organization of the present detailed description are for the purpose of convenience only and are not intended to limit the present invention

[00025] By way of background, it should be noted that the descriptive term "capillarity" has been used herein to indicate the height up to which a liquid ascends within a pore of a given diameter. The greater the height, the greater the capillarity. In general, small size pores have greater capillarity than the larger size pores. In other words, the term "capillarity" is indicative of the attractive force between a liquid and a pore.

[00026] FIG. 1 illustrates by example a writing instrument 10 comprising a container 12 having a divider wall 18 defining a first storage area 14 (reservoir) and a second storage area 16. The first storage area 14 is used to store liquid, and within the second storage area is a capillary storage 20. The divider wall 18 also has an opening 22 that allows a capillary wick 24 having a proximal portion 26 and a distal portion 28 to extend through the second storage area 16 and the first storage area 14. That is, the distal portion 28 penetrates through the opening 22 and into the capillary storage 20. Note that at least a portion, if not all, of the distal portion 28 of the capillary wick 24 is in direct contact with the capillary storage 20. Also, the proximal portion 26 protrudes through the writing side 30 of a container 12 and may be aligned to be in direct contact with a tip 33.

[00027] As further illustrated in FIG. 1, the distal portion 28 of the capillary wick 24 substantially fills the opening 22 in the divider wall 18. This way, the capillary storage 20 may only comes into contact with the liquid in the first storage area 14 via the capillary wick 24. Moreover, a proximal portion 26 protrudes from the writing side 30 such that it is completely sealed between the capillary wick 24 and the writing side 30. A seam may be provided, for example, by crimping the capillary wick 24 and the contact area between the capillary wick and the writing side 30. Alternatively, any other methods known to one skilled in the art may be used to seal the capillary wick 24 from the writing side 30.

[00028] FIG. 2 illustrates by way of example a general distribution of pore sizes between the capillary wick 24 and the capillary storage 20. With regard to the graph in FIG. 2, axis "X" represents a capillarity potential of pores or smaller pore sizes from left to right, and axis "Y" generally represents percentage pores. Moreover, graphs 24 and 20 illustrate exemplary measurable distribution of pore sizes in the capillary storage and capillary wick, respectively. Reference points "SL" refer to a measurable largest pore size in the capillary storage, "SM" refers to a measurable mean flow pore in the capillary storage, and "SS" refers to a measurable smallest pore size in the capillary storage; "CL" refers to a measurable largest pore size in the capillary wick, "CM" refers to a measurable mean flow pore in the capillary

wick, and "CS" refers to a measurable smallest pore size in the capillary wick. Note that with the above distribution of pore sizes, there may be an overlap 32 between the smallest pore size in the capillary storage SS and the largest pore size in the capillary wick CL. With the liquid 30 in direct contact with the capillary wick 24, and with the capillarity force in the capillary wick 24 being greater than the capillary storage 20, the capillary wick 24 may remain wetted. For example, the pore sizes in the capillary wick and capillary storage may be measured by Porous Materials, Inc., located at 83 Brown Road, Ithaca, New York 24850.

[00029] Moreover, if there is an overlap region 32 between the capillary wick 24 and the capillary storage 20, some portion of the capillary storage 20 may be wetted depending on the orientation of the writing instrument 10. For instance, if the writing instrument is in an inverted position, i.e., the tip 33 is facing up, then liquid in the first storage area 14 is held in place by an "underpressure" (slight vacuum) of the air above the ink, which counteracts the force of gravity or weight of the column of liquid in the first storage area, i.e., the head pressure. With the head pressure above the capillary storage 20 in an inverted position, some portion of the capillary storage 20 may be wet.

[00030] If the writing instrument 10 is in a writing position, i.e., the tip is facing down, so that the capillary storage 20 is above the first storage area 14, then the capillary storage 20 may not be affected by the head pressure. Accordingly, most if not all of the capillaries in the capillary storage 20 may be substantially empty, i.e., dry. This improves the performance of the capillary storage because most if not all of the capillaries in the capillary storage 20 may absorb the excess liquid from the first storage area 14. This means that with the present invention, a smaller size capillary storage may be used so that a container having a smaller circumference may be used as well. Therefore, with the present invention, a free ink writing instrument may be as small as a ballpoint pen to write more comfortably.

[00031] Moreover, with the above distribution of pore sizes between the capillary wick 24 and the capillary storage 20, as the underpressure within the first storage area subsides, i.e., increase in absolute pressure in the first storage area 14, some liquid within the first storage area may convey through the capillary wick 24 and be absorbed by the capillary storage 16, until the underpressure in the first storage balances out. That is, at least some of the excess liquid may convey through the capillary storage 20 and store temporarily in the capillary storage 20. On the other hand, once the underpressure within the first storage area rises, i.e., a decrease in absolute pressure within the first storage area, liquid in the capillary wick is drawn back into the first storage area 14. Note that the underpressure in the first storage area 14 may change for many reasons such as a change in the temperature or elevation at which the writing instrument is used.

[00032] With regard to head pressure or column pressure in the first storage container, as the capillary pore sizes get smaller, there may be greater resistance it has to the head pressure. Conversely, larger capillary pore size may have less resistance to the head pressure. That is, if the largest pore size in the tip 33 is too big, then there is a possibility that the liquid in the first storage 14 may leak through that largest pore size. As such, the largest pore size needs to be properly sized or controlled.

[00033] In general, the head pressure within the first storage 14 may be derived by knowing the height "H" of the liquid above the proximal portion 26, and also based on the density of the liquid. Based on head pressure, the capillary resistance to pressure, in other words, the resistance in the largest pore size in the tip may be calculated. Capillary resistance to pressure, commonly referred to as "bubble point," is the pressure required to displace liquid with air in the largest pore, which may be derived from the following equation:

$P = 4 * \gamma * \cos\theta$	where: p is capillary pressure γ is the surface tension of the liquid; and θ is the contact angle of the liquid and solid, that is when the liquid completely wets the solid, $\cos\theta$ goes to 1.

[00034] Moreover, other methods known to one skilled in the art may be used to size the pore sizes in the tip. For example, a variety of tips having different pore sizes may be experimented with until a tip sufficiently restricts the head pressure. Referring back to FIG. 2, graph 33 illustrates the exemplary measurable distribution of pore sizes in tip 33. Reference point "TL" refers to a measurable largest pore size in the tip, and "TM" refers to a measurable mean flow pore in the tip. Accordingly, TM is smaller than CM, and TL is smaller than CL. That is, the pore sizes in the tip 33 are sized to provide sufficient resistance

to head pressure in the first storage area 14 to restrict liquid from leaking through the tip. And, because TL is smaller than CL, air will enter through the distal portion of the capillary wick 28 to relieve the rise in underpressure in the first storage area rather than through the proximal portion 26 due to smaller capillaries blocking passage of air through the tip. As such, to provide air passage, a hole 34 may be provided in the rear side 36 of the container 12 to allow outside air to enter through the hole 34 and then through the largest pore size in the distal portion 28 of the capillary wick 24.

[00035] FIG. 3 illustrates by way of example an alternative embodiment to the present invention having a distal portion 28' of a capillary wick 24' running partially through a capillary storage 20', unlike the embodiment illustrated in FIG. 1. Still further, FIG. 4 illustrates by way of example a distal portion 28'' of a capillary wick 24'' that runs through the opening 22 and is in direct contact with a capillary storage 20'' without penetrating it. In other words, air enters through the capillary storages 20' and 20'' and then to the distal portions 28' and 28'', respectively, to relieve the rise in underpressure.

[00036] FIG. 5 illustrates by way of example yet another embodiment of the present invention to minimize the head pressure due to the column of liquid in the first storage area 14. To do so, a sleeve 50 is provided from the writing side 30 to form a lip 52 in the first storage area 14 around the capillary wick 24. The sleeve 50 seals at least a portion of the capillary wick 24 from the liquid in the first storage area 14. As such, the head pressure "H" within the first storage area 14 is reduced because the column of liquid now applied to the capillary wick 24 is from the lip 52 rather than from the writing side 30. With reduced head pressure, smaller capillaries in the tip may not be needed to resist the head pressure like the embodiment discussed above in FIG. 1. In other words, in this embodiment, the head pressure may be adjusted based on the length of the sleeve 50 so that the largest pore size in the capillary wick can resist the head pressure, yet allow air to enter through the largest pore size to compensate for a rise in underpressure in the first storage area 14.

[00037] Accordingly, with the embodiment illustrated in FIG. 5, a tip may not be needed to resist the head pressure and air may pass through the proximal portion 26 of the capillary wick 24. Still further, a porous divider wall 18' may be provided with the hole 34 on the rear side 36 to allow air to pass through the porous divider wall 18' to compensate for the changes in underpressure within the first storage area, rather than through the largest pore size in the capillary wick 24. FIG. 6 illustrates by way of example still another embodiment of the

present invention having a tip 33' (or sometimes referred to as a nib) within a sleeve 50' extending partially into the first storage area 14 without touching the porous divider wall 18''. Moreover, the porous divider wall 18'' does not have an opening between the first and second storage areas 14, 16 so that liquid or air in the first storage area 14 goes through the pores or the capillaries in the divider wall 18''. In the second storage area 16, the capillary storage 20'' is in direct contact with the divider wall 18''.

[00038] FIG. 7, generally illustrates the distribution of pore sizes among the tip 33', porous divider wall 18'', and capillary storage 20''. As in FIG. 2, axis "X" represents a capillarity potential of pores or smaller pore sizes from left to right, and axis "Y" generally represents percentage pores. Accordingly, the measurable largest pore size in the porous divider wall "DL" is greater than the measurable largest pore size in the tip "TL" so that air will pass through the porous divider wall 18'' rather than through the tip 33' to compensate for the changes in the underpressure within the first storage area 14. Moreover, DL is generally smaller than the measurable mean flow pore of the capillary storage "SM" so that the capillary storage 20'' substantially remains dry relative to the porous divider wall 18''. With regard to the tip 33', the sleeve 50' may be provided to minimize the head pressure within the first storage area 14, and TL is sized to sufficiently resist the head pressure to restrict the liquid from leaking through TL.

[00039] With the above embodiment and the distribution of pore sizes as illustrated in FIG. 7, as the underpressure in the first storage subsides, i.e., absolute pressure increases, air above the liquid in the first storage area will pass through the largest pore size in the porous divider wall DL and into the capillary storage 20'' and out of the hole 34. Conversely, as the underpressure rises in the first storage area 14, air will pass through DL and into the first storage area 14 to compensate for the rise in underpressure. For instance, as the writing instrument is used, liquid or ink will convey through the tip 33' and onto a writing surface, such as paper, causing underpressure to develop in the first storage area 14. To relieve the underpressure in the first storage 14, air will pass through DL and into the first storage area 14. In other words, the porous divider wall 18'' is used to regulate the air in and out of the first storage area 14.

[00040] When the writing instrument is in a horizontal or inverted position, the porous divider wall 18'' may be fully saturated or wet. And if the underpressure subsides in the first storage area, then the capillary storage 20'' which is in direct contact with the porous divider

wall 18'' will absorb the excess liquid from the first storage. Conversely, as the underpressure rises, liquid will convey back into the first storage area.

[00041] There are a number of advantages to the above embodiment. First, there is no need for a capillary wick, which saves cost. And, second, a smaller capillary storage may be used because the capillary storage remains substantially dry.

[00042] FIG. 8 illustrates by way of example yet another embodiment of the present invention where the capillary storage 20''' is adjacent hole 34 on the rear side 36. Such an arrangement prevents any liquid droplets that may be formed within the second storage area 16 from leaking out of the hole 34.

[00043] In closing, it is noted that specific illustrative embodiments of the invention have been disclosed hereinabove. However, it is to be understood that the invention is not limited to these specific embodiments. For instance, sleeve 50 may be molded within the first storage area along with the container 12. The porous divider wall may be a porous plastic to control the size of the pores. Moreover, the tip in FIG. 6 may extend from the writing side 30 without the sleeve within the first storage area. In such a case, the pore sizes in the tip may be smaller than a tip with a sleeve to restrict greater head pressure. With regard to FIGS. 2 and 7, the percentage of pores along the Y axis may vary among the capillary storages, capillary wick, tip, and the porous divider wall. For instance, the percentage of pores in the capillary storage may be less than the capillary pore or the porous divider wall. With regard to liquid, it may be a solvent-based ink or a water based ink or any other ink known to one skilled in the art. With regard to the nib 18', it may be manufactured by Teibow Hanbai Co. Ltd., located at 10-15 Higashi Nihonbashi 3 chome, Chou-Ku, Tokyo 103, Japan. Moreover, the pore sizes in the capillary storage, capillary wick, tip, and porous divider wall may be measured by Porous Material, Inc., 83 Brown Road, Ithaca, New York 14850.

WHAT IS CLAIMED IS:

1. A writing instrument, comprising:

a container (12) having a writing side (30) and a rear side (36);

a divider wall (18) between the writing side (30) and the rear side (36) defining a first storage area (14) for storing liquid between the writing side (30) and the divider wall (18), and defining a second storage area (16) between the rear side (36) and the divider wall (18);

a capillary storage (20) within the second storage area (16), the capillary storage (20) having an measurable mean flow storage pore size; and

a capillary wick (24) having a proximal portion (26) and a distal portion (28), the proximal portion (26) protruding from the writing side (30) of the container (12) and the distal portion (28) extending at least partially into the first storage area (14), the capillary wick (24) having an measurable mean wick flow pore size that is smaller than the measurable mean flow storage pore size.

2. A writing instrument according to claim 1, where the divider wall (18) has an opening (22), the distal portion (28) of the capillary wick (24) substantially filling the opening (22) and in contact with the capillary storage (20) in the second storage area (16), where the capillary wick (24) has a measurable largest wick pore size adapted to transport air to the first storage area (14) to compensate for rise in underpressure in the first storage area (14).

3. A writing instrument according to claim 1, where the divider wall (18) is made of porous material having a distribution of pore sizes including a measurable largest divider pore size that is larger than a measurable largest wick pore size for the capillary wick (24), where the measurable largest divider pore size is adapted to transport air to the first storage area (14) to compensate for rise in underpressure in the first storage area (14).

4. A writing instrument according to claim 1, where the divider wall (18) is made of porous material having a measurable largest divider pore size and a measurable mean flow divider pore size, where the distal end (28) of the capillary wick is within the first storage (14)

and the capillary wick (24) has a measurable largest wick pore size that is smaller than the measurable largest divider pore size adapted to transport air to the first storage area (14) to compensate for rise in underpressure in the first storage area (14), and the measurable mean flow divider pore size is smaller than the measurable mean flow storage pore size to keep the capillary storage (20) substantially dry.

5. A writing instrument according to any one of claims 2 and 3, where the distal end (28) of the capillary wick at least partially penetrates through the capillary storage (20) in the second storage area.

6. A writing instrument according to any one of claims 1- 5, where the second storage (16) has a hole (34) and the capillary storage (20) is adjacent to the hole (34).

7. A writing instrument according to any of claims 1-6, where the capillary storage (20) has an measurable smallest storage pore size, and the capillary wick (24) has an measurable largest wick pore size, where the measurable smallest storage pore size is at least as small as the measurable largest wick pore size.

8. A writing instrument according to claim 7, where the smallest storage pore size is greater than the measurable mean wick flow pore size of the capillary wick.

9. A writing instrument according to any one of claims 1-8, where the second storage (16) of the container has a hole (34).

10. A writing instrument according to any one of claims 1, 2, and 7-9, where the measurable largest wick pore size in the capillary wick (24) in the distal portion (28) of the capillary wick (24) allows air to enter the first storage area (14) to compensate for the liquid taken from the first storage area (14) of the container through the capillary wick (24)

11. A writing instrument according to any one of claims 1, 2, and 7-9, where the measurable largest wick pore size in both the proximal (26) and distal (28) portions of the capillary wick (24) allow air to enter the first storage area (14) to compensate for the liquid

taken from the first storage area of the container through the capillary wick (24).

12. A writing instrument according to any one of claims 1-11, further including a sleeve (50) having a predetermined length extending into the first storage area (14) from the writing side (30) of the container (12), the sleeve (50) sealing the capillary wick (24) along the predetermined length of the sleeve.

13. A writing instrument according to claim 12, where the predetermined length of the sleeve extending into the first storage area (14) from the writing side (30) of the container (12) determines a head pressure within the first storage area (14).

14. A writing instrument according to any one of claims 12 and 13, where the sleeve (50) is a film wrapped around the capillary wick (24).

15. A writing instrument according to any one of claims 12, 13 and 14, where the sleeve (50) extends outwardly from the writing side (30) of the container (12), and the proximal portion (26) protrudes from the sleeve (50).

16. A writing instrument according to claim 1, further including a tip (33) coupled to the proximal portion (26) of the capillary wick (24).

17. A writing instrument according to any one of claims 1-16, where the liquid is a water base ink, and the measurable largest wick pore size has a diameter of about 50 microns to about 30 microns.

18. A writing instrument according to any one of claims 1-17, where the measurable largest wick pore size has a predetermined diameter so that a predetermined underpressure within the first storage area is substantially maintained as the liquid within the first storage area (14) is transferred out of the first storage area (14) through capillarity action of the capillary wick (24).

19. A method for conveying fluid to a wick, comprising:

dividing a container (12) into a first storage area (14) and a second storage area (16), where the first storage (14) is adjacent to a writing side (30) of the container (12) and the second storage area (16) is adapted to hold a capillary storage adjacent to a rear side (36) of the container (12);

protruding a proximal portion (26) of a capillary wick (24) from the writing side (30) of the container (12);

extending a distal portion of the capillary wick (24) into at least the first storage area (14) of the container (12);

underpressuring the first storage area (14) to prevent liquid in the first storage area (14) from leaking through the capillary wick (24); and

maintaining the underpressuring in the first storage area (14) as the liquid in the first storage area (14) convey through the capillary wick (24).

20. A method according to claim 19, further including:

separating the capillary storage from the first storage area so that the liquid from the first storage area only comes into contact with the liquid through the capillary wick.

21. A method according to claims 19 or 20, further including:

sealing between the proximal portion (26) of the capillary wick (24) and the first storage area (14) to prevent the liquid from leaking therethrough.

22. A method according to any one of claims 19-21, where the controlling flow of air into first storage area (14) is through an approximate largest wick pore size in the capillary wick (24).

23. A method according to claim 22, where the liquid is a solvent based ink, and the approximate largest wick pore size in the capillary wick is about 45 microns to about 20 microns.

24. A method according to claim 22, where the liquid is a water based ink, and the approximate largest wick pore size in the capillary wick is about 50 microns to about 30 microns.

25. A method according to any one of claims 19-24, where the capillary wick (24) has an approximate mean wick flow pore size, and the capillary storage (20) has an approximate mean storage pore size, where the approximate mean wick flow pore size of the capillary wick (24) is smaller than the approximate mean storage pore size of the capillary storage (20).

26. A method according to any one of claims 19-25, where the capillary storage (20) has an approximate smallest storage pore size, and the capillary wick (24) has an approximate largest wick pore size, where the approximate smallest storage pore size is at least as small as the approximate largest wick pore size.

27. A method according to claim any one of claims 19-26, where the extending of the distal portion (28) of the capillary wick (24) is partially through the capillary storage (20) in the second storage area (16).

28. A method according to any one of claims 19-27, where the second storage (16) has a hole (34) to allow air to travel through the approximate largest wick pore size in the capillary wick (24).

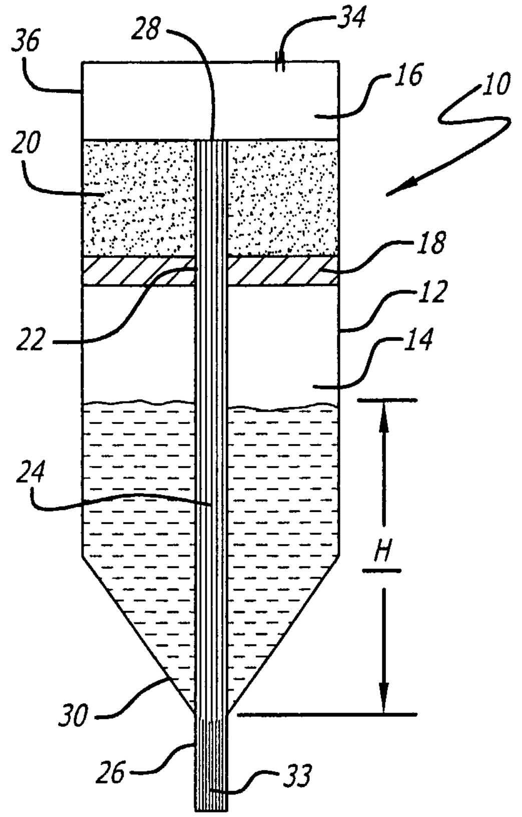


FIG. 1

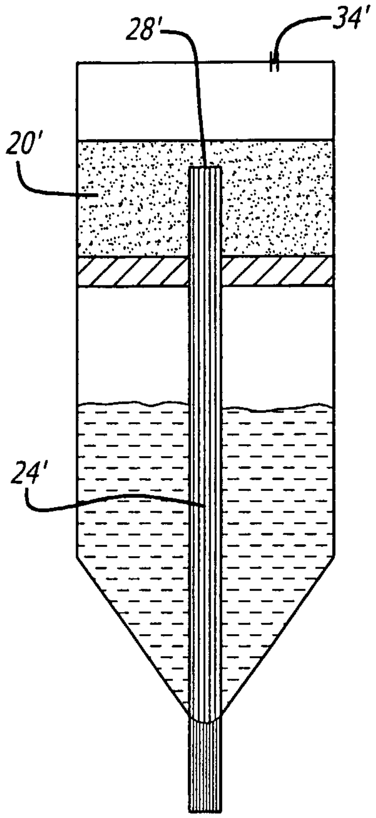


FIG. 3

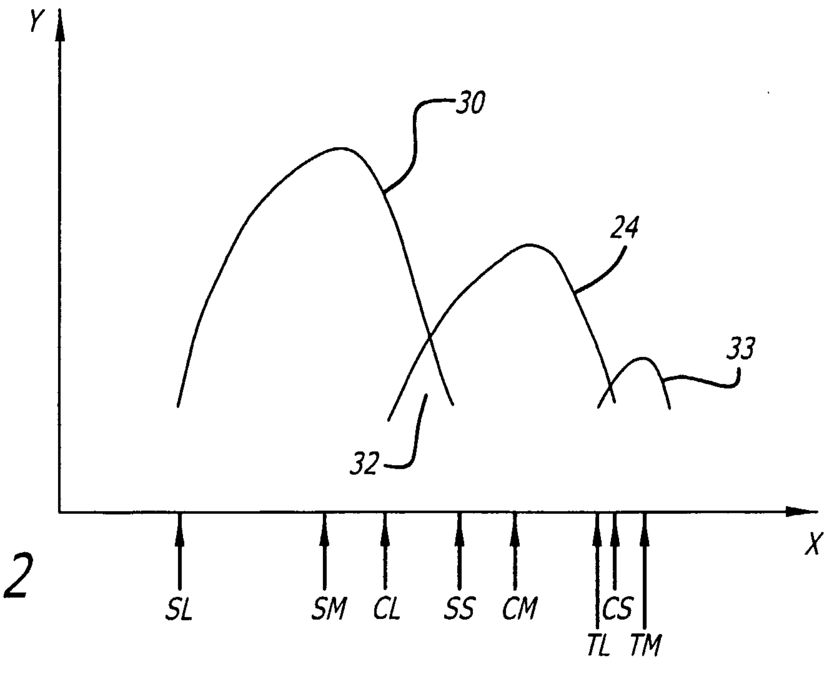


FIG. 2

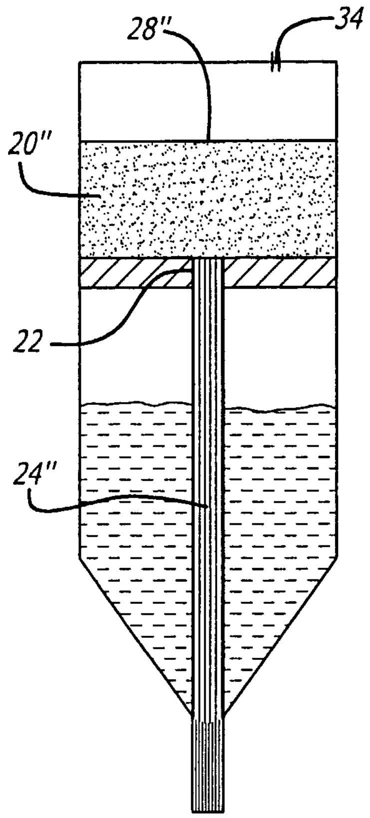


FIG. 4

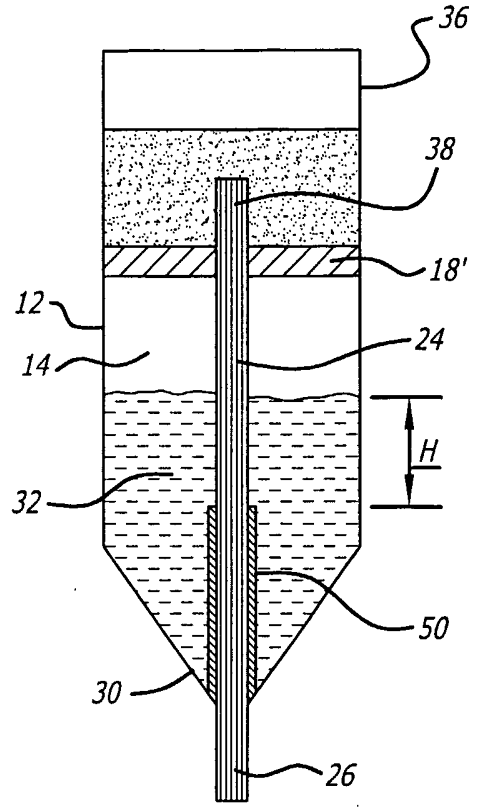


FIG. 5

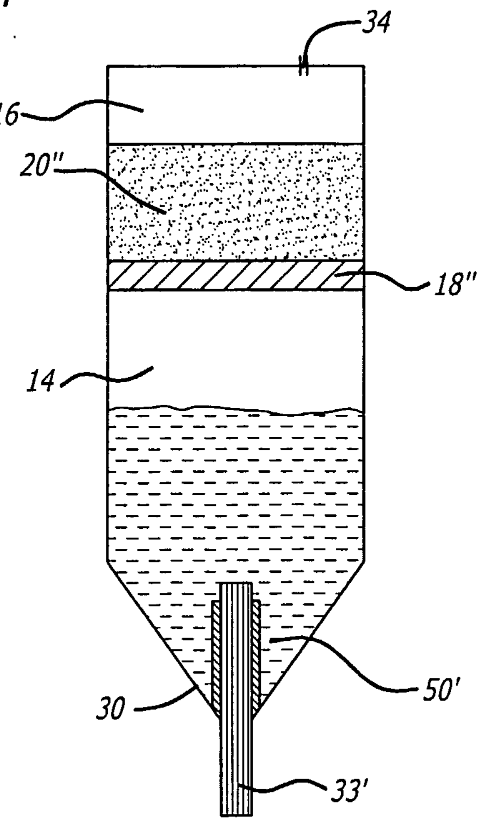
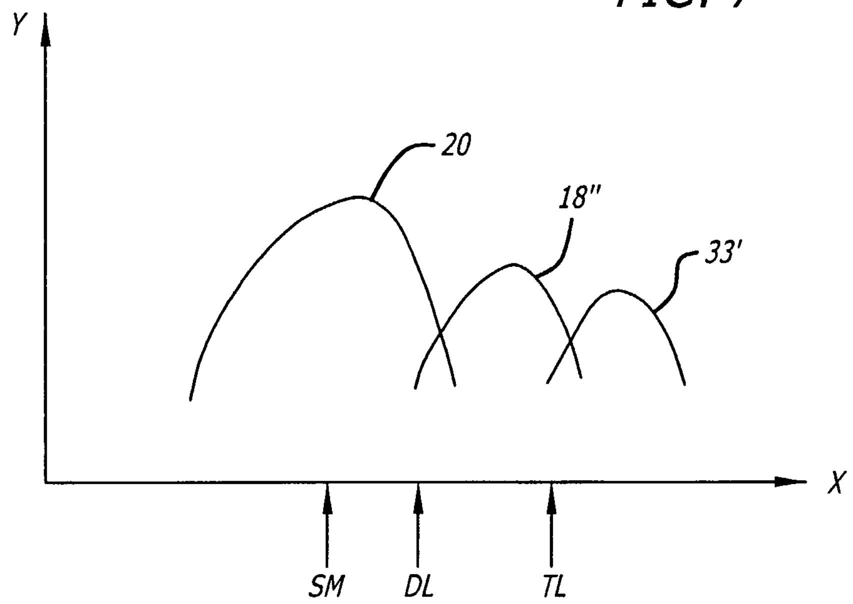


FIG. 6

FIG. 7



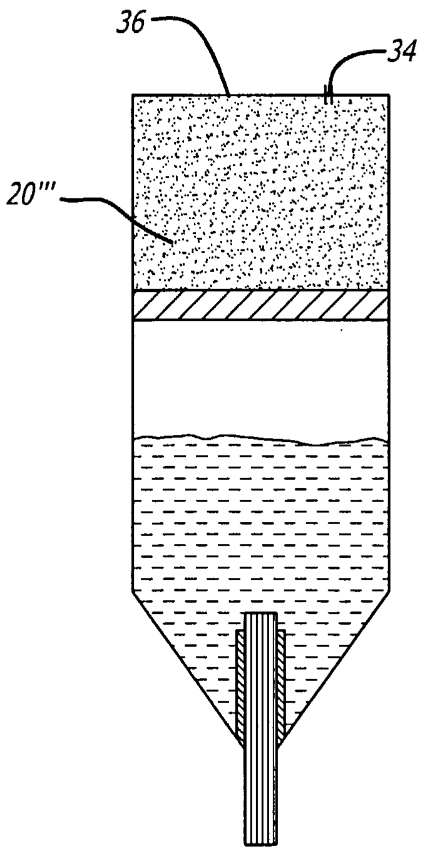


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/19638

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :B43K 5/00, 5/02; B05C 21/00
US CL : 401/199, 198, 196, 205, 223, 224
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)

U.S. : 401/199, 198, 196, 205, 223, 224

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,927,885 A (DUEZ et al.) 27 July 1999, see entire document.	
A	US 5,290,116 A (CHANG) 01 March 1994, see entire document.	

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 JULY 2002	05 SEP 2002

Name and mailing address of the ISA/US	Authorized officer
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