March 31, 1964 H. A. A. EXNER 3,126,874

FOUNTAIN PEN WITH A FLEXIBLE CAPILLARY MATERIAL IN INK CONTAINER

Filed May 1, 1962 3 Sheets-Sheet 1

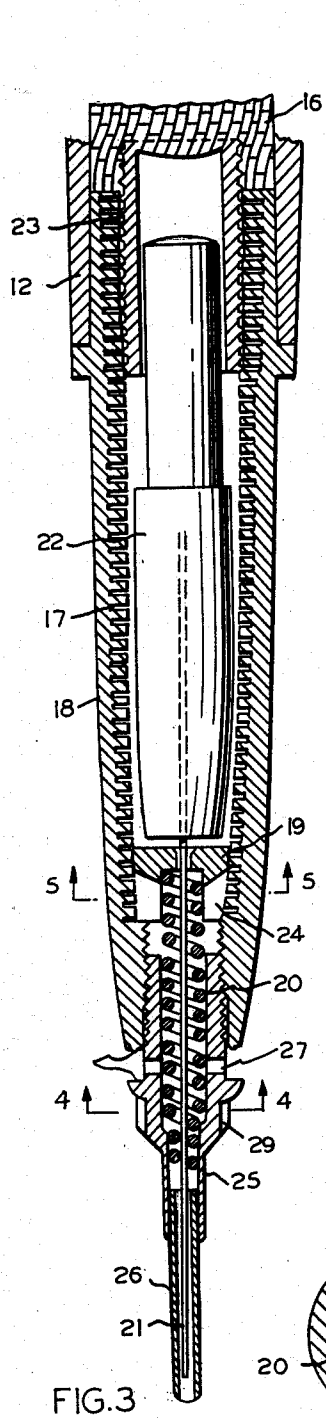


FIG.3

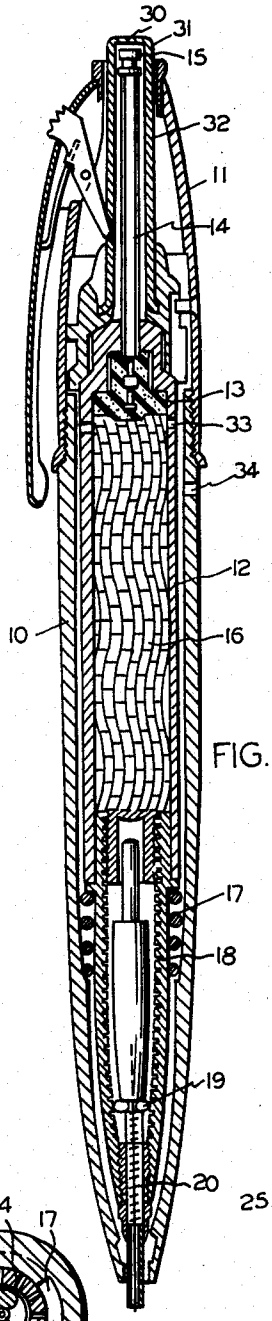


FIG.1

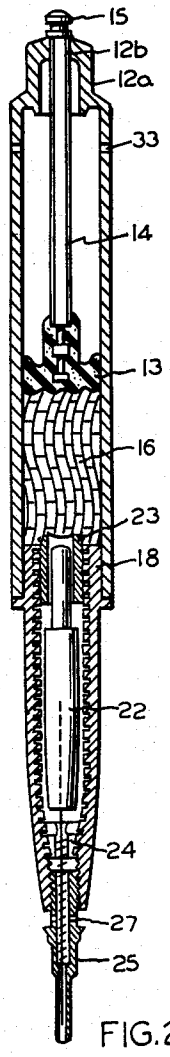


FIG.2

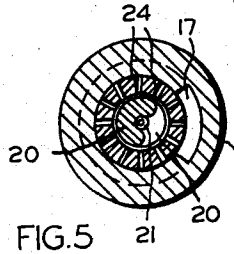


FIG.5

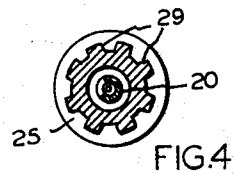


FIG.4

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FOUNTAIN PEN WITH A FLEXIBLE CAPILLARY MATERIAL IN INK CONTAINER

Filed May 1, 1962 3 Sheets-Sheet 2

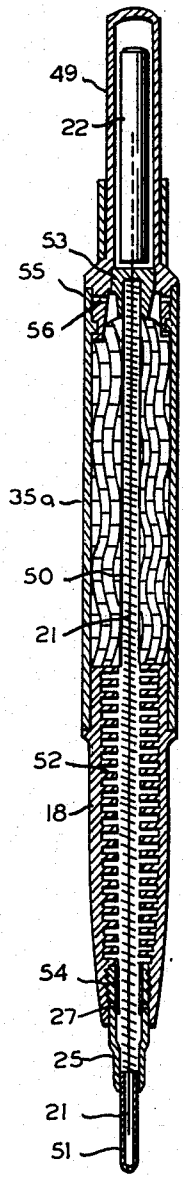


FIG.11

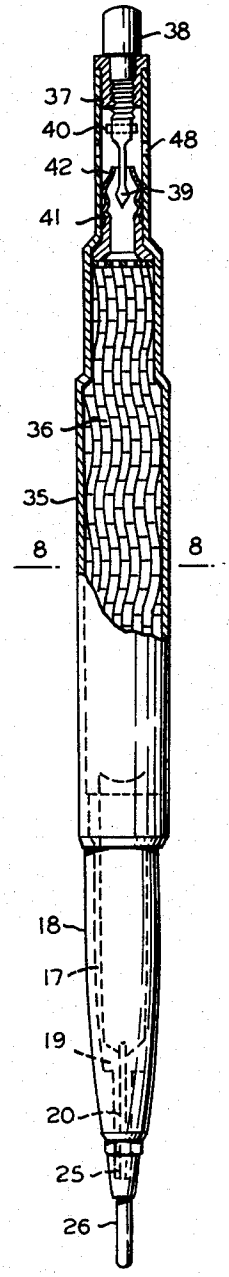


FIG.6

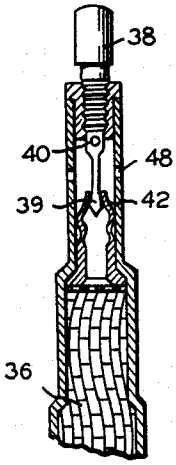


FIG.7

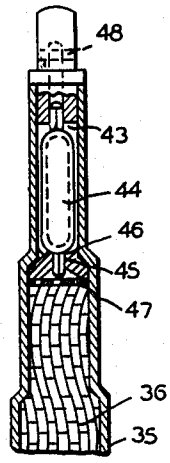


FIG.9

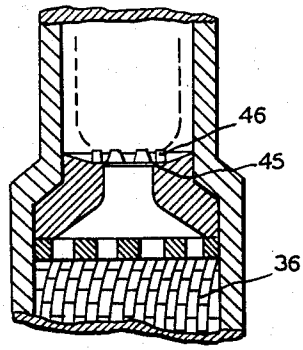


FIG.10

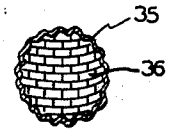


FIG.8

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FOUNTAIN PEN WITH A FLEXIBLE CAPILLARY MATERIAL IN INK CONTAINER

Filed May 1, 1962 3 Sheets-Sheet 3

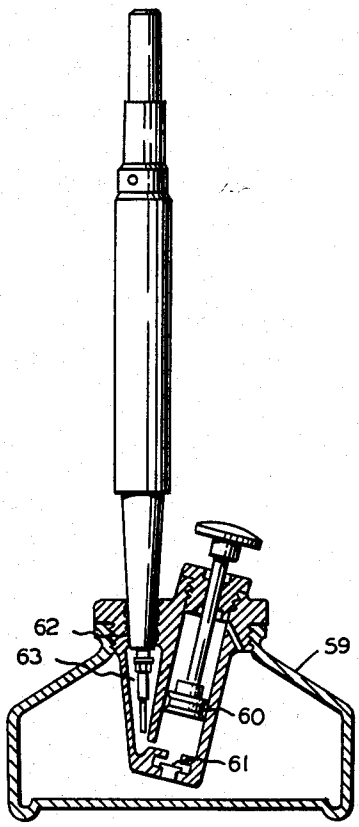


FIG.13

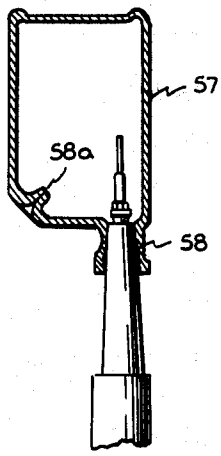


FIG.12

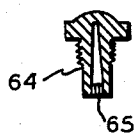


FIG.14

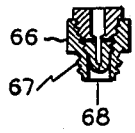


FIG.15

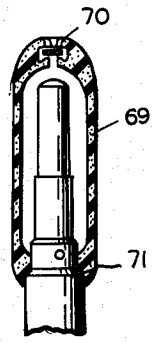


FIG.16

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3,126,874

FOUNTAIN PEN WITH A FLEXIBLE CAPILLARY MATERIAL IN INK CONTAINER

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Filed May 1, 1962, Ser. No. 191,488
Claims priority, application Germany June 30, 1961
12 Claims. (Cl. 120—44)

This invention refers to a fountain pen of the type provided with a piston for letting ink into same, and has as its primary object the elimination of existing unreliable compensator-chambers which are usually found in fountain pens and also to obviate the loss of ink caused by the varying of atmospheric and heat pressures.

To accomplish this objective, the inside of the ink container is furnshed with a flexible capillary ink absorbing material, for example, foam plastic with open cells which is attached at one end to the ink capillary channels and at the other end to the pump plunger of the ink filling mechanism. This attachment is made by soldering, welding, pasting or in any other way, such as by elastic force or by means of a pressure spring, so that when the pump plunger is forced against the ink capillary channels the flexible foam material is pressed together and the air or ink contained in same is forced out. In fountain pens of this type the air and ink are forced through closeable ink openings situated near the writing point and when pulling the pump plunger back, new ink is let into the flexible capillary material through the above-mentioned closable ink openings and the capillary channels. The pump plunger just before it reaches its backward position, leaves an opening free to compensate for the variation of the atmospheric and heat pressures, so that these variations of pressure cannot interfere with the flow of ink to the writing point. This latter condition is often the case with half filled fountain pens of normal make when changed from a cool position to a warm position, for example, caused by: placing them in the sun or other heat; where the compensator chambers are too small; and by the abnormal expansion of the air bubble in the closed ink container which causes the ink to flow out to the compensator chambers.

In fountain pens of the type described, in order to facilitate the opening or closing of the above mentioned closable ink openings, the base of the guide cylinder and also the base of the writing tube are provided with threads to make possible the screwing of the base of the writing tube into the guide cylinder. Also, there is provided on the base of the writing tube openings at the upper part thereof, i.e., the part that is screwed into the guide cylinder. Further, on the base of the writing tube there is provided a threaded or hexagonal head which fits in a keylock that is constructed in the push-button of the cap or cover so that when the writing mechanism is taken out of the pen body the said keylock in the push-button is placed on the threaded head of the writing tube base and used as a key to rotate the writing tube and facilitate an easy opening and closing of said ink openings.

In a second filling system, the ink container is made of flexible material and is also filled with flexible foam plastic or other ink absorbing capillary material, and by unscrewing the push-button which is provided with a depending conical extension, the same fits into an elastic or plastic tube in the upper neck of the ink container and serves the function of an efficient retention valve which in a normal way, that is to say, when the push-button is firmly screwed, is always open to ensure the variation of the atmospheric and heat pressures. By squeezing or pressing the flexible ink container together, the air in the same will be forced out through the just-described retention valve and by lessening the pressure on the ink container,

the writing ink will, in a manner similar to that previously described, enter the ink openings constructed in the base of the writing tube.

Another manner of preventing leakage of ink from the upper air vent when the ink container is filled with ink, is to provide in the neck of the ink container above a perforated disc and the flexible foam plastic material, a floating valve which also serves as a retention valve. Beneath the floating valve, there is located an elastic counter-pressure ring provided with a plurality of upwardly extending projections to ensure the passage of air for variations of the atmospheric and heat pressures. The perforated disc which is located above the flexible capillary material in the ink container prevents said material from interfering with the retention valve.

In fountain pens provided with breather openings in the upper part of the ink container, but constructed with a rigid ink container and with rigid or flexible capillary material, and constructed without aspiration means and retention valves and with or without the closeable ink openings in the writing tube base, the means for letting ink into the ink container can be obtained by pressure, which is produced by a flexible inkwell or an inkwell provided with pumping means. In such cases, the inkwell is furnished with suitable seating means into which the lower part of the writing tube or the guide cylinder is firmly placed. Also, the means for letting ink into the ink container may take the form of an instrument or a cap for an ordinary inkwell, furnished with a retention valve, which can be applied to the breather openings at the top of the ink container, which sucks the air out of same.

An example of the construction of the invention is shown in the drawing, which is as follows:

FIGURE 1 is a longitudinal view of a fountain pen with retractable writing tubes, and with the pump plunger in its backward position, and therefore the flexible capillary foam material in the ink container fully expanded leaving the opening free for the variations of the atmospheric and heat pressures, and with the writing mechanism in its writing position.

FIGURE 2 is a longitudinal view of the writing mechanism with the pump plunger in its forward position and therefore with the capillary foam material pressed fully together and with the ink openings in open position, i.e., with the writing tube base unscrewed sufficiently to leave the ink openings free.

FIGURE 3 is a longitudinal enlarged view of the lower portion of the instrument shown in FIGURE 2 with the writing tube base unscrewed and the ink openings open. Also shown is the capillary ink flow above the ink capillary guides to the flexible capillary material of the ink container.

FIGURE 4 is a sectional view taken on line 4—4 of FIGURE 3 of the said hexagonal head on the writing tube base.

FIGURE 5 is a sectional view taken on line 5—5 of FIGURE 3, of the said capillary ink trunk supply showing the radial capillary channels.

FIGURE 6 shows the writing mechanism with a flexible ink container filled with flexible capillary material and with the conical retention valve constructed in the neck of the ink container in a normal way to ensure the variation of the atmospheric and heat pressures, i.e., open state, and the ink flow channels to the writing tube.

FIGURE 7 shows the same writing mechanism as FIGURE 6, with the push-button and its cone unscrewed from the stop bolt to function as a retention valve in ready position to let ink into the writing mechanism.

FIGURE 8 is a sectional view taken on line 8—8 of the flexible ink container shown in FIGURE 6 showing the undulating form and the even thickness of the walls of the flexible capillary material in same which prevents

the deterioration of same caused by lateral pulsation and resists longitudinal pressures.

FIGURE 9 is a longitudinal view of the upper part of a flexible ink container with a float valve serving as a retention valve and when in a normal position to ensure the variations of the atmospheric and heat pressures with the aid of the elastic counter-pressure ring which is placed underneath the seat of the retention valve.

FIG. 10 is an enlarged view of the counter-pressure ring shown in FIGURE 9.

FIGURE 11 is a longitudinal sectional view of the writing mechanism provided with a flexible ink container showing the counterweight in the hollow push-button and the prolongated ink needle passing through the entire writing mechanism.

FIGURE 12 shows a flexible inkwell with a conical seat and also shown with a sealing mouthpiece.

FIGURE 13 shows an inkwell with an ink pumping mechanism and a conical seat for the lower part of the guide cylinder.

FIGURE 14 shows a cap for the inkwells shown in FIGURES 12 and 13, provided with an internal bore forming a key whose shape corresponds to the shape of the writing tube base.

FIGURE 15 shows a cap for the inkwells shown in FIGURES 12–13, with a flexible punctured seat for the writing tube.

FIGURE 16 shows a flexible cap with a retention valve to be used with an ordinary inkwell, which can be applied to the breather openings at the top of the ink container.

Referring to the drawings in detail, FIGURE 1 shows a completely assembled pen including a body **10** having a threaded cap **11** screwed thereon. The ink container **12** serves as a pump cylinder, and has a pump plunger **13** actuated by means of the pump shaft **14** and head **15**. The ink container **12** is provided with ink absorbing flexible capillary material **16**, for example, with flexible foam plastic having open cells which at one end is attached to the pump plunger **13** and at the other end is attached to the surface of the threaded ink capillary channels **17** by welding, pasting, or by any other means. It must be observed that the capillary force of the capillary flexible material **16** must be stronger at the end which is attached to the openings of the ink capillary channels **17** than at the end which is attached to the pump plunger **13**. This increase in capillarity is obtained as the flexible capillary material with open cells used for the ink container **12**, is cut or otherwise formed conically and therefore, when placed inside the ink container **12** with the base against the ink capillary channels **17**, this part is compressed more than the opposite part of the flexible capillary material **16**, with the result that the open cells are smaller in this part and therefore have more capillary force. The threaded ink capillary channels **17** are formed in guide cylinder **18** and together with the capillary ink supply member **19** and ink needle capillary guide **20** provide a central bore in which the ink needle **21** with its counterweight **22** is guided. The counterweight **22** is limited in its upward movement by a threaded nut **23** which is screwed on the upper end of the guide cylinder **18**, and limited in its downward movement by the upper part of the capillary ink supply member **19**, which also prevents the pressure of the downward movement from being transmitted on to the ink column of the ink needle capillary guide **20**. In the lower part of the central bore in member **19** are a plurality of capillary radial channels **24** which conduct the ink to the ink needle capillary guide **20**. The threads of the above-mentioned threaded nut **23**, which is screwed on the guide cylinder **18** are of a slightly smaller diameter than the threaded capillary channels **17** of the guide cylinder **18** leaving a space free for the passage of ink. Said nut **23** also has a central bore, which guides the upper part of the counterweight **22**, whose shoulder is checked in its upward movement by said nut **23**. The base **25** of the writing tube **26** is screwed in the guide cylinder **18** and the ink openings **27** are formed so as to lie between the closing surfaces **28** of the base **25** and the guide cylinder **18**, when these two latter members are firmly screwed together and by lightly unscrewing the base **25** the ink openings **27** are left free. The base of the writing tube **25** is also provided with a threaded or hexagonal head **29** which fits into key **30** which is formed in the top of the push-button **31** of the slide tube **32**. The key **30** comprises an opening provided with circumferential notches into which the threads **29** fit. To fill the writing mechanism with ink, the same is removed from the pen body **10** by first unscrewing the cap **11** and sliding the tube **32** up over the body of member **25** until the key **30** in the push-button **31** engages the threads **29**. The tube is rotated sufficiently to unscrew member **25** and expose openings **27**. In the upper part of the ink container **12** immediately before the point where the pump plunger **13** reaches its extreme rearward position, there are formed a plurality of breather openings **33** for the variations of the atmospheric and heat pressures, made possible by an opening **34** in the pen body **10** which connects the inside of the fountain pen with the normal outside atmospheric pressure. At the upper part of the ink container **12** there is formed a reinforcing head **12*a*** of lesser diameter than said container **12**. Said head is provided with a central opening **12*b*** of hexagonal shape which serves as a guide for the hexagonal pump shaft **14**, to thus avoid rotation of the pump plunger **13** and the capillary flexible material **16** in the ink container **12**. This reinforcing head **12*a*** also serves as guide for the wiring mechanism since it fits exactly into the lower part of the slide tube **32** in the cap **11**. The above described key **30** may be constructed in any other place on the cap **11** or the pen body **10** and may take any other shape so long as it will firmly engage threads **29** for its intended purpose.

In all fountain pens furnished with pump plungers of the usual type, it is possible to adapt them to the use of flexible capillary material; however, in order to maintain the advantages of the capillary force, the breather openings **33** must be included in the construction.

The writing mechanism shown in FIGURE 6 has the same threaded capillary guide cylinder **18**, counterweight **22**, writing needle **21**, writing tube base **25**, and writing tube **26**, but is provided with a flexible or collapsible wall ink container **35** which is filled with flexible capillary foam plastic **36** or other flexible capillary ink absorbing material. For the purpose of letting ink into the pen, there is provided a threaded bushing **37** at the top of the ink container **35**, which guides and serves as a stop for the threaded push-buton **38**, said push-button has a conical extension **39** and a stop bolt **40** which when unscrewed (FIG. 7) together with the plastic tube **41** situated in the neck of the ink container **35** forms an efficient conical retention valve **42** which in its normal position, i.e., when the threaded push-button **35** and its conical extension **39** is firmly screwed down is always open to ensure free respiration according to the variations of atmospheric and heat pressures.

FIGURE 9 shows the float valve **43** which includes the body **44** and serves to prevent the leakage of ink when filling the pen and, at the same time combines with the lower seat to serve as a retention valve **45**. The seat is provided with an elastic counter-pressure ring **46** having upwardly extending projections which prevent the float body **44** by its own weight from closing same, although it allows the float body **44** to rest in the seat when drawing ink into the pen. This ring is provided to ensure the free inlet and outlet of air for the variations of atmospheric and heat pressures.

The perforated disc **47** which is provided at the top of the flexible capillary material **16** of the flexible ink container **35**, separates the capillary material **16** from retention valve **45**.

In the neck of the ink container **35** above the retention

valves 42 and 45, there is provided some breather openings 48 for the variation of atmospheric and heat pressures.

In fountain pens with a ball-point the writing needle is shortened sufficiently to ensure that the same does not touch the ball in the writing point in the downward movement.

FIGURE 11 shows a ball-point pen including a flexible ink container with flexible capillary material, where the counterweight 22 of the ink needle 21 is situated in the hollow push-button 49 which serves as a guide therefor. The prolongated ink needle 21 is placed inside a capillary guide spiral 50 which passes through the flexible capillary material of the ink container 35*a*, through the inside length of the guide cylinder, through the base 25 and a part of the writing tube 51 of the ball-point pen. The capillary guide spiral 50 is loosely placed in the base 25 and between the threaded capillary channels 52 of guide cylinder 18 but firmly placed in the bushing 53 whose upper surface checks the downward movement of the counterweight 22. The ink openings 27 are formed as ink inlet valves with the aid of a weak elastic tube 54 firmly placed in the base 25 which lightly covers said openings 27. The base 25 is unscrewed to let ink into the ink container 35*a* in the manner previously described by means of the screw threads 29 and the corresponding key 30. After filling the ink container, the base 25 is again screwed on by hand or with a cylindrical enlargement of the base 25 surrounding the same. As well as an elastic tube valve 54 provided in the lower part of the guide cylinder 18, there is provided an upper weak elastic tube valve 55, which covers the area where the push-button 49 joins the ink container, thereby covering the openings 56 which serve as air outlet vents when the pen is being filled. The upper elastic tube valve 55 is lightly lifted to permit variations of the atmospheric and heat pressures through the openings 56.

FIGURE 12 shows a flexible inkwell 57 provided with a conical seat 58 for the lower part of the guide cylinder 18 of the writing element, the inkwell having a lid as shown in FIGURE 14. Also shown is the sealing mouthpiece 58*a*, with which the flexible inkwell 57 may be provided for forcing ink into the ink container through the capillary spaces between ink needle 21 and the writing tube 26.

FIGURE 13 shows an inkwell 59, provided with a pump mechanism 60, a retention valve 61, a conical seat 62 for the lower part of the writing element, and an injection chamber 63. The inkwell is provided with a cap similar to that shown in FIGURE 14.

FIGURE 14 shows the cap 64, which can be used with the inkwells shown in FIGURES 12 and 13, with the key 65 into which the notches on the writing tube base 25 fit for the purpose of facilitating the opening and closing of the ink openings 27.

FIGURE 15 shows another type of cap 66 for the inkwells shown in FIGURES 12 and 13, which permits the ink to be forced into the ink container directly through the capillary spaces between the writing tube 26 and the ink needle 21, thus obviating the use of the ink openings 27. This is made possible with the aid of the flexible and elastic rubber or plastic tube 67 with its central opening 68, into which the writing tube is placed.

FIGURE 16 shows a type of cap 69 to be used with an ordinary inkwell, and which may be applied to the breather openings in the upper part of the writing element as shown in FIGURES 6, 7, and 11, and which makes the construction of the retention valves 42—55 unnecessary. This lid is formed as a flexible and elastic rubber or plastic cap or bulb and placed with its seat 71 over the breather openings 48—56 as shown in FIGURES 6, 7, and 11. By exercising pressure on the collapsible walls of the flexible cap 69, the air inside same is forced out through the retention valve 70 and by lessening the pressure on the cap, the air inside the ink container will be sucked out through the breather openings 48 or 56, and therefore the ink will be forced into the ink container through the ink openings 27, previously opened, or directly through the capillary spaces between the ink needle 21 and writing tube 26.

The operation of the above described ink container provided with a flexible capillary material actuated by pump plungers for the inlet of ink, is as follows:

In order to fill the pen, the cap 11 is unscrewed and the tube 32 and the writing mechanism are removed. The ink openings 27 are made accessible by engaging the key 30 at the top of the tube 32 with the threads 29 on base member 25. By slightly rotating tube 32, the member 25 is unscrewed from the lower part of the body 18 exposing the openings 27. Then by pushing the pump plunger 13 downwardly by means of the pump shaft 14 and its head 15, the flexible capillary material 16 in the ink container 12 is compressed and the air and ink is forced out through the capillary channels 17, the capillary supply member 19, the ink needle capillary guide 20 and finally out through the ink openings 27. By pulling back on the head 15 of the pump shaft 14 the compressed flexible capillary material 16 expands and sucks through the ink openings 27 fresh ink into the material 16. As soon as the pump plunger 13 has been drawn fully back leaving the breather openings 33 free, the ink openings 27 can again be closed by screwing the base 25 of the writing tube 26 into the guide cylinder 18 by use of the key 30 and then the writing mechanism can be replaced in pen body 10 and the head piece 11 screwed thereon. The fountain pen is then again in writing condition.

In the mechanism provided with a flexible ink container as shown in FIGURE 6, in order to let ink into same, the threaded push-button 38 with its conical extension 39 has to be unscrewed until the stop bolt 40 lies against the threaded bushing 37 as shown in FIGURE 7. Then, by exercising pressure on the collapsible sides of the flexible ink container 35, the air inside the same is forced out through the conical retention valve 42 and the breather openings 48 and by releasing the pressure on the container 35, the ink will be caused by the lower pressure in the ink container 35 to enter the ink container 35 through the ink openings 27 in the base 25 of the writing tube 26. The threaded push-button 38 is then screwed down as shown in FIGURE 6 permitting the passage of atmospheric air freely through the breather openings 48.

Referring to FIGURE 9, the float retention valve 43 functions as previously described during the filling of the pen. However, when the ink container is full of ink, the seating of the valve prevents the same from leaking through the valve 43 and out through the respirations openings 48.

The upper surface of the capillary ink supply member 19, which receives the impact of the downward stroke of the counterweight 22, prevents the pressure from being transmitted to the ink column in the ink needle capillary guide 20.

When a flexible inkwell such as shown in FIGURE 12 is used for letting ink into the ink container of the writing mechanism, the cap 64 (FIG. 14) having the key 65 therein, is removed from the flexible inkwell 57, and used to unscrew the base 25 of the writing tube sufficiently to expose the ink openings 27. The writing mechanism is then placed firmly in the conical seat 58, and the inkwell 57 is turned upside down and pressure exerted on the sides of the flexible inkwell 57 until the ink container is full of ink. Then, while maintaining pressure on the sides of the inkwell, it is turned to an upright position and the writing element removed. The pressure on the inkwell can now be released, the ink openings 27 closed, and the cap 64 replaced in the inkwell 57.

The inkwell 59 shown in FIGURE 13 is also furnished with a cap 64 similar to that shown in FIGURE 14, and when letting ink into the ink container, the cap 64 is removed from the inkwell and used in the manner just

described to open the ink openings **27**, with the key **65**. Then, the writing mechanism is placed firmly in the conical seat **62** of the inkwell, and by pulling back on the piston of the pump mechanism **60**, ink is drawn into the injection chamber **63**, and when the piston is pushed downward the ink is forced into the ink container of the writing element through the ink openings **27**. Since the ink is retained in the injection chamber of the retention valve **61**, the pump mechanism is operated until the ink container is full of ink, then the writing mechanism is removed from the inkwell **59**, the ink openings closed, and the cap replaced in the inkwell.

FIGURE 15 shows a second type of cap **66**, which may be used for the inkwells shown in FIGURES 12 and 13 and which has the advantage of eliminating the use of the ink openings **27** and key **30**, since the ink is forced into the ink container directly through the capillary spaces between the writing tube **26** and the writing needle **21**. As shown in the drawing, the writing tube **26** is placed firmly in the flexible and elastic rubber or plastic tube **67** of the cap **66** with the point of the writing tube passing through the central opening **68**, and the ink is forced into the ink container as described in the description to FIGURES 12 and 13.

The flexible and elastic rubber or plastic cap or bulb **69** shown in FIGURE 16 eliminates the construction of retention valves in the writing element. This flexible cap is furnished with a seat **71**, into which the upper part of the writing element is firmly seated as shown in the drawing. In the upper part of the flexible bulb **69**, there is provided a retention valve **70** through which the air is expelled, when pressure is exercised on the collapsible sides of the flexible bulb **69**. When releasing the pressure, the air inside the ink container is sucked out through the breather openings and the ink will be forced by the lower pressure in the ink container to enter same through the ink openings **27**, which are previously made accessible by unscrewing the base **25** with the key **30**, or directly through the capillary spaces between the ink needle **21** and the writing tube **26**. This operation is repeated until the ink container is full of ink, then the bulb is removed from the writing element, and the ink openings **27** closed in the known manner.

I claim:

1. A fountain pen having a body and a cap removably secured to one end thereof and a writing point at the opposite end, an ink container within said body, a compressible cellular capillary material within said container, a plunger slidably disposed in the upper portion of said container, the capillary material secured at its upper end to said plunger and at its lower end to said container, a guide tube secured to the lower end of said container beneath said capillary material, a writing tube threadedly secured to said guide tube, ink inlet openings radially disposed in the side wall of said writing tube, means for opening and closing said openings, and breather openings in said ink container to compensate for variations in atmospheric pressures.

2. A fountain pen according to claim 1, including key means for engagement with said writing tube to separate the same from said guide tube and uncover the ink filling openings in said writing tube.

3. A fountain pen according to claim 1, wherein said guide tube is provided with a plurality of capillary channels along its inner wall.

4. A fountain pen according to claim 1, including ink guide means within said guide tube and writing tube.

5. A fountain pen according to claim 1, wherein a capillary ink supply member is provided to cushion the downward stroke of said counterweight, thereby preventing transmission of the force of said stroke to the ink column of the ink needle capillary guide.

6. A fountain pen having a body and a cap removably secured to one end thereof and a writing point at the opposite end, an ink container within said body, a compressible cellular material within said container, means for compressing said material, a guide tube secured to the lower end of said container beneath said capillary material, a writing tube whose base is threadedly secured to said guide tube, ink inlet openings radially disposed in the side wall of said writing tube, key means engageable with said writing tube base opening and closing said openings, and breather openings in said ink container to compensate for variations in atmospheric pressures.

7. A fountain pen according to claim 6, including a capillary guide member extending throughout the length of said body, an ink needle within said capillary guide member, a counterweight at the end of said needle opposite the writing point, a hollow push-button secured to the upper end of said body, said counterweight slidably disposed in said push-button.

8. The fountain pen of claim 6, wherein said ink container is provided with a collapsible wall to permit compression of said capillary material.

9. The fountain pen of claim 6, including adjustable means in the top of said ink container for controlling the passage of air through said breather openings.

10. A fountain pen according to claim 6, including ink supply means apart from the pen for letting ink into the ink container thereof, said ink supply means attachable to said ink inlet openings and said breather opening to permit filling of said ink container.

11. A fountain pen according to claim 10, wherein said ink supply means includes seating means for the lower part of said writing tube and means for forcing ink into said ink container.

12. A fountain pen according to claim 10, wherein said ink supply means includes suction means having a seat for receiving the upper part of the ink container whereby manipulation of said suction means will draw air out of the ink container through said breather openings.

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