May 29, 1951 F. R. WITTNEBERT 2,554,654

FOUNTAIN PEN

Filed June 13, 1946 2 Sheets-Sheet 1

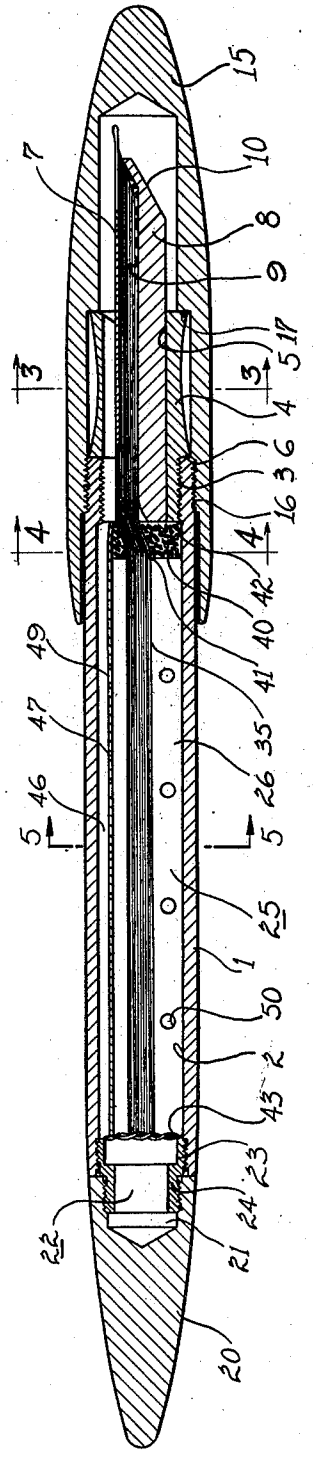



Fig. 1

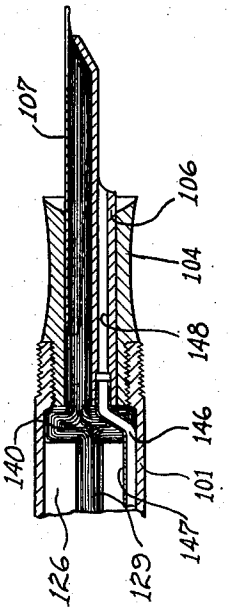



Fig. 11

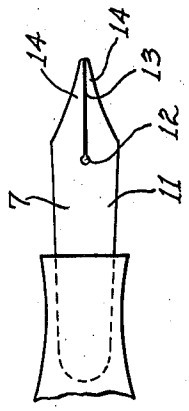



Fig. 2

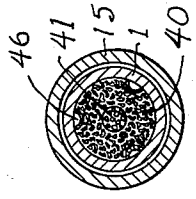



Fig. 4

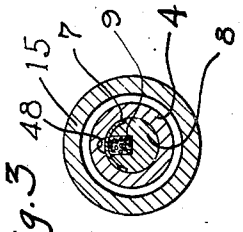



Fig. 3

INVENTOR.
Frederick R. Wittnebert
BY
Fidler & Crane
Attorneys

May 29, 1951 F. R. WITTNEBERT 2,554,654

FOUNTAIN PEN

Filed June 13, 1946 2 Sheets-Sheet 2

Fig. 7

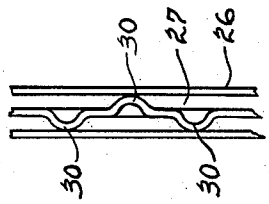
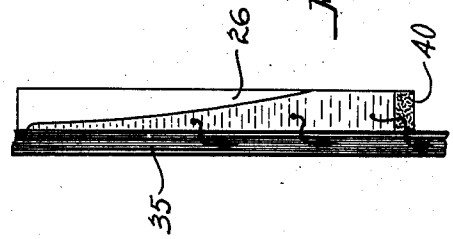



Fig. 10



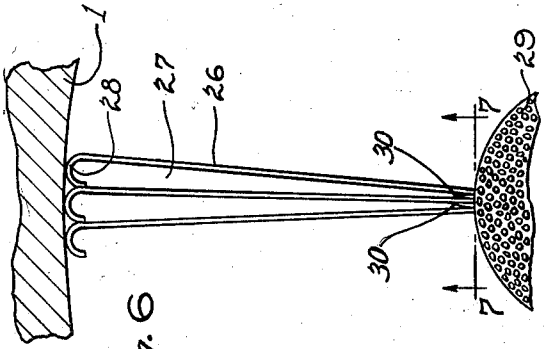
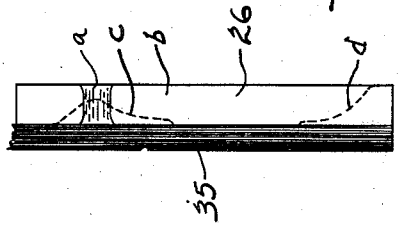




Fig. 6

Fig. 9



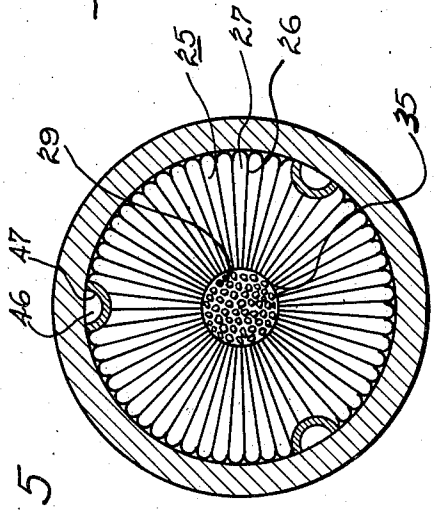
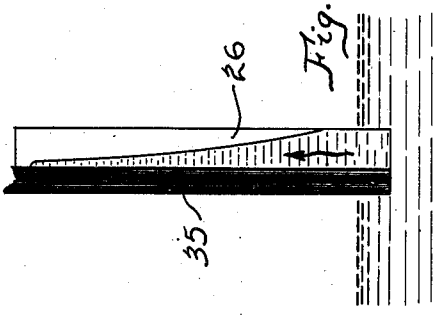




Fig. 5

Fig. 8




INVENTOR.
Frederick R. Wittnebert
BY
Fidler & Crouse
attorneys

Patented May 29, 1951

2,554,654

# UNITED STATES PATENT OFFICE

2,554,654

## FOUNTAIN PEN

Frederick R. Wittnebert, Chicago, Ill., assignor to The Parker Pen Company, Janesville, Wis., a corporation of Wisconsin

Application June 13, 1946, Serial No. 676,514

16 Claims. (Cl. 120—50)

1

This invention relates to improvements in fountain pens and particularly to improvements in fountain pens of the type having an ink reservoir which is filled solely by capillary action.

An object of the present invention is the provision of an improved fountain pen of the capillary filling type which can be filled by merely inserting the end of the pen in a supply of ink and which does not require manipulation of a filling mechanism having moving parts.

Another object of the invention is the provision of an improved fountain pen of the type wherein the ink is entirely maintained under capillary control and is not responsive to influences tending to produce leaking or non-uniformity of flow of ink from the pen in writing, as, for example, changes in atmospheric pressure such as occur when the pen is carried in an airplane, or changes in temperature such as occur when the pen is warmed by the heat of the hand in writing.

Still another object of the invention is the provision of a capillary filling fountain pen having improved filling and feeding means, which pen has increased ink capacity, can be filled rapidly and can be written out, refilled and written out indefinitely without decrease in effective ink capacity.

Still another object of the invention is to provide an improved fountain pen of the capillary filling type, which is simple to manufacture, easy to assemble, and which will operate for a long period of use without adjustment or replacement of parts.

A further object of the invention is the provision in a capillary filling fountain pen of an improved capillary filler element which extends substantially throughout the length and breadth of the ink reservoir and which is formed of members so constructed and arranged that they occupy a relatively small portion of the total volume of the ink reservoir thereby providing increased ink capacity in the reservoir.

Another object of the invention is the provision of a capillary filling fountain pen having improved feed means which prevents the formation of air locks in the feed, which insures that ink is maintained at the point of the nib at all times, which provides constant and uniform ink flow to the nib during writing, and which effects substantially complete write-out of ink from the reservoir.

Another object of the invention is the provision of a capillary filling fountain pen having improved pressure equalizer means whereby the

2

pressure in all portions of the interior of the pen is maintained substantially the same, thereby preventing leaking and which maintains atmospheric pressure on the ink when the pen is used in writing, thereby preventing flooding or starving of the ink feed and insuring a continuous, even feed of ink to the nib.

A further object of the invention is the provision of an improved capillary filling fountain pen wherein the capillary filler element is so constructed that substantially all of the capillary passages or cells thereof are individually placed in direct, capillary filling relation with a supply of ink in filling, thereby insuring rapid filling of the pen.

Another object of the invention is the provision of a capillary filling fountain pen having improved filling and feeding means which provides a plurality of feed paths extending along the ink reservoir which are of greater capillarity than the remaining capillary spaces and arranged to provide continuity of the body of the ink in the pen and prevent the establishment of air locking conditions tending to stop or restrict the filling or feeding of the pen.

Another object of the invention is the provision of an improved capillary filler element for a fountain pen which takes the form of a plurality of radially disposed thin walls or fins extending longitudinally of the reservoir and defining a plurality of ink passages or cells extending longitudinally of the reservoir and converging inwardly toward a central feed element, which cells have filling openings at their rear ends for rapid filling, feeding openings at their front ends for feeding ink longitudinally toward the nib and feeding openings at their side edges providing communication between each of the cells and the central feed element for feeding ink laterally to the feed element.

Still another object of the invention is the provision of improved ink feed means for a capillary filling fountain pen which feed means has sufficient capillarity to insure the feeding of ink from the reservoir to the nib; which is directly connected in feeding relation to the ink in the reservoir; which extends substantially through the length of the reservoir; and which provides continuity of the body of ink during both filling and feeding to provide rapid filling and continuous and even feeding, and substantially complete write-out of ink in the reservoir.

Another object of the invention is the provision of a capillary filling fountain pen having pressure equalizing means including an air pas-

sage extending throughout the length of the ink reservoir and adapted to communicate at its front and rear ends with the exterior of the pen to maintain equal pressure throughout the pen at all times and to maintain atmospheric pressure within the pen when the pen is used in writing.

Other objects and advantages of the invention will appear from the following description, taken in connection with the appended drawings, in which:

Figure 1 is a view of a longitudinal, vertical cross-section taken through a fountain pen embodying the present invention;

Figure 2 is fragmentary top plan view of the forward portion of the pen;

Figure 3 is a transverse cross-sectional view taken along the line 3—3 of Figure 1;

Figure 4 is a transverse cross-sectional view taken along the line 4—4 of Figure 1;

Figure 5 is an enlarged, fragmentary transverse cross-section of view taken along the line 5—5 of Figure 1;

Figure 6 is an enlarged, fragmentary view showing a portion of the structure of Figure 5;

Figure 7 is an enlarged, fragmentary cross-section taken along the line 7—7 of Figure 6;

Figure 8 is an enlarged, fragmentary view of a portion of the cell structure illustrating somewhat diagrammatically the position which the ink takes in one of the cells during filling;

Figure 9 is an enlarged, fragmentary view of a portion of the cell structure showing somewhat diagrammatically the manner in which the air lock is prevented;

Figure 10 is an enlarged, fragmentary view of a portion of the cell structure showing somewhat diagrammatically the feeding of ink from a cell, and

Fig. 11 is a fragmentary, longitudinal cross-sectional view through the forward, or nib end, of a second embodiment of the invention.

It will be understood that while a fountain pen of the pocket type is illustrated herein, the invention may, with suitable structure modifications, be adapted to fountain pens of the desk type, such as are normally used with desk stands, or to convertible fountain pens which can be used as either pocket pens or desk pens.

Referring now particularly to Fig. 1, the fountain pen, according to a preferred embodiment of the invention, includes an elongated body formed of a suitable material, such as hard rubber or a plastic, as for example "Lucite" (methyl methacrylate resin). The body includes a hollow barrel 1 having a chamber 2 defining an ink reservoir which extends throughout a substantial portion of the length of the barrel.

A pen section 4 is secured in the forward or nib end of the barrel 1, as by screw threads 3, and may be positioned by a shoulder 6 which abuts the end of the barrel 1. A suitable writing element which may take the form of a nib 7, associated with a feed bar 8, is received in close fitting engagement in a bore 5, extending through the pen section 4. The feed bar 8, which is essentially cylindrical in shape, is provided with a generally channel-shaped slot or groove 9 in its upper portion for a purpose which will be later explained. The groove 9 is open at its rear end and is closed at its forward end by an end wall 10, which is inclined to prevent the lower portion from bearing on the writing surface when the pen is held at the usual writing angle.

The pen nib 7 may be of conventional form,



including a body 11 having a pierce 12 and a nib slit 13 extending therefrom and defining two nib sections 14. The nib 7 is firmly seated in the bore 5, and extends along the feed bar so that the nib sections bear against and extend beyond the end wall 10; the feed bar 8 (Fig. 3) being relieved appropriately to accommodate the body 11 of the nib.

A front end cap 15 may be provided for enclosing the nib end of the pen and may be secured to the barrel 1, as by screw threads 16, or in any other suitable and well known manner. The cap 15 is formed with a shoulder 17 adapted to abut the pen section 4 to prevent the cap 15 from being screwed down too far onto the barrel 1, and injuring the nib 7.

Removably secured on the rear end of the barrel 1 is a rear end cap 20, which closes the chamber 2 and forms with the adjacent end of the barrel 1 an end space or chamber 21. The rear end cap 20 preferably is attached to the barrel 1 by a bushing 22 having a body 23 threaded into the barrel 1 and a reduced neck 24 onto which the rear end cap 20 may be screwed.

Means are provided for filling the pen by capillary action when the end of the pen is introduced into a supply of ink. Such means also is effective to maintain the ink in the pen entirely under capillary control at all times so that there is no free body of ink within the pen which is subject to influence tending to cause leakage, such as changes in atmospheric pressure or changes in temperature of the air in the pen. During writing the capillary filler means aids in controlling the feed of ink to the nib to provide a continuous, even supply of ink to the nib.

The capillary filler means includes a capillary cell structure 25 extending substantially throughout the length and breadth of the ink reservoir, and which is formed by a plurality of walls or fins 26 extending in generally radial directions from adjacent the wall of the chamber 2 to inwardly short of the center. Each wall or fin 26 extends longitudinally substantially throughout the length of the chamber 2 and is formed from a suitable material which is wettable by the usual inks but is relatively inert thereto and will not deteriorate over a long period of use. In addition, the material has sufficient rigidity so that the fins retain their shape and position during use. A metal such as stainless steel has been found to be highly satisfactory for use in forming the fins, although other materials such as silver, mica or a plastic may be used.

The fins 26 are spaced apart, preferably equally, to provide passages or cells 27 of capillary widths between adjacent fins. Owing to the radial arrangement of the fins, the spaces 27 taper inwardly and are generally wedge shape in cross-section. At their outer side edges the fins 26 preferably extend to the walls of the chamber 2 and are spaced apart as by arcuate, flange-like edges 28, each of which bears against the body of an adjacent fin 26 at the outer edge portion thereof (Fig. 6).

At their inner side edges, the fins 26 terminate short of the center of the chamber 2 and thus a central space 29 is provided, which receives a feed element described hereinafter. The fins 26 are spaced apart at their inner side edges in a manner which will provide communication between all of the cells 27 and the central space or passage 29. For this purpose, alternate fins

26 may be provided with corrugations or beads 30 extending throughout a portion of the length of such fins. At least two of the corrugations 30 on each alternate fin project in opposite directions from the plane of the fin to bear respectively against the two adjacent fins on either side of the fin on which the corrugations are formed.

The fins 26 are made as thin as practicable, consistent with mechanical strength and rigidity, in order that the largest number of cells of predetermined wall-to-wall width may be provided in a chamber of predetermined size. Thus, by forming the fins of very slight thickness, the maximum ratio of capillary cells space to total volume of the ink reservoir is obtained.

The central passage 29 receives and is substantially filled by a feed element which may be formed as a wick 35. The wick 35 extends along the central passage 29 in feeding relation with the open inner side edges of the cells 27 and and extends into the groove 9, and throughout the length thereof. The wick 35 fills the groove 9 and bears against the underside of the nib 7 whereby the capillary passages in the wick 35 are in ink feeding relation with the pierce 12 and slit 13. Preferably, the portion of the wick which extends forwardly of the capillary cell structure has a greater capillarity than the remainder of the wick. This may be accomplished by forming the groove 9 of such size that the wick is slightly compressed between the walls of the groove 9 and the top wall of the bore 9 rearwardly of the nib and between the walls of the groove 9 and the nib 7. This compression also insures that the wick 35 is retained firmly in feeding relation to the nib pierce 12 and nib slit 13.

The wick 35 is formed from a large number of strands or fibers which provide a plurality of capillary paths extending in a generally longitudinal direction through the central passage 29 and which are in communication with the capillary cells 27. Preferably the wick 35 is formed from a material which provides the necessary capillarity, which is sufficiently flexible to provide the desired contact with adjacent elements of the pin and which is sufficiently resilient to retain such contact. Preferably the material is non-absorbent and is not deteriorated by conventional inks. In one successful embodiment, the wick was formed by a bundle of essentially parallel 20 denier nylon threads each consisting of 20 filaments, although other materials such as other plastics, ceramic material or vegetable or animal fibers may be used.

A pad 40 may, if desired, be provided at the front end of the chamber 2 in surrounding engagement with the wick 35 and is seated between the ends of the fins 26 and the adjacent ends of the pen section 4 and feed bar 8. The pad 40 is formed of a suitable material providing capillary passages having a greater capillarity than the capillary cells 27 and which material is wettable by the ink but preferably non-absorbent and will not deteriorate over a long period of use. I have found that nylon or spun glass is very satisfactory for forming the pad. In order to assist in positioning the pad 40 and the fins 26, the barrel 1 is formed at its forward end with a shoulder 42 against which the pad 40 seats. When the pen section 4 and the feed bar 8 are in position their ends are flush with the shoulder 42 and provide additional seating for the pad 40. The pad 40 is formed with an opening 41 to accommodate the wick.



The fins 26 are held in position at their rear ends by a screen 43 which extends across the rear end of the chamber 2 and which preferably is secured between the bushing 22 and a shoulder 44 formed in the barrel. When the bushing 22 is screwed into place it forces the fins 26 firmly against the pad 40 which in turn is forced against its seat and thus the fins 26 are firmly secured in position.

The screen is formed with openings which provide relatively free communication between the capillary cells and the chamber 21. Since the pen barrel is open across substantially its entire rear end area, the cells have relatively free communication with the chamber 21 (and the exterior of the pen when the rear end cap 20 is removed) over substantially their entire rear end area. The screen may be formed of any suitable material which will retain its rigidity and which is not deteriorated by the ink. Metal such as stainless steel has been found suitable for forming the screen, although suitable plastics may be used.

Extending from the chamber 21 along the chamber 2 to the front end of the pen is a vent or pressure equalizer passage 46. This passage may be defined by a trough member 47, formed of suitable material, such as stainless steel, disposed in the upper portion of the chamber 2, and by a groove 48 (Fig. 3) formed in the upper wall of the bore 5, which extends through the pen section 4. In order to accommodate the trough member 47, portions of certain of the fins 26 may be cut away (Fig. 5). Additional venting preferably is provided by one or more additional pressure equalizer passages which are generally similar to the passage 46, but spaced therefrom around the periphery of the chamber 2, and which preferably terminate at the forward end of the cell structure 25 although they may extend through the pen section 4.

In order to provide communication between the passage 46 and the adjacent cells substantially throughout their lengths the trough member 47 preferably is formed with openings 49, although it may be formed as a screen. Alternatively, the passage 46 may be provided by omitting a suitable number of fins 26 at the upper portion of the chamber, the spacing of the fins at either side of the sector shaped space created by the omission of fins being maintained by suitable spacer means (not shown) such as an extended flange on one of the fins.

The air passage 46 provides free air communication between the interior of the pen and the atmosphere, when the front end cap is removed for writing or when the rear end cap is removed for filling the pen and thus, all of the ink in the pen is maintained at atmospheric pressure when either end cap is removed. The air passage serves to equalize the pressure in all portions of the pen so that when both end caps are in position closing the respective ends of the pen, the pressure within the pen body and within both of the caps is equal. It will be understood that when both caps are in position closing the ends of the pen, changes in atmospheric pressure may not be reflected immediately by similar changes within the pen; however, when either cap is removed, the pressure within the pen immediately is equalized with that of the atmosphere. Where either end cap is vented the pressure within the pen interior will remain at atmospheric pressure.

It will be seen that since each of the cells is

in air communication with the chamber 21, the pressure of the air on the ink at the rear ends of all of the cells is substantially equal. However, in order to provide full and immediate equalization of pressure within all of the cells whenever any changes in pressure take place in any portion of the pen, a plurality of openings 50 are provided in each of the fins.

The pen is filled by placing the capillary cells in capillary filling relation with a supply of ink. Preferably the pen is filled at the rear end by removing the rear end cap and inserting the rear end of the pen in a supply of ink to such depth that the rear ends of the cells are below the surface of the ink supply, and the cells are individually in capillary filling relation with the ink supply. The capillary action of the cells and the wick causes ink to be drawn into both the cells and wick and to rise therein. Since the cells are in substantially direct filling relation with the ink supply (through the openings in the screen) ink will be drawn directly into each cell. Since the cells are individually and directly in communication with the ink supply, through the openings in the screen and since the cells present a relatively large total cross-sectional area ink will be drawn into the pen at a relatively rapid rate and the filling operation will require a period of only a few seconds. The wick and the inner portions of the cells provide paths of greater capillary than the outer portions of the cells. Accordingly ink will rise along the former paths in advance of its rise along the portions of the cells remote from the wick. The formation which ink will assume in the cells is illustrated in a generally diagrammatic way in Figure 8.

During the filling, ink will rise in the wick 35 toward its upper end until the wick is completely filled and will enter the nib slit 13. Ink also may be drawn from the wick 35 into the capillary spaces in the pad 40 to fill such spaces; in any event when the pen is placed in writing position, the pad will draw in ink from the adjacent ends of the cells and become saturated. Thus, the ink in the wick 35, the pad 40 and the cells 27 and nib slit 13 forms a substantially continuous body of ink all of which is in passages or cells of capillary size.

Air which is in the capillary cells and wick prior to filling the pen is forced out during the filling by the ink which is drawn into the cells and wick. This air is forced out of the front ends of the cells and out of the wick and into the air equalizer passage which vents the air to the atmosphere. Where the air equalizer passage is in direct communication with adjacent cells, as explained hereinbefore, air will also pass into the air passage directly from adjacent cells, and thence to the end of the passage. In order to insure free venting the front end cap preferably is loosened or removed during filling.

The capillarities of the several passages and cells constituting the capillary system are so selected that ink will be drawn into the pen to fill the cells 27 to the desired extent. The height to which ink will rise in the pen and the rate of rise will depend upon a number of factors. However, for any particular pen, using any particular ink, the height of rise (and rate of filling) is influenced by the angle at which the pen is held relative to the surface of the supply of ink. The minimum height of rise (and rate of filling) will occur when the pen is held vertically and the capillary system should have sufficient capillarity to cause ink to rise to the desired height when the pen is held in this position. However, the pen may be held at a relatively small angle to the surface of the ink supply (for example, around 30°) with the result that the cell would be capable of drawing up more ink than if the pen were held vertically. Accordingly, the capacities of the cells and the capillarity of the capillary system are so selected that even if the pen is filled by holding it at a very small angle to the surface of the ink supply, no more ink will be drawn into the pen that can be retained in the cells by capillary action in any position of the pen. Hence, even if the pen is filled by holding it at a relatively small angle to the surface of the ink supply and then is moved into a vertical position, ink will be held in the pen by the capillarity of the cells and will not drain out or leak.

The height of rise and rate of filling for different designs and constructions of pens is influenced by such factors as the sizes of the various capillary passages, the flow resistance through such passages, the wettability of the surface of the ink used and the surface tension of the ink. In general, the viscosity of the ink also would be a factor but since most fountain pen inks presently used have viscosities substantially equal to that of pure water, the viscosity for such inks may be assumed to be the same. In the pen of the present invention the practically straight, unobstructed passages defined by the cells and the relatively large total cross-sectional area presented to the supply of ink when the cells are in filling relation provide for relatively rapid filling action even though the cross-sections of individual cells are necessarily made relatively small in order to provide the necessary capillarity.

Inasmuch as the pen when used in writing is held with the nib end downwardly, the capillarity of the cells 27 must be such as to retain ink therein when the pen is in such position. Accordingly, the capillarity of each cell must be such as to support the weight of the column of ink which extends from the end of the nib to the upper surface of the ink in the cells.

The relative capillarities of the several portions of the capillary system are so selected that ink will be drawn by capillary action to the nib and will be maintained there at all times so that the pen is always in writing condition. Ink which evaporates, or which is drawn off during writing thus is immediately replaced.

The wick 35 is formed so as to have a greater capillarity than the cells 27 and the pad 40. Thus, any ink withdrawn from the wick at the nib pierce or nib slit will be replaced immediately by ink drawn into the wick from the cells 27 or pad 40.

The pad 40 is formed so as to have a capillarity greater than the cells 27 but less than the wick 35. Thus, the pad 40 acts to draw ink out of the cells 27 at their forward ends, which action tends to maintain ink at the forward ends of the cells; however, since the wick 35 has a higher capillarity than the pad 40, ink is drawn from the pad 40 by the wick 35 and fed to the nib 7. The pad 40 normally will draw ink from the forward ends of the cells 27 and ink will be drawn from the pad 40 by the wick 35. However, the wick 35 is in feeding relation with each of the cells throughout the length of the reservoir and thus the wick will be supplied with ink substantially throughout its length.

Owing to the greater capillarity of the inner

portions of the cells 27 relative to the remainder of the cell portions, any ink which is in a cell will be drawn toward the inner portion of the cell where it is in a position to be drawn into the wick 35.

In writing, when the pen nib is drawn across the writing surface, ink which is held in the nib slot by capillarity is brought into contact with the writing surface and the capillarity established between the nib and the writing surface is sufficient to overbalance the capillarity of the capillary filler element. The capillarity of the pen nib slit, the wick and the pad is such that ink is drawn from the capillary cells to replace ink which is withdrawn from the pen nib slit and left on the writing surface. Because the flow of the ink to the pen nib slit is governed by the relation of the capillarity of the capillary system in the pen to the capillarity established between the pen nib and the writing surface, a very uniform flow of ink to the writing surface is insured. Since the capillarity of the capillary system of the pen is greatest at the pen nib slit, ink is always instantly available at the point of the pen nib for writing.

The cells are in communication individually with the capillary passages in both the pad and the wick so that the ink is in the form of a continuous body entirely under capillary control. Owing to the internal cohesions of the ink and to the fact that the continuous body is under capillary control, the continuity of supply from the cells to the pen nib slit is maintained at all times to replace ink which is drawn off during writing.

As ink is drawn from the pen in writing, air must be drawn into the pen to replace such ink. Air is admitted through the front end of the air passage 46 and enters the cells at their rear ends and also through the openings 50 in the fins 26. Ink normally will be drawn out of the cells at their inner side edges and at their forward ends as illustrated somewhat diagrammatically in Fig. 10. Air normally will enter the cells behind the body of ink therein and will gradually fill the cells from the rear toward the front and from the outer edges toward the inner edges.

It is essential that any and all conditions which might lead to air lock in the capillary system be eliminated for, as is known to those skilled in the art, air locks will prevent ink from being drawn into a pen during refilling. In addition, air locks will prevent ink from being written out of a pen fully and thus will limit the refill capacity. In some cases air locks may cause complete stoppage of the ink feed. In the pen illustrated herein, air lock is prevented by the provision of pilot feed passages of higher capillarity than the remaining portions of the ink reservoir. The central wick and the inner portions of the cells provide pilot passages of higher capillarity than in the remaining portions of the cell and which maintain the continuity of the body of ink in the capillary system to insure feeding even when air is present in the reservoir under such conditions as might cause air lock were it not for the presence of such preventive means.

The action of such pilot passages is illustrated somewhat diagrammatically in Figure 9 to which reference is made to aid in an understanding of this action. If a globule *a* of ink is formed in one of the cells above, or inclosing, a quantity of air *b* the ink forming such globule will be drawn toward the inner portion of the cell and the wick, since the capillarity of these portions of the system is greater than the capillarity of the outer portion of the cell. The ink globule is thus drawn away from the outer portion of the cell, as indicated by the line *c* in Figure 9, thereby, freeing the air entrapped forwardly or within the globule and allowing such air to join the air above the globule. The ink forming the globule may be entirely drawn into the wick. However, if the wick is saturated, the globule may not enter the wick, but it will pass down the cell along the inner edge portion thereof and eventually join with ink in the forward end of the cell, as indicated at *d* in Figure 9.

The capillary action in all parts of the pen is sufficient so that the ink is maintained therein under all conditions of normal use such as changes in position and changes in temperature and pressure, but is caused to flow to the nib by capillary action when the nib is engaged with and moved along a writing surface. Since the ink in the reservoir is maintained substantially under atmospheric pressure, and is fed therefrom by capillary action, the ink will flow smoothly and evenly and will not alternately flood or starve as is often the case in pens of the type wherein ink is retained in the reservoir by partial vacuum and air enters the reservoir intermittently to replace ink which is drawn off in writing. Because the capillarities of the inner portions of the cells and the adjacent wick are higher than the capillarity of the cells at the outer portions, ink will be retained in the upper portions of the cells at the inner portions in the manner indicated in a very general diagrammatic manner in Fig. 10. However, since the central wick is in feeding relation with all of the cells throughout their lengths ink will be drawn out of the cells as the pen is emptied until the cells are substantially empty.

The wick provides a means of relatively large cross-section for supplying ink to the nib and thus a ready but controlled supply of ink is always available at the nib. Since the wick provides a large number of passages in parallel, the clogging of one or more of the passages would not appreciably affect the availability of ink at the nib or the free flow thereto.

The novel features of the present invention may be embodied in pens of various sizes and forms. In one illustrative embodiment of the invention in which the pen barrel, pen section and nib were approximately of the size ordinarily used in a pocket pen, excellent results were obtained by employing an ink reservoir having an internal diameter of 0.375" and an overall length of 1¾" to 2". The capillary cell structure was formed of fins, each having a length of 1¾" and a width of 0.140" providing a central opening having a diameter of 0.095". The wick was formed with a diameter of approximately 0.100" to completely fill the central space. The fins which were 0.001" in thickness were spaced apart to provide cells each having a width of 0.006" at the outer edge and 0.001" width at its inner edge. The air equalizer passage had a diameter of 0.050". The pen had a total initial ink capacity of approximately 2.5 grams and a refill capacity of approximately 1.5 grams.

In Fig. 11 there is illustrated an embodiment of the invention wherein the pad is formed by a portion of the wick. Only the front end construction of the pen is illustrated, since the re-

mainder of the pen may be similar to the pen illustrated in Fig. 1 and described above.

The pen includes a barrel 101 having a pen section 104 carrying a feed bar 106 and a nib 107 and generally similar to equivalent elements illustrated in Fig. 1.

A wick 129 cooperating with cell defining fins 126 is provided which extends along the feed bar 106 and into feeding relation with the nib 107, all in a manner generally similar to that described in connection with the structure of Fig. 1. However, in lieu of providing a separate pad at the forward ends of the capillary cells, a generally equivalent pad element is provided by expanding the wick laterally, as indicated at 140, to fill the space between the forward ends of the fins and the rearward end of the pen section. This is accomplished preferably by pushing toward each other the portions of the wick on either side of the pad-forming section 140 in the nature of an upsetting operation, thereby to cause the wick to bulge laterally.

A modified manner of forming the air equalizer also is illustrated in Fig. 11. The air passage 146 may be defined by a tube 147 extending throughout the chamber in the barrel. At the forward end, the tube 147 enters the end of a passage 148 formed in the underside of the feed bar 106 which passage extends throughout the length of the feed bar and has its forward end open to the atmosphere.

It will be understood, of course, that either of the specific forms of pad illustrated in Fig. 1 or 11 may be used with any of the several forms of air passage described and vice versa.

I claim:

1. A fountain pen comprising a pen body having an ink reservoir space extending throughout a substantial portion of the length thereof, a writing element, means supporting said writing element on said pen body, a plurality of partitions each extending longitudinally in said reservoir space and converging transversely thereof, said partitions being spaced apart to define a plurality of capillary cells increasing in capillarity transversely of said reservoir space, and feed means extending from said cells into feeding relation with said writing element.

2. A fountain pen including a barrel adapted to hold ink, a writing element carried by said barrel, a capillary filler and reservoir structure including a plurality of fins extending longitudinally of said barrel and spaced apart to form longitudinal capillary passages, each fin extending from the wall of the barrel inwardly toward the center thereof, the inner edges of adjacent fins being spaced apart to provide communication with the passages defined between the other fins, and feed means extending from said passages into feeding relation with said writing element.

3. A fountain pen including a barrel adapted to hold ink, a writing element carried by said barrel, a capillary filler and reservoir structure including a plurality of fins extending longitudinally of said barrel and spaced apart to form longitudinal capillary passages, said fins extending from the wall of the barrel to inwardly short of the center of the barrel to form a central passageway, the inner edges of adjacent fins being spaced apart to provide communication with the central passageway and the passages defined between the other fins, and feed means extending from said passages into feeding relation with said writing element including ink-conducting element in said central passageway.

4. A fountain pen including a barrel adapted to hold ink, a writing element carried by said barrel, a capillary filler and reservoir structure including a plurality of fins extending longitudinally of said barrel, and spaced apart to form longitudinal, transversely tapered capillary passages, the edges of adjacent fins at the narrower portions of said passages being spaced apart to provide communication with the passages between the other fins, and feed means extending from said passages into feeding relation with said writing element.

5. A filler element for a capillary filling fountain pen comprising, a plurality of wall elements disposed in generally radial arrangement and extending substantially throughout the length of said filler element and means spacing said wall elements whereby they define a plurality of longitudinally extending capillary cells of sufficient capillarity to lift ink therein to substantially fill said cells when the latter are placed in communication with a supply of ink, said increasing in capillarity toward the center of said filler element.

6. A combined capillary filler and feed element for a capillary filling fountain pen comprising, a plurality of opposed wall elements extending substantially throughout the length of said filler element, means spacing said wall elements whereby they define a plurality of capillary cells of sufficient capillarity to lift ink therein to substantially fill said cells when the latter are placed in communication with a supply of ink, a capillary first feed means extending along said capillary cells in feeding relation therewith, and a second feed means connected to said first feed means and extending beyond an end of said wall elements for association with a writing element when said filler and feed element is assembled in a fountain pen.

7. A fountain pen comprising a pen casing having a feed section and a reservoir section defining a reservoir chamber, a writing element at the forward end of said casing, a capillary filler-and-reservoir element in said chamber including partition means having a plurality of elongate portions providing planar opposed walls extending longitudinally of said chamber and defining therebetween elongate capillary ink storage cells extending longitudinally of said chamber in side-by-side relation, said opposed walls being spaced apart a distance not exceeding that which will produce a capillary rise of ink in said cells, whereby each cell has sufficient capillarity to fill itself by capillary action and to retain the ink therein by capillary action but insufficient to prevent withdrawal of the ink in writing, capillary ink feed means including a feed passage connecting said cells in ink feeding relation with said writing element said feed passage having a width not greater than said cells and sufficiently narrow to maintain a continuous column of ink from said cells to said writing element, and means constantly venting said cells to atmosphere.

8. A fountain pen comprising a pen casing having a feed section and a reservoir section defining a reservoir chamber, a writing element at the forward end of said casing, a capillary filler-and-reservoir element in said chamber including a plurality of elongate, essentially planar partition elements extending longitudinally of said chamber and disposed with their wall surfaces in opposition and spaced to define therebetween

elongate capillary ink storage cells extending longitudinally of said chamber in side-by-side relation, said elements having projections therein abutting adjacent elements for maintaining the spaced relation of said wall surfaces, said opposed wall surfaces being spaced apart a distance not exceeding that which will produce a capillary rise of ink in said cells, whereby each cell has sufficient capillarity to fill itself by capillary action and to retain the ink therein by capillary action but insufficient to prevent withdrawal of the ink in writing, capillary ink feed means connecting said cells in ink feeding relation with said writing element and having a width not greater than said cells and sufficiently narrow to maintain a continuous column of ink from said cells to said writing element, and means constantly venting said cells to atmosphere.

9. A fountain pen comprising a pen casing having a feed section and a reservoir section defining a reservoir chamber, a writing element at the forward end of said casing, a capillary filler-and-reservoir element in said chamber including partition means having a plurality of essentially planar portions extending longitudinally of said chamber and disposed with the wall surfaces of adjacent portions in opposition and mutually inclined in a direction transversely of said chamber to define therebetween elongate, capillary ink storage cells, each extending longitudinally of said chamber and of convergent, transverse, cross-sectional shape, said opposed wall surfaces being spaced apart a distance not exceeding that which will produce a capillary rise of ink in said cells, whereby each cell has sufficient capillarity to fill itself by capillary action and to retain the ink therein by capillary action but insufficient to prevent withdrawal of the ink in writing, and capillary ink feed means connecting said cells in ink feeding relation with said writing element.

10. A fountain pen comprising a pen body having an ink reservoir space extending throughout a substantial portion of the length thereof, a writing element, means supporting said writing element on said pen body, a capillary filler-and-reservoir element including opposed walls defining a plurality of capillary cells in said reservoir space, feed means extending from said cells to said writing element, the walls defining each of said capillary cells being closer together at the portions of the cells adjacent said feed means than in the portions remote from said feed means whereby said cells have greater capillarity in the portions adjacent said feed means than in the remote portions, and means venting said reservoir space to atmosphere.

11. A fountain pen comprising a pen body having an ink reservoir space extending throughout a substantial portion thereof, a writing element, means supporting said writing element on said pen body, capillary filler-and-reservoir means including opposed walls defining a plurality of capillary passages in said reservoir space, the walls being mutually inclined inwardly toward the central portion of said reservoir whereby the cells increase in capillarity toward said central portion, and feed means of greater capillarity than said passages in feeding relation therewith and extending longitudinally and substantially centrally of said reservoir space into feeding relation with said writing element.

12. A fountain pen comprising a pen body having an ink reservoir space extending throughout a substantial portion of the length thereof, a writing element, means supporting said writing element on said pen body, capillary filler-and-reservoir means defining a plurality of capillary cells extending longitudinally throughout said reservoir, a first feed means defining a feed passage of smaller transverse dimension and greater capillarity than said cells disposed between said cells and said writing element and in ink feeding communication with said cells, and a second feed means defining a feed passage of smaller transverse dimension and greater capillarity than the passage of said first feed means, extending from said cells and said first feed means into feeding relation to said writing element.



13. A capillary filler-and-reservoir element for a fountain pen of the type including a body having a vented ink reservoir space, a writing element and means supporting said writing element on said body, said capillary filler-and-reservoir element adapted to be disposed in said space including walls defining a plurality of capillary chambers, said walls extending longitudinally of said reservoir space and inclined inwardly toward the central portion of said reservoir space, feed means including a feed passage of lesser transverse dimension and greater capillarity than said chambers extending from said chambers for connection with said writing element, and vent means including an air passage extending along said reservoir space and communicating with said capillary chambers for venting said chambers to said reservoir space.

14. A fountain pen comprising a pen body, having a reservoir space, a writing element, means mounting said writing element on said pen body, capillary filler-and-reservoir means including a plurality of fins disposed substantially radially of said reservoir space and extending longitudinally thereof to define a plurality of capillary cells, an air passage extending throughout said reservoir space and communicating with the exterior of said pen body for maintaining substantially atmospheric pressure on the air in said pen, and capillary feed means connecting said capillary cells and said writing element.

15. A fountain pen comprising a pen body having an ink reservoir space extending throughout a substantial portion thereof, a writing element, means supporting said writing element on said pen body, capillary filler-and-reservoir means in said reservoir space including rigid, fixed walls defining a plurality of capillary cells each extending longitudinally of said reservoir space, said cells decreasing in wall-to-wall width transversely of said reservoir space and being open at their rear ends, capillary feed means connecting said cells and said writing element, and removable closure means at the end of said pen body remote from said writing element which when removed renders said cells accessible for placing them in capillary filling relation to a supply of ink.

16. A capillary filler-and-reservoir structure for a fountain pen of the type including a barrel adapted to hold ink, a writing element carried by said barrel and feed means connected to said writing element, said capillary filler-and-reservoir structure including a plurality of fins extending longitudinally thereof, and spaced apart to form longitudinal, capillary passages, said fins extending inwardly toward the center of said structure, with the inner edges of adjacent fins spaced apart to provide a central passage communicating with the passages between the other fins, the space between the inner portions of adjacent fins being less than the space

between the outer portions to provide greater capillarity of said passages adjacent the inner edges, and ink-conducting means extending through the central passage of greater capillarity than the capillarity of the passages adjacent the inner edges of adjacent fins for connection to the feed means.

FREDERICK R. WITTNEBERT.


## REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 381,417 | Pellinger | Apr. 17, 1888 |
| 674,943 | St. Clair | May 28, 1901 |
| 715,359 | Dickie | Dec. 9, 1902 |
| 1,001,225 | Sinnot | Aug. 22, 1911 |
| 1,336,119 | Andersen | Apr. 6, 1920 |
| 1,413,476 | Greenlaw | Apr. 18, 1922 |
| 2,114,118 | Studer et al. | Apr. 12, 1938 |
| 2,151,682 | Burkey | Mar. 28, 1939 |
| 2,235,453 | Kirmes | Mar. 18, 1941 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 338,989 | France | 1904 |