Aug. 11, 1953 F. E. BARTELL 2,648,309

FOUNTAIN PEN

Filed Sept. 23, 1950 3 Sheets-Sheet 1

Fig. 1.

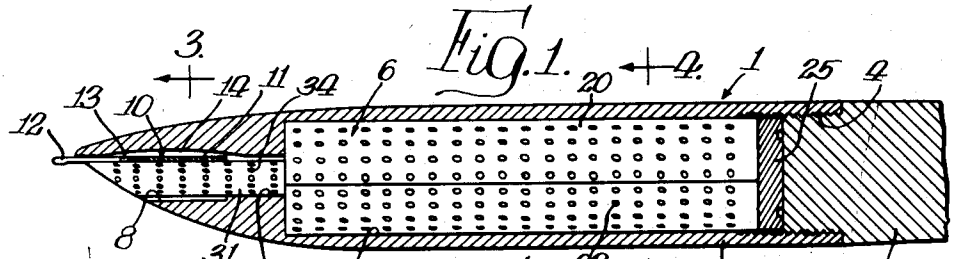


Fig. 2.

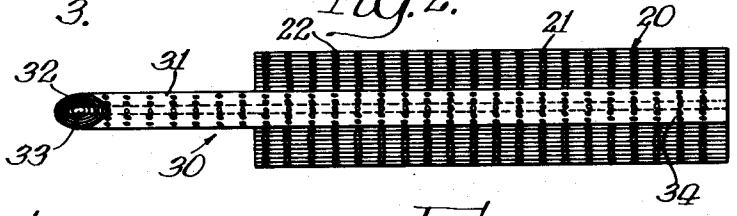


Fig. 3.

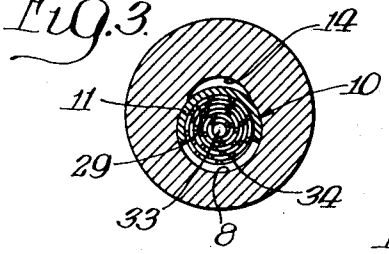


Fig. 4.

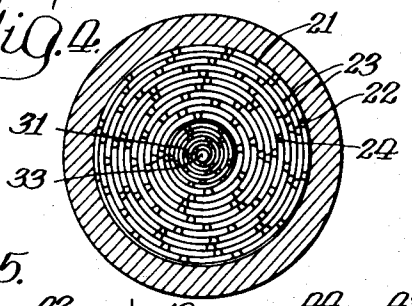


Fig. 5.

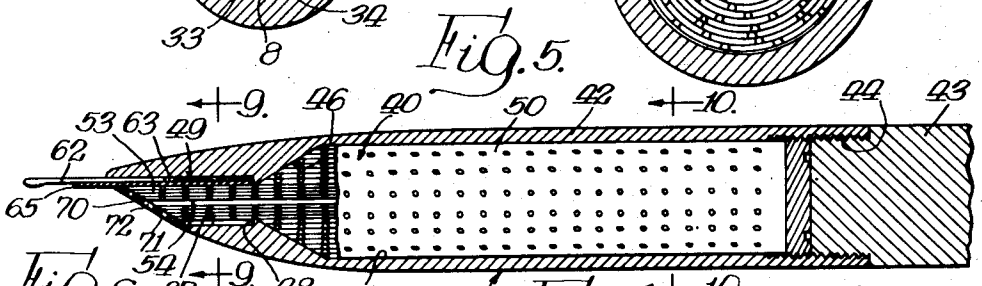


Fig. 6.

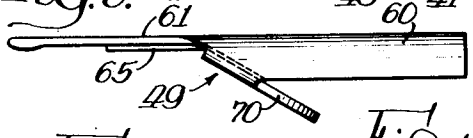


Fig. 7.

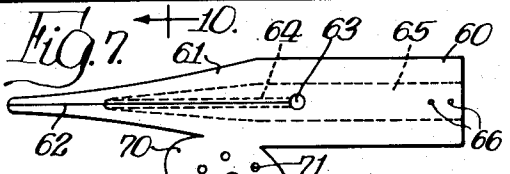


Fig. 9.

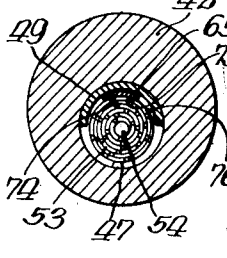


Fig. 10.

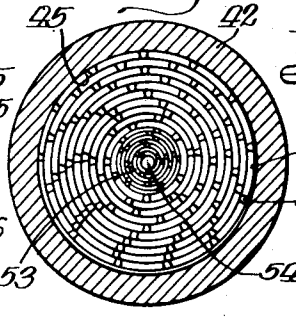
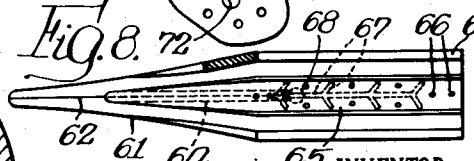


Fig. 8.



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FOUNTAIN PEN

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Fig. 11.

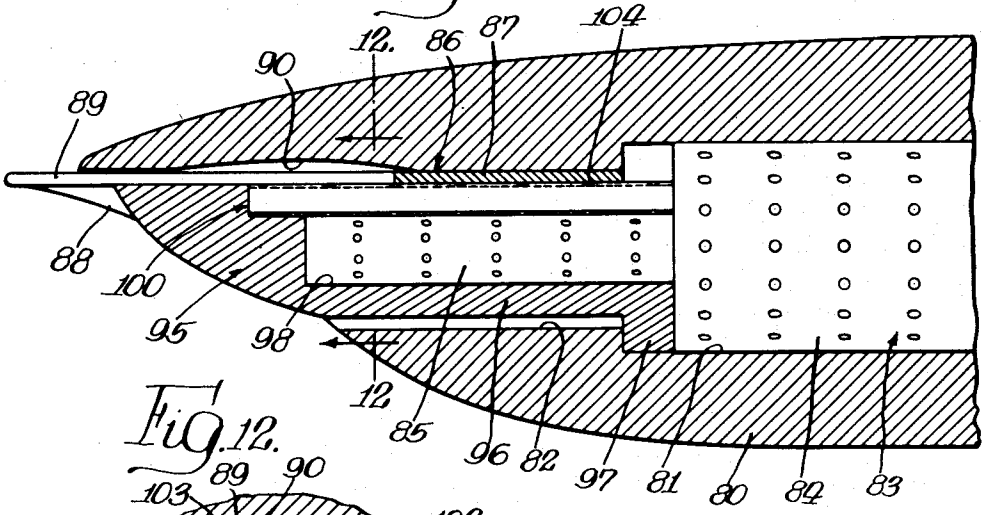


Fig. 12.

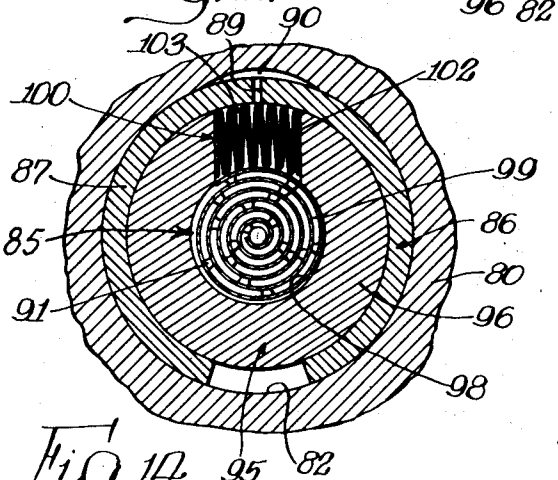


Fig. 13.

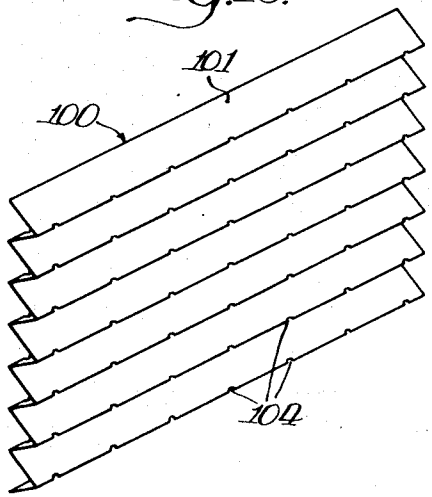
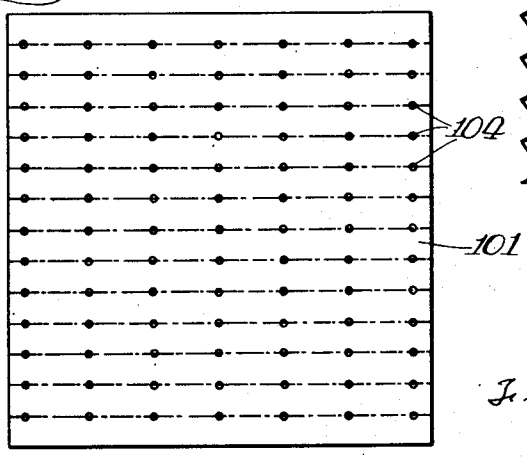


Fig. 14.



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Aug. 11, 1953 F. E. BARTELL 2,648,309

FOUNTAIN PEN

Filed Sept. 23, 1950 3 Sheets-Sheet 3

Fig. 15.

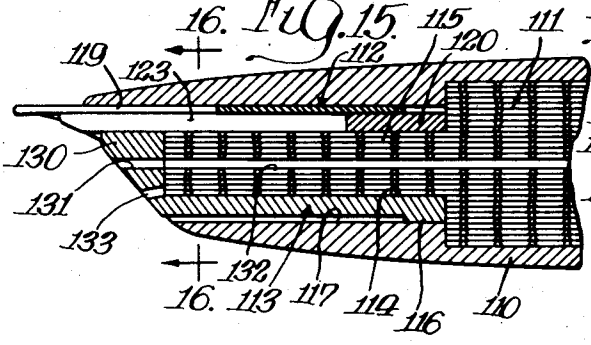


Fig. 16.

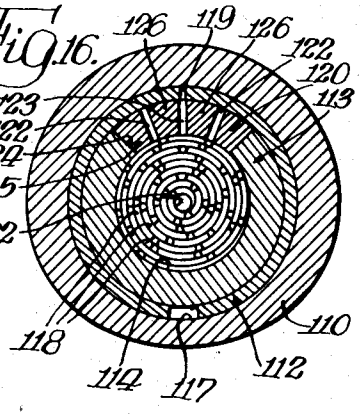


Fig. 17.

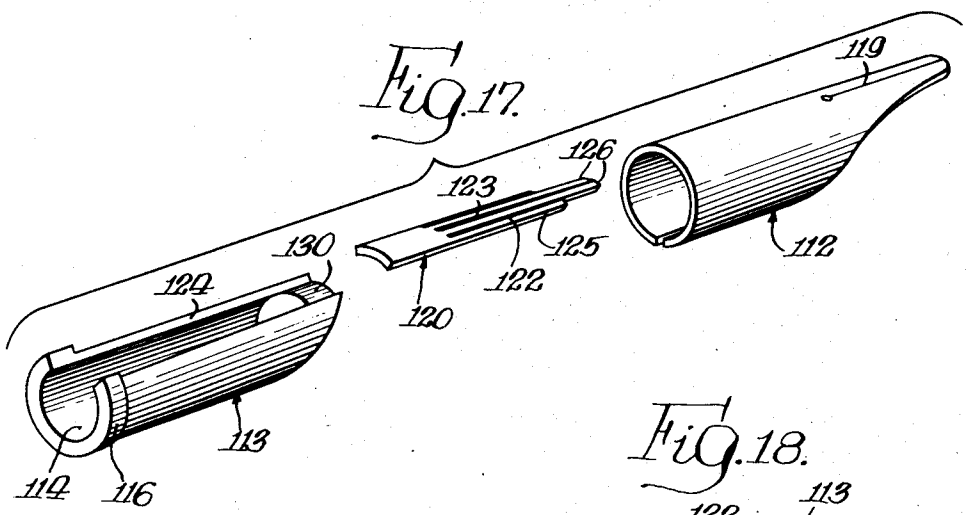


Fig. 18.

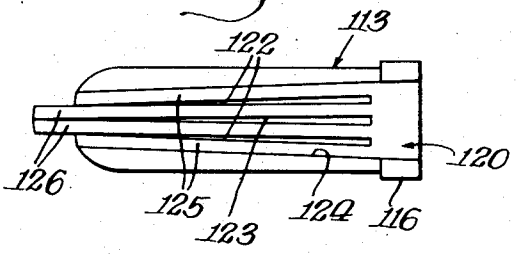
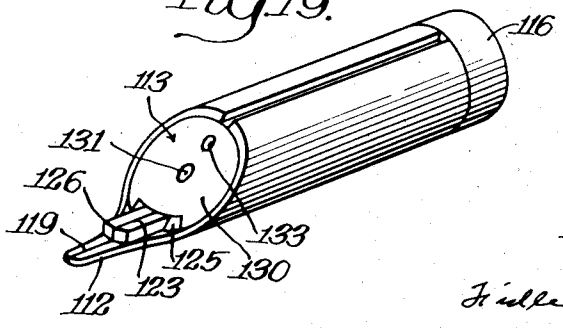


Fig. 19.



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Patented Aug. 11, 1953 2,648,309

UNITED STATES PATENT OFFICE

2,648,309

FOUNTAIN PEN

Floyd E. Bartell, Ann Arbor, Mich., assignor to The Parker Pen Company, Janesville, Wis., a corporation of Wisconsin

Application September 23, 1950, Serial No. 186,415

21 Claims. (Cl. 120—51)

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This invention relates generally to fountain pens and has to do particularly with a fountain pen of the type having an ink reservoir adapted to be filled by capillary action and to retain ink therein by capillary action except when the ink is withdrawn in writing.

An object of the present invention is to provide a fountain pen having an improved capillary ink storage and feed means.

Another object is to provide a fountain pen of the type having a capillary ink storage reservoir in which pen the storage space in the reservoir is directly and effectively connected to the writing point of the pen in such manner that a continuous column of ink is maintained from the storage space to the writing point and is not subject to interruption under the usual conditions of use and handling of the pen.

Another object is to provide an improved combined capillary ink storage reservoir and feed unit which has a maximum ink storage capacity for any predetermined over-all size of pen.

A further object is to provide a pen of the type having an ink reservoir adapted to be filled by capillary action and to retain the ink by capillary action wherein the capillary system is so constructed as to insure rapid filling of the reservoir, effective feed of the ink to the writing point or nib during writing, and substantially complete write-out of ink from the reservoir.

Other objects are to provide a fountain pen of the type having a capillary ink storage reservoir in which pen the reservoir and feed are formed as a unitary structure; to provide a combined capillary ink storage and feed unit which can be readily and inexpensively made and installed in a pen casing; to provide an effectively vented capillary ink storage and feed unit; to provide a capillary ink storage and feed unit having improved filling and feeding characteristics; to provide a capillary pen having an improved feed for connecting the capillary ink storage space with the writing point; to provide a capillary pen which may be rapidly filled by immersing only the extreme forward end of the pen casing in a supply of ink; and to provide a capillary pen in which the ink storage space is directly connected to the writing point.

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

Figure 1 is a fragmentary longitudinal vertical sectional view of a fountain pen embodying my invention;

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Fig. 2 is a view partially in cross section of the reservoir and feed elements of the pen of Figure 1, showing the cross-sectional portion diagrammatically;

Fig. 3 is an enlarged transverse sectional view taken along line 3—3 of Figure 1, showing the capillary unit diagrammatically;

Fig. 4 is an enlarged transverse sectional view taken along line 4—4 of Figure 1, showing the capillary unit diagrammatically;

Fig. 5 is a fragmentary longitudinal vertical sectional view of another embodiment of my invention, showing the capillary unit partially in section and diagrammatically;

Fig. 6 is an enlarged side elevational view of the nib unit of Fig. 5;

Fig. 7 is a top plan view of the nib unit of Fig. 6 in an intermediate stage of the formation thereof;

Fig. 8 is a bottom view, partially in cross section, of the nib of Fig. 6;

Fig. 9 is an enlarged transverse sectional view taken along line 9—9 of Fig. 5, showing the capillary unit diagrammatically;

Fig. 10 is an enlarged transverse sectional view taken along line 10—10 of Fig. 5, showing the capillary unit diagrammatically;

Fig. 11 is an enlarged fragmentary vertical longitudinal sectional view through the forward end portion of a further embodiment of my invention;

Fig. 12 is an enlarged fragmentary cross-sectional view taken along line 12—12 of Fig. 11;

Fig. 13 is an enlarged perspective view of the feed element of Fig. 11;

Fig. 14 is a plan view of a sheet from which the feed element of Fig. 13 is formed;

Fig. 15 is a fragmentary longitudinal sectional view through the forward end portion of still another embodiment of my invention, showing the capillary unit diagrammatically;

Fig. 16 is an enlarged fragmentary cross-sectional view taken along line 16—16 of Fig. 15, showing the capillary unit diagrammatically;

Fig. 17 is an exploded perspective view of the nib, feed bar and feed plate of the structure of Fig. 15;

Fig. 18 is a top plan view of the feed bar and feed plate; and

Fig. 19 is a perspective view of the nib, feed bar and feed plate.

The present invention may be embodied in a fountain pen of the desk type or of the pocket type or of the dual purpose type wherein the pen is adapted to receive either a blind cap for use as a pocket pen or an elongated tail-piece for use as a desk pen.

Referring particularly now to Figure 1 of the drawings, there is illustrated a fountain pen comprising a body or casing 1 formed of suitable material, as for example a suitable plastic, which casing preferably is formed as a plurality of separate members or sections. The casing includes a barrel or forward section 2 and a rear section 3 connected thereto as by a threaded joint 4. The forward section 2 is formed with an axially extending bore 5 which defines an ink reservoir space adapted to receive a combined capillary reservoir and feed element or unit hereinafter more fully described. A reduced bore 7 extends forwardly from the chamber 5 through the forward end of the barrel 2 and preferably is counterbored as at 8.

A writing element of suitable form is carried at the forward or writing end of the casing and preferably takes the form of a nib 10 having a generally arcuate body 11 formed as a portion of a cylinder, and a tapered writing tip provided with a longitudinal slit 12 terminating rearwardly in a pierce 13. The nib 10 is suitably secured in the counterbore 8, preferably by frictional engagement therewith of sufficient tightness to prevent dislodgement or rotation of the nib therein in normal use. The counterbore 8 preferably is relieved in its upper wall portion to provide an arcuate capillary space 14 above the nib for the purpose of retaining ink above the nib which aids in insuring that the nib slit will remain filled with ink as long as there is ink in the pen, in order to provide for instant writing.

The capillary unit or element 6 includes an ink storage or chamber section 20 formed in a manner somewhat similar to the capillary filler and reservoir element disclosed and claimed in my copending application Serial No. 732,032 filed March 3, 1947, now Patent Number 2,522,555, to which reference is made for further details of construction and functioning. Briefly, the chamber or ink storage section 20 is formed by spirally wrapping or rolling upon itself a thin sheet 21 of suitable material such as metal or plastic having surface characteristics rendering it suitably wettable by inks of the type customarily used in fountain pens. The consecutive turns of the sheet 21 are spaced apart in a suitable manner as by projections 22 which may be formed in a manner similar to that disclosed in my aforesaid application such a distance as to provide a capillary space or spaces 23 between the turns. Preferably the chamber or ink storage section 20 is formed from a single sheet of material, in which case there is defined between the turns a single capillary space of generally spiral cross-sectional shape in a direction transversely of the section. On the other hand, the section 20 may be formed of a plurality of sheets rolled together, in which event there will be a plurality of spiral capillary spaces.

The several convolutions of the capillary space 23 preferably are interconnected through the turns of the sheet 21 by spaced openings 24 formed in the turns or convolutions of the sheet to provide for flow of ink or air between consecutive convolutions of the space. The openings 24 may be formed either in the projections 22 as illustrated herein (and as more particularly disclosed in my aforesaid application) or may be formed in the sheet between the imperforate projections (also as more particularly disclosed in my aforesaid application).

The capillary element or unit 6 also includes a core or central section 30 which in the present illustrative embodiment is formed separately from the chamber section 20. The core section 30 is formed in a manner generally similar to the section 20 but the turns of the sheet forming the former preferably are spaced closer together so as to provide a capillary space of greater capillarity than the capillary space of the chamber section 20. The core section 30 is of such diameter that it fits within the inner turn of the sheet forming the chamber section 20 and is of such length that it projects forwardly, as at 31, a substantial distance beyond the forward end of the sheet 21 forming the chamber section 20, as illustrated particularly in Figs. 1 and 2. While the chamber section 20 and core section 30 may be formed separately and assembled, preferably the core section 30 is formed first and the sheet 21 constituting the chamber section 20 is rolled upon the core section 30, the latter serving in the manner of a core or mandrel during the wrapping of the chamber section 20.

It should be noted at this point that while for convenience in the description I have designated the one section of the capillary element as a chamber section and the other as a core section, the latter serves to provide storage space for ink within the pen and therefore forms a portion of the ink storage reservoir of the pen of this invention.

The capillary element 6 is disposed in the forward section 2 of the pen casing with the chamber section 20 snugly fitted within the reservoir space 5 and the projecting portion 31 of the core section extending in the bore 7 and counterbore 8 and into the nib 10. The portion 31 is of such diameter that it snugly fits in the nib and the outer convolution of the sheet forming the core section 30 bears firmly against the under face of the nib 10, thereby establishing and maintaining a capillary connection between the projecting portion 31 and the nib slit 12 and pierce 13. It will be noted in this connection that owing to the close fit between the projecting portion 31 and the nib 10, a narrow arcuate capillary space is provided therebetween into which ink is drawn from the spiral capillary space in the projecting portion 31 and from which arcuate space ink is drawn into the nib slit 12 and pierce 13. The projecting portion 31 cooperates with the nib 10 in a manner somewhat analogous to a feed bar and therefore is referred to sometimes herein as the "feed bar portion" of the capillary unit. It will be noted, however, that the core section 30 extends throughout the chamber section 20 and defines a continuous capillary space throughout its length which is in communication with the capillary space in the chamber section throughout the length of the latter.

The capillary unit 6 is suitably maintained in the forward casing section 2 as by a securing member 25 which may be threaded into the forward casing section to abut the rear end of the unit 6. The feed bar portion extends to the extreme forward end of the pen casing. Preferably the forward end of the casing is inclined as shown, in which case the extreme end preferably is similarly inclined to prevent projection beyond the end of the casing.

The capillary space in the core section 30 preferably is made with a slightly less wall-to-wall dimension than the capillary space in the chamber section, thereby providing in the core section a space of greater capillarity than the space in the chamber section. Accordingly, ink will be drawn from the capillary space 23 into the

capillary space 32 in the core section and the latter will always remain filled with ink so long as there is any ink in the pen.

For the purpose of venting the capillary spaces in the unit 6 to atmosphere, to permit ink to enter such spaces during filling and to permit air to enter such spaces during writing to replace ink which is withdrawn in writing, a vent 33 is provided which communicates with the aforesaid spaces and the exterior of the pen. The vent 33 conveniently is formed by rolling the inner convolution to a suitable diameter to provide a passage of the desired size. It has been found that in order to provide effective venting the diameter of the vent should be approximately ten times or more the wall-to-wall dimension of the capillary spaces. The turns of the core section 30 are spaced by projections 34 and are provided with openings in a manner similar to the turns of the chamber section which openings provide communication between the vent 33 and the innermost turn of the capillary space.

It will be noted that the capillary system which includes the chamber section and the core section provides a substantially continuous capillary space extending from the outermost turn of the capillary space within the chamber section 20 to the forwardmost portion of the core section 30. Thus a continuous column of ink extends from the chamber section to the nib 10. The capillary space within the core section is continuous throughout and since the core section is constituted by a single member there is no possibility of separation of any portions of such capillary space and consequently little likelihood of the column of ink being broken under normal conditions of handling or use of the pen.

To fill the pen the forward end of the pen is inserted in a supply of ink to place the capillary space in the capillary unit in feeding communication with the supply of ink. This may be accomplished by merely inserting the tip of the nib in the supply of ink, whereupon ink is drawn into the pen through the nib slit and from thence to the projecting portion 31 of the capillary unit and the ink is drawn by capillary action upwardly in the core section 30 and from thence into the capillary space in the chamber section 20. On the other hand, where more rapid filling is desired the pen may be inserted in the supply of ink to such an extent that the forward end of the core section 30 is immersed and ink enters the capillary space in the core section directly and is thereupon drawn into the space. Thus a flow path of ink into the pen of substantial cross-sectional area is provided and relatively rapid filling results. The capillary space 32 being continuous and straight from the forward end of the core section 30 to the extreme rear end thereof, the ink will be elevated therein rapidly and will be drawn from such space into the space 23 in the chamber section over a wide extent, thus contributing to the rapidity of the filling action.

In writing, when the tip of the nib 12 is placed in contact with a writing surface the capillary action thus established overbalances the capillarity of the capillary element and ink is drawn therefrom and deposited on the writing surface. Ink is drawn into the nib slit from the core section 30 and since the continuity of the column of ink which extends in the core section is maintained, therefore as ink is withdrawn from the nib a corresponding quantity of ink is drawn into the core section 30 from the chamber section.

Air to replace ink which is withdrawn from the capillary element 6 enters the pen at the forward end and passes into the element by way of the vent 33 and from thence through the perforations in the sheet 21 forming the core section 30 and in the sheet forming the chamber section 20. While the pen may be vented in the manner just described, it may also or additionally be vented at the rear of the capillary element in a manner generally similar to that disclosed in my aforesaid application.

The capillary element may be formed in various sizes with each several portions thereof variably dimensioned in accordance with the principles indicated in the foregoing description. In one practical embodiment of a fountain pen employing my invention and wherein the overall dimensions of the pen were similar to those of a conventional fountain pen, excellent results were obtained by forming the capillary element as follows: A sheet of silver foil approximately 0.002" in thickness, approximately $2\frac{11}{16}$" in length and $1\frac{5}{8}$" in width was perforated by diagonally extending rows of perforations approximately 0.02" in diameter disposed about 0.04" apart in rows which were about 0.08" apart. The projections resulting from punching the sheet were approximately 0.004" in height. This sheet was rolled upon itself and the outer convolutions tacked together as by soldering to prevent unwinding. The core was so rolled that the vent-opening defined by the inner turn was approximately 0.050" in diameter. The core thus formed had a diameter approximately equal to the internal diameter of the pen nib. The chamber section was formed from a sheet 0.001" in thickness and 2" in width by 14" in length. This was provided with perforations approximately 0.004" apart arranged in rows approximately $\frac{5}{32}$" apart. The projections resulting from punching the perforations were approximately 0.005" in height. The inner end of the sheet was inserted under the outer turn of the core and the sheet then wound about the core as a mandrel, thereby resulting in a capillary unit the chamber section of which was approximately 0.311" in diameter. After rolling the sheet to form the chamber section the turns were tacked in place by solder at spaced points along the edges, and the core section and chamber section were firmly joined in a generally similar manner.

If desired, the chamber section may be so formed that the turns adjacent the core have the closest spacing of any of the turns in the chamber section and the remaining turns have progressively greater spacing in a direction toward the outer turns. In this case the innermost turns of the chamber section should be spaced no more closely than the turns of the core. This progressive increase in spacing may be provided by forming the projections of suitably increasing heights from the portion of the sheet which forms the inner turns to the portion which forms the outer turns. For convenience in manufacture the unit may be so formed that the spacing of the turns does not increase progressively in each turn but the spacing of an inner series of turns, for example the inner third, is the same; the spacing of the next outer series of turns, for example the next third, is slightly greater; and the spacing of the outermost series of turns, for example the outer third, is the greatest.

The capillary unit or element may be formed from a single sheet, which sheet is so shaped and rolled that it constitutes both the chamber section and the core section. Such a unit **40** is illustrated in connection with the pen shown in Figs. 5 to 10 inclusive which will now be described.

The pen includes a body or casing **41** having a barrel or forward section **42** and a rear section **43** formed in a manner generally similar to the corresponding members of the pen of Figure 1 and connected as by a threaded joint **44**. The barrel **42** is provided with a bore **45** which may have a convergent or tapering forward wall **46**. A bore **47** extends from the forward end of the barrel **42** to close to the wall **46** thereby leaving a small shoulder **48**. A nib **49**, described more in detail hereinafter, is snugly fitted in the bore **47** and seated against the shoulder **48**.

The capillary unit **40** is formed in a manner generally similar to the unit **20** but, as stated above, is formed preferably from a single sheet **50** of material of suitable shape. The sheet is provided with projections **51** and perforations, in a manner similar to that above described in connection with unit **20**, and the perforations may extend through the projections as described. The sheet when thus rolled defines a spiral capillary space **52** in a manner which will be apparent.

The sheet **50** is of such shape that when rolled the forward edges of the outer turns converge inwardly and forwardly from the outermost turns, whereby the forward portion of the outer turns conform generally to the shape of the forward end wall **46**. The inner turns project beyond the outer turns and define a projecting portion **53** generally similar to the portion **31** above described. The portion **53** extends into the nib **49** and cooperates therewith in a manner generally similar to that described in connection with the form of pen shown in Figure 1. The innermost turn of the sheet is so rolled as to provide an air vent **54** which extends throughout the length of the capillary unit.

While any suitable nib may be employed with the capillary unit just described, excellent results have been obtained by employing the novel form of nib shown in Fig. 5 and illustrated more in detail in Figs. 6 to 8. The nib includes an arcuate body portion **60** and a tapered writing portion **61** provided with a slit **62** terminating in a pierce **63**.

The nib **49** is so constructed as to provide an effective connection between the projecting portion **53** of the capillary unit and at the same time minimize the tendency of ink to evaporate from the nib slit, which drying out results in the pen not being ready for instant writing. To this end I form on the under side of the nib a small groove **64** extending along the nib slit and which groove conveniently is of V-shaped cross-section. The open under side of the groove is covered by a cover strip **65** extending longitudinally along the under side of the nib so as to overlie the groove, which strip is suitably secured to the nib as by small rivets **66** or spot-welding. The strip preferably is secured to the nib only at its rear portion, or central and rear portions, and is free at portions thereof which extend forwardly of the rear end of the nib slit. Thus, the cover strip does not interfere with the flexing of the nib. In this connection, the nib preferably is formed with a somewhat longer and narrower tapered writing section than conventional nibs, which provides increased flexibility of the nib.

The groove **64** and strip **65** thus define a small capillary space extending along the under side of the nib and registering with the nib slit. There is also provided between the under face of the nib and the upper face of the strip **65** a narrow arcuate capillary space **74** which communicates with the capillary passage just described. I also preferably provide additional capillary passages communicating with the aforesaid capillary passage by forming one or more grooves **67** in the upper face of the strip **65**. The grooves **67** may be formed in any suitable manner and one effective form is illustrated particularly in Fig. 8 wherein the groove **67** includes an elongate portion extending longitudinally of the strip with branched portions extending laterally therefrom.

The capillary space defined between the strip **65** and nib body **60** is connected to an arcuate capillary space **75** defined between the strip **65** and the upper surface of the feed bar portion **53** by a plurality of perforations **68** formed in the strip **65**. It will be noted particularly that in addition to the capillary space **75** defined between the upper surface of the feed bar portion **53** and the strip **65** there is also an arcuate capillary space **76** on either side thereof (see Fig. 9) defined between the upper face of the feed bar section **53** and the body **60** of the nib.

For the purpose of protecting the forward end **53** of the core section, a cover or end plate **70** is provided which is formed integrally with or attached to the forward edge of the nib in position to extend over and substantially close the forward open end of the bore **47**. The cover or end plate **70** is provided with a central perforation **72** disposed in registry with the forward end of the vent **54** and having a diameter the same as or slightly larger than the diameter of the vent, thereby providing communication between the vent and the exterior of the pen. A plurality of additional openings **71**, which may be smaller than the opening **72**, are provided in order to permit ink to enter the turns of the capillary space defined by the projecting portion of the core section **53** during filling of the pen.

This form of pen may be filled in a manner generally similar to the pen of Fig. 1 and writes out in a generally similar manner.

My invention also provides a novel feed for connecting the projecting portion of the core section to the nib, which may be employed in lieu of disposing the projecting portion in direct contact with the nib. The novel feed arrangement is illustrated particularly in Figs. 11 to 14 to which reference now is made.

The pen casing may be generally similar to that illustrated in Figure 1 and described hereinabove and includes a barrel **80** the forward portion of which is illustrated in Fig. 5 and which has a bore **81** providing a reservoir space and a smaller bore **82** communicating with the bore **81** and extending through the forward end of the pen.

A capillary unit **83** is disposed in the space **81** and may be formed in a manner generally similar to the unit illustrated in Figure 1 or the unit illustrated in Fig. 5 and described above and includes a chamber section **84** and a core section having a forwardly projecting portion **85**. The forward end of the projecting portion **85** preferably is formed with a straight instead of an inclined forward end, for reasons which will hereinafter appear.

A nib **86** is provided having a split, generally cylindrical body **87**, a tapered writing portion **88**, and a slit **89** extending inwardly from the writing

tip substantially throughout the tapered writing end. The nib is frictionally disposed in the bore 82 and terminates at the inner end thereof. Preferably the upper wall of the bore 82 is relieved slightly above the nib to provide an arcuate capillary space 90 adapted to receive and retain ink to maintain the ink readily available for preventing the nib slit from drying out, thereby to insure that the pen is in condition for instant writing.

A feed bar 95 is provided which is formed with a generally cylindrical body portion 96 extending in the nib and a flange or head 97 frictionally disposed in the space 81 and abutting the forward wall thereof to aid in positioning the feed bar in the barrel 80. The feed bar is provided with a bore 98 adapted to receive the projecting end 85 of the capillary unit, the bore being of such diameter as to snugly receive the projecting end 85 but not to appreciably contract the same and thus the spacing of the turns of the sheet from which the capillary unit is formed is not disturbed.

The capillary spaces 99 defined between the turns of the projecting portion 85 are connected in ink-feeding relation with the nib slit 89 by a feed element 100 of novel construction. The feed element 100 is formed from a sheet 101 of material generally similar to that from which the capillary element is formed except that the sheet is not provided with projections. The sheet 101 is folded reversely in alternate directions along spaced parallel lines in order to provide an accordion pleated structure. For a purpose which will hereinafter appear, the sheet is provided with spaced rows of spaced perforations, which rows are coincident with the lines of fold of the sheet so that the perforations occur at the lines of fold.

The feed element 100 consisting of the folded sheet as just described is disposed in the slot 102 with the alternating sections between the lines of fold extending in a generally vertical direction. The feed element 100 is of such length that it extends preferably throughout the entire length of the projecting portion 85 and forwardly beyond such portion so as to underlie a substantial portion of the nib slit 89. The sheet 101 from which the element 100 is formed is of such width that when folded and disposed in the slot 102 it is sufficiently compressed so that the spaces between successive and opposed portions of the sheet define fine capillary spaces 103 (Fig. 12). The wall-to-wall dimension of each of such spaces does not at any point exceed the wall-to-wall spacing of the spaces 99 and preferably is somewhat less than the latter spacing, but is slightly greater than the width of the nib slit which may be around 0.0015". I have found that the maximum wall-to-wall width of the spaces 103 preferably should be around 0.002" to 0.003", but such spacing may be varied slightly so long as the relationship between the spaces and the width of the nib slit and between such spaces and the wall-to-wall dimension of the spaces 99 is preserved.

The spacing between adjacent folds of the sheet 101 from which the element 100 is formed preferably is such that the feed element 100 abuts the under face of the nib, as illustrated in Fig. 12, and bears firmly against the upper face of the outer turn of the projecting portion 85; thus the feed element is suitably confined and supported in the space defined between the nib, the side edges of the slot 102, and the upper face of the projecting portion 85. The natural resiliency of the sheet 101 serves to maintain substantially uniform spacing between adjacent portions of the sheet and thus the spaces 103 are maintained.

From the foregoing it will be seen that a continuous and positive capillary connection is provided from the capillary space within the chamber section of the capillary unit 83 to the nib slit 89. The capillary space (not shown) within the chamber section is connected directly to the capillary spaces 99 within the core section and the latter communicate with the capillary spaces 103 within the feed element 100 through the openings 91 in the outer turn of the projecting portion 85. The several capillary spaces 103 are interconnected by the openings 104 and are in communication with the nib slit 89. Thus a continuous column of ink extends from the capillary space within the chamber section to the nib slit 89.

The several sections of the capillary system within the pen are maintained in ink-feeding communication by reason of the fact that the various elements which define such sections of the capillary space are positively and firmly maintained in their assembled relation. The capillary unit 83 is maintained in position with the forward end of the chamber section abutting the flange on the feed bar 95 by suitable means (not shown) such as the plug or retainer illustrated in Fig. 1. The feed bar is securely positioned by frictional engagement between its flange and the wall of the space 81 and by the abutment between the forward face of the flange 97 and the forward wall of the space 81. The nib 86 is frictionally held in the bore 82 and longitudinally positioned by abutment with the forward face of the feed bar flange 97. The feed element 100 is confined within the feed bar by abutment with the adjacent portions of the capillary unit 83, the feed bar and the nib.

The form of pen just described may be filled by inserting the forward end in a supply of ink preferably to a sufficient depth to immerse the forward end of the feed element 100. Ink passes into the pen through the nib slit, into the space between the nib and feed bar, into the space between the nib and casing. Ink from one or more of such spaces is drawn into the feed element and from thence into the projecting portion 85 and rises in the core section and from there is drawn into the chamber section. Air is expelled through a suitable vent (not shown) provided in the pen casing and communicating with the space 81. When the pen has ink therein, a continuous column of ink stands in the capillary space in the chamber section, the capillary space in the core section, the capillary spaces in the feed element, the space between the nib and feed bar and the nib slit. In writing, ink which is withdrawn at the nib, is replaced and the aforesaid continuous column of ink is maintained. To insure such action, the several portions of the capillary system preferably are so formed that they increase in capillarity from the capillary space in the chamber section to the nib slit in a manner analogous to that described in connection with the pen of Fig. 1.

A further embodiment of my invention is illustrated in Figs. 15 to 19 inclusive, to which reference now is made. In this form a hollow feed bar and separate feed element are employed, the latter being of somewhat simpler and more rugged construction than the folded sheet previously described. The pen casing 110 may be

generally similar to that described in connection with Fig. 11, as may be the capillary unit 111. A nib 112 is provided which may be generally similar to the nib 86.

A feed bar 113 is provided which may be formed of any suitable material but preferably from a plastic as in the case of the feed bar 95. The feed bar 113 is formed as a generally hollow body having a bore 114 extending from the rear end to close to the front end to receive the projecting portion 115 of the capillary unit 111. The feed bar 113 extends into the nib 112 and is provided at its rear end with a flange 116 for the purpose of aiding in positioning the nib 112. The flange 116 may be formed either in a manner similar to the flange 97, or as illustrated in Figs. 15 to 19 inclusive. In the latter case the flange is of a diameter to fit within the opening 117 in the forward end of the casing 110 and abuts the capillary unit 111 and the nib 112.

The capillary spaces 118 defined between the turns of the projecting portion 115 are connected in ink feeding relation to the nib slit 119 by a feed element 120 of simple, rugged construction. The feed element 120 takes the form of a plate of generally arcuate cross-sectional form corresponding to the curvature of the nib body and provided with a plurality of, and preferably three, longitudinally extending slits 122 and 123. The feed element 120 is disposed in a slot 124 formed in the upper side of the feed bar and opening into the bore 114. The slot 124 is suitably dimensioned, as by tapering it toward the forward end of the feed bar 113, so as to cause the tongues 125 and 126 formed by the slitting of the plate to be contracted toward their forward ends. Thus the slits 122 and 123 taper toward their forward ends. The nib 112, feed bar 113 and feed element 120 are so dimensioned and arranged that the feed element 120 is disposed between and in contact with the outer turns of the extended portion 115 of the capillary element 111 and with the inner surface of the upper portion of the nib 112. Accordingly, the slits 122 and 123 serve as capillary ink feed passages connecting the nib slit 119 and the capillary space between the outer turns of the portion 115. These feed passages 122 and 123 taper forwardly and thus increase in capillarity from their rear toward their forward ends. Accordingly, the ink is drawn from the feed element and toward the forward portion of the nib slit by capillary action.

The feed element 120 is formed of material which is suitably wettable by ink of the type used in the pen, and one such suitable material is silver. The feed element 120 preferably is made approximately equal in thickness to the thickness of the feed bar wall and may be around 0.0625" in thickness. The slots are approximately 0.005" wide and when the feed element is in position in the feed bar the slots are closed at their forward ends. This arrangement insures effective feeding of ink from the projecting portion of the feed element to the nib slit. While the feed element may be so formed that all of the tongues 125 and 126 are of equal length, preferably it is formed with the two inner tongues of greater length than and projecting beyond the forward ends of the outer tongues and beyond the end of the feed bar, with the center slot 123 aligned with and extending along the nib slit to close to the forward end of the nib.

The feed bar is formed with a substantially closed forward end 130 which is provided with a vent opening 131 registering with and approximately of the same diameter as the central vent 132 of the capillary element 111. The feed bar also is provided with a filling opening 133 which communicates with the interior of the feed bar and consequently with the capillary spaces within the extending portion 115 to permit ink to be drawn into the pen during filling. Where the nib is provided with a substantially cylindrical body as shown, the filling opening 133 is formed in the forward end wall of the feed bar. However, where the forward end of the nib is cut back or where the nib is provided with an only partially cylindrical body, the filling opening may be formed in the lower wall of the feed bar rearwardly of the forward end thereof.

It is believed that the operation of this embodiment of my invention will be obvious from the description thereof. However, it may be pointed out that during filling, ink is drawn into the pen through the filling opening 133 and is elevated in the capillary element 111 to fill the same. At the same time ink may be drawn into the pen through the spaces between the feed bar and nib and between the nib and nib body 110. Air which is displaced by the incoming ink passes out of the pen through the vent passage 132 and vent opening 131.

In writing, ink which is withdrawn from the nib is replaced by ink which is supplied to the nib slit 119 by the feed element 120.

I claim:

1. A fountain pen comprising a body, a writing element carried thereby, and a capillary reservoir-and-feed element including spirally rolled sheet material having turns thereof spaced apart and defining therebetween a capillary ink storage space, the turns at the inner portion of said element being spaced more closely than the turns outwardly thereof to provide therebetween a space of greater capillarity than the space between said outer turns, said element being disposed in said body with the space between said inner turns, at least, being connected in ink feeding relation to said writing element.

2. A fountain pen comprising a body, a writing element carried thereby, and a capillary reservoir-and-feed element including spirally rolled sheet material, means including spaced projections on the turns of said sheet for spacing said turns apart whereby they define therebetween a capillary ink storage space, said turns being provided with spaced openings providing communication through said turns between the several portions of said capillary space, the turns at the inner portion of said element being spaced more closely than the turns outwardly thereof to provide therebetween a capillary space of greater capillarity than the space between said outer turns, said element being disposed in said body with the capillary space between said inner turns, at least, being connected in ink feeding relation to said writing element.

3. A fountain pen comprising a body, a writing element carried thereby, and a capillary reservoir-and-feed element including spirally rolled sheet material having turns thereof spaced apart and defining therebetween a capillary ink storage space, the turns at the inner portion of said element being spaced more closely than the remaining turns to provide therebetween a space of greatest capillarity and the remaining turns being spaced progressively farther apart from the inner to the outer portion of said element, said element being disposed in said body with the

space between said inner turns, at least, being connected in ink feeding relation to said writing element.

4. A fountain pen comprising a body having a reservoir section and a feed section forwardly of said reservoir section, a writing nib mounted in said feed section, and a capillary reservoir-and-feed element disposed in said reservoir section and including spirally rolled sheet material having turns thereof spaced apart to define therebetween a capillary ink storage space, the turns at the inner portion of said element projecting forwardly beyond the forward ends of the turns outwardly thereof and extending forwardly into said feed section with the space defined by said inner turns connected in ink feeding relation to said writing element.

5. The invention as set forth in claim 4 wherein a feed bar is disposed in said feed section in ink feeding relation with said writing element, said inner turns extend into said feed bar and capillary means are provided connecting the space defined between said inner turns in ink feeding relation with said writing element.

6. The invention as set forth in claim 4 wherein a feed bar is disposed in said feed section in ink feeding relation with said writing element and means including folded sheet material is disposed between and in capillary relationship with at least one of said projecting turns and said writing element and defines between the folds thereof capillary feed passages connecting the space defined by said inner turns in ink feeding relation with said writing element.

7. The invention as set forth in claim 4 wherein is provided feed means including a member disposed between and in capillary relationship with at least one of said projecting turns and said writing element and having capillary spaces providing feed passages connecting the space defined by said projecting inner turns in ink feeding relation with said writing element.

8. The invention as set forth in claim 4 wherein is provided feed means including a longitudinally slitted feed member disposed between and in capillary relationship with at least one of said projecting turns and said writing element and providing capillary feed passages connecting the space defined by said projecting inner turns in ink feeding relation with said writing element.

9. The invention as set forth in claim 4 wherein is provided a hollow feed bar in said feed section having an opening in its upper side and feed means including a member disposed in said feed bar opening between and in capillary relationship with at least one of said projecting turns and said writing element and providing feed passages connecting the space defined by said projecting inner turns in ink feeding relation with said writing element.

10. The invention as set forth in claim 4 wherein is provided a hollow feed bar in said feed section extending into said nib and having an opening in its upper side, and means including a longitudinally slitted plate disposed in said feed bar opening between and in capillary relationship with at least one of said projecting turns and said writing element, a slit of said member providing capillary feed passages connecting the space defined by said projecting turns in ink feeding relation with said writing element.

11. A fountain pen comprising a body having a reservoir section and a feed section forwardly of said reservoir section, a writing nib mounted in said feed section, and a capillary reservoir-and-feed element disposed in said reservoir section and including a chamber section formed from spirally rolled sheet material having turns thereof spaced apart to define therebetween a capillary ink storage space, and a core section formed from spirally rolled sheet material having turns thereof spaced apart to define therebetween a capillary ink storage space, said core section being disposed in said chamber section with the space thereof connected to the space of the chamber section and with said core section projecting forwardly beyond the forward ends of the turns outwardly thereof and extending forwardly into said feed section with the space defined by the turns thereof connected in ink feeding relation to said writing element.

12. A fountain pen comprising a body having a reservoir section and a feed section forwardly of said reservoir section, a writing nib in said feed section and having an arcuate body and a slitted writing point, and a capillary reservoir-and-feed element disposed in said reservoir section and comprising spirally rolled sheet material having turns thereof spaced apart to define therebetween a capillary ink storage space, the turns at the inner portion of said element projecting forwardly beyond the remaining turns and extending into said nib body to place the space defined by said inner turns in ink feeding relation with said nib slit.

13. A capillary reservoir-and-feed element for a fountain pen comprising spirally rolled sheet material having turns thereof spaced apart to define therebetween a capillary ink storage space, the inner turns being more closely spaced than the outer turns to define a space of greater capillarity than the outer turns and projecting at one end beyond the corresponding ends of the outer turns.

14. A fountain pen comprising a body having a reservoir section and a feed section forwardly of said reservoir section, a writing nib mounted in said feed section, and a capillary reservoir-and-feed element disposed in said reservoir section and including spirally rolled sheet material having turns thereof spaced apart to define therebetween a capillary ink storage space, the turns at the inner portion of said element projecting forwardly beyond the forward ends of the turns outwardly thereof and extending forwardly into said feed section with the space defined by said inner turns connected in ink feeding relation to said writing element, the innermost turn of said reservoir-and-feed element having a diameter substantially greater than the spacing between the remaining turns and providing an air vent extending along said reservoir-and-feed element and communicating with the exterior of said pen.

15. A capillary filler-and-reservoir element for a fountain pen comprising spirally rolled sheet material having turns thereof spaced apart to define therebetween a capillary ink storage space, the turns at the inner portion of said element being more closely spaced than the turns at its outer portion to define a space of greater capillarity than the space at the outer portion of said element.

16. The invention as set forth in claim 15 wherein the turns of said element are spaced apart at progressively greater distances, from the inner portion of said element to the outer portion thereof.

17. A capillary filler-and-reservoir element for a fountain pen comprising spirally rolled sheet

material having turns thereof spaced apart to define therebetween a capillary ink storage space, the turns at the inner portion of said element projecting at one end beyond the corresponding ends of the turns in the outer portion of said element.

18. The invention as set forth in claim 4 wherein the pen body has an open forward end, the inner turns of the reservoir-and-feed element terminate adjacent said open forward end, and cover means is provided for substantially closing said open forward end.

19. The invention as set forth in claim 12 wherein the arcuate nib body is substantially concentric with said projecting inner turns of the reservoir-and-feed element and in contact engagement therewith substantially throughout the length of the nib body.

20. The invention as set forth in claim 12 wherein the nib is provided with a capillary passage in its lower face in ink transfer communication with the space defined by said projecting inner turns of the reservoir-and-feed element and with the slit in the writing point.

21. The invention as set forth in claim 12 wherein the nib body is provided with a capillary groove in its lower face in register with the slit in the writing point, and a cover of lesser transverse dimension than the nib body is secured to the nib body in underlying relation to said groove, said cover having perforations therethrough.

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