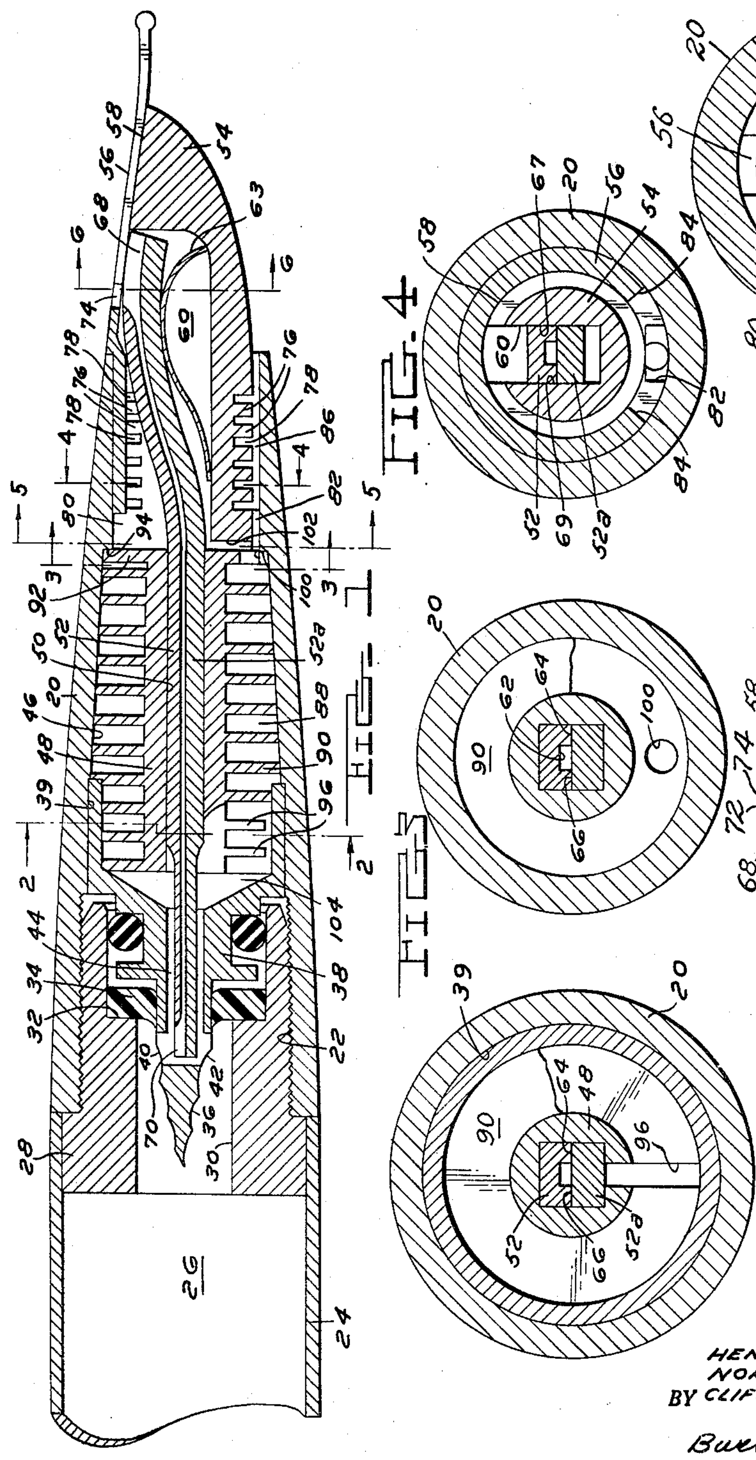
May 10, 1960 H. E. MORSE ET AL 2,935,970

FOUNTAIN PEN INK RESERVOIR

Filed March 23, 1955



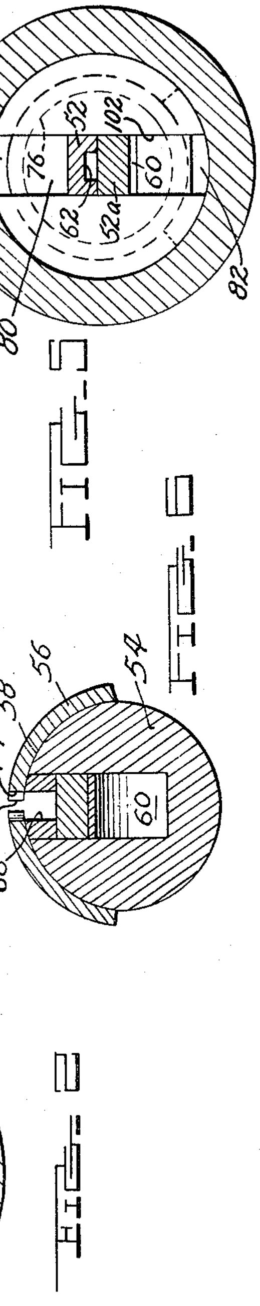


FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5 FIG. 6

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United States Patent Office

2,935,970

Patented May 10, 1960

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FOUNTAIN PEN INK RESERVOIR

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Application March 23, 1955, Serial No. 496,165

6 Claims. (Cl. 120—52)

This invention relates to fountain pens and particularly to an improved reservoir means for accumulating ink discharged from the ink storage chamber during a flooding condition of the pen.

Fountain pens comprise generally a writing element and an ink storage chamber, with a connection for feeding ink to the writing element from the storage chamber. In many of the commercial fountain pens of today the storage chamber comprises a rubber sac or the like. An air inlet for the storage chamber is also provided whereby, as the ink is expended from the chamber in writing, air enters the chamber to replace the expended ink. When the chamber is partially full of ink and partially full of air, the ink will flow out of the chamber toward the writing element if the air pressure in the chamber exceeds the ambient atmospheric pressure. When this differential in air pressure exists, the pen is said to be in a flooding condition. Means have been provided, as disclosed in the prior art, for absorbing this ink forced out of the storage chamber, thereby to prevent the pen from leaking.

With the advent of commercially successful replaceable ink cartridge type fountain pens which have a much greater ink storage capacity than the conventional ink sac type pens of the same size, it has become necessary to provide means for absorbing the much greater amounts of ink which tend to flood from the ink storage compartment when a flooding condition exists in the pen. While the improved overflow ink accumulating reservoir herein disclosed is particularly suited for pens employing the large capacity replaceable ink cartridge, it is to be understood that it may be as well applied to ink sac type pens or the like.

Some of the prior art ink absorbing overflow devices have taken the form of a plurality of closely spaced cells of capillary dimension which have been formed either in the ink feed bar of the pen, or around the ink feed bar, or as disclosed in the patent of Wing, 2,282,840, disposed inside the feed bar. A primary disadvantage of these prior art devices is their inefficiency in operation in that they do not always empty completely when the conditions return from which the original flooding started. For example, if the air pressure inside and outside the ink storage compartment is equal and the overflow absorbing device is empty, and thereafter the air pressure in the storage compartment rises so that it exceeds the ambient atmospheric air pressure, the pen will flood and ink will enter the overflow device. If the air pressure in the pen is thereafter reduced to the same pressure as before the increase (the ambient atmospheric pressure remaining constant), the ink in the overflow device should completely empty back into the storage compartment. However, this does not always occur. If the overflow device has not completely emptied and the cycle is again repeated and again not all of the ink which flooded out of the storage compartment returns to the storage compartment, the overflow device will contain an increased amount of ink. It is apparent that if this

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cycle is repeated often, the overflow device eventually will be filled completely with ink, with the result that upon the next cycle the pen will leak.

Another disadvantage of the prior art overflow ink accumulators becomes apparent upon attempting to adapt them for use with a replaceable cartridge type pen. This disadvantage is that they are not of a large enough capacity to accommodate the flooding from the larger volume replaceable ink cartridge. Because the replaceable ink cartridge pen holds a greater volume of ink than the sac type pen or the like, there is also a greater volume of air that accumulates in the storage chamber as the ink is expended. This greater volume of air will cause more ink to flood out of the storage compartment upon the occurrence of a differential in air pressure between the storage compartment and the atmosphere, than in the sac type pen.

When a flooding condition exists in a fountain pen, there are two possible avenues for the escape of the ink from the storage compartment. One of these avenues is for the ink to pass through the feed duct between the ink storage compartment and the writing element. The other avenue of escape is along the air intake vent to the storage compartment. In the prior art the plurality of cells above mentioned have been disposed in communication with the ink feed duct between the ink storage compartment and the writing element. For example, in the patent to Wing above noted, the closely spaced plurality of cells are disposed beneath the ink feed duct and in communication therewith. The air intake for the storage compartment passes through these cells and enters the feed duct. When the cells are full or partially full of ink and the pen is used for writing, the ink is supposed to empty from the cells before any air enters the storage compartment. However, it may frequently happen that only some of these cells are exhausted of their supply of ink before air is permitted to enter the storage compartment. When this occurs, the pen will then use ink flowing from the storage compartment. As long as air cannot reach the storage compartment, no ink will flow therefrom to the writing element and therefore it is desirable to be able to block the passage of air to the storage compartment as long as there is any ink in any overflow ink accumulator that may be formed in the pen, so that ink disposed in the accumulator will be first exhausted before ink flows out of the storage compartment.

An object of our invention is the provision in a fountain pen of a long continuous air intake passageway opening directly into the ink storage compartment, which long passageway will serve as an overflow ink reservoir for ink forced out of the storage compartment, with ink in the air intake passage blocking the admission of air to the compartment until all of the ink in the passageway has emptied back into the compartment.

Another object of the invention is the provision in a fountain pen of an air intake line of capillary dimension for the storage chamber and which is of greater cross sectional area than the ink feed duct from the storage chamber to the writing element, and which line opens at one end into the storage chamber and at its other end outwardly of the pen into the atmosphere.

Another object of the invention is the provision in a fountain pen of a pair of ink reservoirs for accumulating overflow ink from the ink storage compartment, one of which reservoirs accumulates ink flowing through the feed duct from the storage compartment to the writing element, and the other of which accumulates ink flowing directly out of the storage compartment through the air intake line.

Another object of the invention is the provision in a fountain pen of a pair of reservoirs, one of which is adapted to accumulate ink forced out of the storage compartment by an increase of air pressure therein and which ink flows to the pen nib, with the other reservoir forming the air intake line for the storage compartment and being adapted to hold a greater amount of overflow ink than the first mentioned reservoir.

Still another object of the invention is the provision in a fountain pen of an overflow ink accumulating reservoir which comprises a helical channel of capillary dimension encircling the ink feed duct between the ink storage compartment and the writing element, and which reservoir is formed in a member disposed within the body of the pen between the ink storage compartment and the feed bar of the pen and is adapted to support the feed duct extending between the ink storage compartment and the writing element.

Other objects, advantages, and meritorious features will more fully appear from the specification, claims and accompanying drawings, wherein:

Fig. 1 is a longitudinal cross sectional view through a pen embodying our improved overflow ink reservoir;

Fig. 2 is a cross sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a cross sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a cross sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a cross sectional view on the line 5—5 of Fig. 1;

Fig. 6 is a cross sectional view taken on the line 6—6 of Fig. 1.

We have shown in Figs. 1–6, for illustrative purposes only, a fountain pen embodying one form of our invention. The pen shown in Figs. 1–6 is of the replaceable ink cartridge type. It includes a pen body **20**, internally threaded as at **22**, to threadedly engage the handle or upper pen body **24** of the pen. The handle or upper pen body is hollow to provide an ink storage compartment **26**. The handle itself serves as the replaceable cartridge of the pen. An insert **28**, received and secured in any convenient manner within the lower end of the cartridge, is threaded to engage with the threads **22** of the lower pen body, to secure the cartridge to the body. It is to be understood that the invention disclosed herein is not restricted in its application only to pens of the replaceable cartridge type, but may be incorporated as well in other types of pens.

Seated within the bore **30** of the insert **28**, and disposed against the shoulder **32** thereof, is a puncturable plug **34**. The plug is adapted to be punctured by the threaded point **36** of the pierce **38**, when the cartridge and lower pen body are secured together. The operation and construction of the pierce are set forth in greater detail in the co-pending application of Morse et al., Serial No. 408,105, filed February 4, 1954, now Patent No. 2,826,-174, issued March 11, 1958. The pierce **38** is shaped as shown in Fig. 1, and is received in a snug fit as at **39** within the lower pen body. Spaced from the end of the point **36** is a pair of cross apertures **40** and **42** which open into the passage **44** within the pierce.

Received within the forward end of the pierce in a snug fit, and disposed for the greater portion of its length in the bore **46** of the pen body **20** in a snug fit, is the primary ink reservoir **48** more fully described hereinafter. The reservoir is provided with an axially extending aperture **50**, through which in a snug ink sealing fit extend the elements **52** and **52–*a*** of an ink feed channel, which elements, for convenience, are termed a sandwich feed.

An ink feed bar **54** is received within the forward end of the pen body **20**. A writing element or nib **56**, overlying the nib supporting surface **58** of the feed bar, is gripped between the feed bar and the pen body. The feed bar is provided with a sandwich feed receiving slot **60**, opening through the rear of the feed bar and upwardly through the nib supporting surface thereof. The sandwich feed extends at its rear end into the passage **44** of the pierce, and extends at its forward end into the slot **60** of the feed bar, and is held up against the writing element by the spring **63** which is disposed within slot **60** beneath the sandwich feed.

The sandwich feed is more fully described in the co-pending application of Morse et al., Serial No. 500,755 filed April 12, 1955. The members **52** and **52–*a*** forming the sandwich feed are juxtaposed as shown in Figs. 1–6, with member **52** provided with a longitudinal channel **62** opening toward the meeting faces of the members. At opposite sides of channel **62**, the meeting faces of members **52** and **52–*a*** define therebetween, as at **64** and **66**, ink film passages. The channel **62** is of capillary size and communicates with the ink film passages **64** and **66** which are also of capillary dimension, throughout the length of the sandwich feed. Member **52** is provided, as shown in Figs. 1 and 6, with an upwardly opening slot **68** and **70** at each end. The nib **56** is provided with an ink feed slit **72** which registers with the slot **68** in the forward end of member **52**.

Ink in the storage compartment enters the sandwich feed by passing through the cross apertures **40** and **42** in the point **36** of the pierce, and thence through the slot **70**. It enters passages **64** and **66** by passing through the cross apertures **40** and **42** in the point **36** and thence surrounds the end of the sandwich feed and lies adjacent the edges of the meeting faces of members **50** and **52–*a***. Such ink lying adjacent the members is sucked into the passages by capillary attraction. The ink enters the slot **70** in member **52** by virtue of capillary attraction. The ink then travels by capillary action through the sandwich feed toward the writing element and passes into the slit **72** therein from the slot **68**.

The forward end of the sandwich feed is sufficiently flexible that the spring **63** will normally urge the sandwich feed up against the nib, and will flex sufficiently to permit the nib to be removed from the feed bar for replacement or repair.

The nib is provided as shown in Figs. 1 and 6 with an air intake opening at **74**, which extends through the nib and opens at its forward edge into the ink slit **72**. The feed bar is provided with a plurality of combs **76** which form therebetween a plurality of ink overflow absorbing cells **78**, which for convenience are termed the secondary ink reservoir, and which communicate with the slot **60** along the nib supporting surface of the feed bar. The cells **78** are of capillary dimension. The feed bar is provided with a shoulder **80** which is snugly received within the body **20** of the pen, and is cut away as at **82** to provide an opening therethrough. The diameter of the feed bar forwardly of the shoulder is reduced to receive the writing element **56**, which extends around the feed bar and terminates short, as shown at **84** in Fig. 4, of extending completely around the feed bar. Because the nib terminates short of extending completely around the feed bar, a passage **86** is provided between the feed bar and the pen body **20**. This passage is of capillary dimension and communicates with the ink overflow cells **78**, and with the aperture **82** through the shoulder **80**.

The reservoir or member **48**, which functions both as an air intake and as a temporary ink storage chamber, is disposed just behind the feed bar. The reservoir is shaped to provide an external helical groove or channel **88**, which winds around the reservoir from one end to the other, forming a long continuous air intake passage. The spiral comb **90**, which cooperates at each turn to form the helical channel, terminates at its forward end in a wall section **92**. The wall **92** abuts the shoulder **94** formed in the body **20**, and serves to position the reservoir axially within the body. The reservoir is received in the body in a snug ink-tight fit at the perimeter of the comb **90**, such that the helical channel **88** is closed at its periphery by the encircling wall of the body. The last two turns of the helical channel are cut away as at 96 to form a slot therethrough, shown in Fig. 2. The helical channel 88 in the reservoir is of capillary dimension, and the spacing between each turn of the helical comb 90 is constant throughout the length of the reservoir. The forward wall 92 is provided with an opening therethrough at 100. This opening provides communication between the helical channel of the reservoir and the passage 86 between the feed bar and the body. It will be noted that the rear of the feed bar is cut away as at 102 to provide a vertical slot opening at its upper end into the sandwich feed receiving slot 60, and opening at its lower end into the slot 82 formed in the shoulder 80 of the feed bar.

It will be noted that the rear end of the helical channel 88 in the reservoir opens into the space 104 within the pierce 38. Space 104 communicates with the passage 44 in the pierce, which passage surrounds the sandwich feed as hereinabove explained. It is now apparent that air may enter the ink storage compartment 26 by entering the pen through the passage 86, thence through the slot 82 and into the helical channel 88 through the opening or aperture 100 in the wall 92 of the reservoir. Air may travel through the reservoir by following the turns of the helical channel until it reaches the rear end of the reservoir from whence it passes into the space 104, and then into the passage 44, and finally out through the cross apertures 40 and 42 in the pierce and directly into the storage chamber. It is also apparent that air may enter the ink storage compartment 26 by passing through the air intake opening 74 in the nib, and passing from such opening through the sandwich feed receiving slot 60 to the vertically extending slot 102 in the rear face of the feed bar to the slot 82 in the shoulder 80. From this point such air travels through the reservoir to the ink storage compartment in the manner above described.

The helical channel 88 of the primary reservoir forms, as will now be appreciated, a portion of the air inlet for the ink storage compartment, this portion being a single continuous ribbon-like and uninterrupted passageway portion which provides at least a major portion of the air intake passageway. Any air entering the ink storage compartment must pass through the helical channel in the reservoir. On the other hand, ink may leave the ink storage compartment through two different paths. One of these paths is through the sandwich feed, and this ink will pass toward the pen nib. The other path that the ink may travel is through the passage 44, into the space 104, and from there into the helical channel 88 of the reservoir. Such ink moves toward the opening 100 in the forward wall 92 of the reservoir. Whenever the ink storage compartment is partially full of ink and while the pen is held in a writing position, or with the nib downwardly, and the atmospheric pressure surrounding the pen decreases, or the air in the ink storage compartment increases in pressure, a condition will arise in the pen which will tend to force ink out of the ink storage compartment. Such condition is caused by the air pressure in the ink storage compartment exceeding the air pressure of the atmosphere surrounding the pen. Such condition is frequently termed a flooding condition, and unless the pen is provided with some means for absorbing ink which is forced out of the ink storage compartment, the pen will leak.

It has become desirable to provide pens with replaceable ink cartridges which will hold a considerably greater amount of ink than is possible with the conventional rubber sac type pens or the like. Pens employing the replaceable ink cartridge must be provided with a greater capacity for absorbing ink forced from the cartridge during the flooding condition than pens which employ the rubber sac or the like. This is true because the replaceable cartridge contains a greater volume of ink and consequently will hold a greater amount of air when the cartridge is partially exhausted. The reservoir arrangement shown in the drawings is capable of holding a substantially greater amount of ink than is possible with the conventional ink overflow grooves in use today.

In the normal operation of the pen for writing, ink from storage compartment 26 will pass through cross apertures 40 and 42 in the pierce, and pass through the sandwich feed passages 62, 64 and 66 to the pen nib, and from thence to the writing surface. As ink is exhausted from storage compartment 26, air contemporaneously enters the compartment by way of the helical channel 88 in the primary reservoir.

To explain the operation of the pen during a flooding condition, i.e., when the air pressure in the ink storage compartment exceeds the air pressure surrounding the pen, assume for illustrative purposes that the ink storage compartment is only partially filled with ink, and that the pen is held in a position such that the writing element extends in a downwardly position. Under such conditions ink will tend to flood out of the ink storage compartment. Some of this ink will pass down the sandwich feed channel 62 and ink feed passages 64 and 66 toward the pen nib, and some of the ink will enter the helical groove 88 in the primary reservoir. That ink which passes through the sandwich feed toward the pen nib is absorbed by the ink overflow cells 78, or secondary reservoir, in the feed bar, and the ink traveling through the passage 44 and into the space 104 is received by the helical channel 88 of the reservoir. The pasageway 44 and the helical channel 88 are of larger wall to wall or cross sectional dimension than the feed duct 62 and the ink passages 64 and 66 of the sandwich feed. Therefore a greater amount of ink will flow into the helical channel than will flow through the sandwich feed to the pen nib. It is preferable that the relative sizes of the ink passages through the sandwich feed and the passage to the helical channel and the helical channel itself be so proportioned that a substantially greater amount of ink will enter the primary reservoir as will travel through the sandwich feed toward the pen nib. We have found that a ratio of 1:5 is satisfactory, i.e., the cross-sectional areas of the passage 44 and helical channel 88 are substantially five times greater than the cross-sectional areas of the feed channel 62 and passages 64 and 66 in the sandwich feed. As a result, substantially five times as much ink will flow into the primary reservoir as will pass toward the pen nib through the sandwich feed. As the ink enters the helical channel it follows the course of the channel along the comb 90 and moves toward the forward end of the reservoir. Normally the increase in air pressure in the ink storage compartment will be reduced to equality with the air pressure in the atmosphere surrounding the pen before the reservoir is filled with ink. Only under an extreme differential in pressures between the ink storage reservoir and the atmospheric pressure will the reservoir be completely filled with ink.

The overflow cells 78 comprising the secondary reservoir serve to absorb that portion of the ink flooding from the storage compartment which passes toward the pen nib through the feed duct in the sandwich feed. The primary reservoir acts to absorb the remainder of the ink flooding from the storage compartment. Because of the relative proportions, as above mentioned, in the sizes of the feed duct and the passages to the helical channel in the primary reservoir and the size of the helical channel itself, the greater portion of this flooding ink enters the primary reservoir. The primary reservoir comprising the helical channel is adapted to hold more ink than the secondary reservoir. We have found that satisfactory results may be obtained when the capacities of the two reservoirs are in the ratio of 5:1 which, it will be noted, is substantially the same as the ratio of the passageway 44 and the helical channel 88 is to the size of the feed duct 62 and passageways 64 and 66. It is to be understood that these ratios may vary with various pen constructions and designs. These two reservoirs cooperate to prevent leakage of the pen, each providing a container for ink leaving the storage compartment, one absorbing it from the ink feed duct, the other absorbing it directly from the storage compartment.

It may be pointed out that the ink which passes through the sandwich feed toward the pen nib during a flooding condition in the pen leaves the sandwich feed and enters the slot **60** in the feed bar, and lies above the sandwich feed in the slot and/or between the meeting faces of the sandwich feed and the slot, as at **67** and **69** in Fig. 4. As ink continues to flood toward the nib, the ink lying in the slot moves into the capillary cells **78** in the feed bar. It is therefore apparent that the sandwich feed communicates with the capillary cells **78** in the secondary reservoir.

The reservoirs are emptied when either of two conditions occurs, namely, the ambient atmospheric pressure exceeds the pressure in the ink storage compartment, or the pen is used for writing. With the advent of the first condition, the atmospheric pressure reacts upon the ink in the cells **78** to urge such ink back through the sandwich feed into the storage compartment and contemporaneously urges the ink in the helical channel **88** back into the storage compartment. If the pressure differential exists for a sufficient length of time, the two reservoirs are completely emptied, and some air may even enter the storage compartment by way of the primary reservoir. If, on the other hand, the pen is written across a writing surface, ink flows from the nib to the writing surface as the nib travels thereover. As is well known, this flow of ink is caused by the capillary attraction of the ink in the nib to the porous surface of the paper. As the ink on the nib flows upon the paper, it is replenished by ink flowing from the cells **78** of the secondary reservoir. When the ink in the secondary reservoir is exhausted, or while it is being exhausted, ink flows from the storage compartment, through the sandwich feed to the nib. This ink flowing out of the storage compartment creates a partial vacuum in the storage compartment, viz: the pressure in the storage compartment falls below the ambient atmospheric pressure. Upon this occurrence, the atmospheric pressure urges ink in the helical channel **88** back into the storage compartment to equalize the pressure differential. The capillary attraction of the ink on the nib to the porous writing surfaces overcomes the force of gravity on the ink in the helical channel and so the ink in the channel will move upwardly against gravity and into the storage compartment.

As mentioned above, the helical channel **88** is of capillary dimension and is of larger cross-sectional area than the passageways in the sandwich feed. Because the helical channel is of capillary dimension, ink standing in the channel will not run out of the vent opening **100** if the pen is held in a writing position. Similarly, ink standing in the channel will not separate into individual slugs of ink separated by air pockets. This latter feature of the channel ensures that, as the primary reservoir is emptied back into the storage compartment, only ink will enter the compartment until the reservoir is completely exhausted. There will be no air pockets in the ink in the reservoir which may be expelled into the storage compartment ahead of a slug of ink. The ink in the helical channel is a solid thread of ink, completely filling the channel for as far along the channel as it extends, and this thread of ink moves as a solid column of ink either toward or away from the storage compartment.

What we claim is:

1. In a fountain pen including a pen body, an ink storage chamber and a writing element, the improvement which comprises: means extending between the storage

chamber and the writing element providing an ink feed duct of capillary dimension in cross-section for delivering ink to said writing element; means connected to the storage chamber providing an air intake passageway for the storage chamber vented to the atmosphere at one end and vented to the storage chamber at the other end; said air intake passageway throughout at least a major portion of its length being a single continuous, ribbon-like and uninterrupted passageway portion and of predetermined capillary cross-sectional area, of less capillary strength than the feed duct and being isolated therefrom, to prevent air percolation through ink therein and insure movement of the ink body as a single continuous unbroken ribbon; said air intake passageway serving, when the pressure in the storage chamber exceeds that of the ambient atmosphere, to receive ink forced from the chamber and temporarily store such ink, with that ink received by said portion of the air passageway being stored as a solid unbroken ribbon, and with such ribbon being forced back toward the storage chamber through said major portion as a solid unbroken ribbon when the ambient atmospheric pressure exceeds the pressure in the storage chamber; and said air intake passageway throughout said portion and to the end of the air intake passageway vented to the atmosphere being separate from and operatively independent of the ink feed duct.

2. In a fountain pen as defined in claim 1 and said major portion of said air intake passageway winding through a plurality of turns.

3. In a fountain pen as defined in claim 1 and including accumulator means in fluid communication with the ink feed duct at said writing element, said accumulator means including a capillary cell for receiving overflow ink from the ink feed duct.

4. In a fountain pen as defined in claim 1 characterized in that said pen body is hollow and said means providing the air intake passageway includes a member received in the hollow pen body and shaped to define a helical channel constituting said single passageway portion of the air intake passageway.

5. In a fountain pen as defined by claim 4 further characterized in that said means providing the ink feed duct is at least partially supported by the member defining the helical channel.

6 In a fountain pen as defined by claim 1 characterized in that said pen body is hollow and has an inner wall, and said means providing the air passageway includes a member shaped to provide an external spiral comb cooperating with said wall to define a helical channel constituting said single passageway portion of the air intake passageway.

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