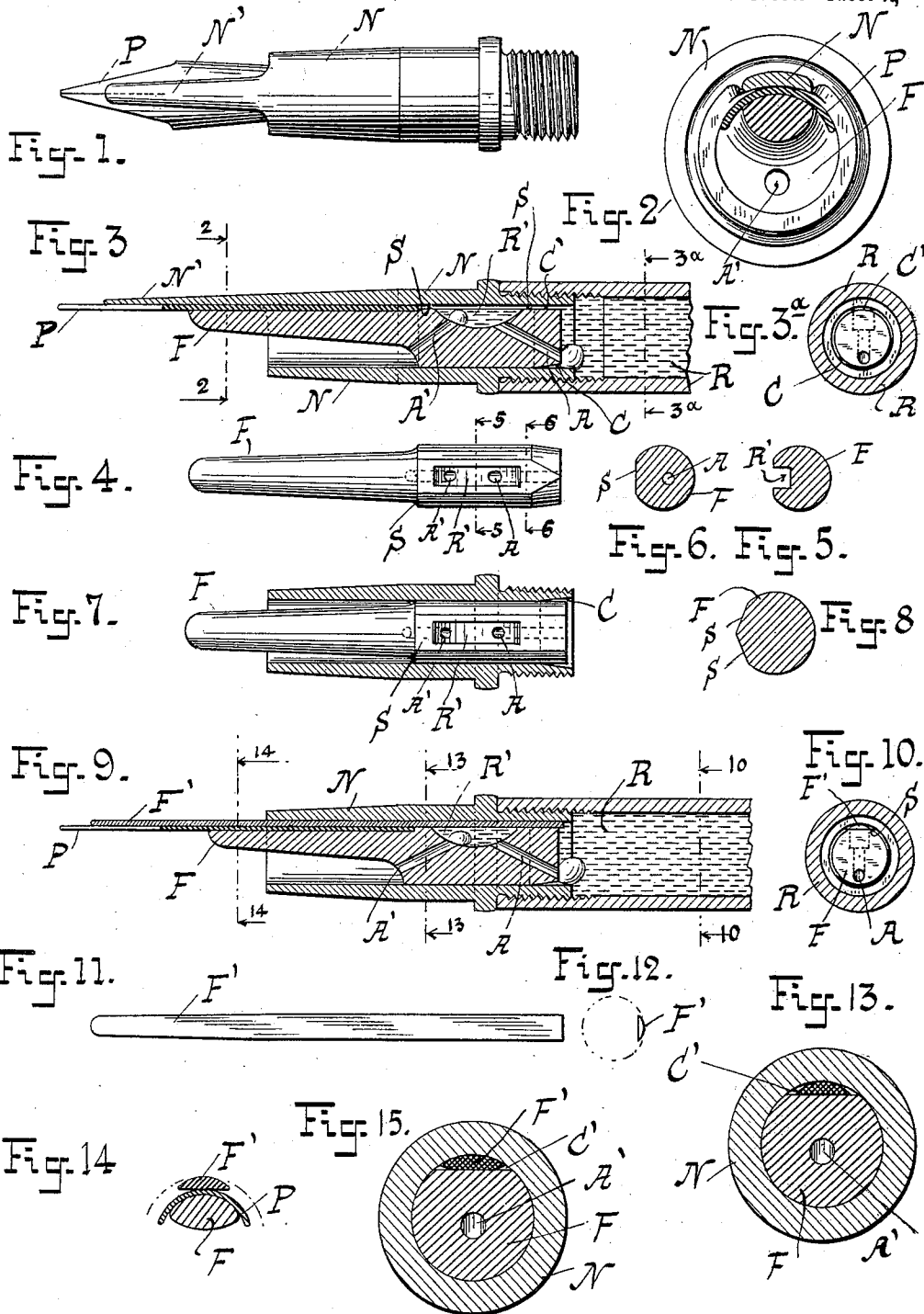


L. E. WATERMAN.  
FOUNTAIN PEN.

(Application filed Sept. 22, 1897.)

(No Model.)

2 Sheets—Sheet 1.



Witnesses  
Charles Hanimann  
Edward S. Berrall.

Inventor  
*L. E. Waterman*

L. E. WATERMAN.  
FOUNTAIN PEN.

(Application filed Sept. 22, 1897.)

(No Model.)

2 Sheets—Sheet 2.

Fig. 16.

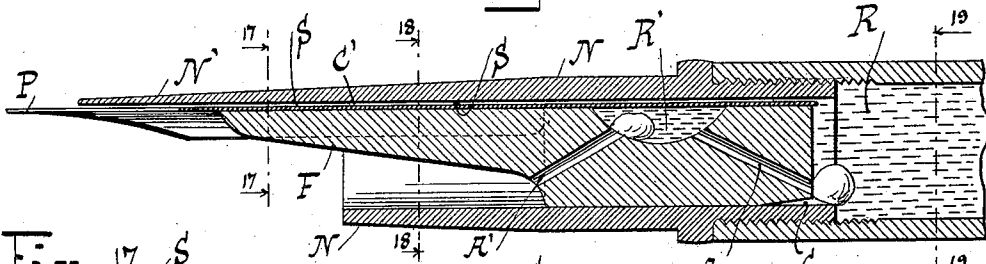


Fig. 17.

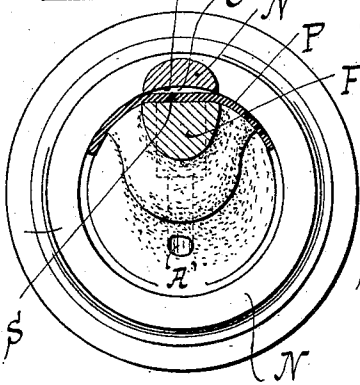


Fig. 18.

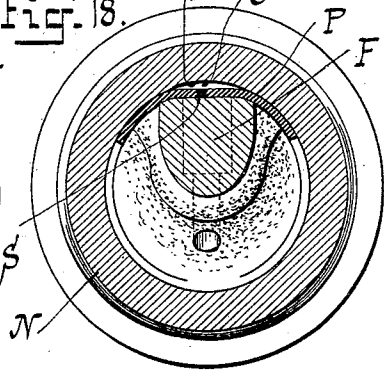


Fig. 19.

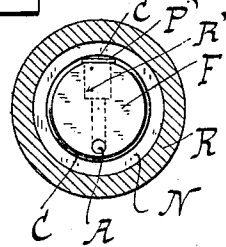


Fig. 20.

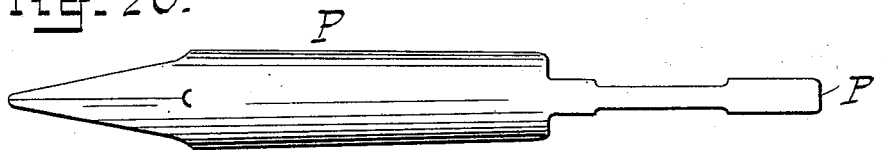
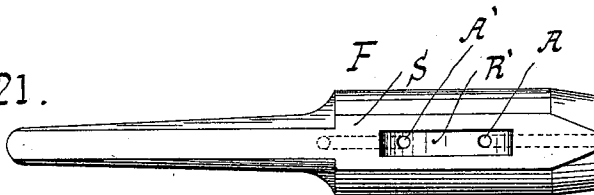


Fig. 21.



Witnesses  
Charles Hanemann  
Edward S. Berrall.

Inventor  
Lewis Waterman

# UNITED STATES PATENT OFFICE.

LEWIS E. WATERMAN, OF NEW YORK, N. Y.

## FOUNTAIN-PEN.

SPECIFICATION forming part of Letters Patent No. 607,400, dated July 12, 1898.

Application filed September 22, 1897. Serial No. 652,554. (No model.)

*To all whom it may concern:*

Be it known that I, LEWIS E. WATERMAN, a citizen of the United States, residing in the city of New York, (Brooklyn,) county of Kings, and State of New York, have made a new and useful Invention in Fountain-Pens, of which the following is a specification.

My invention relates in general to improvements in fountain-pens or pens in which the ink is carried in a reservoir and fed to the writing-pen automatically by or through its own use, and it more particularly relates to improvements in the devices and method of feeding ink by capillary action to the writing-pen known as "top feed." This top-feed system of feeding ink in fountain-pens is a system in and by which the ink reaches the nibs by passing along the top of the writing-pen by or through capillary convection. Heretofore top feed has not been as successful or perfect as a system of feed wherein the ink is conducted to the nibs under the writing-pen by capillary fissures coöperating with an ink-duct or with an air-duct. The two main defects in top feed have been a tendency to gush or over ink-supply and at other times a tendency to ink-failure or under ink-supply, both often found in the same fountain-pen. The objects of my improvements are to remedy these and other defects and to provide means for better regulating and controlling the flow of the ink by associating with the top-feed mechanisms and devices a chamber or cavity that has the characteristics of a sub or secondary ink-reservoir, of an ink-valve, and of an air-valve, with which I combine an annular or nearly annular capillary chamber or channel between the feed-bar and the nozzle at and near their inner ends made either by cutting away the former or the latter, as may be preferred. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a top view of the nozzle and the writing-pen. Fig. 2 is a sectional view cut on the line 2 2, Fig. 3. Fig. 3 is a vertical sectional view of the writing-pen, nozzle, feed-bar, and part of the reservoir or handle. Fig. 3<sup>a</sup> is a sectional view cut on the line 3<sup>a</sup> 3<sup>a</sup>, Fig. 3. Fig. 4 is a top view of the feed-bar. Fig. 5 is a sectional view of the feed-bar, cut on the line 5 5, Fig. 4. Fig. 6 is a similar

view cut on the line 6 6, Fig. 4. Fig. 7 is a top view of the feed-bar and a sectional view of the nozzle. Fig. 8 is a sectional view showing a variation in the form of the top of the feed-bar. Fig. 9 is a longitudinal sectional view of the nozzle, top feed-bar, writing-pen, main feed-bar, and part of the reservoir or handle. Fig. 10 is a sectional view cut on the line 10 10, Fig. 9. Fig. 11 is a top view of the top feed-bar. Fig. 12 is a sectional view of the same. Fig. 13 is a sectional view cut on the line 13 13, Fig. 9. Fig. 14 is a sectional view cut on the line 14 14, Fig. 9. Fig. 15 is a sectional view showing a partial variation in the shape and relations of the top feed-bar. Fig. 16 is a sectional view of the nozzle, writing-pen, and feed-bar and of the lower part of the reservoir. Fig. 17 is a sectional view on the line 17 17, Fig. 16. Fig. 18 is a sectional view on the line 18 18, Fig. 16. Fig. 19 is a sectional view on the line 19 19, Fig. 16. Fig. 20 is a top view of the writing-pen, and Fig. 21 is a top view of the feed-bar.

Similar letters relate to similar parts throughout the several views.

Figs. 1 to 7, inclusive, show the invention in a form in which the adjacent part of the nozzle and of an extension thereof form the upper side of the two opposite capillary top-feed surfaces, and Figs. 9 to 15, inclusive, show the invention in the form in which the under side of an independent piece interposed between the main feed-bar and the nozzle, or, rather, between the nozzle, the writing-pen, and the main feed-bar, furnishes that upper side and surface.

Only the old screw ink-joint is shown; but the invention may be used with any other form of fountain-pen ink-joint or in a fountain-pen without any joint.

The system of ink-feed referred to as "top feed" is a system in which the ink is fed to the nibs of the writing-pen along the top of the writing-pen and between that top and a surface which with that of the writing-pen forms a capillary channel for the ink on its way from the reservoir to the paper. It is distinguished from the under-feed system in and by the fact that in the latter the ink traverses the under side of the writing-pen on its way to the nibs, following a capillary

channel located there and formed by or between the under surface of the writing-pen and an adjacent capillary surface. In both cases the channel is a capillary channel and  
 5 transfers ink to the nibs of the pen by capillary action, which dominates the movement, although the action of gravity may not be entirely wanting, and if or when the gravity  
 10 action in any way obtains control of the ink movement in such construction the danger of ink-gush and other injurious action becomes imminent. Displacement of parts and other  
 15 causes produce such derangements, and my invention is intended to prevent such derangements.

The nozzle N, as shown in Figs. 1, 2, and 3, has the extension N'. The feed-bar F extends under the writing-pen and may or may not reach to and under the nibs, and it assists in holding the writing-pen in place. Its  
 20 inner end consists of a plug which closely fits the inside of the nozzle N everywhere except where ink or air channels or spaces are shown. This fitting and secure holding of the plug is  
 25 necessary as an element in the problem of the perfect control of the ink and air movements in the pen, which is the ultimate object of the invention. The main drift and tendency in fountain-pen invention has been to or toward  
 30 the use of numerous openings and channels, accompanied by a sort of trust in luck to get the ink where it is wanted without having it get where it is not wanted. It is believed that this tendency has been at least in  
 35 part due to a lack of complete mastery of the principles of ink and air movements in fountain-pens. In my invention surplus openings and channels are discarded and the action of the pen is intrusted to automatically-controllable channels and openings. This principle  
 40 when applied properly prevents surprise or unexpected and undesired ink-flow and insures ink-flow when proper and wanted.

The main feed-bar F in one form is flat on  
 45 top from the rear end up to the point where the butt-end of the writing-pen is located and has the secondary reservoir, cavity, or air and ink valve R' located back of the writing-pen and cut into and through and forward of the  
 50 rear end of the feed-bar found in the longitudinal center of that flat surface, but so as to leave flat places on each side of it to make the capillary surface S continuous. The cavity R' is so related and connected with the  
 55 capillary surfaces S S, along and by which the ink is transferred from the reservoir R to the writing-pen point by the route of the upper side of the main feed-bar F and of the writing-pen P, that it receives, holds, and  
 60 may be filled by the surplus ink not applied to or on paper in writing, and thereby checks air-inlet and further ink-flow for the time being. The secondary reservoir or cavity R' is also connected with the reservoir R by an air-  
 65 duct A and with the outer air by the air-duct A', the function of the former being to act as a channel for the air in passing from the sec-

ondary reservoir or cavity R' to the ink-reservoir R and that of the latter being to admit air to the secondary reservoir R' from  
 70 without. Between these two air-ducts the cavity or chamber R' is interposed in such a way that when it contains ink it checks excessive air-inlet, and when it is empty it checks excessive ink-flow by receiving and  
 75 retaining ink.

At the inner end or at and near the inner end of the feed-bar F, I locate an annular or approximately annular capillary chamber or  
 80 channel C, which may be made V-shaped in section by beveling the feed-bar F at and near the inner end, as shown, or by reaming out the inner end of the nozzle, or it may be made of the same size in section throughout  
 85 by simply forming a straight annular chamber around the feed-bar and either by cutting away the bar or by cutting away the nozzle; but I prefer the conical chamber, because it gives a better clearance, is not so likely to  
 90 hold sediment and become obstructed, and if sediment does collect at first it only fills part of the chamber, leaving the other parts still clear and operative for capillary purposes.

Fig. 9 more particularly shows the arrange-  
 95 ment of parts where an independent top feed-bar F' is used and where it extends from the split in the writing-pen back to or in reach of the ink in the reservoir R. The top feed-bar F' may rest upon the main feed-bar F in the  
 100 manner shown in Fig. 13, leaving capillary conduits or spaces C' at the upper side of each edge and between the top feed-bar F' and the inner surface of the nozzle. This arrangement leaves two capillary chambers or chan-  
 105 nels C', one on the top of each side or edge of the top feed-bar F', which extend to the outer end of the nozzle; but I prefer the arrangement shown in Fig. 15, where the capillary channels C' are shown in the same relative  
 110 positions, except that they are formed or located under instead of over the outer edges of the top feed-bar F'.

The capillary channel C at and near the inner end of the feed-bar connects directly  
 115 with the lower capillary surface S on the top of the plug part of the feed-bar, which continues along each side of the cavity or pocket R' and is further continued by the top surface of the writing-pen. The upper capil-  
 120 lary surface S with the lower one forms a continuous capillary channel for ink from the annular channel to the nibs of the pen. The theory and explanation of the action of these devices while performing the function of  
 125 transferring the ink from the reservoir R to the writing-pen and its nibs for use in writing are as follows: The pen being, as usual, carried in the pocket with the pen-point up-  
 130 permost, when taken in hand for writing in the first part of the manipulation has its ink in the main reservoir R; but the moment the fountain-pen is held with the writing-pen point downward the capillary surfaces imme-

diately begin the operation of transferring the ink to the writing-pen point by capillary action first in and through the annular capillary chamber C, then by the capillary channel C', formed between the flat top surface of the feed-bar F and the adjacent nozzle-surface or the top-feed-bar surface, as the case may be, and when the ink has reached the rear end of the writing-pen it will follow the capillary chamber C', formed by and between the top of the writing-pen and the adjacent nozzle or the top-feed-bar surfaces, until it finds access to the nibs through the split in the pen or through an opening in the pen adjacent to the split. During this operation of ink-transfer, or after the pen-point has been supplied with ink and the capillary spaces above it have been filled, the ink will gradually fill up the secondary-reservoir cavity R', and thereby check the further flow of ink in the capillary channels through the closure of the air-duct A' by the ink, which prevents further entrance of air and the further passage of ink from the reservoir R and toward the pen. The use of the writing-pen in this way sets up the automatic action by or through which ink is transferred from the reservoir to the writing-pen as it is used and may be required. A necessary incident of the continuance of this transfer is the proper supply of air to the reservoir R, and, on the other hand, in order to prevent ink-gush and air-supply the air must not be admitted too freely, and in order to prevent a failure of ink in the writing-pen the air must be supplied with sufficient freedom to facilitate or permit the necessary transfer of ink. The route taken by the air in coöperating with the ink-supplying function is from without through the air-duct A' into the secondary reservoir, cavity, pocket, or valve R', thence through the air-duct A into the reservoir R; but before the air can pass through the secondary reservoir R' when filled with ink the capillary surfaces in front of the secondary reservoir must draw upon the ink in the secondary reservoir sufficiently in force and quantity to empty or partly empty it, and thereby permit the air to enter the secondary reservoir from without. As the use of the ink from the secondary reservoir increases and its supply of ink diminishes the amount of air in the secondary reservoir increases until the pressures become so readjusted and related that the air enters and traverses the air-duct A and finally enters the reservoir R in bubble form, as shown in Figs. 3 and 9. The capillary channel C' being relieved from the strain of vacuum tension by the admission of air immediately increases ink transfer and supply to the cavity R', where it again acts as a check on too great air-supply. The subreservoir R' and the air-ducts A and A' must not be made too large, and the air traverses them in attenuated form and only enlarges into bubble form as the quantity of air admitted increases, as shown in those two figures. The size of the air-ducts in

cross-section may increase with the size of the pen or its capacity to transfer ink to paper.

The writing-pen continuing to be used, the whole of the contents of the reservoir R will eventually be transferred to the writing-pen for writing purposes. During the operation the secondary reservoir R' is alternately filling with air or ink and also emptying the same or passing the former up and the latter down, as required, the ink acting as a stop to prevent the entrance of air automatically in connection with the capillary feed and to a certain extent under its control. As the capillary feeding-surfaces are freed and call for more ink air automatically supplies its place in the secondary reservoir in the first instance and finally in the main reservoir R in continuous succession until the ink in the main reservoir is exhausted.

The annular capillary chamber or channel C at the inner end of the nozzle and feed-bar by its complete exposure to the ink of the main reservoir R down to the last drop and its large capillary capacity effects the sufficient and complete and, it may be said, large supply of ink to the capillary surfaces between it and the writing-pen with great rapidity, and the action of that chamber at and around the inner end of the air-duct A, or, rather, the ink constantly held therein by capillarity, not only facilitates the passage of the air from the air-duct A into the reservoir R—at times drawing the ink from the air-duct A or assisting the air to push the ink out of that air-duct into the reservoir because of its intimate relation and proximity to that air-duct—but also prevents the movement of air toward the reservoir R through the capillary channel C'. The capillary channel C' in front of the secondary reservoir R' in much the same way facilitates the entrance of air from without into the secondary reservoir R', establishing a siphon-like action, of which the air automatically takes advantage to assist it to enter the secondary reservoir on its way to the main reservoir. At one moment the ink checks the flow of the air inward and at another moment the air checks the flow of the ink outward, both of them in and through the secondary reservoir, and the secondary reservoir thereby becomes a sort of automatic air and ink valve for the writing-pen and the reservoir. It is this functioning of the secondary reservoir largely that enables me to remedy previous defects and to prevent excessive ink-supply to the writing-pen and to secure an adequate ink-supply thereto for all necessary purposes when using the top-feed system of supplying ink from the reservoir to the writing-pen. Heretofore top-feed pens have not been successful or satisfactory in a complete sense because of these and other defects, which are remedied by the ink and air valve action in and through the secondary reservoir R' coöperating with the associated parts, as shown and described.

A variation or modification of this inven-

tion is shown on Sheet 2, Figs. 16 to 21, inclusive, wherein the writing-pen has a rear end elongation P' extending along the whole top of the feed-bar and to or into the main reservoir R. The writing-pen is not only extended, but the extension is a narrow elongation of the central part of the pen, which is cut out over the secondary reservoir R', as shown, in such a way as to facilitate the entrance of the ink into the secondary reservoir and its subsequent removal therefrom by capillary action on its way to the nibs of the pen in the manner previously described. In other respects the arrangement in this variety is preferably like that shown in Figs. 1 to 7, inclusive, wherein the top surface of the capillary channel is formed on or by the underside of the adjacent part of the nozzle and its extension over the nibs of the pen. It therefore has the advantage of furnishing a continuous capillary channel from the main reservoir to the nibs of the pen between the top of the pen and the nozzle, as well as capillary channels on the sides of the plug and extension part of the nozzle, without the use of a separate piece. The writing-pen is shown flat on top; but it may be rounded in the usual form, sufficient space being left at the sides or anywhere on top of the pen for the capillary channels and their action. Where the narrowed extension of the writing-pen commences in Fig. 20 are shown two shoulders on each side of the pen, which may strike against shoulders formed in or on the top of the feed-bar. They limit the inward movement of the writing-pen toward the reservoir when the feed-bar is placed in position. The subreservoir, (shown in Figs. 16 and 21 more particularly,) with its two openings, one an inlet and the other an outlet, for the passage of the air, operates in the same way in relation to all the parts, and particularly to the contents of the main reservoir, the capillary channels, and the writing-pen, as heretofore set forth in describing the two forms shown on Sheet 1 of the drawings, and also the method of operation is substantially the same. In all these combinations the length and size of the subreservoir and the size of the ducts A and A' may be modified so as to secure proper ink-flow and proper control, and the principle of my invention permits such modification.

I claim as my invention—

1. A fountain-pen, provided with a chamber or cavity having an air-inlet and an air-outlet and acting automatically as a secondary reservoir, as an air-valve and as an ink-valve, in combination with a suitable capillary channel, or channels, as required to take ink from the main reservoir and supply it to the writing-pen.

2. A feed-bar of a fountain-pen provided with a secondary reservoir having an air-inlet duct connecting it with outer air and also with an air-outlet duct connecting it with the main reservoir, for the purpose of conducting

air to and through the secondary reservoir and thence into the main reservoir, in combination with a suitable capillary channel or channels connecting the main reservoir, the secondary reservoir and the writing-pen.

3. In combination with top capillary feed devices and channels, a secondary reservoir located between the main reservoir and the writing-pen provided with an air-inlet duct and an air-duct communicating with the main reservoir.

4. In a fountain-pen a chamber or cavity located within the nozzle, in or near the feed-bar, and functionally related to top-feed devices, acting automatically as a secondary reservoir, an air-valve and an ink-valve as required to supply ink from the main reservoir to the writing-pen.

5. In a fountain-pen a chamber or cavity located within the nozzle, in or near the feed-bar, and functionally related to top-feed devices, acting automatically as a secondary reservoir, an air-valve and an ink-valve as required to supply ink from the main reservoir to the writing-pen, in combination with top capillary feed devices and a longitudinal capillary channel, and with an annular capillary channel connecting with such channel and located at and opposite the inner end of the feed-bar.

6. In a fountain-pen a chamber or cavity acting automatically as a secondary reservoir, an air-valve and an ink-valve as required to supply ink from the main reservoir to the writing-pen, in combination with top capillary feed devices and with an annular capillary channel located at and opposite the inner end of the feed-bar.

7. In fountain-pens, an upper capillary feed-surface extending from the main reservoir along the top of the feed-bar and of the writing-pen to the nibs, together with the under and opposite capillary surface, in combination with a cavity or chamber opening into the capillary conduit or space between the two surfaces and provided with an air-inlet thereto for air from without and with an air-outlet connected with the main reservoir.

8. In fountain-pens, an upper capillary feed-surface extending from the main reservoir along the top of the feed-bar and of the writing-pen to the nibs, together with the under and opposite capillary surface, in combination with a cavity or chamber opening, from below, into the capillary conduit or space between the two surfaces and provided with an air-inlet thereto for air from without and with an air-outlet connected with the main reservoir.

9. In fountain-pens, an upper capillary feed-surface extending from the main reservoir along the top of the feed-bar and of the writing-pen to the nibs, together with the under and opposite capillary surface, in combination with a cavity or chamber opening into the capillary conduit or space between the two surfaces and provided with an air-inlet there-

to for air from without and with an air-outlet connected with the main reservoir, and with an annular capillary channel around the feed-bar at and near its inner end.

5 10. In fountain-pens, an upper capillary feed-surface extending from the main reservoir along the top of the feed-bar and of the writing-pen to the nibs, together with the under and opposite capillary surface, in combination with a cavity or chamber opening, from  
10 below, into the capillary conduit or space between the two surfaces and provided with an air-inlet thereto for air from without and with an air-outlet connected with the main reservoir, and with an annular capillary channel  
15 around the feed-bar at and near its inner end.

11. As elements in a combination of devices for feeding ink from the reservoir to the writing-pen of a fountain-pen, an annular capillary channel located at the inner end of the  
20 feed-bar, a connecting capillary channel on the upper side of the inner end of the feed-bar connecting with a secondary reservoir located in the feed-bar, which reservoir is pro-

vided with an air-inlet connecting with the  
25 outer air and an air-outlet connecting with the main reservoir, and a connecting-over capillary channel and feeder located on the upper side of the feed-bar and of the writing-pen between the secondary reservoir and the  
30 nibs of the writing-pen.

12. As elements in a combination of devices for feeding ink from the reservoir to the writing-pen of a fountain-pen, a capillary channel on the upper side of the inner end of the feed-  
35 bar connecting with the secondary reservoir located in the feed-bar, which reservoir is provided with an air-inlet connecting with the outer air and an air-outlet connecting with the main reservoir, and a connecting-over  
40 capillary channel and feeder located on the upper side of the feed-bar and of the writing-pen between the secondary reservoir and the nibs of the writing-pen.

LEWIS E. WATERMAN.

Witnesses:

EDWARD S. BERRALL,  
JAMES A. SKILTON.