No. 607,401. Patented July 12, 1898.

L. E. WATERMAN.

FOUNTAIN PEN.

(Application filed Sept. 22, 1897.)

(No Model.)

Fig. 1.

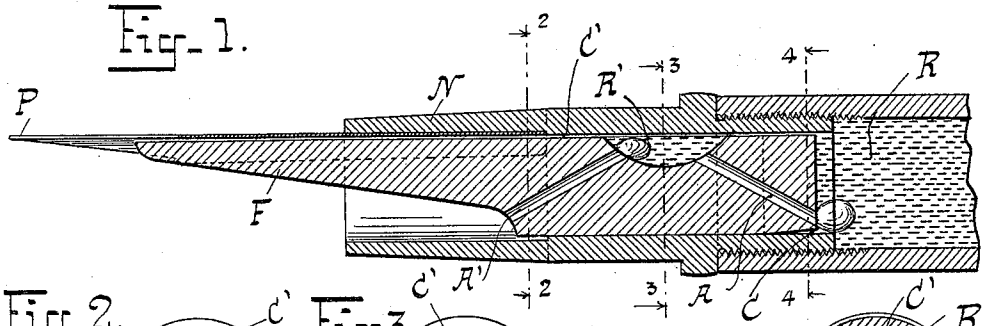

Fig. 2.

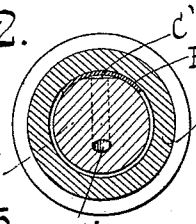

Fig. 3.

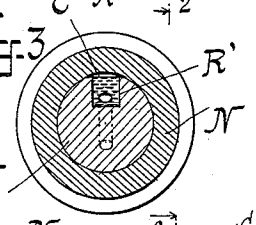

Fig. 4.

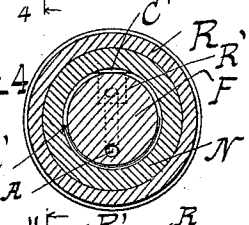

Fig. 5.

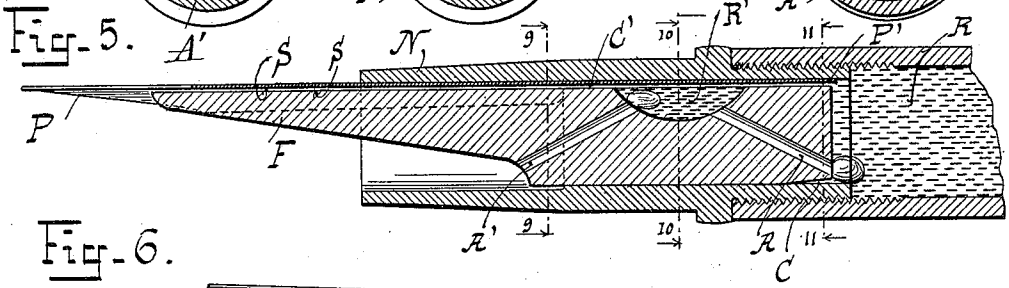

Fig. 6.

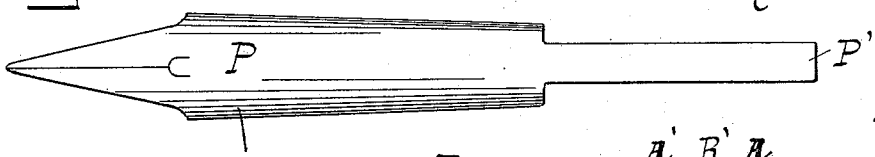

Fig. 7.

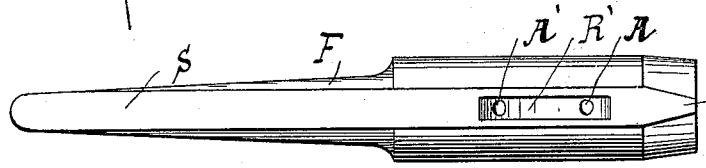

Fig. 8.

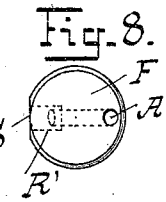

Fig. 9.

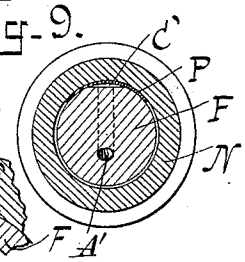

Fig. 10.

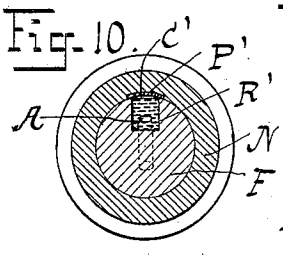

Fig. 11.

Fig. 12.

Fig. 13.

Witnesses
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UNITED STATES PATENT OFFICE.

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

FOUNTAIN-PEN.

SPECIFICATION forming part of Letters Patent No. 607,401, dated July 12, 1898.

Application filed September 22, 1897. Serial No. 652,555. (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 "under feed." This under-feed system of feeding ink in fountain-pens is a system in and by which the ink reaches the nibs by or through capillary convection by passing along the under side of the writing-pen and between the writing-pen and an opposite surface forming therewith a capillary channel. Heretofore underfeed 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 under 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 under-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 longitudinal vertical sectional view of the nozzle, writing-pen, feed-bar, and part of the reservoir. Fig. 2 is a sectional view cut on the line 2 2, Fig. 1. Fig. 3 is a sectional view cut on the line 3 3, Fig. 1. Fig. 4 is a sectional view cut on the line 4 4, Fig. 1. Fig. 5 is a longitudinal vertical sectional view of the nozzle, the writing-pen, the feed-bar, and the lower end of the reservoir, showing the pen extending up into the reservoir. Fig. 6 is a top view of the writing-pen. Fig. 7 is a top view of the feed-bar. Fig. 8 is a rear end view of the feed-bar. Fig. 9 is a sectional view cut on the line 9 9, Fig 5. Fig. 10 is a sectional view cut on the line 10 10, Fig. 5. Fig. 11 is a sectional view cut on the line 11 11, Fig. 5. Figs. 12 and 13 are enlarged part sectional views, both of them cut through the rear narrow end of the pen, the former showing a flat top surface of the feed-bar under the pen and the latter a curved surface in the same place as a modification.

Similar letters relate to similar parts throughout the several views.

Figs. 1 to 4, inclusive, show the invention in a form in which the writing-pen extends along the top of the front half, more or less, of the feed-bar and does not extend to or into the reservoir, and the lower or front part of the capillary channel C′ is formed between the under side of the writing-pen and the front part of the flat top of the feed-bar F, and the upper or rear part of the channel is formed between the remaining rear end portion of the flat part of the top of the feed-bar and the opposite part of the inner surface of the nozzle; and Figs. 5 to 13 show a variation in which the writing-pen P has an extension P′ broad enough to cover the secondary reservoir R′ and the adjacent flat parts of the top of the feed-bar on each side of the secondary reservoir, and which extends into the main reservoir R, and the capillary channel is formed throughout between the under side of the pen and the flat top of the feed-bar. In both cases the ink is conducted to the under side of the pen-nibs by capillary action along the continuous longitudinal capillary channel C′.

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 "under feed" is a system in which the ink is conducted or fed to the writing-pen along the under side of the writing-pen and between

it and the opposite top surface of a feed-bar, the space between the two surfaces forming a capillary channel for the ink on its way from the reservoir to the paper. It is distinguished from the upper-feed system in and by the fact that in the latter the ink traverses the upper side of the writing-pen on its way to the nibs, following a capillary channel located there and formed by or between the upper surface of the writing-pen and an adjacent opposite capillary surface. In both cases the channel formed between these two surfaces is a capillary channel and transfers the ink to the nibs of the pen by capillary action, which is intended to dominate the movement, although the action of gravity may not be entirely wanting and may at times defeat the intention, and if or when the gravity 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 causes produce such derangements, and my invention is intended to prevent such derangements and their evil consequences by providing a regulating device connected actually and functionally with the longitudinal capillary channel and located between its two ends, and also an additional and annular or approximately annular capillary channel open to the ink in the main reservoir and connecting with the longitudinal capillary channel.

The nozzle N, as is shown in Figs. 1 and 5, may be of the ordinary type used to receive a tight-fitting plug of a feed-bar and is without any necessary extension to the nibs on top of the pen and without any necessary capillary channel between the writing-pen and the nozzle, although it might have both without avoiding my present invention. The feed-bar F has a plug portion which fits tightly within the nozzle and excludes air and ink movement, except through the channel or channels respectively provided for that purpose. It has a narrowed front end projection the top of which has a flat surface, an approximately flat surface, a slightly-curved surface, or a surface slightly beveled each way from the longitudinal center and continuous with that over the plug part of the feed-bar along which the ink moves to the nibs of the pen, and the capillary channel formed between the top of the feed-bar and the pen consists of a narrow space, made so for the purpose of moving or holding the ink in the channel by capillary action and thereby preventing the passage of air by that route from without into the reservoir, another channel, duct, or route being provided for the outer air on its way to the main reservoir.

The close fitting and secure holding of the plug in position is an important 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 have in the past been to or toward the use of badly-fitted parts, which leave numerous openings and channels not well guarded or controlled. It is believed that this tendency has been, at least in part, due to a lack of complete mastery of the principles of ink and air movements in fountain-pens. In my invention surplus and carelessly-constructed channels and openings are discarded and the action of the pen is intrusted to automatically-controllable channels and openings only. This principle when applied properly prevents surprise or unexpected or undesired ink-flow and insures proper ink-flow as and when wanted.

The main feed-bar F is flat, nearly flat, or only slightly curved or slightly beveled sidewise on top from the rear end forward to and under the nibs of the writing-pen P and has the secondary reservoir, cavity, or air and ink valve or regulator R′ located in the plug portion of the feed-bar and cut into the feed-bar through the capillary surface of the feed-bar to the depth shown in the drawings, more or less, leaving continuous flat capillary surfaces or places on each side of it to make the capillary surface S continuous from one end of the feed-bar to the other. The cavity R′ is so related and connected with the capillary surfaces S S, along and by which the ink is transferred from the reservoir R to the nibs of the writing-pen P by the route of the upper side of the main feed-bar F and the under side of the writing-pen P, that it receives, holds, and may be filled by the surplus ink brought by capillarity from the main reservoir and not drawn away by the writing-pen and not applied to or on the paper in writing. Being so therein received and held when not required by the writing-pen, the ink in the cavity or reservoir R′ acts as a regulator and for the time being checks further air-inlet and ink-flow from the reservoir as well as from the writing-pen by covering the inner end of the air-inlet A′ and also the inner end of the air-outlet A of the secondary or sub reservoir. The secondary reservoir or cavity R′, as shown, is connected with the reservoir R by the air-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 secondary reservoir or cavity R′ to the ink-reservoir R and that of the latter to admit air to the secondary reservoir from without as the ink is drawn therefrom toward the pen by use. Between these two air-ducts the cavity or chamber R′ is interposed in such a way that when it contains ink the inner end of the air-duct A′ is covered and the entrance of the air is checked, and when it is empty and the writing-pen is in use ink-flow from the main reservoir to and through the capillary channel is promoted by the air entering the main reservoir therefrom until the ink-supply is more than sufficient, when further ink-flow is automatically checked by the reception and retention of the ink in the

cavity, which in turn checks further entrance of air.

At the inner end or at and near the inner end of the feed-bar I locate an annular or approximately annular capillary chamber or channel C, which connects with the capillary channel C′ and may be made V-shaped in section by beveling the feed-bar at and near its 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 by simply forming a straight annular chamber around the feed-bar, either by cutting away the bar or by cutting away the nozzle, so as to connect the main reservoir with the capillary channel C′. I prefer the conical chamber, because it gives a better clearance, is not so likely to 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 the purposes of capillary transfer of ink.

The theory and explanation of the action of these devices while performing the function of transferring the ink from the reservoir R to the writing-pen and its nibs for use in writing is as follows: The pen being, as usual, carried in the pocket with the pen-point uppermost, when taken in hand for writing, in the first part of the manipulation has the ink in the main reservoir R, but the moment the fountain-pen is held with the writing-pen point downward the capillary surfaces immediately begin the operation of transferring the ink to the writing-pen point by capillary action first in and through the annular capillary channel C, then by the capillary channel C′, formed between the top surface of the feed-bar and the adjacent nozzle-surface or the adjacent under side of the writing-pen surface, as the case may be, and when the ink has entered the annular channel C it will be transferred to the capillary channel C′ and thereby find its way to the nibs of the pen, where it will remain ready for use in writing. 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 pass into and fill up the secondary reservoir or regulating-cavity R′ and thereby check the further flow of ink from the main reservoir through the capillary channels, because of the closure of the air-duct A′ by the ink, which prevents further entrance of air into the reservoir and its movement toward the main reservoir for the time being. The use of the writing-pen sets up or continues the automatic action by or through which ink is transferred from the reservoir to the writing-pen as needed. A necessary incident of the continuance of this transfer is a 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 thereto. In order to prevent a failure of a supply of ink to 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 of the devices is from without, through the air-duct A′, into the secondary reservoir, cavity, or pocket R′, thence through the air-duct A into the reservoir; but before the air can pass through the secondary reservoir R′ when filled with ink the capillary surfaces or channel in front of the secondary reservoir must draw upon the ink in the secondary reservoir sufficiently in force and quantity to empty or partially empty it, and thereby permit the air to enter the secondary reservoir from without. The capillary channel between the secondary reservoir and the pen will first draw upon the ink in that reservoir rather than from the ink in the main reservoir, because, being directly connected with the outer air through the air-duct A′, the place of the ink in the secondary reservoir can be immediately and most easily supplied by air entering it from without. This is accomplished by a sort of siphon-like action, the downward pull of the ink assisting the air to rise within the air-duct A′ and enter the cavity R′. 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 ink of the secondary reservoir being exhausted and the ink of the main reservoir being in turn drawn upon by capillary and siphon-like action, the previous operation is repeated and the air enters and traverses the air-duct A and finally reaches the reservoir R in bubble form, as shown in Figs. 1 and 5. Coincidently, as the capillary channel C′ is relieved from the strain of vacuum tension by the admission of air ink-transfer from the main reservoir to the capillary channel and to the subreservoir proceeds until the cavity R′ is again filled, when the ink again acts so as to check too great air-supply to the subreservoir and to the main reservoir, and thereby control ink-flow. The subreservoir R′ and air-ducts A and A′ must not be made too large, but of such a size that the air will traverse them in attenuated form and only enlarge into bubble form and escape into the main reservoir when the quantity of air reaching the inner end of the air-duct is sufficiently increased. The size of the air-ducts in cross-section may be increased to match the size of the pen or its capacity to transfer ink to the paper; but it is desirable that the air should enter rapidly in small quantities rather than more slowly in large quantities, because in the latter case there is less steadiness and continuity of flow of the ink. 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, the transfer being checked when the secondary reservoir is filled with ink and being increased when or after it is filled with

air. During the operation the secondary reservoir is being drawn upon, alternately filling and emptying with air or ink 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 under the pen and to a certain extent under its control. As the capillary feeding-surfaces are freed and call for more ink by increased capillary tension air automatically supplies its place in the secondary reservoir in the first instance and finally in the main reservoir in continuous succession until the ink in the main reservoir is exhausted.

The annular capillary channel or chamber C at the inner end of the nozzle and feed-bar by its complete exposure to the ink of the main reservoir down to the last drop and by its large capillary capacity effects the complete or sufficient supply of ink to the capillary surfaces and channel between it and the writing-pen with great rapidity, and the action of that chamber or channel at and around the inner end of the air-duct A, or rather upon the ink held there by capillarity or otherwise, 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 if it has entered the same under the control of gravity, or assisting the air to push the ink out of or away from that air-duct into and through the ink to the top of the main 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′, which is intended to be a capillary channel for ink only, and particularly through its upper end. In this the cavity R′ and the capillary channel between it and the writing-pen coöperate, since the ink will be first drawn from R′, because of least resistance, and the larger capacity and capillary power of the annular channel C will keep the upper end of the channel C′ filled with ink, and thereby prevent the entrance of air into the main reservoir by that route.

The capillary channel C′, in front of the secondary reservoir R′ in much the same way as in the case of the main reservoir facilitates the entrance of air from without into the secondary reservoir R′ by the route of the air-duct A, preventing all air-entrance by other routes and establishing a siphon-like action of which the air automatically takes advantage to assist it in entering 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 and regulates the flow of ink outward, both of them in and through the secondary reservoir, and the secondary reservoir thereby becomes at one moment a sort of automatic air and ink valve and at another moment a source or resource of immediate ink-supply to the writing-pen from the subreservoir without bringing down a sudden avalanche of ink from the main reservoir. It is this function of the secondary reservoir, largely, that enables me to remedy previous defects in under-feed pens and to prevent excessive ink-supply to the writing-pen, and also to secure an adequate ink-supply thereto for all necessary purposes when using the under-feed system of supplying ink from the reservoir to the writing-pen. Heretofore under-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.

The subreservoir is an intermediate source of supply for the writing-pen and may be located anywhere in the plug portion of the feed-bar; but I prefer to locate it near the middle of it, since that leaves room for the air-ducts connecting with it from each side. In performing its function as an intermediate subreservoir it stands guard over the contents of the main reservoir and, as it were, spoons or deals out the ink therefrom in regulated quantity and time to the writing-pen. Even if the ink passes into it from the main reservoir directly through the inner air-duct at any time, and as a consequence of any particular way of handling, it cannot be thereby caused to gush or spurt from the writing-pen upon the paper, because it can only reach the writing-pen through a capillary passage or channel located between the subreservoir and the writing-pen, and as all the air passages and spaces leading to the main reservoir must at the moment or by the same operation be filled with ink air-supply cannot take place and help the movement, but must help prevent ink-gush.

The extension P′ of the writing-pen over the secondary reservoir is intended to cover the open mouth or top of the secondary reservoir not only from end to end, but from side to side far enough to cover the capillary surfaces on each side of it. This not only brings the ink in the secondary reservoir into contact with the under side of the pen extension, but it connects the same with the capillary channel and surfaces in front, in rear, and on each side of the secondary reservoir, and consequently as the ink is used by the writing-pen the new supplies must in the first instance come directly from the secondary reservoir, and when the supply of the secondary reservoir is exhausted it will immediately become refilled by the action of the annular capillary channel C and the upper part of the capillary channel C′ coöperating with the air-ducts to admit air into the main reservoir. By this covering of the secondary reservoir the ink is prevented from escaping from or is confined to the capillary channel. The two shoulders of the pen make contact with corresponding shoulders in the nozzle and the pen is thereby prevented from being

forced in too far and at the same time the extension P′ is held in proper relation to the adjacent parts. In the absence of the extension P′, where the pen is made short, as shown in Fig. 1, the ink in the secondary reservoir of course when it is filled will rise in contact with the under side or interior nozzle-surface, which in that case forms part or one side of the capillary channel C′.

If desired, instead of the extension P′ a similar-shaped piece of rubber or other suitable material may be inserted in its stead and place; but that multiplies parts, which are likely to be lost or broken, and that method therefore is not desirable.

I claim as my invention—

1. In combination with under 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.

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

3. In a fountain-pen, a chamber or cavity located within the nozzle, in or near the feed-bar, and functionally related to under capillary feed channels and devices, acting automatically as a secondary reservoir, an air-valve and an ink-valve as required to control the supply of ink from the main reservoir to the writing-pen, in combination with under 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.

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

5. In fountain-pens, an under capillary feed-surface extending from the main reservoir along the top of the feed-bar and under the writing-pen to the nibs, together with the over and opposite capillary surface, in combination with a cavity or chamber opening into the capillary conduit or channel 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.

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

7. In fountain-pens, an under capillary feed-surface extending from the main reservoir along the top of the feed-bar and under the writing-pen to the nibs, together with the over and opposite capillary surface, in combination with a cavity or chamber opening into the capillary conduit or channel 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 around the feed-bar at and near its inner end.

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

9. 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-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 under capillary channel and feeder located on the upper side of the feed-bar and on the under side 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.

Correction in Letters Patent No. 607,401.

It is hereby certified that in Letters Patent No. 607,401, granted July 12, 1898, upon the application of Lewis E. Waterman, of New York, N. Y., for an improvement in "Fountain-Pens," an error appears in the printed specification requiring correction, as follows: On page 4, line 54, the reference letter "A" should read *A'*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 19th day of July, A. D., 1898.

[SEAL.]

WEBSTER DAVIS,
Assistant Secretary of the Interior.

Countersigned:

A. P. GREELEY,
Acting Commissioner of Patents.