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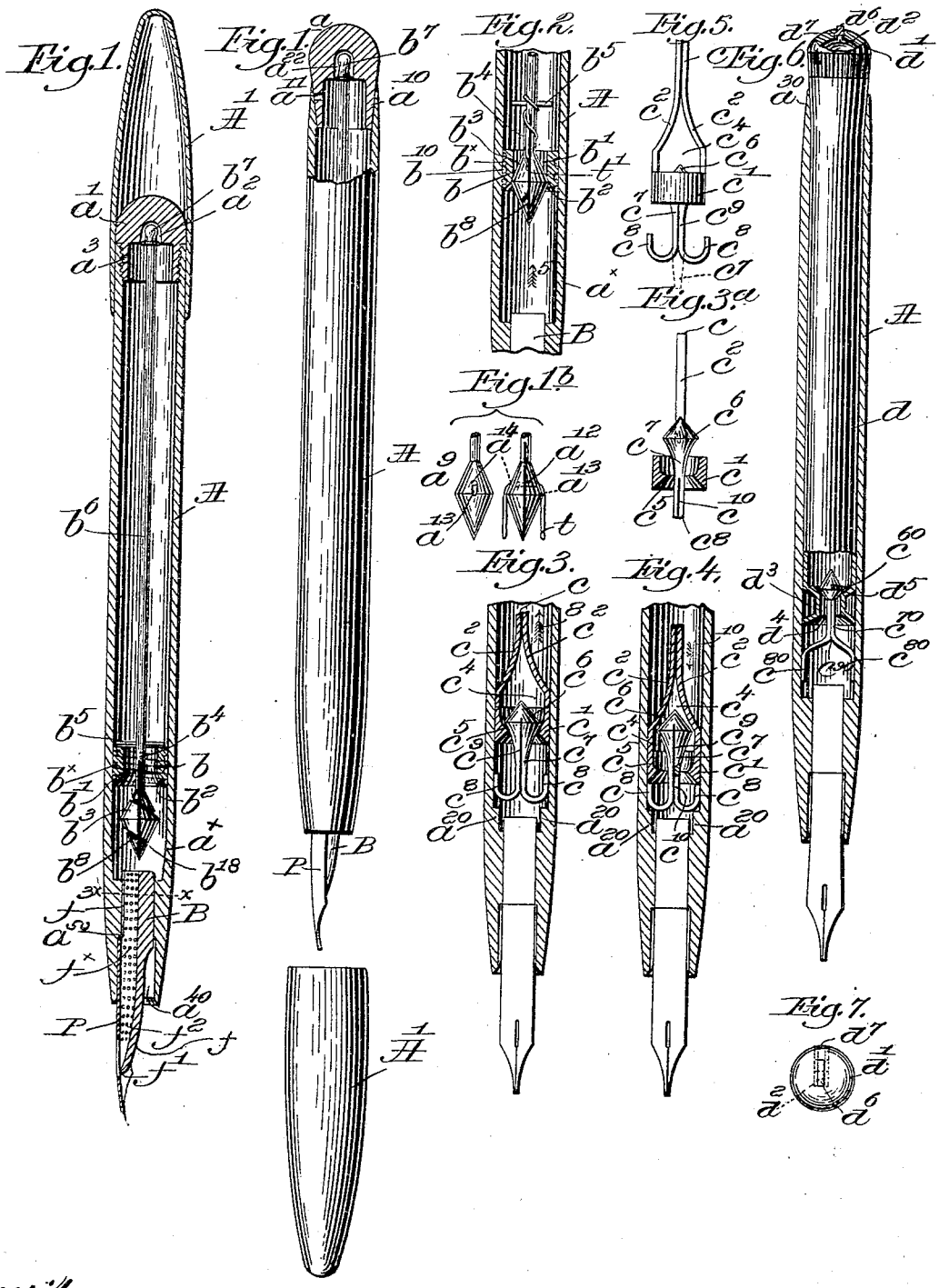
A. A. WATERMAN & F. W. STEVENS.

FOUNTAIN PEN.

(No Model.) (Application filed May 3, 1897.)



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UNITED STATES PATENT OFFICE.

ARTHUR A. WATERMAN, OF ARLINGTON, AND FREDERICK W. STEVENS, OF BOSTON, MASSACHUSETTS, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO RHODES LOCKWOOD, OF BOSTON, MASSACHUSETTS.

FOUNTAIN-PEN.

SPECIFICATION forming part of Letters Patent No. 633,538, dated September 19, 1899.

Application filed May 3, 1897. Serial No. 634,814. (No model.)

To all whom it may concern:

Be it known that we, ARTHUR A. WATERMAN, of Arlington, in the county of Middlesex, and FREDERICK W. STEVENS, of Boston, in the county of Suffolk, State of Massachusetts, have invented an Improvement in Fountain-Pens, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to fountain-pens; and it has for its object certain improvements in the construction thereof, including simple and effective self-contained means for providing the reservoir, of any usual construction, with a fresh supply of ink when necessary.

Owing to the inconvenience of filling fountain-pens by means of separate devices, which are frequently mislaid when most urgently needed and which at best are a care and trouble to the user, various attempts have been made to provide filling apparatus which when not in use will be held and concealed within the body of the pen. A comparatively small number of these devices are practical, owing to various reasons; and it is the object of our present invention to simplify the construction and lighten the weight of the filling device or pump and also to increase the convenience of operation, so that the pen can be filled from an ordinary inkstand or bottle quickly and cleanly.

The various features of our invention will be fully illustrated and described in the drawings and specification and set forth in the claims.

Figure 1, in longitudinal section, represents a fountain-pen with one form of our invention applied thereto, the pen being shown ready for use. Fig. 1^a shows in elevation a complete pen with a portion of the barrel broken away at one end to show a modified form of end plug in place. Fig. 1^b shows in detail a valve of altered construction. Fig. 2 is a view similar to Fig. 1, showing the pump device on the outward or filling stroke. Fig. 3 is a detail sectional view of the feed end of the barrel with a modified form of pump, the latter being shown on the filling stroke. Fig. 3^a is a detail view in side elevation, partly in section, of the piston and valve. Fig. 4 shows the pump illustrated in Fig. 3 in its normal position when inoperative. Fig. 5 is a side elevation, detached, of the pump valve and rod shown in Fig. 3. Fig. 6 is a longitudinal sectional view of a fountain-pen with yet another form of pump. Fig. 7 is an end or top view of the pump-actuator shown in Fig. 6.

In devising a pump for fountain-pens we have had in view simplicity, light weight, the ability to fill the barrel with a single pumping stroke or a series of short ones and irrespective of the particular position of the pumping device within the pen-barrel, and the capability of always and automatically insuring an open valve when the pump is not in use and of producing and maintaining a flow of ink through or past the valve as needed when the pen is in use.

Referring to Fig. 1, the pen-barrel A, forming the ink-reservoir, may be of any suitable or desired construction, but preferably is made closed at one end and thereafter bored or pierced to receive the feed-bar B, of construction to be hereinafter more fully described, through a duct f^3, in which the ink is fed from the reservoir to the pen P. The opposite end of the barrel is threaded to receive a screw-head plug a', having an internal recess a^2, for a purpose to be described, a suitable cap A′ being shown as slipped over and held by friction on the barrel, the cap being transferred to the opposite end thereof to protect the pen P when not in use. Instead of being threaded the head-plug may be fitted to be otherwise held in its place in the end of the barrel, as by friction, as seen in Fig. 1^a at a^{10}. The internal bore of the barrel A is cylindrical throughout the greater portion of its length, but may taper slightly near the feed end, as shown at $a^\times$, to cause the walls to project into the path of the pump and act as a limiting-stop for an annulus or piston b, fitted to slide with frictional contact longitudinally in the barrel. This piston has a comparatively large aperture b' therethrough communicating on the feed or lower side with a preferably conical valve-seat b^2 for a valve b^3 of corresponding shape, the

valve-stem b^4 extending through the aperture b' and having a suitable stop (shown as a pin b^5 thereon) adapted at times to rest on the upper or opposite side of the piston. It will be seen that in Fig. 1 the valve b^3 is unseated, leaving a free passage for ink from the upper reservoir-chamber—*i. e.*, the space between the piston and the end of the barrel closed by the head-plug—to the lower reservoir-chamber—*i. e.*, the space between the piston and the end of the barrel in which is the feed-bar B—and it will also be seen that the valve-stem is continued at b^6 to form an actuator and extended into the recess a^2 of the head-plug a'. The piston b is held by the sloping wall $a^\times$ of the barrel from movement toward the feed-bar not only to insure separation of the operating parts of the pump by opening the valve when the piston reaches this position, but also to prevent the feed-bar from being hit by either piston or valve b^3, and it will be noted also that there is considerable play or lost motion for the piston between the stop b^5 and valve b^3.

"To fill the pen," such term being used to denote the apparatus generically, the head-plug a' is removed while the other end of the pen is held over an inkstand or other source of supply, and the pen P and the feed-bar B are immersed in the ink or other fluid quite up to the lower end of the barrel A, deeper immersions being avoided to prevent soiling the barrel, and the operator grasps and draws out the actuating-spindle b^6 by means of its head b^7. This movement of the latter first seats the valve b^3, (see Fig. 2,) closing the aperture b' in the piston, and the ink will be sucked up into the barrel either by one long stroke or by a series of short ones, as most convenient. Short strokes are preferable as taking the pump a less distance from the point of rest, to which it is to be returned after the last stroke. In either case reversal of movement of the spindle—*i. e.*, opposite to the arrow 5, Fig. 2—unseats the valve, the piston being held by friction in the barrel until engaged by the stop b^5, and on the instroke there is a free passage for the ink through the piston, as described. The alternate closing and opening of the valve are continued at each outward and inward stroke until the barrel is filled, when the parts are returned to the position shown in Fig. 1, the contraction $a^\times$ of the barrel stopping the piston and automatically insuring an open passage through the piston when the spindle b^6 is pushed in sufficiently to enable the head-plug a' to be inserted in and to close again the end of the barrel to which it is fitted, or so long as the friction between the piston and the barrel is sufficient to unseat the valve wherever the pump stands after reversal of the stroke, and to maintain the valve thus unseated the parts need not be returned to the position shown in Fig. 1, but the pump may come to rest at any point in the barrel after its spindle b', of any desired length, is pushed in far enough to allow the head-plug to close the open end of the barrel, as provided; but the preferred position of rest is in the lower half of the reservoir. The bead b^7 on the spindle substantially closes the recess a^2, the slight quantity of air inclosed assisting to prevent the ink from reaching the end of the spindle when the pen is not in use, even though the pen be accidentally reversed, so that the fingers will not be soiled when refilling.

In inserting the head-plug a' some pressure otherwise made on the ink in the reservoir, causing a loss of ink at the feed end, is much reduced by a vent-hole a^3, Fig. 1, through the wall of the portion of the plug that engages the threaded part of the barrel. A similar vent a^{11} is provided for the plug in Fig. 1^a.

The pumping may be carried on at any portion of the barrel, as may be most convenient, and the passage through the piston when open is larger than the feed-duct through the bar B, so that very little ink will be forced out on the inward stroke.

The piston b is preferably provided with a peripheral groove $b^\times$, which serves to hold moisture when once wet, and thus aid in keeping the piston air-tight in the barrel and make tightly-fitted or hard-moving pistons less essential, and if packed with soft fiber, as indicated in Fig. 2, b^{10}, it permits the use of still more loosely-fitted pistons. When cut in a spiral form, this groove has another function, to be explained elsewhere. The valve b^3 is conical at its head, in this instance the lower end, so that on the inward pump-stroke it will meet the air or ink in the reservoir with a less abrupt impact, and thus cause but little loss from forcing ink out through the feed-bar B.

An important feature of our invention and one designed to insure its successful use in fountain-pen reservoirs of all sizes, especially those of relatively small diameter, will now be described. It is well known that if a small tube closed at one end and filled with a liquid, like ink, be held with open end down the liquid will not run out, because the elastic skin, which theoretically is regarded as forming the surface of the liquid, resists the action of gravity in its attempt to pull down the liquid from the tube. This elastic resistance is always present, and when not stronger than gravity—*i. e.*, able to keep all the liquid in the tube—it is seen holding back more at the edges of the opening, where the gravity-pull is least, but yielding, like an elastic bag, in the center, where the pull is strongest, till the skin breaks there and portions of the liquid fall in successive drops. If a small rod or stem is introduced into the open end of the tube, a continuous flow is started, provided the surface of the rod is such that the surface-skin of the liquid will quickly attach itself to and extend itself along the rod. In other words,

the surface of the rod must be such that it is easily "wetted" by the liquid on coming into contact with it. Now in the various forms of our invention the apertures extending through the piston of the pump whenever made relatively small in diameter may act as the small tube is explained to act, and thus retard the passage of ink from the upper to the lower reservoir-chamber. To eliminate this retardation, we so construct the parts as to provide an ink-directing path of high ink conductivity between the upper and lower reservoir-chambers, constituting means to render possible an immediate flow of ink therebetween whenever the valve is unseated. In Fig. 1 we have illustrated this path as constituted in this instance by a spiral groove b^{18}, acutely V-shaped in cross-section, extending around and up on the valve-stem far enough to insure its communication with the ink in the upper reservoir-chamber at all times. If desired, a cleft or fissure, as that illustrated in the form of a longitudinal bisection b^8 of the valve, may be used in addition to or in place of the groove, such cleft virtually forming a recess acting as an ink-receptacle, the capillarity of which is preferably heightened by having its walls at their boundaries and preferably throughout their extent in close relation to each other. Thus the pump is provided with a feeding-path which insures the flowing of ink past the unseated valve to replace any ink that has been drawn out of the lower reservoir-chamber in the act of writing. The path formed as above described obviates the objection to which valves and their stems as ordinarily produced are open—*i. e.*, the objection that their surface is too smooth or they are otherwise too ink-repellent to furnish the desired valve-feeding action. It is obvious that the necessary path may be produced by the formation of suitable fissures, cleft-like or otherwise, or an equivalent ink-directing construction, such as the spiral peripheral groove $b^{\times}$ on the piston, already mentioned, or like arrangements in the barrel or other parts, and likewise a path of high efficiency may be secured by the use of thread or wire, either as such or in the form of fabric, Fig. 1^{b} illustrating a valve a^9 of the form already described, having a thread t passing through a body-channel a^{14}, which intersects the fissure a^{12}, and seated for convenience in a notch a^{13}, although such thread or its equivalent may be, as in Fig. 2, t, inserted in the fissure or arranged to serve to prevent leak or for other purposes or may be arranged without the use of either notch or fissure.

A different form of valve mechanism is shown in Figs. 3, 4, and 5, the actuator, here an actuating-spindle c, being shown as carrying a valve-case or piston c', having a close frictional fit in the barrel A. The piston is preferably formed of an integral blank of material oppositely cut away or slabbed off, leaving suitable strips c^2, which may be continued, as illustrated, to form the spindle or (if the latter is formed separately) to serve as means for attaching the piston to the spindle, the material being further cut away to form a central aperture c^4 in the piston, having a valve-seat c^5 for a gravity-valve c^6, provided with a stem c^7, extended through the case c'. This stem serves the twofold purpose of guiding the valve in its play between its seat and the end of the actuating-spindle c and of providing a convenient member to coöperate with means in the path of the pump to separate the operating parts to permit outflow past the pump, in this instance by opening the valve automatically when the pump is at rest, either by impinging against the inner end of the feed-bar if straight, as in dotted lines, Fig. 5, or against other suitable means—as, for example, a shoulder or lug a^{20}—on the interior of the barrel. In the latter case the stem is bent to one side, as at c^8, Fig. 3, in one or more directions, this construction rendering the opening of the valve independent of the feed-bar. Such bent leg or legs c^8 are preferably resilient and extended to contact frictionally with the inner walls of the barrel to positively seat and unseat the valve. The valve-stem is shown as having a longitudinal bisecting cleft or fissure c^9, similar in arrangement and function to that illustrated in Fig. 1 and described, and an extension of the ink-feeding path is provided, preferably, by bisecting each of the legs c^8 to form fissures c^{10}, (see Fig. 3^{a},) extending from their extremities inward until they connect with the stem-fissure c^9. In place of these fissures or in connection with them any one of the feeding expedients to which reference has been made or their equivalents may be used. As the feed-bar is longitudinally adjustable in the end of its barrel, the valve-stem c^7 must be long enough and the play of the valve in its case c' great enough to effect the unseating of the valve no matter what the adjustment of the feed-bar when it is used instead of a projection on the barrel. When pumping, the operation of the device will be obvious, gravity and the friction of the valve-stem legs seating the valve on the outstroke, the resistance of the ink ahead of the valve, aided similarly by friction, unseating it on the instroke to permit the ink to pass through the case or piston c' to the other side. In Fig. 3 the valve-case is shown on the out or suction stroke and in Fig. 4 on the inward stroke, the direction being indicated by the arrows 8 and 10, respectively. The parts of the pump may be made of any suitable material, and in practice we have found rubber to be very satisfactory, as it is light, readily fashioned, and not subject to disintegration by the action of the ink.

In both constructions referred to the actuating-spindle takes up some space in the barrel, though small; but in Fig. 6 we have

shown a construction whereby the actuator is made hollow to telescope into the barrel, said actuator itself forming a part of or an addition to the reservoir for the ink. This actuator d acts as a valve case or piston, having in its end a valve-seat d^5, a valve c^{60}, a valve-stem c^{70}, and an aperture d^4, all similar in operation to those shown in Figs. 3, 3^a, and 4, the recess d^3 being shown as annular to illustrate a modification from the spiral groove $b^\times$ of Fig. 1.

The form of valve shown in Fig. 6 is a slightly-modified form of the valve shown in Fig. 3, the valve-stem c^{70} being split and divided into legs c^{80}, brought into contact frictionally with opposite walls of the reservoir, as were the legs c^8 in Fig. 3, but carried down instead of being turned up. Whenever the pump is pushed in quite to the end of the feed-bar B, these valve-stem legs, being at once relatively long and thin, hit the end of the barrel and easily open the valve and maintain it open, if friction has failed to do so, without touching or disturbing the feed-bar. The valve-stem is shown as having a longitudinal bisecting cleft or fissure c^{90}, similar in arrangement and function to that illustrated in Fig. 3 and described, and an extension of the ink-feeding path is provided, preferably, by bisecting each of the legs c^{80} to form fissures (not shown, but similar to the fissures c^{10} in Fig. 4) c^{10}, extending from their extremities inward, until they connect with the stem-fissure c^{90}. In place of these fissures or in connection with them any one of the feeding expedients to which reference has been made or their equivalents may be used.

The barrel may be threaded internally at its upper end—*i. e.*, the end opposite the one holding the pen P—to engage threads on the tube d to tightly close the barrel, a shoulder on the actuator-tube engaging the end of the barrel; but the form shown in Fig. 6 provides that the actuator near its outer end d' be enlarged a little gradually, thus dispensing with an abrupt shoulder, so that the tube-head may be crowded part way into the end of the barrel and held there tightly as a friction-plug. Making the end of the barrel thin, as at a^{30}, where the friction-plug is inserted, aids in securing easily a tightly-fitting contact. This end of the actuator-tube is closed, with the exception of a vent-opening d^2 of any needed size, which opening is closed just as soon as the reservoir has been filled by a slide d^6, movable in an undercut recess d^7, as shown in Fig. 7. Now when the actuator is freed from the end of the barrel it can be reciprocated therein to draw in a supply of ink; but the latter passes into the tube d through the valve-aperture d^4, the vent d^2 being opened to permit escape of air, and just as the ink rises to fill the vent-opening d^2 the slide d^6 is pushed in, closing the vent, (or the vent may be closed in other ways according to construction,) so that the full supply of ink then in the reservoir can be retained, thus avoiding the loss of whatever ink might escape otherwise at the feed end while bringing the pump to the position of rest after the filling-stroke is taken.

It is obvious that with this construction provision is made for holding an increased or even a double supply of ink, for by operating the pump near the outer end of the barrel A not only will the latter be filled, but the ink will be forced into the tube d, filling it. After closing the vent d^2 the lengthened penholder can then be used in ordinary manner until all the ink has been used from both barrel and tube, the friction of the valve-legs c^{80} in the barrel maintaining the valve open, or the pen may be thus used for a time and then closed up to the usual length of barrel by forcing the tube back into the barrel, during which operation the feed end of the pen should be held over some receptacle to receive the surplus ink forced out through the feed-bar B. A valuable fountain-pen is thus provided for court reporters or stenographers or others who are at times unable to stop in the midst of lengthy note-taking to refill the ink-reservoir.

In the constructions of pumps shown in Figs. 1, 2, and 3 the friction would serve practically, as explained, to maintain the valve open with the pen in use and to guard against the accidental contact of the piston and valve with the feed-bar B; but we prefer to insure both these results positively by the contraction of the barrel or in some other equivalent manner.

Our invention is not restricted to the precise constructions and arrangements herein shown, as the same may be modified or altered without departing from the spirit and scope of our invention, and so far as we are aware it is broadly new to provide a fountain-pen with a pump which may after operation in any portion of the barrel be left at any desired position. Nor, so far as we are aware, has any pump hitherto been provided with means to maintain the valve open when the pump is at rest or with a feed-path to maintain a constant ink-conducting connection between the two chambers separated by the operating parts of the pump.

Any suitable feeding device B may be used, the one shown following in its construction that patented to Arthur A. Waterman in United States Patent No. 619,701, dated February 14, 1899.

Having fully described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a fountain-pen, the combination with a barrel or reservoir, of a pumping device adapted to operate therein to fill the same with ink; and comprising as operating parts a piston and coöperating valve and means in the path of the pumping device to positively engage one of the operating parts thereof and insure

separation of said parts when near the forward end of said path, substantially as described.

2. In a fountain-pen, the combination with the barrel or reservoir, of a piston therein having a valve, and means to automatically engage and open the piston-valve and to retain the same open when the barrel is closed, substantially as described.

3. In a fountain-pen, the combination with the barrel or reservoir, of a piston having a valve, means to reciprocate the piston in the barrel, to fill the latter with ink, and means to hold the valve open positively after forward stroke of said reciprocating means, substantially as described.

4. In a fountain-pen, the barrel or reservoir having a feed-opening at one end, combined with an apertured piston adapted to slide in the barrel, a manually-operated actuator for said piston, and a valve coöperating with the piston upon the side thereof distant from the feed-opening, and provided with means actuated independently of the fluid being pumped, to automatically seat and unseat said valve upon reciprocation of the piston, substantially as described.

5. In a fountain-pen, the barrel or reservoir having a feed-opening at one end, combined with an apertured piston adapted to slide in the barrel, a valve for the aperture in said piston coöperating with the latter on the side thereof distant from the feed-opening, and a tubular actuator fitted to slide in the barrel and secured to the piston, said tubular actuator being adapted to serve as a reservoir, substantially as described.

6. In a fountain-pen, the barrel or reservoir having a feed-opening at one end, combined with an apertured piston, adapted to slide in the barrel, a coöperating valve on the side of the piston distant from the feed-opening, a tubular actuator fitted to slide in the barrel and secured to the piston, an air-vent in the closed outer end of the actuator, and a closure therefor, substantially as described.

7. In a fountain-pen, the barrel or reservoir having a feed-opening at one end, combined with a tubular actuator fitted to slide in the barrel and arranged near its inner open end as a piston, to coöperate with the barrel, a valve to close said open end upon outward movement of the actuator, and a closure for the outer end thereof, substantially as described.

8. In a fountain-pen, the barrel or reservoir having a feed-opening at one end, combined with a tubular actuator fitted to slide in the barrel and arranged near its inner open end as a piston, to coöperate with the barrel, a valve to close said open end upon outward movement of the actuator, and means to maintain the valve unseated during and after forward movement of the piston, substantially as described.

9. In a fountain-pen, the barrel and a pump device therein, including a piston, and a valve provided with means to contact frictionally with the walls of said barrel, to provide for seating and unseating of said valve upon reciprocation of said pump device, substantially as described.

10. In a fountain-pen pump; a piston; a coöperating valve having a head, and a stem divided for a portion of its length to form leg-like continuations offset from the axis of the stem to contact with the barrel, and extended along the latter away from the head, substantially as described.

11. In a fountain-pen pump; a piston; a coöperating valve having a head, and a stem divided for a portion of its length to form leg-like continuations; said continuations being fissured, or of like ink-conducting construction, substantially as described.

12. In a fountain-pen pump; a piston; a coöperating valve cleft for a portion of its length to provide a laterally-extended recess, the walls whereof are placed in close relation to each other at their boundaries, constituting the recess an ink-receptacle of high capillarity, and considerable capacity, substantially as described.

13. In a fountain-pen pump; a piston having a valve-aperture; a valve therefor having a body-cleft of the character described, constituting an ink-receptatcle of high capillarity, said cleft being adapted to stand at times in communication with the chambers on both sides of the valve-aperture, substantially as described.

14. In a fountain-pen pump; a piston having a valve-aperture; a valve having a body-cleft of the character described, constituting an ink-receptacle of high capillarity, said cleft being adapted to stand at times in communication with the chambers on both sides of the valve-aperture, and an auxiliary ink-conductor consisting of a thread of fibrous material in communication with said cleft and extending from the valve into one of said chambers, substantially as described.

15. In a fountain-pen, the barrel, a pump therein, its movable piston, and means to maintain a substantially continuous moistened path intermediate the chambers into which the ink-reservoir is divided by the piston, regardless of the position of the latter, substantially as described.

16. In a fountain-pen pump; a piston having a spiral peripheral groove completely traversing the depth of the piston and in communication with the chambers on both sides thereof, substantially as described.

17. In a fountain-pen pump; a piston having a spiral peripheral groove completely traversing the depth of the piston and in communication with the chambers on both sides thereof, and thread in said groove and extending to the upper and lower edges of the piston, substantially as described.

18. In a fountain-pen pump; a piston; a

coöperating valve having a head, and a stem divided for a portion of its length to form leg-like continuations offset from the axis of the stem to contact with the barrel, and extended along the latter away from the head, a fissure in said stem, and fissures in the legs, in connection with, but in planes at an angle to, the stem-fissure, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ARTHUR A. WATERMAN.
FREDERICK W. STEVENS.

Witnesses:
GEO. W. GREGORY,
ALEX. C. PROUDFIT.