No. 698,881. Patented Apr. 29, 1902.

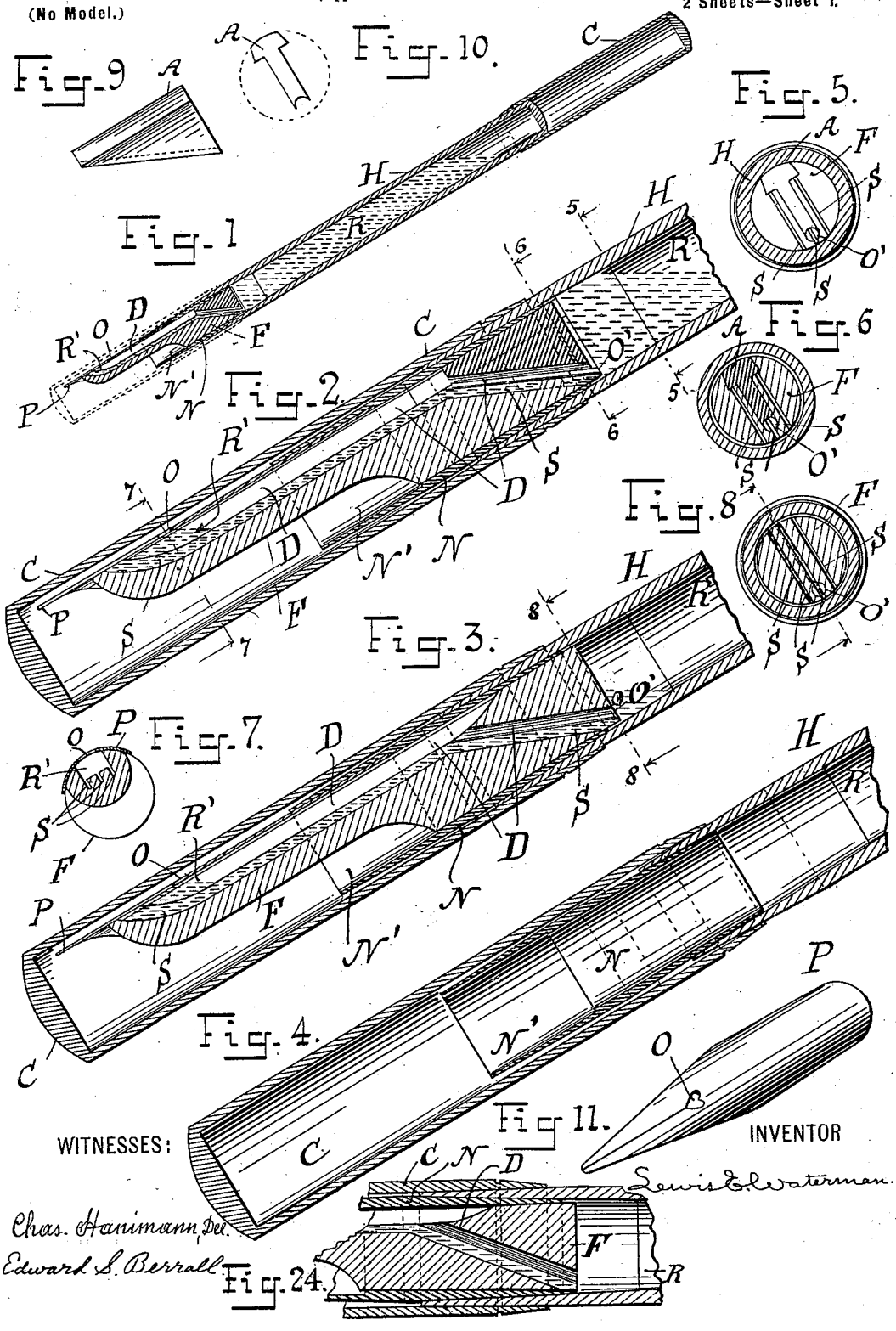
L. E. WATERMAN, Dec'd.

F. D. WATERMAN, Executor.

FOUNTAIN PEN.

(Application filed Feb. 1, 1896.)

(No Model.) 2 Sheets—Sheet 1.



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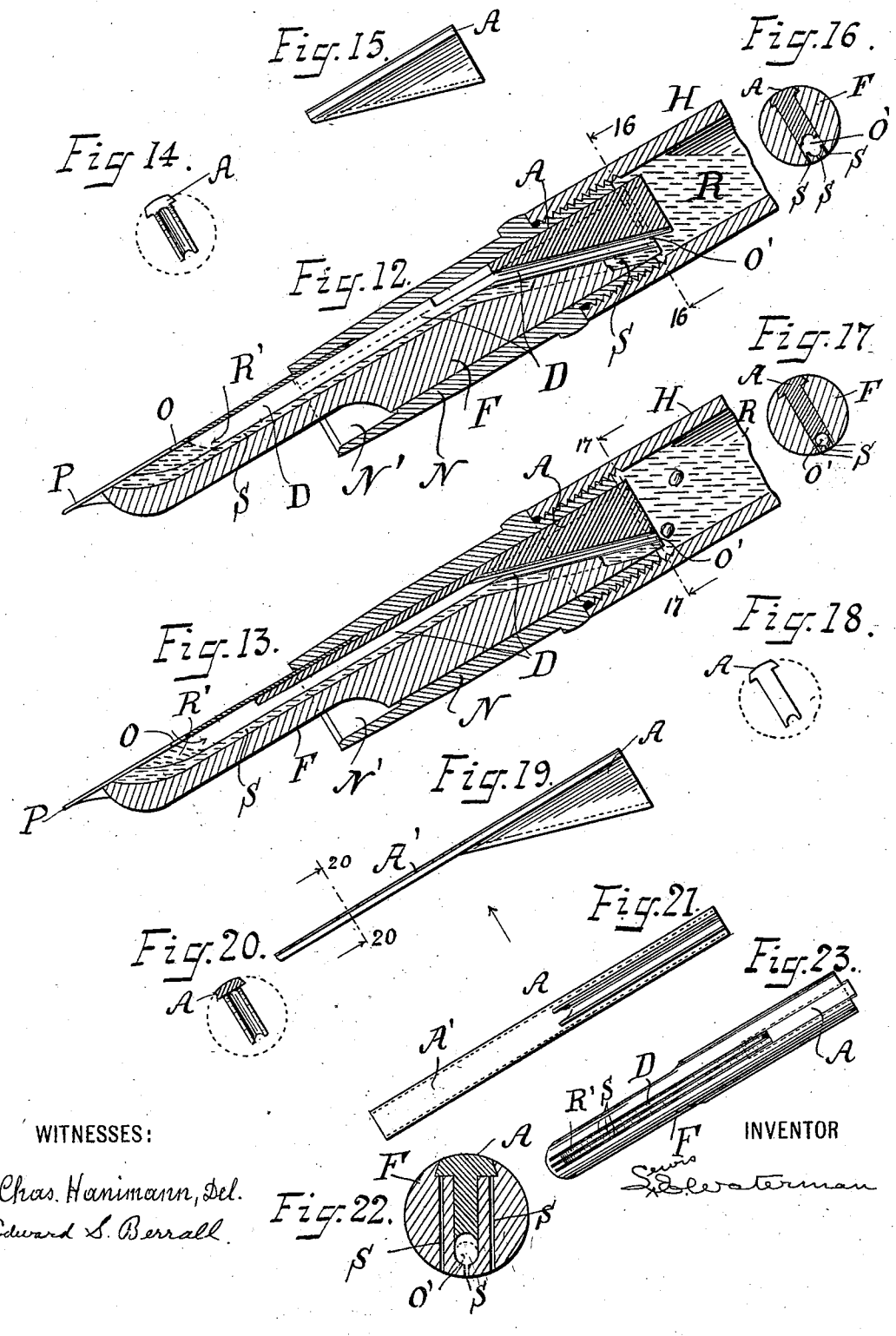

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LEWIS E. WATERMAN, OF BROOKLYN, NEW YORK; FRANK D. WATERMAN EXECUTOR OF SAID LEWIS E. WATERMAN, DECEASED.

FOUNTAIN-PEN.

SPECIFICATION forming part of Letters Patent No. 698,881, dated April 29, 1902.

Application filed February 1, 1896. Serial No. 577,679. (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 Brooklyn, county of Kings, and State of New York, have made a new and useful Invention in Fountain-Pens, for which I have obtained no foreign Letters Patent whatever and of which the following is a specification.

My invention has for its objects in general the improvement and perfection of fountain-pens by the remedying of certain of their defects which have not heretofore been overcome.

More in detail the objects of my invention may be stated as follows:

One object in particular is to increase the size of the main reservoir and the quantity of ink it is capable of carrying without increasing the outer dimensions or size of the holder and to obtain and retain complete automatic control over the ink therein nevertheless. Another is to make a complete and sufficient conical-joint contact between the nozzle and the fountain, preferably along with a simple non-capillary joint between the feed-bar and the nozzle. Another is to give suitable control over ink movement and the air inlet and inflow to the main reservoir, along with increased steadiness and regularity in the flow and quantity of ink-supply and transfer from the main reservoir to the subreservoir and the pen through capillary fissures only and air inflow to the main reservoir through the air-duct only. Another is, incidentally, the preventing of irregular spurts and gushes of ink from the main reservoir and subreservoir and the pen.

Still another object is to increase or make more perfect the control over the contents of the main reservoir when it is full and continuously until it is empty. Another is to automatically stop the flow of the ink from both reservoirs and from the writing-pen when the user stops using the pen in whatever position the pen may be placed. Another is to make a more complete non-capillary joint by contact between the fountain and the nozzle by bringing the external surface of the rear end of the nozzle into elastic joint relations with the fountain. Still another is to promote the free and prompt return of the ink from the subreservoir to the main reservoir whenever the use of the pen is suspended; and in general the objects of my invention are the absolute, complete, continuous, and automatic control of the fountain-pen in all its functions and functioning and of the ink therein, such control being obtained by placing all the functions and operations referred to in the complete and automatic control of the writing-pen whenever in use and also whenever not in use.

I attain the objects of my invention by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view. Fig. 2 is an enlarged longitudinal sectional view of the forward end of the fountain covered with its cap and containing the nozzle, feed-bar, and pen. Fig. 3 is a similar longitudinal sectional view with a modified feed-bar. Fig. 4 is a similar view, but with the feed-bar and pen omitted. Figs. 5, 6, and 7 are cross-sectional views on lines of the corresponding numbers, Fig. 2. Fig. 8 is a cross-sectional view on the line of the same number, Fig. 3. Figs. 9 and 10 are side and end views, respectively, of the air-duct-adjusting device. Fig. 11 is a top view of the writing-pen. Fig. 12 is an enlarged longitudinal sectional view of the forward end of the fountain provided with a screw-thread nozzle and the feed-bar with adjustable device. Fig. 13 is a similar view to Fig. 12, the adjustable device being provided with an extension to close the upper side of the air-duct D toward its forward end. Fig. 14 is an end view of the adjusting device; Fig. 15, a side view of the same; Fig. 16, a sectional view on line 16 16, Fig. 12; Fig. 17, a sectional view on line 17 17, Fig. 13. Fig. 18 is a rear end view of Fig. 19. Fig. 19 is a side view of the adjusting device with its forward extension. Fig. 20 is a sectional view on line 20 20, Fig. 19. Fig. 21 is an under side view of the adjusting device shown in Fig. 19. Fig. 22 is a sectional view of the same in position, with three capillary fissures in the feed-bar. Fig. 23 is a top view of the feed-bar, and Fig. 24 is a sectional view showing the rear end of the nozzle with conical chamber and corresponding conical feed-bar.

Similar letters relate to similar parts throughout the several views.

C is the cap, H the holder, R the reservoir or fountain, N the nozzle, F the feed-bar, and P the writing-pen, of the fountain-pen.

D is the air-duct, and S indicates capillary fissures.

So far as the joints are concerned this application and invention has to do with that insidious almost irrepressible force that even dominates and overcomes gravity itself and by the aid of which all vegetable growth is developed, capillarity being the primary and most active element at work, not only in all vegetable life and growth, but also in the earth, out of which all vegetation grows, being, in fact, an impelling or drawing force of circulatory systems everywhere. The most common or ordinary joint or union in and by which two separate pieces of material are brought together is in whole or in part non-capillary by non-contact or by such separation of surfaces as prevents capillary action; but where some special pains are taken to make it otherwise by properly approaching the surfaces a capillary joint is produced, which is a joint that develops capillarity—that is to say, a joint between the surfaces of which capillarity will draw water or other fluids to the action of which the joint may be in any way exposed. In other words, two surfaces may be placed in such juxtaposition as to have joint relations and yet not capillary joint relations, for the reason that the surfaces are in whole or in part sufficiently separated to prevent capillary action, since capillary action requires that the surfaces should be in close relations to produce capillarity. Another kind of joint may be designated as non-capillary—that is, as a joint in which capillary action does not and cannot take place, because the joint-surfaces are in such close contact and maintained in such relations that capillarity is overcome or prevented. For the most part, if not always, non-capillarity of the last-mentioned kind, being the non-capillarity of contact and not of separation, is brought about and maintained between surfaces that are sufficiently smooth, in sufficiently close contact, and so held under more or less elastic pressure, expansion, or tension. A capillary joint has its joint-surfaces in relations that are intermediate to those of the two opposite non-capillary kinds. There are two genera of non-capillary joints, one of non-contact and the other of contact.

In the present application two forms or species of non-capillary joint by contact are shown acting in combination in different parts of the same general joint or in parts of the same general or continuous joint-surfaces, the elastic force or tension in one of them acting constrictively or by oral or sphincter-like contraction and in the other expansively to form the non-capillary contact-joint. The first of these forms of non-capillary contact-joints was first shown in a prior application. The second was first shown in this application, but in combination with the first form of non-capillary contact-joint in a single, general, common, or the same structural joint. The capillary joint is intermediary between the two genera of non-capillary joint.

The joints between the cap and the fountain, the fountain and the nozzle, and the nozzle and the feed-bar are, preferably, all of the conical, elastic, non-capillary contact variety. The joint between the fountain and the nozzle is sufficient, and preferably non-capillary throughout, from the front end of the fountain to the inner end of the nozzle. That between the nozzle and the feed-bar, one office of which is to assist in making the non-capillary joint between the fountain and the nozzle at the inner end of the latter, may be either of the simple conical form or with some though not so perfect effects of any ordinary but sufficiently tight-fitting variety that will expand the rear end of the nozzle and give its inner chamber a slight conical or enlarged form by elastic expansion, or it may be simply cylindrical and of proper fit. The automatic air-supply and ink feeding and controlling devices, the feed-bar, capillary fissures, and air-duct may, however, also be associated in a modified combination with the ordinary screw-thread-joint construction.

The conical joint parts, relations, and combinations of my invention are shown in Figs. 1 to 11, Sheet 1 of the drawings, and those of the screw-thread joint are shown in Figs. 12 to 22, Sheet 2 of the drawings.

The air-duct D for the greater part of its forward length may be channeled or bored in the upper side and forward end of the feed-bar F. At the rear end it is inclined downward, whether in whole or in part bored or channeled, and finds an outlet immediately at the lower edge of the rear end of the feed-bar adjacent to the side or inside surface of the holder H or inside wall of the reservoir or that of the nozzle. Preferably the air-duct is closed on top and under the rear end of the writing-pen, either as shown in Figs. 13 and 19 or otherwise. The fissures S—one, two, or three, preferably three—preferably follow and are formed in and below the bottom of the air-duct D at or near the corner or sides and in the longitudinal center throughout its entire length. At the rear end of the feed-bar the fissures (one or more) may be formed by making saw cuts entirely across and into its rear end until they reach the air-duct and then to a sufficient and preferably uniform depth below the air-duct along its whole length, as shown, the bottom of the cuts rising with the duct toward the front to meet the fissures in the forward end of the feed-bar, as shown in Figs. 2 and 3. Preferably in the absence of the adjusting device A and as shown in Figs. 3 and 8 the central cut or fissure S may be left open throughout from top to bottom at the rear end and the other two may be filled and closed at and for a greater or lesser depth

from the top at the rear end of the feed-bar, or either or both of them may be omitted, as may be desired. The function of the capillary fissures is to transfer the ink from the main reservoir to the subreservoir and to the pen by capillarity. That of the air-duct is to conduct air to the main reservoir exclusively, except possibly when under accidental or extraordinary conditions ink may overflow into the air-duct and there act as a valve to prevent air-inlet. The function of the opening O is to admit air to the duct D, which extends from the opening O backward to the reservoir and also to the subreservoir R′, being closed or opened as a valve-opening and automatically by the ink as it rises or falls in that reservoir, thus controlling the functions of air-duct, fissures, and whole fountain-pen.

The holder is preferably beveled or cone-shaped on the inside and on the outside at and near its front or open end, as shown in Figs. 1 to 4. The nozzle N is also beveled or cone-shaped on the outside at its rear end and corresponding part and has a projecting outer end N′, preferably cone-shaped, and therefore the nozzle has an external form diminishing from the center outwardly in both directions, the bevel on its inner end being shaped, preferably, either to make a joint consisting of the combination of a non-capillary joint by contact at and near the forward end of the fountain and a capillary and supporting joint back of the non-capillary joint or to make such non-capillary joints at both ends of the conical surfaces at and near both of the thin and elastic edges. The first mentioned of these joints may be most easily and simply made by making the angle or pitch of the cone-surface on the inside of the outer member slightly less than that of the inner member. It will then strike first at the forward end and there stretch and conform itself to the nozzle or inner member by the time it reaches its proper seat and bearing to form a joint that is non-capillary by contact with a capillary and supporting or steadying joint back of the non-capillary joint. These two parts of the joint, the non-capillary by contact and the supporting capillary parts of the joint, coöperate to make the whole joint self centering, holding, and maintaining. The second-mentioned joint may be made by making the pitch of the inner member at the rear end slightly less than the outer and large enough to strike before reaching its extreme position.

The projecting end N′ of the nozzle holds the writing-pen, and where the joint is conical it becomes useful as a handle or lever to assist in expanding the mouth of the conical chamber in making and unmaking the joint. It is a better form for the fingers in writing and where the joint is conical permits the use of a larger writing-pen, especially in the smaller sizes. The complete or total joint may, however, at will be made non-capillary by contact at its rear end and capillary or non-capillary at will at and near its outer or front end or the forward end of the fountain. This may be done by making a simple elastic conical joint between the feed-bar and the nozzle at and near the rear end of the nozzle, or, though not so perfectly, by making the rear end of the feed-bar conical to fit in a cylindrical chamber in the rear end of the nozzle, or, still less perfectly, by making the nozzle-chamber and the corresponding part of the feed-bar cylindrical in form, but so tight-fitting as to expand the nozzle-chamber, and for a short distance make it conical by elastic expansion, and thereby bring about non-capillary contact-joint relation between the fountain and the nozzle at and near the rear end of the latter. In all of these cases the conical-joint combination may be of the type of the ordinary mere conical-surface variety; but in none of these places would a joint of that kind best and most efficiently answer the purpose. Therefore I prefer the conical and the non-capillary joints shown in the drawings. The nozzle is therefore preferably made very thin, the diameter of the bore and seat of the feed-bar at its inner end being preferably the same or about the same as the bore of the main reservoir or fountain itself and the combined thickness of the beveled parts of the two members forming the conical joint being preferably made about equal to the total thickness of the wall of the fountain or reservoir. As stated, however, the angle or pitch of the conical surface on the inside of the outer member of the conical joint may be made slightly less than that of the inner member, as and for the purpose stated. This enables me to increase the size of the reservoir or ink-fountain and its capacity for holding ink without increasing its outside dimensions and while diminishing the thickness of the wall of the fountain, since I support the thin wall of the nozzle and of the fountain by the nearly solid feed-bar F located within them, which at or near its rear end closely fits and fills the inside of the nozzle N and strengthens and supports the nozzle, and fountain, and the cap in making the combined non-capillary and capillary joints between them. I am able to accomplish these results because the conical joint does not require as much thickness of material substance in the nozzle, fountain, and cap as the screw-thread and shoulder joint heretofore used and because the nearly solid feed-bar supports the thin nozzle and the thin fountain and a thin cap. Consequently I gain an additional advantage in that I am able to make the parts stronger and more durable and less likely to be broken and at less expense than before, although taken separately they are all thinner and slighter than before, except as to the feed-bar. A further object and advantage of this arrangement, however, is the enlargement of the outside dimensions of the feed-bar to about the size of the bore of the reservoir, which enables me to carry the inner end of the air-duct into

close contact with the inside surface of the enlarged reservoir, and thereby introduce the air through the air-duct D into the fountain at the point where it will most perfectly perform its function of holding back the ink flow and preventing gushes of ink when the fountain is nearly empty, as well as at all other times, the more prompt escape of the air from the inner end of the air-duct, and also other important functions mentioned elsewhere in this specification. Further, the thinness of the material at and opposite the conical joint gives increased elasticity and superior joint relations not only without sacrificing strength, but with a substantial gain in strength and stability, as well as in lightness, with saving in fitting, cost, and material, the greater strains being finally received and borne by the nearly solid part of the enlarged feed-bar.

The feed-bar F at or near its rear end, whether cylindrical or conical in form, closely fits and fills the inside of the thin-walled nozzle N, preferably passing beyond it and supports the nozzle in making the combined joint non-capillary or capillary between the nozzle and the holder. Consequently both the nozzle and the holder may be made very thin, not only without sacrificing the strength of the pen, but while improving or increasing it and with other gains or advantages mentioned. The forward end of the holder H is also conical on its outer surface, as well as on its inner surface, receives the cap C thereon, which has a conical chamber like that in the front end of the fountain, as well as an external conical end or lip, and forms therewith a similar elastic conical joint in a similar way, preferably consisting of a combined non-capillary contact-joint and a capillary and self-centering maintaining and supporting joint or of some other form of that joint. As the characteristics of two of these three conical joints in their general primary and simpler forms are described in detail in another pending application, they need not be more fully described here, except to call special attention to the fact that these joints, and particularly the joint between the nozzle and the fountain, are of such a character that the wall of the reservoir or fountain may be made very thin and the size of the reservoir and the amount of ink it will hold thereby very much increased as compared with the reservoir and holder in which the screw-thread and shoulder joint is used, because the latter style of joint requires greater thickness of material, as well as closer fitting and greater cost, not only in the reservoir, but also in the nozzle and in the cap in order to form the non-capillary joint effected between the two by screw-pressure, and the other by the tight fit of an inelastic cap on a cylindrical part. The contact-surfaces of the non-capillary joints being at right angles to the bore of the reservoir, the screw-thread joint necessarily occupies considerable space and compels the use of enough material to cause greater and unnecessary as well as objectionable thickness than when the joint is made more nearly parallel with the longitudinal axis of the reservoir and holder by the use of the elastic conical joint. At the same time while not requiring so much thickness of material the elastic conical joint is less liable to injury and more certain and effective, as well as more durable and less costly to make. Another important characteristic may be mentioned. The outer end, edge, or mouth of the outer member in all these joints being so related as to make contact with the surface of the inner member orally before reaching its joint seat and bearing, which last it does by expanding elastically as it moves on, this thin outer edge and end in reaching its ultimate place scrapes and cleans the joint-surface of the inner member each time the parts are put together. Consequently grit and other kinds of dirt cannot get into and injure the joint-surfaces and joint relations, as they frequently do in the square shoulder or undercut shoulder-joint. If they do get between the joint members, it must be back from the joint-forming thin edge, where they will do least harm and may be crushed, embedded, or neutralized by the method of approach of the two surfaces and any grooving that may occur will later be automatically ground away in use, whereas in the old screw-thread joints a groove in the joint-surfaces destroys the joint and compels renewal.

The outer or writing-pen end of the air-duct D has its inlet or opening O at or near its forward end and in, through, or under—preferably in and through—the pen P, located at or near the rear or upper end of the subreservoir R′. The pen is the cover of and receives its ink from the subreservoir R′, and if the opening O be not made through the pen it may be made through the side or wall of the air-duct under the pen and above the fissures S. The functions of the opening O are to supply air to the reservoirs R and R′ as the ink is drawn therefrom and to act as a valved inlet in connection with the ink in the reservoir R′ as it rises and fills the opening or lowers and opens it. Acting as a valved opening it separates or differentiates the air-duct D and the fissures S and holds them to the performance of their separate functions of air and ink ducts or conduits exclusively, or practically so, during normal use and conditions. This opening O should not be too large for the ink to fill, be retained and act therein as a valve and check to the inflow of air when filled, or so large as to allow an undue amount of air to enter the main reservoir, as that promotes excessive ink-flow. At its inner or upper end the air-duct D communicates with the reservoir through an exit or outlet orifice O′ in the rear end of the feed-bar F and at its lower or bottom side, close to the inner wall of the reservoir there, through which the air

passes, to form bubbles in the ink on the way to the upper end of the reservoir and where it is covered by ink and continues covered from first to last, or as long as any ink remains in the reservoir, however large the reservoir may be, and at which point it delivers air-bubbles, large or small, frequently or infrequently, according to the size of the air-duct, whether adjusted or regulated or unadjusted or unregulated at its inner end and according to the use made of the pen and the effect of that use in drawing ink from the subreservoir first and then from the main reservoir by the contributory action of the capillary fissures S, one or more. The air and air-bubbles so delivered at the opening O′ in the lower side of the rear end of the feed-bar always meet ink there, if any ink remains in the main reservoir.

I have found that when the air-duct is channeled through on its top and terminates at the top side and rear end of the feed-bar the air-bubbles become frictionally engaged and are detained against the upper part of the reservoir side and adjacent upper rear end of the feed-bar, or against both of them, and are hindered thereby from moving away with due celerity, and that they consequently, being so detained, tend to check, resist, choke, or interfere with the action of the capillary fissures and the feeding of the ink to the subreservoir R′ and to the pen in due quantity at the right time and as required. The bubbles frequently seem to attach themselves or adhere and remain there, receiving increments of air and enlarging from moment to moment without breaking away, until finally becoming very much enlarged and subjected to sufficient pressure of the ink they break away suddenly, rise to the air-space at the inside top of the reservoir, and thereby at last allow the ink to flow suddenly or with a gush in excessive quantity into the air-duct on the way to the subreservoir, and the pen thereby blocking or interfering with free-air movement in the air-duct and free-ink movement in the capillary fissures on the way toward the subreservoir, and the pen frequently causing spurts or ink overflow there. Such tendencies diminish as the inner or upper end of the air-duct is moved from the upper side toward the lower side of the feed-bar and lower inner surface of the reservoir; but they are only entirely prevented by locating the outlet at O′. Further, when the inner end of the air-duct is so located as to allow it to become in whole or in part uncovered while a considerable quantity of ink remains in the reservoir ink gushes are likely to occur, being promoted by periodical free-air inflow, especially when the pen is brought to a level in handling. My invention makes continuous or excessive free-air inlet impossible or difficult in all positions of the pen so long as ink remains in the subreservoir, toward which it will continue to tend as long as there is ink in the pen and it is held in position for writing until checked by the closing of the opening O. I prefer to make the air-duct D round, especially in or at its outlet O′, because air-bubbles naturally assume a globular form. A round air-duct facilitates air movement and a round outlet facilitates globular formation, and thereby the flow of the ink; but the duct may be made rectangular in form, particularly where three capillary fissures are used and accompany or follow it and are formed in the bottom of the duct—say at its two sides and center.

At first or when the pen is dry air will pass into the air-duct D between the under side of the pen and the upper side of the feed-bar, because it is impossible to make an original and permanent or dry air-tight joint between them; but these surfaces are in such relations as to form capillary spaces between them, and when the ink descends into the subreservoir, if not before, it will be drawn by capillary force into these spaces, one on each side, between the writing-pen and the feed-bar until they are thereby closed against further air-inlet by those routes under normal conditions. The opening O being of larger diameter than these spaces and being located over a more free body of ink in the subreservoir will then under the conditions mentioned be open for air-inlet through the removal of ink from the subreservoir and the opening O by the use of the writing-pen before the spaces between the pen and the feed-bar can be or will be opened, since the thinner and stronger capillary spaces will hold the ink in place with a greater tenacity. Consequently within certain practical and sufficient limits the opening O becomes the sole air-inlet of the air-duct D, and as the ink in the subreservoir rises to and fills the opening or is drawn away therefrom to the pen becomes a valve opened and closed by ink automatically and in a way to supply air to the subreservoir and facilitate the flow of the ink to the writing-pen and also to effectually control all the ink in the main reservoir and completely regulate the functioning of the pen. Furthermore, in whatever position the pen may be held that permits the ink to tend toward the writing-pen the opening O, filling and thereupon acting as a closed valve-opening, automatically resists and stops further ink flow and also further air flow into both reservoirs.

The location of the opening O in the writing-pen determines the size of the subreservoir R′, and consequently the amount of ink directly in contact with the pen and within its immediate and instant control. Therefore by the simple but effective expedient of changing pens with holes O higher up or lower down the immediate ink-supply in the control of the writing-pen may be increased or diminished at will, as required by pens of broader or narrower points by writers who press more or less heavily on the paper in writing or by the greater or lesser prompt-

ness of action of the fissure or fissures and the air-duct in causing or permitting ink transfer from the main reservoir to the subreservoir.

The fissures S are preferably continued so as to have their inlets or a portion of their inlet areas located near or under the opening O′ of the air-duct. So placed, when the fountain becomes nearly empty and to the last moment the opening O′ and a sufficient portion of the fissures together remain covered with ink in such a way as to promote capillary movement of the ink out of the main reservoir to prevent all ink gush through the air-duct or otherwise, and especially to allow capillarity to act upon the ink-envelop of the air bubble or bubbles there formed until the quantity of ink in the reservoir becomes so small as to be capable of entire capillary control and transfer to the subreservoir without tendency to gush or overflow. In all cases where the air-duct terminates elsewhere in the rear end of the feed-bar, and even one side and ever so little of the end of the air-duct becomes uncovered, all control of the ink movement is immediately and for a time lost, since the air can at once enter freely or uncontrolled, and the ink will for a time or in a variable way, according to the location of its outlet, flow out of the reservoir and downward, as if from a spoon, through the air-duct. A desirable object is also attained by bringing the fissures S into close relations with the inner wall of the reservoir. Under certain conditions ink-flow moves more easily along the wall or inner surface of the reservoir, aided by surface attraction than when deprived of such surface attraction, and when the pen is held with the point or writing-pen upward or in any way inclined with the top of the handle downward the ink in the subreservoir, including that in and around the writing-pen, the feed-bar, and the fissures, will be conducted speedily back into the main reservoir without danger of escaping from the pen, and this by the automatic reverse action of the capillary fissures in connection and through contact with the inner wall of the main reservoir, down which the ink will trickle freely. Where the air-duct and fissures do not terminate in contact with this inner wall of the main reservoir and in a similar upright position of the pen, ink on its way back into the reservoir will form in a drop at their inner end or ends and tend there to remain, having no adjacent and attracting surface to follow, thereby obstructing the return of the ink from the pen and subreservoir to the main reservoir; but when the ink is brought into direct contact with the inner surface of the reservoir, and particularly at its under side, the point where that wall is most certain to be moist, the ink will trickle and travel downward in the main reservoir along that wall or surface without forming into drops or adhering and remaining in such relation to the capillary fissures and air-duct as to obstruct their further action. In other words, the ink being returned to the inner end of the feed-bar is taken charge of by the ordinary surface attraction that is the basis of capillarity between two surfaces when adjacent and is readily and promptly carried down to and mingled with the ink remaining in the main reservoir. Another result of this construction of air-duct and fissures is the complete control of the ink when the reservoir is full and nearly full, as well as when it is nearly empty. When an air-duct opens in the rear end of the feed-bar anywhere else, it is subject in certain positions of the pen to invasion or gush, because the inner end of the air-duct may be uncovered in whole or in part, and when the surface of the ink in the reservoir does fall below the top side of the air-duct and the air-inlet opening is not closed air is free to enter and is almost sure to enter in excess, there being no control over it for the time, and the quantity of ink in the reservoir being still large ink gush is likely to occur, particularly when aided by the fluid momentum of the ink originated by some sudden movement of the hand holding the fountain-pen—that is to say, downward motion being given to the ink by some sudden movement the momentum of the ink, being a fluid, causes gush or outflow at existing openings or fissures before the momentum of the fluid is overcome. It being made impossible by my invention to uncover the air-duct outlet O′ while the opening O is not closed, and thereby to admit air into the reservoir until the fountain is nearly empty when it is located as shown and to take the ink out of the automatic control of the pen and the valve-opening O, the ink in both reservoirs, particularly in the main reservoir, is at all times under complete automatic control, however enlarged the reservoir may be and however increased the amount of ink it contains. This part of my invention therefore combines the writing-pen and the fountain or source of ink-supply in a single integral device in which the writing-pen has automatic and as complete control over all the ink in the two reservoirs and the fissures as the ordinary writing-pen has over the ink which it takes up when dipped in an inkstand.

Thus far my invention has been described without distinction between an air-duct simple, unadjustable, and unchangeable at will and one that is changeable and adjustable at will. The first is shown in Figs. 3 and 8, and the other in Figs. 1, 2, 5, 6, 8, 9, 10, 12 to 22, inclusive. A is a movable adjusting wedge or piece, with or without the extension A′ for covering the air-duct. The size of the rear end of the air-duct D and outlet at O′ may be varied by moving this adjustable adjusting-piece, thereby increasing or diminishing and regulating the size of the air-bubbles admitted to the reservoir and also the amount of ink flow.

I am aware that it is not new to simply

locate the inner end of an air-duct at the lower side of the feed-bar of a fountain-pen in the broadest sense. Such an arrangement is shown in my Letters Patent of the United States No. 307,735, dated November 4, 1884; but in that invention the inlet-opening of the air-duct is not in the automatic control of the writing-pen. Its outer end is freely open to the outer air. As related to the pen it is wholly in the plane of the lower side of the feed-bar and has no control or regulating power as to air-inlet, that is at once complete automatic, and subject to the action of the user of the pen in writing. The capillary fissures and the air-duct in that patent and invention are separated or are only related to each other by the separate connection of both at their inner ends with the main reservoir and not otherwise functionally throughout or throughout their functioning. At their outer ends they are independent or in no way completely related and controlled by the writing-pen or any other device whatever, either automatically or otherwise. Consequently the pen so made is not as reliable as is now required, does not have a flow of ink that is now considered satisfactory or necessary, and is subject to ink-gushes, even where, as in that patent, the air-duct is accompanied by capillary fissures, the function of which is to conduct the ink from the main reservoir to the pen.

In the invention herein described the relations of the writing-pen P and its ink-valve opening O are such, both to the fissures and to the air-duct, as to give complete, differentiating, and automatic control over them and the contents of both reservoirs at all times and to avoid the objections that exist to an air-duct and fissures located and related like those referred to in my Letters Patent above mentioned.

While I prefer to associate the feed-bar and automatic ink controlling and feeding devices so far described with a fountain, nozzle, and cap having the elastic conical joint described between them, they may be applied, used, or combined with a fountain or holder and a nozzle in which the joint is of the screw-thread and shoulder type and in which the cap has a cylinder-like opening in its front end that fits a cylindrical part of the nozzle or holder. This may be done and a considerable and valuable portion of the advantages of automatic ink feed and movement secured thereby that have been already mentioned, but with limitations due to the smaller reservoir possible when that kind of joint is used, to the use of more and thicker material in the fountain, the nozzle, and the cap, to less perfect control over the ink, and to other defects. Such an arrangement of parts is shown in Figs. 12 and 13, Sheet 2. Here also the size of the air-duct D may be varied by the use of the adjustable or adjusting device A, (shown in Figs. 14 to 22, inclusive,) or the feed-bar may be made entire in one piece and without adjustment devices at the rear end, as shown in Fig. 3; but in each case the air-outlet opening O′ cannot be located immediately adjacent to the inner and lower wall of the reservoir, since the screw-thread portion of the nozzle intervenes, and therefore will not work with completest or most perfect facility and satisfaction. The adjacent part of the screw-thread portion of the nozzle cannot be made strong enough and yet thin enough to allow the opening O′ in the feed-bar to be located adjacent to the inner wall of the reservoir, since it would become too weak and fragile, unless, it may be said, the air-duct is continued through the nozzle inner end, the juxtaposition for which is not easy to secure.

The rear end of the air-duct D may, whatever form of nozzle is used, be located and conducted through any other portion of the rear part of the feed-bar, as by a connected channel or groove formed anywhere in its outside and straight or spiral or by a diagonal channel connecting the forward part of the air-duct and an outside channel or air-duct formed in the under and outside of the feed-bar, all of these terminating as closely as possible adjacent to the inside wall of the reservoir.

The capillary fissures, and preferably all of them, continue under the writing-pen P and toward the nib of the pen till they rise in a curve, as shown, to the under surface of the nib, where they terminate, having no other outlet at that end. The ink traverses the fissures under capillary action, and when ink movement is not somehow normally checked or improperly hindered or interfered with it is brought into such relations with the pen-nib that it will be transferred therefrom to paper in the ordinary way in using the pen. When not used as fast as so delivered to the pen, it follows the adjacent surfaces upward or backward and fills the sub-reservoir R′ up to and including the opening O.

The fountain or reservoir, the nozzle, the feed-bar, and the cap of the fountain-pen shown in this application are composed of hard rubber, the substance now usually employed, or may be made of some equivalent material.

In this invention and specification the hollow plug or nozzle is a tubular piece seated in a conical chamber and in such relations thereto as to form a non-capillary joint or be capable of forming such joint between the inner end of the conical seat and the elastic inner end of the hollow plug or tubular piece N.

I claim as my invention—

1. A feed-bar F provided with an air duct or channel D.

2. A feed-bar F provided with an air duct or channel D, and the automatic ink-valve or inlet-opening O, in combination.

3. A feed-bar F of a fountain-pen, provided with an air duct or channel D and a capillary fissure or fissures S.

4. A feed-bar F of a fountain-pen, provided with an air duct or channel D, a capillary fissure, or fissures, S, and in combination with an air-inlet opening O communicating with the air-duct D and located at its forward end.

5. The feed-bar of a fountain-pen, provided with an air duct or channel D, the subreservoir R′, a capillary fissure, or fissures, S, and, in combination, an air-inlet opening O communicating with the air-duct D and located at its forward end.

6. The feed-bar of a fountain-pen, provided with an air duct or channel D, a subreservoir R′, a capillary fissure, or fissures, S, and, in combination, an air-inlet opening O communicating with the air-duct D and located at its forward end, and made in and through the pen P.

7. The feed-bar of a fountain-pen, provided with an air duct or channel D, a subreservoir R′, a capillary fissure, or fissures, S, and an air-inlet opening communicating with the air-duct D and located at its forward end, in combination with the main reservoir R.

8. The feed-bar of a fountain-pen, provided with an air duct or channel D, a subreservoir R′, a capillary fissure or fissures S and an air-inlet opening O communicating with the air-duct, in combination with the main reservoir R, and with the conical nozzle N seated in a conical chamber in the forward end of the fountain or holder, forming an elastic conical joint between them.

9. The feed-bar of a fountain-pen, provided with an air duct or channel D, a capillary fissure, or fissures, S, a writing-pen P, and, in combination, an air-inlet opening O therein communicating with the air-duct D and located at its forward end.

10. A feed-bar F of a fountain-pen, provided with an air-duct D, a subreservoir R′, a capillary fissure, or fissures, S, a writing-pen P, and an air-inlet opening O communicating with an air-duct D, in and with which the ink conducted to the subreservoir R′ by the fissure, or fissures, S, acts automatically to close or open the inlet-opening to the air by a valve-like action.

11. The feed-bar of a fountain-pen, provided with an air duct or channel connecting at its forward end with a sub ink-reservoir located under the writing-pen and at the other end with the main ink-reservoir only at the lower side of the lower or forward end of the main ink-reservoir, and also provided with a capillary fissure, or fissures, connecting the two reservoirs.

12. The feed-bar of a fountain-pen, provided with an air duct or channel connecting at its forward end with a subreservoir located under the writing-pen and at the other end with the main ink-reservoir only at the lower side of the lower or forward end of the reservoir, with a capillary fissure, or fissures, connecting the two reservoirs, and also in combination with an air-inlet opening communicating with the air-duct and located at its forward end.

13. The feed-bar of a fountain-pen, provided with an air duct or channel connecting at its forward end with a sub ink-reservoir located under the writing-pen and at the other end with the main ink-reservoir only at the lower side of the lower or forward end of the main reservoir, with a capillary fissure, or fissures, connecting the two reservoirs, with an air-inlet opening communicating with the air-duct at its forward end and also with a secondary reservoir at its rear end.

14. The feed-bar of a fountain-pen, provided with an air duct or channel connecting at its forward end with an ink-reservoir located under the writing-pen and at the other end with the main ink-reservoir only at the lower side of its lower or forward end, with a capillary fissure, or fissures, connecting the two reservoirs, and also in combination with an air-inlet and ink-valve opening located and communicating with the air-duct at its forward end.

15. The feed-bar of a fountain-pen, provided with an air duct or channel connecting at its forward end with a subreservoir located under the writing-pen and at the other end with the main reservoir only at the lower side of its lower or forward end, with a capillary fissure, or fissures, connecting the two reservoirs, in combination with an air-inlet and ink-valve opening located and communicating with the air-duct at its forward end, and also with the subreservoir at its rear end.

16. The feed-bar of a fountain-pen, provided with an air duct or channel connecting at its forward end with a sub ink-reservoir located under the writing-pen and at the other end with the main ink-reservoir only at the lower side of its lower or forward end, and also with a capillary fissure, or fissures, connecting the sub ink-reservoir with the main ink-reservoir only at the lower side of the lower or forward end of the main reservoir.

17. The feed-bar of a fountain-pen, provided with an air duct or channel connecting at its forward end with a sub ink-reservoir located under the writing-pen and at the other end with the main ink-reservoir only at the lower side of its lower or forward end, and also with a capillary fissure, or fissures, connecting the sub ink-reservoir with the main ink-reservoir only at the lower side of the lower or forward end of the main reservoir, in combination with the writing-pen provided with an air-inlet opening.

18. The feed-bar of a fountain-pen, provided with an air duct or channel connecting at its forward end with a sub ink-reservoir located under the writing-pen and at the other end with the main ink-reservoir only at the lower side of its lower or forward end, with a capillary fissure, or fissures, connecting the sub ink-reservoir with the main ink-reservoir at the lower side of its lower or forward end,

and, also, in combination with an air-inlet and ink-valve opening located and communicating with the air-duct at its forward end and also with the subreservoir at its rear end.

19. In a feed-bar provided with a fissure or fissures for conducting the ink from the main reservoir to the writing-pen, an air-duct for conducting air to the reservoir, provided with means for increasing or diminishing the size of the air-duct at will.

20. In a feed-bar provided with a fissure or fissures for conducting the ink from the main reservoir to the writing-pen, an air-duct for conducting air to the reservoir, provided with means for increasing or diminishing the size of the air-duct at will, consisting of an adjustable device A.

21. In a feed-bar provided with a fissure or fissures for conducting the ink from the main reservoir to the writing-pen, an air-duct for conducting air to the reservoir, provided with means for increasing or diminishing the size of the air-duct at will, consisting of an adjustable device A for increasing and diminishing the area of the outlet-opening at the rear end of the feed-bar.

22. In a feed-bar provided with a fissure or fissures for conducting the ink from the main reservoir to the writing-pen, an air-duct for conducting air to the reservoir, provided with means for increasing or diminishing the size of the air-duct at will, consisting of an adjustable device A for increasing and diminishing the area of the outlet-opening at the rear end of the feed-bar, in combination with an air-inlet opening at the forward end of the air-duct.

23. The fountain or reservoir of a fountain-pen provided with a conical chamber at and near its open end, the mouth of which is thin and elastic, and the nozzle of a fountain-pen the rear end of which is externally conical in form and the extreme end of which is thin and elastic, making between these conical surfaces an elastic joint that is non-capillary.

24. The fountain or reservoir of a fountain-pen provided with a conical chamber at and near its open end, the mouth of which is thin and elastic, and the nozzle of a fountain-pen the rear end of which is externally conical in form and the extreme end of which is thin and elastic, making between these conical surfaces an elastic joint that is non-capillary at its outer end by contact.

25. The fountain or reservoir of a fountain-pen provided with a conical chamber at and near its open end, the mouth of which is thin and elastic, and the nozzle of a fountain-pen the rear end of which is externally conical in form and the extreme end of which is thin and elastic, making between these conical surfaces an elastic joint that is non-capillary at both ends by contact.

26. The fountain or reservoir of a fountain-pen provided with a conical chamber at and near its open end, the mouth of which is thin and elastic, and the nozzle of a fountain-pen the rear end of which is externally conical in form and the extreme end of which is thin and elastic, making between these conical surfaces an elastic joint that is non-capillary at both ends by contact, in combination with a feed-bar provided with an air duct or channel connecting at its forward end with an air-inlet opening and at its rear end with the main reservoir at the lower side of the lower or forward end of the same.

27. The fountain or reservoir of a fountain-pen provided with a conical chamber at and near its open end, the mouth of which is thin and elastic, and the nozzle of a fountain-pen the rear end of which is externally conical in form and the extreme end of which is thin and elastic, making between these conical surfaces an elastic joint that is non-capillary at both ends by contact, in combination with a feed-bar provided with an air duct or channel connecting at its forward end with an air-inlet opening and at its rear end with the main reservoir at the lower side of the lower or forward end of the same, and provided at its front end with an air-inlet opening accessible to the ink in the subreservoir for automatic valve action in opening and closing the air-inlet.

28. The fountain or reservoir of a fountain-pen provided with a conical chamber at and near its open end, the mouth of which is thin and elastic, and the nozzle of a fountain-pen the rear end of which is externally conical in form and the extreme end of which is thin and elastic, making between these conical surfaces an elastic joint that is non-capillary at both ends by contact, in combination with a feed-bar provided with an air duct or channel connecting at its forward end with an air-inlet opening and at its rear end with the main reservoir at the lower side of the lower or forward end of the same, and also with a capillary fissure or fissures connecting with the main reservoir and with the writing-pen.

29. A feed-bar of a fountain-pen provided with an air-duct and one or more capillary fissures fitting and filling the interior chamber in the rear and elastic end of a nozzle and expanding the same to form, by contact, an elastic non-capillary joint with the conical chamber in the front end of the reservoir in which it is seated.

30. In a fountain-pen and in combination, three elastic non-capillary joints, by contact, one between the cap and the fountain, another between the fountain and the nozzle, and still another between the nozzle and the feed-bar.

31. An elastic non-capillary joint between the rear end of the thin nozzle of a fountain-pen and the adjacent surface of the fountain, formed by elastic contact without the aid of screw-threads.

32. In a fountain-pen, surfaces in the form of three truncated female cones in combination with four surfaces in the form of male cones, forming three air and ink joints, one

between the feed-bar and the nozzle, another between the nozzle and the fountain, and still another between the holder and the cap, substantially as shown and described.

33. A feed-bar provided with a surface in the form of a male cone inserted in a seat in the form of a truncated female cone provided in the rear end of the nozzle, in combination with a nozzle provided with a surface in the form of a truncated male cone inserted in a seat in the form of a truncated female cone provided in the forward end of the fountain, and also with a fountain provided on its front end with a truncated male cone inserted in a seat in the form of a truncated female cone provided in the open end of the cap.

34. A feed-bar provided with a surface in the form of a male cone inserted in a seat in the form of a truncated female cone provided in the rear end of the nozzle, in combination with a nozzle provided with a surface in the form of a truncated male cone inserted in a seat in the form of a truncated female cone provided in the forward end of the fountain, and also with a fountain provided on its front end with a truncated male cone inserted in a seat in the form of a truncated female cone provided in the open end of the cap, the open end of the cap being provided with a short truncated male cone on its exterior end surface.

35. In the feed-bar of a fountain-pen, provided with an air-duct, a movable part made adjustable for increasing or diminishing the dimensions of the air-duct and controlling the air movement into the reservoir.

36. In the feed-bar of a fountain-pen, provided with an air-duct, a movable part arranged to diminish the size of the air-duct when moved toward the forward end of the feed-bar and to increase the size of the air-duct when moved in the opposite direction.

37. In a feed-bar of a fountain-pen, provided with an air-duct and one or more capillary fissures, a movable part for increasing or diminishing the size of the air-duct and controlling the amount of air inflow.

38. A feed-bar of a fountain-pen in combination with an adjustable part A for increasing or diminishing the air-supply to the reservoir of a fountain-pen.

39. A non-capillary joint by contact, formed between a hollow elastic conical plug composed of hard rubber or other equivalent material and a conical seat in the top of a receptacle for fluids.

40. In a receptacle for fluids provided with an inwardly-tapering mouth related to an outwardly-tapering hollow plug or nozzle composed of hard rubber or other equivalent material, a non-capillary joint formed between the inner edge of the nozzle and a corresponding surface of the mouth of the receptacle.

41. In a receptacle for fluids provided with an inwardly-tapering mouth related to an outwardly-tapering hollow plug or nozzle composed of hard rubber or other equivalent material, a non-capilliary joint formed between the inner edge of the nozzle and a corresponding surface of the mouth of the receptacle by the elastic resistance of the corresponding part of the inner member.

42. In the mouth of a receptacle for fluids, a conical chamber or seat and a conical hollow plug composed of hard rubber or other equivalent material forming a non-capillary joint between the inner end of the conical seat in the receptacle and the elastic inner end of the hollow plug.

LEWIS E. WATERMAN.

Witnesses:
W. I. FERRIS,
EDWARD S. BERRALL.