(No Model.)

# L. E. WATERMAN.

## FOUNTAIN PEN.

No. 604,690. Patented May 24, 1898.

Fig. 1.

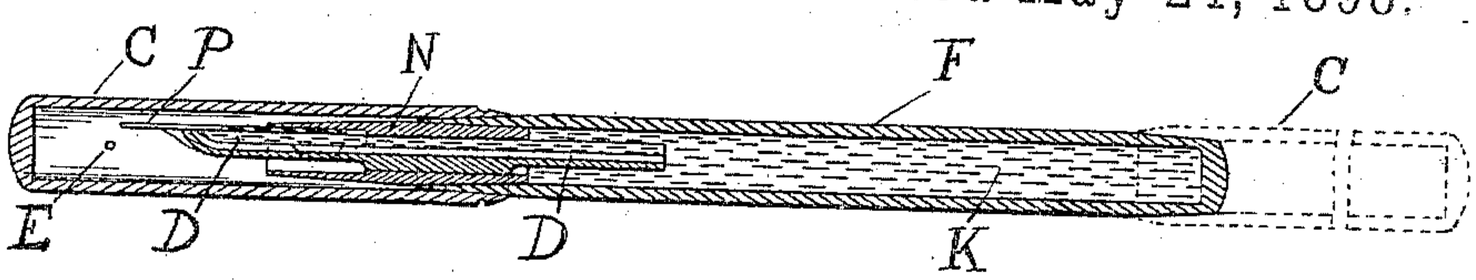



Fig. 2.

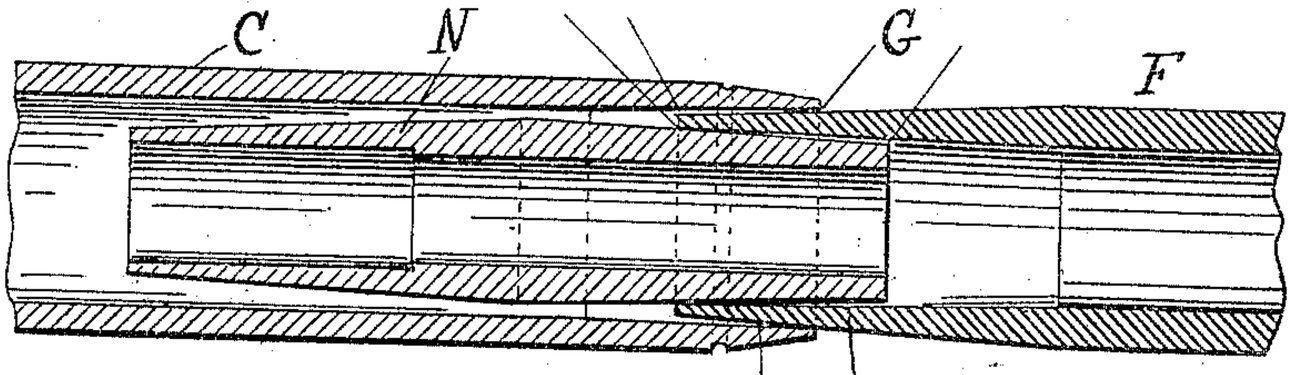



Fig. 3.

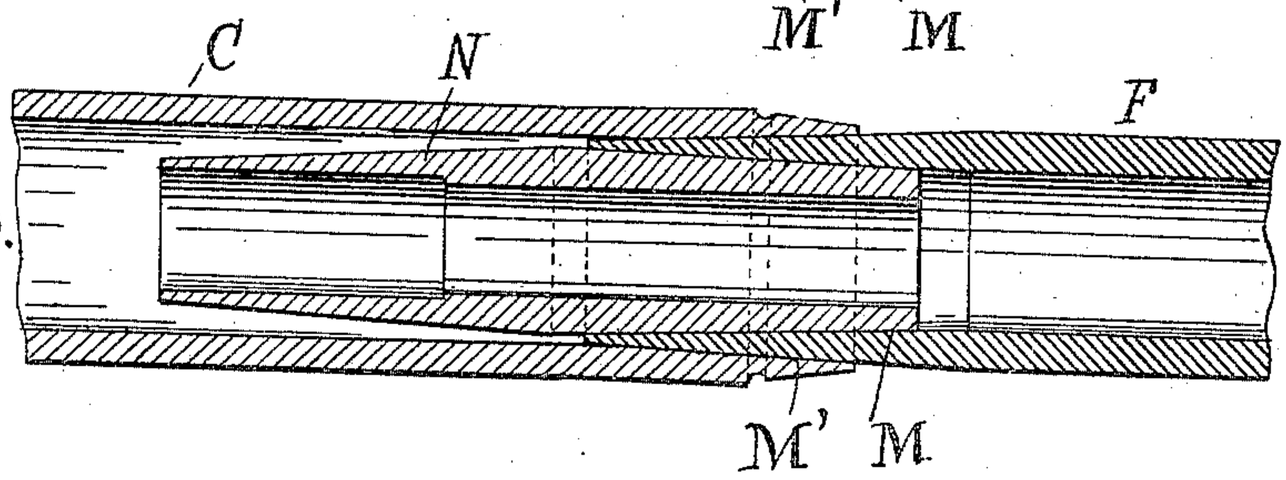



Fig. 4.

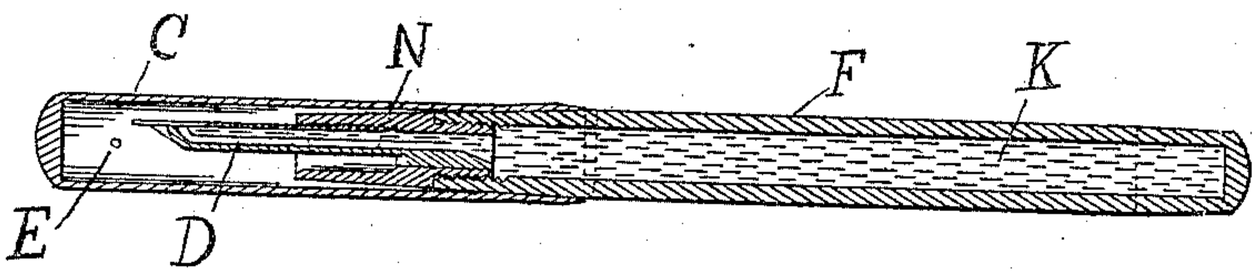



Fig. 5.

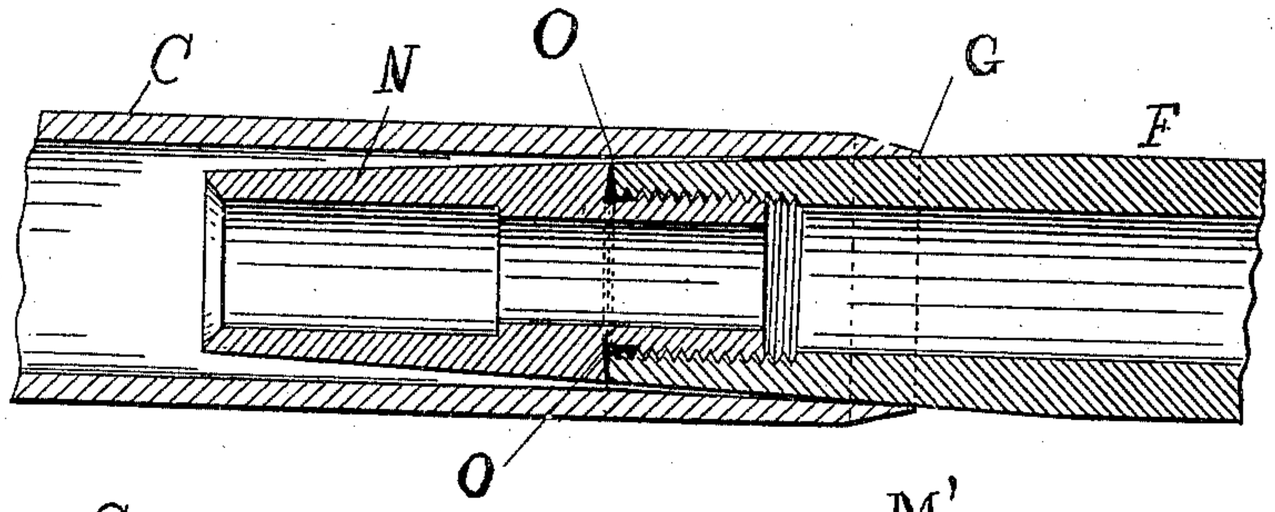
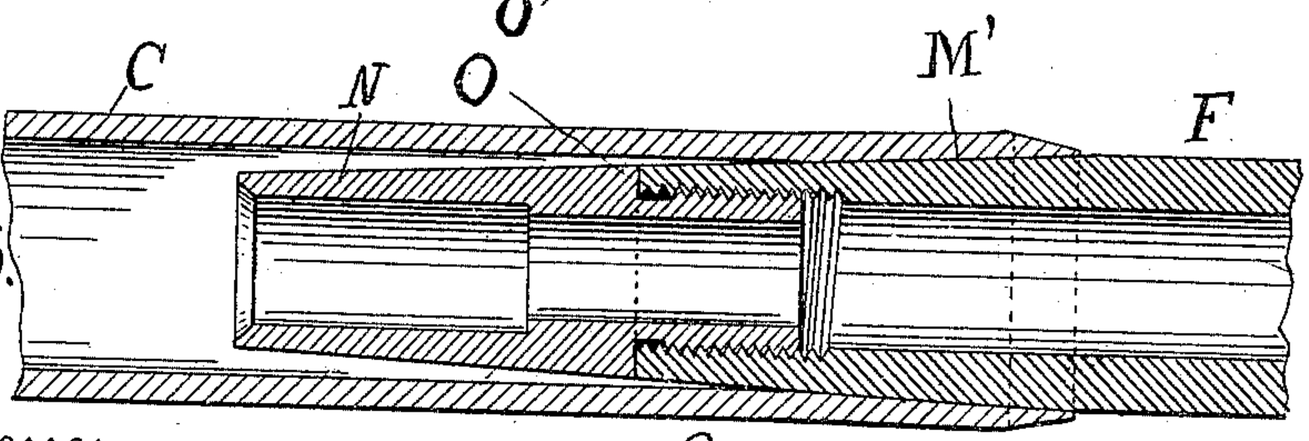



Fig. 6.




Witnesses
Chas. Hanimann
Edward S. Berrall.

Lewis E. Waterman Inventor

# UNITED STATES PATENT OFFICE.

LEWIS E. WATERMAN, OF BROOKLYN, NEW YORK.

## FOUNTAIN-PEN.

SPECIFICATION forming part of Letters Patent No. 604,690, dated May 24, 1898.

Application filed August 12, 1895. Serial No. 558,974. (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 and Vessel-Closures, of which the following is a specification.

My invention relates to joints and means of uniting and separating different parts constituting a fountain-pen and to their effects in strengthening the pen and making it more durable, simple, reliable, and easy in use and manipulation. As the new joint or joints are or may be made non-capillary in the sense that they resist and prevent the passage of fluids through the joint by capillary action, my invention also relates to means for closing vessels and receptacles for fluids and other contents.

It also relates to the formation of air-tight joints in the same way and includes union-joints as well.

Two of the objects of my improvements are to provide a joint or joints sufficiently tight to prevent the movement and escape of ink by capillary action and otherwise and to prevent or control the admission or passage of air.

Other objects, also, are to avoid the use of shoulders in the formation of a joint; to produce s h and approximately continuous surf he outside of the pen for the comfort o the fingers; to avoid the tendency to displacement of the parts in the handling of the pen; to avoid the tendency to disturb or injure the ink-joint, or the joint between the nozzle and the reservoir, in removing the cap and in using and handling the pen generally; to aid the ink-joint positively by making it more effective; to strengthen the pen structurally at the point where heretofore it has been weakest; to obtain greater ease and facility with which the parts may be put together, taken apart, cleaned, manipulated, or filled, and, finally, to provide a new style of cap and a new manner of securing the cap to the barrel or to the holder.

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

Figure 1 is a longitudinal sectional view of an entire pen. Fig. 2 is an enlarged sectional view of the entire nozzle, the adjacent parts of the reservoir, fountain, or handle, and also of the cap, all in juxtaposition. Fig. 3 is a sectional view of the parts shown in Fig. 2, but with all the parts in final positions and functional relations. Fig. 4 is a sectional view of an entire fountain-pen, in which the ink-joint between the nozzle and the reservoir is a joint in which a screw-thread is employed. Fig. 5 is an enlarged view of the entire nozzle and the adjacent parts of the cap and handle as shown in Fig. 4 in juxtaposition; and Fig. 6 is a sectional view of the parts shown in Fig. 5, but with all the parts in final positions and functional relations.

Similar letters refer to similar parts throughout the several views.

F is the fountain, reservoir, barrel, or handle that contains the ink K and to which the nozzle N is attached. The nozzle carries the writing-pen P and also makes the ink-joint with the fountain or handle. The barrel and the nozzle together hold the ink, the writing-pen, and the ink-duct or feed-bar, and may be called the "holder."

C is the cap.

D is the ink-duct or feed-bar used to conduct the ink from the fountain to the writing-pen either by capillary action or otherwise, according to the kind or make of fountain-pen; and my invention is applicable to most if not all kinds of fountain-pens, not being limited to those of my own make.

O, Figs. 5 and 6, represents an improved ink-joint, but without a shoulder-boss, and which otherwise and so far as the action of the immediate joint itself is concerned is made in the way hitherto practiced. The face of this ink-joint on the forward end of the ink-fountain is undercut inwardly in the usual way. The corresponding face on the nozzle is similarly undercut inwardly or away from its end, and both of these undercuts are extended around the entire joint-surfaces. In Fig. 5 the joint O is shown slightly open, as indicated by the large opposite black cones shown at that point and having their bases toward each other, and at top with one screw-thread space and at bottom two thread-spaces, (shown in black,) thereby indicating the absence of the thread and the presence instead

of an air-space or ink-receptacle and the presence of ink or air. When these parts are screwed together, as shown in Fig. 6, the outer edges of the adjacent joint-surfaces first make contact when accurately tooled and are forced together by means of the screw-threads with such close contact as to prevent the escape of the ink by capillary action or otherwise, or of air, as far as possible. This joint as ordinarily made in fountain-pens has on one side or the other of it a collar enlargement or boss which acts as part of the shoulder against which the other part of the joint is forced by the screw-threads. This old form of ink-joint is not altogether satisfactory. The nozzle has to be entered carefully until the threads "take," and then the nozzle has to be carefully and completely screwed up and into position, as shown in Fig. 6, in order to make a satisfactory joint. This takes time and care to make it and close attention to maintain it. The screw-threads cut away the material and weaken the pen structurally at these points, and where the threads are themselves cut away the material is still further structurally weakened, and that, too, at a joint or point of junction where all the strains center at whichever end of the pen force may be applied. For this kind of joint and for other joints I substitute and prefer the joint M. (Shown in Figs. 1 to 3, inclusive.) In this new joint the rear end of the nozzle is of a truncated-cone shape, diminishing from the central portion of the nozzle toward its rear end, and the fountain, reservoir, or barrel part of the joint consists of a female cone widening outwardly to receive the small end of the nozzle-cone. These male and female cones are not necessarily made throughout in exact counterparts, so as to make contact and fit accurately from end to end and without pressure, but preferably so as to come to a bearing under pressure when the thinner parts are expanded and conformed or forced into place for the purpose of making the joint solid, stable, and satisfactory. If made originally as exact fitting counterparts, the rubbing of the inner surface at the rear end and thicker portion of the inner or female cone of the fountain or barrel against the opposite part of the male nozzle-cone in ordinary use will slowly grind away those parts of the cones first instead of the thinner part at the forward end of the female cone, which, being thin and composed of elastic material, will give or yield more readily, and therefore not grind away so fast. Its opposing surface will also wear less.

As shown in Fig. 2, the nozzle-cone enters the fountain, reservoir, or barrel cone more freely and quickly than the threaded end of the nozzle (shown in Figs. 4, 5, and 6) enters its seat, and may therefore be more easily and promptly brought into position and to first contact, whereupon, the proper force being applied, the nozzle may be forced into position, as shown in Fig. 3, with the opposite cone-surfaces in contact, but particularly in more complete and grasping engaging and non-capillary contact at the front end and mouth of the female cone, which, being at that point thin and also elastic and capable of expansion and change of form, will conform itself to the outside of the nozzle-cone, even when the parts are not made so as to fit accurately in the first instance, and that without undue expansion or modification of form. I find that this makes a superior non-capillary ink-joint, which is in practice effected with less manipulation than the old, and leaves the pen at that part where the fingers are likely to come in contact with it practically smooth and without any objectionable shoulder, particularly when the forward end of the barrel or reservoir is slightly rounded or beveled on its outer edge, and also stronger at that point than before, this rounding also contributing to the elastic conformation and molding of the parts together, because of the thinness of the material there.

It will be perceived from the foregoing description that instead of making the ink-joint by forming and forcing into contact the carefully-prepared adjacent reverse undercut surfaces or edges, as shown in Figs. 4, 5, and 6, the union of the parts is effected through the cone shape, progressive thinness, and elasticity of the conforming parts of the mechanism, the joint union of or between the two surfaces being sufficient to overcome capillary action and the escape of the ink at the joint during manipulation and also during contact of the fingers while using the pen in writing, as well as to overcome air movement. Even if the heat of the fingers produces expansion, as it may to some extent in some cases, the joint may still be made or adjusted and readjusted and kept perfect. As the parts wear in use the opposing joint-surfaces making contact are more capable of being renewed and extended than in the other kind of joint, and therefore tend to automatically improve in joint action and prevent the escape of the ink with more certainty and ease and that without returning the pen to the shop to be tooled or otherwise have its joint remade. I make a similar joint in a similar way between the cap C and the fountain F, as shown in all the figures from 1 to 6, inclusive—that is, both in relation to a screw ink-joint and to a conical ink-joint, but particularly in relation to the latter, as shown in Figs. 1, 2, and 3, in which the outer surface of the forward part of the fountain, reservoir, or barrel F and the nozzle N are both cone-shaped, diminishing toward their forward and rearward ends, respectively, thereby forming an outer continuous male cone on the complete holder, which is inserted into the female cone, chamber, or surface formed in the forward end of the cap C. Here, also, the forward end of the cap or outer cone of the joint first makes contact at G, as shown in Fig. 2, and then by continued pressure fur-

ther and more extended contact is made, completing the joint M', as shown in Fig. 3. This is accomplished not simply and alone because the adjacent or related parts have the forms of opposite cones, but because the outer end of the cap and cap-cone is composed of material made capable of expansion within elastic limits and is or may be in addition also made thinner there than elsewhere by means of a bevel on its outer edge or lip, thereby being given increased flexibility, elasticity, and capacity to conform to and make a joint with the male cone of the fountain inserted within the female cone, as shown in the form of the cap C. Here, too, the act of insertion is more simple and easy, and the effort necessary to perfect the joint and hold the cap in position and also that to release it is much less than where the usual method of uniting the cap and holder is employed, in which the two surfaces are made parallel and carefully given sizes such that they will fit and hold to each other by contact throughout their length and by the aid of a shoulder against which the forward or open end of the cap makes contact. The upper or top end of the reservoir or barrel F, as shown in Fig. 1, is also given a corresponding taper, so that when the cap C (shown in that figure in dotted line) is applied to that end of the holder it will make a holding or union joint therewith and will remain attached thereto, after having been placed in position, with corresponding ease and without careful preliminary or maintained fitting as of any new cap in the shop and without the usual careful manipulation by the user. When used in this position, however, the joint performs a function of maintaining the relation of the parts—that is, of holding the cap in position only—whereas when applied to the forward end of the holder F, as shown in full lines, Fig. 1, additional functions are performed which have their relations to the useful functions and operations of the fountain-pen broadly and generally.

In the old kind of joint made by parallel-conforming and carefully-fitted surfaces and shoulders, whether these surfaces are cylindrical or conical in form, it is impossible to make an air and ink tight joint or to maintain it if made; but when the joint is formed in the new way herein described an ink-tight joint is easily and quickly made during manipulation and also during manufacture, and also easily and quickly unmade. If desired, an air-tight joint may also be formed in the same way and be easily and quickly made and unmade.

It is a marked and characteristic feature of my joint that it permits and provides for the use of leverage in making and unmaking or loosening the joint between the outer and the inner member and separating them, and this is true as to the joint for securing the nozzle and the barrel together, as well as to that for securing the barrel and the cap together. In the old form of screw-shoulder joint between the nozzle and the barrel, as well as in the cylindrical joint between the holder and the cap, leverage always was and is a menace and frequently caused and causes a fracture of the parts, owing to the unyielding rigidity of both of these joints; but in my new joint the leverage is an advantage in making and in unmaking or loosening and separating the parts of the joint and also in case of accidental blows or pressures upon either part or at either side of the joint, since leverage when applied to my pen acts automatically to relieve, unmake, or separate the joint safely without danger or breakage, as in the case of the old joint. The outer or closed end of the cap and the projecting end of the nozzle, in which last the writing-pen is held, furnish in the case of the conical joint the handle or long arm of the lever and give complete and safe control over the joint under all circumstances without menace to or danger of breakage of the parts. In other words, while the projecting end of the nozzle of the closed outer end and half or more than half of the cap, which are necessary to the manipulation of the parts, as well as to the functioning of the old-style fountain-pen, are at the same time a menace or a danger to that pen, because of the leverage, strain on and breakage at the joint which they cause, produce, or promote, the same projections in my invention not only facilitate or help the making and unmaking of the joint to a greater extent, but instead of being a menace to the joint they furnish protection to it and the parts forming it and to the integrity of the whole fountain-pen. Under leverage strains that will break the pen at the old joint my pen will loosen its joint and allow the parts to be separated without injury at the joint or elsewhere.

Again, if pressure or force be brought to bear, say, suddenly or by a blow directly upon the pen at and opposite the old joint—say when backed with a yielding support, as clothing or the human body—fracture of the neck of the nozzle is likely to occur; but if a like pressure or blow under like conditions is brought to bear upon or directly over the joint in my fountain-pen no fracture will occur, because the structure is thicker and stronger there than elsewhere and also because the parts that form the joint will yield (not being held together rigidly by screw-thread means of attachment) and separate before they will break. This is true, although the areas of the contact-surfaces of my joint are much greater than those of the old joint and give a larger joint surface or bearing, because in my joint these surfaces are located lengthwise nearly parallel with the longitudinal axis of the fountain-pen and overlap each other, while those of the old joint are located at right angles with the axis and are cut well into the substance of the pen, and so as to leave only a slender neck of material to re-

sist strains. Hardly anything except a crushing force can break my pen at and near the joint if brought directly to bear there, since the material is solid from circumference to axis, except for one or more fine capillary fissures and a small air-passage. An additional advantage is that the ink-joint is protected from all initial strains by my preferred construction, in which the cap has its joint-bearing directly upon the barrel, reservoir, fountain, or handle itself and not upon the nozzle, as is and was customary when the old screw-thread and shoulder-joint is or was used. The aim everywhere and always is in my invention to diffuse all strains. In the old pen there was, however, a sort of fatality due to bad ideas and construction, not only to concentrate strains, but to concentrate them at and upon the weakest part of the whole structure. Consequently these two cone-joints, one outside of the other, mutually help, strengthen, and relieve each other, making the fountain-pen stronger at and opposite the ink-joint, where it was before the weakest and most liable to break and leaving the holder part of the fountain-pen smooth and more pleasant to the fingers. As shown in Figs. 4, 5, and 6, the cap-joint, being made between the cap and the barrel only or preferably, protects the screw-thread, ink-joint, and parts structually as well from leverage strains, because when force is applied to the cap it relieves itself by opening its joint without stress upon the ink-joint and nozzle, the surfaces being cone-shaped and therefore preventing contact and leverage until the cap is loosened, and when loosened no lever action can be produced upon the joint by the cap, since the loosening separates it from its fulcrum. The same is true, in its own measure, as to the ink-joint and leverage action upon its related parts. The screw-thread and shoulder-joint promotes strain, while the cone-joints relieve all strains coming from all or any directions.

It will be observed that in Figs. 1, 2, and 3 these two separate joints, formed substantially in the same way, are in juxtaposition, being formed one outside of the other and in such relation that the completion, perfection, and maintenance of the inner joint is aided by the outer joint at will through the pressure made at will by the cap upon the thinner or tapered forward end of the fountain or barrel F, thereby compelling closer contacts between the cone of the nozzle and the cone of the fountain or barrel. On the other hand, the construction, solidity, and perfection of the inner and strictly ink joint and parts aid in perfecting and maintaining the joint between the cap and the holder by furnishing a thicker, more solid, and less yielding bearing and surface upon and against which the cone or taper surface on the inner part and end of the cap makes contact, and otherwise. In other words, all the parts contribute in making and maintaining each and all of the joints concerned and in giving them strength, as well as ease, certainty, and facility of engagement and disengagement and general operation.

Where the cap is applied as shown in Figs. 4, 5, and 6, the conformation of the cap, through the flexibility and elasticity of the thinner part of the cap at and near its mouth, has a distinct bearing and action upon the fountain or barrel F at the point of contact, more or less there compressing, shaping, and conforming the holder to itself in the act of forming the joint by a sphincter-like action, so that there is everywhere, as shown in all these figures, a distinct operation of conformity set in motion between all the parts, due to the peculiar shape and thickness or thinness of the forward part of the cap C and also to those of all the other parts.

When the cap is removed from the holder for the purpose of uncovering and using the writing-pen, it will be found that the cone on the forward end of the nozzle and that formed on the forward end of the fountain or barrel and used to make a part of the cap-joint are drawn on lines so nearly parallel that in use they will have upon the fingers the pleasing effects of being parallel or continuous and be capable of being grasped by the fingers engaged in writing at places where large or small at will. Different people prefer holders of different sizes. These different sizes are here found in the same pen and holder for use as mere matters of manipulation and adjustment at will. They are among the minor results of the conical joint construction and permit a change of position of the fingers, and consequently relief of nerve tension at any and all times. In themselves these are matters of no mean advantage.

The rear end of the nozzle and the front end of the fountain have forms and effects of truncated cones. They are tubular wedges, related as such to each other and to the cap. Consequently they can be easily and quickly put together in such a way as to be mutually supporting and very strong, and yet may be easily and quickly separated. These are qualities expressly suited to fountain-pens and all their special and particular requirements. In addition all these conical surfaces being smooth and free from male or female screw-threads or shoulders of any kind may be very easily kept clean and in condition for immediate use. Even the ink-duct D and its capillary fissures or ink-channels in my pens are kept in a better working condition by the use of these conical joints, both that between the nozzle and fountain and that between the cap and fountain.

In the drawings I have shown the chamber in the barrel and also that in the cap as very slightly conical or tapering in shape. I have also shown these chambers, more particularly that in the cap, as being made still more conical, as by expansion, when forced and by being forced onto the taper or conical surface

of the inner member or barrel. The conical or taper form is the ideal and best original or set form of both chambers, and in any event ultimately becomes their actual working form, since the practical effective working joint is when in action a conical or taper joint, and necessarily so, because of the practically permanent and unchanging conical or taper form of the interior member onto which the yielding elastic exterior member is to be pressed with sufficient force to unite the two—inner and outer—surfaces and develop the joint. The final completed effective working joint which I have invented, whether merely a union-joint or a non-capillary joint, is then a conical or taper joint, and therefore the chamber member and the member seated in the chamber, both of them, are either originally made conical or taper or they take on that form in, by, and during use and action; but the taper of the chamber in the external member is very slight, and the material of which it is composed being elastic and yielding, especially where it is made very thin, even when cylindrical or without taper in form and when forced upon the tapering interior member the exterior member, will temporarily, but necessarily, assume the conical or taper shape of chamber, or as to its chamber.

Hard rubber has an elastic limit which may be overcome by forcing the outer member onto the inner member by hand. This elastic limit may be overcome by forcing the cap upon the inner member. The consequence will be that the material will become set or permanent, and so far the chamber will become permanently enlarged, and on the next application will pass up so much farther on the inner member and still properly form the joint. This change may occur, and under like circumstances will occur, whether the chamber is made originally conical or originally cylindrical, and when so set as a new and enlarged conical chamber it will, when made of hard rubber, the material ordinarily used, still have an elastic quality and limit remaining and sufficient to maintain the union and the non-capillary joints. Of course this permanent expansion is more easily produced—that is, produced by the use of less force in proportion to the thinness of the material and less easily in proportion to its thickness. It is therefore more likely to occur in the case of the cap which receives the barrel than in the case of the barrel and the conical nozzle which make the ink-joint. The material of the outer member in the latter case being purposely made thicker in order to give increased strength and permanence to the ink or fluid joint, it will be more difficult to overcome the elastic limit of the outer member of that joint than in the other. In fact, one way of giving the chamber the permanent conical or taper form in the first instance is by forcing it upon the inner conical or taper member. A cap, and even a discarded cap of the old type, having the old cylindrical chamber, may be permanently tapered or set as to the chamber in a tapered form by simply pressing it upon the conical or taper barrel or holder shown with sufficient force to overcome the elastic limit of the material. If it be previously and slightly heated or warmed at and near the mouth, even any old cylindrical chambered cap may be in that way given a permanent taper form of chamber, and it will require the use of a very small amount of force to do so.

Where the material of the exterior member is made too thick to yield and take on the taper form of the chamber under practicable pressures, the chamber must be made conical in form at the outset. Further, when made cylindrical at the outset, as well as when made conical or tapering at the outset, the ordinary wear of normal use causes the external member to gradually conform to the inside member in shape, and eventually causes the cylindrical chamber to assume or receive a permanent conical or taper form due to automatic wear and conformation. The cylindrical chamber conforms to the interior member in the first instance by expansion within the elastic limits of the material, and later on does so less by expansion than by the conforming effects of use and wear. At the same time the joint as well as the stop are variable in their location as to each member.

The essential thing is the conical or taper joint, resulting from the union of the two parts, and the better way is to make the external member or chamber conical or tapering in the first instance, substantially as shown. This conical joint is made a union joint or a non-capillary and union joint at will by mere manipulation, and the exterior surface of the inner member, which gives the form to the conical joint, also becomes a stop or means for limiting the further progress of the external member and controlling its location on the interior member without the aid of the objectionable shoulder-stop always made use of previous to my invention, and this conical joint-stop is a variable and progressive stop, made so by differences of pressure or by normal wear of the parts.

The material used throughout for the practical operating parts of the fountain-pen and joint is preferably hard rubber. It is slightly but sufficiently elastic when properly shaped to develop the required elasticity, as in the case of the external member shown and described; but any other suitable elastic material may be used instead. Hard rubber also has a quality or capability of wearing slowly in use or by the friction of normal use, but it wears in such a way as to maintain and improve rather than injure the union or non-capillary joint and also the stop, thereby greatly increasing the durability or life of the parts, and particularly of the external member. Even the non-capillary joint improves by use, and if originally made defec-

tive, so as to be not quite non-capillary, use will automatically and speedily improve and eventually perfect it. Grooves through any other joint are fatal to the joint since capillary action is so searching and powerful in finding out defects in all joints. When these occur in screw-shoulder joints, the parts have to be returned to the shop for renewal or in many cases must be thrown away; but with the conical joint, when one has or when both have become slightly grooved, mere friction of the surfaces developed by the fingers will regrind the joint and form a new one by the action of the surfaces one upon the other.

The chamber being preferably composed of material made progressively thicker and therefore less yielding from the outer to the inner end of the conical chamber surface, the thicker parts protect the thinner edge or mouth of the chamber against undue strain and fracture from the use of too much strength in the application of the exterior to the interior part, and in so doing it forms or coöperates with a stop or develops an automatic stop action, which is variable and progressive within suitable limits, arrests the further progress of the external member upon the internal member, and prevents the splitting of the mouth of the exterior member. This stop feature acts in connection with the joint in all its forms, whether a union-joint or a non-capillary or ink joint, or both together, or whether an air-tight joint, and owing to the effect of wear all these joints become automatic and progressive or automatically maintainable during the normal wear of the parts in practical use instead of being destroyed like the old joints. Being thinner at or near its mouth and annular lip or bevel the external member is capable of exerting an elastic sphincter-like grip or pressure at that point upon the inner member and all the way around it, which shuts off capillary action, apparently overcoming it by the development of a superior force exerted by the elastic sphincter-like pressure of the external upon the internal member when pushed on far enough.

The external bevel and the annular lip assist in producing the sphincter-like grip; but this grip may be obtained in their absence, for the material at and near the mouth of the cap is more elastic than that farther in or along the chamber and will yield there more than elsewhere with continued elastic resistance or grip at that point within practical working limits. This is true when the external bevel is omitted, as it also is if the internal taper is omitted. In each case the taper-joint is formed all the same. In the earlier specimens made and experiments tried by me the external surface of the cap was cylindrical in form to the extreme open end or mouth, as well as elsewhere, and the external bevel, groove, and lip, as shown, were absent. These last were first added as finish or ornament; but the experimental tests speedily showed that they had mechanical value and importance, that they improved the elastic grip of the outer upon the inner member and the action of the joint as a union-joint, and still later it appeared that the external bevel when elongated improved the joint as an ink-joint as well.

In the shape and proportions shown in or on the cap C, Figs. 5 and 6, the external bevel gave a lighter but more secure, longer, and lasting grip upon the barrel. This grip was still further improved by the annular groove shown in Figs. 1, 2, and 3 and located at the point of junction of the cylindrical with the beveled surface or lip. The groove has a tendency or effect to localize the elastic action at and near the mouth of the external member or to form a lip and develop a more marked sphincter-like grip action.

In the shape and proportions shown in or on the barrel, Figs. 1, 2, and 3, the external bevel or taper is much longer and the material is much thicker. This gives a stronger and still more secure grip and a joint more reliable for the purpose of holding ink and also for holding the nozzle, the feed-bar, and the writing-pen more firmly, as is necessary during use in writing. The difference between the external bevel on the cap and that on the barrel is a difference of degree largely; but the bevel on the barrel receives the cap and therefore has additional relations that are different from those of the cap and are of importance in the combination.

Whether the form of joint used between the barrel and the nozzle be that shown in Figs. 1 to 3, inclusive, or that shown in Figs. 4 to 6, inclusive, but particularly in the case of the conical joint shown in the first three figures, the combination of the cap with the barrel and the nozzle is such that the breakage, if any, inevitably occurs to or in the mouth of the cap, which is purposely made the weakest part of the fountain-pen and can be resupplied at a trifling cost and without any special fitting of the cap to the particular holder. In this way the safety and endurance of the holder or main portion of the fountain-pen and its contents are assured and maintained until the parts are simply worn out, which must take a very long period to accomplish.

Perhaps the foundation principle of the invention may be said to consist in the progressive-wedge element of the joint, a joint that utilizes a taper or conical surface to make the union as well as the non-capillary engagement of the parts, which engagement is not fixed or permanent, but may be easily disengaged and as easily made, and that as frequently as may be desired, and which joint will therefore be found useful in joining adjacent parts of a fountain-pen and in closing vessels holding fluids, air, or gas and will improve by frequent and long use instead of wearing out or being otherwise destroyed thereby. Such a joint may be formed

in any of the ways heretofore described herein. In a less perfect way it may be formed and made sufficient for ordinary union-joint purposes by applying a cap or outer member having the taper, conical, or wedged-formed chamber or union surface to and upon an interior cylindrical member which it otherwise approximately fits. I do not desire to confine my invention to the case where the outer member is elastic only at and near the mouth, and in the joint between the nozzle and the barrel I have shown an outer member that is elastic throughout the chamber and the joint, but progressively less so from the mouth inward, because of the increased thickness, which furnishes the ultimate stop feature. This feature gives a variable stop action in the joint, the location of which depends on the amount of force used in pressing the outer upon the inner member and, later, to some extent, on wear.

So far my invention has been shown and mainly explained as being an invention in fountain-pens; but the invention has a wide range of applications as covering closure devices for all vessels or receptacles for air, gas, water, and other fluids and that have to be filled and emptied again and are intended meantime to hold their contents. The barrel F is such a receptacle, or a type of it, and is provided with an elastic mouth, which forms a non-capillary joint with the nozzle and prevents the escape of the contents through that joint, and the cap C has an elastic mouth which forms a non-capillary joint with the outer side of the mouth of the barrel, and thereby prevents the escape of the contents of the barrel or receptacle.

It is not necessary to explain at length and further the application of the invention to such receptacles. The essential principles and features already explained are applicable in whole or in part to all vessels requiring closure devices and action and have been already sufficiently set forth.

I claim as my invention—

1. An ink and air joint consisting of the fountain of a fountain-pen provided at its front end with an inner surface in the form of a truncated female cone, in which is inserted a nozzle provided at its rear end with an outer surface in the form of a truncated male cone, the front end of the fountain having on its outer surface the form of a truncated male cone which is inserted in the open end of the cap of a fountain-pen provided at its front end with an inner surface in the form of a truncated female cone.

2. An ink and air joint consisting of the fountain of a fountain-pen provided at its front end with an inner surface in the form of a truncated female cone, in which is inserted the nozzle provided at its rear end with an outer surface in the form of a truncated male cone, the front end of the fountain having on its outer surface the form of a truncated male cone which is inserted in the open end of the cap of a fountain-pen provided at its front end with an inner surface in the form of a truncated female cone, the outer edge of the open end of the cap being beveled to a thin edge.

3. An air and ink joint consisting of 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, in combination with an air-joint consisting of 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.

4. In a fountain-pen, surfaces in the form of two truncated female cones in combination with three surfaces in the form of truncated male cones forming two air and ink joints, one between the nozzle and the fountain and the other between the holder and the cap, substantially as shown and described.

5. In fountain-pens, one or more annular progressive elastic ink and union joints and stops formed by the combination of truncated tubular wedges, without an abutting shoulder, and with an elastic mouth in the outer member of each joint engaging the opposite part of the inner wedge or member with a comparatively slight elastic pressure, the stop being formed at and opposite the inner part of the conical chamber where its wall is thicker, less elastic and more rigid.

6. In fountain-pens, an ink and union joint and stop consisting in the coöperative and supporting union of external and internal conical members, the external member provided with an internal conical surface, seat or chamber and composed of material made progressively thicker and less yielding from the outer to the inner end of its conical surface, and the internal member provided with an external conical surface, in which the external member, at, by and near its mouth, engages the opposite part of the internal member with elastic pressure, and forms a non-capillary joint and stop.

7. In fountain-pens, an automatic and progressive ink joint and stop, consisting in the coöperative and supporting union of external and internal conical members, the external member provided with an internal conical surface, seat or chamber and composed of material made progressively thicker and less yielding from the outer to the inner end of the conical surface, and the internal member provided with an external conical surface, in which the external member, at, by and near to its mouth, engages the opposite part of the internal member with elastic pressure and forms a non-capillary joint and variable stop, and the internal conical member projects beyond the external conical member

and thereby provides for the automatic maintenance of a progressive ink and union stop and joint during both use and wear.

8. In fountain-pens, an ink and union joint and stop consisting in the coöperative and supporting union of external and internal conical members, the external member being also provided at its open end with an elastic, externally-beveled annular lip that engages the opposite part of the internal member with elastic pressure and forms a non-capillary joint and stop with and upon the internal member.

9. In fountain-pens, a cap having within its open mouth a conical seat or chamber for the conical end of the fountain also provided at its mouth with an externally-beveled elastic annular lip engaging the conical end of the fountain at and near its base.

10. An elastic, non-capillary joint for the convenient opening and closing of the outlets of vessels to contain fluids, consisting in the combination of mutually-supporting members having exterior and interior conical surfaces, the outer one of which members is elastic at and near its mouth.

11. An elastic, non-capillary joint for the convenient opening and closing of the outlets of vessels to contain fluids, consisting in the combination of mutually-supporting members having exterior and interior conical surfaces, the outer one of which members is elastic at and near its mouth and is provided with a beveled or conical exterior surface as well.

12. An elastic, non-capillary joint for the convenient opening and closing of the outlets of vessels to contain fluids, consisting in the combination of mutually-supporting members having exterior and interior conical surfaces, the outer one of which members is elastic at and near its mouth and is provided with an external conical or beveled and elastic lip.

13. An elastic cap or cover surrounding and forming a non-capillary joint with the outside of the outlets of vessels to contain fluid, consisting in the combination of mutually-supporting members having exterior and interior conical surfaces, the outer one of which members is elastic at and near its mouth.

14. An elastic cap or cover surrounding and forming a non-capilliary joint with the outside of the outlets of vessels to contain fluid, consisting in the combination of mutually-supporting members having exterior and interior conical surfaces, the outer one of which members is elastic at and near its mouth and is provided with a beveled or conical exterior surface as well.

15. An elastic cap or cover surrounding and forming a non-capillary joint with the outside of the outlets of vessels to contain fluid, consisting in the combination of mutually-supporting members having exterior and interior conical surfaces, the outer one of which members is elastic at and near its mouth and is provided with an external conical or beveled and elastic lip.

16. In fountain-pens, a combined non-capillary and capillary joint between the nozzle and the fountain, the nozzle having an exterior conical surface and the fountain having an interior conical surface or chamber therefor, in combination with an ink-duct conducting ink from the reservoir to the pen by means of capillary grooves or other capillary ducts, and also in combination with a cap provided with a conical chamber for the conical front end of the fountain the two forming a non-capillary joint at and near the mouth of the chamber.

17. A tapered interior member and an exterior member having at and near its mouth an elastic bearing thereon and a positive supporting-bearing thereon back of the mouth, forming a union-joint, substantially as shown and described.

18. A holder of a fountain-pen tapered on its forward open end, in combination with a cap which is elastic at and near its mouth and thereby makes and maintains union-joint connection with the holder.

19. In fountain-pens, a holder provided with a tapered hollow end and with a cap which is elastic and flexible at and near its mouth.

20. In fountain-pens, an internal member having a taper surface and bearing, and an external member or cap having an elastic mouth, seat or chamber, which engages with the internal taper surface and forms a variable elastic joint.

21. In fountain-pens, an internal member having a taper surface and bearing, and an external member or cap having an elastic mouth, seat or chamber, which engages with the internal taper surface and forms a variable elastic combined joint and stop.

22. In fountain-pens, an external member or cap having an elastic mouth, seat or chamber, which engages with a taper surface on an internal member and forms a variable stop.

23. In fountain-pens, an external member or cap having an elastic mouth, seat or chamber, which engages with a taper surface on an internal member and forms a variable stop and elastic joint.

24. In fountain-pens, a cap or exterior member which is elastic at and near its mouth and forms a variable-stop joint on and with a taper surface of an interior member.

25. In a fountain-pen, a cap and a holder engaged and held together by an elastic progressive-wedge union-joint.

26. In fountain-pens, a cap and a holder engaged and held together by an elastic progressive-wedge union-joint which also is a stop.

LEWIS E. WATERMAN.

Witnesses:
JAMES A. SKILTON,
EDWARD S. BERRALL.