Aug. 19, 1958 R. A. LAWTON 2,847,975

WRITING INSTRUMENT

Filed Dec. 10, 1953 2 Sheets-Sheet 1

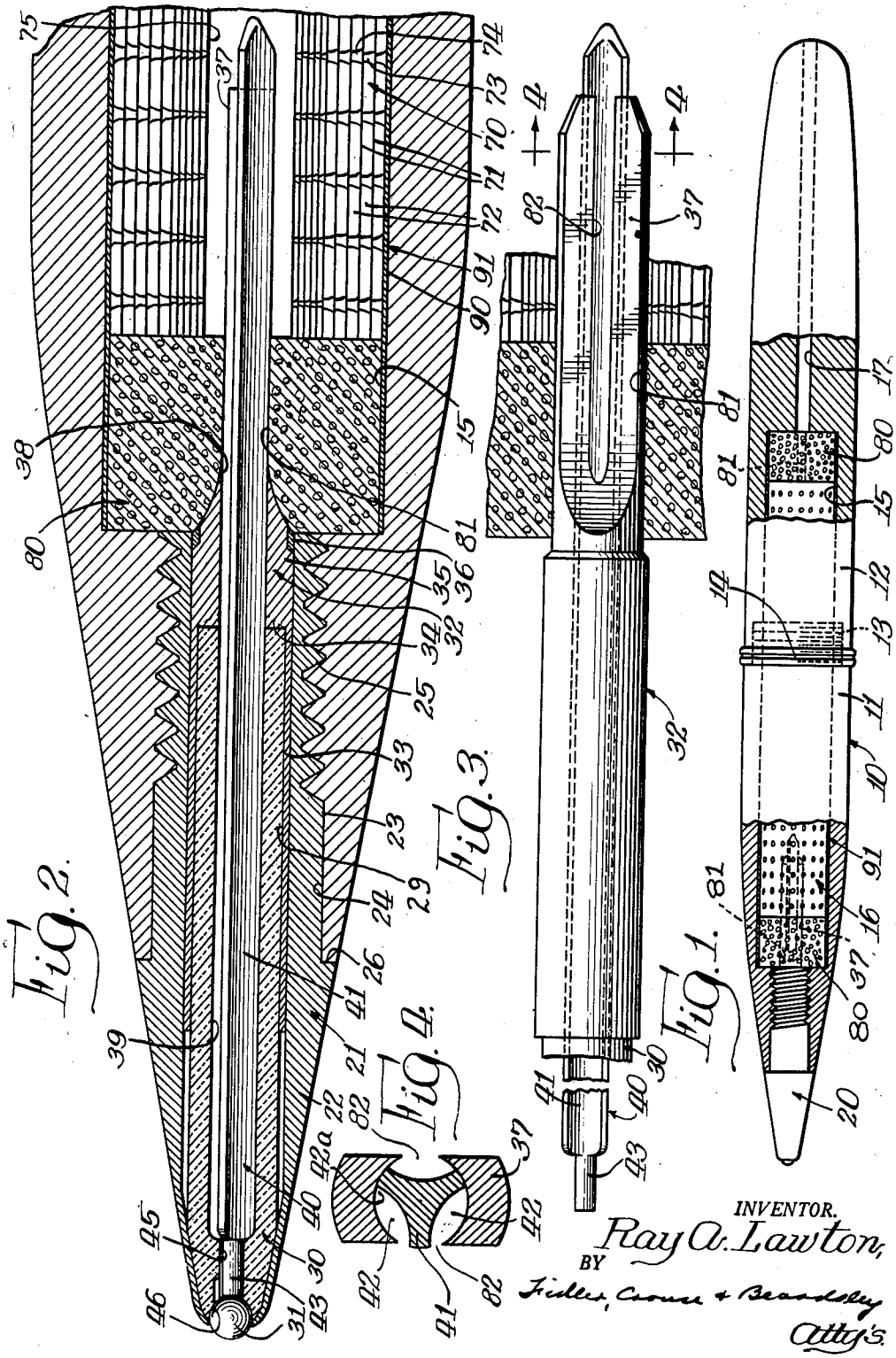


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1.

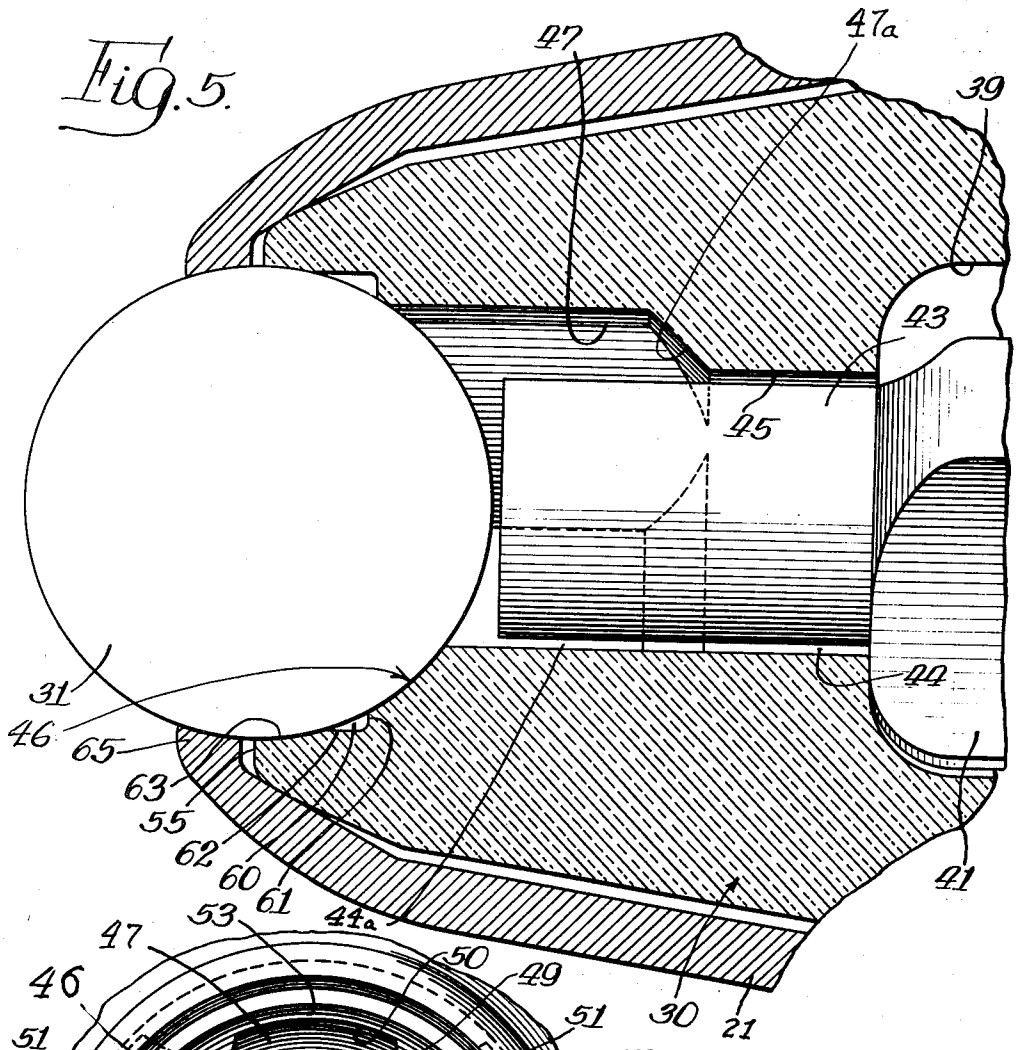
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Fig. 5.



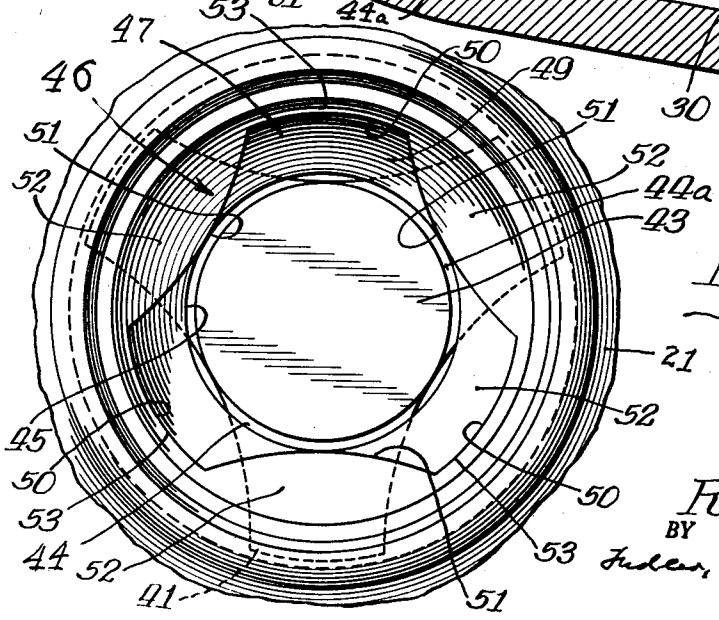


Fig. 6.

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WRITING INSTRUMENT

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Application December 10, 1953, Serial No. 397,449

2 Claims. (Cl. 120—42.4)

This invention relates to ball point writing instruments and has to do more particularly with such an instrument having a novel filling and ink storage means.

An object of the present invention is to provide an improved ball point writing instrument.

Another object is to provide a ball point writing instrument having an improved filling and ink storage arrangement.

Another object is to provide a ball point writing instrument adapted to use inks of a thin fluid nature, as for example conventional fountain pen inks.

Another object is to provide a ball point writing instrument wherein the ink storage space or reservoir may be filled by a simple and easy manipulation by the user.

Another object is to provide a ball point writing instrument wherein the ink storage space or reservoir may be filled merely by placing a portion of the instrument in filling relation to a supply of ink.

A further object is to provide a ball point writing instrument having a reservoir capable of filling itself by capillary action, retaining the ink therein by capillary action when the instrument is not used in writing and controlling by capillary action the withdrawal of ink in writing.

Other objects are to provide a ball point writing instrument wherein: the reservoir is capable of being refilled repeatedly by the user; the feed of ink to the writing ball is even and well controlled and there is no flooding or starving at the point; there is substantially no "gooping"; the instrument may be readily manufactured and assembled and when so assembled is ready for use; the instrument may be made of materials which insure a long useful life with a minimum of servicing or replacement of parts, but which is so constructed that should any parts require replacement this may be accomplished readily and at relatively small cost.

Other objects and advantages of the invention will appear from the following description taken in connection with the appended drawings wherein:

Figure 1 is a side elevational view, partially in cross section, showing a writing instrument constructed in accordance with the present invention;

Fig. 2 is a longitudinal sectional view through the front end portion of the instrument of Fig. 1;

Fig. 3 is an enlarged fragmentary elevational view showing a portion of the feed of the instrument of Fig. 1;

Fig. 4 is an enlarged, fragmentary elevational view taken along line 4—4 of Fig. 3.

Fig. 5 is an enlarged fragmentary sectional view showing the ball writing point and its seating members; and

Fig. 6 is a front elevational view of the ball seat with the ball removed.

In accordance with the present invention the writing instrument includes a writing ball which is retained in a seat at the forward or writing end of the instrument for universal rotation within the seat, and feed means are provided for conducting ink from an ink storage reservoir to the ball seat so that the ink is deposited on the ball and rolled onto the writing surface by the ball as the latter is drawn cross the writing surface. The ball and seat arrangement is so constructed that the instrument is capable of using relatively thin writing inks having viscosities approximately the same as, or not substantially less than, those of conventional liquid inks such as used in fountain pens. In fact, the instrument of the present invention is adapted for use for ordinary liquid inks.

While the ball and seat arrangement may take other forms than those disclosed herein so long as it is suitable for use with thin liquid inks, I prefer to employ a ball and ball seat such as disclosed in the copending United States patent application of Wendell K. Beckwith, Serial No. 274,741, filed March 4, 1952.

The writing instrument of the present invention also includes a capillary filler-and-reservoir element having a capillary ink storage space therein, the element being so formed that it is capable of drawing ink therein by capillary action to fill the ink storage space or reservoir, retaining the ink therein by capillary action when the instrument is not used in writing and controlling the flow of ink from the instrument by capillary action when the instrument is used in writing. A capillary feed connects the ink storage space or reservoir with the ball seat and insures capillary feed of the ink thereto so as to maintain the instrument always in readiness for writing. While any suitable form of capillary filler-and-reservoir element may be used, I prefer to employ one somewhat similar to that disclosed in United States Patent No. 2,522,555 to Floyd E. Bartell.

Referring now particularly to Fig. 1, the instrument comprises a casing or barrel 10 of suitable construction which for convenience may be formed by a forward section 11 and a rearward section 12 secured thereto as by a threaded joint 13. If desired, a cap clutch ring 14 of known construction may be provided.

The barrel 10 is provided with a reservoir chamber or space 15 adapted to receive a capillary reservoir unit 16 described more in detail hereinafter and suitably vented to atmosphere as by a vent passage 17 extending rearwardly therefrom and through the rear casing member 12. The forward end of the forward barrel section 11 is adapted to receive a point unit 20 which includes the writing ball, seat and feed which will now be described. The point unit or tip assembly 20 includes a tip member 21 (Fig. 2) of generally tubular form and having a tapered forward portion 22 and a rearward shank portion 23 fitted in a bore 24 in the forward barrel member 11 and secured therein as by threads 25. Preferably the tip member 21 terminates flush with the forward end wall of the chamber or space 15.

The tip member 21 preferably is formed with a rearwardly facing shoulder 26 which abuts the extreme forward end of the barrel member 11 to aid in positioning the tip assembly 20.

A ball seat member 30 described more in detail hereinafter, adapted to seat and hold a ball 31, is secured within the tip member 21 by a sleeve member 32 having a sleeve portion 33 telescoped over the rearward portion of the seat member 30 and a forwardly facing shoulder 34 abutting the rear end of the seat member 30 to retain it in position in the tip member 21. The sleeve 32 also has a central portion 35 snugly seated in the bore 29 of the tip member 21 and secured therein as by solder 36. The sleeve 32 further has a rearwardly extending shank 37 which projects a substantial distance into the chamber 15 for cooperation with the capillary filler-and-reservoir element as hereinafter explained. A bore 38 is formed in the shank 37 and central portion 35 of the sleeve 32 and communicates at its rear end with the interior of the chamber 15. At its forward end it communicates with a bore 39 preferably of similar diameter formed in the

seat member 30, the two bores together being adapted to receive a feed member 40 described hereinafter.

The seat member 30 is formed of a hard glass, and preferably a glass having a low coefficient of expansion, such as certain types of borosilicate. One glass found suitable for this purpose is that manufactured by Corning Glass Works and sold under the name of "Pyrex."

The seat member 30 is of generally tubular form and has a reduced bore 45 in axial alignment with and forwardly of the bore 39 and which opens into a forwardly open ball socket 46 formed in the forward end of the ball seat member 30. A plurality of (preferably three) longitudinally extending narrow side channels 47 (Figs. 5 and 6) extend rearwardly for the socket 46 and communicate throughout their length through the reduced bore 45. The side channels 47 have inclined rear walls 47*a* which diverge outwardly and forwardly from the walls of the reduced bore 45.

Thus it will be seen that the forward portion of the reduced bore 45, together with the side channels 47 provide a passage of generally tricorn cross-sectional shape. This passage is defined by three concave surfaces 50 equally spaced about the axis of the bore 45 and three convex surfaces 51 intermediate the concave surfaces 50.

The ball socket 46 is formed with a rear wall into which the tricorn passage just described leads to provide an opening 49 of corresponding tricorn shape. The rear wall, which is of generally spherical form, thus is made up of three inwardly projecting ball seating surfaces 52 of substantial radial dimension and three narrow surfaces 53 which are peripherally continuous with the outer portion surfaces 52. This peripherally continuous surface, which is spaced very slightly from the adjacent surface of the ball, serves as a metering ring surface to determine and control the thickness of the layer of ink which is carried out of the ball socket by the ball.

Preferably the surface of the socket intermediate the outer edge or rim 55 and the edges 50 and 51 of the opening 49 is formed with a peripherally continuous groove 60 of uniform cross section and having a rear wall 61 extending substantially radially and a side wall 62 extending substantially coaxially with the socket. The wall 63 of the socket forwardly of the groove 60 is of spherical shape and is peripherally continuous and is spaced from the adjacent surface of the ball very slightly so as to serve as a doctor ring surface as hereinafter pointed out more in detail.

The ball 31 is retained in its seat and against the rear wall and the doctor ring by the forward portion 65 of the tip member 21 which is formed inwardly and extends to very close to the ball forwardly of the portion of maximum girth or "equator" so as to prevent the ball from moving forwardly out of its seat.

The feed member 40 has a main or body portion 41 so formed as to provide with the bore 38 of the sleeve member 32 and the bore 39 of the seat member 30 a plurality of capillary feed passages 42 extending throughout the length of the sleeve member 32 and throughout the length of the bore 39. The body 41 preferably is of generally tricorn shape and is dimensioned to fit snugly in the bores 38 and 39. By reason of the shape of the body 41, each of the capillary feed passages 42 has two side portions 42*a* adjacent the surfaces of the body 41 which abut the walls of the bores 38 and 39, which are of lesser wall to wall dimension, and consequently greater capillarity, than the remaining portions of such space. This longitudinally extending portion of greater capillarity aids in insuring that a continuous column of ink is maintained throughout the length of the passage 42 and overcomes any air locking which might result should an air bubble enter the capillary passage 42.

The feed member 40 is formed at its forward end with a reduced cylindrical portion 43 which extends through the reduced bore 45. The diameter of the cylindrical portion 43 is slightly less than the diameter of the reduced bore portion 45, thus providing an annular space 44 of capillary dimension. The reduced cylindrical portion 43 defines with the wall portions 51 intermediate the side channels 47 circumferentially spaced extensions 44*a* of the annular capillary space 44 which extensions 44*a* continue to the forward end of the reduced portion 43 and hence substantially to the ball socket 46. They also communicate with the side channels 47.

The feed member 40 is disposed with its forward end just short of the ball 31 and the passage 44 thus extends to close to the rear surface of the ball and the rear wall of the ball socket.

The ball 31 is of spherical form and preferably is formed of hard metallic oxide such as corundum, although it may be formed of a hard metal. It preferably is formed with a multiplicity of minute pits or depressions in its surface, the lands between the depressions being highly polished so that the surface of the ball is a true sphere except for the depressions.

A capillary filler-and-reservoir element 70 is disposed in the chamber 15 and is suitably connected, as hereinafter explained, in ink feeding relation with the writing ball 31. The capillary filler-and-reservoir element 70 preferably is constructed in a manner generally similar to that disclosed in the aforementioned Bartell Patent No. 2,522,555. Briefly, it is formed by rolling a sheet (or a plurality of sheets) of thin-wall material upon itself, with the several convolutions or wall elements 71 spaced apart to provide therebetween a space 72 of generally spiral cross section. The several wall elements 71 are spaced apart in suitable manner, as by the projections 73, at such distances that the several spaces or space portions 72 between opposing wall elements 71 are of small dimension and capable of exerting a strong capillary effect on a liquid entering such spaces. Thus, the spaces or space portions 72 are capable of filling themselves by capillary action when placed in filling relation with a supply of ink. Preferably the several spaces or space portions are connected in direct communication with one another by openings 74 extending through the wall portions which openings may be conveniently formed in the projections 73 as disclosed in the aforementioned Bartell Patent No. 2,522,555.

As also disclosed in the aforesaid Bartell patent the sheet material from which the capillary filler-and-reservoir element is formed is one which has sufficient rigidity to maintain its shape and position when rolled but is sufficiently flexible to permit it to be rolled readily. Also it is one which has such surface characteristics whereby it is suitably wettable by inks of the type with which the writing instrument is adapted to be used. Also it is a material which is not deteriorated by the inks used and does not adversely affect such inks. One material which is eminently suitable for forming the capillary filler-and-reservoir element is silver.

Preferably the capillary filler-and-reservoir element is so formed that the spaces or space portions 72 at the inner portion of the element are narrower—that is the walls are more closely spaced—than the spaces disposed outwardly therefrom, as disclosed in the aforesaid United States Patent No. 2,522,555. The wall elements or portions defining the capillary spaces preferably are spaced apart approximately 0.004 inch at the inner turns and approximately 0.005 inch at the outer turns.

The innermost turn of the capillary filler-and-reservoir element is so formed as to provide a central air passage or space 75 extending longitudinally throughout the filler-and-reservoir element which space is of a diameter such that it will not hold ink by capillary action. The diameter of this space is sufficient to accommodate snugly therein the shank 37 of the sleeve member 32.

Disposed forwardly of and in abutment with the forward end edge of the capillary filler-and-reservoir element 70 is a feed and auxiliary ink storage member 80 of flexible, resilient and porous material. One material which is excellently suited for forming the member 80 is cellulose sponge. The pores in this member are of such

size as to provide a plurality of interconnected small capillary passages, the capillarity of which is at least as great as and preferably slightly greater than the capillarity of the inner spaces 72 of the filler-and-reservoir element 70. The capillary passages of the feed member 80 are thus in communication with the forward ends of the spaces 72 in the filler-and-reservoir element 70, and thus in ink feeding relation therewith.

The feed member 80 is provided with a central opening 81 of such dimension as to receive the stem 37 which projects into the chamber 15. This opening however is somewhat smaller than the narrowest dimension of the stem 37 so that the feed member 80 may fit snugly around and engage all portions of the periphery of the stem which extends through the feed member 80. In order to place the capillary passages in the feed member 80 in ink feeding relation with the capillary passages 42 in the stem 37 the latter is provided with longitudinally extending lateral openings 82, preferably of slit form, in its two opposite sides as will be seen from Fig. 4. Thus, when the feed member 80 and stem 37 are in the assembled positions as shown, the former fits snugly against the side portions of the stem 37 and the capillary passages in the member 80 are in ink feeding relation with the feed passages 42 through the openings 81.

The capillary filler-and-reservoir element 70 and the feed member 80 preferably are assembled with a containing casing 90 to form therewith a unitary cartridge 91 which is frictionally fitted in but removable from the chamber 15. The cartridge 91 preferably includes a second member 80 which is similar in all respects to the other member 80 but is disposed in abutment with the rearward end of the capillary filler-and-reservoir element 70. It will be observed that the cartridge 91 is symmetrical end-for-end and may be reversed in position within the chamber 15 without any change in functioning.

The rearward member 80 is also provided with an opening 81, which opening is in alignment with the air vent space 75 of the capillary filler-and-reservoir element 70 and with the air vent passage 17 in the barrel 10. Thus, the air vent space 75 and consequently the spaces 72—which are vented through the openings 74 to the space 75—are vented to atmosphere at all times. At this point, it should be noted that by reason of the venting arrangement all ink-air interfaces in the instrument are maintained at atmospheric pressure.

When the writing instrument is to be filled with ink the capillary spaces 72 are placed in filling relation with a supply of ink. This may be conveniently accomplished by removing the rear barrel section 12 and inserting the rear portion of the cartridge 91 in the supply of ink. Ink is drawn by capillary action into the rear feed member 80, from thence into the capillary spaces 72, thence into the capillary spaces in the forward feed member 80, thence through the openings 82 into the capillary feed passages 42. Ink is drawn along the capillary feed passages 42, and particularly the narrowed side portions 42*a* thereof, and from thence into the annular capillary space 44 and into the capillary spaces 44*a*. Ink progresses from the passages 44*a* into the channels 47 because of the gradual divergence of the surfaces 51 with respect to the peripheral surface of the reduced portion 43. When the ink reaches the forward end of the reduced portion 43, ink that is in the channels 47 is enabled to pass into the space between the forward end of the reduced portion 43 and the ball 31. Thus, ink will be picked up by the surface of the ball as it rotates in its seat during writing.

Air which is displaced by the ingoing ink passes along the wider portions of the capillary feed passages 42 and out of the rear end of the stem 37 and into the air space 75. Should the passages 42 be filled with ink, nevertheless, due to the fact that the capillarity of the wider central portions is less than the edge portions 42*a*, any air will pass rearwardly through the passages 42 and will not block such passages. From thence it passes through the opening in the rear member 80 and bubbles up through the supply of ink from which ink is being drawn into the filler-and-reservoir element.

The capillary filler-and-reservoir element 70 also may be filled with ink by removing the cartridge 91 from the barrel 10 and inserting either end thereof in the supply of ink and ink is drawn into the capillary spaces within the filler-and-reservoir element 70 (and the two feed members 80) in the manner above described. However, in this second mode of filling air which is displaced by the ingoing ink is vented through the end of the cartridge opposite that which is immersed in the supply of ink. Under ordinary circumstances, this second mode of filling results in a slightly more rapid filling than the first mode but involves somewhat more manipulation of the elements forming the writing instrument. After the filler-and-reservoir element 70 (and the feed members 80) is filled the cartridge is reassembled in the instrument to place the passages in the forward feed member 80 in ink feeding relation with the passages 42 and ink is delivered to the ball in a manner similar to that above described.

So long as the writing instrument is not used in writing, ink is retained therein by capillary action. The capillarity of the ink storage spaces 72 and of the several passages connecting such spaces with the ball socket is sufficient to retain ink in the writing instrument under all normal conditions and there is no leakage of the ink from the instrument.

When the instrument is used in writing the ball is rolled across the writing surface in a manner in which ball point writing instruments are normally used and ink which has been deposited on the surface of the ball within the socket is carried out of the ball socket and rolled onto the writing surface. As the ball rotates in its socket the ink is "metered" as the ball passes the metering surface or ring 64. That is, the desired amount of ink is permitted to be carried out by the ball to produce an even, solid line on the writing surface. As the outgoing surface of the ball passes the doctor ring surface 63 any nonuniformities in ink distribution on the outgoing surface of the ball are smoothed out so that a uniform layer of ink is carried out of the ball socket on the spherical surface portions of the ball and applied to the writing surface.

Any air or foreign material which is carried into the ball socket by the ingoing surface of the ball passes into the groove 60 or trap and is prevented from passing inwardly past the metering ring 64 and the seating surfaces 52 and rearwardly of the rear wall of the ball socket. Such air or foreign matter will tend to pass around the groove 60 and be carried out of the ball socket as explained more in detail in the aforementioned copending Beckwith application.

As ink is carried out of the ball socket by the rotatable ball and transferred to the writing surface additional ink for further writing is delivered to the ball along the feed passages hereinabove described, such ink being withdrawn from the capillary ink storage spaces 72 in the filler-and-reservoir element 70. The capillarity of the several feed passages, or at least longitudinally continuous portions thereof, leading from the spaces 72 to the ball socket is at least as great as the capillarity of the ink storage spaces 72 and preferably slightly greater. In fact, the arrangement preferably is such that the capillarity of the several sections of the feed passages from the ink storage spaces 72 to the ball socket increases progressively so as to insure that a continuous column of ink is maintained from the ink storage spaces to the ball socket.

Air to replace the ink which is withdrawn from the ink storage spaces 72 in writing enters the writing instrument through the air vent passage 17, the opening 81 in the rear feed member 80, the air vent space 75 and the openings 74. Should an air bubble form in any of the feed passages 42 during writing it will not cause inter-

ruption in the feed of ink but will eventually find its way out of the rear end of the passage 42 and be discharged into the air vent space 75. Thus there will be no interruption in the feed owing to the formation of such air bubble.

It will be understood that whenever any air is present in the feed passages 42, either during a writing or filling operation, a counterflow action will take place; that is, owing to the greater capillarity of the side portions 42*a* of the passages 42, ink will be drawn forwardly along such portions. On the other hand, owing to the greater wall-to-wall dimension and lesser capillarity of the central portions, air, if any is present in the passages 42, will pass rearwardly along such central portions and be vented.

It will be seen from the foregoing that the present invention provides a ball point writing instrument which is capable of filling itself merely by placing the ink storage spaces in filling relation with the supply of ink. This may be accomplished conveniently in either of the two ways described hereinbefore. The ink is retained in the writing instrument by capillary action when the instrument is not used in writing and the withdrawal of ink in writing is controlled by capillary action. All of the ink-air interfaces of the ink in the instrument are maintained at atmospheric pressure so that the instrument is not subjected to flooding or starving, and particularly when subjected to such otherwise adverse influences as a sudden increase or decrease in atmospheric pressure, or heating of the contents of the instrument such as produced by the heat of the hand when it is held by the user.

The instrument is capable of using thin liquid inks either of a conventional nature or inks of an improved nature and may readily be filled by the user in the manner generally similar to that in which capillary fountain pens are filled. Accordingly it is not necessary to provide a replaceable ink cartridge as is customary in prior art ball point writing instruments using thick, pasty inks but the filler-and-reservoir element may be used without replacement almost indefinitely. Thus no part of the instrument need be replaced unless it should become damaged through accident or from some other extraordinary cause. Moreover, since the instrument uses thin liquid inks, it may use inks which are relatively quick drying, or rapidly penetrative of the writing surface and which are nontransferable.

While the instrument is not normally subject to clogging, nevertheless, should any portion of the ink storage or feed spaces become clogged such as might take place where inferior ink containing sediment is used, such clogging ordinarily can be corrected by flushing the clogged spaces to remove the sediment.

The instrument is extremely simple in construction and operation and is of such construction that it can readily be manufactured and assembled. Substantially no adjustment is required in assembling the instrument and there are no adjustments which need be made by the user during the normal life of the instrument. However, should any of the parts become damaged they may be readily removed and replaced.

I claim:

1. A ball point writing instrument comprising a casing having a chamber therein, a ball socket at the forward end of said casing, a writing ball rotatably retained in said socket, a capillary filler-and-reservoir element in said chamber including a thin-walled sheet spirally wound upon itself to provide between the convolutions thereof a capillary ink storage space, and a pair of yieldable, resilient and porous members, said members disposed for abutting opposite ends of said sheet and having capillary ink feed passages in communication with said ink storage space, and ink feed means including a rigid member engaging one of said porous members throughout a substantial distance in longitudinal direction and having a fixed capillary ink feed passage connecting the ink feed passages therein and said ball socket.

2. A filler-and-reservoir element for a writing instrument comprising a casing having an opening in each end, a capillary filler-and-reservoir element in said casing including a thin-walled sheet spirally wound upon itself to provide between the convolutions thereof a capillary ink storage space, and a pair of yieldable, resilient and porous members in said casing, said members disposed adjacent the opposite open ends and in abutment with an end edge of said sheet and having capillary passages in communication with said ink storage spaces, said porous members each having an opening therein registering with the opening in said casing, one of said members disposed for venting the element and the other for reception of an ink feed means.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,847,975 August 19, 1958

Ray A. Lawton

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 61, for "fragmentary elevational" read -- transverse sectional --; column 2, line 2, for "cross" read -- across --; line 8, for "for", second occurrence, read -- with --; column 3, line 14, for "for" read -- from --.

Signed and sealed this 2nd day of December 1958.

(SEAL)

Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents