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D. KAHN ET AL
 WRITING INSTRUMENTS
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3,008,453

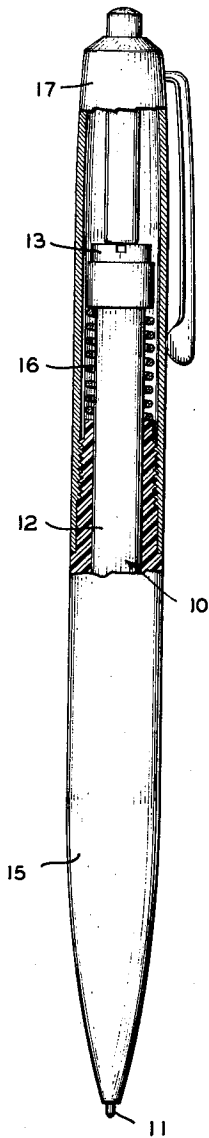


FIG. 1

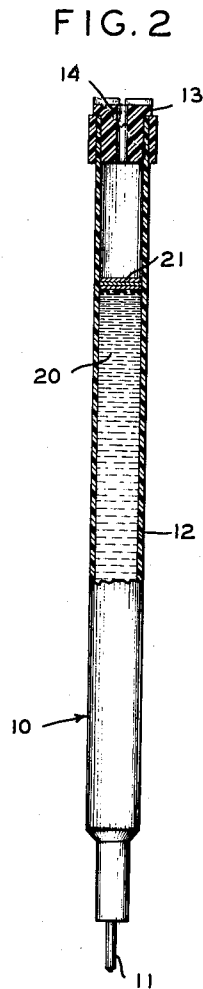


FIG. 2

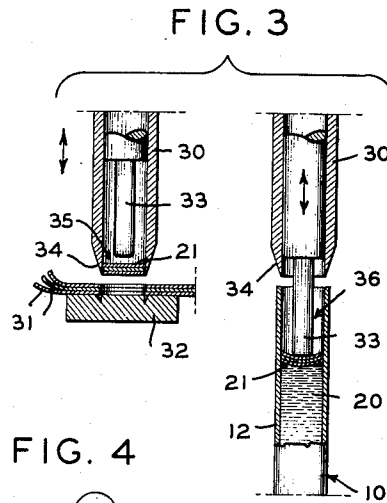


FIG. 3

FIG. 4

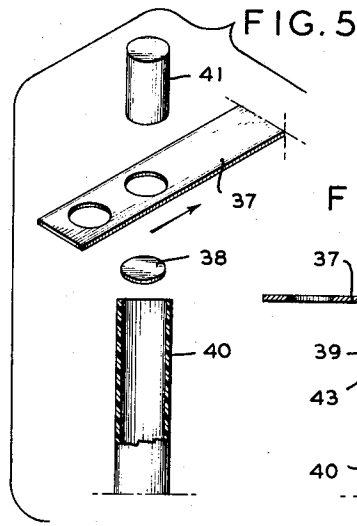


FIG. 5

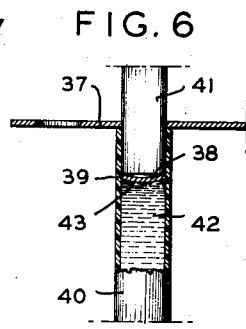


FIG. 6

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3,008,453

WRITING INSTRUMENTS

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6 Claims. (Cl. 120—42.4)

The present invention relates to writing instruments and more particularly to improvements in storage reservoirs therefor having present a writing fluid feeding to the writing end of the writing instrument.

In a ball point writing instrument, the ball point writing tip is conventionally mounted in the forward end of a tubular reservoir which is vented at the rear and the writing fluid or ink in the reservoir is fed to the writing tip by capillary attraction. Usually, in a ball point writing instrument the writing fluid or ink is a viscous one and may have a viscosity of approximately 11,000 centipoises at 20° C., and the ink reservoir of the writing instrument is constituted by a narrow bore tube so that the ink will not be subject to flow by gravity when the writing instrument is inverted or shaken. The narrow bore of the ink reservoir in a conventional ball point writing instrument has greatly limited the supply of writing fluid or ink which is normally present in the average cartridge units, the latter usually containing sufficient ink to last several weeks when extensively used.

The limited writing fluid or ink supply of the prior art conventional cartridge units having a capillary feed has previously been recognized and the art has attempted to provide a cartridge unit in which the tubular reservoir was of increased internal diameter to accommodate increased quantities of ink. When a large diameter reservoir was employed, the ink was fed from the reservoir to the writing tip by gravity and it became necessary to prevent the writing fluid or ink in the reservoir from sloshing about when the writing instrument was inverted or shaken. The disadvantage so introduced was the possibility of leakage of the writing fluid through the vented rear of the reservoir and the danger of introducing bubbles of air into the writing fluid which would interrupt the flow of the writing fluid to the writing tip.

The prior art efforts to successfully employ ink reservoirs feeding to a ball point have, for various reasons, been only partially effective. More specifically, it has been proposed to provide a writing instrument in which an immiscible pulpy mass such as paraffin or wax is slidably disposed within the ink reservoir and positioned in contact with the surface of the column of ink. The physical properties of these pulpy materials vary with change of temperature to thereby alter the writing characteristics of the pen and to introduce the danger of leakage of ink from the reservoir.

Further, it has been proposed to provide an ink reservoir having two separate members, the upper of which is buoyant and the lower of which is heavier than the ink and rises and falls within the ink present in said reservoir to prevent the buoyant member from rising when the pen is inverted. This construction is unduly expensive. It has also been proposed to employ weighted followers, but practically, the interior of the reservoir and the exterior of the follower could not be mated with sufficient accuracy to overcome minor variations in clearance which permitted the ink to escape to the space behind the follower.

While the present invention is particularly advantageous when employing large diameter tubular reservoirs of increased capacity, it is not limited thereto as it may be employed in narrow bore capillary reservoirs of the prior art ball point writing instruments. In accordance with the present invention, there is provided a flexible thin follower

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film of solid material, the exterior edge or periphery of which is in contact with the interior surface of the tubular reservoir. This invention may be carried out utilizing a plurality of flexible, resilient, self-sustaining or self-supporting follower films of solid material, or a single self-sustaining or self-supporting follower film of solid material. In either case, the exterior edge of the follower film or the edges of each of the plurality of follower films are in contact with the interior surface of the tubular reservoir. While so contacting the interior surface of the reservoir, the superimposed films of flexible, resilient material, or the single follower film moves independently of and vertically with the upper surface of the writing fluid in the reservoir as this surface descends in the reservoir with the consumption of writing fluid, said follower film or said superimposed follower films and the upper surface of the writing fluid descending in unison so there is no air space between the writing fluid and the follower film or films of flexible, resilient solid material to disturb the tendency of the film or films to follow the upper surface of the writing fluid as the latter is consumed.

It is believed that the tendency of the follower film to move downwardly with the consumption of writing fluid is partly due to the suction developed as the writing fluid attempts to move away from the follower film, and partly to a capillary attraction between the writing fluid and the follower film. The single follower film or plurality of follower films of solid material superimposed one upon another, as herein set forth in detail, prevent gravity flow of the writing fluid upon the writing instrument being moved from its normal writing position.

The film of solid material utilized in carrying out the present invention is desirably, but not necessarily, in the form of a flexible resilient disk since the reservoir is usually in the form of a circular or oval-shaped tube. However, the principle of the present invention can be practiced utilizing a reservoir container of any predetermined shape including a rectangular reservoir tube. The solid follower films used in carrying out the present invention may be in the form of an exceedingly flexible, thin, metallic disk, such as a thin disk of aluminum, gold, silver, nickel, and the like, or a thin plastic follower film, said films being inert with respect to the writing fluid. Polyethylene is representative of a plastic follower film. The follower films of the present invention are extremely flexible so they may follow and conform with the shape and contour of the interior wall of the tubular reservoir irrespective of minor irregularities and obstructions therein. Further, while extremely flexible, these follower films have sufficient resiliency to prevent the follower film from collapsing as the follower film or a plurality of follower films follow the upper surface of the writing fluid on the consumption thereof.

The follower film or the plurality of follower films utilized in carrying out the present invention have such a cross-section as to be capable of being inserted in the tubular reservoir to very closely contact the interior surface of the reservoir and further, when so inserted and disposed on the top surface of the column of writing fluid present in the reservoir, follow the upper surface of the writing fluid upon the consumption thereof, this being true irrespective of whether a single follower film is utilized or a plurality of follower films is utilized.

Desirably the flexible follower film of solid material or the follower disk has smooth surfaces so the tendency of the disk to move along the surface of the reservoir is enhanced. Further, when a plurality of disks are employed, the smooth broad surfaces of each disk facilitate the tendency of the disks to move together as a unit along the interior surface of the tubular reservoir. In one form of the invention, the disks are stamped from a single sheet of material. In another form of the invention, the

disks are stamped from a plurality of sheets of material of the character herein set forth, and simultaneously deposited in the open end of the reservoir as by a punch, as hereinafter set forth, or by equivalent means, the follower films having substantially the same cross-sectional dimension or dimensions as that of the reservoir or approximately so. As the films are in the form of disks, they may have an external diameter which is substantially equal to the internal diameter of the tubular reservoir, or substantially so.

The disks may be a trifle larger than the internal diameter of the reservoir as, for example, 0.0005" larger than the internal diameter of the reservoir. The disk when using a single disk, or a plurality of disks when superimposed disks are used, cup up slightly upon being inserted in the tubular reservoir.

The term "disk" as herein used is not confined to a circular disk. The disk or the plurality of superimposed disks may be in the form of an oval and then the reservoir will have the same internal contour so that the edges of the oval disk will conform with the interior surface of the reservoir. The term "disk" is a species of the generic term "follower film." The follower film may not be circular, or oval, and conceivably may be rectangular in shape.

The flexible follower film or disk, or the plurality of superimposed disks moving substantially as a unit prevent the writing fluid, for example, a viscous ink, from flowing by gravity when the pen is inverted or shaken, and do not interfere with extremely slow flow of the viscous writing fluid from the reservoir to the ball point writing tip. The flexible follower film or disk or the plurality of superimposed disks move independently and vertically with the upper surface of the writing fluid in the reservoir as this surface descends in the reservoir with the consumption of writing fluid.

The follower film or the plurality of superimposed follower films herein set forth are extremely flexible so that they may follow and conform to the shape and contour of the inside of the tubular reservoir irrespective of minor obstructions. They should have sufficient resiliency to prevent them from collapsing as with the consumption of the viscous writing fluid the single disk or the plurality of superimposed disks progress toward the forward extremity of the reservoir. The thickness of the film or the plurality of superimposed films should, therefore, conform to this criterion.

As previously pointed out, the follower film utilized in carrying out the present invention may be constituted by various materials, including thin metal or metal alloy films, and thin plastic films, all of said films being inert with respect to the writing fluid. Polyethylene is representative of a plastic follower film, a thin film thereof being exceedingly tough and smooth. The follower film or films are desirably constituted by any material which over a long period of time as, for example, three to six months or twelve months, substantially retains its original properties, such as flexibility and resiliency, and is substantially inert with respect to the writing fluid present in the reservoir of the writing instrument. When utilizing a metal or metal alloy follower film, the latter may take the form of any metal that can be rolled down to a thickness of about 0.001 or 0.002". The term "metallic follower film" as used herein includes a film made from a metal as, for example, gold, silver, nickel, and the like, or any metal alloy.

The above is set forth as an illustrative thickness. The criterion is that the metallic film must be flexible, self-sustaining, and self-supporting and resilient.

An object of the invention is the provision of a ball point cartridge unit in which the writing fluid or ink flows from the tubular reservoir to the ball point writing tip by gravity in which novel means are employed to prevent flow of the writing fluid or ink in the cartridge by gravity when the cartridge is inverted or when the pen is

shaken, said means being inexpensively provided and being effective for its intended purpose despite change in temperature.

A further object of the invention is the provision of a ball point cartridge unit in which the upper surface of the writing fluid or ink in the tubular reservoir is covered to thereby protect the writing fluid or ink against change in physical properties occasioned by loss of one or more volatile constituents thereof.

Still another object of the invention is the provision of a ball point cartridge unit of enlarged internal diameter in which the writing fluid or ink flows from the tubular reservoir to the ball point writing tip by gravity in which a thin follower disk or a plurality of thin superimposed follower disks of the character herein set forth are employed to prevent flow of the writing fluid or ink in the cartridge by gravity when the cartridge is inverted or when the pen is shaken.

Still another object of the invention is the provision of a novel method of assembling a ball point cartridge unit in which means are provided for protecting the upper surface of the writing fluid or ink within the tubular reservoir and for preventing the writing fluid or ink within the tubular reservoir from flowing by gravity when the writing instrument is shaken or inverted.

Other and further objects of the invention will become apparent from the description which follows taken in conjunction with the accompanying drawings in which:

FIG. 1 is an elevation, partly in section, showing a writing instrument constructed in accordance with the invention and depicting a cartridge unit housed within an enclosing barrel, the writing instrument being shown in assembled condition;

FIG. 2 is an elevation, partly in section, and showing a cartridge unit constructed in accordance with the invention;

FIG. 3 is a diagrammatic view illustrating a method of the invention in which disks are stamped from a sheet or from a plurality of superimposed sheets and inserted into the rear of the tubular reservoir after the reservoir has been filled with writing fluid, the view showing two successive stages, in the first of which the disks are stamped and retained by the stamper, and in the second of which the disks are ejected from the stamper and inserted upon the upper surface of the writing fluid;

FIG. 4 is a plan view of a follower film, a plurality of which are adapted to be superimposed one on another and deposited in the reservoir of the writing instrument as shown in FIG. 3;

FIG. 5 is an exploded perspective view illustrating a modified form of the invention where the follower disk is stamped out from a thin strip of metallic foil; and

FIG. 6 is a fragmentary vertical sectional view illustrating the application of the follower film of FIG. 5 to the reservoir container of the cartridge unit.

The first form of the invention which will be illustrated is that form in which the follower film comprises a plurality of thin flexible and resilient superimposed disks.

Referring to FIGS. 1 and 2, the numeral 10 generically indicates a ball point cartridge unit, the cartridge comprising a ball point writing tip 11, a tubular reservoir 12 and a cap 13 provided with a vent hole 14. As can be seen in FIG. 1, the cartridge unit 10 is mounted within a lower casing 15 and a spring 16 is interposed between the bottom of the cap 13 and the top of the lower casing 15, the spring 16 surrounding the upper portion of the reservoir 12.

An upper casing 17 is secured to the lower casing 15 and the top of the cap 13 abuts against the upper end of the upper casing 17 which serves to project or retract the writing tip 11 from the lower open end of the lower casing 15. Means are also provided to retract the writing tip.

Referring more particularly to FIG. 2, a viscous writing fluid 20 fills the tubular reservoir 12 and a plurality of

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thin disks 21 are fitted within the tubular reservoir 12 upon the upper surface of the writing fluid or ink 20.

In accordance with the invention, the cartridge unit shown in FIG. 2 is assembled by inserting the writing tip 11 in the lower end of the tubular reservoir 12, filling the tubular reservoir 12 with writing fluid through the open rear thereof, inserting the disks 21 and then closing the upper end of the reservoir 12 with the cap 13.

As can be seen in FIG. 3, the disks 21 are stamped from superimposed sheets of suitable material, held with respect to the stamping member and then thrust into the open end of the tubular reservoir 12 by means of a rod having a diameter smaller than the diameter of the disks so that the peripheral portion of the disks are unsupported to permit air to escape from the space between the disks and the upper surface of the writing fluid 20.

More specifically, disks 21 are stamped from superimposed sheets 31 by means of a tubular cutting or stamping plunger 30 which acts in cooperation with the die 32. As will be seen, the disks 21 are retained within the lower open end of the plunger 30 until the inserting rod 33 is actuated. The open end of the tubular reservoir 12 is positioned immediately beneath the plunger 30 and the rod 33 is moved downwardly to force the disks 21 upon the upper surface of the writing fluid 20.

Referring more particularly to FIG. 3, it will be observed that the forward extremity of the plunger 30 tapers to a knife edge 34 and the discrete portions of the superimposed sheets 31 which are severed are retained within the lower open end of the plunger which is then moved to a position immediately overlying the reservoir 12. The rod 33 is retracted within the plunger 30 during the cutting operation and the rod 33 is formed so that the exterior of at least the forward portion of the rod is spaced from the interior of at least the forward extremity of the plunger, said space being indicated by the numeral 35. When the rod 33 is protracted, the disks 21 are ejected from the plunger and inserted in the reservoir 12 and forced downwardly therein until the upper surface of the writing fluid 20 is encountered. The rod 33 is smaller than the interior of the reservoir 12 so that the peripheral portion of the disks 21 are unsupported to permit air to escape past the disks 21 to the space 36 between rod 33 and the reservoir 12 to the atmosphere.

As shown in FIG. 5, the stamping plunger 41 has cut a follower film 38 from the metallic sheet 37 and the follower film is ready to be inserted in the reservoir tube 40. As shown in FIG. 6, the stamping plunger 41 has deposited on the upper surface 43 of the writing fluid 42 the follower film 38 which is provided with a peripheral edge 39, said follower film being desirably cupped so as to allow air in the reservoir tube 40 beneath the follower film to be displaced from above the writing fluid as the follower film or disk is deposited on the top surface 43 of the writing fluid.

The metallic foil 37 is sufficiently flexible and thin to permit the cupping of the peripheral edge of the foil. The foil as it encounters protuberances on the interior surface of the reservoir is sufficiently flexible and resilient to enable it to pass over and around said protuberances.

In one form of the invention, the strip 37 is passed between the stamping plunger 41 and the reservoir container 40 and successive disks constituting follower films are successively stamped from the foil strip 37 as the latter passes in the direction of the arrow. Simultaneously, successive tubular cartridge units are passed in the direction of the arrow. The movement of the strip 37 and the series of reservoir tubes 40 are coordinated so that as each disk or follower film 38 is cut or stamped, a reservoir tube 40 appears thereunder and each disk is successively inserted on the upper surface of the writing fluid surface 43 of each successive reservoir tube 40, said disks being preferably cupped during insertion. There is thereby provided a method of providing each of a plurality of writing instrument reservoir containers of a cartridge unit, each thereof

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containing writing fluid, with a follower film by forming a plurality of successive flexible resilient follower films from a thin flexible and resilient sheet material as it passes over the top portion of successively positioned writing instrument cartridge unit reservoirs containing writing fluid and successively inserting on the top surface of each of said reservoirs a follower film.

It will be appreciated that the foregoing is illustrative of one form of the invention, it only being essential that the follower film be formed, preferably by stamping, and then inserted and deposited by a member which is smaller than the film or films to leave the peripheral portion of each film unsupported so that the follower film or disk can act as a valve to permit the escape of air from between the film or plurality of films, and the writing fluid.

In the form of the invention shown in FIGS. 1-4 it is important to retain the film or films in position with respect to the cutter until such time as the film or films is or are inserted in each reservoir. This may or may not require movement of the cutter for any substantial intervening time. Thus, a film may be severed and inserted with a substantially simultaneous movement of the cutter and inserting rod or separate motions may be used, as illustrated in FIG. 3, and these motions may be effected at separate locations, FIG. 3 illustrating a preferred embodiment.

It will be appreciated that only one sheet 31 may be used in which case a plurality of stamping operations is required in the formation of a plurality of disks for insertion in each cartridge unit 10. It will also be appreciated that the follower films or disks 21 as shown in FIGS. 1-4 are extremely thin and difficult to handle and this prevents, as a practical matter, the follower films or disks 21 from being separately formed and then after formation inserted in the tube 10.

Of course, when a metal or metal alloy foil strip is utilized to produce the follower film as set forth in FIGS. 5 and 6, it is most satisfactory to insert merely one follower film or disk on the surface 43 of the writing fluid 42 present in the tube or cartridge unit 40 which forms the reservoir for the writing fluid.

In general, the follower film of the present invention whether it be of metal or metal alloy film or plastic film gives very satisfactory results when the thickness of the follower film varies broadly between .001 of an inch and about .010 of an inch, and more narrowly between about .001 of an inch and about .005 of an inch. An aluminum follower film or disk having a thickness between .001 and .005 of an inch has given satisfactory results when it is used in cartridge units or tubes having a diameter of .135 of an inch, the diameter of the aluminum disk being about .136 of an inch so that the disk will cup when inserted into the cartridge tube on the top surface of the writing fluid present therein. When cupping is not necessary or desirable, the diameter of the metal or metallic follower film can be slightly less than the internal diameter of the writing fluid reservoir tube 12 or 40. For example, the metal or metallic follower film can have a diameter of about .132 of an inch when inserted in a cartridge reservoir tube having an internal diameter of .135 of an inch, the thickness of the metal or metallic follower film or disk being about .002 of an inch.

In general, as the diameter of the cartridge reservoir tube 12 or 40 increases, the thickness of the follower film or disk to provide adequate resiliency will also be increased, and this is particularly true when using a plastic follower film or disk of the character herein set forth, or a plurality of said films or disks.

Referring more specifically to FIGS. 1-4, the reservoir tube 12 is constructed to have an outside diameter of .210 of an inch and an internal diameter of .160 of an inch. Therefore, the thickness of the tubular member 12 is .025 of an inch. This tubular member 12 may be constructed of polyethylene. The ink 20 within the tubular member 12 has a viscosity between about 8,000 and 20,000

centipoises at 20° C. but preferably between 16,000 and about 20,000. The ink can be more viscous than is normally employed since the disk 21 or plurality of such disks effectively prevent further thickening through loss of volatile constituents. Each of the three disks 21 are constructed of polyethylene and have a thickness of .0015 of an inch and a diameter of .160 of an inch.

When a tubular reservoir having an internal diameter of .160 of an inch is employed as previously described, the follower film or disk or the plurality of follower films or disks may have a thickness of between approximately .001 and .0015 of an inch. If the internal diameter of the tubular reservoir is .200 of an inch, then the follower film or the plurality of follower films may have a thickness between .002 of an inch and .003 of an inch. Further, if the internal diameter of the tubular reservoir 12 is .250 of an inch, then the disk or plurality of disks when the latter is employed may have a thickness of between about .003 of an inch and about .005 of an inch.

As herein set forth, when employing a plurality of disks, the thickness and number thereof which are superimposed one upon another are exemplary of satisfactory disks. However, it is to be understood that the invention resides broadly in the utilization of flexible thin follower film or in the utilization of a plurality of superimposed follower films one disposed on another, said follower film or assembly of follower films being disposed on the upper surface of the writing fluid in the reservoir as this surface descends in the reservoir with the consumption of the writing fluid, and it is upon the latter that broad protection is desired.

When using the form of the invention set forth in FIGS. 1-4, there may be four, five, or six disks superimposed one upon another, and these disks are of such a character to perform the functions herein set forth.

While the reservoir container or tube is usually a cylinder, it is within the province of the present invention to utilize a rectangular reservoir container or an oval reservoir container or any other shape.

It is believed that the flexible and resilient follower film by-passes the minor faults in and on the interior surface of the tubular reservoir which as a matter of commercial practicability, cannot be avoided. The reservoir container may be either rigid or flexible, and may be manufactured from plastic materials including acrylate and methacrylate resins, some of these resins being marketed under the trademark Lucite. The tubular reservoir may also be made of any of the forms of polyethylene now on the market, or of polystyrene. The reservoir container may be made of a metal alloy as, for example, brass or steel or brass and steel alloys.

If when using a plastic follower film, for any reason, a minor portion of the highly viscous writing fluid or ink should leak past the first of the series of superimposed follower films or disks, then this increment of writing fluid leakage will be caught by the peripheral edge of the succeeding follower film. This is one of the advantages of having present a plurality of follower films. The follower film or disk superimposed on the upper surface of the column of ink also functions to prevent air from being introduced into the column of ink, it being understood that there is a column of air above the follower film or disks, and this air should be prevented from having access to the column of viscous writing fluid.

The viscous writing fluid herein set forth may be a fatty acid base quick-drying ink or any suitable viscous ink. While it is preferred that the viscous ink have a viscosity between about 16,000 and 20,000 centipoises at 20° C., this is the preferred and somewhat higher viscosity of writing fluid than that which is usually used in the capillary ball point pens. It is to be understood that the above set forth viscosity of the writing fluid can be considerably departed from and will still function in accordance with the present invention.

While in the form of the invention shown in FIGS.

1-4, inclusive, the plurality of disks are preferably made of polyethylene, these plastic disks may be made from other materials which are physically and chemically inert with respect to the viscous writing fluid in the tubular reservoir container of the writing instrument. The follower film or films may be made of a thin sheet of polystyrene, it being preferred that the polystyrene films be free of a plasticizer which would not be substantially inert with respect to the viscous writing fluid. The follower film may be made of thin nylon, which may be defined as a thermoplastic long-chain super polyamide produced by polymerization from the basic raw materials such as benzene, air and water, and characterized by molecular orientation along the long axis of cold-drawing.

The follower film or films may be made of flexible glass. In fact, the follower film or a plurality of follower films may be made of any flexible resilient material which is substantially physically and chemically inert with respect to the viscous writing fluid or ink, the plastic, metal and metallic follower films giving satisfactory results. The follower films, of course, are essentially non-porous with respect to the passage of the viscous writing fluid therethrough.

It is desired to point out that in accordance with one form of the present invention, the reservoir of the cartridge may have therein from 2½ to 5 times more ink than is present in cartridges of the prior art so-called capillary writing instruments. The writing fluid volume of the usual capillary reservoir is about 0.6 ml. and in accordance with one form of the present invention, the reservoir capacity is much greater. However, as previously pointed out, the present invention can be employed with the prior art writing fluid reservoirs of capillary dimension.

The utilization of a single or plurality of thin flexible resilient self-sustaining follower films, including disks, in accordance with the present invention, presents a very simple, effective and inexpensive manner of successfully employing tubular reservoirs in ball point writing instruments wherein leakage of the writing fluid from the upper portion of the reservoir is substantially inhibited. Further, the follower film is not affected by any change in climatic conditions. The follower film or disk seals the upper normally exposed surface of the writing fluid and prevents loss of volatile constituents and prevents flow of writing fluid despite the fact that, in accordance with one form of the present invention, the internal diameter of the tubular reservoir is sufficiently large to permit gravity flow in the absence of means preventing such flow when the writing instrument is tilted from its normal position of writing. There may be some wetting of the peripheral edge of the writing disk and if for any particular follower film material, this occurs, then the solution of the problem is to use a plurality of superimposed follower films. However, in normal operation the peripheral edge of the film or the peripheral edges of the superimposed films are not wetted by the ink. As stated, if such wetting should occur in any particular instance due to the character of the ink, then several additional follower films may be used, one superimposed on the other. For example, if one plastic film or one aluminum follower film is not sufficient, then an additional follower film may be superimposed upon the first follower film or on the second follower film.

While there is no intention that the present invention be limited to any particular theory of operation, it is thought that when the film is inserted, that the air within the reservoir between the ink and the film is forced past the peripheral margin of the flexible film by the inserting plunger until the film contacts the top surface of the ink, there being practically no air between the film and the top surface of the writing fluid or ink after the film is assembled within the cartridge reservoir of the writing instrument. As the writing fluid is consumed,

the top surface of the ink is lowered and the follower film moves downwardly with the top surface of the writing fluid. This probably is not due solely to the weight of the follower film itself, since the weight may not be, and generally is not, sufficient to overcome the resistance between the reservoir and the periphery of the film. This is particularly true when using plastic films of the character herein set forth. When using metallic foil, the weight of the foil may at least assist in overcoming the frictional resistance between the solution of the reservoir and the periphery of the follower film. It is to be appreciated that frictional resistance is a variable depending on such factors as the size of the film in comparison with the size of the reservoir container, the flexibility and resilience of the film, the latter being governed at least partially by the material, the thickness of the film, and the surface characteristics of the reservoir container. Further, the weight of the follower film is a variable and the ratio of the contact surface of the follower film with respect to the weight of the follower film may also be a variable. This ratio is generally decreased as the larger reservoirs are used.

It is thought that the surface tension of the writing fluid as, for example, writing ink, assists in retaining the follower film on the top surface of the writing fluid when the writing instrument and the reservoir container is inverted. Further, any tendency of the follower film to be separated from the top surface of the writing fluid is readily resisted by the air pressure in the reservoir above the follower film. Since in one form of the invention the area covered by the follower film is relatively large, the pressure of the air in the reservoir above the follower film easily overcomes the frictional resistance of movement of the follower film downwardly, this being easily apparent when it is considered that any tendency of the follower film to leave the writing fluid will generate a substantial vacuum therebetween.

The density of the follower film has some importance from the standpoint that it is not desired to have the follower film sink in the viscous writing fluid. As previously pointed out, the frictional resistance between the peripheral edge of the follower film and the wall of the reservoir container is generally sufficient to prevent movement of the follower film by gravity, and in the most satisfactory form of the present invention, the follower film or the plurality of follower films move with the upper surface of the writing fluid in the reservoir container as this surface descends in the reservoir container with the consumption of the writing fluid. When the pen is in writing position, the follower film in the reservoir moves vertically with the upper surface of the writing fluid in the reservoir container as this surface descends in the reservoir container. Even if the writing instrument is held at an angle, the follower film moves with the upper surface of the writing fluid as this surface descends in the reservoir container with the consumption of the writing fluid.

In accordance with one form of the present invention, there is provided a writing instrument having a writing end, a reservoir in operative connection with said writing end, said reservoir having present therein a column of writing fluid which will flow by gravity along the length of said reservoir upon movement of the writing instrument from its normal writing position. There is superimposed upon the surface of the writing fluid a thin flexible resilient self-sustaining and self-supporting follower film substantially inert with respect to the writing fluid, said follower film being in contact with the interior surface of the reservoir, said follower film preventing gravity flow of the writing fluid upon the writing instrument being moved from its normal position. The follower film follows the upper surface of the writing fluid as said writing fluid descends in the reservoir, the latter being a large reservoir of the character herein set forth, or a capillary reservoir. The follower film

has sufficient resiliency to prevent collapsing of the follower film as the latter follows the upper surface of the writing instrument. Instead of using a single follower film, a plurality of thin flexible resilient self-sustaining and self-supporting follower films may be superimposed upon the upper surface of the writing fluid.

Broadly, there has been provided in a writing instrument, a reservoir in operative connection with the writing end of the writing instrument, said reservoir having present therein a column of writing fluid. There is superimposed upon the upper surface of the writing fluid a follower film of the character herein set forth.

The present invention is not to be considered to be limited to the use of aluminum foil, gold foil, silver foil, or nickel foil. Any foil which is substantially inert with respect to the writing fluid can be used and by substantially inert means substantially inert during the life of the writing fluid, which usually may vary from about six weeks to six months. Instead of using gold foil, an alloy of gold may be used. The hardness of gold can be increased by adding a hardener thereto. For example, it may be alloyed with a small amount of silver or any of the usual materials used for producing a gold alloy resilient to wear. For example, a follower film may be made of white gold containing from 75-80% gold, 8-10% nickel, and a small amount of zinc. The notation "metallic" as herein used covers pure metal or an alloy of the metal, it only being necessary that the pure metal or the alloy be rollable to produce a thin foil, and that the foil be relatively inert as specified with respect to the writing fluid.

The present invention is particularly applicable to writing instruments provided with a reservoir having a top open portion and a writing end, said reservoir or reservoir container having present a relatively viscous writing fluid, the latter having a tendency to flow by gravity as the writing fluid is consumed and the writing instrument moves from its normal writing position. In the production of such an instrument, protection is desired upon the steps of forming from a strip of follower film material successive follower films as the tops of successive reservoir writing fluid containers pass below said strip of follower film, and successively inserting in the top of each reservoir container and on the surface of the writing fluid contained therein one of said successively produced follower films, said film in one form of the invention being a metallic film. In this form of the invention, the follower film is peripherally unsupported from the top of each reservoir container and on the surface of the writing instrument contained therein.

This application is a continuation-in-part of application Serial No. 555,112, filed December 23, 1955.

What is claimed is:

1. In a writing instrument provided with a writing end, a reservoir in operative connection with said writing end, said reservoir having present therein a column of writing fluid, and a thin, flexible, resilient, preformed, temperature stable, solid, self-sustaining and self-supporting metallic follower film inert with respect to the writing fluid and superimposed upon the upper surface thereof, said film having a thickness substantially less than the diameter thereof, the edge of said follower film being in contact with the interior surface of the reservoir and said film following the upper surface of said writing fluid as the latter is consumed.

2. In a writing instrument provided with a writing end, a reservoir in operative connection with said writing end, said reservoir having present therein a column of writing fluid, and a thin, flexible, resilient, preformed, temperature stable, solid, self-sustaining and self-supporting metallic follower film inert with respect to the writing fluid and superimposed upon the upper surface thereof, said film having a thickness substantially less than the diameter thereof, the edge of said follower film being in contact with the interior surface of the reservoir and

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said film following the upper surface of said writing fluid as the latter is consumed, said follower film having sufficient resiliency to prevent collapsing of the follower film as the latter follows the upper surface of the writing fluid during consumption of the writing fluid.

3. The writing instrument defined in claim 1 in which the metallic follower film is an aluminum follower film.

4. A writing instrument as recited in claim 2 in which the follower film comprises a thin flexible self-sustaining aluminum film inert with respect to the writing fluid.

5. In a writing instrument provided with a writing end, a reservoir in operative connection with said writing end, said reservoir having present therein a column of writing fluid, and a thin, flexible, resilient, preformed, temperature stable, solid, self-sustaining and self-supporting polyethylene follower film inert with respect to the writing fluid and superimposed upon the upper surface thereof, said film having a thickness substantially less than the diameter thereof, the edge of said follower film being in contact with the interior surface of the reservoir and said film following the upper surface of said writing fluid as the latter is consumed.

6. In a writing instrument provided with a writing end, a reservoir in operative connection with said writing end, said reservoir having present therein a column of writing fluid, and a thin, flexible, resilient, preformed temperature stable solid, self-sustaining and self-supporting polyethylene follower film inert with respect to the writing

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fluid and superimposed upon the upper surface thereof, said film having a thickness substantially less than the diameter thereof, the edge of said follower film being in contact with the interior surface of the reservoir and

5 said film following the upper surface of said writing fluid as the latter is consumed, said follower film having sufficient resiliency to prevent collapsing of the follower film as the latter follows the upper surface of the writing fluid during consumption of the writing fluid.

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