Oct. 2, 1962 D. KAHN ET AL 3,056,194

METHOD OF ASSEMBLING A FOLLOWER FILM IN THE CARTRIDGE OF A BALL POINT PEN

Filed Dec. 23, 1955

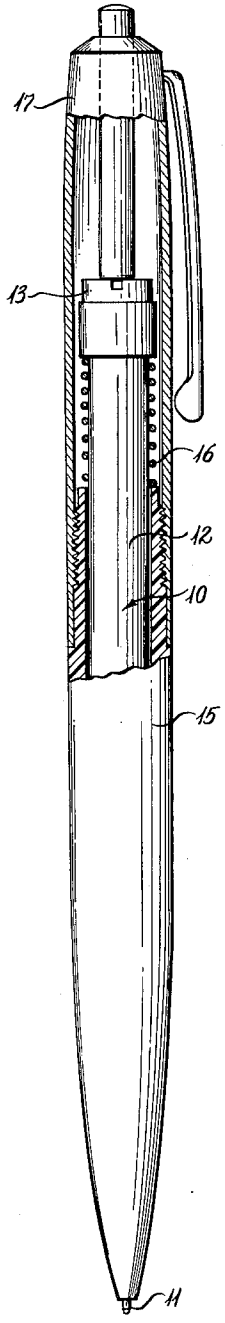


Fig. 1.

Fig. 2.

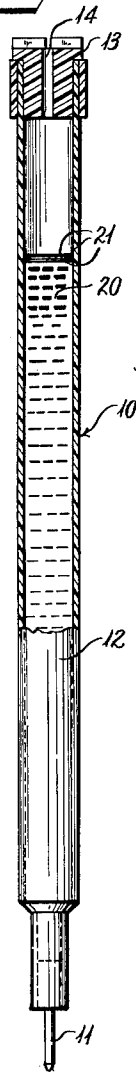


Fig. 3.

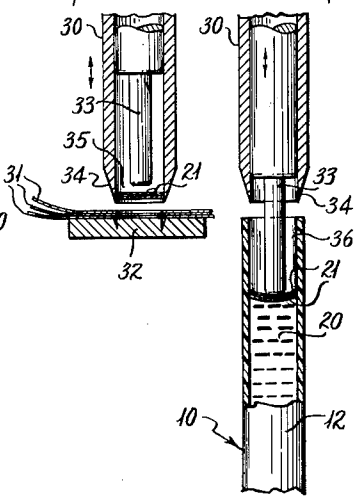


Fig. 4.



INVENTORS

David Kahn

Karl Weisser

BY

ATTORNEY

United States Patent Office 3,056,194 Patented Oct. 2, 1962

3,056,194

METHOD OF ASSEMBLING A FOLLOWER FILM IN THE CARTRIDGE OF A BALL POINT PEN

David Kahn, Englewood Cliffs, and Karl Weisser, Cresskill, N.J., assignors to David Kahn, Inc., North Bergen, N.J., a corporation of New Jersey

Filed Dec. 23, 1955, Ser. No. 555,112
4 Claims. (Cl. 29—434)

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 centiposes 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 large diameter 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.

Broadly, in accordance with the present invention there is provided a plurality of flexible resilient self-sustaining or self-supporting follower films of solid material, the exterior edges of which are in contact with the interior surface of the tubular reservoir. While so contacting the internal surface of the reservoir, the superimposed films of flexible resilient material move 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 the writing fluid, said films and the upper surface of writing fluid descending in unison so there is no air space between the writing fluid and the films of flexible resilient solid material to disturb the tendency of the film 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. These flexible films of solid material superimposed one upon the other, as herein set forth, prevent gravity flow of the writing fluid upon the writing instrument being moved from its normal writing position.

The films of solid material are desirably but not necessarily in the form of flexible resilient disks 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 herein set forth follower films of solid material, and in one form of the invention, disks are extremely flexible so that 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 being extremely flexible, these follower films have sufficient resiliency to prevent the follower films from collapsing as the films follow the upper surface of the writing fluid on the consumption thereof.

The films 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 one on top of the other, and on the top surface of the column of writing fluid present in the reservoir, follow the upper surface of the writing fluid upon consumption thereof.

Desirably the flexible follower films of solid material or disks have smooth surfaces so that the tendency of the disks to move together is enhanced. Since these films, and in one form of the invention the disks, are stamped from a plurality of sheets of material of the character herein set forth and simultaneously deposited into the open end of the reservoir as by a punch as hereinafter set forth, the films have substantially the same cross sectional dimension or dimensions as that of the reservoir, or approximately so. If the flexible and resilient films of solid material 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 approximately so.

The disks may be just a trifle larger than the internal diameter of the reservoir, as for example 0.0005" larger than the internal diameter of the reservoir. These disks may cup slightly upon being inserted in the tubular reservoir but they still function satisfactorily. The term "disk" is not confined to a circular disk. Each of the disks of the plurality of 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 disks will conform with the interior surface of the reservoir.

The term "disk" is a species of the generic term "follower film." The follower films need not be circular or oval, and conceivably may be rectangular in shape.

These flexible films or disks 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 the extremely slow flow of the viscous writing fluid from the reservoir to the ball point writing tip. The flexible films or 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 the writing fluid.

The films or disks 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, they progress toward the forward extremity of the reservoir. The thickness of the films should, therefore, conform to this criterion.

While the follower medium of the present invention may be constituted by various materials, it has been found that thin films made of polyethylene material give excellent results. The utilization of films or disks of polyethylene is particularly advantageous because this material is inert with respect to the writing fluid and in the form of a thin film is exceedingly tough and smooth. The follower films are preferably constituted by any material which over a relatively long period of time, as for example 3 months to 6 months, or even 12 months, substantially retains its original properties such as flexibility and resiliency and is substantially inert with respect to the writing fluid.

An object of the invention is the provision of a method of assembling 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 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 method of assembling 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 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 the method of the invention in which disks are stamped from a sheet or from a plurality of superposed 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; and

FIG. 4 is a plan view of a follower film.

The present invention will be illustrated using as the follower film a plurality of thin flexible and resilient 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 protract 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 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 superposed 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 superposed 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 tubular cutter or 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 superposed 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. The disks or films **21** may be cupped as shown in FIG. 4.

It will be appreciated that the foregoing is simply illustrative, it being only essential that the film be formed, preferably by stamping, and then inserted and deposited by a member which is smaller than the films to leave the peripheral portion thereof unsupported so that the film can act as a valve to permit the escape of air from between the films and the writing fluid. It is also important to retain the films in position with respect to the cutter until such time as the films are inserted in the reservoir which may or may not require movement of the cutter or any substantial intervening time. Thus, the films can be severed and inserted with a substantially simultaneous movement of the cutter and inserting rod or separate motions may be used, as illustrated, and these motions

may be effected at separate locations, as is also illustrated in the presently preferred embodiment of FIG. 3.

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 disks **21** are extremely thin and difficult to handle and this prevents, as a practical matter, the disks **21** from being separately formed and then handled after formation.

To illustrate the construction of a cartridge unit in accordance with the invention, the tubular reservoir **12** is constructed to have an outside diameter of .210" and an internal diameter of .160". Therefore, the thickness of the tubular member **12** is 0.025". 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 about 20,000 centipoises at 20° C. but preferably between about 16,000 and about 20,000. The ink **20** can be more viscous than is normally employed since the disks **21** 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" and a diameter of .160".

When a tubular reservoir having an internal diameter of .160" is employed as previously described, the disks may have a thickness of between approximately .001" and .0015". The invention is not limited to the use of a tubular reservoir having any particular internal diameter. Thus, if the internal diameter of the tubular reservoir is .200", then the disks should have a thickness of between .002" and .003". Also, if the internal diameter of the tubular reservoir is .250", then the disks should have a thickness of between .003" and .005".

In general, the follower films of the present invention give very satisfactory results when the thickness thereof is between about .001" and about .005". As the internal diameter of the tubular reservoir departs from .250", a greater number of flexible resilient followers may be disposed on the top surface of the viscous writing fluid. However, in general, as the diameter of the reservoir increases, the thickness of the disks necessary to provide adequate resiliency will also increase.

As herein set forth the thickness of the disks and the number of disks which are superimposed one upon another are exemplary of one precise form of the invention. However, it is understood that the invention resides broadly in the utilization of flexible thin follower films, one disposed upon the other, said assembly of 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 this invention that broad protection is desired.

Instead of three disks disposed one upon another as shown in FIG. 3, there may be four or five or six disks superimposed one upon another and these disks are of such a character as to perform the functions herein set forth.

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

It is believed that the flexible and resilient assembly of follower films by-pass the minor faults in and on the interior surface of the tubular reservoir which, as a matter of commercial practicality, cannot be avoided. The tubular reservoir may be either rigid or flexible and may be manufactured from plastic materials including the acrylate and methacrylate resins, some of these resins being marketed under the trademark "Lucite." The tubular reservoir may also be made of a polyethylene or a polystyrene. The tubular reservoir may be made of a metal or alloy, as for example, brass or steel. If, for any reason, a very 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 leakage ink will be caught by the edge of the succeeding follower film. This is one of the advantages of having present a plurality of follower films.

The plurality of follower films or disks superimposed upon the upper surface of the column of ink also function to prevent air from being introduced into the column of ink, it being understood that there is a column of air above the follower films 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 has a viscosity between about 16,000 and 20,000 centipoises at 20° C., this is a preferred and somewhat higher viscosity writing fluid than that which is used in the so-called 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 the disks have been set forth as being preferably made from polyethylene, these disks may be made from other materials which are physically and chemically inert with respect to the viscous writing fluid present in the tubular reservoir of the writing instrument. For example, these follower films or disks may be made of thin sheets 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 also 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 films or disks may be made of flexible glass. In fact, the follower films may be made of any flexible resilient material which is physically and chemically inert with respect to the viscous writing fluid or ink. The follower films are essentially non-porous with respect to the viscous ink.

It is desired to point out that, in accordance with the present invention, the reservoir of the cartridge may have present therein from about two and one-half to five times more ink than is present in the cartridges of the prior art so-called capillary writing instruments. It is desired to point out that the writing fluid volume of the usual capillary reservoir is about 0.6 ml. and, in accordance with the present invention, the reservoir capacity is much greater.

It is desired to point out that the utilization of a plurality of thin, flexible, resilient self-sustaining follower films including disks in accordance with the invention presents a very simple, effective and inexpensive manner of successfully employing tubular reservoirs in ball point writing instruments and that the resulting construction is not affected by change in climatic conditions. The follower films or disks seal the upper, normally exposed surface of the writing fluid and prevent loss of volatile constituents and prevent flow of writing fluid despite the fact that 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 one or more follower disks. However, in normal operation, the peripheral edges of the topmost films are usually not wetted by the ink, and if such should occur in any particular instance due to the character of the ink, then several additional follower films may be added. For example, if three are not sufficient, then two additional follower films may be superimposed upon said assembly of three follower films.

While there is no intention that the present invention be limited to any particular theory of operation, it is thought that when the films are 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 ink after the film is assembled within the barrel of the writing instrument. As the writing fluid or ink is consumed, the top surface of the ink is lowered and the follower film moves downwardly with the top surface of the ink. This probably is not due solely to the weight of the film itself since the weight may not be, and generally is not, sufficient to overcome the frictional resistance between the reservoir and the periphery of the 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 reservoir, the flexibility and resilience of the film which is governed by the material, thickness of the film, and the surface characteristics of the reservoir. Further, the weight of the film is a variable and the ratio of the contact surface of the film with respect to the weight of the film may also be a variable. This ratio is generally decreased as larger reservoirs are used.

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

The density of the film and the film follower has some importance from the standpoint that it is not desired to have the film sink into the viscous writing fluid. As previously pointed out, the frictional resistance between the film and the reservoir is generally sufficient to prevent movement of the film by gravity, and in the best form of the present invention, the superimposed films or disks constituting the follower move vertically with the upper surface of the writing fluid in the reservoir as this surface descends in the reservoir with the consumption of the writing fluid. The follower films and the upper surface of the writing fluid descend in unison so there is no air space between the writing fluid and the films of flexible resilient solid material to disturb the tendency of the film follower to follow the upper surface of the writing fluid as the latter is consumed.

In accordance with one form of the invention, there is provided a method of assembling a cartridge unit for a writing instrument, preferably one provided with a ball point, the cartridge of said unit comprising a tubular reservoir provided with a ball pointed writing tip at the lower end thereof and a column of writing fluid within the reservoir above said writing tip, said column of writing fluid having an upper surface positioned within the reservoir. The cartridge is also provided with means preventing the flow of writing fluid from said reservoir, said means being positioned at the upper surface of said column of writing fluid, said method comprising forming at least one solid flexible follower film and inserting the follower film into the open end of the tubular reservoir and depositing said follower film on the upper surface of said column of writing fluid by forcing said film into said reservoir while permitting the air above said column of writing fluid to escape around the peripheral edge of said follower film, said peripheral edge being unsurrounded while the film is forced into said reservoir. Preferably at least one follower film is stamped from at least one sheet of material and the stamped follower film is inserted into the open end of the tubular reservoir and deposited on the upper surface of the column of writing fluid by forcing said film into the reservoir while permitting the air above said column of writing fluid to escape around the peripheral edge of said follower film, said peripheral edge being unsupported while the film is forced into said reservoir. While in this method it is preferred to stamp the follower film from a sheet of material, it is within the province of the present invention to cut a follower film, hold it by any suitable means onto the end of an inserting rod, as by a vacuum, and then deposit the so-cut film on the upper surface of the writing fluid by forcing said film into the reservoir while permitting the air above said column of writing fluid to escape around the peripheral edge of the follower film.

What is claimed is:

1. A method of assembling a cartridge unit for a ball point writing instrument, said cartridge comprising a tubular reservoir having a ball point writing tip at the lower end thereof and a column of writing fluid within said reservoir above said writing tip, said column having an upper surface positioned within said reservoir, and means preventing the flow of ink from said reservoir positioned at the upper surface of said column of ink, comprising forming at least one follower film from at least one sheet of solid, flexible, resilient material by means of a tubular cutter, said film having the same shape as the opening through the tubular reservoir and being at least as large as said opening, retaining said film within the open forward extremity of said cutter, and inserting the formed follower film into the open end of said tubular reservoir and depositing said formed film on the upper surface of said column of writing fluid by projecting a small diameter rod from within said cutter to eject said film from said cutter and force said film into said reservoir while said film is peripherally unsupported.

2. A method as recited in claim 1 wherein said film is slightly larger than said opening so that the film cups upon being inserted into the tubular reservoir.

3. A method as recited in claim 1 wherein a plurality of superimposed sheets are employed so that a plurality of follower films are simultaneously formed, inserted and deposited.

4. A method as recited in claim 3 wherein said films are formed at a first location by means of said tubular cutter, the cutter is moved, while retaining the films within the open forward extremity of the cutter, to a second location immediately overlying said reservoir and the films are inserted into said reservoir while said cutter is at said second location.

References Cited in the file of this patent

UNITED STATES PATENTS

2,118,817	Laursen	May 31, 1938
2,417,813	Curtis	Mar. 25, 1947
2,426,453	Huenegerdt	Aug. 26, 1947
2,433,058	Mesaros	Dec. 23, 1947
2,672,127	Fehling	Mar. 16, 1954
2,678,634	Henriksen	May 18, 1954
2,686,963	Freyssinet	Aug. 24, 1954
2,728,981	Hooper	Jan. 3, 1956

FOREIGN PATENTS

666,795	Great Britain	Feb. 20, 1952
722,448	Great Britain	Jan. 26, 1955
1,012,827	France	Apr. 23, 1952
65,051	France (Addition to 1,009,146)	Sept. 28, 1955
907,384	Germany	Mar. 25, 1954
300,081	Switzerland	Sept. 16, 1954
165,418	Australia	Sept. 28, 1955