

[54] **EXTRUDED FIBROUS LIQUID RESERVOIR AND METHOD OF MAKING SAME**

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[22] Filed: **Nov. 24, 1971**

[21] Appl. No.: **202,026**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 648,589, June 26, 1967, abandoned.

[52] U.S. Cl. .... **161/175, 156/166, 156/244, 161/173, 161/176, 401/196, 401/198**

[51] Int. Cl. .... **D02g 3/00, B43k 5/00**

[58] Field of Search ..... **161/173, 175, 176; 131/10-10.9, 267; 264/207, 342; 401/196, 198, 199; 156/244, 180, 166**

[56]

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[57]

**ABSTRACT**

The reservoir comprises a length of raw filamentary tow encased in a plastic sleeve.

**4 Claims, 12 Drawing Figures**

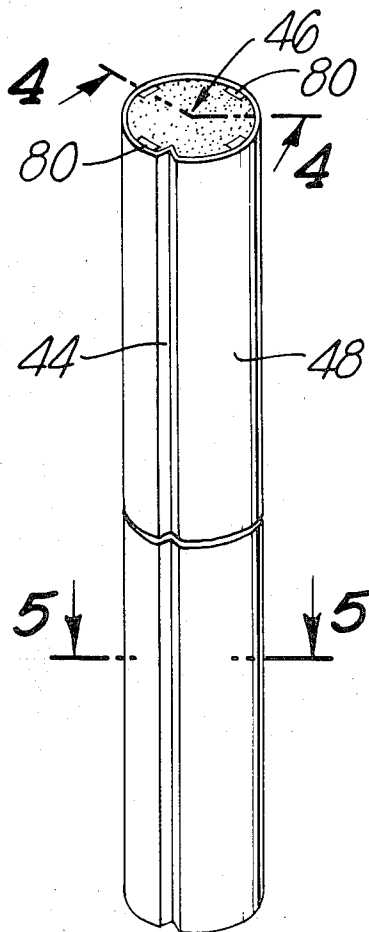


FIG. 3.

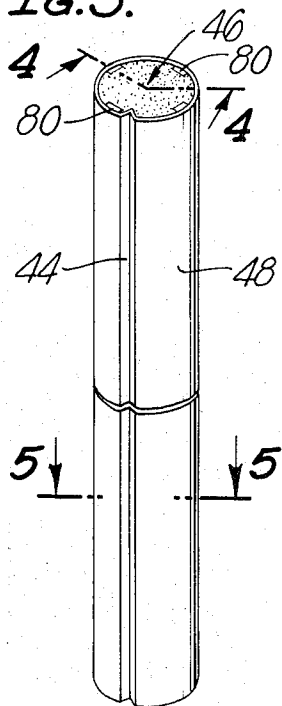


FIG. 4.

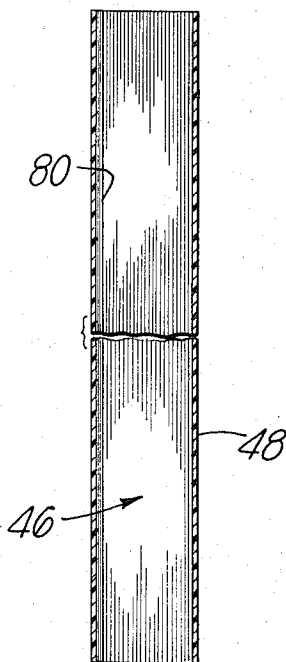


FIG. 1.

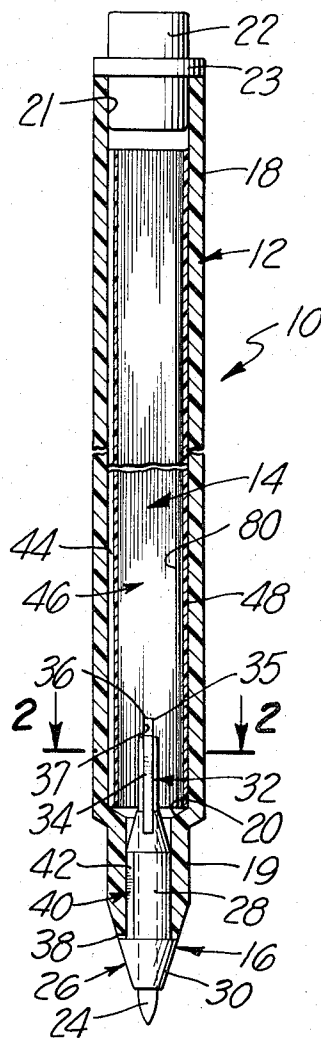


FIG. 6.

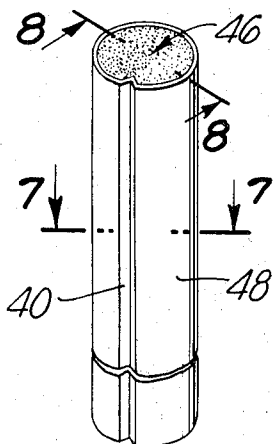


FIG. 5.

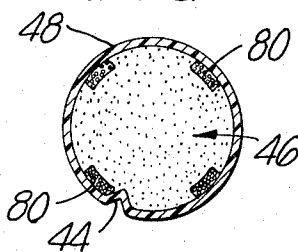


FIG. 7.

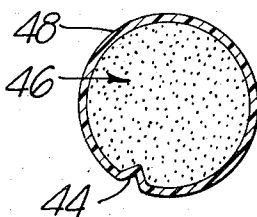
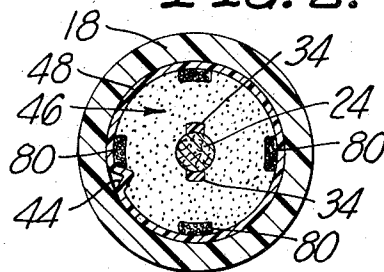


FIG. 8.



FIG. 2.



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FIG. 9.

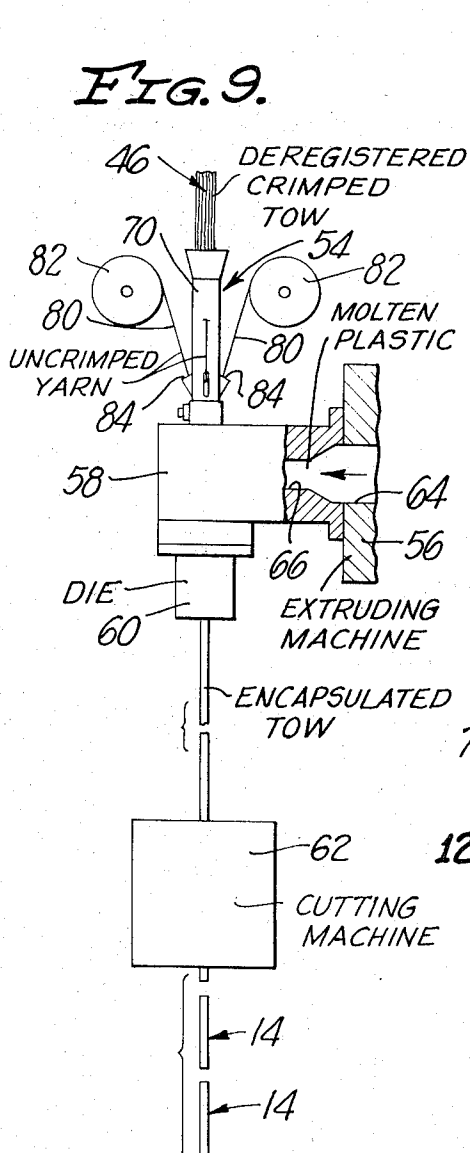


FIG. 10.

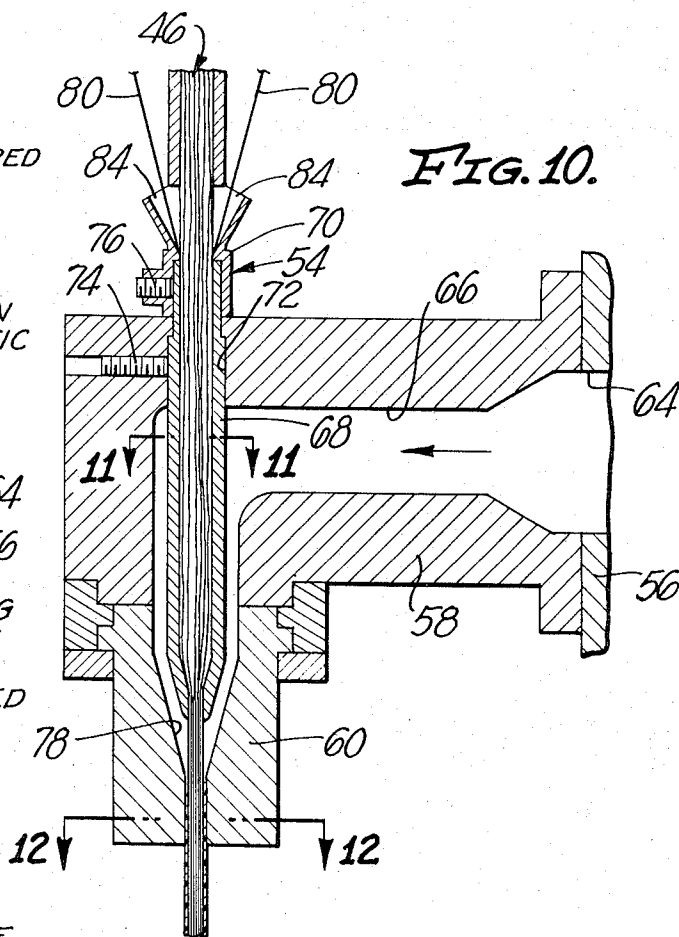


FIG. 11.

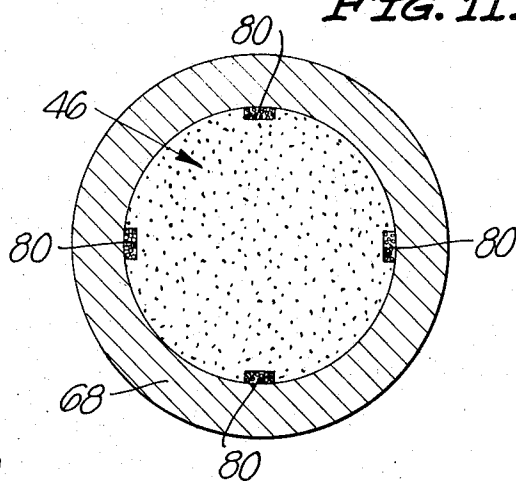
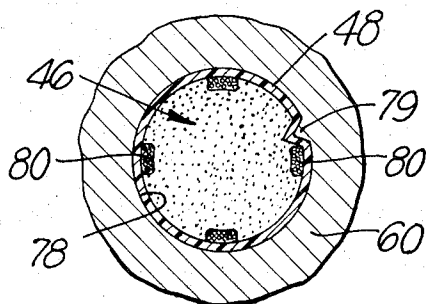


FIG. 12.



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## EXTRUDED FIBROUS LIQUID RESERVOIR AND METHOD OF MAKING SAME

This application is a continuation of co-pending application Ser. No. 648,589 filed June 26, 1967, and now abandoned.

The present invention relates to improvements in liquid reservoirs and, more particularly, to a novel ink reservoir and the method of producing same.

Like conventional writing pens, marking pens basically comprise a tubular case housing an ink reservoir, and a tip connected to the ink reservoir and extending from one end of the case to transfer ink to various writing surfaces. Rather than being a metal penpoint however, the tip of the marking pen comprises a nib of felt or treated fibers. The ink reservoir of the marking pen also differs from conventional pens in that it usually comprises a mass of fibrous material, such as a filamentary tow, into which the ink is absorbed.

A filamentary tow is an elongated compact bundle of thousands of longitudinally extending filaments or fibers. In a "raw" state, the tow is untreated and individual fibers are transversely crimped to form hills and valleys which register with like hills and valleys in other fibers in the tow.

To render such tow suitable to use as ink reservoirs, and as described in detail in U. S. Pat. Nos. 3,095,343 and 3,111,702, issued June 25, 1963, and Nov. 26, 1963, respectively, it has heretofore been common practice to treat the raw tow by first spreading and deregistering the crimps in the filaments or fibers in order to form a bulky mass. The fibers are then impregnated with a solvent or glue and gathered into a consolidated rod-like structure. The rods are then cut into suitable lengths which are impregnated with ink by dipping or injection, and the impregnated rods are subsequently used in pens.

The foregoing ink reservoir forming process is rather elaborate, time-consuming and expensive. Moreover, the treated lengths of tow are messy to fill and thereafter to handle, particularly during assembly of marking pens, since the ink is exposed on all surfaces of the rod. This also causes the ink to dry out rapidly during assembly operations. Furthermore, the residual solvent often causes chemical reactions with the ink. This requires those assembling the marking pens to exercise great care.

Accordingly, it is an object of the present invention to provide an improved and relatively inexpensive liquid reservoir which may be rapidly and cleanly handled and assembled by unskilled personnel or automatically by machines without loss or undesired transfer of ink from the ink reservoir, and without fear of subsequent chemical reactions.

Another object of the present invention is to provide an improved ink reservoir in which a freer flow of ink is accomplished.

A further object of the present invention is to provide such an ink reservoir comprising a length of raw filamentary tow encased in an impervious plastic sleeve.

Still another object of the present invention is to provide a simple and inexpensive method of producing large quantities of ink reservoirs of the foregoing character including forming a plastic sleeve on and around a de-registered and then transversely compressed raw filamentary tow and cutting the plastic covered tow into suitable lengths.

An important feature of the present invention is that the liquid reservoir can be provided in two forms:

1. where the tow has receded inwardly of the ends of the plastic outer sleeve thereby providing recessed ends on the reservoir; and

2. where the tow has not receded and its ends are substantially flush with the ends of the sleeve. The reservoir with the flush ends is made by encasing the tow in a plastic sleeve while the tow is substantially untensioned longitudinally due to the tow being guided and carried by a plurality of tensioned, uncrimped yarn threads. The threads are included within the plastic sleeve and aid in the flow of ink within the reservoir because the fibers in the thread are closer together than the fibers in the crimped tow and thus the capillary flow of ink in the threads is greater than in the tow. This permits a rapid delivery of ink to the end of the reservoir during use in writing.

The reservoir of the present invention is useful in many environments other than its use as an ink reservoir. For example, as a reservoir for a liquid medicine such as iodine, as a reservoir for a liquid glue, and the like.

The foregoing, as well as other objects and advantages of the present invention, may be more clearly understood by reference to the following detailed description when considered with the drawings which, by way of example only, illustrate one form of marking pen, two forms of ink reservoirs, and the method of forming same.

In the drawings:

FIG. 1 is a sectional side view of a marking pen utilizing the ink reservoir of the present invention;

FIG. 2 is an enlarged cross-sectional view taken along the line 2—2 in FIG. 1, illustrating the inner construction of the marking pen;

FIG. 3 is a perspective view of one form of the ink reservoir for the marking pen;

FIG. 4 is a sectional view taken along the line 4—4 in FIG. 3 illustrating the interior of the ink reservoir;

FIG. 5 is an enlarged cross-sectional view taken along the line 5—5 in FIG. 3;

FIG. 6 is a perspective view of a second form of the ink reservoir for the marking pen;

FIG. 7 is an enlarged cross-sectional view taken along the line 7—7 in FIG. 6;

FIG. 8 is an enlarged cross-sectional view taken on line 8—8 of FIG. 7;

FIG. 9 is a schematic representation of one method of forming the ink reservoirs for use in the marking pens of the present invention;

FIG. 10 is an enlarged sectional view of the plastic extruding machine and die portions of the process of FIG. 9 for forming the plastic covered tow;

FIG. 11 is an enlarged cross-sectional view taken along the line 11—11 in FIG. 10; and

FIG. 12 is an enlarged cross-sectional top view taken along the line 12—12 in FIG. 10.

In FIGS. 1 and 2, the marking pen is represented by the numeral 10 and, generally speaking, comprises a tubular case 12 housing a fibrous ink reservoir 14, and a tip 16 connected to the reservoir and extending from a forward end of the case to apply ink to writing surfaces.

The tubular case 12 includes a cylindrical barrel portion 18 and a forward end portion 19 of reduced inner and outer radial dimension having a forwardly and in-

wardly converging outer surface adjacent its front end. The barrel portion 18 is internally dimensioned to tightly receive the ink reservoir 14 through an open rear end 21 and to firmly support the reservoir within the case with a forward end of the reservoir bearing against an inner annular shoulder 20 between the barrel and forward end portions. With the ink reservoir stationed within the case 12, the open rear end 21 is sealed by a cylindrical plug 22 having an annular flange 23 seated against the outer rear end of the barrel.

The forward end portion 19, on the other hand, is adapted to tightly receive and support the ink applicator 16 including an elongated cylindrical nib 24 and a tubular nib holder 26.

The nib holder 26 has a cylindrical main body portion 28, a frusto-conical forward end portion 30, and a rear portion 32 including laterally spaced, rearwardly extending arms 34 connected by a bridge 35 having a pointed rear end 36. The main body portion 28 is adapted to fit snugly into the forward end portion 19 of the case 12 with the frusto-conical portion 30 bearing tightly against a front end of the case. In this position, the pointed end 36 pierces the fibrous material comprising the ink reservoir 14 and the arms 34 form a recess 37 in the end of the reservoir for receiving the rear end of the nib 24.

The nib 24 may be of conventional structure, such as a compressed body of fiber or other porous matter, and is adapted to fit snugly into the nib holder 26 with a rear end bearing against the bridge 35 and a forward end extending forwardly beyond the end of the holder 26. In this manner, the bridge 35 limits rearward movement of the nib 24 while combining with the arms 36 to form the recess 37 which permits ink to flow directly from the ink reservoir 14 into the ends and sides of the fibers comprising the rear end portion of the nib. The ink then flows by capillary action through the nib to the pointed forward end thereof for transfer to a writing surface.

In order for ink to flow by capillary action through the ink reservoir 14 and nib 24, it is of course necessary that the marking pen 10 include a passageway for air from atmosphere to the rear end of the reservoir to replace used ink. In the illustrated form of the marking pen 10, such a passageway is provided by an air vent 38 in the front end of the case 12, a passageway 40 defined by the inner surface of the forward end portion 19 and a flat 42 on and extending the length of the main body portion 28 of the nib holder, and a channel 44 in the outer surface and extending the length of the ink reservoir 14. Thus arranged, air passes through the vent 38, passageway 40, and channel 44 to the rear end of the reservoir where it enters the rear of the ink reservoir 14 and displaces ink as it flows by capillary action from the nib 24 and to a writing surface. The replacement of the ink by the air permits the transfer of substantially all ink from the reservoir thereby maximizing the writing capacity and life of the marking pen 10.

In accordance with the present invention, the reservoir 14 comprises a length of transversely compressed raw crimped filamentary tow 46 encased in a plastic sleeve 48 with the crimps in the fibers of the tow de-registered from adjacent fibers. Ideally a significant portion of the filaments are in de-registration from adjacent filaments. The crimps are of conventional type and have a known zig-zag configuration.

Since the filamentary tow 46 is encased in the plastic sleeve 48, it is easily and cleanly handled during filling of the reservoir 14 with a fluid such as ink in the preferred example. The fluid or ink is stored in the voids in the tow, since the preferred synthetic fiber from which the tow is made is polyester fiber which does not absorb ink or dye. Acetate fibers may also be used but are not as effective.

After filling, the plastic sleeve 48 permits clean and easy handling of the tow 46, particularly during insertion of the reservoir 14 into the tubular case 12. Therefore, ink reservoirs such as 14 may be cleanly handled either by hand or by machines and rapidly inserted into the barrel portions of cases, such as 12, during assembly of the marking pens 10. This makes for extremely efficient assembly of the marking pens 10 and corresponding reductions in the over-all costs thereof when compared to commercially available marking pens.

The fibrous, ink reservoirs 14, may be rapidly and economically manufactured in large quantities by the apparatus illustrated diagrammatically in FIGS. 9 and 10 and may take the forms illustrated in FIGS. 3 through 5. Generally speaking, the apparatus comprises a funnel or guide assembly 54, a molten plastic extruding machine 56, a crosshead 58, a die 60, and a cutting machine 62. With the apparatus, raw, crimped filamentary tow 46 (which has previously been treated in a known manner to de-register the crimps in adjacent fibers to form a bulky absorbent mass) and circumferentially spaced uncrimped yarn or threads 80, preferably of polyester or acetate fibers, are continuously drawn into and through the funnel assembly 54 where the tow is transversely compressed. Then, as the compressed raw filamentary tow 46 travels with the threads 80 from the funnel assembly into the die 60, molten plastic such as polypropylene, polyethylene, polyvinylchloride, or the like, is flowed onto and around the outer surface of the tow. As the tow is drawn from the die 60, the plastic forms the plastic sleeve 48 therearound having the channel 44 therein. The plastic covered tow is then fed to the cutting machine 62 where it is cut into desired lengths for use in the marking pens 10 or in other structures requiring fluid reservoirs or filters of filamentary tow.

More particularly, and as illustrated in FIG. 10, the crosshead 58 is attached to the outlet 64 of the extruding machine 56 and includes an L-shaped passageway 66 leading from the outlet 64 and downwardly into the die 60 which is secured to the bottom of the crosshead.

The funnel assembly 54 includes an inner funnel 68 having an upper end extending through a top hole 72 in the crosshead 58 and secured therein by a set screw 74. A lower end of the inner funnel 68 is of reduced inner and outer radial dimensions and extends downwardly into the crosshead through a vertical leg of the passageway 66 and therebeyond into the die 60. An outer funnel 70 receives the upper end of the inner funnel 68 and is secured thereto by a set screw 76. The outer funnel 70 is adapted to receive the tow 46 through its upper open end and to guide the tow downwardly into the die 60, the tow being transversely compressed as it passes through the lower end of the inner funnel 68. The outer funnel 70 is also adapted to receive the threads 80 and to guide them along the outer surface of the tow 46 and into the die 60. In regard to the latter, a plurality of circumferentially spaced side openings 84 are included in the upper end of the funnel

70 for receiving the threads from spools 82. The threads 80 are fed downwardly along the inner surface of the funnels 70 and 68 and, as will be described hereinafter, effectively carry the tow 46 through the funnels and die 60.

As previously indicated, the die 60 is fixedly secured to the under side of the crosshead 58 and includes a funnel-shaped passageway 78 communicating with the passageway 66. The passageway 79 is thus adapted to receive molten plastic flowing from the crosshead 58 and to direct the plastic inwardly around and onto the outer surface of the transversely compressed tow 46 as it emanates from the lower end of the inner funnel 68. The molten plastic flows with the moving tow 46 through the lower portion of the passageway 78 and is pressed tightly thereagainst to form the plastic sleeve 48 encasing the tow as it is drawn from the die 60. As illustrated most clearly in FIG. 12, the lower portion of the passageway 78 includes a vertically extending and pointed rib 79 which forms the channel 44 in the outer surface of the sleeve 48 as the encapsulated tow is drawn from the die.

As the encapsulated tow moves from the die 60 to the cutting machine 62, the plastic cools and upon reaching the cutting machine is ready for cutting, as by a conventional guillotine blade or cutter included in the cutting machine. Operation of the cutting machine 62 thus severs the encapsulated tow into the reservoirs 14 of predetermined length.

Various means may be employed to feed and draw the tow through the apparatus illustrated in FIGS. 9 and 10. For example, drive rollers (not shown) may be included in the cutting machine 62 for such a purpose. In any case, during the process just described, the uncrimped threads 80 bear almost all of the axial or longitudinal forces exerted to draw the tow 46 through the processing apparatus. At least two such threads are necessary to accomplish this, however, and the preferred embodiment of FIGS. 9 and 10 shows the use of four threads 80. As the threads 80 are drawn downwardly through the apparatus, they effectively carry the surrounding tow through the funnels 70 and 68 and through the die 60. This, of course, avoids tensioning the tow longitudinally and produces a very even flow of the tow through the apparatus. In turn, the resulting reservoirs 14 possess very uniform inner constructions and ink storage characteristics.

In addition to improving the uniformity of movement of the raw tow 46 through the funnel assembly 54, the uncrimped threads 80 extend along the inner surface of the sleeve 48 and provide paths for the flow of ink in each of the resulting reservoirs 14 which are more direct than the crimped filamentary tow 46. Therefore, in a marking pen including such an ink reservoir (FIGS. 1 and 2), the uncrimped threads 80 provide an immediate flow of ink to the nib 24 allowing the pen to immediately mark on a writing surface upon contact therewith. Thereafter, continuous and even flow of ink is provided to the nib 24 by the filamentary tow 46 in the ink reservoir.

Since the tow 46 is substantially free of longitudinal tension during formation of the ink reservoir 14 of FIGS. 3-5, a cutting of the encapsulated tow leaves the ends of the tow substantially flush with the ends of the sleeve 48. By substantially flush is meant that the ends of all or most of the fibers comprising the tow are even with the ends of sleeve 48 and that ends of any remain-

ing fibers are immediately adjacent the ends of the sleeve. This is in direct contrast to the ends of the reservoirs shown in FIGS. 6-8. Such reservoirs do not incorporate the threads 80. Therefore, to draw the raw, crimped tow 46 through the reservoir forming apparatus of FIGS. 9 and 10, the tow is pulled by the drive rollers (not shown) and longitudinally tensioned. Accordingly, when the plastic encapsulated tow is severed in the cutting machine 62, the longitudinal tension is relaxed and the tow, due to the "memory" of the plastic material from which it is formed, effectively "snaps back" to its crimped state with the ends of the tow withdrawing into the ends of the sleeve 48 (See FIG. 8). In this regard, it is to be noted that the peripheral layer of the plastic sleeve encased filamentary tow 46 is relatively soft as contrasted with the stiff peripheral layer of the filamentary tow treated in accordance with conventional methods, such as those described in the previously referred to U. S. patents. This permits all but the few outermost fibers in the filamentary tow 46 which may be bonded to the sleeve 48, to recede into the sleeve, thereby insuring against accidental contact of the ink holding fibers with foreign objects which might otherwise result in undesired transfer of loss of ink from the ink reservoir.

From the foregoing description, it is appreciated that the present invention provides an improved fluid reservoir which is simple in construction and which may be rapidly assembled into a marking pen without fear of loss or transfer of ink from the ink reservoir. The ink reservoir is of unique design including a length of raw, de-registered, crimped filamentary tow encased in a plastic sleeve with opposite ends recessed within the sleeve, or including a length of raw, crimped, de-registered filamentary tow having a plurality of uncrimped threads within or around the tow, and the entire side walls of the tow structure encased in a plastic sleeve.

While a particular form or marking pen, two forms of ink reservoirs, and a method of forming same have been described in some detail herein, changes and modifications may be made therein without departing from the spirit of the invention. For example, other methods and apparatus may be used in providing the sleeve 48 on the outside of the tow such as continuously wrapping the tow with a strip of plastic and subsequently heat-fusing the strips together. Accordingly, it is intended that the present invention be limited in scope only by the terms of the following claims.

We claim:

1. A fluid reservoir adapted for use in a marking implement and including:

- a. a transversely compressed raw synthetic filamentary tow comprising an elongated bundle of crimped deregistered longitudinally extending filaments, said tow having an outer surface, and,
- b. an elongated shape retaining impervious plastic sleeve encapsulating said filamentary tow and having inner and outer surfaces, the inner surface of which is melted onto and around the outer surface of said tow.

2. A fluid reservoir according to claim 1 wherein said filamentary tow is a polyester filamentous material and said plastic sleeve further includes a channel in the outer surface of said sleeve which extends substantially the length thereof.

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3. A fluid reservoir adapted for use in a marking implement and including:
- a. an elongated impervious plastic sleeve having inner and outer surfaces; and
  - b. a length of deregistered raw filamentary tow comprising an elongated bundle of crimped longitudinally extending filaments transversely compressed and confined within said plastic sleeve; and

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- c. a plurality of substantially uncrimped threads within said plastic sleeve and extending the length of said filamentary tow.
4. A fluid reservoir according to claim 3 wherein said filamentary tow is a polyester filamentous material and said threads are spaced around the periphery thereof and bear against the inner surface of said plastic sleeve.
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