

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Fountain Pens

We, MENTMORE MANUFACTURING CO., LIMITED, a Company registered under the laws of Great Britain, of Platignum House, Six Hills Way, Stevenage, Hertfordshire, (formerly of Platignum House, Tudor Grove, Well Street, Hackney, London, E.9.), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to fountain pens of the kind (hereinafter referred to as "the kind specified") in which capillary action alone is utilised for filling the ink reservoir, for retaining ink therein and for feeding ink from the reservoir to a writing surface when the pen is in use, the reservoir having a portion contained within the barrel of the pen and a portion contained within the nib section of the pen.

It has already been proposed in such pens to provide a filling for the reservoir composed of a material incapable itself of absorbing ink and having relatively fixed, rigid walls defining a capillary ink storage space. Similarly, it has also been proposed to employ a filling composed of a porous mass of solid material which material is itself non-absorbent. Such fillings are not inexpensive to produce and assemble into the pens.

Other pens of the kind specified have been proposed in which the reservoir is filled with an ink-absorbent material, such as cellulose or cotton. Fillings of this character are found to lose their absorbency progressively during the life of the pen.

In the pens having a non-absorbent filling it has been suggested that this should be a spirally rolled sheet extending the full length of the reservoir and in the other type of pens the proposals include filling the reservoir with a stack of discs cut from a woven cotton fabric.

[Price 4s. 6d.]

The object of the present invention is to provide a relatively inexpensive yet highly efficient pen of the kind specified which shall remain capable of taking up a full charge of ink throughout an extended life.

According to this invention a fountain pen of the kind specified has the portion of the reservoir within the barrel filled with contacting layers of a fabric formed from fibres which have their surfaces freely exposed and are incapable themselves of absorbing ink.

The term "freely exposed" is intended to mean non-coated.

It is preferred also to fill the portion of the reservoir within the nib section of the pen with such a fabric, the two fillings being in contact with each other, and there is generally provided a wick of braided or woven fibres which is in close contact with the nib of the pen and also with at least the filling in the nib section. The fibres of the wick may be capable of absorbing ink but it is preferred that they be non-absorbent.

A preferred arrangement is one in which the fabric filling the barrel-portion of the reservoir is provided in the form of a large number of discs stacked one upon the other and the filling of the nib section portion is provided in the form of a spirally rolled length of fabric. With advantage, the stack of discs is held in place between an abutment at the end of the reservoir remote from the nib section and a retaining ring inserted into the barrel after the stack has been introduced thereinto. A similar retaining ring may be interposed between the stack and the abutment.

Preferably, the fabric disc which is to constitute the endmost disc of the stack at the end concerned is attached to the retaining ring before this is inserted, for example by being heat-welded thereto or by being stuck thereon with a suitable adhesive or cement.

The fabric employed is of a relatively open mesh and may have been produced by weav-

ing, knitting or other suitable processes, the fibres being of a very fine count or low denier and employed either as mono-filaments (which is preferred) or as spun yarns. A very suitable fibre is one composed of nylon and the fabric produced therefrom is preferably a knitted mono-filament tricot.

It is necessary to provide means whereby air may pass freely between the reservoir space and the atmosphere and this means comprises an air inlet aperture formed through the wall of the barrel of the pen to open into an air chamber above the end of the capillary filling remote from the nib-end of the pen, this air chamber being of such a cross-sectional area that the ink cannot form a stable meniscus therein. An ink baffle for preventing access of the ink to the air inlet may be provided in the form of a small tube fitted into the inlet.

One example of a pen according to the invention embodying all the preferred features of construction will now be described with reference to the accompanying drawings, wherein:

Fig. 1 is a longitudinal section of the pen, the closing cap normally provided not being illustrated,

Fig. 2 is a section, to a larger scale, taken on the line II—II of Fig. 1,

Fig. 3 is a fragmentary longitudinal section, also to a larger scale, showing the mouth of the barrel of the pen after the nib section of the latter has been removed.

Fig. 4 is a longitudinal section of a retaining ring employed in the mouth of the barrel,

Fig. 5 is a view in the axial direction, to a larger scale, of the nib end of the pen,

Fig. 6 is an enlarged plan view of the nib,

Fig. 7 is a cross-section of the nib section of the pen taken on the line VII—VII of Fig. 8, and

Fig. 8 is a section taken on the line VIII—VIII of Fig. 7, the nib, wick and capillary filling of the nib section being omitted in both Figs. 7 and 8.

The pen comprises a barrel 1 closed at one end by a metal plug 2 and a nib section 3 screwed into the other end of the barrel and carrying a writing nib 4 at its free end. 5 is a metal ring interposed between the nib section and the barrel for engagement by the cap (not shown) of the pen when this is placed in position to protect the nib.

The nib section 3, which may be a moulding from a thermoplastic material such as polystyrene, is formed with a hollow rear end, the wall of the cavity in which is formed with longitudinal shallow flutes or corrugations 6 (see Fig. 2), and a solid front or free end formed with an axial passage 7 of small cross-section and a longitudinally extending slot 8 of substantially crescent shape in cross-section (see Figs. 5 and 7). The passage 7 and slot

8 extend from the end face 3a of the nib section, which is preferably bevelled as shown in Fig. 1, to open at their inner ends into the cavity of the hollow rear end of the section.

At the inner end of the slot 8 are formed two shallow nibs or projections 8a (see Figs. 7 and 8) adapted to engage in notches 4a formed in the longitudinal edges of the pen nib 4 when this is engaged in the slot 8 with its writing tip protruding.

Also located in the slot 8, over the upper face of the nib 4, is a narrow wick 9 covering the greater part of the width of the nib (see Fig. 5) and extending from the free end of the nib section to the other end thereof, the portion of the wick lying in the slot 8 being somewhat compressed between the upper wall of the slot and the upper face of the nib 4.

The cavity in the rear end of the nib section 3 is filled with a tightly rolled length 10 of a nylon tricot fabric which at one end abuts against the inner face of the free end of the section and at the other end projects somewhat beyond the screw-threaded end of the section. The wick 9 is disposed between the roll of fabric 10 and the corrugations 6 and has its free end folded across the end face of the roll and tucked in between the roll and the inner surface of the nib section (see Figs. 1 and 2).

The barrel 1 of the pen has a reservoir space 11 extending from near its screw-threaded mouth towards its closed end and terminating at a narrow annular shoulder 12 connecting its wall to the wall of an air chamber 13 which occupies the remainder of the length of the barrel and is of slightly smaller diameter than the reservoir space. Near the shoulder 12 a lateral air inlet is provided, this taking the form of a small-bore plastic tube 14 inserted in an aperture 15 formed through the wall of the barrel a short distance along the length of the air chamber 13, the tube extending radially inwards to terminate at or near the axis of the pen.

In the reservoir space 11 is fitted a stack of discs 16 cut from a nylon tricot fabric of the same character as that used for forming the roll 10 in the nib section. The stack of discs is held under axial compression between two retaining rings 17, one of which is supported by the shoulder 12 and the other of which is pressed into the mouth of the barrel 1 after the discs have been inserted. This ring is preferably a press-fit in the barrel but it may be cemented in place if desired. The rings 17 are of a thermoplastic material and each has one of the fabric discs 16 attached thereto before it is inserted into the barrel, the disc being heat-welded to the ring or stuck thereon by means of a suitable adhesive or cement. The compression produced in the stack of discs 16 is such that the central areas of the discs immediately adjacent to the respective ring, 17 are caused to bulge through the

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opening of the ring, see the upper ring in Fig. 1 and the lower ring in Fig. 3. The bulge thereby produced at the mouth end of the reservoir space ensures that the roll of fabric 10 accommodated in the nib section 3 of the pen will make certain contact with the endmost disc of the stack when the pen is assembled, the length of the roll of fabric being such that its end will project into the opening in the lower retaining ring and press back the bulging central areas of the endmost discs 16 of the stack (see Fig. 1).

It is preferred that the roll of fabric 10 has the outer edge of the rolled strip of fabric turned back on itself inwardly as the rolling is completed (as shown at 10a in Fig. 2) and that the roll be inserted into the nib section with this longitudinally extending double thickness of the outer layer arranged to bear upon the wick 9.

The wick 9 may be a braided cotton wick originally produced in tubular form but rolled flat before use. The pressure employed in flattening the wick may be substantial so that it is highly compressed and becomes fairly stiff, this facilitating the assembly operations. With advantage the end of the wick which is to be disposed at the nib end of the nib section is treated to prevent fraying thereof, for example by coating its extremity with a cellulose acetate varnish.

It is preferred, however, to form the wick 9 from fibres which are incapable themselves of absorbing ink, for example from braided nylon fibres. In this case, fraying of the end of the wick may be prevented by heating the extremities of the fibres to cause them to adhere together, *e.g.* by using a heated cutting blade for severing the wick from a length of the braided fibres.

The back of the nib 4 (see Fig. 6) may be formed with shallow grooves 4b extending from near the longitudinal edges to the nib slit 4c, the grooves being inclined inwards towards the point of the nib (which latter may be provided with a hard metal writing point 4d of iridium or the like). The wick 9 will be in contact with the back of the nib 4 over the full width of the grooved surface thereof.

The air chamber 13 is of sufficiently large a cross-sectional area that any usual aqueous fountain-pen ink cannot form a stable meniscus therein and has a sufficient volume to accommodate all or at least a major portion of the entire charge of ink which can be taken up by the fabric roll 10 and discs 16.

It will be understood that the length of the stack of discs 16 is selected to accord with the capillary nature of the fabric employed *i.e.* the mesh size, and the closeness of the discs to each other so that the pen cannot be over-filled when the nib section is immersed to the appropriate extent in a body of ink. Normally, the nib section is immersed for not more than half its length and the arrangement is such

that the ink will then be raised to the upper end of the stack by capillary action. Since the air chamber 13 is such that the ink cannot form a stable meniscus therein there is no substantial risk of overfilling even when the nib section is immersed too deeply into the body of ink.

A suitable fabric for the roll 10 and discs 16 is a nylon tricot fabric having the wales spaced apart by about twenty-five thousandths of an inch and which has been produced from nylon monofilaments having a thickness of one thousandth of an inch.

A pen as described can readily be filled with ink (to the top of the reservoir space 11) by merely dipping the nib end of the nib section into a body of ink. When the pen has been written out it can be refilled in the same manner and the quantity of ink taken up at each refilling operation does not vary substantially throughout the life of the pen.

So long as the point end of the nib slit can be brought into contact with the writing surface the charged pen will write, even if this surface is of a non-capillary nature. It is desirable therefore to finish the point of the nib with care in order that this may be done. It is also desirable, for the best results, that the nib be made relatively stiff so that there will be no substantial spreading of the nib points under the pressures exerted during writing.

Owing to the relatively large diameter of the air chamber, any ink dislodged into the same from the reservoir space under the action of shocks can flow freely in the chamber and when the pen is restored to the writing attitude the ink will return into the capillary filling of the reservoir. Due to the location of the inner end of the air inlet tube at about the axis of the air chamber there is practically no risk of any ink gaining access to this inlet.

The grooves in the back of the nib, when provided, permit of a slightly higher rate of flow of the ink from the wick to the writing point of the nib than is available when the back of the nib is smooth.

In the specification of our co-pending application No. 21545/58 (Serial No. 903,560) we have claimed a fountain pen of the kind in which capillary action alone is utilised for filling the ink reservoir, for retaining ink therein and for feeding ink from the reservoir to a writing surface when the pen is used and having the reservoir filled with contacting layers of fabric, the fabric filling the portion of the reservoir contained in the barrel of the pen being provided in the form of a large number of discs stacked one upon the other, wherein the filling of the portion of the reservoir contained in the nib section is provided in the form of a spirally rolled length of fabric, the two fillings being in contact with each other when the nib section is assembled to the barrel.

WHAT WE CLAIM IS:—

1. A fountain pen of the kind specified having the portion of the reservoir within the barrel filled with contacting layers of a fabric formed from fibres which have their surfaces freely exposed and are incapable themselves of absorbing ink.
2. A fountain pen according to claim 1, wherein the portion of the reservoir within the nib section of the pen is also filled with contacting layers of a fabric formed from fibres which have their surfaces freely exposed and are incapable themselves of absorbing ink, the two fillings being in contact with each other.
3. A fountain pen according to claim 1 or 2, wherein a wick of braided or woven fibres is provided which is in close contact with the nib of the pen and also with the filling in the barrel-portion of the reservoir of the pen.
4. A fountain pen according to claim 2, wherein a wick of braided or woven fibres is provided which is in close contact with the nib of the pen and also with at least the filling in the nib section portion of the reservoir.
5. A fountain pen according to claim 3 or 4, wherein the fibres of the wick are incapable themselves of absorbing ink.
6. A fountain pen according to any one of the preceding claims, wherein the fabric filling the barrel-portion of the reservoir is provided in the form of a large number of discs stacked one upon the other.
7. A fountain pen according to any one of claims 1 to 5, wherein the portion of the reservoir within the nib section of the pen is filled with a spirally rolled length of fabric.
8. A fountain pen according to any one of the preceding claims, wherein the fabric employed is of a relatively open mesh and the fibres are of a very fine count.
9. A fountain pen according to claim 8, wherein the fibres are nylon mono-filaments.
10. A fountain pen according to claim 8 or 9, wherein the fabric is a knitted mono-filament tricot.
11. A fountain pen according to any one of the preceding claims, wherein an air chamber vented to the atmosphere is provided within the barrel in free communication with the reservoir and between the latter and a closed outer end of the barrel.
12. A fountain pen according to claim 11, wherein the vent to the atmosphere is provided by an air inlet tube passing through the wall of the barrel of the pen and extending to

about the axis of the latter.

13. A fountain pen according to any one of the preceding claims, wherein, as claimed *per se* in the Specification of co-pending application No. 21545/58 (Serial No. 903,560), the barrel-portion of the reservoir is filled with fabric in the form of a large number of discs stacked one upon the other and the nib section portion of the reservoir is filled with a spirally rolled length of fabric, the two fillings being in contact with each other when the nib section is assembled to the barrel.

14. A fountain pen according to claim 6, or claim 6 and any one of claims 7 to 12, or claim 13, wherein the stack of discs is held under axial compression between retaining rings.

15. A fountain pen according to claim 14, wherein the retaining rings have fabric discs which are to constitute the endmost discs of the stack secured thereto before being inserted into the barrel of the pen.

16. A fountain pen according to claim 14 or 15, wherein the axial compression of the stack of discs is such as to cause the endmost discs to bulge through the openings of the rings.

17. A fountain pen according to claim 7 and 16, wherein the spirally rolled length of fabric in the nib section is adapted to pass into the opening of the retaining ring at the nib-section end of the stack and press back the discs bulging there-through when the pen is assembled.

18. A fountain pen according to claim 17, wherein a wick of braided or woven fibres is provided in close contact with the back of the nib of the pen and extending along the roll of fabric to be folded across the end thereof remote from the nib.

19. A fountain pen according to any one of the preceding claims, wherein the back of the nib is formed with grooves leading to the nib slit.

20. A fountain pen according to claim 1, constructed and adapted to operate substantially as herein described with reference to the accompanying drawings.

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 Surrey, and
 75, Victoria Street, London, S.W.1.

PROVISIONAL SPECIFICATION

No. 22219 A.D. 1957

Improvements in or relating to Fountain Pens

We, MENTMORE MANUFACTURING CO., LIMITED, a Company registered under the laws of Great Britain, of Platignum House, Tudor Grove, Well Street, Hackney, London,

E.9, do hereby declare this invention to be described in the following statement:—

This invention relates to fountain pens of the kind (hereinafter referred to as "the kind

specified") in which capillary action alone is utilised for filling the ink reservoir, for retaining ink therein and for feeding ink from the reservoir to a writing surface when the pen is in use.

It has already been proposed in such pens to provide a filling for the reservoir composed of a material incapable itself of absorbing ink and having relatively fixed, rigid walls defining a capillary ink storage space. Similarly, it has also been proposed to employ a filling composed of a porous mass of solid material which material is itself non-absorbent. Such fillings are not inexpensive to produce and assemble into the pens.

Other pens of the kind specified have been proposed in which the reservoir is filled with an ink-absorbent material, such as cellulose or cotton. Fillings of this character are found progressively to lose their absorbency during the life of the pen.

In the pens having a non-absorbent filling it has been suggested that this should be a spirally rolled sheet extending the full length of the reservoir and in the other type of pens the proposals include filling the reservoir with a stack of discs cut from a woven cotton fabric.

The object of the present invention is to provide a relatively inexpensive yet highly efficient pen of the kind specified which shall remain capable of taking up a full charge of ink throughout an extended life.

According to this invention a fountain pen of the kind specified has the reservoir filled with fabric formed from fibres which are incapable themselves of absorbing ink.

It is preferred also to fill the space within the nib section of the pen with such a fabric, the two fillings being in contact with each other, and there is generally provided a wick of braided or woven fibres which is in close contact with the nib of the pen and also with at least the filling in the nib section. The fibres of the wick may be capable of absorbing ink.

A preferred arrangement is one in which the fabric filling the reservoir is provided in the form of a large number of discs stacked one upon the other and the filling of the nib section is provided in the form of a spirally rolled length of fabric.

The fabric employed is of a relatively open mesh and may have been produced by weaving, knitting or other suitable processes, the fibres being of a very fine count or low denier and employed either as mono-filaments (which is preferred) or as spun yarns. A very suitable fibre is one composed of nylon and the fabric produced therefrom is preferably a knitted mono-filament tricot.

In one example of a pen according to the invention there is a pen barrel closed at one end and a nib section screwed into the other end of the barrel and carrying a writing nib at its free end. The nib section may be a moulding from a thermoplastic material, which may be transparent, formed with a crescent-shaped slot in which the pen nib is engaged with its writing tip protruding. Also located in the slot, over the upper face of the nib, is a narrow wick covering the greater part of the width of the nib and extending from the free extremity of the nib section to the other end thereof. The free end of the section is solid except for the slot and an axial passage of small cross-section, the slot and passage opening at their inner ends into the cavity of the hollow rear end of the section which is filled with a tightly rolled length of a nylon tricot fabric. The wall of the cavity is formed with longitudinal shallow flutes or corrugations and the roll of fabric projects somewhat beyond the screw-threaded end of the nib section to have the inner end of the wick folded across its end face and tucked in between the roll of fabric and the inner surface of the nib section.

The barrel of the pen has a reservoir space extending from its screw-threaded mouth towards its closed end (say, to terminate within about one-third of its length from this end) and a bore of small diameter extends axially from the base of the reservoir space to near the closed end of the barrel, a lateral bore establishing communication between the axial bore and the outside air near the closed extremity of the axial bore.

In the reservoir space is fitted a stack of circular discs cut from a nylon tricot fabric, the end of the stack being adapted to contact the end of the roll of fabric in the nib section with light pressure when the latter is screwed home in the barrel.

Such a pen can readily be filled with ink by merely dipping the nib end of the nib section into a body of ink. When the pen has been written out it can be refilled in the same manner and the quantity of ink taken up at each refilling operation does not vary substantially throughout the life of the pen.

It will be understood that the mesh side of the nylon fabrics employed is selected so that the pen may be filled by capillary action and yet can be emptied during writing due to the more powerful capillary action exerted by the fibres of the writing paper at the point of contact of the nib.

For the Applicants,
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 75, Victoria Street, London, S.W.1.

PROVISIONAL SPECIFICATION

No. 5295 A.D. 1958

Improvements in or relating to Fountain Pens

We, MENTMORE MANUFACTURING Co., LIMITED, a Company registered under the laws of Great Britain, of Platignum House, Tudor Grove, Well Street, Hackney, London, E.9, do hereby declare this invention to be described in the following statement:—

This invention relates to fountain pens of the kind (hereinafter referred to as "the kind specified") in which capillary action alone is utilised for filling the ink reservoir, for retaining ink therein and for feeding ink from the reservoir to a writing surface when the pen is in use.

More particularly stated, the invention is concerned with fountain pens of this kind as described in the specification of our co-pending application No. 22219/57, dated 12th July, 1957, and has for its object to improve such pens.

According to this invention, in a fountain pen of the kind specified having the reservoir and nib section filled with fabric formed from fibres which are incapable themselves of absorbing ink, the filling of the reservoir being in the form of a large number of fabric discs stacked one upon the other and the filling of the nib section being in the form of a spirally rolled length of fabric, the stack of discs is held in place between an abutment at the end of the reservoir remote from the nib section and a retaining ring inserted into the barrel after the stack has been introduced thereinto.

Preferably, the fabric disc which is to constitute the endmost disc of the stack at the nib-section end of the latter is attached to the retaining ring before this is inserted, for example by being heat-welded thereto or by being stuck thereon with a suitable adhesive or cement.

With advantage, the retaining ring is a press-fit in the barrel (although it may be cemented in position) and is pressed in so far that the stack is compressed axially, the central areas of the discs immediately adjacent to the ring being thereby caused to bulge through the opening of the ring so that the roll of fabric accommodated in the nib section of the pen may make certain contact with the endmost disc when the pen is assembled. Preferably, the length of the roll is such that its end will project into the opening in the retaining ring and press back the bulging central areas of the endmost discs of the stack.

It is preferred that the roll of fabric accommodated in the nib section have the outer edge of the rolled strip of fabric turned back on itself inwardly as the rolling is completed and that the roll be inserted into the nib section with this longitudinally extending double thickness of the outer layer arranged to bear

upon the wick provided in the nib section. This wick may conveniently be a braided cotton wick originally produced in tubular form but rolled flat before use. The pressure employed in flattening the wick may be substantial so that it is highly compressed and becomes fairly stiff, this facilitating the assembly operations. With advantage, the end of the wick which is to be disposed at the nib end of the nib section is treated to prevent fraying thereof, for example by coating its extremity with a cellulose acetate varnish.

If desired, the back of the nib of the pen may be formed with grooves extending from near the longitudinal edges to the nib slit, the grooves being inclined inwards towards the point of the nib. The wick will be in contact with the back of the nib over the full width thereof, as will be understood.

The abutment at the end of the reservoir remote from the nib section is normally provided by a reduction in the diameter of the passage through the barrel, the portion of the passage of reduced diameter being so dimensioned that the ink can form a stable meniscus therein. Although it is possible with some moulding materials to mould the barrel with the wider and narrower portions of the passage in one operation, it is preferred with other materials which shrink after moulding to provide a separate tubular insert having the narrower portion of the passage formed therein and to place this in a tubular barrel having an internal diameter of the size of the wider portion of the passage. It is necessary to ensure that the insert is adequately sealed to the inner surface of the barrel in order to prevent any possibility of creep of ink up any fine capillary gaps which might otherwise exist between the outer surface of the insert and the inner surface of the barrel. The desired result may be achieved by moulding the barrel around the insert.

It will be understood that the length of the stack of discs is selected to accord with the capillary nature of the fabric, *i.e.* the mesh size, and the closeness of the discs to each other so that the pen cannot be overfilled when the nib section is immersed to the appropriate extent in a body of ink. Normally, the nib section is immersed for not more than half its length and the arrangement is such that the ink will then be raised to the upper end of the stack by capillary action.

So long as the point end of the nib slit can be brought into contact with the writing surface the pen will write, even if this surface is of a non-capillary nature. It is desirable therefore to finish the point of the nib with care in order that this may be done. It is also

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desirable, for the best results, that the nib be made somewhat stiffer than is commonly the case in fountain pens designed for use with aqueous inks.

5 Since it is usual to connect the nib section to the barrel of the pen by means of a screw-threaded connection, it is preferred to make some provision whereby the end of the rolled fabric filling of the nib section may be kept
10 neat despite the fact that initially it will be rotated in contact with the end of filling in the barrel when the nib section is either screwed home or unscrewed. One way of effecting this is to provide a polyethylene sleeve which en-

circles the projecting end of the rolled fabric 15 filling together with the terminal portion of the wick while leaving a portion of the latter free to contact the endmost disc of the stack filling the reservoir. The sleeve may rotate 20 relative to the nib section. Alternatively, the end of the nib section may have an intumed flange which encircles the end of the rolled fabric but leaves the central portion of the wick end projecting slightly.

For the Applicants,
RAWORTH, MOSS & COOK,
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75, Victoria Street, London, S.W.1.

PROVISIONAL SPECIFICATION

No. 21543 A.D. 1958

Improvements in or relating to Fountain Pens

25 We, MENTMORE MANUFACTURING Co., LIMITED, a Company registered under the laws of Great Britain, of Platignum House, Tudor Grove, London, E.9, do hereby declare this invention to be described in the following
30 statement:—

This invention relates to fountain pens of the kind (hereinafter referred to as "the kind specified") in which capillary action alone is utilised for filling the ink reservoir, for retaining ink therein and for feeding ink from
35 the reservoir to a writing surface when the pen is in use.

Various types of fillings for the ink-reservoir of such a pen have been proposed, such as a stack of discs cut from a woven or knitted fabric which may be composed either of ink-absorbent fibres or of fibres themselves incapable of absorbing ink, or a porous mass
40 of solid material which material is itself non-absorbent, or a spirally rolled sheet of a non-absorbent material providing relatively fixed, rigid walls defining a capillary ink storage
45 space.

In all cases it is necessary to provide means whereby air may pass freely between the reservoir space and the atmosphere and such means usually takes the form of an air inlet aperture formed through the wall of the barrel of the pen to open into an air chamber above
50 the end of the capillary filling remote from the nib-end of the pen. The length of the column of filling material is chosen so that the capillary action thereto can cause ink to rise to the top of the column when the nib-end of the pen is immersed in a body of ink and in
55 general the ink thus drawn into the filling is satisfactorily held therein while the pen is not being used for writing purposes, whether the nib-end is lowermost or uppermost.

65 In such pens as hitherto proposed, in which the reservoir filling comprises a stack of discs, these discs have been held against movement towards the end of the pen remote from the nib by an abutment shoulder formed between
70 the inner wall of the reservoir and the mouth

of the air chamber the diameter of which is small compared with that of the discs. It is found that in certain cases there are small spaces in the barrel or nib-section of the pen which are not occupied by the capillary filler
75 but may fill with ink during the normal charging of the reservoir with ink. Since these spaces are larger than the capillary spaces in the filling, the ink in them cannot be supported so readily by the capillary system of the pen
80 and some or all of this surplus ink may be shed into the bore of the air chamber when the pen is placed nib-uppermost.

Again, the system even when in balance, may be subjected to shock (*e.g.* by being
85 dropped to the floor) or other severe forces tending to displace the ink relative to the barrel (*e.g.* by being moved rapidly through an arc) and there is then likely to be some displacement
90 of ink from the capillary filling into the air chamber. In any case in which ink gains access to the air chamber there is a risk of the ink leaking out through the air inlet with consequent unpleasant results due to the initiation
95 of a partial or even complete draining of the ink storage unit when the pen is held nib-uppermost. This is primarily due to the fact that any ink displaced into the air chamber can form a stable meniscus in the latter, due
100 to its small diameter, and increases the total length of the ink column. If this total length exceeds the length of column which can be stably held by the capillary system, further descent of the column of ink occurs with a
105 progressive aggravation of the situation. Since the meniscus formed in the air chamber is stable there is no possibility of sufficient ink breaking away from the column in this chamber to restore equilibrium conditions when the
110 pen is temporarily turned to the nib-downwards position.

An object of the present invention is to provide an improved pen of the kind specified in which this risk of ink-leakage shall be
115 greatly minimised if not completely avoided.

- According to the invention, in a fountain pen of the kind specified, the air chamber into which the air inlet opens is made of such a cross-sectional area that the ink cannot form a stable meniscus therein. 5
- When such an air chamber is provided the pen is found to be far less susceptible to shock and other extreme forces and to be substantially free from leakage of ink through the air inlet. However, in order to provide against all contingencies, such as excessive shock or abnormal application of large forces to the ink in the system (as may be encountered in high speed aircraft during turns or dives), which may urge the ink-content of the reservoir towards the air chamber, it is preferred to arrange that the air chamber has a sufficient volume to accommodate all or at least a major proportion of the entire charge of ink. 10
- It is also desirable to provide an ink baffle for preventing access of ink to the air inlet, for example a small tube fitted into the inlet and extending radially inwards to the axis of the pen. 15
- In one example of a fountain pen according to the invention the reservoir and nib section are filled with fabric, the filling of the reservoir being in the form of a large number of fabric discs stacked one upon the other and the filling of the nib section being in the form of a spirally wound length of fabric. The fabric may be formed from fibres which are incapable themselves of absorbing ink, such as nylon fibres, or from cotton or other fibres which are absorbent. Beyond the stack of discs the barrel of the pen is formed with an axial bore having a closed outer end and constituting an air chamber, an air inlet aperture being formed in the wall of the barrel at a point close to but rearwards of the rearmost disc in the stack. The air chamber is of a cross-sectional area such that ink cannot form a stable meniscus therein and of a length such that its volume is approximately equal to that of the ink capable of being stored in the capillary filling of the pen. It is preferred to fit a small tube, of polyethylene for example, in 20
- the air inlet aperture so that its inner end projects radially towards the axis of the pen, terminating at or near this axis. 50
- As the diameter of the air chamber is but slightly smaller than that of the reservoir space of the pen, it is necessary to provide means or positively preventing the stack of fabric discs from moving into the air space. A suitable means is a retaining ring arranged to bear on the annular shoulder between the reservoir and the air chamber and having the fabric disc which is to be the endmost disc of the stack attached thereto before it is inserted, for example by heat-welding the disc to the ring or by sticking it thereon with a suitable adhesive or cement. 55
- It is preferred to employ a similar retaining ring and disc at the other end of the stack of discs, the spirally rolled fabric filling of the nib section making firm contact with the stack when the pen is assembled. The nib section is provided with a writing nib having an ink-feeding wick disposed in contact with its back and extending in contact with the spirally rolled fabric. With advantage, the features of the pens described in the specifications of co-pending Applications No. 22219/57 dated 12th July, 1957, and 5295/58, dated 18th February, 1958, may be employed in the present pen, provided that the air chamber be arranged as above set forth. 60
- Any ink dislodged from the reservoir into the air chamber can flow freely in this chamber and when the pen is restored to the writing attitude the ink will return into the capillary filling of the reservoir. Due to the location of the inner end of the air inlet tube at about the axis of the air chamber there is practically no risk of any ink gaining access to this inlet. 65
- It is found that pens constructed in accordance with this invention are particularly free from leakage troubles. 70
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