PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in Fountain-pens

I, RYOSUKE NAMIKI, of 717, Takinogawa-Machi, Takinogawa-Ku, Tokyo-Shi, Empire of Japan, a Japanese Subject, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in fountain-pens and has for its object to provide a fountain-pen of simple construction, and which is capable of withstanding hard usage throughout a comparatively long period of use thereby avoiding the necessity of continual repairs to the pen, and of the kind in which the nib is held or wedged in a tubular pen holder portion by a feed bar between which and the nib the ink flows to the outer end of the nib, the nib carrier usually being in the form of a short tubular piece screwed into or otherwise detachably connected to the outer end of a tubular ink reservoir forming the main body portion of the pen.

According to the present invention the feed bar comprises an outer portion having an inwardly directed extension, this outer portion being provided upon its upperside with an air-groove, and there being formed on one side or upon each side of the air-groove, and in spaced relationship with respect thereto, an ink-duct extending also along and to the innermost end of the extension, and in which the inner end part of said outer portion is on its upperside provided with a flat surface which also extends along the whole length of the upper side of said inwardly directed extension.

In order that the invention may be the better understood, reference is directed to the accompanying drawings, which illustrate, by way of example, one form of the present invention, and in which:—

Fig. 1 is a longitudinal section of a fountain-pen constructed in accordance with the invention.

Fig. 2 is a longitudinal section of the same, illustrating the manner in which the filling is effected.

Fig. 3 is a longitudinal section of the feed bar and the extension thereof.

Fig. 4 is a plan of the feed bar, illustrating the arrangement of the air-groove, ink-ducts, auxiliary ink-duct and overflow trapping cavities.

Fig. 5 is a section on line *a*—*b* Fig. 4.

Fig. 6 is a section along the line *c*—*d* Fig. 4.

Fig. 7 is a section along the line *e*—*f*, Fig. 4.

Throughout the drawings, like reference numerals indicate corresponding parts.

Referring to the accompanying drawings, the reference 1 indicates a cap, which may be of any known construction. The bore 4 of the nib-carrier 2 is slightly flared at its outer end 3, the nib being indicated by 5 and the feed bar by 6. The nib-carrier has a threaded portion 7 which screws into a correspondingly threaded portion of the casing 8. The bore 4 is provided with an enlarged inner end portion 9, which shrouds part of the feed bar 6, with the inner end of which latter is formed integral an extension 12, which passes along the outer casing 8 to a point near the closed end thereof. The feed bar 6 is of substantially circular cross-sectional outline. The extension 12 is also substantially of circular cross-sectional outline, but is of smaller diameter than the feed bar and is on its upperside provided with a flat face which extends throughout its length and at its outer end is extended along the feed-bar proper so as to project somewhat into the enlarged bore portion 9.

The reason why the end portion of the flat face of the extension 12 is extended as just described and projects into the enlarged bore portion will be hereinafter explained.

The casing 8 is simply a tube, closed at one end, with external threads 11 and internal threads 7 at its outer end, into which last mentioned threads the nib-carrier 2 is screwed. The feed bar 6 is characterized in that it is a comparatively long member consisting of a solid portion 6 and has the aforesaid extension 12. The lower-most end of the extension 12, as previously stated, extends to a point near the closed end of the casing.

[*Price* 1/-]

The extension, however, can be made shorter if desired, but it should be noted that the extension must be of somewhat considerable length, for the reason to be explained later. The length of the larger cross-sectional area portion 6 is, as shown, such that it projects slightly beyond the inner edge of the nib-carrier. The extension 12 should be of as small a cross-sectional area as possible, so as not to decrease any more than necessary the ink carrying capacity of the reservoir. Extending along the upperside of the portion 6, that is on the side adjacent the nib, to a point near the outer end thereof, from the outer end of the aforesaid flat surface (that is, from about midway of the length of the portion 6), is an air-groove 13, the purpose of which, and of the flat face formed upon and extending inwardly therefrom and along the extension is that, when ink is being filled into the reservoir the displacement of air therefrom is not hindered, and consequently neither is the inflow of ink. The said displacement will be explained later. The cross-section of the extension 12 may be rectangular, square or circular, but generally the cross-section shown in the drawings is best, in view of the ease of manufacture.

The particular construction of the feed-bar will now be described in fuller detail with reference to Figs. 3 to 7. As previously stated the portion 6 has formed along its upperside an air-groove 13 (see Figs. 3, 4 and 5), the inner extremity of which is indicated by 10. The air-groove serves as an outlet passage for air from the reservoir. The air, when ink is supplied to the pen, escapes upwardly into the ink bottle as shown by dotted lines in Fig. 2. The air-groove 13 also serves as an inlet passage for air to the reservoir to permit the ready flow of ink during the use of the pen. In view of these functions of the air-groove, its cross-section should be made comparatively greater than that of the ink-ducts to be hereinafter described, but should not be so great as to permit a too ready flow of ink.

The cross-sectional area of the air-groove 13 should be below 0.5 square millimetre, so as to avoid this happening. As stated above, the air-groove serves as a passage for air only, and for this reason it must be independent of the hereinafter described ink-ducts.

At the opposite sides of the air-groove 13, there are disposed ink-ducts 14 and 15, extending axially from near the outer end of the portion 6 to the innermost end of the extension 12, their outer end portions being in spaced parallel relationship with respect to the air-groove. It is along these ducts that the ink is drawn partly by gravity and partly by capillary action, into the reservoir. The ink-ducts also serve as passages for the outflow of the ink during the use of the fountain-pen, under the combined capillary action and the action of gravity. It is therefore to be noted that the ink-ducts thus serve as passages for ink only, but not for any air. Therefore, they should be in section a rectangle of small width and great depth, and such width should be considerably smaller than the depth or width of the air-groove 13. However, as the fountain-pen according to the present invention also to some extent depends upon the action of gravity upon the ink for its filling and operation, the ink-ducts must not be of too small a cross-section. Furthermore, it is most desirable that the filling of the pen shall be always accomplished in a minimum of time. According to the experience of the inventor, it has been found that the width of the ink-ducts is preferably of from 0.3 to 0.4 millimetre. The depth of the ink-ducts should be as great as possible.

Disposed between but in spaced relationship to the ink-ducts 14 and 15, there is an auxiliary ink-duct 16 (see figs. 3 and 4), extending from the innermost end of the extension 12 to, and outwardly for a short distance beyond, the inner end of the air-groove 13. This auxiliary ink-duct 16 acts, when the air-groove 13 is for any reason filled with ink, to force this ink out and remove it from the air-groove. In this way, the proper function of the air-groove is secured. When the fountain-pen is used, the auxiliary ink-duct serves to convey ink to near the extremity 10 of the air-groove 13, and thus this portion is filled up with ink. This assures that the outside air is for the time being positively prevented from freely entering the casing. If this means were not adopted the air-groove would not be filled with ink when the pen would be in use, and consequently it would be open to the free passage of air, the outside air thus passing freely into the casing and thereby giving rise to the danger that the ink in the casing would pour down the ink-ducts 14 and 15. In the fountain-pen according to the invention, the ink can be freely and quickly replenished, while, when the fountain-pen is in use the ink will only flow at a proper rate. This phenomena may at first appear to need explanation. However, it may be easily understood if one considers the fact that the air-groove 13 is always in an open state during the filling opera-

tion, while it is always filled with ink when the pen is in use.

The reason why ink can flow continually during the use of the fountain-pen is as follows: As ink is absorbed by the paper surface, a slight vacuum is created in the casing, and therefore, the outside air tends to pass through the central groove 13 of the pen and into the casing, so as to relieve this vacuum.

When the vacuum becomes sufficiently strong the external air pressure overcomes the resistance of ink filling the air-groove 13, and air then passes therealong and into the casing. Thus, during the use of the fountain-pen there occurs first a vacuum in the casing, and then the outside air pressure overcomes the resistance of ink in the groove 13, and enters the casing, and thus relieves the vacuum, and these actions are repeated in continual succession, and thus prevent the ink-flow from being interrupted, or becoming excessive.

Near the upper end of the portion 6 of the feed-bar, there may be disposed, as in known way, two crescent shaped cavities 17 and 18 at the opposite sides of the ink-ducts 14 and 15. These cavities serve as sub-reservoirs for the ink, which might be expelled from the inner casing in the event of overflowing, as a result of the air in the casing expanding due to the heat of body when the pen is in use. Thus, these cavities serve to trap such ink and prevent it from being entirely expelled.

Referring to Fig. 2, the filling of the pen with ink is effected as follows:—The nib bearing end of the fountain-pen is inserted in the opening formed in the stopper of the ink-bottle, shown in dotted lines, and the whole is turned upside down. Then, the ink enters the ducts 14 and 15 and the ink is drawn down these by a combined capillary action and the force of gravity. This combined action causes the ink to flow along the ink-ducts down to the lowermost end of the extension 12, and subsequently to drop. As the level of the ink of the bottle is lowered, the air pressure above same in the bottle falls to a value lower than that of atmospheric pressure, while the pressure in the casing increases to a pressure greater than atmospheric pressure. However, an equalization of pressure periodically takes place through the air-groove 13, the air in the casing escaping through this groove into the bottle, ascending through the ink in the form of bubbles.

When the ink fills the ink-ducts throughout their whole length, the capillary action will no longer continue, and thereafter, the filling operation is completed under the action of gravity, air continuing to escape into the bottle in the manner just described.

The reason for the capillary action becoming discontinued in this manner is due to the fact that when the ducts have become filled with ink the capillary attraction therein has become satisfied, so to speak.

If in the filling operation, the air-groove 13 should not be filled with ink and therefore be in an open state, the air in the casing can escape easily through the air-groove into the bottle regularly. This would permit the casing always to be completely filled with ink. However, if the air-groove becomes filled with ink, the air in the casing cannot readily escape, with the result that the displaced air can bubble through only very irregularly, or sometimes cannot escape at all, thereby making it impossible to properly fill the casing.

It will, therefore, be readily seen that it is indispensable that the respective passages for the ink and for air are arranged entirely apart from each other. This is the reason why according to the present invention the air-groove 13 is centrally disposed, and entirely separated from the ink-ducts 14 and 15, at the opposite sides of the air-groove.

The air in the casing cannot escape into the bottle, before the difference between the pressures in the bottle and in the casing reaches a definite value. Nothing but the force of descending ink can establish such a difference. It is therefore important that the force of descending ink be made as large as possible. The force exerted by the descending ink can, in turn, be maintained by utilizing as much as possible, consistent with not upsetting the initial capillary action on the action of gravity. This is the reason why in the invention the ink-ducts formed in the feed bar are of comparatively ample proportions.

Furthermore, it will be seen that in the foregoing arrangement there is a large space 19 formed at the upperside of the portion 6 within the enlarged bore portion 9, and also a comparatively narrow space 20 at the diametrically opposite point. This will be clearly seen upon reference to Fig. 2. Due to the difference in size between the two spaces, ink tends, by its surface tension, to be attracted always into the narrow space 20. Furthermore, ink cannot form a film adjacent the wide space 19. This causes ink to be attracted more into the narrow space 20, and thus induces it to flow along the inner wall of the casing. It should be

noted, however, that while ink is in this manner flowing along the inner wall of the casing, ink is also flowing along the two ink-ducts, as well as along the auxiliary ink-duct. As stated above, the aforesaid wider space 19 always remains in an open state, and therefore, the air in the casing can easily escape through the air-groove 13, and through the central slit in the nib into the bottle.

It is not always necessary for the extension 12 of the feed bar to be as long as shown in the drawings, for if desired it may be of such a length that ink will pass along the ink ducts solely under the action of gravity. In this latter case, the time taken for filling will be somewhat longer, but the capacity of the ink reservoir will of course be larger.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. A fountain-pen in which the feed bar comprises an outer portion having an inwardly directed extension, the said outer portion being provided upon its upper side with an air-groove, and there being formed on one side or upon each side of the air-groove and in spaced relationship with respect thereto, an ink-duct extending also along and to the innermost end of the extension, and in which the inner end part of said outer portion is on its upper side provided with a flat surface which also extends along the whole length of said inwardly directed extension, for the purpose specified.

2. A fountain-pen as claimed in claim 1, in which the inner end portion of the bore of the nib-carrier is enlarged and through which enlarged bore portion the flat surfaced part of the outer end portion of the feed-bar which adjoins the extension projects and extends slightly inward beyond the nib-carrier, so that a cavity of larger cross-sectional area is formed between said flat surface and the adjacent part of the inner surface of said nib-carrier than is formed between the under-surface of said portion and the part of said inner surface adjacent thereto for the purpose specified.

3. A fountain-pen as claimed in claim 2, in which there is provided between and in spaced relationship with respect to the ink-ducts an auxiliary ink-duct, the outer end of which slightly intersects with the inner end of the air-groove so that said auxiliary duct and the air-groove are in communication with each other.

4. A fountain-pen as claimed in claim 3, in which the air-groove is made of a comparatively larger cross-sectional area than that of the ink-ducts, but less than 0.5 square millimetre, so as to prevent ink from dropping due to a slight shock.

5. A fountain-pen as claimed in claim 4, in which the cross-sectional outline of each of the ink-ducts is a rectangle of small width and great depth.

6. A fountain-pen as claimed in claim 5, in which there are formed in the feed-bar crescent shaped cavities, at the opposite sides of the ink-ducts, substantially as and for the purpose specified.

7. A fountain-pen as claimed in claim 6, in which the cross-sectional area of the feed-bar extension is as small as possible in order that the capacity of the ink reservoir shall be maintained at a maximum.

8. A fountain-pen as claimed in claim 7, in which the part forming the ink reservoir constitutes the handle or stock of the pen.

9. A fountain-pen as claimed in claim 7, wherein the ink reservoir is contained within the handle or stock of the pen.

10. Fountain-pens, constructed, arranged and adapted to operate substantially as described with reference to and as illustrated in the accompanying drawings.

Dated this 21st day of February, 1938.

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