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(54) Valve for a writing instrument.

(57) There is provided a valve gear which comprises a valve base (11) serving as a base of the valve gear and a valve body (12) closing and opening by its elastic deformation, and which actuates with minute pressure and minute flow rate. In said valve base (11), a valve seat (16), a flow passage (20), a valve body fixing portion (13) are formed. The valve body is formed by that unhardened synthetic resin, which is supplied to contact at least the valve seat of the valve base and the valve body fixing portion, is hardened as it is. The synthetic resin material has elasticity and a characteristic of non-adhesion to the valve base (11). Since the valve body (12) has a surface having a shape, which correctly corresponds to the minute concave and convex portions of the valve seat (16), and is adhered to the valve seat, the interior leakage is prevented, and the valve gear correctly actuates with minute pressure.

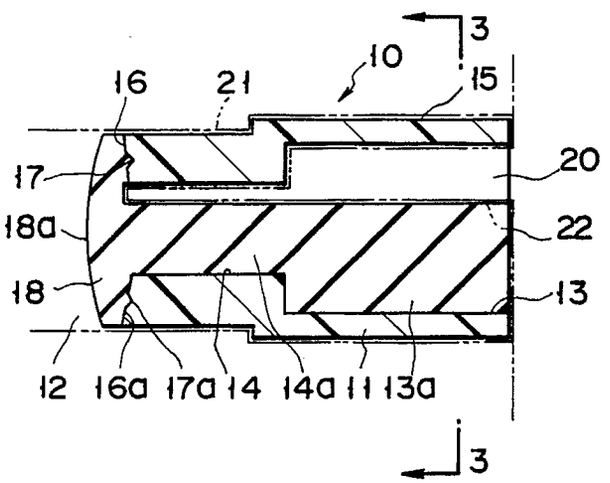

FIG. 2

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VALVE GEAR ACTUATING WITH MINUTE PRESSURE AND MINUTE FLOW RATE

The present invention relates to a valve gear opening with minute difference pressure and allowing fluid with minute flow rate to flow and, more particularly to a valve gear, which is built-in a writing tool, for controlling the flow rate of ink supplied from an ink reservoir to a nib.

Conventionally, in a writing tool such as a ball-point pen and a felt pen using water base ink, a porous material such as cotton was packed in an the ink reservoir in an axial cylinder of the writing tool, and ink was infiltrated into the porous material. However, in such a writing too, there were disadvantages in that an amount of maintaining ink was small, an amount of supply ink was small, so that a handwriting became unclear when the handwriting was speedy performed.

To overcome such disadvantages, there has been developed a writing tool which directly reserves ink in the ink reservoir having a large capacity. This writing tool is structured so that a liquid-tight slide stopper is slidably inserted into the ink reservoir and the expansion and contraction of ink is compensated for sliding the slide stopper. Also, in addition to the ink reservoir, an ink sub-chamber having a small capacity is formed to communicate with the nib such as a ball chip and a felt chip. The ink reservoir and ink sub-chamber are communicated with each other via a check valve. The check valve allows ink to flow from the ink reservoir to the ink sub-chamber. Also, in a case where differential pressure between the ink reservoir and the ink sub-chamber is more than a predetermined value, the check valve opens to supply ink from the ink reservoir to the sub-chamber. Such a writing tool can interrupt the change of pressure generated in the ink reservoir with a large capacity and prevent ink from being dropped and the intake of air.

However, in such a writing tool, when a writing is performed, the check valve must be opened by the capacity of the ball chip or the felt chip to discharge ink inside (pressure of several hundreds mm at a water head). Moreover, the above-mentioned slide stopper must be moved against the slide resistance. Therefore, there is required the check valve which is opened by an extremely low differential pressure, for example, about 100 mm. Moreover, in a case where ink in the above-mentioned the ink reservoir contracts slowly for a long time and an extremely little ink is leaked to the check valve, ink in the sub-chamber flows backward into the ink reservoir and air is taken from the nib.

Therefore, the value gear such as a check valve using in the writing tool must correctly actuate with minute differential pressure and minute flow rate. Also, no leakage is generated in the valve. Of course, it is possible to produce such a valve gear in the conventional technique. However, in the conventional technique, a valve seat of the valve gear and a valve base were separately manufactured and assembled. Therefore, these part needs a considerably high accuracy. Additionally, since such a valve gear is contained in the writing tool, the valve gear must be small-sized. Due to this, one must pay closest attention to the manufacture of the valve gear. Also, to ensure the quality of the valve gear, all products must be checked. For these reasons, in conventional, the cost of manufacturing such a valve gear was high. In general, the writing tool using such a valve gear is a disposable type, and the manufacture cost must be reduced as low as possible.

The present invention has been made in consideration of the above-mentioned problems. An object of the present invention is to provide a valve gear which can surely actuate with minute pressure, minute flow rate and a high accuracy, and which can simply manufacture with a low cost without interior leakage.

According to the present invention, a valve seat is formed in a valve base, and a passage, which opens to the valve base. Also, a valve body fixing portion is formed and an unhardened synthetic resin material is supplied to the valve seal and the valve body fixing portion, and the synthetic resin material is hardened, thereby forming a valve body. The synthetic resin material to form the valve body, which has no adhesion to a material to form the valve base in hardening, is selected. The valve is connected to the valve base in the valve body fixing portion. Therefore, the valve body is formed to be hardened in a state in which the valve body is adhered to the valve seat. In a seat surface contacting the valve seat, concave and convex portions, which correctly correspond to the minute concave and convex portions of the valve seat, are formed. There is made a correct relation of a male and female between the valve seat of the valve base and the seat surface of the valve body. Thereby, these valve seat and the seat surface are extremely correctly adhered to each other without space and a complete sealing property can be obtained, and no interior leakage is generated at all. Then, fluid flows between the valve seat and the seat surface of the valve body via the passage, and pushes the valve body slightly, so that the valve gear is set in a state in which the valve is opened. Therefore, the valve opening pressure of the valve gear can be easily set to about 100 mm or the pressure which is extremely below 100 mm.

Moreover, the valve opening pressure can be correctly set to a predetermined range by suitably setting the shape of the valve base and the quality of the valve body. Furthermore, the structure of this valve gear is simple and there is no need that the accuracy of processing these parts is set high. For this reason, the manufacturing cost is low, and the accuracy of the actuation of the valve opening pressure is high, so that there is no need that all products are tested.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a longitudinal cross section of an entire writing of a first embodiment of the present invention;

Fig. 2 is a longitudinal cross section of a valve gear;

Fig. 3 is a cross section taken along the line III - III of Fig. 2;

Fig. 4 is a longitudinal cross section of a second embodiment of the present invention;

Fig. 5 is a cross section taken along the line V - V of Fig. 4;

Fig. 6 is a cross section taken along the line VI - VI of Fig. 4;

Fig. 7 is a longitudinal cross section of a valve gear of a third embodiment of the present invention;

Fig. 8 is a cross section taken along the line VIII - VIII of Fig. 7;

Fig. 9 is a cross section taken along the line IX - IX of Fig. 7;

Fig. 10 is a longitudinal cross section of a valve gear of a fourth embodiment of the present invention;

Fig. 11 is a longitudinal cross section of a fifth embodiment of the present invention;

Fig. 12 is a longitudinal cross section of a sixth embodiment of the present invention;

Fig. 13 is a longitudinal cross section of a valve gear of a seventh embodiment of the present invention;

Fig. 14 is a cross section taken along the line XIV - XIV of Fig. 13;

Fig. 15 is a longitudinal cross section of a eighth embodiment of the present invention;

Fig. 16 is a cross section taken along the line of 16 - 16 of Fig. 15;

Fig. 17 is a longitudinal cross section of a valve gear of a ninth embodiment of the present invention;

Fig. 18 is a cross section taken along the line 18 - 18 of Fig. 4;

Fig. 19 is a longitudinal cross section of a valve gear of a tenth embodiment of the present invention;

Fig. 20 is a cross section taken along the line 20 -20 of Fig. 19;

Fig. 21 is a longitudinal cross section of a valve gear of a eleventh embodiment of the present invention;

Fig. 22 is a cross section taken along the line 22 - 22 of Fig. 21;

Fig. 23 is a longitudinal cross section of a valve gear of a twelfth embodiment of the present invention;

Fig. 24 is a cross section taken along the line 24 - 24 of Fig. 23; and

Fig. 25 is a cross section taken along the line 25 - 25 of Fig. 23.

The embodiments of the present invention will be explained with reference to the drawings.

Figs. 1 to 3 show a first embodiment of the present invention in which a disposable felt chip pen using water base ink is applied to the valve gear of the present invention.

In the drawings, reference numeral 1 is an axial cylinder of the pen. An ink reservoir 2 with a large capacity is formed in the interior of the axial cylinder 1 and liquid ink are packed in the interior of the ink reservoir 2. Also, a nib 3 is formed in the end of the axial cylinder 1. In this embodiment, the nib 3 is felt-chip type, and formed of a felt chip 5 and a holder 4. Moreover, a ink sub-chamber 6 with a small capacity is formed in the end portion of the axial cylinder 1 and is communicated with the nib 3. Also, the ink sub-chamber 6 is communicated with the in reservoir 2 via a valve gear 10 of the present invention. Then, ink is supplied to the ink sub-chamber 6 from the ink reservoir 2 via the valve gear 10.

Moreover, in the ink reservoir 2, a slide stopper 7 is slidably provided. The slide stopper 7 has a characteristic of liquid tight, and ink packed and air, which are packed in the ink reservoir, are divided by the slide stopper 7. The slide stopper 7 slides in accordance with the consumption of ink or the expansion and contraction, and compensates for these consumption and expansion and contraction, thereby equilibrating the pressure of ink in ink reservoir with air pressure. Additionally, a tail stopper 8 is attached to a tail end portion of the axial cylinder 1, and a passage 9 for air pressure is formed in the tail stopper 8.

The above-mentioned valve gear 10 is a check valve which allows only the flow of ink in the direction from the ink reservoir 2 to the ink sub-chamber 6, and is structured to be opened with minute differential pressure. In the writing tool, if ink in the ink sub-chamber 6 is consumed by writing, the valve gear 10 opens and ink is supplied to the ink sub-chamber 6 from ink reservoir 2, so that the ink sub-chamber 6 is maintained to be always filled with ink. Also, in accordance with the

consumption of ink in the ink reservoir 2, the slide stopper 7 slides in the left of the drawing and compensates for the consumption of ink. The felt chip 5 has a function in which ink in the interior is drawn by capillary phenomenon and the ink is held by capillary phenomenon to maintain the sealing. This capacity is about 200 mm at water head. Then, by the capillary power of the felt chip 5, the valve gear 10 is opened and the slide stopper 7 overcomes the slide resistance, and is slid. Moreover, in a case where ink in the ink reservoir 2 expands or contracts by the change of temperature and a positive pressure or a negative pressure is generated in the ink reservoir, these negative or positive pressure is interrupted by the valve gear 10 and is not transmitted to the nib 3. Furthermore, in a case where one drops the pen on the floor, the positive or negative pressure is instantaneously in the ink reservoir 2 by the above impact. The negative pressure is interrupted by the check valve, that is, the valve gear 10. Also, the positive pressure is largely reduced by the valve gear 10, so that ink is not dropped from the nib 3.

As mentioned-above, the valve gear 10 must actuate with an extremely minute predetermined differential pressure and be able to prevent the interior leakage correctly. To achieve such an object, the valve gear is structured as shown in Figs. 2 and 3. Specifically, the valve gear 10 comprises a valve base 11 and a valve body 12. The valve base 11 is formed of a synthetic resin material, and is substantially cylindrical. The outer peripheral surface of the base end portion of the valve base 11 is expanded in its diameter and a fixing insertion portion 15 is formed therein. The fixing insertion portion 15 is inserted into the inner surface of the axial cylinder 1 to maintain liquid tightness, so that the valve gear is fixed at a predetermined position. In the interior of the valve base 11, a head cavity portion 13 with a large diameter and an axial neck cavity portion with a diameter smaller than the diameter of the head cavity portion 13. These portions form a valve fixing portion. Also, the front end portion of the valve base 11 is formed as a valve seat 16. The valve seat 16 is an inverse conical surface with a small angle, and a positioning groove 17 is formed therein. The positioning groove 17 is shaped annular and its cross section is V-shaped with an angle of about 90°. Moreover, the valve body 12 is formed of a synthetic resin material having elasticity such as silicon rubber. In the valve body 12, silicon rubber, which is unhardened, is provided in the interior of the valve base 11, that is, the valve body fixing portion, and the valve seat, thereafter silicon rubber is hardened. The valve body 12 is formed of a head portion 13a of the head cavity portion 13 and an axial neck portion 14a of the axial neck portion 14, and a valve head portion 18, which is supplied on the valve seat 16. The silicon rubber, which forms the valve body 12, has no adhesion to the material forming the valve base 11. However, since the head portion 13a and the axial neck portion 14a are inserted into the head cavity portion 13 of the valve fixing portion and the axial neck cavity portion 14, the valve is mechanically prevented from being detached. Moreover, the rear face of the head portion 18 is adhered to the valve seat 16 and serves as a seat 16a. Of course, in a valve seat surface 17a, a positioning projection 17a, which corresponds to the positioning groove 17, is formed. There is a relationship of female-and male-type between the seat 16a and the valve seat 16, and the seat 16a faithfully corresponds to the valve seat 16 though the valve seat 16 has minute concave and convex portions. Therefore, no space is formed between the valve seat 16 and the seat surface 16a and these portions are completely adhered to each other. Moreover, the valve head portion 18 has no interior stress, and the seat surface 16a is only adhered to the valve seat 16 and they are not pressed on each each other. Also, in the valve head portion 13 and the axial head portion 14a, a passage 20 is formed in the axial direction. The passage 20 opens to the back end surface of the valve base 11 and the valve surface 16.

The passage 20 is formed by inserting a passage mold 22 shown by a two-dotted chain line of Fig. 2 into the interior portion of the valve base 11 when silicon rubber forming the valve body 12 is injected. Or, the valve base 11 is inserted into the mold 21, which is shown by a two-dotted chain line of Fig. 2 and the silicon rubber is injected in a state that the top end of the valve base 11 is positioned upward. The mold 21 is opened in its upper end, and the silicon rubber is injected to leave a free surface 18a. Since silicon rubber is hardened in a state that the free surface 18a is left, even if the silicon rubber contracts when hardening, the free surface lowers thereby compensation for the contraction. Moreover, this can prevent a space between the seat surface 16a and the valve seat 16 from being formed.

Additionally, since the contraction of silicon rubber is in general extremely small in hardening, there is used a mold which completely encloses the valve seat 16. Then, silicon rubber may be completely packed in the space formed between the mold and the valve seat 16. In place of such a mold, by viscosity of silicon which is unhardened, it is possible to provide silicon rubber on the valve seat 16 and harden silicon rubber.

The above-structured valve gear 10 functions as a check valve. If differential pressure is generated in the front and back of the valve gear 10,

the valve head portion 18 of the valve body 12 is slightly pushed up. Then, a slight space is generated between the seat surface 16a and the valve seat 16, and ink is supplied to the sub-ink chamber 6. In this case, the pressure of the opening valve can be correctly set by appropriately setting the thickness of the valve head portion 18 and the shape of the valve surface 16. Also, the seat surface 16a faithfully corresponds to the valve seat 16. Even if there are some concave and convex portions in the valve seat 16, no space is generated between the seat surface 16a and the valve seat 16, so that the interior leakage can be surely prevented and the correct actuation of the opening valve can be achieved. Moreover, the positioning groove 17 is formed in the valve seat 16 and the positioning project 17a, which corresponds to the position groove 17, is formed in the seat valve 16a, thereby the valve surface 16 and the seat surface 16a are not shifted. Therefore, the minute convex and convex portions of the valve seat 16 and the minute concave and convex portions of the seat surface 16a, which are formed to faithfully correspond to those of the valve seat 16, are not shifted, thereby preventing the space from being formed therebetween. Moreover, the above-mentioned structure is simple and the actuation is surely performed, and the accuracy of the parts to be required is not so high. Therefore, the manufacture cost is low and reliability is high.

Figs. 4 to 6 show a second embodiment of the present invention. According to the second embodiment, three ribs 30 are provided in an inner surface of an axial neck cavity portion 14 of the valve base 11, and a passage 31 is formed at the center of the valve base 11 to contact the top end edges these ribs. The passage is opened to the central portion of the valve seat 16. The passage 31 is formed by inserting a passage mold (not shown) into the center of the valve base 11. In the second embodiment, when the passage mold is inserted, the insertion is guided by the ribs and the rotation of a valve body 12 is stopped by these ribs. The structure of the second embodiment is substantially similar to that of the first embodiment, and the same reference numerals as the first embodiment are added to the corresponding parts.

Figs. 7 to 9 show a third embodiment of the present invention. According to the third embodiment, a valve fixing groove 42 serving as a valve body fixing portion is formed in a valve seat surface 40 of the front end surface of the valve base 11. Reference numeral 41 is a passage. The valve fixing groove is, for example, shaped substantially semicircle, and a primer processing for applying adhesion to silicon rubber forming a valve is provided in the inner surface. In the actual product, the primer processing is provided in the entire surface of the valve seat 40, thereafter, a primer layer of the front surface of the valve seat 40 is removed, thereby leaving only a primer layer of the valve body fixing groove 42. Then, unhardened silicon rubber is provided on the valve seat surface, thereafter, silicon rubber is hardened, so that a valve body 43 is formed. In this case, a passage mold (not shown) is inserted into the passage 41 to prevent unhardened silicon rubber from being introduced into the passage 41. A part of the valve body 43 is introduced into the valve body fixing groove 42 and adhered to the inner surface, thereby fixing the valve to the valve base.

Fig. 10 shows a fourth embodiment of the present invention. According to the fourth embodiment, a conical valve seat 51 is formed in the top end portion of a valve base 11, and an annular valve body fixing groove 52 is formed in the base end portion of the valve seat 51. Reference numeral 53 is a passage. Then, silicon rubber is provided in the valve seat 51 and the part of the valve fixing groove 52, thereby forming a valve body 54. A part of the valve body 54 is inserted into the valve body fixing groove 52, so that the valve body is held. According to the fourth embodiment, since the valve body 54 is provided in the outer periphery of the conical valve seat 51, even if the provided silicon rubber contracts a little when being hardened, no space is generated between the valve and the valve seat.

Fig. 11 shows a fifth embodiment of the present invention. According to the fifth embodiment, a valve body fixing hold 62 is formed in the top end portion of a valve seat 61 and a primer processing for applying adhesion to silicon rubber is provided in the hole surface. Reference numeral 63 is a passage. A part of the valve body 64 is adhered to the valve body fixing hole 62.

Fig. 12 is a sixth embodiment of the present invention. According to the sixth embodiment, there is formed a wall 71 which completely closes the front end portion of the cylindrical valve base 11, and the front surface of the wall 71 is used as valve seat 72. A valve fixing groove 73 is formed in a part of the valve seat 72. There is provided a primer processing for applying adhesion to silicon rubber in the inner surface of the groove. Then, silicon rubber is provided in the valve seat 72, so that a valve body 74 is formed. After silicon rubber is hardened, a needle member 76 pierces thereinto from the front portion and passes through the valve body 74 and the wall, thereby forming a passage 75 in the wall 71. In this case, a hole is formed in the valve body 74. However, since the valve body 74 is formed of silicon rubber with sufficient elasticity, the hole of the valve body 74 is closed after the needle member 76 is pulled out. According to the sixth embodiment, the passage is not originally

formed, and it is unnecessary to form a passage mold for preventing silicon rubber from being introduced into the passage. Since the passage is formed after silicon rubber is hardened and the needle member is pierced thereinto, the manufacture is simple.

Figs. 13 and 14 show a seventh embodiment of the present invention. According to the seventh embodiment, in the front end portion of the cylindrical valve base 11, there is formed a wall 81 which is along the direction of the diameter. The cross section of the wall 81 is semicircular and the outer surface of the wall 81 is formed in a valve seat surface 85. Also, a valve body fixing groove 83 is formed in a part of the valve seat 85. Then, in the inner surface of the valve body fixing groove 83, there is provided a primer processing having adhesion to silicon rubber. Moreover, a passage 82 is formed in the wall 81. Then, unhardened silicon rubber is provided in the valve seat 85 and the silicon rubber is hardened, so that a valve 84 is formed.

Figs. 15 and 16 show an eighth embodiment of the present invention.

The valve gear 110 comprises the valve base 111 and the valve body 112. The valve base 111 is formed of a synthetic resin material, and is substantially cylindrical. The outer peripheral surface of the base end portion of the valve base 111 is expanded in its diameter and a fixing insertion portion 115 is formed therein. The fixing insertion portion 115 is inserted into the inner surface of the axial cylinder 1 to maintain liquid tightness, so that the valve gear is fixed at a predetermined position. A valve axis insertion hole 111b whose cross section is shaped, for example, circle is formed in the interior of the valve base 111. Also, in the top end portion of the valve base 111, there is formed a substantially conical valve seat 111a which retreats into the base end portion. In the base end portion of the valve base 111, there is formed a valve base side engaging portion. The valve base side engaging portion comprises the step portion 11d which is formed in the base end portion of the valve base 111. The step portion 11d is formed in a surface of the direction crossing a central axis line of the valve axis insertion hole 111b, for example, a conical surface. In the valve base side engaging portion, there are formed four engaging convex portions 111c which are projected from the step portion 111d to the back in the axial direction. The back end portions of these engaging convex portions 111c reach up to the portion of the base end portion of the valve base 111. Also, inner surface portions 121 of these engaging convex portions 111c are continuously connected to the inner peripheral surface off the valve axis insertion hole 111b.

Moreover, the valve 112 is formed of a synthetic resin material having elasticity such as silicon rubber. The synthetic resin material, which forms the valve body 112, has no adhesion to the valve base 111. In the valve body 112, unhardened silicon rubber is provided and packed in the interior portion of the valve base 111, that is, the valve fixing portion and the portion of the valve seat surface, thereafter, silicon rubber is hardened. Therefore, the valve body 112 is formed to correspond to the shape of the interior portion of the valve base 111.

In the valve body 112, there is integrally formed a valve axis portion 112b which is hardened in a state that the valve axis portion 112b is packed in the valve axis insertion portion 111b. The valve axis portion 112b is shaped cylindrical to correspond to the valve axis insertion hole 111b.

Also, the valve head portion 112a is formed in the top end of the valve 112. In the valve head portion 112a, unhardened synthetic resin material provided on the valve seat surface 111a in a state that the top end portion of the valve base 111 is positioned upward, and the synthetic resin material is hardened as it is. Therefore, the valve head portion 112a has a top end portion, which is substantially spherical, and is adhered to the valve seat surface 111a.

Moreover, the valve side engaging portion 112c is formed in the base end portion of the valve body 112. The valve side engaging portion 112c is placed between the interior of the valve base side engaging portion, that is, the base end inner peripheral surface of the valve base whose diameter is expanded by the step portions 111c, and the engaging convex portions 111c. Then, the valve side engaging portion 112c is formed by the hardened portion.

When silicon rubber comprising the valve body 112 is hardened, a little contraction is generated. Therefore, each part of the valve body 12 contracts in the axial and diameter directions.

Due to this, the valve axis portion 112b also contracts in the axial direction, but the base end portion of the valve body 112 is mechanically integrated with the valve base 111 by the valve side engaging portion 112c and the valve base side engaging portions 111c and 111d. Therefore, by the axial contraction of the valve axis portion 112b, the valve head portion 112a is pressed to the valve seat 111a with a predetermined pressure. In this state, tensile stress is slightly generated in the valve axis portion 112b. Then, by elasticity of the valve axis portion 112b, the valve head portion 112a is slightly pressed to the valve seat 111a with a little pressure.

By the contraction of the valve axis 112b in the diameter direction, a space 120 is formed between

the outer peripheral surface of the valve axis portion 112b and the the inner peripheral surface of the valve axis insertion hole 111b. The space 120 is formed as a passage through which fluid, that is, ink passes. Similarly, a space 122 is formed between the outer peripheral surface of the valve axis portion 112b and an inner side surface 121 of the engaging convex portion 111c by the contraction of in the diameter direction. The inner side surface 121 of the engaging convex portion 111c is continuously connected to the inner peripheral surface of the valve axis insertion hole 111b. For this reason, the space 122 is also continuously connected to the space 120 and these spaces 120 and 122 are used as a passage for ink. Ink passes through these passages and circulates from the base end surface of the valve base 111 up to the valve head portion 112a and the valve seat surface 111a.

According to the above-formed valve gear 110, there is the relationship of the male and female between the rear surface of the valve head portion 112a and the valve seat surface 111a. The valve head portion 112a faithfully corresponds to minute concave and convex portions of the valve seat surface 111a, and no space is generated therebetween, so that these portions are completely adhered. Moreover, since the valve head portion 112a of the valve base 112 is hardened as being provided, no interior stress is generated in the valve head portion 112a. Also, since valve head portion 112a is surely adhered, the interior leakage can be completely prevented.

In such a valve gear, if the differential pressure between the ink reservoir 2 and the ink-sub chamber 6 is more than a predetermined differential pressure, the valve axis portion 112b slightly extends by the pressure. Thereby, a little space is formed between the valve head portion 112a and the valve seat 111a, and ink is circulated in a state that the valve is opened. Also, if the pressure in the ink sub-chamber 6 becomes high, such a valve gear is functioned as a check valve, and the back flow of ink is prevented.

Figs. 17 and 18 show a ninth embodiment of the present invention. According to this embodiment, an extended valve base side engaging portion having a step portion 131d is formed in the base end portion of the valve base 111. In the base end portion of the valve body 112, there is formed a valve side engaging portion 132c which is packed in the valve base side engaging portion and hardened. Moreover, when unhardened silicon rubber is packed in the valve base 111, a die 133 is inserted into the valve base 111. A convex portion 134 is formed in the bottom portion of the die 113, and the height of the convex portion 134 is set so that the top end of the convex portion 134 reaches the inner peripheral surface of the a valve axis insertion hole 111b of the valve base 111. Therefore, in the packed silicon rubber, a passage 135 is formed in the convex portion 134, and the passage 135 reaches the inner peripheral surface of the valve axis insertion hole 111b, that is, the space 120 forming the ink passage. Then, ink is introduced into the space 120 via the passage 120.

Figs. 19 and 20 show a tenth embodiment of the present invention. According to the tenth embodiment, in the base end portion of the valve base 111, a valve base side insertion hole 141d crossing the valve axis insertion hole 111b. In the base end portion of the valve body 112, there is integrally formed the valve side engaging portion 142c which is packed in the base end portion and hardened. The valve axis portion 112b is extended up to the base end portion of the valve base 111. The space 120, which is formed between the outer peripheral surface of the valve axis portion 112b and the inner peripheral surface of the valve axis insertion hole 111b, opens to the base end surface of the valve base 111.

Figs. 21 and 22 show an eleventh embodiment of the present invention. According to this embodiment, in the base end portion of the valve base 111, there are formed four valve base side engaging grooves 151d which are radially arranged. In the base end portion of the valve body 112, there is integrally formed a valve side engaging engaging portion 152c which is packed in a cavity portion enclosed with the valve base side engaging grooves 151d and a die 153, and hardened. The space 120, which is formed between the outer peripheral surface of the valve axis portion 112b and the inner peripheral surface of the valve axis insertion hole 111b, passes through the portion between the valve base side engaging portion 151d and the valve side engaging portion 153 and opens to the base end surface of the valve base 111.

Figs. 23 to 25 show a twelfth embodiment of the present invention. According to the twelfth embodiment, there is formed the valve base side engaging portion comprising an extended diameter portion 165 which is extended by forming a step portion 161 in the base end portion of the valve base 11. A plurality of rib grooves 166, for example, four taper rib grooves 166, are formed over inner inner peripheral surface of the extended diameter portion 165. The valve body 112 is shaped to correspond to the shape of the interior of the valve base 111. A valve side engaging portion 162, which corresponds to the valve base side engaging portion is formed. Also, rib portions 167, which correspond to the rib grooves 166, are formed. Then, by the contraction in hardening silicon rubber, which forms the valve body 112, there is formed a space 169 between the inner peripheral

surface of the extended diameter portion 165 and the outer peripheral surface of a valve side engaging portion 162. Also, there is formed a space 169 between the bottom of the rib groove 166, that is, the inner side surface portion and the top face of the rib portion 167. The space 169 is communicated with an intermediate portion of the space 120, which is between the inner peripheral surface of the valve axis insertion hole 111b and the outer peripheral surface of the valve axis portion 112, via the space 168. Therefore, the space 120 is opened to the base end surface of the valve base 111 via spaces 168 and 169. Then, ink is circulated through these spaces.

The present invention is not limited to the above-mentioned embodiments. For example, the shape and the structure of the valve base, the valve seat surface, the valve base side engaging portion, and the valve base side engaging portion are not limited to those described in the above-embodiments, and the use of these shape and structure can be suitably as required. Moreover, the elastic material forming the valve is not limited to silicon rubber, and a synthetic resin material having the other elasticity can be used. Furthermore, the present invention is not limited to the valve gear used in the writing tool. It goes without saying that the present invention can be applied to the valve gear which is used to other usage.

Claims

1. A valve gear having a valve base forming a base portion of the valve gear and a valve body opening and closing by its elastic deformation, said valve gear, characterized by comprising:
a valve seat (16, 111a) provided in said valve base (11, 111);
a passage (20, 120) for introducing fluid up to the portion of said valve seat; and
a valve body fixing portion (13, 42, 52, 62, 111c, 111d, 131d, 141d, 151d) for fixing a part of said valve body (12, 112),
said valve body (12, 112) is formed by that unhardened synthetic resin material, which is supplied in the interior of the valve base or on the valve base to contact at least said valve seat (12a, 112a) of said valve base (11, 111) and said valve body fixing portion (13, 42, 52, 62, 111c, 111d, 131d, 141d, 151d), is hardened in a state that said valve seat and said valve body fixing portion are in contact with each other, said synthetic resin material has elasticity and a characteristic of non-adhesion to the surface of said valve base (11, 111).

2. A valve gear according to claim 1, characterized in that said valve base (11, 111) is shaped cylindrical, a valve axis insertion hole (111b) is formed in the interior of said valve base, said valve seat (111a) is formed in the top end portion of said valve base, said valve fixing portion (111c, 111d, 131d, 141d, 151d) is formed in the base end portion of said valve base, said valve body (112) is formed by supplying the unhardened synthetic resin material over said valve seat (111a) of said valve body (111), said valve axis insertion hole (111b), and said valve body fixing portion (111c, 111d, 131d, 141d, 151d) and hardening the synthetic resin material leaving said valve seat of said valve body, said valve axis insertion hole, and said valve body fixing portion as they are.

3. A valve gear according to claim 1, characterized in that said unhardened synthetic resin material is supplied to at least portion contacting said valve seat (16, 111a) of said valve body (12, 112) as a free surface, which is not restricted by a mold, is left when said unhardened synthetic resin material is supplied, and said unhardened synthetic resin is hardened as said free surface is left as it is.

4. A valve gear according to claim 1, characterized in that the synthetic resin material forming said valve body is silicon rubber.

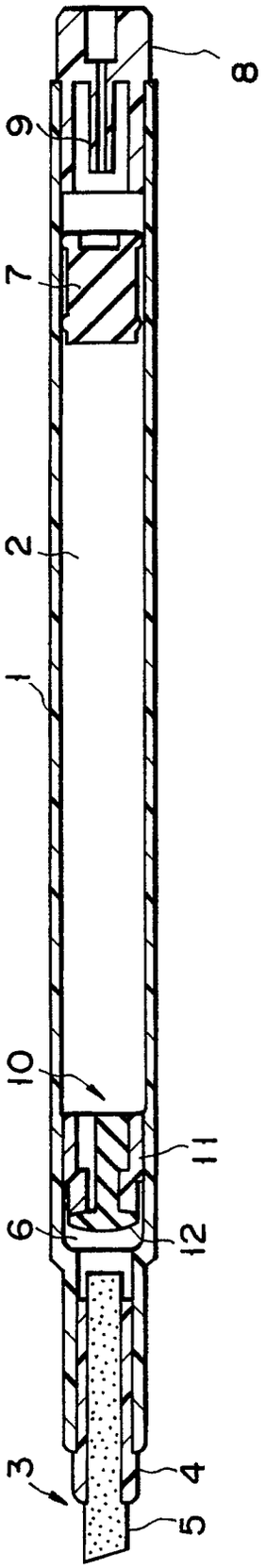

FIG. 1

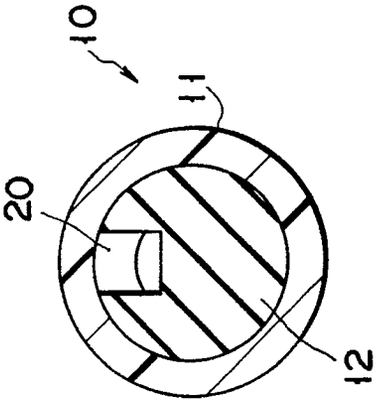

FIG. 3

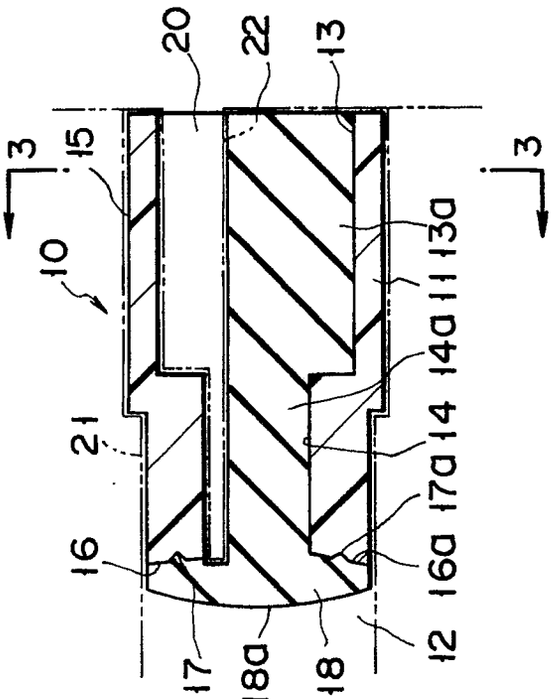

FIG. 2

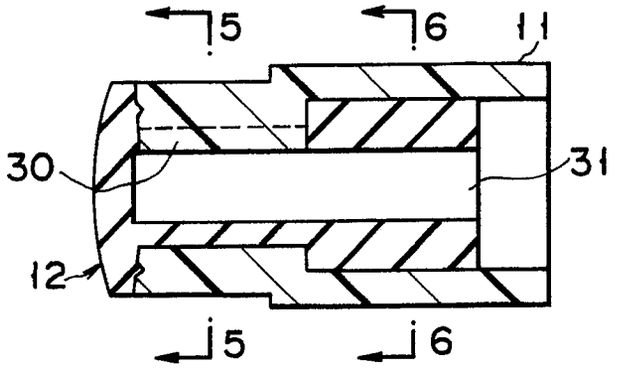

FIG. 4

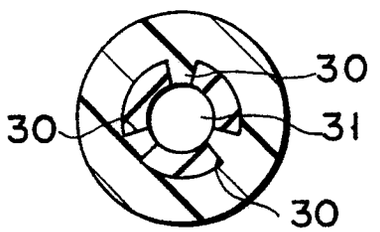

FIG. 5

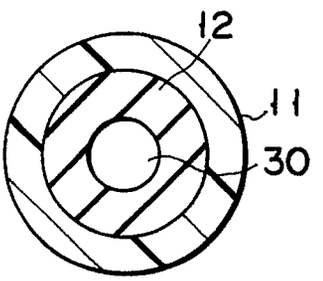

FIG. 6

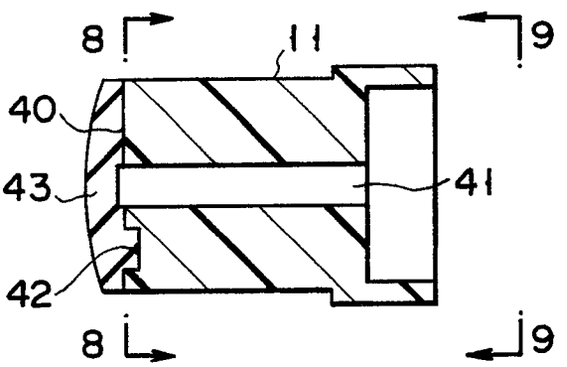

FIG. 7

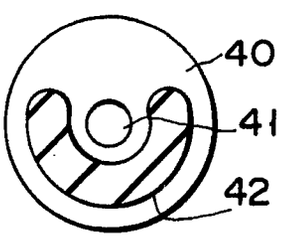

FIG. 8

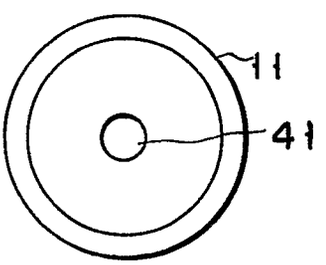

FIG. 9

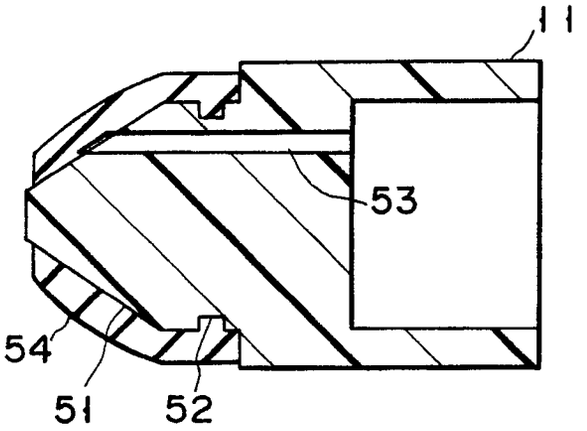

FIG. 10

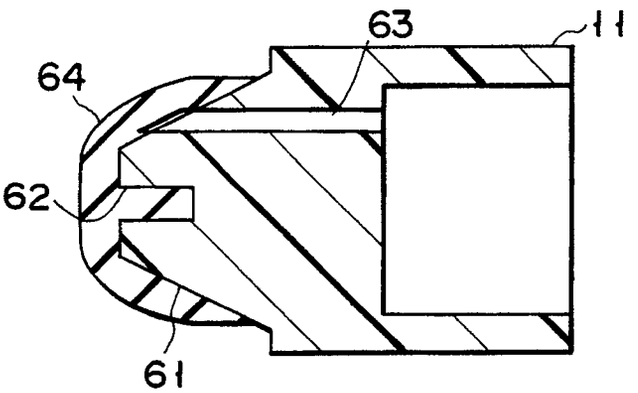

FIG. 11

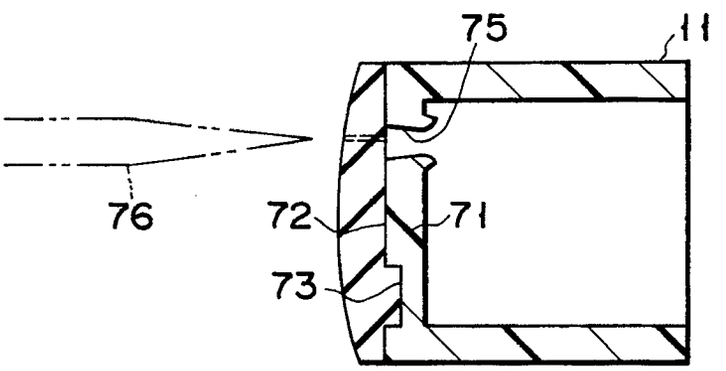

FIG. 12

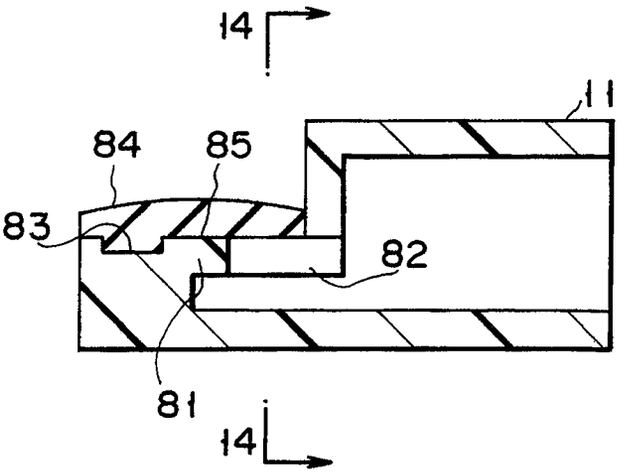

FIG. 13

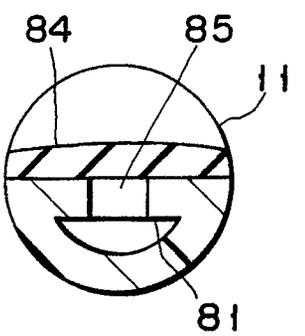

FIG. 14

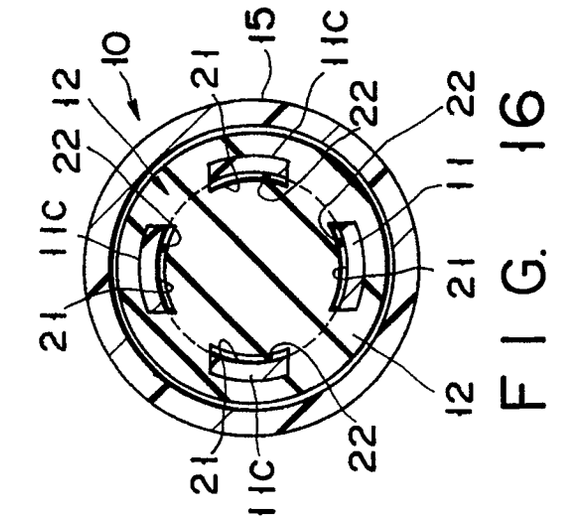

FIG. 16

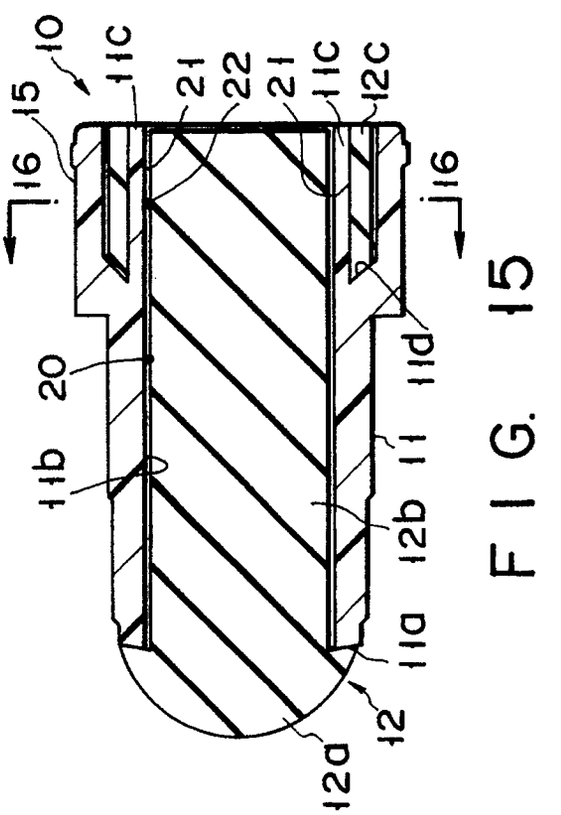

FIG. 15

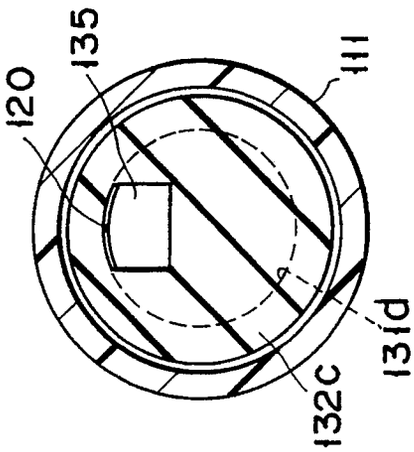

FIG. 18

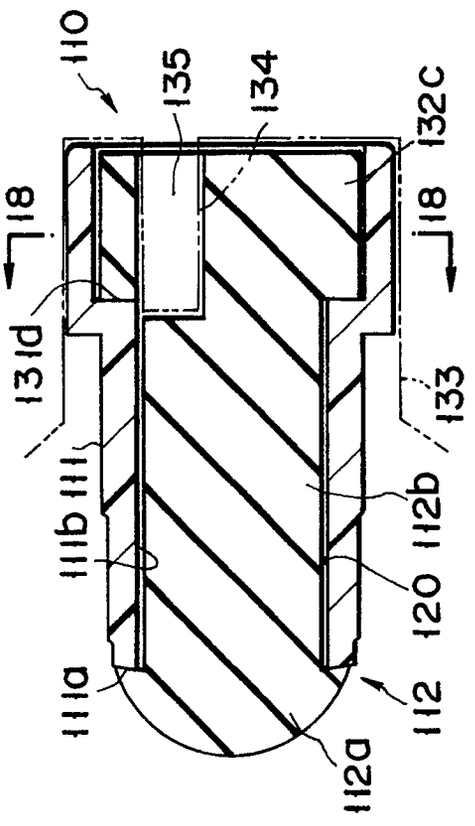

FIG. 17

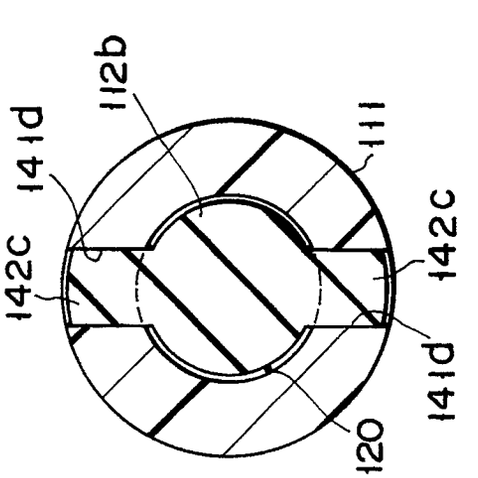

FIG. 20

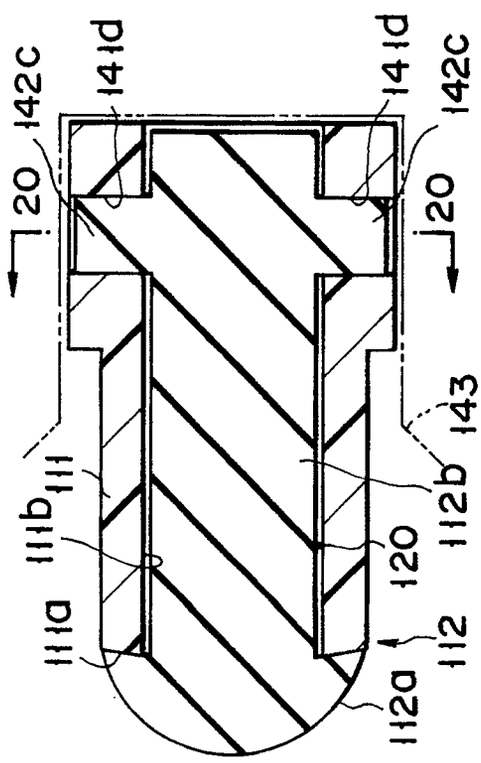

FIG. 19

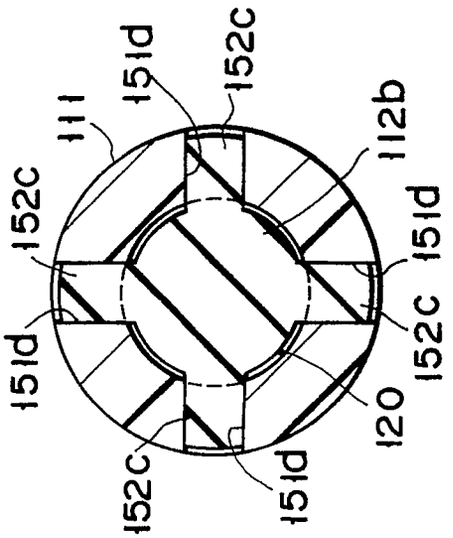

FIG. 22

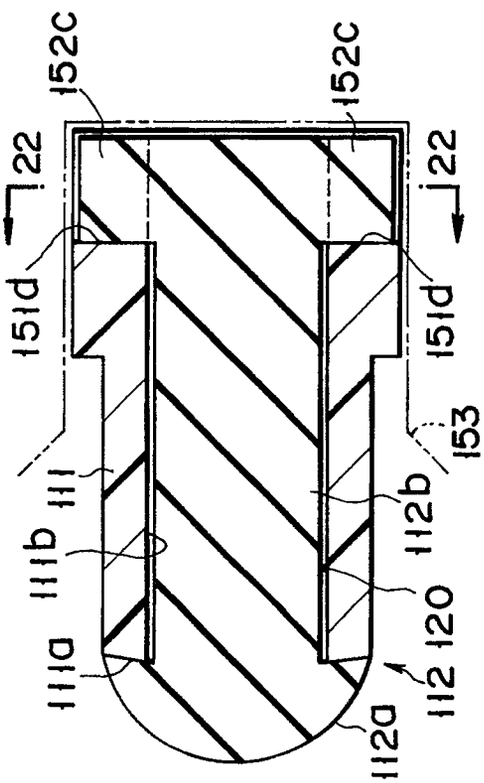

FIG. 21

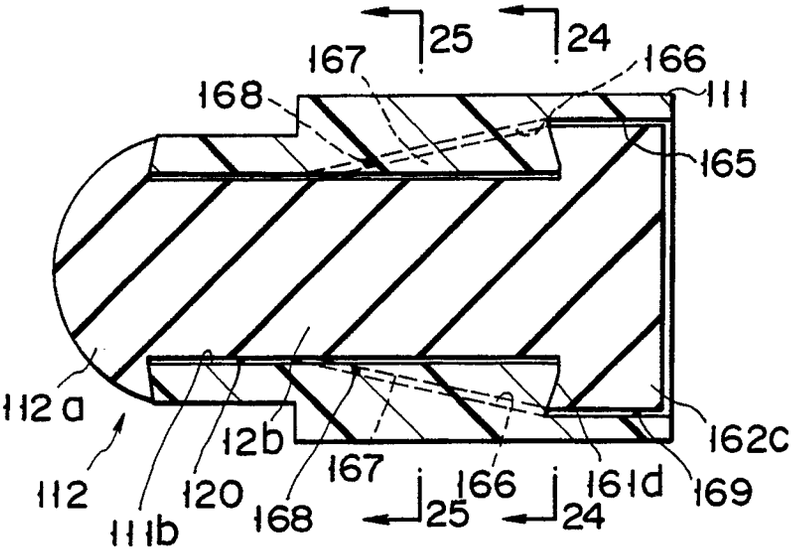

FIG. 23

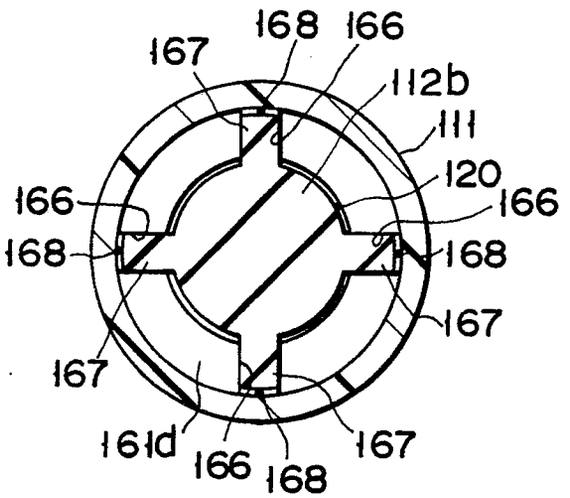

FIG. 24

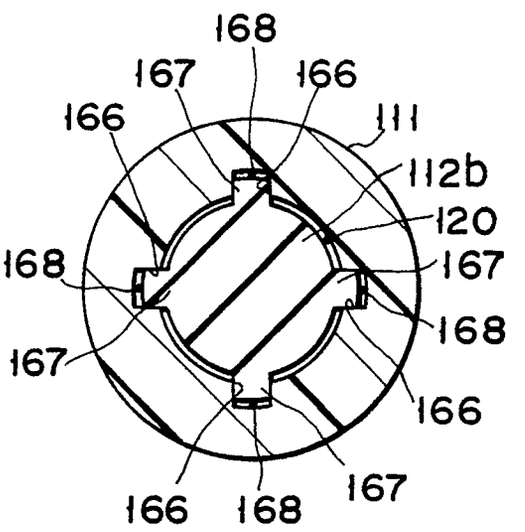

FIG. 25

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 11 5405

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 240 994 (HORI) * column 2, line 36 - column 3, line 24 * * column 8, lines 19 - 31; figures 1, 4, 12 *	1,2,4	B 43 K 5/18
A	US-A-3 085 591 (SCHNEIDER) * column 1, lines 1 - 29; figures 2, 3 *	1,4	
A	FR-A-2 216 125 (SCAL) * claims 1, 2; figures 1, 3 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 43 K
F 16 K

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	29 November 90	PERNEY Y.J.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document