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(72) Inventors:  
• Hayashi, Hisaaki  
Kariya-shi, Aichi-ken (JP)  
• Niimi, Kiwamu  
Kariya-shi, Aichi-ken (JP)

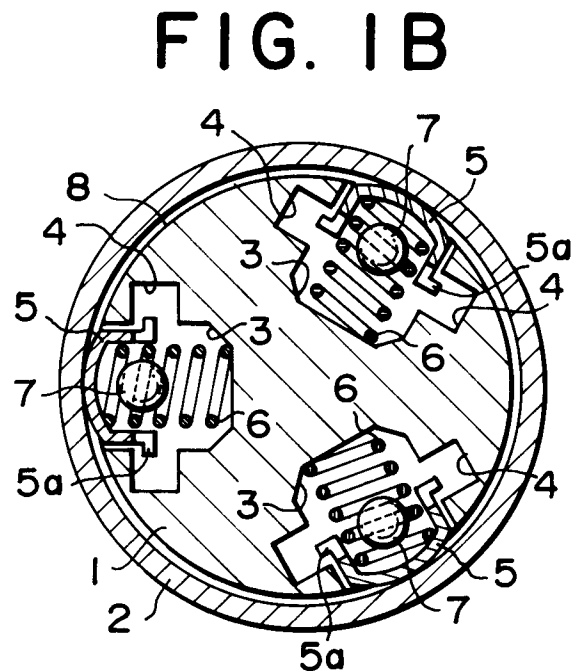
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(74) Representative: HOFFMANN - EITLÉ  
Patent- und Rechtsanwälte  
Arabellastrasse 4  
81925 München (DE)

(71) Applicant:  
Kabushiki Kaisha  
Toyota Jidoshokki Seisakusho  
Aichi-ken 448 (JP)

(54) Spindle for a spinning machine

(57) A spindle for a spinning machine is provided which can prevent a bobbin from slipping even if rotational speed changes are great during the starting and stopping of rotation, and in addition which decreases the pulling force and insertion force needed to exchange bobbins. A plurality of recesses (3) are formed at equal intervals in a top portion of the spindle (1). An annular groove (4) is formed in an inner circumferential surface of each recess (3). A cap (5) is received in the recess (3) with a part of the cap (5) projecting outside of the circumferential surface of the spindle (1). A coil spring (6) is disposed within the recess (3). A ball (7) is disposed inside of the coil spring (6). The spring force of the coil spring (6) is set at such a level that a biasing force that can prevent slippage of the bobbin (2) is applied to the cap (5) even when the rotational speed changes are great during the starting and stopping of rotation. The ball (7) is formed to have a weight wherein the sum of the biasing force of the coil spring (6) to the cap (5) when a full bobbin (2) is rotated and the biasing force caused by the centrifugal force of the ball (7) can prevent the slippage between the fully wound bobbin (2) and the cap (5).



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## Description

### BACKGROUND OF THE INVENTION

#### Field of the Invention

[0001] The present invention relates to a spindle for a spinning machine such as a ring type fine spinning machine or a ring type yarn spinning machine.

#### Description of the Related Art

[0002] In such spinning machines, a bobbin inserted into a spindle must be rotated together with the spindle without any slippage between the spindle and the bobbin from the start of winding to the stop of winding. This is because it is important to avoid thread degradation and breakage.

[0003] A typical means for rotating the bobbin together with the spindle is such that, as shown in Fig. 7, a cap 43 is disposed within a recess 42 formed in an upper portion of a spindle 41 with part of it protruding outside of the circumferential surface of the spindle 41 with a coil spring 44 disposed within the recess 42 (for example, see Japanese Patent Application Laid-open No. 47-9817). The spring force of the coil spring 44 is set so that the cap 43 is biased toward a bobbin 45 without any slippage between the spindle 41 and the bobbin 45 in a fully wound condition.

[0004] Also, as shown in Fig. 8, another approach has been proposed in which, instead of the coil spring 44, a ball 46 is received in the recess 42 so that the slippage between the spindle 41 and the bobbin 45 is prevented by the centrifugal force applied to the ball 46 when the spindle 41 is rotated (Japanese Patent Application Laid-open No. 5-222627).

[0005] However, in the arrangement in which the cap 43 is brought into pressing contact with the inner surface of the bobbin 45 by the force of the coil spring 44, the bobbin 45 is always held at a constant force (for example, 1.6 kgf per cap) or more. Accordingly, when the bobbin 45 is to be mounted on the spindle 41 and the bobbin 45 is pulled off of the spindle 41, a large force is required. For this reason, in the case where the ball pickup work (bobbin exchange work) is performed automatically, it is necessary to increase the pulling force or the insertion force and the bobbin holding force of the bobbin exchanging device. As a result, there is a problem that power consumption is increased and the overall apparatus is enlarged. Also, conventional systems suffer from a problem that the load imposed on a worker is increased where the bobbin exchange work is performed manually.

[0006] On the other hand, in the arrangement in which the bobbin 45 is held rotatably together through the cap 43 by the centrifugal force of the ball 46 when the spindle 41 is rotated, unless the rotational speed of the spindle 41 is high somewhat, it is impossible to prevent

slippage between the spindle 41 and the bobbin 45. In particular, upon starting or stopping the apparatus, slippage is usually generated between the bobbin 45 and the spindle 41. As a result, the conventional system encounters a problem that thread breakage or non-uniformity of thread quality (yarn irregularity) due to winding failures occur.

### SUMMARY OF THE INVENTION

[0007] In view of the foregoing defects, an object of the present invention is to provide a spindle for a spinning machine, which can prevent a bobbin from slipping even if rotational speed changes are significant during the starting or a stopping of rotation, and in addition which can decrease the pulling force and insertion force on the bobbin when exchanging bobbins.

[0008] In order to attain this object, according to a primary aspect of the invention, a spindle for a spinning machine is characterized by comprising: an engagement piece received in a recess formed in a circumferential surface of the spindle, a portion of which projects outside of the circumferential surface to engage with an inner surface of a bobbin inserted onto the spindle; a resilient member causing a biasing force, that can prevent slippage of the bobbin, to act on the engagement piece when rotational speed changes are great during the starting and stopping of spindle rotation; and a mass body having such a weight that the sum of the biasing force of the resilient member and a biasing force caused by centrifugal force in the engagement piece can prevent slippage between a full bobbin and the engagement piece when the full bobbin is rotated.

[0009] When stopping spindle rotation and when the rotational speed is low, the engagement piece provided in the spindle is kept in a pressing condition on the inner surface of the bobbin inserted onto the spindle by the biasing force of the resilient member. Also, when the rotational speed of the spindle reaches a predetermined level or greater, the engagement piece is kept in the pressing condition by the biasing force caused by the centrifugal force applied to the mass body and the biasing force of the resilient member. Accordingly, in a stopped condition, the force required when the bobbin is pulled off of the spindle against the biasing force of the resilient member and when the bobbin is inserted onto the spindle becomes smaller than that for the conventional spindle using a coil spring.

[0010] According to another aspect of the invention, a plurality of recesses are formed at equal intervals in the circumferential surface of the spindle. Consequently, slippage between the bobbin and the spindle can be positively prevented.

[0011] According to another aspect of the invention, the engagement piece is a cap detachably mounted in the recess so that an amount of projection from the recess of a tip end portion is variable. The cap detachably mounted in the recess functions as the engagement

piece. Accordingly, in comparison with the arrangement in which the engagement piece also serves as the mass body, the task of inserting the bobbin on the spindle and the task of pulling the bobbin from the spindle may be performed smoothly.

[0012] According to another aspect of the invention, the resilient member and the mass body are not in engagement with each other. Consequently, the manufacture thereof may be facilitated.

[0013] According to another aspect of the invention, the mass body is formed into a spherical shape. Therefore, the manufacture of the mass body is facilitated and can be readily obtained.

[0014] According to another aspect of the invention, the resilient member is a coil spring and the mass body is disposed inside of the coil spring. Consequently, the mass body may move inside of the coil spring and the coil spring may serve as the guide of the mass body.

[0015] According to another aspect of the invention, the engagement piece is formed as a leaf spring and also serves as the resilient member. In this case, the number of parts may be reduced and assembly work may be facilitated.

[0016] According to still another aspect of the invention, a guide portion is provided in the cap for guiding the mass body in a radial direction of the spindle. In this case, the centrifugal force applied to the mass body is effectively applied as a biasing force for pressing the inner surface of the bobbin to the cap.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0017] In the accompanying drawings:

Fig. 1(a) is a partial cross-sectional view showing a spindle in accordance with a first embodiment in the spindle for a spinning machine according to the present invention;

Fig. 1(b) is an enlarged cross-sectional view taken along the line B-B of Fig. 1(a);

Fig. 1(c) is a partial enlarged view of Fig. 1(a);

Fig. 2 is a perspective view of a cap;

Fig. 3 is a graph showing a relationship between the bobbin holding force and the spindle rotational speed;

Fig. 4 is a partial sectional view showing another embodiment in a spindle for a spinning machine according to the invention;

Fig. 5 is a partial sectional view showing still another embodiment in a spindle for a spinning machine according to the invention;

Fig. 6 is a partial sectional view showing still another embodiment in a spindle for a spinning machine according to the invention;

Fig. 7 is a partial sectional view showing a spindle of a conventional spinning machine; and

Fig. 8 is a partial sectional view showing a spindle of a conventional spinning machine.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Embodiments which may be currently considered to be the best mode of the present invention will now be described with reference to the accompanying drawings. In the following description, the same reference numerals are used to indicate like components in each drawing. Incidentally, in the description, it is to be understood that the terms "right", "left", "upper" and "lower" are used for the sake of convenience and are not to be interpreted in a limited fashion.

##### Embodiment 1

[0019] A first embodiment of the present invention will now be described with reference to Figs. 1 and 2. As shown in Figs. 1(a) to 1(c), a gap  $\delta$  is formed between an outer circumferential surface of a spindle 1 and an inner circumferential surface of a bobbin 2 inserted onto the spindle 1. A plurality (three in the first embodiment) of recesses 3 are formed at equal intervals in an upper portion of the spindle 1. The recesses 3 are formed substantially into cylindrical shapes so as to be perpendicular to a rotary axis of the spindle 1. Annular grooves 4 are formed in the inner circumferential surfaces of the recesses 3.

[0020] A cap 5 is received in each recess 3 as an engagement piece. A part of the cap 5 projects outside of the circumferential surface of the spindle 1. The cap 5 has a pair of flanged portions 5a each having a smaller thickness than the width of the groove 4. The flanged portions 5a are detachably mounted in the recess 3 in engagement with the groove 4. The cap 5 is mounted so that the amount of projection of the tip end portion from the recess 3 may be changed by a difference between the thickness of the flanged portions 5a and the width of the groove 4. As shown in Fig. 2, in the cap 5, cutaways 5b are formed at opposite positions. The cap 5 may be bent by depressing both sides of the cap 5 at opposite positions (positions of the flanged portions 5a) displaced 90° from the positions where the cutaways 5b are formed. Accordingly, upon assembling the cap 5, the flanged portions 5a of the cap 5 are engaged with the groove 4 by inserting the flanged portions 5a into the recess 3 under the condition that the cap 5 is bent.

[0021] A coil spring 6 to be used as a resilient member

is disposed in each recess 3 so that it is in contact with the inner surface of the cap 5 and the bottom surface of the recess 3. The spring force of the coil spring 6 is set so as to make it possible to apply a biasing force to the cap 5 which can prevent slippage of the bobbin 2 even if rotational speed changes are great during the starting and stopping of spindle rotation. In the first embodiment, the spring force of the coil spring 6 is set at a minimum level that may meet the requirements of the above-described biasing force. This level is changed depending upon the weight of the bobbin 2 to be used, the frictional force between the bottom portion 2a of the bobbin 2 and the spindle 1, the frictional force between the inner surface of the bobbin 2 and the cap 5, or the deceleration conditions when stopping rotation or the acceleration conditions when starting rotation of the spindle 1. This level may be determined through experiments in advance or theoretically.

**[0022]** A spherical ball 7 to be used as a mass member is received in each recess 3. The ball 7 is formed to have a diameter that is somewhat smaller than the inner diameter of the coil spring 6, and is disposed inside of the coil spring 6. Since the ball 7 is provided out of engagement with the coil spring 6, the ball 7 may move inside of the coil spring 6 along with the coil spring 6. The ball 7 is formed to have a minimum weight so that the sum of the biasing force of the coil spring 6 to the cap 5 during rotation when the bobbin 2 is full and the biasing force caused by the centrifugal force of the ball 7 can prevent slippage between a fully wound bobbin 2 and the cap 5.

**[0023]** The operation of the spindle 1 thus constructed will now be described.

**[0024]** The bobbin 2 is held from inside by having its upper inner surface pressed by the cap 5 and is rotated together with the spindle 1. The magnitude of the pressure from the cap 5 needed so that slippage between the spindle 1 and the bobbin 2 is not generated is related to the weight of the bobbin 2 which includes the rotational speed of the spindle 1 and the wound thread. Then, the higher the rotational speed of the spindle 1, the larger the pressure that will be needed. Also, in the case where the rotational speed is kept at the same level, the larger the weight of the bobbin 2, the larger the pressure that will be needed.

**[0025]** Fig. 3 is a graph showing the relationship between the pressure (bobbin holding force) of the cap 5 to the bobbin 2 and the spindle rotational speed. In Fig. 3, the dotted line indicates a spindle according to the prior art (conventional case A) using coil springs, the broken line indicates the case of a spindle according to the prior art (conventional case B) using the balls, and the solid line indicates the case of the spindle 1 according to the first embodiment of the present invention. In Fig. 3, the position indicated by F1 in the vertical axis indicates the bobbin holding force required for normal rotation when the bobbin is full. As is apparent from Fig. 3, in the rotational region used during the normal rota-

tion, the holding force of the invention is designed to be larger than F1. Also, the position indicated by F2 indicates the bobbin holding force (biasing force) required during the starting and stopping of rotation.

**[0026]** When the spindle 1 is rotated, the combined or resultant force of the spring force of the coil spring 6, the centrifugal force applied to the ball 7 in accordance with the rotation of the spindle 1 and the centrifugal force applied to the cap 5 itself is applied to the cap 5. Then, in the first embodiment, during the starting and stopping of rotation where the rotational speed of the spindle 1 is low, the slippage between the bobbin 2 and the spindle 1 is suppressed mainly by the spring force of the coil spring 6. Since the rotational speed of the spindle 1 is low when starting rotation, the centrifugal force applied to the ball 7 is small but the rotational speed change of the spindle 1 is large. Also, during the stopping rotation, the brake force is applied when the rotational speed is lowered down to a predetermined speed to stop the spindle 1. Also in this case, since the rotational speed of the spindle 1 is low, the centrifugal force applied to the ball 7 is low but the rotational speed change of the spindle 1 is large. Accordingly, in both cases, the slippage between the bobbin 2 and the spindle 1 is suppressed by the spring force of the coil spring 6 without depending upon the centrifugal force applied to the ball 7.

**[0027]** Also, under normal operating conditions, the slippage between the bobbin 2 and the spindle 1 is prevented mainly by the resultant force of the centrifugal force applied to the ball 7 and the spring force of the coil spring 6. The spring force of the coil spring 6 and the mass of the ball 7 are set so that the slippage between the bobbin 2 and the spindle 1 can be prevented during rotation when the bobbin is full. Accordingly, even under the conditions where the spindle 1 is rotated at a high speed when the bobbin is almost full, slippage between the bobbin 2 and the spindle 1 can be positively prevented.

**[0028]** On the other hand, where the spindle 1 is stopped to perform pickup of bobbins and insertion of empty bobbins, the bobbin 2 is pressingly held to the spindle 1 only by the spring force of the coil spring 6. This pressure is smaller than the pressure required to prevent slippage between the bobbin 2 and the spindle 1 when a full bobbin is rotated. Accordingly, the force required to pull an inserted full bobbin off from the spindle 1 and the force required to insert (press) an empty bobbin onto the spindle 1 are small in comparison with the forces required for a conventional spindle using a coil spring.

**[0029]** The first embodiment has the following advantages.

(A) The resultant force of the biasing force of the resilient member (coil spring 6) and the centrifugal force applied to the mass member (ball 7) is applied as the biasing force to the engagement piece (cap 5) for pressingly holding the bobbin 2 inserted onto

the spindle 1. Accordingly, even if rotational speed changes are remarkable as in the starting and stopping of rotation, it is possible to prevent the slippage of the bobbin, and at the same time to reduce the pulling force and the insertion force of the bobbin during the exchange of bobbins. As a result, the load applied to a bobbin exchange apparatus or a worker during the exchange operation is reduced.

(B) The biasing force of the resilient member (coil spring 6) is set to a minimum level that can prevent the generation of the above-described slippage. Accordingly, the pulling force and the insertion force of the bobbin during the exchange of bobbins are more reduced even further.

(C) The cap 5 is detachably mounted in the recess 3. Accordingly, in comparison with the arrangement in which the mass body is fixed to the recess 3 through the spring without the cap 5, the interference between the mass body and the lower portion of the bobbin inserted into the spindle 1 may be prevented. As a result, the work to insert the bobbin 2 into the spindle 1 and the work to pull the bobbin 2 apart from the spindle 1 may be performed smoothly.

(D) Since the resilient member (coil spring 6) and the mass body (7) are not engaged with each other, in comparison with an arrangement in which the resilient member and the mass body are engaged and received in the recess 3, the manufacturing and assembly work become facilitated.

(E) Since the ball 7 is used as the mass body, it is possible to use commercially available steel balls. Accordingly, the production of the mass body is easy and the mass body may be readily obtained.

(F) Since the mass body (ball 7) is provided inside of the coil spring 6, the coil spring 6 serves to guide the mass body. As a result, the centrifugal force applied to the mass body is applied so as to effectively press the bobbin 2 through the cap 5.

(G) The mass body (ball 7) is formed to have a minimum weight so that the sum of the biasing force of the coil spring 6 applied to the cap 5 when the bobbin 2 is full and the biasing force caused by the centrifugal force of the ball 7 may prevent the slippage between the fully wound bobbin 2 and the cap 5. Accordingly, the amount of power consumed for driving the spindle 1 is smaller than that of the prior art shown in Fig. 8, and the gravitational center of the spindle 1 is lower to thereby stabilize the rotational balance.

**[0030]** The embodiment of the present invention is not limited to the above-described ones but the invention may be embodied as follows.

(1) Instead of arranging the ball 7 (mass body) inside of the coil spring 6, as shown in Fig. 4, the ball 7 may be fixed at a first end of the coil spring 6,

and the second end of the coil spring fixed to the recess 3.

(2) In the arrangement in which the ball 7 is mounted through the coil spring 6 in the recess 3, a guide portion for guiding the ball 7 in the radial direction of the spindle 1 is provided in the cap 5. For example, as shown in Fig. 5, the cap 5 is formed to have a cylindrical portion 5c as the guide portion whose inner diameter is a little larger than the diameter of the ball 7. As shown in Fig. 4, in the case where the inner diameter of the cap 5 is sufficiently larger than the diameter of the ball 7, or in the case where the cap 5 has an increased diameter toward the bottom of the recess 3, the contact condition of the ball 7 to the cap 5 changes depending upon the fixed condition of the coil spring 6. As a result, it is difficult to have the ball press the bobbin 2 effectively with the centrifugal force applied to the ball 7. However, in the case where the cap 5 has the above-described guide function, the centrifugal force applied to the ball 7 effectively works on the cap 5 as the biasing force for pressing the inner surface of the bobbin 2.

(3) The cap 5 functions as the resilient member, and as shown in Fig. 6, only the ball 7 is provided inside of the cap 5 without the coil spring. The width of the groove 4 is smaller than that where the cap 5 does not function as the resilient member. In this case, the number of parts is decreased and the assembly work is facilitated.

(4) The shape of the mass member is not limited to a spherical shape but may be formed into a cylindrical shape, a prismatic shape, a bullet-shape or any other desired shape. However, in the case of columnar shape, it is preferable that the tip end face that is to be brought into contact with the inner surface of the cap 5 be curved into a spherical surface.

(5) The mass member is not formed into a discrete member but may be formed integrally with the cap 5. Namely, the weight of the cap 5 is designed so as to have the sum of the weights of the cap 5 and the ball 7 in the first embodiment. Accordingly, only the resilient member (coil spring 6) is received inside of the cap 5.

(6) Without provision of the cap 5, it is possible to have an arrangement in which the mass body directly presses the bobbin 2. For example, in the arrangements shown in Figs. 4 and 5, the cap 5 may be dispensed with. In this case, the assembly work may be facilitated.

(7) The resilient member is not limited to the coil spring 6 but may be changed in to a leaf spring.

Also, rubber may be used instead of the leaf spring.

[0031] The embodiments of the present invention that are currently considered to be the best mode and modifications instead thereof have been described above in detail. However, it will be understood that the present invention is not limited thereto or thereby and any additional applications or modifications of the spindle of the spinning machine become apparent and may be readily embodied for those skilled in the art within the scope of the appended claims and the spirit of the present invention.

### Claims

1. A spindle for a spinning machine comprising:

an engagement piece (5) received in a recess (3) formed in a circumferential surface of the spindle (1) a portion of which projects outside of said circumferential surface to engage with an inner surface of a bobbin (2) inserted onto said spindle;

a resilient member (6) causing a biasing force, that can prevent slippage of said bobbin (2), to act on said engagement piece (5) when rotational speed changes are great during starting and stopping of spindle rotation; and

a mass body (7) having such a weight that the sum of a biasing force of said resilient member and a biasing force caused by centrifugal force in said engagement piece can prevent slippage between a full bobbin and said engagement piece (5) when the full bobbin is rotated.

2. A spindle for a spinning machine according to claim 1, wherein a plurality of recesses (3) are formed at equal intervals in the circumferential surface of the spindle (1).

3. A spindle for a spinning machine according to claim 1 or 2, wherein said engagement piece (5) is a cap (5) detachably mounted in said recess so that an amount of projection from said recess (3) of a tip end portion is variable.

4. A spindle for a spinning machine according to any one of claims 1 to 3, wherein said resilient member (6) and said mass body (7) are not in engagement with each other.

5. A spindle for a spinning machine according to any one of claims 1 to 4, wherein said mass body (7) is formed into a spherical shape.

6. A spindle for a spinning machine according to claim

4 or 5, wherein said resilient member is a coil spring (6) and said mass body (7) is disposed inside of said coil spring

5 7. A spindle for a spinning machine according to any one of claims 1 to 3, wherein said engagement piece (5) is formed as a leaf spring and also serves as said resilient member.

10 8. A spindle for a spinning machine according to any one of claims 3 to 5, wherein a guide portion is provided in said cap (5) for guiding said mass body (7) in a radial direction of said spindle (1).

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FIG. 1A

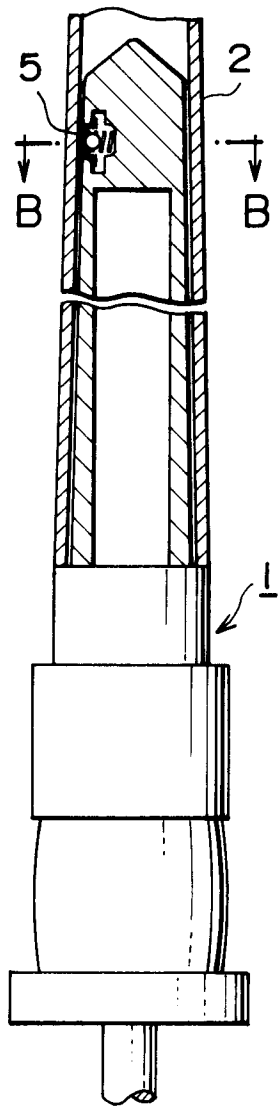


FIG. 1B

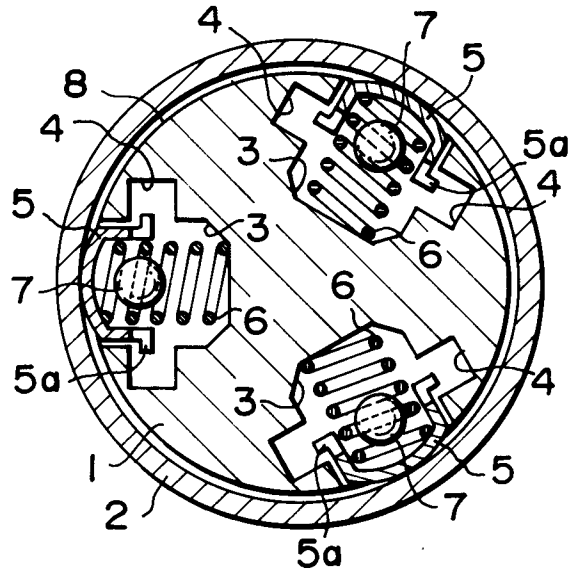


FIG. 1C

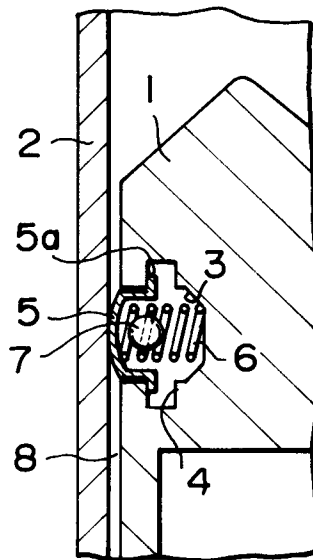
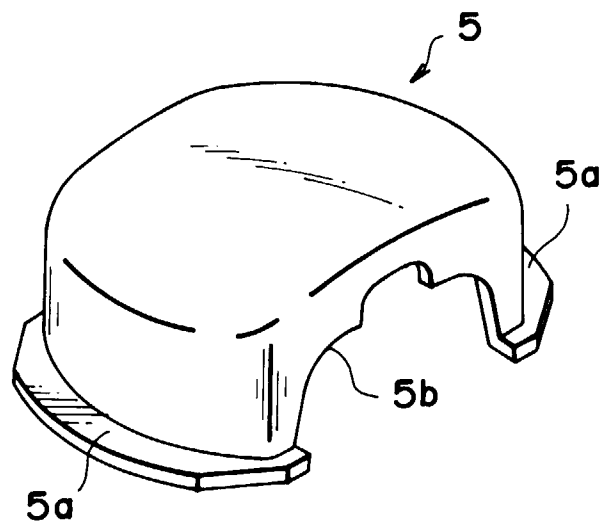


FIG. 2



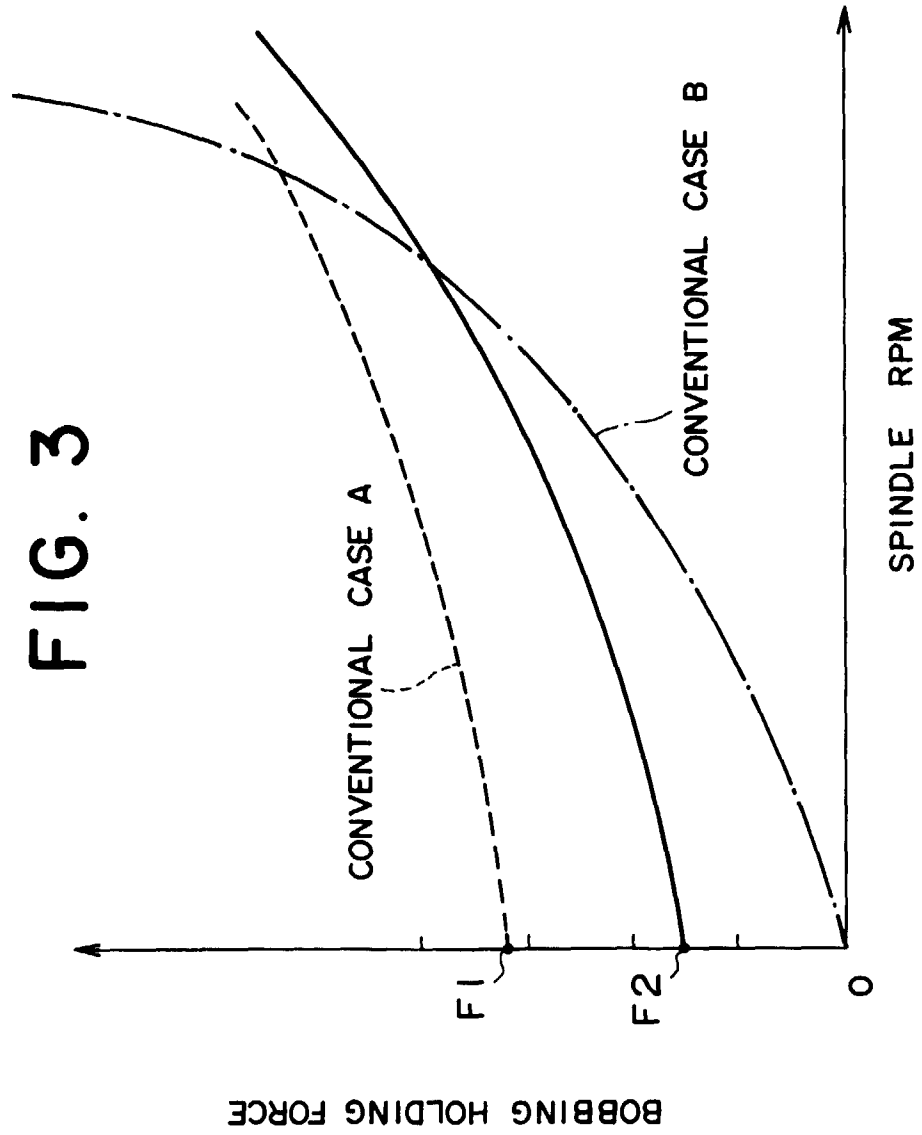


FIG. 3

FIG. 4

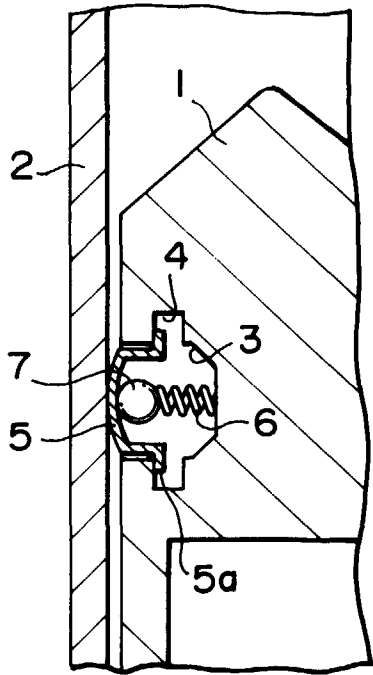


FIG. 5

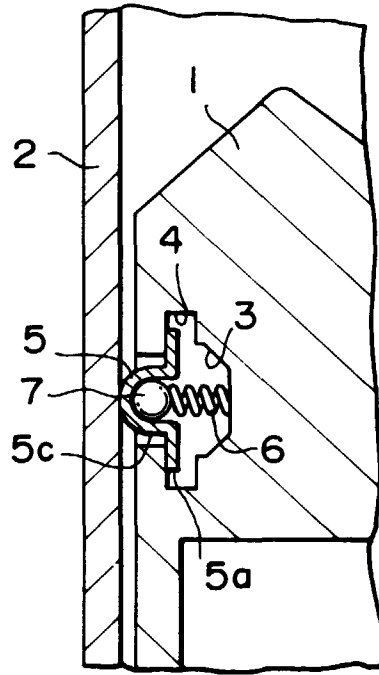
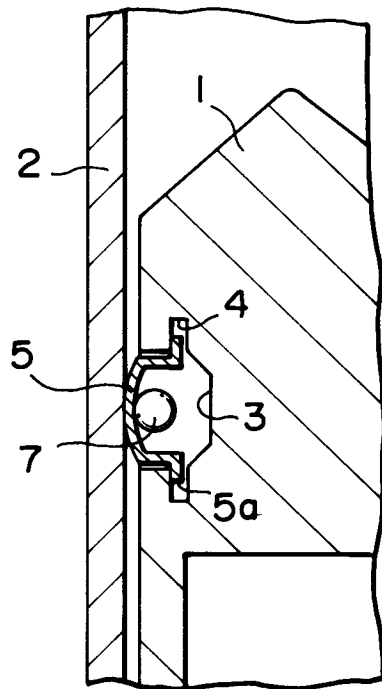
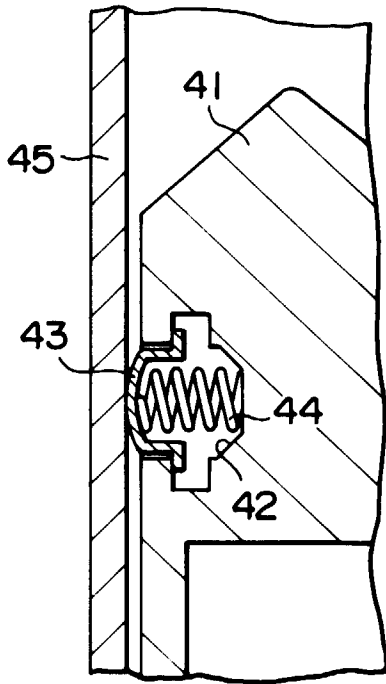


FIG. 6



**FIG. 7**  
PRIOR ART



**FIG. 8**  
PRIOR ART

