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(54) **Capping head with linear motor actuator**

Verschliesskopf mit Linearmotorantrieb

Tête de fermeture avec entraînement par moteur linéaire

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(73) Proprietor: **Sidel S.p.A.**
43126 Parma (IT)

(72) Inventors:
• **Preti, Fabrizio**
43126 Parma (IT)
• **Vescovi, Marco**
43126 Parma (IT)

(74) Representative: **Long, Giorgio et al**
Jacobacci & Partners S.p.A.
Via Senato 8
20121 Milano (IT)

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EP 1 182 165 B2

Description

[0001] The present invention relates to a device for the capping of containers, in particular bottles.

[0002] In the field of bottling plants, capping machines of the revolving type are known which are equipped with a plurality of capping heads and with a plurality of plates for supporting the bottles. The plates and the capping heads revolve in synchrony on the carousel so as to complete the capping cycle within the 360° arc of rotation. The operational stages of the capping process may be summarized as follows: the container enters the carousel in synchrony with the capping head, on which the cap is already present. Specifically, the cap has previously been taken from the cap feed system and has then been precentred within the capping head. The capping head, actuated by a cam, is lowered into contact with the mouth of the container, on which it begins to exert the pressure necessary to secure the cap on the container. The plate on which the bottle is supported is in actual fact a jack on which a calibrated spring acts. This calibrated spring offsets the lowering of the capping head by exerting a reactive force which guarantees a predetermined and constant capping force irrespective of the height of the container. The capping head is then raised, again by the action of the cam, so as to disengage from the container which can thus leave the capping carousel.

[0003] The prior art apparatus described above suffers, however, from disadvantages which make its use costly and somewhat impractical.

[0004] DE 17 82 378 A discloses a device for capping containers, wherein the linear actuator is linked to the capping head.

[0005] DE 25 26 234 A discloses a device that can be used in filling and closing machines, in which the respective filling or closing head remains stationary and the bottle is lifted towards the respective head.

[0006] GB 1 079 120 A discloses a capping machine comprising a helical spring that acts between the upper surface of the piston and the inner surface of the upper portion of the outer body of the capping device.

[0007] The object on which the present invention is based is therefore that of providing an apparatus for the capping of containers as specified in the attached apparatus claims.

[0008] A further object of the present invention is a method for the capping of containers as defined in the attached method claims.

[0009] Further features and advantages of the capping device for containers forming the subject of the present invention will become apparent primarily from the descriptions of examples of embodiment given hereinbelow by way of indication and implying no limitation with reference to the following figures:

Figure 1 shows a sectional view of a capping head according to the present invention;

Figure 2 shows a sectional view showing the se-

quence of operations for capping a bottle with the device according to the present invention;

Figure 3 shows a sectional view of a detail of the capping head according to an alternative embodiment of the present invention.

[0010] With reference to the abovementioned figures, the capping device forming the subject of the present invention, designated as whole by the numeral 1, essentially comprises a capping head 2 and a plate 3 for supporting the container 4.

[0011] The capping head 2 and the plate 3 are securely fixed to the carousel (not shown in the drawings) by means of respective arms 5, 5'.

[0012] Fixed on the arm 5 of the capping head 2, for example by means of a screw/nut system, is a sleeve 6 in which the outer body 7 of the said capping head is slidably accommodated. Guide bushings 8 are disposed between the sleeve 6 and the hollow body 7.

[0013] The outer body 7 of the capping head is hollow and slidably accommodates within it the capping element 9. The said capping element 9 possesses an upper portion 9' in sliding engagement with the inner surface of the outer body 7 and the lower portion 9". The upper portion 9' is substantially cylindrical and is in turn composed of two sections of different diameters, the lower section having a lesser diameter, so as to permit the seating of a guide bushing 10. The lower portion 9" of the capping element 9, by contrast, is of frustoconical shape, so as to create a seat for a restoring spring 11 between its outer surface and the inner surface of the outer body 7. The spring 11 exerts pressure at one end on the shoulder made at the point of connection between the upper portion 9' and the lower portion 9" of the capping element 9, and at the other end on a flange 12 protruding from the inner surface of the outer body 7. In this way, the capping element 9 is held in the raised position within the outer body 7.

[0014] Above the upper end of the capping element 9, a seating is made for a calibrated spring 13, preferably of the polyurethane elastomer type. The calibrated spring 13 exerts pressure on the upper surface of the capping element 9 and on the inner surface of the upper end 7' of the outer body 7.

[0015] The capping element 9 possesses magnets at its lower end by means of which the crown cap 14 is retained.

[0016] The upper end 7' of the outer body 7 of the capping head 2 is linked to the piston 15 which is connected to a linear actuator 16. The actuator 16 is a linear motor of the brushless type. Motors which may be used as linear motors include synchronous permanent magnet motors and asynchronous linear induction motors.

[0017] The said linear actuator 16 is connected to a control and monitoring unit for regulating the capping force relative to a predetermined value. The control and monitoring unit may, for example, perform the following functions:

- recording the power consumption of the motor, which is proportionate to the capping force applied to the bottle,
- comparing the recorded power consumption value with a predetermined value, to which a predetermined capping force value will correspond, and
- sending a control signal to the said motor to control its operational status, for example for shutting down the motor or reversing the travel of the piston.

[0018] The control and monitoring unit may also:

- record, for example by means of an appropriate sensor, the position of the piston, the capping head or the plate,
- compare the recorded position of the piston, the capping head or the plate with a predetermined value, which will be preset as a function of the capping force to be applied to the container, and
- send a control signal to the motor to regulate the travel of the piston so as to obtain the predetermined capping force.

[0019] With reference to Figures 2a-2d, a description will now be given of the functioning of the capping device according to the invention.

[0020] Figure 2a shows the device according to the invention in a capping phase in which the crown cap 14 has already been gripped by the capping head 2 and has been precentred by means of an upward movement followed by a downward movement of the outer body 7 relative to the capping element 9. This precentring phase is performed in a conventional manner and will therefore not be described in detail.

[0021] As shown in Figure 2b, the capping head 2 is then lowered until it comes into contact with the neck of the bottle by means of a downward vertical movement of the piston 15 driven by the linear actuator 16. At this point the capping phase in the true sense begins, providing for two consecutive phases. During the first phase, as shown in Figure 2c, the capping head 2 continues its downward descent, while the capping element 9 maintains its initial position in contact with the neck of the bottle. As this happens, the calibrated spring 13 is compressed until it exerts on the cap 14 a reactive force sufficient to cause the deformation of the inner lining of the said cap. In the second phase, when the calibrated spring 13 is partially compressed, a further descent of the capping head 2, which now takes place with movement relative to the capping element 9, causes the final securing of the crown cap 14 onto the neck of the bottle 4. Since this securing takes place at a predetermined compressive force, the control and monitoring unit of the device acts to interrupt the descent of the capping head 2 as soon as that force has been reached, as illustrated previously. Subsequently, as shown in Figure 2d, the linear actuator 16 acts to raise the capping head 2 by means of a vertical ascending movement of the piston 15, re-

turning the capping head to the initial position. At this point, before the carousel to which the capping device is fixed has completed the 360° rotation to bring the capping device 2 back into the position shown in Figure 2a, the latter will pass from the cap feeding station, from which it will remove a new crown cap 14 and precentre it as described above.

[0022] The advantages of the capping device according to the present invention are numerous.

[0023] First and foremost, the replacement of the cam with a linear actuator 16 allows the number of mechanical parts subject to wear, and therefore to constant maintenance, to be dispensed with or at least reduced to the essential minimum. This advantage is particularly apparent as the actuator 16 is a brushless linear motor. The reason is that this type of motor operates by direct engagement and does not involve the use of ball screws, gears or pulleys.

[0024] A further advantage is obtained by making use of a control and monitoring unit of the type described above. This control and monitoring unit makes it possible to adjust the capping force relative to a predetermined value. This is reflected, in substance, in the possibility of adjusting the travel of the piston 15 completely automatically as a function of the size of the bottle to be capped. By contrast, in the prior art devices which make use of a cam, the piston stroke is fixed and it is therefore necessary to prearrange the calibrated spring below the plate to ensure a predetermined capping force.

[0025] Figure 3 shows a second embodiment of the present invention.

[0026] In this embodiment, the linear actuator 16 is connected via the piston 15 to the plate 3.

[0027] In this case also the actuator 16 is a brushless electric linear motor.

[0028] The control and monitoring unit will act to regulate the capping force, as was described above.

[0029] The mode of functioning of the device is substantially analogous to what was described above, with the difference that, in this case, it will be the plate 3 that moves vertically while the capping head 2 will remain substantially fixed.

[0030] In this case also, the advantages of the present embodiment of the invention can be summarized as a reduced need to maintain the apparatus.

[0031] It is clear that what has been described are only particular embodiments of the capping device forming the subject of the present invention, to which the person skilled in the art will be able to make any modifications necessary to adapt them to particular applications.

[0032] In other embodiments, the control and monitoring unit will read, by means of appropriate recording means, the height of the bottle subject to capping, will compare the recorded value with a reference value, and consequently will send a control signal to the linear actuator 16 so as to adjust the stroke of the piston and, therefore, the capping force.

[0033] In yet other embodiments, the control and mon-

itoring unit will comprise means for recording the force applied to the container, for example by means of measurement with a dynamometer of the reactive force to which the capping head is subjected, the recorded value of which will then be compared with a predetermined reference value, and a control signal will then be sent to the linear actuator 16 for the adjustment of the capping force.

Claims

1. Device for capping containers (4) with a crown cork (14), comprising a container support plate (3) and a capping head (2), wherein a linear actuator (16) is linked, without the interposition of a cam, either to the said capping head (2) or to the said plate (3) for the reciprocal movement of the capping head relative to the plate, the said capping head comprising an outer body (7) in which a capping element (9) is slidably accommodated, a seating for a calibrated spring (13) being defined between the upper surface of the said capping element (9) and the inner surface of the upper end (7') of the outer body (7) and said calibrated spring acting upon the said surfaces, **characterized in that** the said linear actuator (16) is a brushless linear motor and the linear actuator (16) is connected to a control and monitoring unit for the regulation of the capping force with reference to a predetermined value.

2. Capping device according to claim 1, wherein the said calibrated spring (13) is of the polyurethane elastomer type.

3. Capping device according to claim 1 or claim 2, wherein the said linear actuator (16) is connected to the said capping head (2) by means of a piston (15) and wherein the said capping head (2) is slidably inserted into a sleeve (6) fixed to an arm (5) secured on the carousel of the capping machine.

4. Capping device according to any one of claims 1 to 3, wherein the said linear actuator (16) is connected to the said plate (3) by means of a piston (15).

5. Capping device according to claim 1, in which the said control and monitoring unit:

- records the power consumption of the linear actuator (16),
- compares the recorded power consumption value with a predetermined value, and
- sends a control signal to the linear actuator (16) to control its operational status.

6. Capping device according to any one of claims 1 to 5, in which the said control and monitoring unit:

- records the position of the piston (15), the capping head (2) or the plate (3),
- compares the recorded position with a predetermined value, and
- sends a control signal to the linear actuator (16) to regulate the travel of the piston (15) so as to obtain the predetermined capping force.

7. Capping device according to any one of claims 1 to 6, wherein the said control and monitoring unit:

- records the height of the container (4) subjected to capping,
- compares the recorded value with a reference value, and
- sends a control signal to the linear actuator (16) to regulate the travel of the piston (15) so as to obtain the predetermined capping force.

8. Capping device according to any one of claims 1 to 7, in which the said control and monitoring unit:

- records the force applied to the container,
- compares the recorded value with a predetermined reference value, and
- sends a control signal to the linear actuator (16) to regulate the capping force with reference to a predetermined value.

9. Capping device according to claim 8, wherein the said device comprises a dynamometer for measuring the reactive force to which the capping head (2) is subjected during the phase of capping the container (4).

10. Capping machine of the revolving type, **characterized in that** it comprises a capping device (1) according to any one of claims 1 to 9.

11. Method of capping containers (4) with crown caps (14), comprising the phases of:

- providing a capping device according to claim 1, and
- automatically regulating the capping force relative to a predetermined value.

12. Method according to claim 11, wherein the said automatic regulation of the capping force takes place by means of the control and monitoring unit.

13. Method according to claim 12, wherein the said automatic regulation of the capping force takes place by means of:

- recording the power consumption of the linear actuator (16),
- comparing the recorded power consumption

value with a predetermined value, and

- sending a control signal to the linear actuator (16) to control its operational status.

14. Method according to claim 12, wherein the said automatic regulation of the capping force takes place by means of:

- recording the position of the piston (15), the capping head (2) or the plate (3),
- comparing the recorded position with a predetermined value, and
- sending a control signal to the linear actuator (16) to regulate the travel of the piston (15) so as to obtain the predetermined capping force.

15. Method according to claim 12, wherein the said automatic regulation of the capping force takes place by means of:

- recording the height of the container (4) subjected to capping,
- comparing the recorded value with a reference value, and
- sending a control signal to the linear actuator (16) to regulate the travel of the piston (15) so as to obtain the predetermined capping force.

16. Method according to claim 12, wherein the said automatic regulation of the capping force takes place by means of:

- recording the force applied to the container (4),
- comparing the recorded value with a predetermined reference value, and
- sending a control signal to the linear actuator (16) to regulate the capping force with reference to a predetermined value.

Patentansprüche

1. Vorrichtung zum Verschließen von Behältern (4) mit einem Kronkorken (14), die eine Behälterlagerplatte (3) und einen Verschließkopf (2) aufweist, wobei ein Linearantrieb (16) für die Hin- und Herbewegung des Verschließkopfs relativ zu der Platte ohne Einfügen einer Nocke entweder mit dem Verschließkopf (2) oder der Platte (3) verbunden ist, wobei der Verschließkopf aufweist: einen Außenkörper (7), in dem ein Verschließelement (9) verschiebbar untergebracht ist, eine Aufnahme für eine kalibrierte Feder (13), die zwischen der oberen Oberfläche des Verschließelements (9) und der inneren Oberfläche des oberen Endes (7') des Außenkörpers (7) definiert ist, und wobei die kalibrierte Feder auf die Oberflächen wirkt,

dadurch gekennzeichnet

dass der Linearantrieb (16) ein bürstenloser Linearantrieb ist und der Linearantrieb (16) mit einer Steuerungs- und Überwachungseinheit zur Einstellung der Verschließkraft in Bezug auf einen vorbestimmten Wert verbunden ist.

2. Verschließvorrichtung gemäß Anspruch 1, wobei die kalibrierte Feder (13) vom Polyurethan-Elastomertyp ist.

3. Verschließvorrichtung gemäß Anspruch 1 oder 2, wobei der Linearantrieb (16) mittels eines Kolbens (15) mit dem Verschließkopf (2) verbunden ist und wobei der Verschließkopf (2) verschiebbar in eine Hülse (6) eingesetzt ist, die an einem Arm (5) befestigt ist, der auf dem Karussell der Verschließmaschine befestigt ist.

4. Verschließvorrichtung gemäß einem der Ansprüche 1 bis 3, wobei der Linearantrieb (16) mittels eines Kolbens (15) mit der Platte (3) verbunden ist.

5. Verschließvorrichtung gemäß Anspruch 1, in der die Steuerungs- und Überwachungseinheit:

- den Stromverbrauch des Linearantriebs (16) aufzeichnet,
- den aufgezeichneten Stromverbrauchswert mit einem vorgegebenen Wert vergleicht, und
- ein Steuersignal an den Linearantrieb (16) sendet, um dessen Betriebszustand zu steuern.

6. Verschließvorrichtung gemäß einem der Ansprüche 1 bis 5, wobei die Steuerungs- und Überwachungseinheit:

- die Position des Kolbens (15), des Verschließkopfs (2) oder der Platte (3) aufzeichnet,
- die aufgezeichnete Position mit einem vorgegebenen Wert vergleicht, und
- ein Steuersignal an den Linearantrieb (16) sendet, um den Hub des Kolbens (15) einzustellen, um die vorgegebene Verschließkraft zu erhalten.

7. Verschließvorrichtung gemäß einem der Ansprüche 1 bis 6, wobei die Steuerungs- und Überwachungseinheit:

- die Höhe des Behälters (4) aufzeichnet, welcher dem Verschließen unterzogen wird,
- den aufgezeichneten Wert mit einem Referenzwert vergleicht, und
- ein Steuersignal an den Linearantrieb (16) sendet, um den Hub des Kolbens (15) einzustellen, um die vorgegebene Verschließkraft zu erhalten.

8. Vorrichtung gemäß einem der Ansprüche 1 bis 7, wobei die Steuerungs- und Überwachungseinheit:
- die auf den Behälter (4) angewendete Kraft aufzeichnet, 5
 - den aufgezeichneten Wert mit einem vorgegebenen Referenzwert vergleicht, und
 - ein Steuersignal an den Linearantrieb (16) sendet, um die Verschließkraft unter Bezug auf einen vorgegebenen Wert einzustellen. 10
9. Verschließvorrichtung gemäß Anspruch 8, wobei die Vorrichtung ein Dynamometer zum Messen der Reaktionskraft aufweist, welcher der Verschließkopf (2) während der Phase des Verschließens des Behälters (4) unterworfen ist. 15
10. Verschließvorrichtung vom revolvierenden Typ, **dadurch gekennzeichnet, dass** sie eine Verschließvorrichtung (1) gemäß einem der Ansprüche 1 bis 9 aufweist. 20
11. Verfahren zum Verschließen von Behältern (4) mit Kronenkorken (14), das die folgenden Phasen aufweist: 25
- Bereitstellen einer Verschließvorrichtung gemäß Anspruch 1, und
 - automatisches Einstellen der Verschließkraft relativ zu einem vorgegebenen Wert. 30
12. Verfahren gemäß Anspruch 11, wobei die automatische Einstellung der Verschließkraft mittels der Steuerungs- und Überwachungseinheit stattfindet. 35
13. Verfahren gemäß Anspruch 12, wobei die automatische Einstellung der Verschließkraft stattfindet mittels:
- Aufzeichnen des Stromverbrauchs des Linearantriebs (16), 40
 - Vergleichen des aufgezeichneten Stromverbrauchswerts mit einem vorgegebenen Wert, und
 - Senden eines Steuersignals an den Linearantrieb (16), um dessen Betriebszustand zu steuern. 45
14. Verfahren gemäß Anspruch 12, wobei die automatische Regelung der Verschließkraft stattfindet mittels: 50
- Aufzeichnen der Position des Kolbens (15), des Verschließkopfs (2) oder der Platte (3),
 - Vergleichen der aufgezeichneten Position mit einem vorgegebenen Wert, und 55
 - Senden eines Steuersignals an den Linearantrieb (16), um den Hub des Kolbens (15) zu re-

geln, um die vorgegebene Verschließkraft zu erhalten.

15. Verfahren gemäß Anspruch 12, wobei die automatische Regelung der Verschließkraft stattfindet mittels:

- Aufzeichnen der Höhe des Behälters (4), welcher dem Verschließen unterzogen wird,
- Vergleichen des aufgezeichneten Werts mit einem Referenzwert, und
- Senden eines Steuersignals an den Linearantrieb (16), um den Hub des Kolbens (15) einzustellen, um die vorgegebene Verschließkraft zu erhalten.

16. Verfahren gemäß Anspruch 12, wobei die automatische Einstellung der Verschließkraft stattfindet mittels:

- Aufzeichnen der auf den Behälter (4) angewendeten Kraft,
- Vergleichen des aufgezeichneten Werts mit einem vorgegebenen Referenzwert, und
- Senden eines Steuersignals an den Linearantrieb (16), um die Verschließkraft unter Bezug auf einen vorgegebenen Wert einzustellen.

Revendications

1. Dispositif de capsulage de récipients (4) à capsule-couronne (14), comprenant une plaque de support de récipient (3) et une tête de capsulage (2), dans lequel un actionneur linéaire (16) est relié, sans interposition de came, soit à ladite tête de capsulage (2), soit à ladite plaque (3) pour le mouvement de va-et-vient de la tête de capsulage par rapport à la plaque, ladite tête de capsulage comprend un corps externe (7) dans lequel un élément de capsulage (9) est logé en coulissement, un siège pour ressort calibré (13) étant défini entre la surface supérieure dudit élément de capsulage (9) et la surface interne de l'extrémité supérieure (7') du corps externe (7) et ledit ressort calibré (13) agissant sur lesdites surfaces, **caractérisé en ce que** ledit actionneur linéaire (16) est un moteur linéaire sans balai et l'actionneur linéaire (16) est relié à une unité de commande et de contrôle pour régler la force de capsulage en référence à une valeur prédéterminée.
2. Dispositif de capsulage selon la revendication 1, dans lequel ledit ressort calibré (13) est du type élastomère de polyuréthane.
3. Dispositif de capsulage selon la revendication 1 ou la revendication 2, dans lequel ledit actionneur linéaire (16) est relié à ladite tête de capsulage (2) au

moyen d'un piston (15) et dans lequel ladite tête de capsulage (2) est insérée par coulisement dans un manchon (6) fixé à un bras (5) fixé sur le carrousel de la machine de capsulage.

4. Dispositif de capsulage selon l'une quelconque des revendications 1 à 3, dans lequel ledit actionneur linéaire (16) est relié à ladite plaque (3) au moyen d'un piston (15).

5. Dispositif de capsulage selon la revendication 1, dans lequel ladite unité de commande et de contrôle:

- enregistre la consommation d'énergie de l'actionneur linéaire (16),
- compare la valeur de la consommation d'énergie enregistrée avec une valeur prédéterminée, et
- envoie un signal de commande à l'actionneur linéaire (16) pour commander son état de fonctionnement.

6. Dispositif de capsulage selon l'une quelconque des revendications 1 à 5, dans lequel ladite unité de commande et de contrôle :

- enregistre la position du piston (15), de la tête de capsulage (2) ou de la plaque (3),
- compare la position enregistrée avec une valeur prédéterminée, et
- envoie un signal de commande à l'actionneur linéaire (16) pour régler le déplacement du piston (15) afin d'obtenir la force de capsulage prédéterminée.

7. Dispositif de capsulage selon l'une quelconque des revendications 1 à 6, dans lequel ladite unité de commande et de contrôle :

- enregistre la hauteur du récipient (4) soumis au capsulage,
- compare la valeur enregistrée avec une valeur de référence, et
- envoie un signal de commande à l'actionneur linéaire (16) pour régler le déplacement du piston (15) afin d'obtenir la force de capsulage prédéterminée.

8. Dispositif de capsulage selon l'une quelconque des revendications 1 à 7, dans lequel ladite unité de commande et de contrôle :

- enregistre la force appliquée sur le récipient,
- compare la valeur enregistrée avec une valeur de référence prédéterminée, et
- envoie un signal de commande à l'actionneur linéaire (16) pour régler la force de capsulage en référence à une valeur prédéterminée.

9. Dispositif de capsulage selon la revendication 8, dans lequel ledit dispositif comprend un dynamomètre pour mesurer la force de réaction à laquelle est soumise la tête de capsulage (2) durant la phase de capsulage du récipient (4).

10. Machine de capsulage du type rotatif, **caractérisée en ce qu'elle** comprend un dispositif de capsulage (1) selon l'une quelconque des revendications 1 à 9.

11. Procédé de capsulage de récipients (4) à capsules-couronnes (14), comprenant les étapes de :

- fourniture d'un dispositif de capsulage selon la revendication 1, et
- réglage automatique de la force de capsulage relativement à une valeur prédéterminée.

12. Procédé selon la revendication 11, dans lequel ledit réglage automatique de la force de capsulage est réalisé au moyen de l'unité de commande et de contrôle.

13. Procédé selon la revendication 12, dans lequel ledit réglage automatique de la force de capsulage est réalisé au moyen de :

- l'enregistrement de la consommation d'énergie de l'actionneur linéaire (16),
- la comparaison de la valeur de la consommation d'énergie enregistrée avec une valeur prédéterminée, et
- l'envoi d'un signal de commande à l'actionneur linéaire (16) pour commander son état de fonctionnement.

14. Procédé selon la revendication 12, dans lequel ledit réglage automatique de la force de capsulage est réalisé au moyen de :

- l'enregistrement de la position du piston (15), de la tête de capsulage (2) ou de la plaque (3),
- la comparaison de la position enregistrée avec une valeur prédéterminée, et
- l'envoi d'un signal de commande à l'actionneur linéaire (16) pour régler le déplacement du piston (15) afin d'obtenir la force de capsulage prédéterminée.

15. Procédé selon la revendication 12, dans lequel ledit réglage automatique de la force de capsulage est réalisé au moyen de :

- l'enregistrement de la hauteur du récipient (4) soumis au capsulage,
- la comparaison de la valeur enregistrée avec une valeur de référence, et
- l'envoi d'un signal de commande à l'actionneur

linéaire (16) pour régler le déplacement du piston (15) afin d'obtenir la force de capsulage prédéterminée.

16. Procédé selon la revendication 12, dans lequel ledit réglage automatique de la force de capsulage est réalisé au moyen de :

- l'enregistrement de la force appliquée sur le récipient (4),
- la comparaison de la valeur enregistrée avec une valeur de référence prédéterminée, et
- l'envoi d'un signal de commande à l'actionneur linéaire (16) pour régler la force de capsulage en référence à une valeur prédéterminée.

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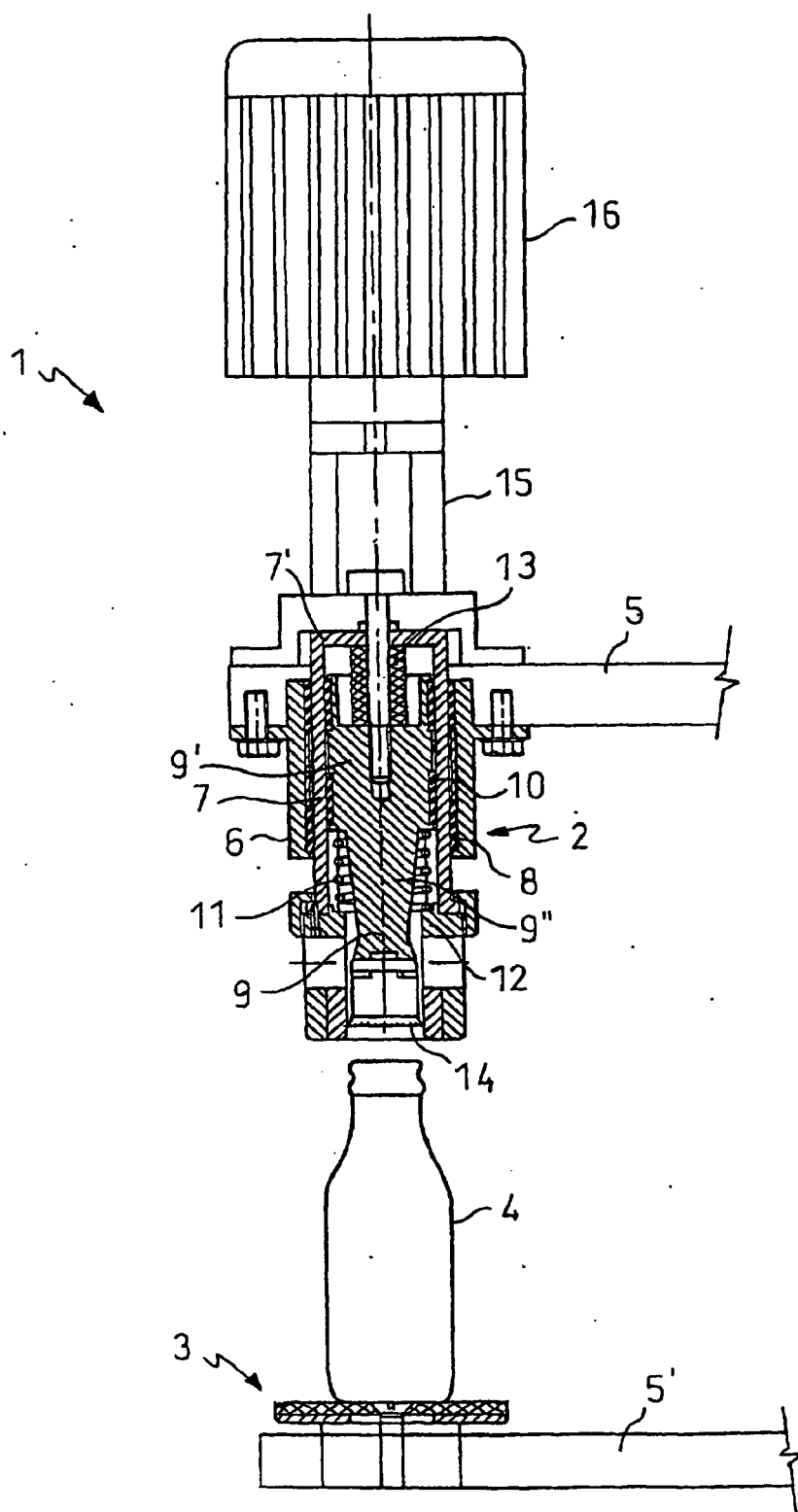
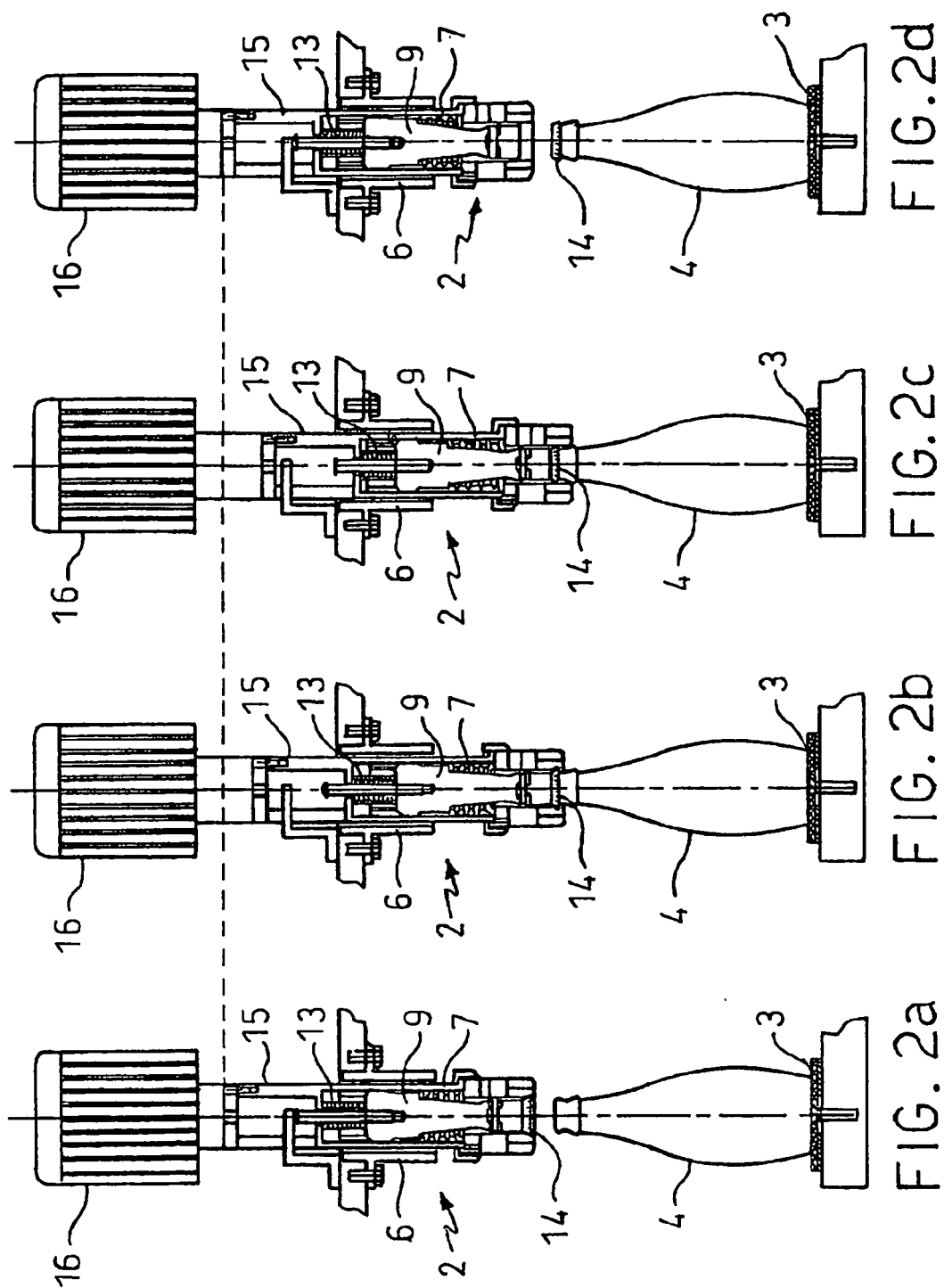


FIG. 1



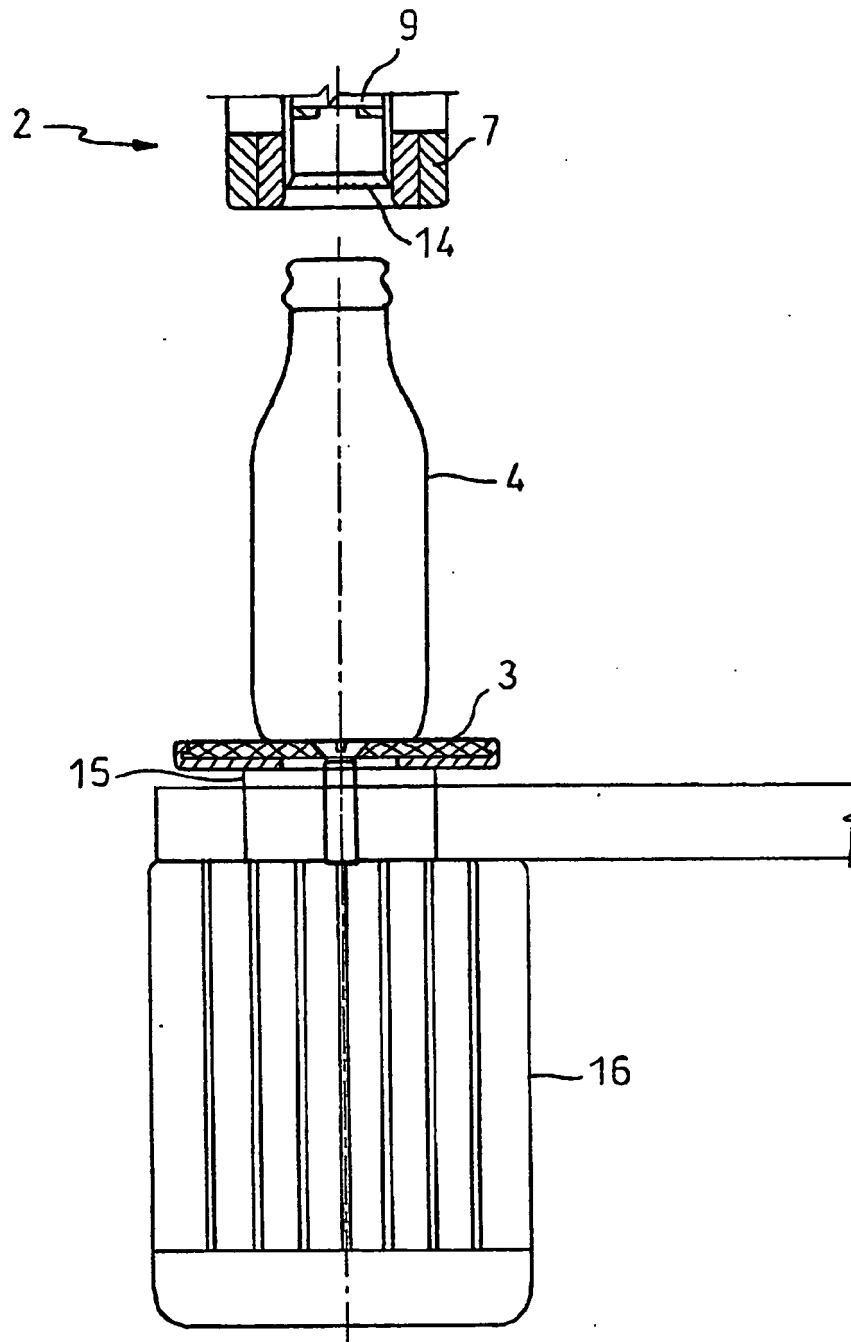


FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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