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(54) **Machine for applying capsules on bottles with rubber stoppers.**

(57) In a capsule applying machine (100) each bottle (10) is locked by a stem (41) which slides in a through hole (5) of a turntable (4) and carries a small cup-shaped pad (27) that pushes the capsule (11). The bottle (10) is put on a plate (21) which has a cylindrical shank (22) inserted in a cup-shaped plunger (24) of a pneumatic actuator (23) carried by the disc (3) and connected to a modulating valve (25) so as to obtain a constant pressure.

A first gear (51) is keyed to the stem (41) and engages with a toothed wheel (53) with which a second gear (52) is engaged. This second gear is driven by two pulleys (56,57) linked by a belt (58) and a shaft (59,49) connected to a motor (48) which is electronically controlled.

There is provided, for folding the edge of the capsule (11), a blade (61), carried by a rocker element (62) having its pivot point on a supporting cradle (64) and subjected to the action of a pneumatic actuator (65) connected to a modulating valve (69), so as to maintain a constant pressure.

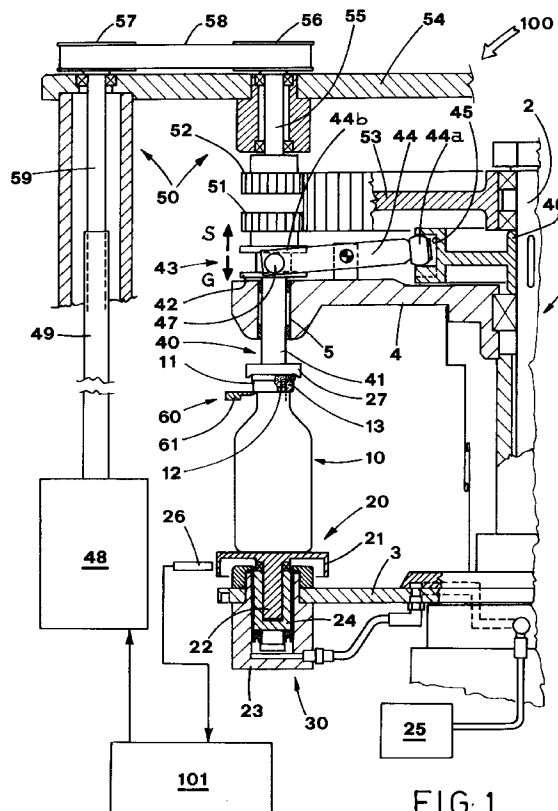


FIG. 1

The present invention relates to the technical sector concerning the construction of automatic machines for packing products in containers, e.g. bottles.

In particular, the invention relates to a machine that fits metal capsules, i.e. that blocks the sealing capsule on the bottle by folding the border of the capsule skirt that extends beyond the bulge of the bottle.

Various machines are known for performing this operation according to different methods, usually comprising a carousel that is driven to rotate and that features a number of housings designed to receive and support single containers, already filled.

The containers are fed to the carousel by separating means, e.g. Archimedean screws with horizontal axis, and, at the end of the cycle they are taken by other means. The bottles already filled are then brought to other sections of the machine, or to other machines, so as to complete the packing.

In the first section of the carousel, or immediately upstream of it, a stopper made of rubber and a capsule, generally of aluminium, are put on the bottle already filled.

During the passage along the circumferential section of the carousel, the capsule and the stopper are pressed on the bottle, and the border of the capsule, that extends downwards beyond the bulge of the bottle, is folded, thus fastening the capsule to the bottle.

Due to the upward elastic reaction of the stopper of rubber, the folded border is pressed against the bulge, thus blocking the capsule.

Usually, the border of the capsule is folded by means of a blade of suitable shape, e.g. extending in a circular sector, or by a rotary disc placed, together with a rotary axle, inside the circumference covered by the bottles.

The edge of the blade or of the disc grips the underside of the bottle bulge thus folding the border of the capsule and realising the blocking of the metal capsule.

Nevertheless, various problems arise concerning both the correct positioning of the bottle and blocking of the capsule.

In fact, the height of each bottle diverges a bit from the medium height, according to which the machine has been set up, similarly the heights of the rubber stopper and the same capsule diverge.

Moreover, also the hardness of the stopper changes, therefore different elastic reaction determines different intensity of the blocking force of the capsule to the bottle.

Since the ideal to be realised is a uniform blocking of all the bottles, it is necessary to provide means that react with minor displacement for a bigger stopper hardness, when the capsule is compressed with constant force, thus making the blocking force remain within a prefixed range.

Bottles whose capsules are blocked with force that does not enter in the prefixed range, are subsequently rejected.

A machine of this type is described in the patent publication DE-A-3908582. This machine is equipped with a device gripping the capsule and subjected to the elastic reaction of a spring, so as to compensate possible differences in the bottles height.

The bottles supporting plates are raised and lowered during the carousel rotation, by means of a circular cam concentric with the carousel axis, that acts on the rolls, each of which fixed rotatably on the inner side of a bush integral with a metal tube inside which the plate shank runs.

The upper edge of the tube transmits the thrust to the plate.

A spring, designed to compensate light variations of the hardness of the rubber of which the stopper is made, is joined to the plate-tube unit.

The bottles that, after the capsule has been blocked, do not have characteristics remaining within the prefixed values, due to variations of dimensions or constitution of the materials used for the stopper and capsule, or due to machine functional deficiency, are rejected.

The bottles are made to rotate during the carousel rotation by means of a system of belts engaging with pulleys made integral with the bottom of the plate shaft.

In other cases, the bottle is made to rotate by the upper locking member that is linked, via a gears train, to a threaded wheel, keyed to the fixed carousel axle.

Since the carousel rotates, the relative motion between the toothed wheel and the first gear engaged therewith, provokes the rotation of the latter and therefore also of the gear keyed on the locking member of the bottle that hence is made to rotate.

The speed of the bottle rotation is directly proportional to the speed of the carousel rotation. In the case described in the patent publication DE-A-3908582, the internal gripping disc is idle on the carousel axle, so, even if the bottles dimension changes, the disc rotation speed conforms to the needs every time.

When instead there is a fixed blade with circular section shape, every time that the bottle size is changed, it is also necessary to change the bottle rotation speed in order to avoid slippings of the capsule border on the blade provoking scratches and metal dusting.

In the known systems the rotation speed is changed by substituting two or more gears in the linkage gear train driving the bottle locking member, or there is provided a small speed change system.

It is obvious that in both cases the number of bottle sizes that can be handled depends on the limited number of rotation speeds that can be obtained, and handling the bottles of different sizes requires long and difficult set up operations of the machine.

Another problem resulting from using the known capsule fitting machines derives from the different vertical positioning of the bottle bulge, as well as of the border to be folded, with respect to the folding blade, that is the consequence of the difference from the nominal values, as described above.

Besides functional disadvantages, this problem provokes also differences between the bottles in consideration of different forces exerted by the folding blade on the border to be folded. This provokes different blocking forces in the bottle capsules.

Generally, the philosophy followed in designing the known machines was that a high number of products should have been made and then a selection should have been done, thus eliminating those products which did not fall in the ranges assigned to the various parameters.

Presently, design and construction of these machines try to privilege an operation with a constant product quality, even with a lower production rate. Particularly, in many cases it is requested to issue a certificate, wherein all the requirements for all the articles being produced by the machine, are guaranteed.

The present trend is to provide controlled and checked processes which allow for issuing such certificates, while avoiding at the same time any product discard.

Under this view, the machines presently manufactured include devices which are more and more versatile and that can be adjusted in accordance with the various requirements. Particularly, the systems presently adopted tend to coordinate the stages of the process, for instances filling and sealing operation, and to put them under global control of a microprocessor control unit.

The microprocessor control unit has the task of checking the variable characteristics of the products, and then it immediately intervenes to correct the trend to deviate from the standard values.

In this way, production of articles presenting unacceptable characteristics is avoided, and product discard in a following stage is prevented.

The object of the present invention, is to provide a capsule fitting machine that follows the new trend, as far as its functional characteristics are concerned, thus avoiding all problems and drawbacks encountered in the known machines, as set forth hereinabove.

A further object of the present invention is to provide the machine as just mentioned equipped with devices having a basically simple operation that is, as far as possible, free with respect to the bottle and related stopper size, as well as with respect to any dimensional or constructive variation, so that a basically uniform blocking force can be obtained for all the bottles, or anyway a blocking force that falls within a very small value range. Consequently a certificate

that guarantees that all the products meet the established requirements can be issued, and no products are discarded.

All the devices mounted on the machine are constructed and coordinated in such a way that they can be controlled by means of a microprocessor control unit, and can be easily adjusted, in continuous and quick way, in accordance with the variations of dimensions and constitution of the articles.

The above mentioned objects are achieved by means of the machine made in accordance with the content of claim 1.

Particulars and details of the invention are highlighted in the following, with particular reference to the attached drawings, in which:

- Fig. 1 shows, schematically and partially, the machine that is the subject of the present invention;

- Fig. 2 shows, in enlarged view, a detail of the machine, this detail not being shown in Fig. 1 for better understanding of the representation.

With reference to the figures listed hereinabove, reference numeral 100 generally indicates the machine for fitting a closure capsule to a bottle, which machine is the subject of the present invention.

The machine 100 is made in such a way as to perform a global quality check, and particularly, as far as the fitting of the closure capsule is concerned, it is able to assure that all the capsule 11 fitted to the bottles 10 are secured with a constantly acting force, so that the lower skirt of every capsule gripped under the bulge 13 of all the bottles 10 pushes with the same force on the lower surface of the same bulge 13.

With reference to Figure 1, and according to a known configuration that is herein considered as an example without any limitation, the machine 100 basically includes a rotating carousel 1 that is supported by a vertical axle 2 driven by driving means not shown, so that the axle rotates.

The carousel 1 includes a disc 3, at a lower level, and a turntable 4 situated over the disc 3. The disc 3 is equipped with a plurality of support means 20 for the bottles 10 which are situated along and near the circumference of the disc, in equispaced relation.

The turntable 4 carries a plurality of bottle gripping means 40, which are situated along and near the circumference of the same turntable 4 in equispaced relation. The gripping means are moved vertically in opposed directions S and G with strokes having constant length and performed in phase relation with the rotation of the carousel 1.

The support means 20 together with the gripping means 40 form a plurality of seats where the bottles 10 are to be placed in. The bottles are fed to the carousel 1 by a feeder, for instance a screw feeder, that has the task of separating them from one another.

The bottles 10, with the stopper and capsule already fitted to them, are delivered at the outlet of the

carousel to a transporter, for instance a screw conveyor, which has the task to bring them to further sections of the machine, or alternatively to other machines, in order to complete the packaging.

The feeder and the delivery transporter are not shown in the drawings, as they are well known in the art.

Folding means 60 are aimed at folding the lower border of the closure capsule 11 which protrude downwardly beyond the bulge 13 of the bottles 10.

The means 20, 40 and 60 above mentioned are described in further detail in the following.

In order to perform a global quality check in the best way, the capsule fitting machine 100 is further equipped with pneumatic means 30, which are aimed at defining the vertical position of the support means 20 with a constant elastic reacting force, with independent driving means 50 for driving the locking means 40 with a varying speed, and with pneumatic means 70 which are aimed at operating the folding means 60 with a constant elastic reaction force.

Also the means 30, 50 and 70 that have been just cited and that characterise the present invention, are described in detail in the following.

The locking means 40 that hold the bottle at the top, which are of known type, comprise a stem 41 located in each position. Each stem is slidably inserted in a through hole 5 made in the upper turntable 4, and carries at its lower end a cup-shaped pad 27 designed to push and grip the capsule 11 of a bottle placed in the respective position.

At the upper end of the stem 41 there is a collar 42 coaxially keyed to the stem, with a circumferential groove 43. A rocker 44 is pivoted to the upper turntable 4 so that the pivot point is located at an intermediate region of the rocker. One end 44a of the rocker 44 runs in a cam groove 45 made in a wheel 46 keyed on the vertical axle 2, while the other end 44b of the rocker is shaped like a fork with two counterfacing prominences 47 which run in the groove 43. In this way, when the rocker 44 swings vertically, as a consequence of the rotation of carousel 1, the stem 41 is made to oscillate vertically.

The driving means 40, for independently driving the means 40 with variable speed, include a first gear 51 having vertical axis and made integral with the stem 41. The first gear 51 meshes with a toothed wheel 53 that is idling mounted on the vertical axle 2.

The first gear is allowed to shift vertically without going out of mesh with the toothed wheel 53.

A second gear 52 is supported, with its axis being vertical, by a frame 54 associated to the machine 100, in a position near to the toothed wheel 53, so that it is always in mesh with this latter.

The axle 55 of the second gear 52 is rotatably supported by the frame 54 and is connected to rotary driving means 56, 57, 58, 59, 49, 48 which basically include two pulleys 56 and 57, linked by means of a belt

58, and a vertical shaft axially extendible. The shaft comprises a first section 59, with the second pulley 57 keyed to the upper end of this first section, and a second section 49 connected at its lower end to a motor 48.

The motor 48 is controlled electronically so that its rotational speed can be varied in accordance with the rotational speed of the carousel 1 as well as with the size of the bottles 10.

The control device for the motor 48 is not shown, as it is well known, and is connected to an electronic control unit 101, as schematically shown in Figure 1.

Also in Figure 1 there are shown the support means 20 for the bottles 10, these support means including, for each position defined on the carousel, a rotary plate 21 having a cylindrical shank 22 made integral therewith and extending downwards.

The pneumatic means 30 for defining the vertical position of the support means 20, include a pneumatic actuator 23 with a cup-shaped plunger 24 into which there is rotatably inserted the cylindrical shank 22.

The pneumatic actuator 23 is connected to a compressed air source via a modulation valve 25, i.e. a valve that is aimed at keeping the air pressure present within the pneumatic actuator 23 at a constant value, so that the force exerted on the bottom of every bottle 10 does not change as a consequence of the change of dimensions and constitution characteristics of the articles, thus maintaining also the force exerted on the related rubber stopper 12 at a constant value.

In this way the elastic reaction of the rubber stoppers 12 is the same for all the bottles 10, this resulting in locking of the stoppers with a force unvaried for all the bottles, or anyway with a variation contained within a very strict range.

There is also a sensor 26, connected to the electronic control unit 101, that has the task of detecting the downward displacement of the plate 21, in order to check the presence, the missing or the braking or crashing, of the bottle 10 on the plate 21.

The sensor, due to a different displacement of the plate 21, is also able to detect the missing of the capsule 11 or of the stopper 12. The sensor 26 include a photocell or a proximity sensor.

The folding means 60 for folding the lower border of the closing capsule, include a circular sector-like blade 61, and the lower border of the closing capsule 11, to be folded, is brought against the blade 61 owing to the rotation of the carousel 1.

Since the bottle 10 is rotated, the entire border of the capsule 11 is folded by the blade 61 in the extension of the circumference arc covered by the bottle 10 and that corresponds to the length of the blade 61.

The means 70 for the operation of the folding means, with a constant elastic reaction, include a supporting cradle 64 associated to the capsule fitting

machine 100, and a rocker element 62 having its pivot point located on a pin 63 fixed to the supporting cradle 64. The blade 61 is fixed to an end 62a of the rocker element 62.

A pneumatic actuator 65, supported by the cradle 64, pushes through its stem 66 on the other end 62b of the rocker element 62. The pneumatic actuator 65 is connected to a source of compressed air via a modulating valve 69, so that the air inside the actuator is kept at a constant pressure.

In this way the blade 61 acts with a constant force on the lower border of the capsule 11.

Furthermore there is a tailpiece 67, extending from the rocker element 62, that passes through the action field of a sensor means 68 when the rocker element 62 swings, so that the action performed by the blade 61 on the capsule 11 of a bottle 10 can be detected. The sensor means 68 is connected to the electronic control unit 101.

It is clear that when the sensor means 68 does not detect any displacement of the tailpiece 67, that is when there is no action of the blade 61 on the capsule 11 of the bottle 10, then the electronic control unit 101 will command the discard of what there is in the related position, i.e. of the that bottle that is not integral or that is missing the stopper or the capsule.

Also in case that the bottle is missing, then the electronic control unit will set up all the device downstream for the bottle being missing.

The operation of the devices takes place in a simple and coordinated way.

The motor 48 is electronically controlled by the electronic control unit 101, and necessary information concerning the sizes of the bottles and capsules are entered into the control unit by means of a key-word suitably adapted, so that the motor speed is automatically varied in accordance with the sizes.

Moreover, the unit 101 automatically controls the speed of the motor 48 in a rate proportional to the rotational speed of the carousel 1.

The disengagement of the motor operational speed from the carousel rotational speed is one of the basic principles according to which the machine of the invention operates.

With reference to a single bottle 10, with a stopper and a capsule already placed on it, it is first positioned on a plate 21 of the disc 3.

The end 44a of the rocker 44, suitably fitted with a bearing, is in engagement with the cam groove 45, and because of the relative slipping between the rocker end and the cam groove occurring during rotation of the carousel 1, the rocker end 44b goes downwards, as well as the stem 41, so that the cup-shaped pad 27 goes to push on the capsule 11 of the bottle 10.

The lowering of the bottle, equal to the upward displacement of the cam groove path, along with the upward force exerted by the pneumatic actuator 23

provoke the compression of the stopper 12.

The adoption of the pneumatic actuator 23 connected to the modulating valve 25, allows for obtaining a constant force that has no connection with the downward displacement of the plate 21, and that is independent from the actual height of the bottle 10, of the capsule 11 and of the rubber stopper 12, as well as from the hardness of the material use to make the stopper 12.

The sensor 26 checks whether the plate 21 has lowered, and consequently whether the bottle 10 is present on it, whether the bottle 10 has the capsule 11 and the stopper 12, and whether the bottle is integral.

The sensor 26 may be replaced with other detecting means or systems, which are well known to the skilled in the art, it being sufficient that they perform the task of detecting the downward displacement of the plate, which is a fundamental movement for the operation of the machine in accordance with the operating method adopted.

Due to the rotation of the carousel 1, the bottle 10 is brought towards the blade 61 that strikes the lower border of the capsule 11 and folds it under the bottle bulge 13.

The axial rotation of the bottle allows the action of the blade along the whole circumference of the capsule border.

The force through which the blade 61 pushes the border upwards, depends on the action exerted by the pneumatic actuator 65 on the rocker element 62. Mounting the pneumatic actuator 65, connected with the modulating valve 69, allows to obtain a constant force acting on the blade 61, force that is independent from the actual position of the lower surface of the bulge 13.

In this way the value of the force acting on the capsule border does not depend on both the bulge height and the difference in height level of the bulge lower surface, provoked as a consequence of the different hardness of the material with which the stoppers 12 are made.

The tailpiece 67, along with the sensor 68, check whether or not the blade 61 has been touched by the capsule 11 of the bottle 10, and accordingly send a signal to the electronic control unit 101.

In case the signal corresponds to the blade not having been touched by the capsule, the bottle 10 is rejected in that it is not regular or it misses the capsule 11.

Also in this case the sensor 68, as well as the tailpiece 67, may be replaced with other suitable means or systems also known to the skilled in the art. The essential condition is that they perform the task of detecting the downward displacement of the blade 61, that means that the blade is striking the capsule. Also this fact is a fundamental event in the machine operation according to the operating method adopted.

It must be stressed that in the example described herein, the motion which provokes the clenching for the bottle 10 is effected by the stem 41, that is from up downwards. However the capsule fitting machine 100, made in accordance with the invention, will as well operate if the clenching motion is effected by the pneumatic actuator 23, that is from down upwards. It is necessary, however, to set a fixed shoulder to limit the upward displacement for the bottles 10.

Claims

1. Machine for fitting a closure capsule to a bottle with a rubber stopper (12), this machine including: a carousel (1) supported by a vertical axle (2) that is driven to rotate;
a disc (3) coaxial with respect to said vertical axle (2), which disc features, near its circumference and in equispaced relation, a plurality of supporting means (20) for the bottles (10);
a turntable (4), also coaxial with respect to said vertical axle (2), which turntable carries, near its circumference and in equispaced relation, a plurality of locking means (40) positioned as the corresponding supporting means (20) and designed to clench the bottles (10), the locking means and the supporting means together defining a plurality of positions where the bottles (10) are to be located, the said locking means being moved vertically according to opposite directions (S,G) with a constant stroke in phase relation with the rotation of the said carousel (1); and
folding means (60) designed to fold the lower border of the said capsule (11) that extends downwards beyond the bulge (13) of the said bottle (10), the said folding means (60) including a circular sector-like blade (61);
the said capsule fitting machine (100) being **characterised in that** it also includes:
vertical positioning pneumatic means (30) with constant elastic reaction, designed to set the vertical position of the supporting means (20) for the bottles (10);
driving means (50) designed to independently cause rotation of said bottle locking means (40) with a variable speed;
pneumatic means (70) designed to operate, with constant elastic reaction, folding means (60) designed to fold the border of the said capsule (11) of the said bottle (10).
2. Machine as in claim 1, **characterised in that** said locking means (40) are driven to rotate by a motor (48) that is electronically controlled by an electronic control unit (101), so that by entering proper information into said control unit the rotational speed of the said motor (68) is accordingly varied

automatically, and consequently also the said locking means (40) are rotated in accordance with the rotational speed of the said carousel (1) as well as of the size of the said bottles (10).

3. Machine as in claim 2, **characterised in that** said driving means (50) designed to independently cause rotation of said bottle locking means (40) with a variable speed, further include:
a first gear (51), with vertical axis, made integral with the said locking means (40) for locking the bottle at the top, and in engagement with a toothed wheel (53) in such a way that it can move vertically, said toothed wheel being idling mounted on the said vertical axle (2);
a second gear (52) supported by a frame (54) that is associated to the said capsule fitting machine (100), and located near to the said toothed wheel (53), so that the said second gear is constantly kept in engagement with the said toothed wheel, the axle (55) of the said second gear (52) being rotatably supported by said frame (54) and carrying, keyed thereto, a first pulley (56) linked to a second pulley (57) by means of a belt (58);
a vertical shaft axially extendible including a first section (59), to the upper end of which there is keyed the said second pulley (57), and a second section (49), connected at the lower ends with the said motor (48).
4. Machine as in claim 1, **characterised in that** the said supporting means (20) for the bottles (10) include, at each position, a rotary plate (21) having a cylindrical shank (22) made integral therewith and extending downwards, while the said vertical positioning pneumatic means (30), for positioning the said bottle support means (20), include a pneumatic actuator (23) with a cup-shaped plunger (24) into which there is inserted the said cylindrical shank (22), the said pneumatic actuator (23) being connected to a source of compressed air via a modulating valve (25) aimed at keeping the pressure inside the said pneumatic actuator (23) at a constant value.
5. Machine as in claim 4, **characterised in that** said supporting means (20) for the bottle (10) further include a sensor means (26) connected to the electronic control unit (101), this sensor being aimed at detecting the downward displacement of the said plate (21), so as to determine the presence or missing of a bottle (10) on the same plate (21), or to detect incompleteness of the bottle (10) or missing of the capsule (11) or stopper (13) on the said bottle (10).
6. Machine as in claim 1, **characterised in that** the said pneumatic means (70) designed to operate,

with constant elastic reaction, the folding means (60), include:

a supporting cradle (64), associated to the capsule fitting machine (101);

a rocker element (62) pivoted about a pin (62) fixed to the supporting cradle (64), the said blade (61) being fastened to an end (62a) of the said rocking element (62); 5

a pneumatic actuator (65) supported by the said supporting cradle (64) and acting with its stem (66) on the other end (62b) of the said rocker element (62), the said pneumatic actuator (65) being connected to a source of compressed air via a modulating valve (69) that is aimed at keeping the pressure inside the said pneumatic actuator (65) at a constant value, so as to obtain an action with constant force exerted by the said blade (61) on the lower border of the said capsule (11). 10 15

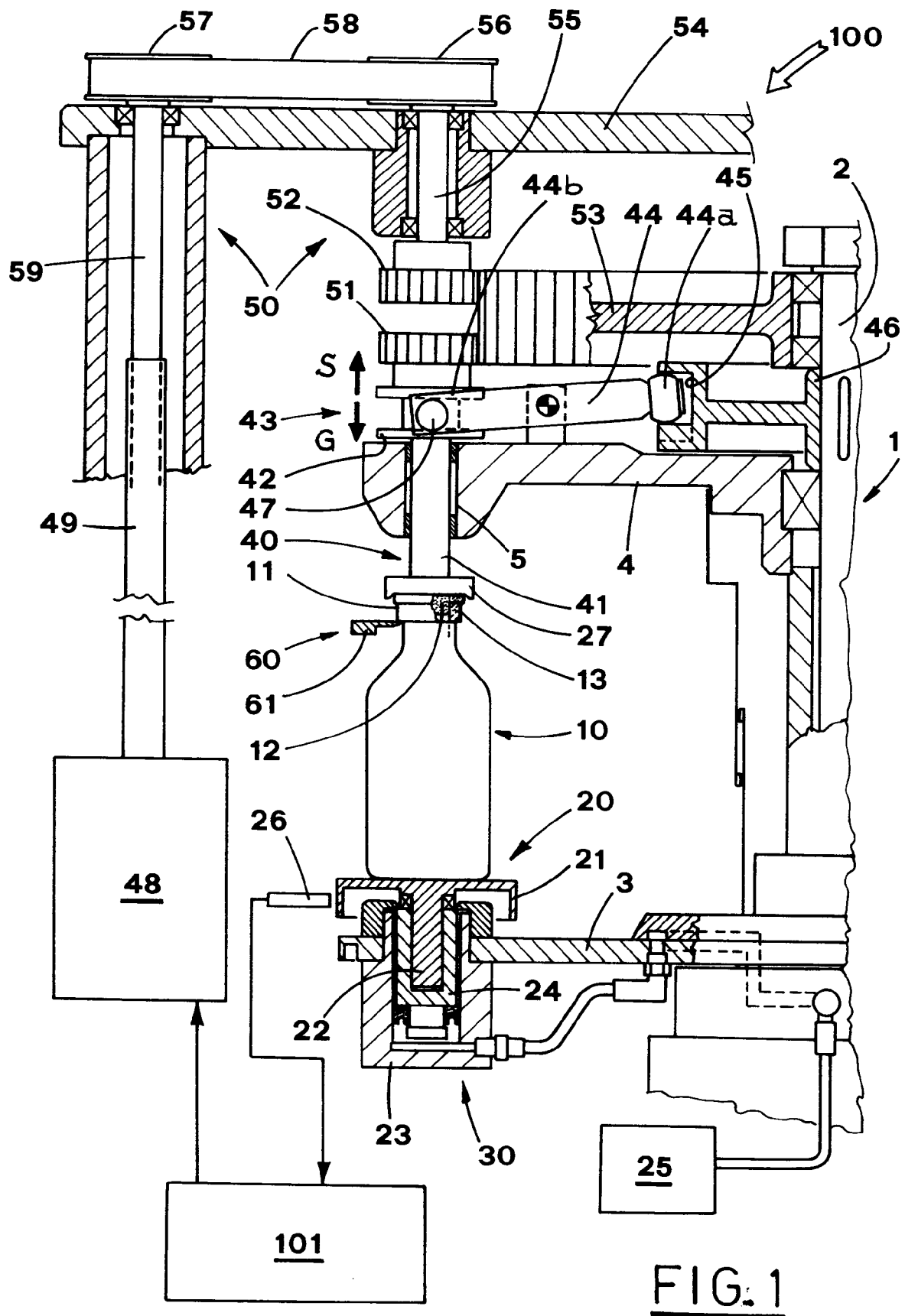
7. Machine as in claim 6, **characterised in that** the said pneumatic means (70) designed to operate, with constant elastic reaction, the folding means (60), further include a tailpiece (67) extending from the said rocker element (62), the said tailpiece (67) passing through the sensing field of a sensor means (68), so that the action of the said blade (61) on the said capsule (11) of a bottle (10), can be detected, the said sensor means (68) being connected to an electronic control unit (101). 20 25 30

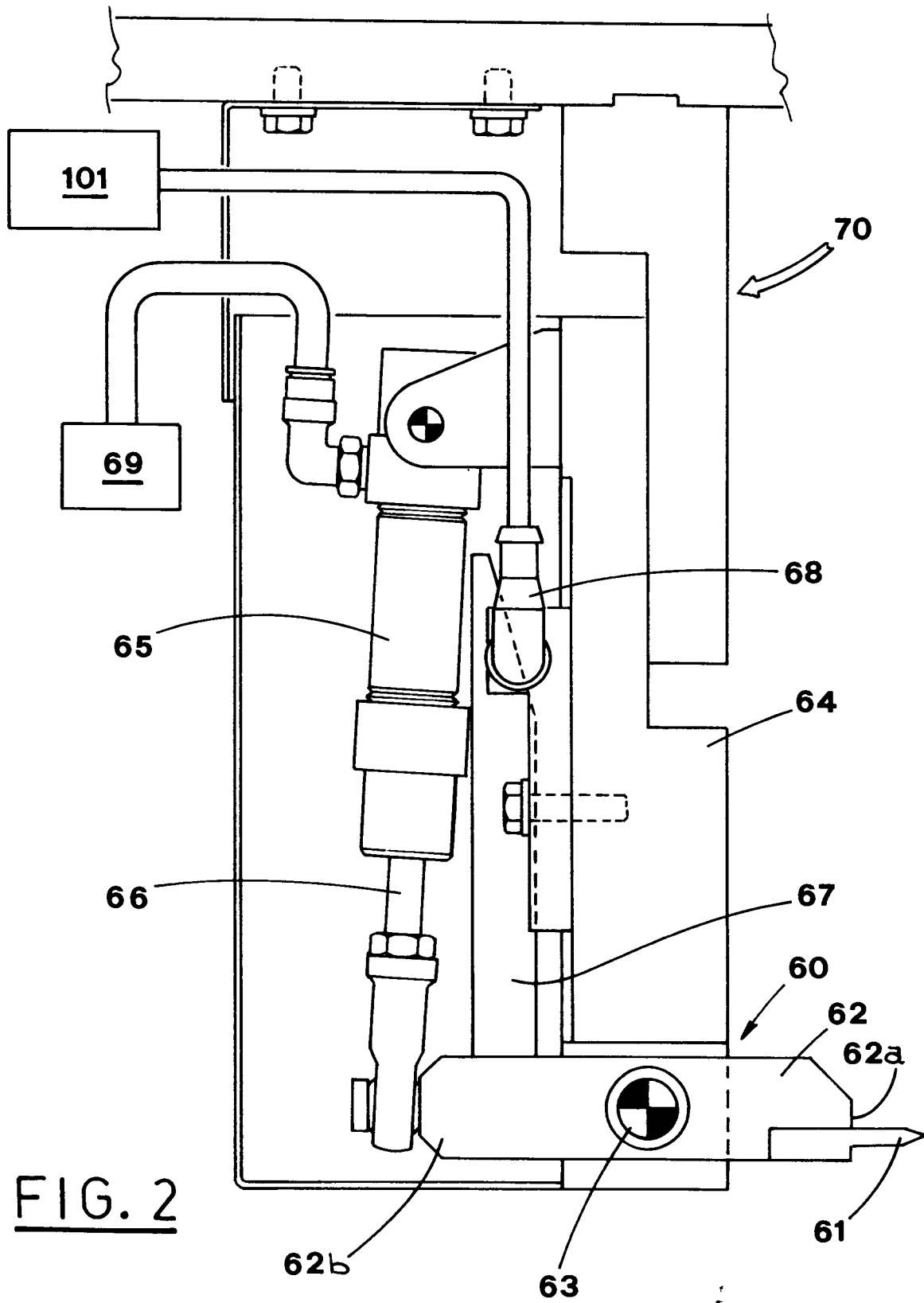
8. Machine as in claim 1, **characterised in that** the said turntable (4) carrying the said bottle locking means (40), is located at an upper position with respect to the said disc (3), carrying the said bottle supporting means (20) and the said vertical positioning pneumatic means for the bottle supporting means (20), that is instead located at a lower position. 35 40

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European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 83 0400

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.6)
D,A	DE-U-90 00 905 (GRONINGER & CO GMBH) * page 9, line 13 - page 16, line 5 * * figures 1,1A,1B * & DE-A-39 08 582 (GRONINGER & CO GMBH) ---	1	B67B1/04 B67B5/03 B67B3/28
A	FR-A-2 163 869 (ELELMEZESIPARI TERVEZO VALLALAT) * page 4, line 28 - page 6, line 36 * * figures 1-4 * ---	1	
A	FR-A-2 215 382 (ALUMINIUM COMPANY OF AMERICA) * page 2, line 15 - page 6, line 24 * * figures 1-3 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B67B B67C B65C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 December 1994	Examiner SMOLDERS, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category 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			

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