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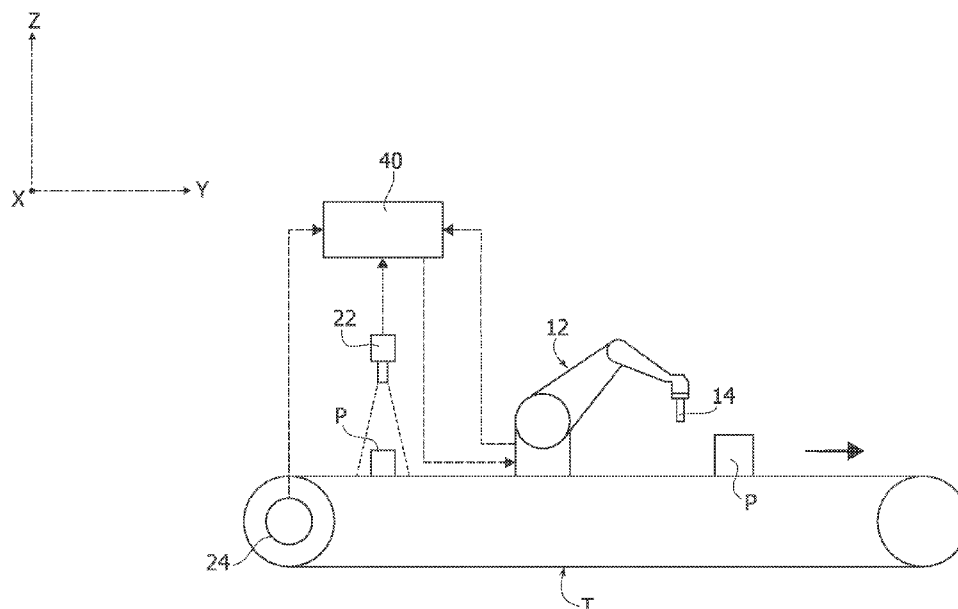
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(54) Title: METHOD FOR PERFORMING COMPRESSION TESTS ON PRODUCTS ADVANCING ON A CONVEYER BELT

FIG. 2



(57) Abstract: Described herein is a process for conducting squeeze tests on products (P) that advance along a conveyor line (T). The process uses a device (12) that governs a feeler member (14) for squeezing the product to be tested while the latter advances along the conveyor line. The process described is characterised in that it can operate directly on products that travel on a conveyor line without any need to intervene on control of the line.



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METHOD FOR PERFORMING COMPRESSION TESTS ON PRODUCTS
ADVANCING ON CONVEYER BELT

* * * *

DESCRIPTION

5 The present invention relates in general to quality control of products coming from a production line and/or an industrial packaging line.

 More in particular, the invention regards a process and an apparatus for conducting a squeeze test on the aforesaid products. Herein, by “squeeze test” is meant a generic test in which the product is subjected to an action of
10 compression or squeezing, and the mechanical behaviour thereof is examined.

 As will be said in what follows, a preferred application of the solution described herein regards conduct of leakage tests on sealed packages. A further application regards conduct of tests of softness on
15 products, whether naked or packaged.

 With reference now to the prior art, WO2017/192035 describes a system for measuring the tightness of sealed packages, which envisages setting a deformable chamber alongside the package to be tested and monitoring the pressure within the chamber, while this and the package are
20 squeezed together between two rigid surfaces.

 Integration of the above testing system on an industrial production line requires control of the conveyor means of the line so as to stop advance of the products whenever it is necessary to conduct the leakage test, this evidently penalising the efficiency of the production line.

25 In this context, the object of the present invention is to provide an improved solution that will overcome the aforesaid drawback.

 In particular, the present invention regards a process for conducting squeeze tests according to Claim 1 and a testing apparatus according to Claim 10.

The characteristics specified in the claims form an integral part of the technical teaching provided herein.

Further characteristics and advantages of the present invention will emerge clearly from the ensuing description with reference to the annexed
5 drawings, which are provided purely by way of non-limiting example and in which:

- Figure 1 shows a block diagram representing the process described herein;

- Figure 2 illustrates an example of apparatus for implementation of
10 the process described herein;

- Figures 3A, 3B, 4A, 4B, 5A, 5B, 6A, 6B, 7A, 7B, 8A, and 8B represent curves regarding different modes of implementation of the process described herein; and

- Figure 9 illustrates a further example of apparatus for
15 implementation of the process described herein.

In the ensuing description are various specific details are illustrated aimed at enabling an in-depth understanding of the embodiments. The embodiments may be obtained without one or more of the specific details, or with other methods, components, materials, etc. In other cases, known
20 structures, materials, or operations are not illustrated or described in detail so that various aspects of the embodiment will not be obscured.

The references used herein are provided merely for convenience and hence do not define the sphere of protection or the scope of the embodiments.

25 The process described herein is provided for conducting squeeze tests on products that advance along a conveyor line.

In general, with reference to Figure 1, the process comprises the following steps:

- providing at least one device equipped with at least one mobile feeler member and one or more actuators for movement of the feeler member (step 101);

5 - determining the position and speed of a product to be tested as it advances along the conveyor line (step 102);

- driving one or more actuators of the device as a function of the position and speed of the product to be tested in order to reach, with the feeler member, the product to be tested (step 103);

10 - bringing the feeler member into a condition of contact with the product to be tested while the latter advances along the conveyor line (step 104);

- maintaining the feeler member in the condition of contact with the product to be tested while the latter advances along the conveyor line (step 105);

15 - detecting at least one signal indicating the force of contact and/or at least one signal indicating the position of contact of the feeler member while the latter is kept in the condition of contact with the product to be tested (step 106); and

20 - determining a condition of the product to be tested as a function of the signal indicating force of contact and/or of the signal indicating position of contact (step 107).

In view of the foregoing, the process described herein uses a device that governs a feeler member for squeezing the product to be tested while the latter advances along the conveyor line.

25 The device governs the feeler member on the basis of the position and speed of the product in order to reach, with the feeler member, the product advancing on the conveyor line.

Once again while the product is advancing, the feeler member is brought into a pre-set condition of contact with the product to be tested, and is then kept in this condition of contact with the product, for a given time.

In various embodiments, the process envisages driving the actuators of the device so as to bring the feeler member in the pre-set condition of contact, on the basis of reference data indicating a required force of contact and/or a required position of contact of the feeler member. The force of contact corresponds to the force exerted on the product tested by the feeler member, whereas the position of contact corresponds to the position assumed by the feeler member.

The process determines the state of the product on the basis of a detection of the position of contact and/or of the force of contact of the feeler member while the latter is kept in the aforesaid condition of contact.

In various embodiments, the process compares the signals detected with reference data indicating a position of contact and/or a force of contact corresponding to a reference condition of the products tested.

The process described herein can be implemented for conducting squeeze tests in the context of applications in which products arranged in a random way and/or of different types advance on the conveyor line.

As will be seen in what follows, according to some embodiments, the process envisages detecting an image of the product to be tested and determining the position of the product and/or the type of product on the basis of data obtained from processing of the aforesaid image.

In various embodiments, the process described herein may envisage the use of a database containing reference data for a plurality of different types of product. In this case, the process hence envisages determining the type of the product to be tested, and retrieving from the aforesaid database the reference data regarding the type of product identified.

In some embodiments, the process described herein may envisage a self-learning step, in which, for each type of product to be tested, the device simulates a squeeze test on a standard product to obtain reference data on the basis of the signals of force of contact and/or position of contact
5 detected during simulation of the squeeze test.

In view of the foregoing, the process described herein can operate directly on products that travel on a conveyor line without any need to intervene on control of the line, but adapting in real time to its operating conditions, which may regard the speed of advance of the products, their
10 arrangement on the conveyor line, and their type.

With reference now to Figure 2, this represents an example of apparatus for implementation of the process described herein. In the application represented, the apparatus is installed on a conveyor T of an industrial production line, on which products P advance in a direction Y.

15 According to the example of Figure 2, the apparatus comprises a manipulator robot 12, which carries on its end a feeler member 14, constituting the end effector, with which the robot 12 comes into contact with the products to be tested for conducting the squeeze test. The robot 12 is pre-arranged for moving the member 14 within the space of the reference
20 system X, Y, and Z.

The apparatus further comprises a camera 22, which is set upstream of the robot 12, with respect to the direction of advance of the products along the conveyor T, and is positioned so as to film from above the products advancing on the conveyor.

25 The apparatus comprises a control unit 40 connected to the robot 12 and to the camera 22. The unit 40 is moreover set in connection with a movement sensor 24 associated to the conveyor T and provided for detecting the conveying speed of the conveyor.

The control unit 40 is configured for determining the position of the products P on the conveyor on the basis of the images taken by the camera 22. In some embodiments, the control unit 40 may moreover be configured for determining the type of product on the basis of the images taken by the camera 22.

In this connection, the control unit 40 can implement any image-processing technique known in the automation sector. As regards determination of the type of product, the control unit 40 can consider one or more characteristics of the product that can be detected via the camera 22, for example dimensions, colour, etc.

The control unit 40 governs the robot 12 so that it carries out the squeeze test on the products P that are moving on the conveyor T.

To conduct a squeeze test on an approaching product, the robot 12 must carry out the following steps:

- reach the product P with the feeler member 14;
- set the feeler member 14 in a condition of contact with the product P; and
- keep the feeler member 14 in the above condition of contact with the product P for a given time.

In the first step, the control unit 40 determines a path for bringing the feeler member 14 into the position of the product P on the conveyor. For this purpose, the control unit 40 is configured for processing the data of speed and position derived from the signals coming from the sensor 24 and from the camera 22.

For instance, the control unit 40 can calculate a future position that the product P will reach after a given time, and process a path for bringing the feeler member 14 into the aforesaid future position within the aforesaid time. This path can be determined in the reference plane X, Y or else in the entire reference system X, Y, Z; in fact, it should be noted that reaching of

the product by the feeler member may correspond to reaching of the position X, Y of the product, or else to reaching of its position X, Y, Z (i.e., it may correspond to contact with the product).

In general, the control unit 40 can in any case implement any robot
5 control and positioning technique known in the automation sector.

In the second step referred to, the feeler member 14 squeezes the product P until it is brought into a pre-set condition of contact.

In various preferred embodiments, the above pre-set condition of contact corresponds to a positioning in Z of the feeler member 14 as a
10 function of a reference position and/or of a reference force of contact.

In other words, the actuator member 14 is brought into a position along Z that may be i) pre-set, or else ii) such as to determine a pre-set force of reaction by the product P on the feeler member 14, or else iii) such as to satisfy a given correlation between the position along Z and the force of
15 reaction of the product P.

Incidentally, it should be noted that the control in Z described herein derives uniquely from the modality with which the squeeze test is carried out on the products, i.e., from the fact that the products are pressed directly against the horizontal surface of the conveyor T, along the axis Z. In any
20 case, it is possible to envisage embodiments in which squeezing of the products occurs in other directions, for example against appropriate non-horizontal contrast surfaces, and consequently also the control of position of the feeler member will be made in other directions.

To return to the succession of steps referred to above, in the third
25 step, the feeler member 14 is kept in the aforesaid condition of contact with the product P for a given time.

The control unit 40 then determines a condition of the product tested as a function of a signal indicating the position of contact of the feeler member 14 and/or of a signal indicating the force of contact, which are

detected during the aforesaid third step. The position of contact corresponds to the position assumed by the feeler member in the pre-set condition of contact. Likewise, the force of contact corresponds to the force exerted by the feeler member on the product, in the pre-set condition of contact.

5 In various embodiments, the signals in question come from respective sensors that are associated to one or more joints of the robot 12 and are pre-arranged, respectively, for measuring the movement of the joint (for example, an encoder) and the intensity of the current absorbed by the actuator for driving the joint. In this embodiment, the use of a collaborative
10 robot is considered the preferred choice.

 In alternative embodiments, the apparatus may, instead, comprise a sensor associated to the feeler member 14 and pre-arranged for measuring its position along Z and/or the force exerted thereby along Z. In this embodiment, the use of a voice-coil actuator associated to the feeler
15 member 14 is considered the preferred choice.

 In any case, the apparatus may then comprise additional sensors for guaranteeing a greater accuracy and repeatability of the detections of force and position referred to above.

 According to preferred embodiments, the control unit 40 determines
20 the condition of the tested product by comparing the aforesaid signals with one or more reference data. To outline these aspects in greater detail, reference will now be made to an application of the apparatus for conducting leakage tests on sealed packages.

 In what follows, the three control modes referred to above will be
25 considered, based, respectively, on measurement of i) the force of contact, ii) the position of contact, and iii) the position and the force of contact. For this purpose, reference will be made to Figures 3A, 3B, 4A, 4B, 5A, 5B, 6A, 6B, 7A, 7B, 8A, and 8B.

In the first mode, the pre-set condition of contact is represented by a pre-set position along Z of the feeler member 14.

It will be noted that this position will correspond to a given distance of the feeler member 14 from the surface of the conveyor T, and hence to a given level of squeezing of the product P lying on the aforesaid surface.

With reference to Figure 3A, this represents the displacement of the feeler member 14 during the test.

As represented in the above figure, the feeler member 14, after coming into contact with the package (position P_0), proceeds until the pre-set position P_R is reached and then remains in this position for a given time. The distance between the position of initial contact P_0 and the pre-set position P_R determines the level of squeezing exerted on the product.

On the other hand, this control mode envisages detecting, during the test, the force of contact of the feeler member.

Figure 3B represents the plot of this force that is expected for a perfectly sealed package.

As represented in the above figure, the force of contact is clearly equal to zero up to contact between the feeler member and the package, and then increases continuously until a maximum value F_{TEST} is reached in the pre-set position P_R . The plateau identified in the final part of the curve corresponds to the step of maintenance of the pre-set condition of contact, i.e., to the step in which the feeler member is kept in the pre-set position P_R ; in the absence of leakage, i.e., loss of tightness, the force of contact must in fact remain constant during this step.

To determine the condition of tightness, the control unit 40 compares the force signal detected with the reference curve referred to above.

According to preferred embodiments, as in the one illustrated, the above evaluation is carried out with reference to a specific measurement interval t_{TEST} that is located in a final phase of the test, which starts from the

moment when the feeler member has reached or is about to reach the pre-set condition of contact.

Figures 4A and 4B represent the curves of a test carried out on a package presenting not perfectly closed seals.

5 The curve represented in Figure 4A, corresponding to displacement of the feeler member 14, is clearly identical to that of Figure 3A.

10 Instead, the curve of Figure 4B, which regards the force signal detected during the test, presents within the aforesaid test interval t_{TEST} an evolution different from that of the curve of Figure 3B. In particular, after reaching a peak in a position slightly anticipated with respect to the pre-set position P_R of the feeler member, the force of contact decreases sensibly, albeit in an irregular way, this being a behaviour that indicates a drop in pressure within the package, i.e., the presence, therein, of leakage.

15 The control unit 40 may clearly use tolerance intervals for evaluating the condition of the product tested on the basis of the aforesaid signals.

Figures 5A-B and 6A-B regard the second control mode referred to above. In this case, the pre-set condition of contact corresponds to a pre-set force of contact F_R .

20 According to the above control mode, the feeler member 14 is hence moved along Z, against the package, until the pre-set force of contact F_R is detected. Figure 5A represents the plot of the force of contact during conduct of the test.

25 On the other hand, the above control mode envisages detection, during the test, of the position of contact of the feeler member.

In this connection, Figure 5B represents the plot of the position of the feeler member 14 for a test carried out on a perfectly sealed package: the feeler member moves into the position P_{TEST} for determining the force

F_R of the pre-set condition of contact, and then remains in this position P_{TEST} during the phase of maintenance of the force F_R .

Also for this control mode illustrated in Figures 6A, 6B are curves regarding a test conducted on a package presenting leakage.

- 5 In any case, apart from the aspects pointed out, also for this second control mode there apply the considerations of a general nature already expressed with reference to the previous control mode.

10 In the third control mode, the pre-set condition of contact corresponds to a given correlation between the position along Z of the feeler member and the force generated thereby in this position. The feeler member 14 is governed on the basis of the aforesaid correlation. This correlation is defined so as to take into account possible variations of the conformation of the portion of the products with which the feeler member moves into contact. In preferred embodiments, this correlation is a function
15 that represents a given evolution towards a condition of stability. During this control mode, both the position and the force are detected, and it is the impossibility of reaching a stable condition that determines a negative index as regards the condition of tightness of the package. This control mode is particularly advantageous in applications where the packages/products to be
20 tested have complex structures or else belong to different types. For instance, for products having areas of different softness, the force generated for a given position along Z, and, vice versa, the position along Z reached for generating a given force, may vary from area to area; in any case, this control mode makes it possible to verify whether a stable condition is
25 reached, without considering the specific values of position and force measured. Figures 7A and 7B represent the reference curves for the position of contact and the force of contact, respectively. Figures 8A and 8B represent the corresponding curves detected for a package presenting leakage.

In the examples illustrated, in order to determine the condition of the product, the control unit makes a comparison between the signals detected and the reference curves. In alternative embodiments, the comparison may, instead, be made with respect to simple threshold values.

5 These reference data (reference curves or threshold values) may be stored in a database.

As mentioned previously, the apparatus described herein may be pre-arranged for carrying out the squeeze test on products of different types conveyed by one and the same conveyor line. For these applications, the
10 database referred to may contain the reference data of the various types of product, and the control unit 40 retrieves, from the database, the reference data for the type of the product under test. As has been seen above, the same control unit can be configured for determining the type of product on the basis of the images detected by the camera 22.

15 On the other hand, on the basis of what has been discussed above, the person skilled in the sector will be able to understand that the reference data can also be defined by the apparatus itself in a self-learning step carried out on samples of the products to be tested, on the basis of the signals of position of contact and/or force of contact detected during this
20 step.

In the light of the foregoing, it appears evident how the solution described lends itself to being used in applications in which the flow of products on the conveyor line is irregular and in which the products to be tested are of different types.

25 In particular, consider, for example, a conveyor line on which there converge a plurality of packaging lines for different products and that conveys the products to a packing station downstream. The apparatus described herein may be set in a position corresponding to the aforesaid

conveyor line common to the different packaging lines to conduct squeeze tests indifferently on the products coming from each line.

It should in general be noted that, according to the applications, the test may be carried out on a sample basis or else on all of the products that
5 travel on the line.

With reference now to Figure 9, this illustrates a different embodiment of the apparatus that is recommended for use in applications where the products are positioned on the conveyor not in a random way but according to a predefined and unvaried formation, for example by rank.

10 In this case, the robot 12 carries, at its end, an end effector having a plurality of feeler members 14' arranged with respect to one another according to a scheme corresponding to the formation of the products on the conveyor. In particular, in the example illustrated, the aforesaid feeler members are arranged in a row that reproduces the single rank of products.

15 The end effector referred to evidently makes it possible to conduct the test simultaneously on a number of products, exploiting precisely the regular arrangement of products being fed along the conveyor line.

In this embodiment, associated to each feeler member of the aforesaid end effector is a force sensor and/or position sensor (for example,
20 a voice-coil actuator) so as to be able to distinguish the detections for the various packages simultaneously tested by the end effector.

To return to Figure 9, the apparatus comprises, instead of the camera 22, a movement sensor 22', for example an infrared sensor, set upstream of the robot 12 and designed to detect passage of the products. In this case, the
25 position of the products can be determined on the basis only of this detection thanks to the fixed arrangement with which the products present as they approach the robot.

Alternatively, in the cases where the aforesaid production line is equipped with a system for tracking the products, the position of the

products may be determined simply from the data processed by this system, without any need for providing any sensor for the apparatus.

On the other hand, the apparatus may, instead, include the camera 22 for identifying the type of product, in the applications where the products
5 conveyed are of different types.

It should now be noted that the manipulator robot referred to above constitutes just one example of device for movement of the feeler member (or feeler members). In general, this device may be constituted by any movement structure with a variable number of degrees of freedom
10 according to the specific applications. For instance, in the application illustrated in Figure 9, the manipulator robot 12 may be replaced by a movement structure with just two degrees of freedom. Once again by way of example, this structure may comprise a slide that is mobile along the conveyor line (in the direction Y) and a linear actuator carried by said slide
15 and designed to govern movement along Z of the feeler members 14'.

On the other hand, with reference to the control unit 40, it is to be noted that, even though in the figures it is defined by a single block for convenience of representation, it may be constituted by a plurality of separate control modules, each configured for implementing respective
20 steps of the control process described above.

Finally, it should be noted that the same teachings represented above with reference to conduct of leakage tests on packages may be adopted also for carrying out tests of softness on (naked or packaged) products. In particular, also in these applications, the position of contact and the force of
25 contact will constitute the control parameters of the test, according to the modalities illustrated above.

Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary, even significantly, with respect to what has been illustrated herein purely by way of non-

limiting example, without thereby departing from the scope of the invention, as defined by the annexed claims.

CLAIMS

1. A process for conducting squeeze tests on products (P) that advance along a conveyor line (T), comprising:

5 - providing at least one device (12) equipped with at least one mobile feeler member (14; 14') and with one or more actuators for movement of said feeler member (14; 14');

 - determining the position and the speed of a product to be tested as it advances along said conveyor line (T);

10 - driving one or more actuators of said device as a function of the position and speed of said product to be tested in order to reach, with said at least one feeler member (14; 14'), said product to be tested;

 - bringing said at least one feeler member (14; 14') into a condition of contact with the product to be tested while the latter advances along said
15 conveyor line (T);

 - maintaining said at least one feeler member (14; 14') in said condition of contact with said product to be tested while the latter advances along said conveyor line (14; 14');

 - detecting at least one signal indicating the force of contact and/or at
20 least one signal indicating the position of contact of said at least one feeler member (14; 14') while the latter is kept in said condition of contact with said product to be tested; and

 - determining a condition of said product to be tested as a function of said signal indicating force of contact and/or said signal indicating position
25 of contact.

2. The process according to Claim 1, wherein bringing said at least one feeler member (14; 14') into a condition of contact comprises driving said one or more actuators as a function of one or more reference data indicating a required force of contact (F_R) and/or a required position of

contact (P_R) of said at least one feeler member (14; 14').

3. The process according to Claim 1 or Claim 2, wherein:

detecting a signal indicating the force of contact of said feeler member comprises detecting a signal indicating the intensity of current
5 absorbed by said one or more actuators of said device; and/or

detecting a signal indicating the position of said feeler member comprises detecting a signal coming from a movement sensor associated to said one or more actuators.

4. The process according to Claim 1 or Claim 2, wherein:

10 detecting a signal indicating the force of contact of said feeler member comprises detecting a signal coming from a force sensor associated to said feeler member; and/or

detecting a signal indicating the position of said feeler member comprises detecting a signal coming from a position sensor associated to
15 said feeler member.

5. The process according to any one of the preceding claims, wherein determining said condition of said product comprises comparing said signal indicating force of contact and/or said signal indicating position of contact with reference data (P_{TEST} , F_{TEST}) indicating a position of contact and/or a
20 force of contact corresponding to a reference condition.

6. The process according to Claim 5, wherein detecting said signal indicating force of contact and/or said signal indicating position of contact comprises detecting the evolution of said signal indicating force of contact and/or said signal indicating position of contact for a pre-set time, and
25 wherein determining said condition of said product comprises comparing said signal indicating force of contact and/or said signal indicating position of contact with the evolution of a reference signal, or else with a reference datum after said pre-set time has elapsed.

7. The process according to any one of the preceding claims,

comprising determining the type of said product from among a plurality of pre-set types of product.

8. The process according to Claim 7, wherein determining the type of product comprises detecting a characteristic of said product, and wherein
5 determining said condition of said product comprises retrieving reference data from a database on the basis of said detected characteristic.

9. The process according to any one of the preceding claims, comprising receiving an image of said product on said conveyor line from a camera and processing said image to determine the position of said product
10 and/or a characteristic of said product.

10. An apparatus for conducting squeeze tests on products (P) that advance along a conveyor line (T), comprising:

- a device (12) equipped with at least one mobile feeler member (14, 14') and one or more actuators for governing movement of said feeler
15 member; and

- a control system (40) connected to said device (12) and configured for implementing the steps of the process according to any one of the preceding claims.

11. The apparatus according to Claim 10, comprising a sensor (22; 22') for carrying out detection on the products (P) advancing on said
20 conveyor line (T).

12. The apparatus according to Claim 11, wherein said sensor is a camera (22) or else a movement sensor (22').

13. The apparatus according to any one of Claims 10 to 12, comprising a sensor for detecting the intensity of current absorbed by said
25 one or more actuators of said device; and/or

a movement sensor associated to said one or more actuators of said device.

14. The apparatus according to any one of Claims 10 to 12,

comprising a force sensor and/or a position sensor associated to said feeler member.

15. The apparatus according to any one of Claims 10 to 14, wherein said device is equipped with a plurality of feeler members (14') for
5 conducting squeeze tests simultaneously on a plurality of products (P).

FIG. 1

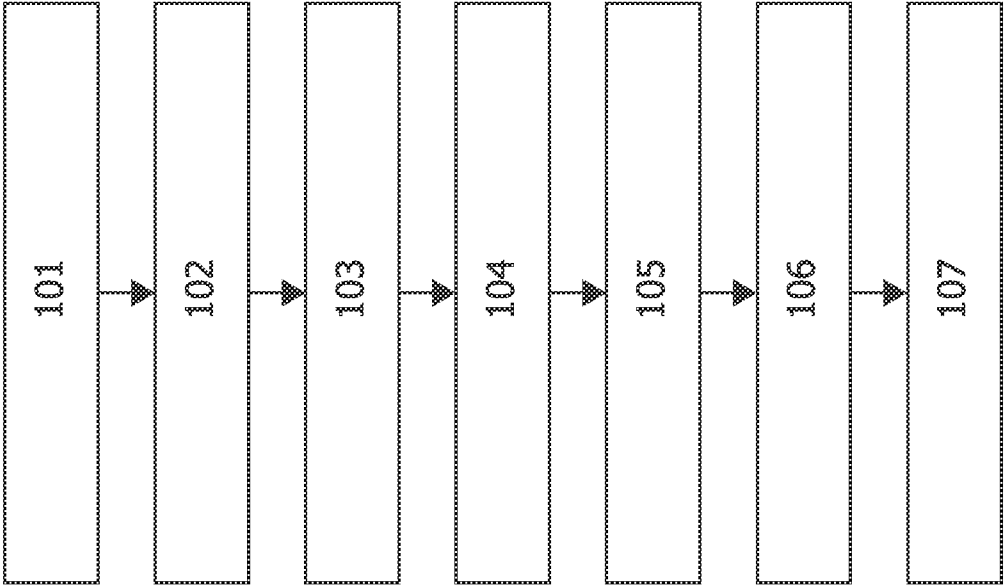


FIG. 2

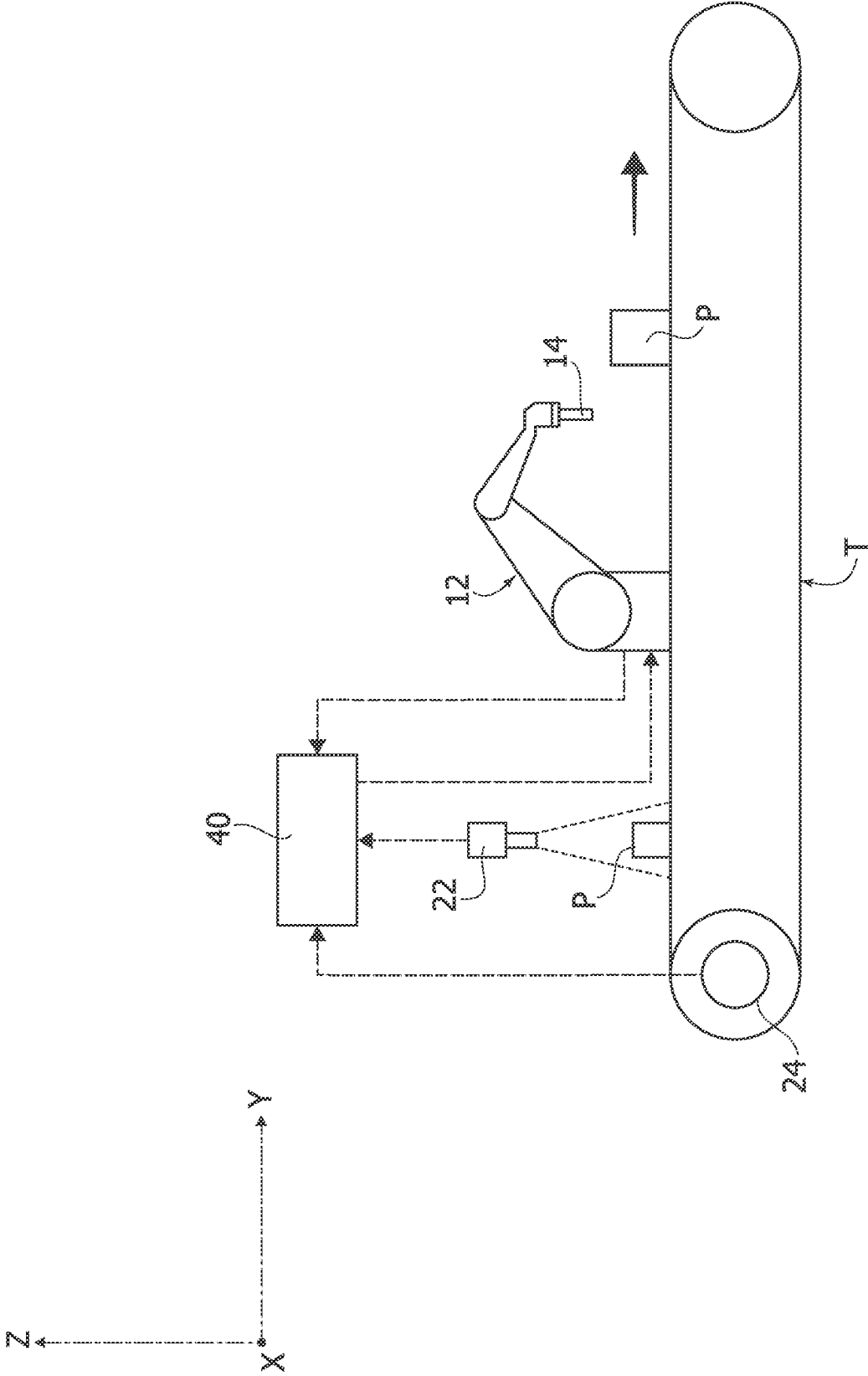


FIG. 3A

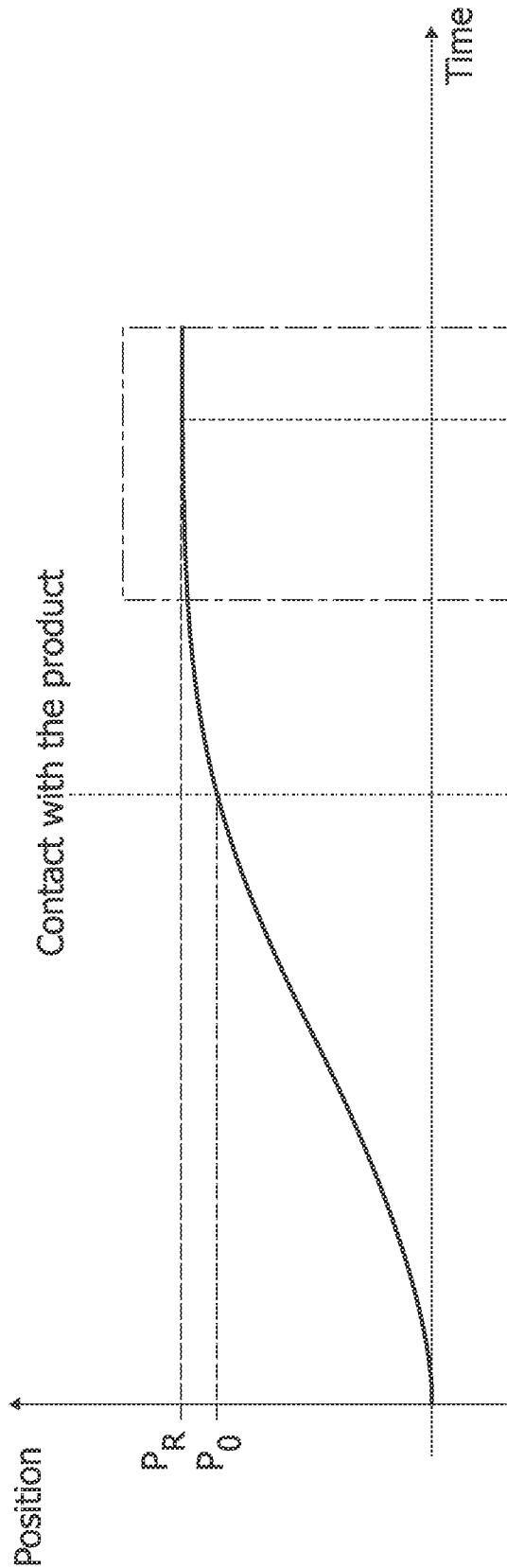


FIG. 3B

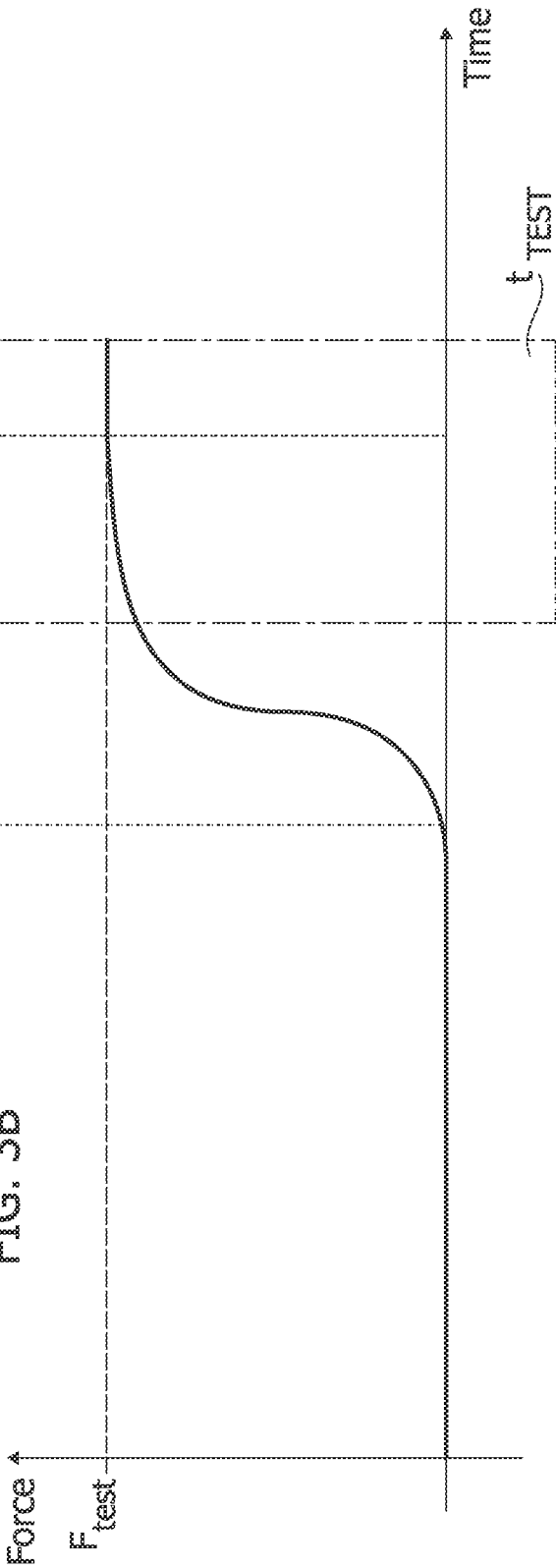


FIG. 4A

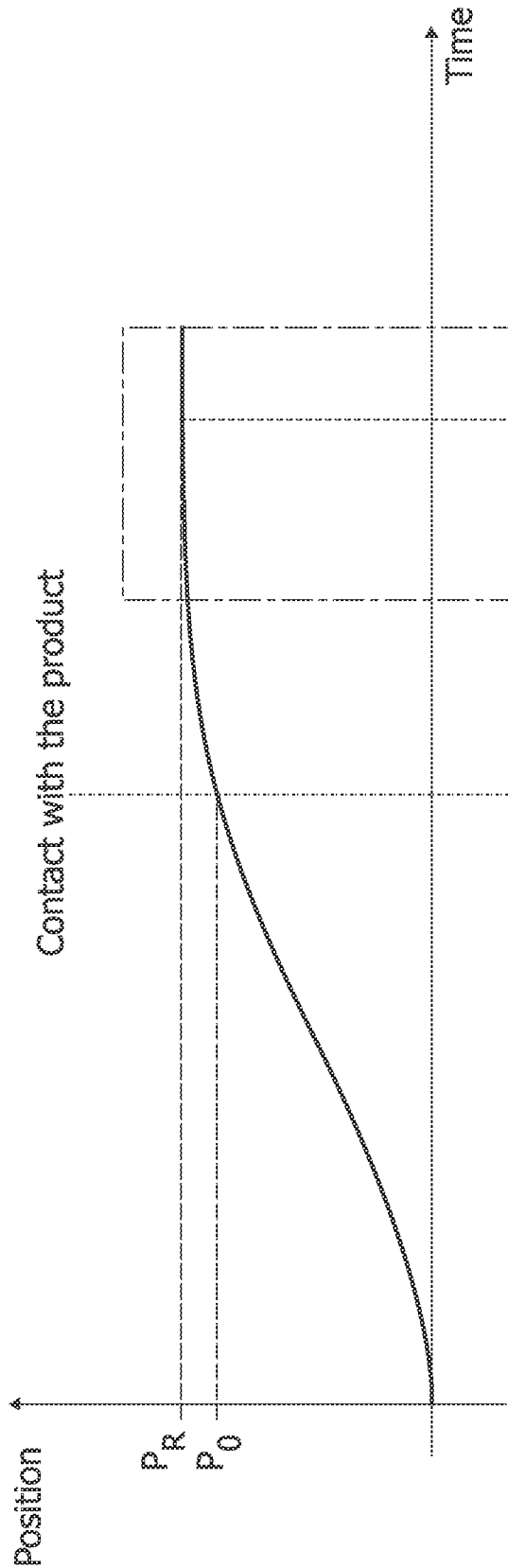


FIG. 4B

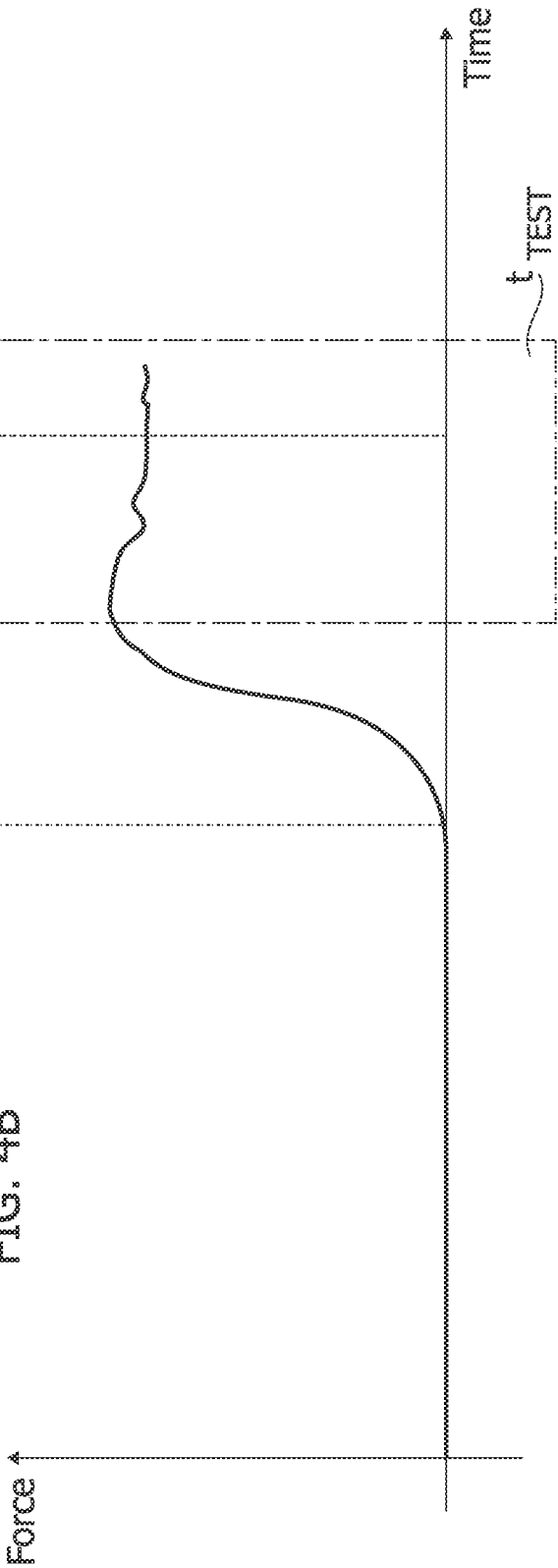


FIG. 5A

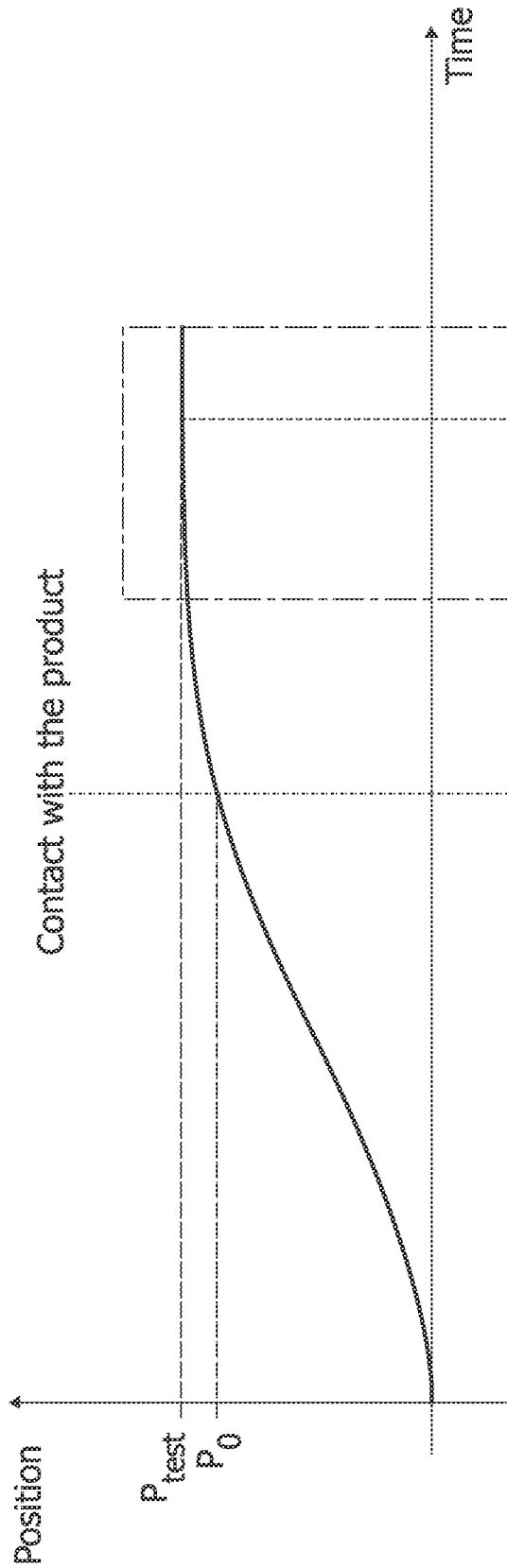


FIG. 5B

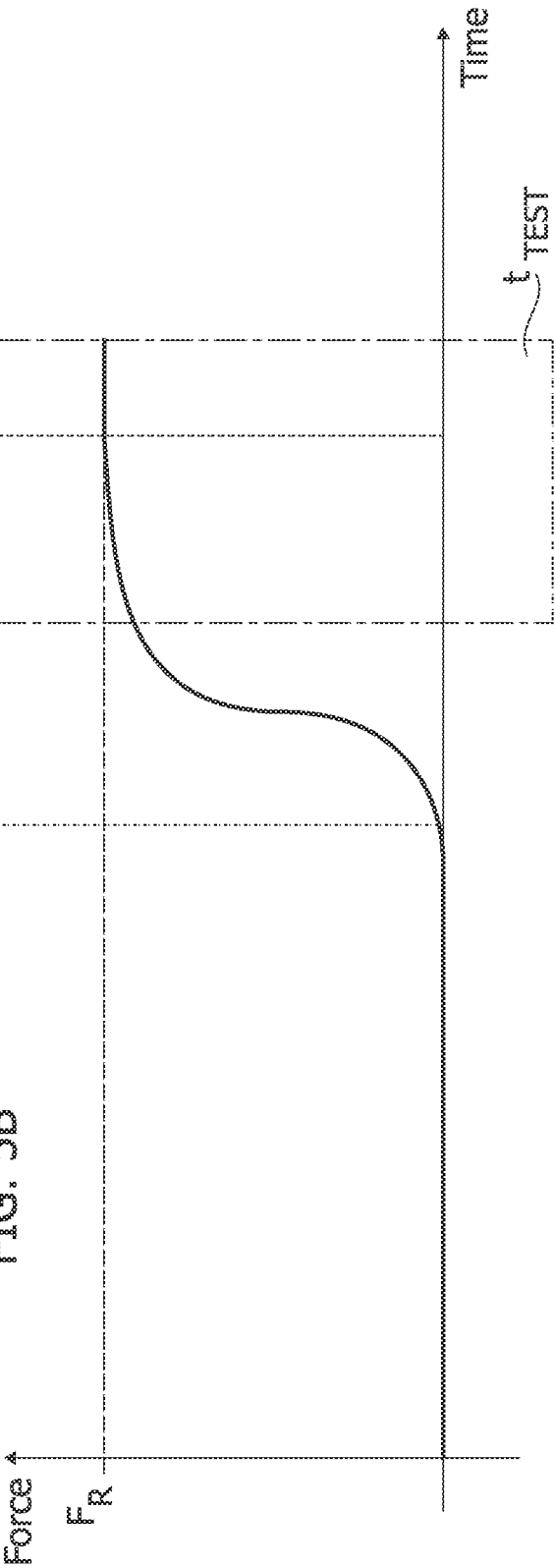


FIG. 6A

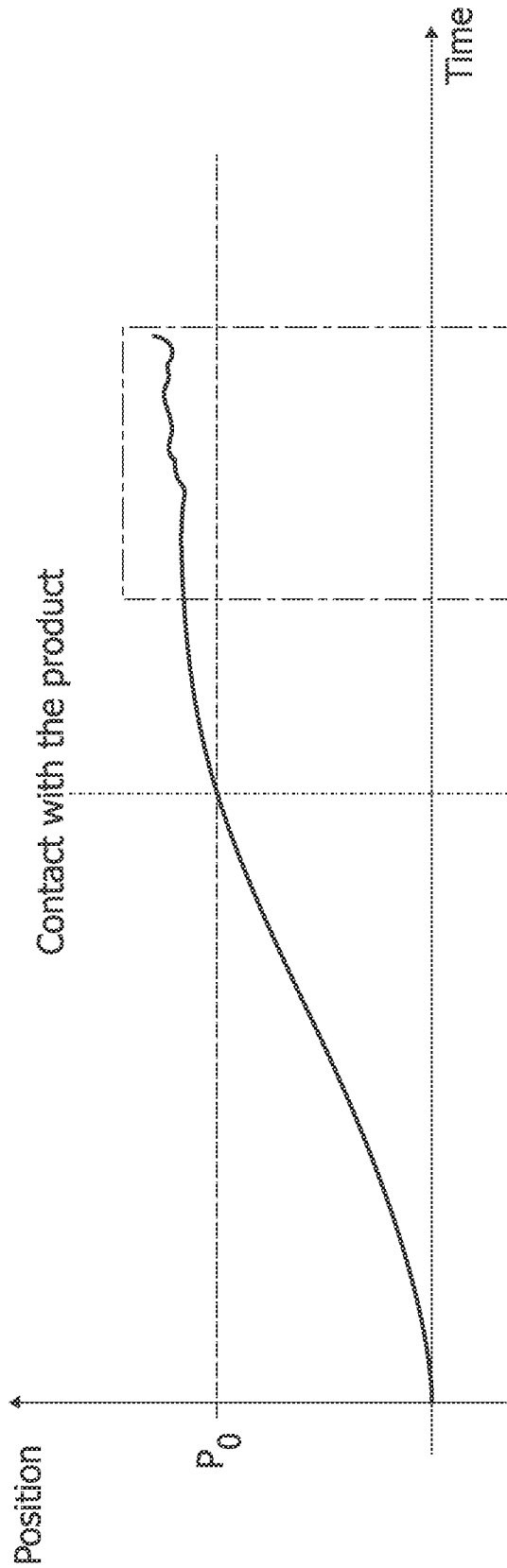


FIG. 6B

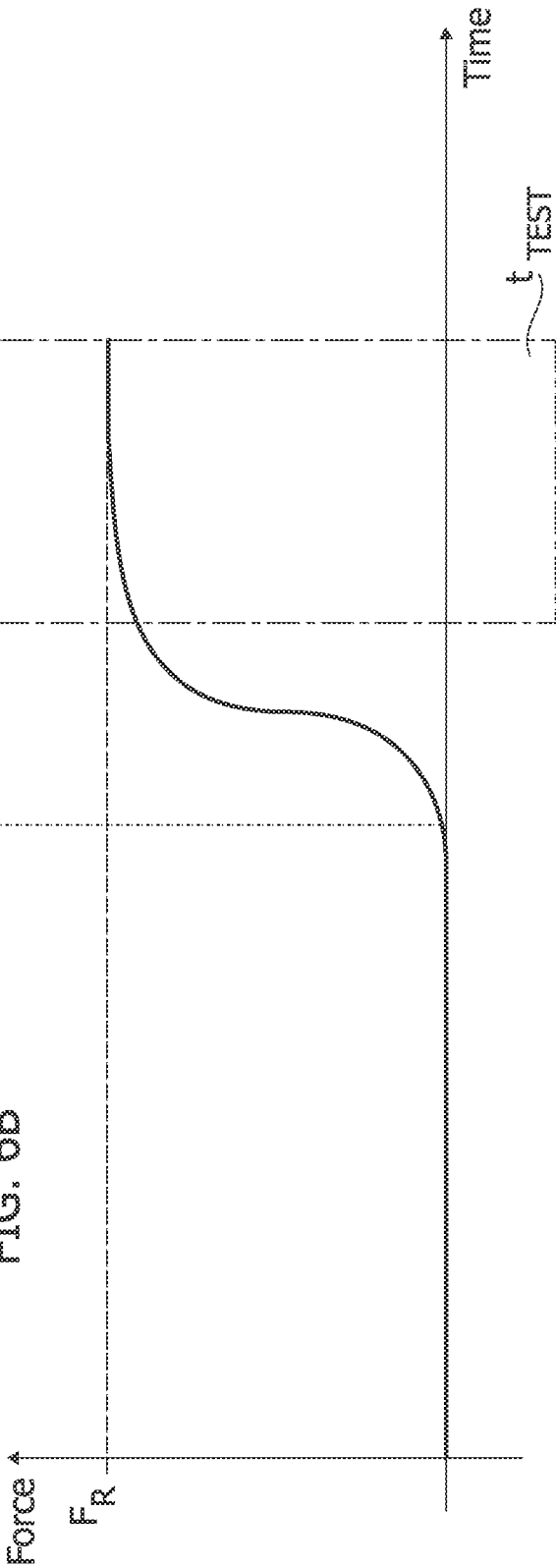


FIG. 7A

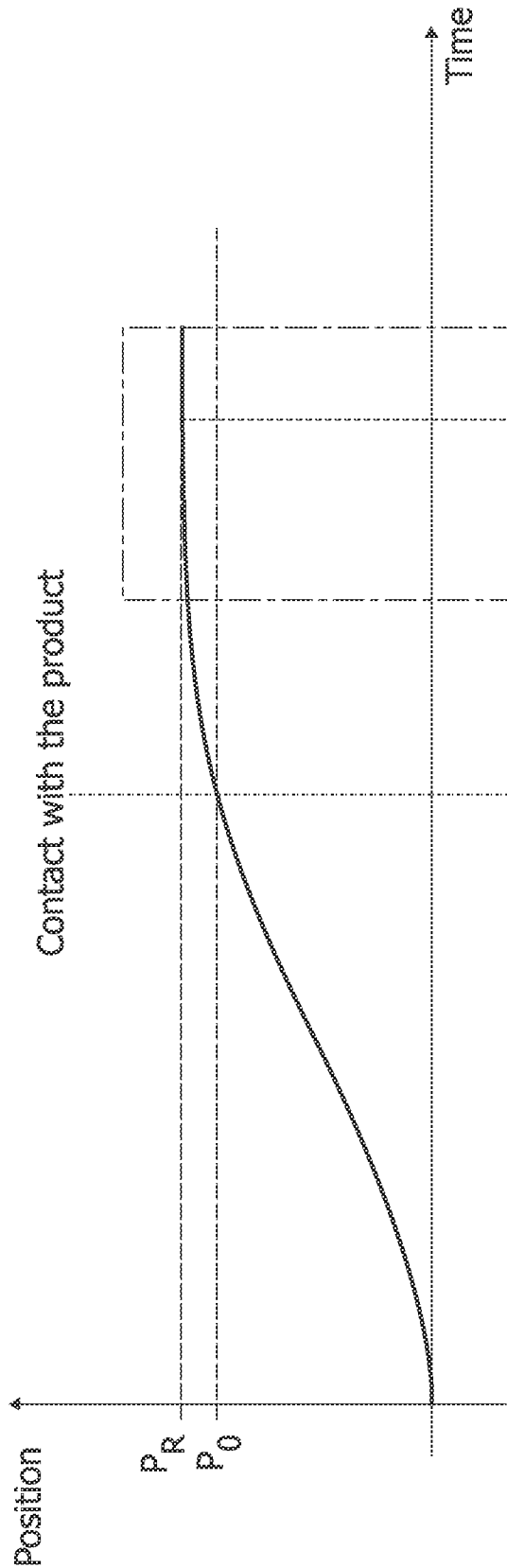


FIG. 7B

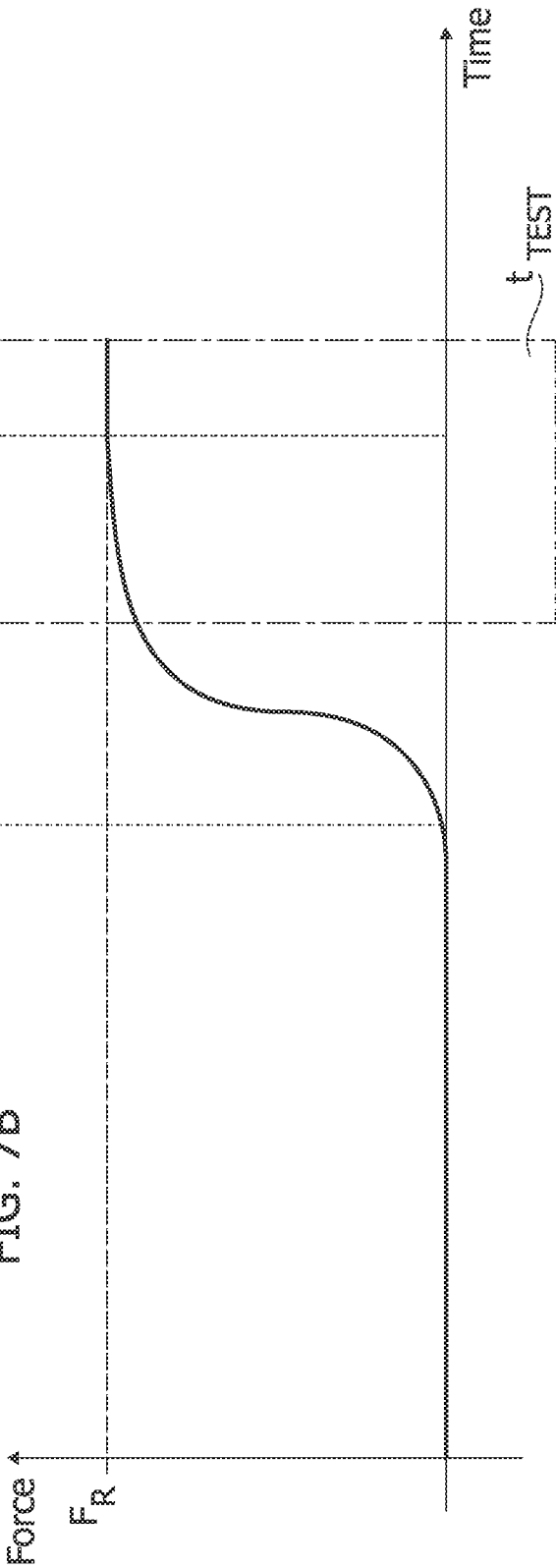


FIG. 8A

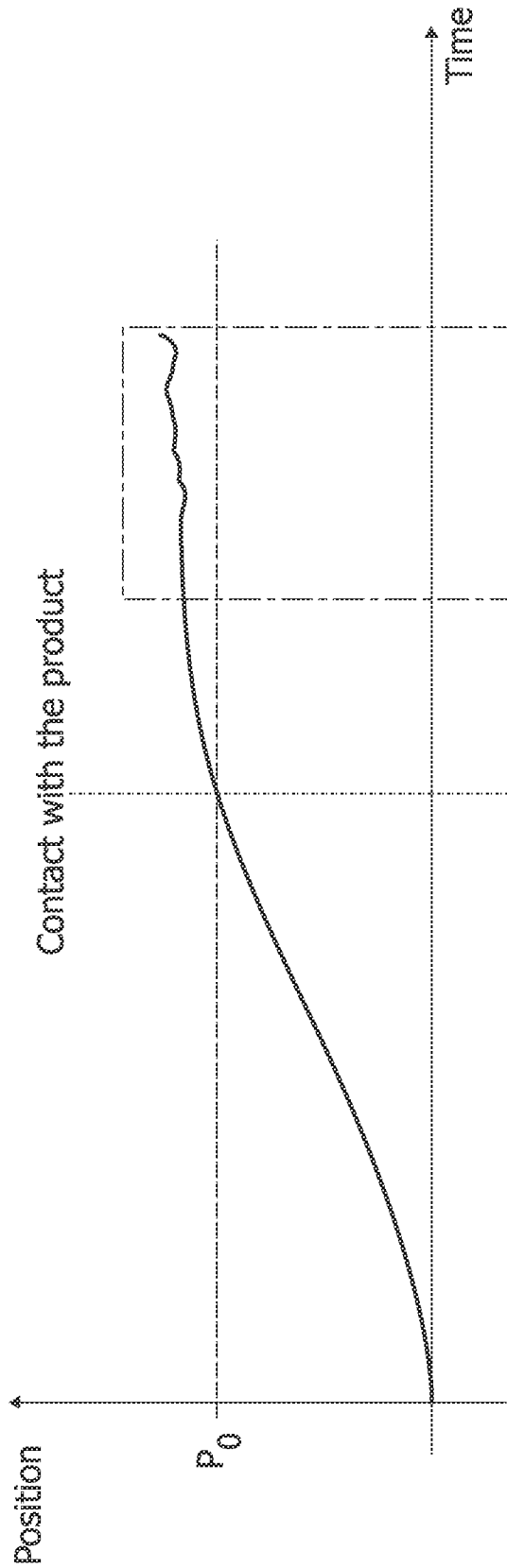


FIG. 8B

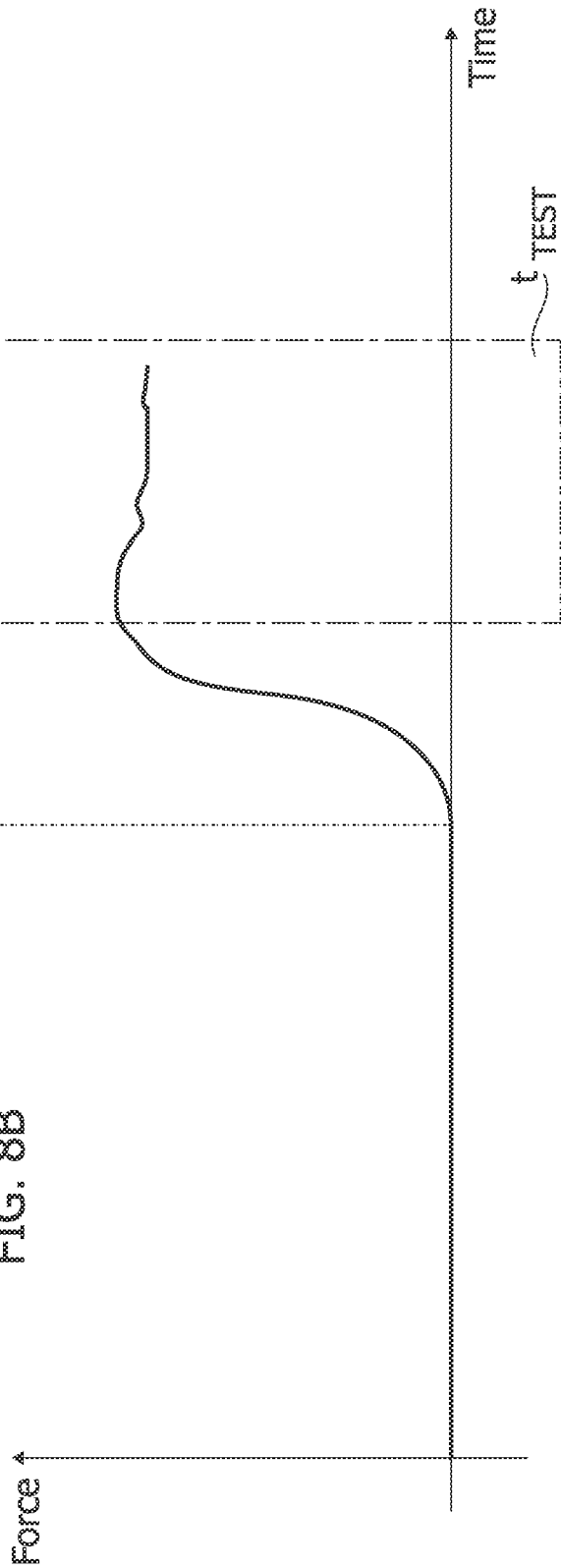
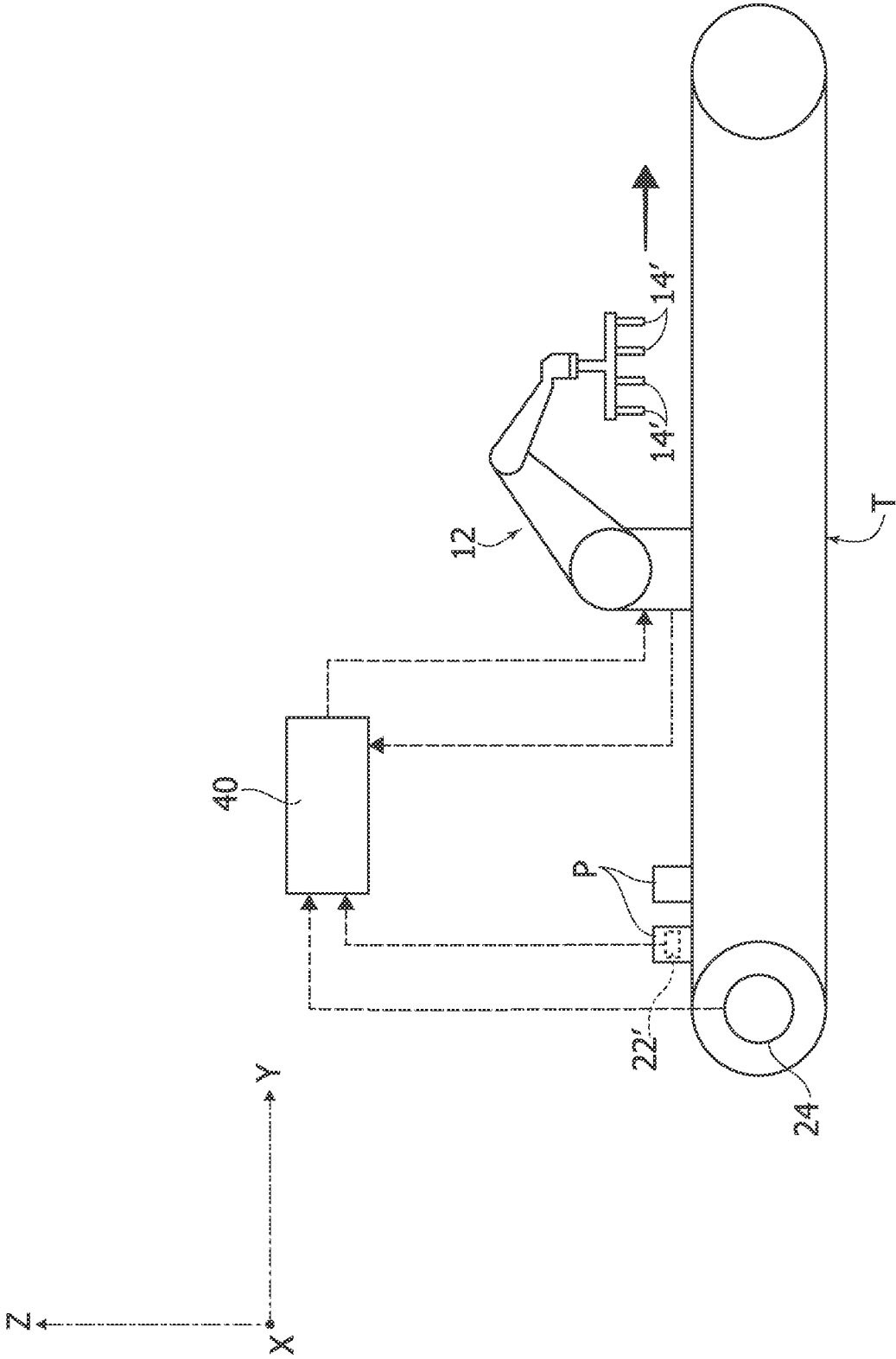


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/055503

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01M3/32 G01M3/36
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 01/29528 A2 (BENTHOS INC [US]) 26 April 2001 (2001-04-26) abstract; claims 1-37; figures 1-20 page 8, lines 1-11 page 14, line 24 - page 15, line 6 -----	1-15
Y	WO 2016/051341 A1 (FT SYSTEM SRL [IT]) 7 April 2016 (2016-04-07) abstract; claims 1-14; figures 1-8 page 20, line 28 - page 21, line 12 -----	1-15
A	CN 202 411 009 U (SHANDONG MINGJIA PACKAGE INSPECTION TECHNOLOGY CO LTD) 5 September 2012 (2012-09-05) the whole document -----	1-15

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Further documents are listed in the continuation of Box C.

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See patent family annex.

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Date of the actual completion of the international search

21 October 2019

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2019/055503

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0129528	A2	26-04-2001	AT 536541 T 15-12-2011
			EP 1222449 A2 17-07-2002
			ES 2378880 T3 18-04-2012
			US 6427524 B1 06-08-2002
			WO 0129528 A2 26-04-2001

WO 2016051341	A1	07-04-2016	BR 112017006482 A2 19-12-2017
			CA 2961453 A1 07-04-2016
			CN 107076637 A 18-08-2017
			EP 3201588 A1 09-08-2017
			JP 2017535761 A 30-11-2017
			KR 20170063862 A 08-06-2017
			RU 2017115171 A 02-11-2018
			US 2017299455 A1 19-10-2017
			WO 2016051341 A1 07-04-2016

CN 202411009	U	05-09-2012	NONE
