(19) DANMARK

(10) DK/EP 3062113 T3

Patent- og Varemærkestyrelsen

(12) Oversættelse af europæisk patentskrift

(51) Int.Cl.: *G 01 P 3/487 (2006.01)* *B 65 B 57/02 (2006.01)* *B 65 C 9/04 (2006.01)* *B 65 G 47/244 (2006.01)* *G 01 N 21/90 (2006.01)* *G 01 P 3/488 (2006.01)*

(45) Oversættelsen bekendtgjort den: **2019-10-21**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2019-08-21**

(86) Europæisk ansøgning nr.: **15192971.8**

(86) Europæisk indleveringsdag: **2015-11-04**

(87) Den europæiske ansøgnings publiceringsdag: **2016-08-31**

(30) Prioritet: **2015-02-25 DE 202015001463 U**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **Rotationsovervågning**

(56) Fremdragne publikationer:
DE-A1-102009 014 663
DE-A1-102013 206 989
DE-T2- 60 203 769
JP-A- 2009 156 607
JP-U- H0 569 611

The present invention relates to a rotary monitoring device as well as to an inspection machine which comprises such a device.

Inspection machines or also inspection carousels are used to inspect test specimens, in particular containers for liquid and dry products. The test specimens, or vessels, such as ampules, cartridges (=cylindrical ampules) or injection vials are rotated using a servo drive separate for each vessel. The servo drive, which is available for each vessel to be inspected, is used to orient the vessel in a certain manner and/or to rotate the vessel at a certain rotational speed. In particular in inspection processes such as particle inspection, the vessel must be rotated around its own axis in order to obtain a feedback on the nature of the product present in the vessel.

However, the rotary monitoring device is not limited to the use as an inspection machine or an inspection carousel, since a rotary monitoring is required in a plurality of technical applications. It is, for example, also useful in the case that substances are to be mixed.

In the fields of application of the rotary monitoring device, it is desirable to carry out a verification as to whether the test specimen, or the vessel, is actually being rotated at a desired predetermined rotational speed.

Thus, it is conceivable that the servo drive is in a normal state, but nevertheless, the associated vessel is not rotated due to a defect. The vessel is typically placed on a rotary plate (which is also called a plate), which is in connection with a servo drive via a transmission. In a transmission failure, e.g. breaking of an axle, no force transmission from the servo drive to the rotation plate or to the vessel occurs, although the servo drive per se operates regularly.

Furthermore, a slip occurs between the rotary plate and the test specimen, which is placed thereon, which slip leads to a situation where the test specimen does not at all rotate, or not rotate at the desired rotational speed. This may lead to errors in a method that requires a certain rotation of the test specimen.

In an inspection method, a sufficiently high and exactly settable rotational speed of the test specimen is often a basis for a reliable inspection result, which can not be achieved under irregular conditions (reduced rotational speed).

The test specimen, which is arranged on the rotary plate, is typically pressed against the rotary plate by a pressing part located opposite the rotary plate, in order to clamp the test specimen, or the vessel, between the pressing part and the rotary plate. Nevertheless, the above further described undesired effects occur.

JP 2009 156697 A discloses a generic rotary monitoring device having the features of the preamble of claim 1. It is known from DE 10 2013 206 989 A1 to detect the rotation of a test specimen via a measurement of angular difference of two spaced sensors. JP H05 69611 U, DE 10 2009 014663 and DE 602 03 769 T2 disclose further rotary monitoring devices.

The object of the present invention it thus to provide a rotary monitoring device, which can be implemented in a cost-efficient manner, and which is reliable.

This object is achieved by the rotary monitoring device having the features of claim 1.

In accordance with the subject-matter of claim 1, a test specimen is clamped between a rotary plate and a rotatably-supported pressing part in such a way that the test specimen is rotated around its own axis if the rotary plate is rotated. Furthermore, the device comprises a unit for determining the target rotational speed of the rotary plate, a detection unit for determining the rotational speed of the pressing part and/or of the rotary plate, and a comparing unit for comparing the rotational speed of the pressing part and/or of the rotary plate with the target rotational speed of the rotary plate. The comparing unit is connected with a detection unit and is configured to output an error signal if a certain difference between the target rotational speed of the rotary plate, and the rotational speed of the pressure plate and/or of the rotary plate.

The unit for determining the rotational speed of the rotary plate is mostly realized in that the target rotational speed of the rotary plate is concluded from the rotational speed of the servo drive driving the rotary plate, and the known transmission ratio between the servo drive and the rotary plate, which is given to the unit for determining the rotational speed. However, any other unit for determining the target rotational speed of the rotary plate is possible for the purposes of the invention.

The invention additionally comprises a detection unit for determining the rotational speed of the pressing part. The pressing part is rotatably supported, so that the pressing part is induced to rotate if the test specimen is rotated. The pressing part is preferably provided with a plate-like surface directed to the test specimen, with which the test specimen, or a closure of the test specimen, is in contact. Furthermore, a skirt can be present on the edges of the pressing part, which prevents a slipping-off of the test specimen from the pressing part.

The comparing unit compares the rotational speed of the pressing part and/or of the rotary plate, to the target rotational speed of the rotary plate, and outputs a signal if a certain difference occurs, which indicates the discrepancy. By the driven rotary plate, on which the test specimen is placed, and the pressure plate being in contact with the test specimen, the rotational speed can be determined using the pressure plate, with which the test specimen is at least rotated. The system is considered to be properly functioning if the difference to the target rotational speed is smaller than a correspondingly predetermined threshold value.

The device further includes a magnetic pole ring, which is arranged on the pressing part and/or the rotary plate in a rotationally-fixed manner. The pole ring is laterally externally magnetized with multiple poles. The detection unit for determining the rotational speed of the pressing part and/or of the rotary plate is configured as a magneto-resistive sensor, which is configured to detect the magnetic fields of the magnetic pole ring.

The system is hardly susceptible to a contamination of the device due to the use of the magnetic pole ring, so that the reliability of the system is very pronounced. As a result, it is possible to provide a very cost-efficient rotary monitoring device, which can also be retrofitted in an existing inspection machine. The magnetic pole ring is preferably arranged in such a way that its center point corresponds to the axis of rotation of the pressing part, of the test specimen, and/or of the rotary plate.

An inductive sensor, or a Hall sensor, can be used instead of the magneto-resistive sensor.

According to the invention, two or more of the above-mentioned sensors are arranged next to one another, in order to make a particularly reliable determination of the rotational speed of the pressing part or of the rotary plate possible. It is advantageous if two sensors are located in the plane in which the pole ring, or the gear, is located. In this way, the rotary monitoring can be conducted over a larger area. The signals of the two sensors are commonly evaluated by the comparing unit.

The pole ring preferably consists of an elastomer. A pole ring configured this way is lighter compared to a normally used ferrite magnet ring, less susceptible to shocks, and easier to fixate.

In accordance with a further variation of the invention, the detection unit for determining the rotational speed of the pressing part and/or of the rotary plate is arranged in a stationary manner. The rotary plate, the test specimen, and the pressing part have a translatory movement compared to the detection unit.

Through this arrangement, it is possible to guide a continuous row of test specimens past the rotary monitoring device. In this way, each of the multiple test specimens can be subjected to a rotary monitoring without variation in the conveying speed.

Furthermore, the rotary plate is coupled with a drive unit, which is configured to induce the rotary plate to rotate. In this case, a transmission can be interposed between the

drive unit and the rotary plate, which transmission converts the original rotational speed of the drive unit.

Furthermore, the present invention relates to an inspection machine, which includes a rotary monitoring device according to any one of the above-explained configurations.

Using the device according to the invention, or the inspection machine according to the invention, it is possible to recognize a transmission failure of the transmission arranged between the drive motor and the rotary plate, an axis breakage of an axis provided between the servo motor and the rotary plate, slippage that occurs between the rotary plate and the test specimen during an acceleration or a rotation of the rotary plate, and/or a jammed bearing in the pressing part.

In the case that the detection unit determines only the rotational speed at the rotary plate, a transmission failure or an axle breakage of the axle provided between the servo motor and the rotary plate can be identified, which, however, also is of advantage in some cases.

The device according to the invention makes a contact-free measurement possible. This provides the advantage that no contact-related and thus wearing parts, such as friction rings, are required for the transmission of the measuring data.

The present invention has been explained by means of an inspection machine above. However, the inventive concept is not limited to such an inspection machine. The rotary monitoring device can rather be used on any machines where any kinds of test specimens are induced to rotate, wherein the term “test specimen” is to be understood in a very broad sense. The test specimens can be mixing vessels used to mix a mixture, or be ampules, in which a solid is to be swirled by rotation of the ampules, for example.

Further details, features and advantages of the invention will be explained based upon exemplary embodiments illustrated in the Figures. The Figures show in:

Figure 1: a schematic structure of the device according to the invention,

Figure 2: an embodiment of the device according to the invention, with a magneto-resistive sensor, and

Figure 3: a further view of the device according to the invention, including a magneto-resistive sensor, in which the downstream signal processing is explained in greater detail.

Figure 1 shows a test specimen 1, which is clamped between a rotary plate 2 and a pressing part 3 arranged at the other end of the test specimen 1. An output shaft 8 of a drive motor 7 can be discerned on the side of the rotary plate 2 facing away from the test specimen 1. The rotary plate 2 is induced to rotate via the output shaft 8 of the drive motor 7, wherein the rotational speed is advantageously be regulated. By the clamping effect between the rotary plate 2 and the test specimen 1, the test specimen 1 is also induced to rotate, and leads to a rotation of the rotatably supported pressing part 3. A shaft 9 can be discerned at the side of the pressing part 3 facing away from the test specimen 1, which shaft is rotatably supported. Reference character 4 denotes the detection unit for determining the rotational speed of the pressing part.

Not shown is the comparing unit for comparing the rotational speed, or the target rotational speed of the pressing part 3, to the rotational speed of the rotary plate 2. Depending on the field of use, a signal is output if a certain difference of the two rotational speeds is exceeded, which indicates this situation. It is thereby possible to identify, that an inspection of the test specimen 1 has presumably occurred under irregular conditions.

Figure 2 shows an embodiment of the invention, in which the detection unit for the determining of the rotational speed of the pressing part 3 is a magneto-resistive sensor 41, which delivers a signal to determine the rotational speed of the pressing part 3, in interaction with a magnetic pole ring 6, which is arranged on the pressing part 3 in a rotationally fixed manner. Furthermore, a shaft 9 can be discerned, which is rotatably

supported on the bearing elements 91. The pressing part 3 and the rotary plate both rotate around a common axis of rotation. In Figure 2, the test specimen 1 is a vessel, which surrounds a material 10. The vessel 1 further comprises a closure 13, which is in direct contact with the pressing part 3. A rotary plate 2 can be discerned at the end of the test specimen 1 facing away from the pressing part 3, as well as the transmission 8, which is in connection with the drive motor 7. Arrow 11 indicates the direction of rotation of the test specimen 1 by way of example. Moreover, the translatory movement of the vessel 1 with respect to the stationary sensor 41 is indicated using arrow 12. The person skilled in the art understands that the present invention can of course be carried out in a different orientation of rotational direction or movement direction.

Figure 3 shows a slightly more abstract representation of the present invention. For the sake of simplicity, only the magnetic pole ring 6 is shown, and the components such as test specimen 1, rotary plate 2, pressing part 3, drive motor 7, and transmission 8 are omitted.

Discernable is the circular translatory movement 12, which represents e.g. a travel direction of the test specimen 1 in the conveying path of an inspection machine independently of a rotation of the magnetic pole ring 6. In addition, one can discern a rotary movement 11 of the pole ring 6 in the same direction as this movement 12, which is detected using the magneto-resistive sensor 41. Two magneto-resistive sensors, arranged next to one another, are provided in Figure 3, so that the rotation of the test specimen can be detected over a longer travel path.

The detected signal is output to the comparing unit 5, which comprises a converter 51, an exclusive-OR module 52, and a counter 53.

The measurement occurs if the pole ring, or the gear, is in a certain spatial relation to the region 42.

Patentkrav

1. Indretning til rotationsovervågning, hvor et testemne (1) klemmes mellem en rotationsplade (2) og en drejeligt lejret pressedel (3) på en sådan måde, at testemnet (1) ved en rotering af rotationspladen (2) drejer sig om sin egen akse, hvor indretningen omfatter:
en enhed til at konstatere rotationspladens (2) indstillingsomdrejningstal,
en registreringsenhed (4) til bestemmelse af pressedelens (3) og/eller rotationspladens (2) omdrejningstal, og
en sammenligningsenhed (5) til sammenligning af pressedelens (3) og/eller rotationspladens (2) omdrejningstal med rotationspladens (2) indstillingsomdrejningstal, hvor sammenligningsenheden (5) er forbundet med registreringsenheden (4) og er indrettet til fra en bestemt difference mellem rotationspladens (2) indstillingsomdrejningstal og pressedelens (3) og/eller rotationspladens (2) omdrejningstal at udlæse et fejlsignal,
kendetegnet ved,
at der er tilvejebragt mindst to stationære registreringsenheder (4) til at bestemme pressedelens (3) og/eller rotationspladens (2) omdrejningstal, hvilke er anbragt ved siden af hinanden på en sådan måde, at pressedelens (3) og/eller rotationspladens (2) rotation kan registreres langs med en længere vejstrækning af en translatorisk bevægelse, og
at der er tilvejebragt en magnetisk polring (6), som er anbragt rotationsfast på pressedelen (3) og/eller rotationspladen (2), hvor registreringsenhederne (4) til at bestemme pressedelens (3) og/eller rotationspladens (2) omdrejningstal er magnetresistive sensorer (41) til registrering af den magnetiske polrings (6) magnetiske felter.

2. Indretning ifølge krav 1, hvor rotationspladen (2) er forbundet med en drivenhed (7), som er indrettet til at sætte rotationspladen (2) i rotation.

3. Inspektionsmaskine med en indretning til rotationsovervågning ifølge et af de foregående krav.

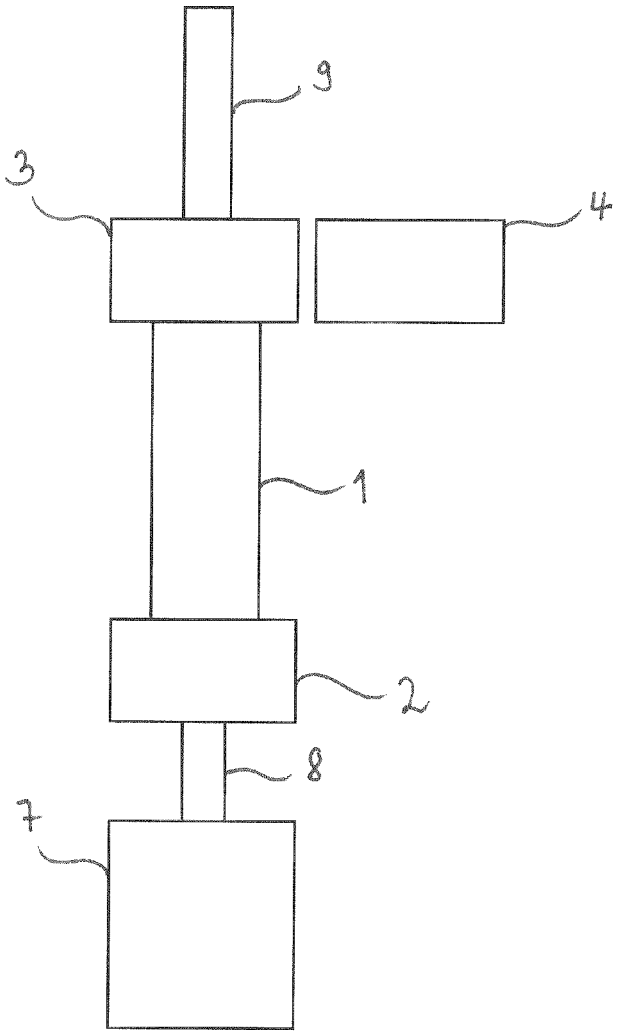

Fig. 1

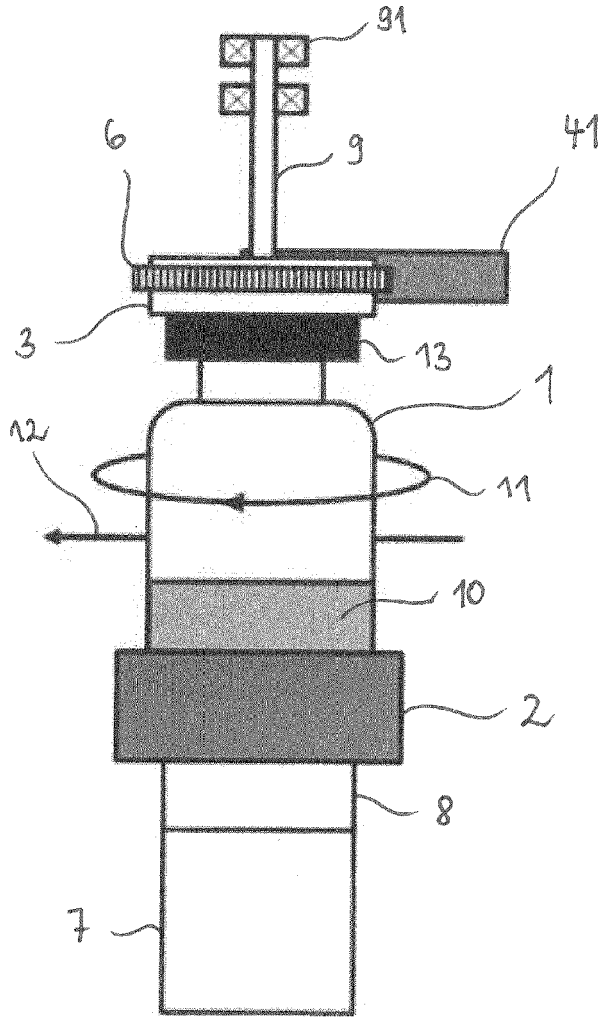

Fig. 2

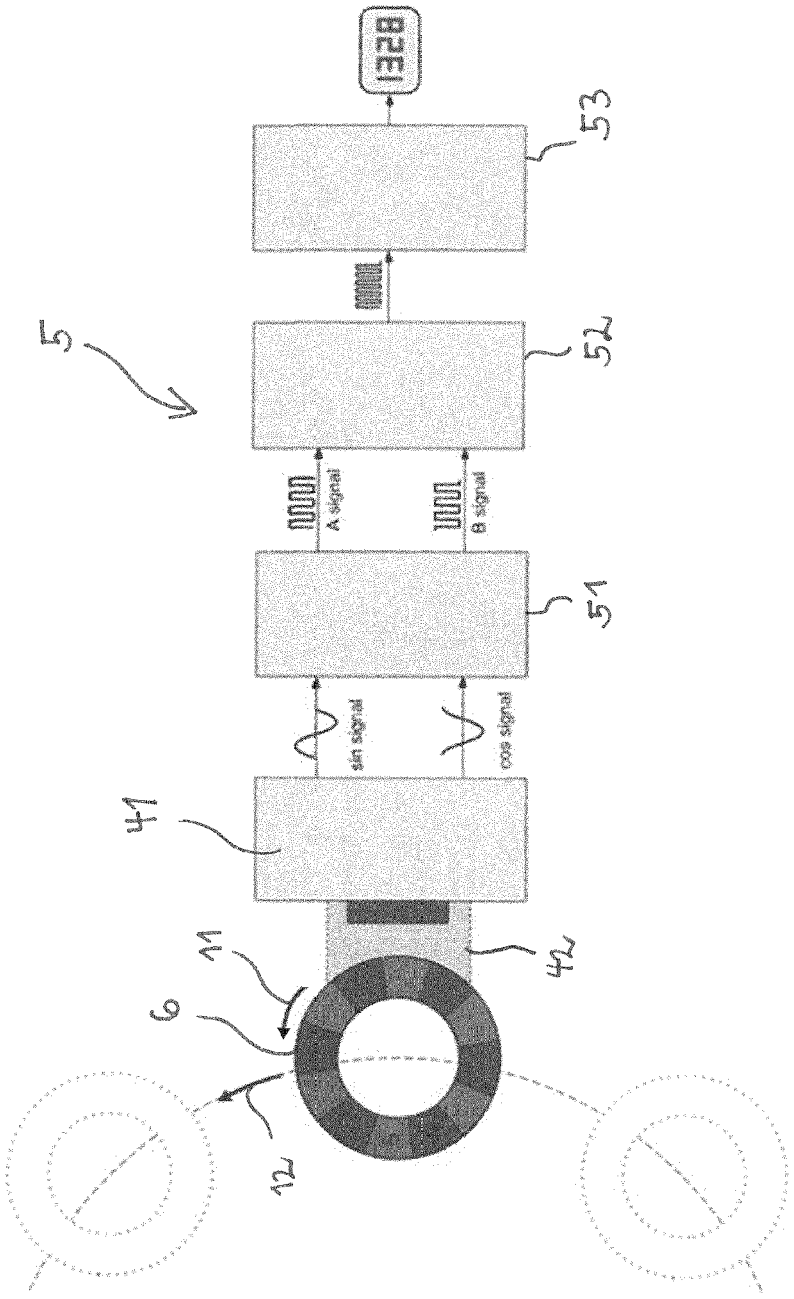
1328
53
52
5
A signal
B signal
51
sin signal
cos signal
41
42
11
6
12

Fig. 3