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• **Risseeuw, Dimitri Johannes Paul**
2960 Brecht (BE)

(74) Representative: **Hess, Peter K. G.**
Patent- und Rechtsanwälte
Bardehle . Pagenberg . Dost .
Altenburg . Geissler
Postfach 86 06 20
81633 München (DE)

(71) Applicant: **Omron Europe B.V.**
2132 JD Hoofddorp (NL)

(72) Inventors:
• **Van de Ven, Clement Jeroen Maarten Maria**
5421ZW Gemert (NL)

(54) **Inspection table**

(57) The invention relates to an inspection table (11) for flexible quality inspection of objects in production or assembly lines. The inspection table has at least one area (8, 10) on which objects to be inspected and related

inspection sensors (2, 4) are placed, wherein the inspection sensors are freely positionable with respect to the objects to be inspected and fixed in position by quick-fixing means (1, 3).

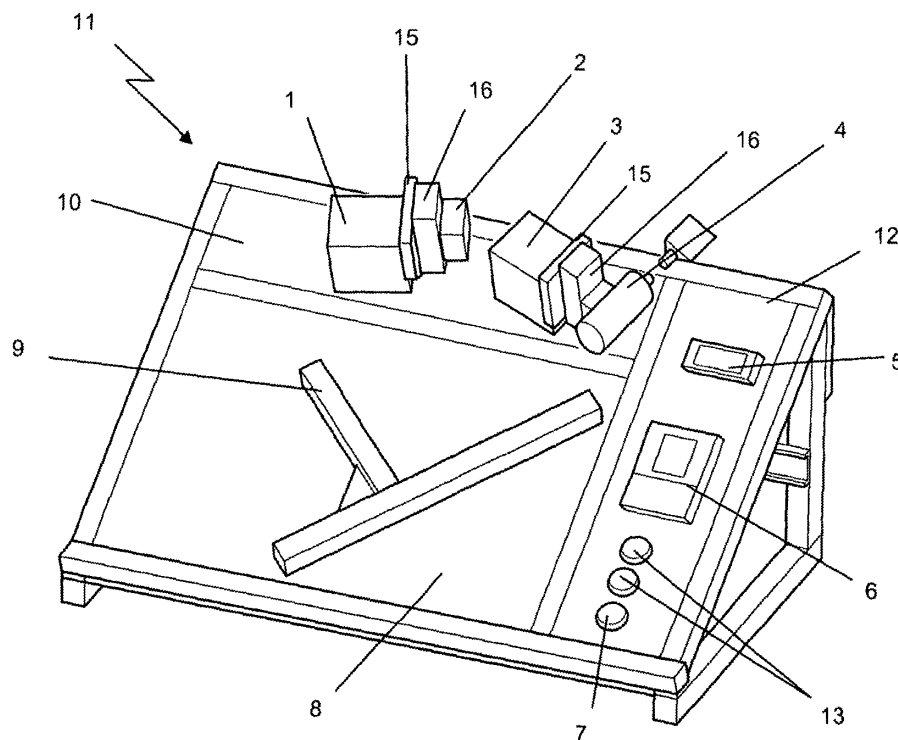


Figure 1

Description

1. Field of the invention

[0001] The invention relates to an inspection table for a flexible quality inspection of objects in production or assembly lines, with at least one area, on which objects to be inspected and related inspection sensors are placed.

2. Prior art

[0002] In production or assembly lines it is common to check the quality of the produced objects or products during the production process and at the end of the production process. Such quality inspections can be made in form of random tests or if necessary of the total of produced products. A constant monitoring of the produced quality is not only necessary to ensure, that the produced products themselves have the proper quality, so that they can be shipped to potential customers or passed on to further processing, but it is also very important for the monitoring of the whole production process. By checking the quality of the produced products, of preliminary or final products, problems or interferences in the production or assembly lines can be detected early, and appropriate counter measures can be taken, before too many defective products are shipped. To facilitate the inspection of the quality of the produced products, it is common to build inspection set-ups with a fixed arrangement of inspection sensors, that do for example check the dimensions of a particular produced product, to check, e.g. whether all the tolerances are met. For each product or object to be inspected, in the art it was necessary to build a specific fixed inspection set-up. Many manufacturers however produce dozens or even hundreds of different products on one production facility. In such a case it is very expensive to build up dozens of different fixed inspection set-ups. Another disadvantage of the art is that the inspection set-ups are usually build rather provisional on the side of the production or assembly line. The quality of the inspection set-up therefore depends highly on the individual skills of the technicians or engineers responsible for the quality inspection at the respective assembly line. Further, since the build up of many different fixed inspection set-ups is relatively expensive and time-consuming the chances are high, that the necessary quality inspections are neglected during the production process. This in turn can lead to unnecessary loss of production, which could be avoided with appropriate quality control.

[0003] It is therefore an object of the present invention to overcome the disadvantages of the art. In particular it is an objection of the invention, to provide a flexible inspection set-up, that can be used for the quality inspection of different products or objects. It is a further object of the invention to provide an inspection set-up, that has a wide range of usability, is easy to implement and cost-

efficient.

[0004] These and other objects, which will derive from the following description, are solved by the presented invention.

3. Summary of the invention

[0005] According to the invention, an inspection table is presented, with at least one area on which objects to be inspected and related inspection sensors are placed. The inspection sensors are freely positionable with respect to the objects to be inspected and fixed in position by quick-fixing means.

[0006] By providing quick-fixing means for the inspection sensors the same can be rearranged fast and very efficiently, to adjust the inspection set-up to a large range of different products or objects to be inspected. The inspection sensors can be freely positioned in the plane of the inspection table, so that a flexible two dimensional arrangement of the sensors with respect to the objects to be inspected can be achieved.

[0007] The quick-fixing means of the inspection sensors can be realized in many different ways, as will be apparent to the person skilled in the art. Preferably quick-fixing means are applied, that can be operated without any tools or at least without any special tools for the fixing means. The quick-fixing means can for example be realized by suction devices as for example suction pads or suction or vacuum cups or the like. Alternatively the quick-fixing means can be realized in the form of hook-and-loop fasteners, also known as Velcro fasteners. Another preferred alternative are magnetic fixing means.

[0008] In a preferred embodiment the sensors are adjustably arranged on the quick-fixing means respectively are arranged adjustable on holders, which holders comprise or consist (as e.g. in the case of a magnet) of the quick-fixing means. The sensors are preferably arranged angularly adjustable on the quick-fixing means. This is e.g. achieved by providing a pivot axle or joint pin on the quick-fixing means, around which the sensor can be rotated. In another preferred embodiment the sensors are arranged on the quick-fixing means by means of linear positioning guides that allow for an adjustment of the sensors in a vertical direction. Such a linear positioning guide could for example be implemented by means of a guide rail, in which a correspondingly formed guide element attached to the sensor can be moved up and down and fixed in a desired vertical position by means of e.g. a winged screw. In a most preferred embodiment the sensors can be adjusted angularly and vertically. This can e.g. be implemented by providing a swivel joint that is arranged in a vertical guide rail and can thus be moved up or down with respect to the quick-fixing means. Thus the inspection sensors can be freely positioned in the plane of the inspection table by means of the quick-fixing means and at the same time they can be adjusted in the vertical axis, i.e. orthogonal to the plane of the inspection table, and they can be adjusted angularly with respect to

the plane of the inspection table.

[0009] In one embodiment, the sensor area is for example a metal plate that can be attracted by a magnet and the sensor devices are provided with magnets. In this way the inspection sensors are readily fixed in the desired position relative to the object to be inspected and at the same time can be readjusted precisely with almost no effort. Alternatively, the sensor area is provided with an electromagnet and the sensor devices are provided with a base or a holder which is attracted by a magnet. The electromagnet can be switched on and off as necessary. During the alignment or adjustment of the respective sensor device the electromagnet is switched off. After the inspection device is correctly positioned the electromagnet is switched on by the operator and thus the sensor is fixed in the desired position. In a preferred alternative, the inspection sensors are provided with magnetic holders, as they are well-known in the art, to hold tools or objects in a certain position. The magnetic holder is preferably provided with an actuator to energize or deenergize the magnet. The area to place the inspection sensors on is in this case for example simply a plate of magnetic steel. Most preferably the magnetic holder provides means to adjust the angular and/or vertical position of the inspection sensor as was described above.

[0010] When the quick-fixing means are realized in the form of hook-and-loop fasteners, the area to place the inspection sensors on can e.g. be provided with the hook-material and the bottom of the sensors or the bottom of a holder of the sensor with respective loop-material or vice versa. Such hook-and-loop materials are available in many different qualities and retention forces, so that proper materials can be chosen for almost all kind of application.

[0011] Another preferred quick-fixing means are suction cups respectively vacuum cups. Such fixing means are for example known from the glass processing industry, where they are used to carry flat glass panels like window. By providing suction cups on the sensors respectively on a holder of the sensor the sensors can be repositioned on the inspection table very quickly without the necessity for any tools. In this case the area to place the inspection sensors on is preferably a smooth surface, suitable for suction devices.

[0012] It is of course possible to mix different kinds of quick-fixing means and to provide e.g. one sensor or sensor holder with a magnetic fixing means and another with e.g. a Velcro fastener.

[0013] As inspection sensors all kinds of sensors known to the man skilled in the art might be used, as for example optical inspection sensors like for example photo transmitting sensors or video cameras. With such sensors, it is for example possible to detect the inclination of an object or a work piece. Further it is possible to detect the thickness, surface texture, the size and dimensions of a product or object, the colour, printings, letters, symbols, LEDs, switch positions, metals, materials etc. As optical inspection sensor for example the ZFV high speed

inspection sensor produced by the same applicant, Omron, or similar optical inspection sensors are preferred. With modern inspection devices it is for example possible to detect patterns, like for example bar codes or labels, or to measure the dimensions of an object to determine proper assembly. It is further possible to detect for example the positions of labels or sheets, to detect presence/absence of certain features based on the measurements of average white content in an area, so that it is for example possible to detect defects such as scratches and dirt on work pieces. It is further possible to detect characters, to detect for example missing characters in a marking or the presence of codes, expiration dates, or embossed characters or similar. The huge versatility of such optical inspection sensors makes them suitable for the inspection of an almost unlimited number of different products or objects.

[0014] The at least one area, on which the objects to be inspected and the inspection sensors are placed, can be for example a single area. In an alternative embodiment of the invention the at least one area comprises a first sensor area and a second object area. The separation of the areas is preferably recognizable by for example a different colour, structure or other visible partitioning. Such separation is in particular helpful if the sensor area is a magnet or provided with an electromagnet, since the magnetic field might in some cases influence or damage objects to be inspected, if these objects are sensitive to magnetic forces.

[0015] The object area may be provided with a surface with a high friction index, for example a rubberized surface or a surface provided with a profile.

[0016] In a preferred embodiment, the at least one area is inclined at an angle. This allows for a more ergonomic arrangement of the work place of the operator or inspector. On the other hand it can facilitate the inspection of objects, because the operator can place for example the objects to be inspected on the inclined surface, and the objects slide down the surface on their own into the correct inspection position. In this case it is of course preferable to provide a stopper on the lower edge of the object area and to provide the object area with a low friction or very smooth surface, to allow for an unobstructed sliding of the object to be inspected. Additionally an inclined inspection table is more room efficient than a non-inclined table. The inclination of the inspection area can for example be between 15 to 60°, most preferably between 30 and 45°.

[0017] In a preferred embodiment the object area is provided with one or more adjustable reference means. Such a reference means facilitates the correct positioning of the products or objects to be inspected on the object area. The reference means is most preferably adjustable, to allow the correct positioning of different objects. Most preferably the reference means has the form of a triangle. The reference means is arranged on the object area to hold the objects to be inspected in the correct position and can be fixed to the area, by e.g. screws. The

object to be inspected is placed against the reference means, e.g. into the angle formed by the tri-square, so that it is always held in the correct position. This allows for a very fast positioning of the objects to be inspected. In an even more preferred embodiment, the adjustable reference means is combined with an inclined object area. The inspector or operator of the inspection table thus only has to place the objects to be inspected in the correct orientation on the inclined surface and the objects will then slide on their own down the inclined surface, until they are stopped by the reference means in the correct position. In this way it is possible to inspect a large number of objects in a relatively short time, since the positioning of the objects to be inspected is fast and accurate.

[0018] In another preferred embodiment the inspection table is further provided with a control panel. The control panel can be connected to the inspection sensors used, and may serve to operate and/or adjust the inspection sensors. The control panel might be a separate device from the inspection table, however preferably it is integrally formed with the inspection table. In a preferred embodiment, the inspection table is provided with visual or acoustic signal means, to inform the operator or inspector about the inspection results. The inspection table could e.g. be provided with a red and a green LED, which light up to indicate whether a product passed (green) or failed (red) the inspection.

4. Description of preferred embodiments

[0019] In the following one preferred embodiment is exemplary described with reference to the enclosed figure.

[0020] The figure shows one preferred embodiment of the inventive inspection table 11 in a schematic three-dimensional view. The table comprises one area 8 to place objects to be inspected on (also referred to as object area), and one area 10 to place inspection sensors 2, 4 on (also referred to as sensor area). In the depicted embodiment, the inspection sensors 2, 4 are provided with magnetic tool holders 1, 3 as quick-fixing means. The sensor area 10 is a steel plate, on which the magnetic tool holders can be attached by a magnetic force. The magnetic tool holders 1, 3 are preferably provided with an actuating switch to actuate or release the magnetic bond. In the depicted embodiment, two sensor devices 2, 4 are applied. It is however of course possible to apply more or less than the depicted two devices. One of the inspection devices is preferably an optical inspection sensor, which is for example able to measure dimensions, surface structures, characters and numbers, bar codes, colours, brightness, or shape of different objects to be inspected.

[0021] In a preferred embodiment, one of the inspection sensors is a product detection sensor, which can identify the products placed on the inspection area. In this way it is for example possible to configure the in-

spection sensors to inspect different objects, by automatically detecting the type of object and then choosing the appropriate measuring parameters. In this way one single set-up for the inspection table can be used to inspect a large number of different objects, and it is even possible to inspect different features or properties depending on the kind of object inspected. If for example an object A has to be inspected with respect to a certain physical dimension and another object B has to be inspected with respect to a certain surface quality, the product detection sensor will first identify the kind of object A or B and then the appropriate inspection process will be chosen, that means in the case of object A, the physical dimension is inspected and in the case of object B the desired surface characteristics. This can be done with the same inspection sensors, since modern sensors can be programmed for a large amount of different inspection tasks.

[0022] On the right side of inspection table 11 a control panel 12 is provided. In the figure, reference number 5 denotes a controller for inspection sensor 2 and reference number 6 denotes a controller for the inspection sensor 4 respectively. The necessary various control equipment, power supply etc. is arranged on the backside of the control panel and/or the inspection area 8 and sensor area 10. Inspection sensors 2, 4 are for example connected to the control equipment by suitable wiring (not shown). Reference number 7 indicates in the depicted embodiment a start/stop button. Additionally the control panel has two indication lights 13, giving visual signals about the inspection results, for example pass/fail.

[0023] The object area 8 is provided with a reference means 9. The reference means 9 has the form of a tri-square. Before starting the inspections, the reference means is adjusted and fixed on the object area. Then the inspector or operator of the inspection table puts the object to be inspected between the two blades of reference means 9, so that the object is correctly positioned with respect to inspection sensors 2, 4. Since inspection area 8 and sensor area 10 are in the same horizontal plane, the horizontal adjustment of the inspection sensors is easily accomplished. To provide for an adjustment in the vertical direction, i.e. perpendicular to the plane of inspection area 8 and sensor area 10, the quick-fixing means 1, 3 are provided with linear positioning guides 16, which are attached to the holders by means of fixing plates 15. The sensors 2, 4 can be moved up and down along the linear positioning guides 16, without the necessity to readjust the holders 1, 3 on the inspection table 11. To allow for an angular adjustment of the sensors with respect to the plane of the object respectively sensor area, the sensors can be attached to the quick-fixing means 1, 3 by means of pivotable point.

[0024] As can be seen from the figure, object area 8 and sensor area 10 are inclined with respect to the horizontal. The angle of inclination is preferably between 15 and 60°, most preferably 30 to 45°. The inclination offers several advantages: for one the required space for the inspection table is less than with a non-inclined surface.

Second, the ergonomics of the work-place is improved, since the operator or inspector can better reach the distant edge of the inspection table. Thirdly, the inspected object can slide automatically towards a reference means or a stopper provided at the lower edge of the inspection table.

[0025] The whole inspection table 11 is preferably provided to be moveable, so that it can easily be used on any location in a factory or assembly line. The power supply for the inspection sensors and for the control panel 12 may come from the power grid system or it can be provided by batteries or rechargeable batteries, which makes the product even more flexible.

[0026] Although in the figure only one reference means 9 is shown, it is of course possible to provide more than one, so that an even larger number of different objects can be inspected on the same inspection table 11. The same is of course true for the number and type of inspection sensors used.

[0027] By the combination of the free positioning by means of the quick-fixing means in the two-dimensional plane and the additional adjustability in the vertical direction and the adjustability of the angle of the inspection sensors, a very flexible sensor set-up is possible, that offers a wide range of usability and that can be readjusted to different inspection tasks in a fast and efficient manner. The inspection table is easily readjusted to accommodate a large number of different products or objects to be inspected. It is possible to program the inspection sensors for the inspection of various different products or objects. When placing an object onto the object area the inspector or operator may indicate the type of object to be inspected manually to the control panel or the inspection sensors. Preferably however, a product detection sensor is provided, which automatically detects the type of object and chooses the corresponding inspection parameters. In this way a lot of different objects can be inspected in a short time, while at the same time human errors are effectively prevented.

Claims

1. Inspection table (11) with at least one area (8, 10) on which objects to be inspected and related inspection sensors (2, 4) are placed, wherein the inspection sensors (2, 4) are freely positionable with respect to the objects to be inspected and fixed in position by quick-fixing means (1, 3).
2. Inspection table according to claim 1, **characterized in that** the at least one area (8, 10) comprises a first sensor area (10) and a second object area (8).
3. Inspection table according to claim 1 or 2, **characterized in that** the quick-fixing means (1, 3) are comprised of magnetic fixing means, suction fixing means and/or Velcro fixing means.

4. Inspection table according any of claims 1 to 3, **characterized in that** the sensor area (10) is provided with an electromagnet.
5. Inspection table according to any of claims 1 to 4, **characterized in that** the object area (8) is inclined at an angle.
6. Inspection table according to claims 4 or 5, **characterized in that** the inclined surface is inclined at an angle of 15 to 60°, in particular 30 to 45°.
7. Inspection table according to any of claims 1 to 6, **characterized in that** the object area (8) is provided with at least one adjustable reference means.
8. Inspection table according to claim 7, **characterized in that** the at least one adjustable reference means is an adjustable tri-square (9).
9. Inspection table according to any of the foregoing claims, **characterized in that** the sensors are angularly adjustable.
10. Inspection table according to any of the foregoing claims, **characterized in that** the sensors (2, 4) are vertically adjustable by means of linear positioning guides (16).
11. Inspection table according to any of the foregoing claims, **characterized in that** the table (11) is provided with at least one control panel (12) to operate the inspection sensors (2, 4).
12. Inspection table according to any of the foregoing claims, **characterized in that** the table (11) is provided with a power supply based on batteries or rechargeable batteries.
13. Inspection table according to any of the foregoing claims, **characterized in that** the table (11) is provided with a control panel (12) that gives audio and/or visual feedback about the inspection results.
14. Inspection table according to any of the foregoing claims, **characterized in that** at least one of the sensors (2, 4) is an optical inspection sensor.
15. Inspection table according to any of the foregoing claims, **characterized in that** at least one of the sensors (2, 4) is a product detection sensor.
16. Inspection table according to any of the foregoing claims, **characterized in that** the object area (8) is provided with a high friction surface.

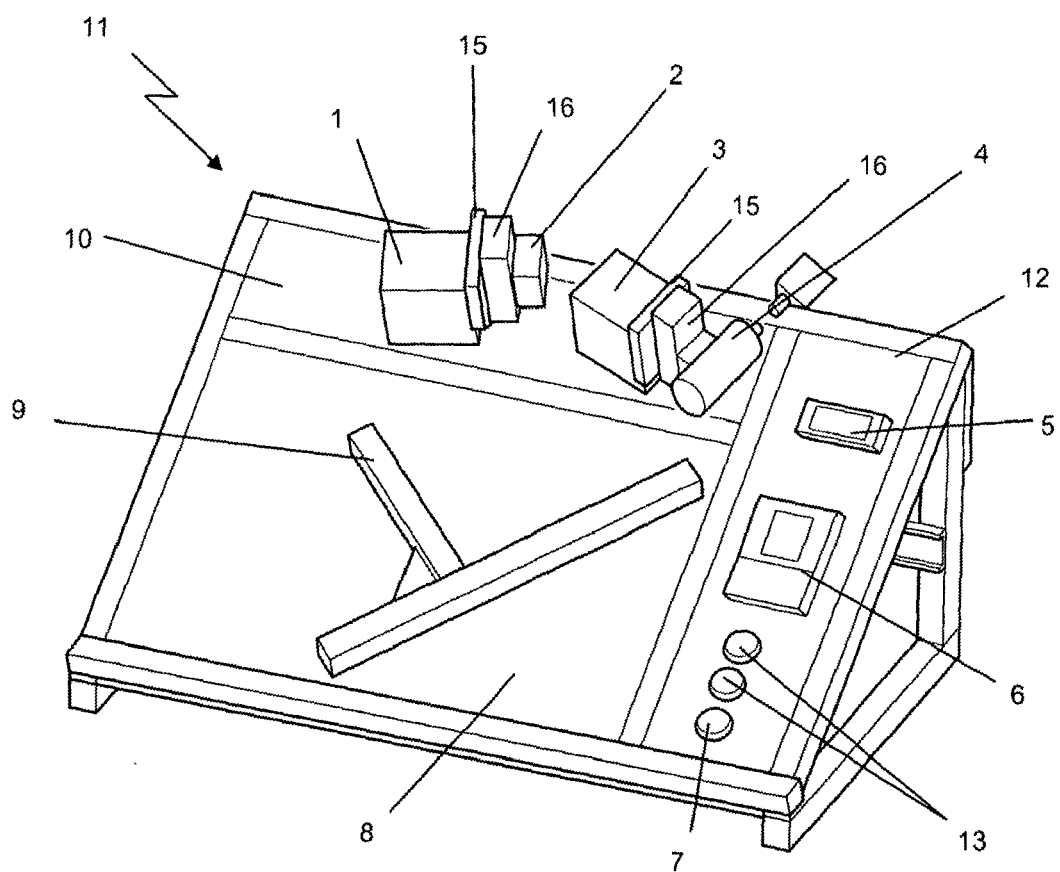


Figure 1



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Place of search The Hague		Date of completion of the search 9 March 2006	Examiner David, R.A.
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			

**ANNEX TO THE EUROPEAN SEARCH REPORT
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