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## (54) Apparatus and method for decorating objects

(57) An apparatus comprising a conveying device (3) for advancing a product (2) along an advance direction (A) at an advance speed (V), deformable decorating means (10) that is brought into contact with said product (2) to deposit a decorating material on said product (2), driving means (8, 9, 16) for driving said deformable decorating means (10) at a driving speed (B), control means for setting an interference value (I1; I2) between said deformable decorating means (10) and said product (2) on said conveying device (3), further comprises controlling means (17) arranged for coordinating said advance speed (V) and said driving speed (B) on the basis of said interference value (I1; I2) in such a way that said deformable decorating means (10) interacts with said product (2) substantially without sliding.

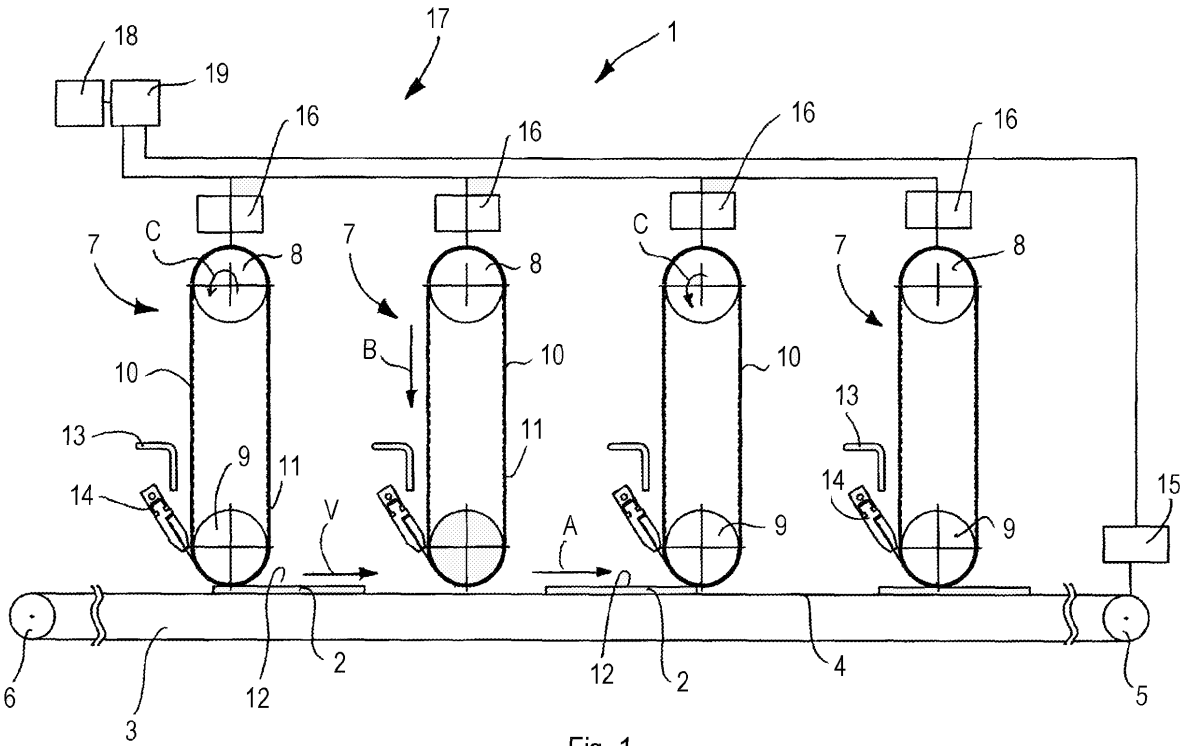


Fig. 1

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## Description

**[0001]** The invention relates to an apparatus and a method for decorating objects, in particular ceramic products.

**[0002]** Roller decorating apparatuses are known for decorating ceramic products, comprising a conveyor that conveys ceramic products to be decorated at a preset advance speed and along an advance direction, and a decorating element such as a printing roller that is rotatable around a longitudinal axis thereof at a preset driving speed. The printing roller is provided with a cylindrical support to which an element of elastomeric material is fixed elastically, arranged in such a way as to have a transferring surface pointing outwards to interact with the ceramic products to be decorated that are arranged on the conveyor. On the transferring surface a plurality of cavities are cut that define decorative patterns that, during operation of the apparatus, are impressed on the ceramic products.

**[0003]** A supply conduit is provided that deposits on the transferring surface a decorating glaze that is received inside said cavities. A doctor blade is also provided that interacts with the transferring surface to remove the excess decorating glaze from zones that are not occupied by the decorative patterns and to promote filling of the cavities with the aforesaid decorating glaze.

**[0004]** The decorating apparatus further comprises a pressing roller positioned inside the printing roller that presses on an internal surface of the printing roller in such a way as to promote the transfer of the decorating glaze from the cavity of the transferring surface to the ceramic product.

**[0005]** Belt-type decorating apparatuses are further known, in which the decorating element comprises a decorating belt of elastomeric material wound on a drive roller, by which it is driven at a driving speed, and on at least a return roller that presses the decorating belt against a ceramic product to be decorated. The decorating belt, similarly to what has been disclosed with reference to the printing roller, is provided with cavities that define decorative patterns. A conduit is also provided for dispensing a decorating glaze and a doctor blade that removes the excess decorating glaze from the belt and promotes filling of the cavities.

**[0006]** The ceramic products can be provided with corrugated surfaces that are provided with protruding and recessed zones. In order for the decorating glaze to be able to be deposited suitably on the ceramic product it is necessary to adjust, in function of the type of corrugated surface to be decorated, a certain contact pressure between the decorating element and the ceramic product. This is necessary for the decorating glaze to be able to reach correctly also the recessed zones of the ceramic product and the latter to be decorated to a high quality level.

**[0007]** The decorative elements, through the effect of the contact pressure exerted on the ceramic products, undergo compression deformation. This compression deformation, that increases in proportion to the pressure contact, is associated with sliding phenomena of the ceramic product relative to the decorating element, detracting from the decorative quality of the ceramic products.

**[0008]** An object of the invention is to improve known apparatuses and methods for decorating products, in particular ceramic products.

**[0009]** A further object is to obtain an apparatus and a method able to provide a high quality of decoration even if high contact pressures are requested between a decorating element of the apparatus and products to be decorated.

**[0010]** In a first aspect of the invention there is provided a method comprising advancing a product on a conveying device along an advance direction at an advance speed, decorating said product by deformable decorating means that is brought into contact with said product to deposit a decorating material on said product, said decorating comprising driving said deformable decorating means at a driving speed, setting an interference value between said deformable decorating means and said product on said conveying device, characterised in that it further comprises coordinating said advance speed and said driving speed on the basis of said interference value in such a way that said deformable decorating means does not substantially slide on said product.

**[0011]** In a second aspect of the invention, there is provided an apparatus comprising a conveying device for advancing a product along an advance direction at an advance speed, deformable decorating means that is brought into contact with said product to deposit a decorating material on said product, driving means for driving said deformable decorating means at a driving speed, control means for setting an interference value between said deformable decorating means and said product on said conveying device, characterised in that it further comprises controlling means arranged for coordinating said advance speed and said driving speed on the basis of said interference value in such a way that said deformable decorating means interacts with said product substantially without sliding.

**[0012]** Owing to these aspects of the invention, it is possible to generate on products, in particular ceramic products, decorations of good quality, even if the deformable decorating means is required to exert considerable contact pressure on the ceramic products. In particular, it is possible also to decorate in a satisfactory manner products that are provided with corrugated surfaces.

**[0013]** In order to obtain a desired contact pressure of the deformable decorating means on the product, a suitable interference value is set between the deformable decorating means and the product conveyed by the conveying device, in such a way that a decorating surface of the deformable decorating means is pressed with a certain force against the product. The deformable decorating means thus undergoes compression deformation that generates variation in peripheral speed on zones of

the decorating surface that from time to time interact with the product.

**[0014]** Owing to the invention, it is possible to coordinate the driving speed and the advance speed on the basis of the interference value, in such a way that the decorating surface, in a contact zone with the product that is decorated, moves substantially at the same speed as the product. This means that the decorating surface does not slide with respect to the product. In this way, the decorating material is deposited correctly without smudges being generated on the product. Further, the decorative patterns impressed on the product have a high definition, also if the deformable decorating means comprises a plurality of deformable decorating elements - each arranged for depositing a decorating material - positioned in sequence on the conveying device, along said advance direction.

**[0015]** The invention can be better understood and implemented with reference to the enclosed drawings that illustrate a nonlimiting embodiment thereof by way of example, in which:

Figure 1 is a schematic side view of an apparatus for decorating ceramic products;

Figure 2 shows schematically an enlarged portion of the apparatus in Figure 1 in an operating configuration;

Figure 3 shows schematically an enlarged portion of the apparatus in Figure 1 in a further operating configuration.

**[0016]** Figure 1 shows an apparatus 1 for decorating ceramic products 2, comprising a conveying device 3 provided with a conveyor belt 4 arranged for conveying the ceramic products 2 to be decorated. The conveyor belt 4 is wound on a drive roller 5 and on a return roller 6, arranged at opposite ends of the conveyor belt 4. The drive roller 5 is guided by a first motor 15 for driving the conveyor belt 4 in such a way as to advance the ceramic products 2 at an advance speed V along an advance direction A.

**[0017]** The apparatus 1 comprises one or more decorating devices 7, each arranged for depositing on the ceramic products 2 a decorating glaze. The decorating devices 7 are arranged one after the other along the advancing direction A and above the conveyor belt 4.

**[0018]** Each decorating device 7 comprises a decorating belt 10, comprising a deformable material, for example elastomeric material, having a preset thickness S and a decorating surface 11 facing the outside of the decorating belt 10 to interact with the ceramic products 2. On the decorating surface 11 a plurality of cavities is cut that define decorative patterns that, during operation of the apparatus 1, are impressed on the ceramic products 2.

**[0019]** The decorating belt 10 is wound on a pressing roller 9 and on a driving roller 8 that is driven by a second motor 16. The driving roller 8 drives the decorating belt 10 at a driving speed B and in a driving direction C. The pressing roller 9 presses the decorating belt 10 against an upper surface 12 of the ceramic product 2.

**[0020]** A supply conduit 13 is provided that deposits on the decorating surface 11 the decorating glaze that is received inside said cavities. A doctor blade 14 is also provided that interacts with the decorating surface 11 to remove the excess decorating glaze from the decorating surface 11 and to promote filling of the cavities with the decorating glaze.

**[0021]** Each decorating device 7 can be positioned at an operating distance from the conveying device 3, in such a way that the decorating belt 10 presses against the upper surface 12 of the ceramic product 2 with an appropriate force. In this way the decorating glaze can reach all the zones that are to be decorated of the ceramic product 2, even if the upper surface 12 is corrugated.

**[0022]** Figure 2 shows schematically a portion of the decorating device 7 interacting with a ceramic product 2 in a first operating configuration X, in which the pressing roller 9, that is rotatable around a first angular speed W1 around an axis O is separated from the conveyor belt 4 by a first distance D1.

**[0023]** In Figure 2 the deformation of the decorating belt 10 has been emphasised to make the description clearer.

**[0024]** In the first operating configuration X, the decorating device 7 is positioned in such a way that the pressing roller 9 is separated from the upper surface 12 of the ceramic product 2 by a second distance D2, so that the decorating belt 10, in a contact zone Z1 with the ceramic product 2, is compressed by a set quantity and has a lesser thickness than the thickness S, i.e. than the thickness that the decorating belt 10 has in an undeformed condition.

**[0025]** In other words, between the decorating belt 10 and the ceramic product 2 an interference is defined having an interference value I1.

**[0026]** In order to show the aforesaid interference, the decorating belt 10 - in an undeformed condition - has been shown by a broken line in Figure 2.

**[0027]** It should be noted that portions 11a of the decorating surface 11 that are in the contact zone Z1 advance at lower peripheral speeds than portions 11b of the decorating surface 11 that are far from the contact zone Z1 and are therefore not affected by compression deformation.

**[0028]** For example, a first point P1 of the decorating surface 11 is, at a given instant, in the contact zone Z1, i.e. on a straight line passing through the axis O and perpendicular to the conveyor belt 4, in such a way as to be separated from the axis O by a first distance R1. The first point P1, in this first position, moves at a first peripheral speed that is substantially equal to the product of the first angular speed W1 by the first distance R1.

**[0029]** A second point P2 of the decorating surface 11 is situated, at a given instant, near the pressing roller 9, but outside the contact zone Z1, in such a way as to be separated from the axis O by a second distance R2 that

is greater than the first distance R1. The point P2 moves at a second peripheral speed that is substantially equal to the product of the first angular speed W1 by the second distance R2, this second peripheral speed thus being greater than the first peripheral speed.

**[0030]** The apparatus 1 is provided with controlling means 17 arranged for coordinating the advance speed V and the driving speed B on the basis of the interference value I1 that is set in function of the type of ceramic product 2 that it is desired to decorate.

**[0031]** The controlling means 17 comprises a control unit 18 and adjusting means 19, operationally connected to the first motor 15 and to the second motor 16.

**[0032]** The control unit 18 is associated with moving means, which is not shown, that moves each decorating device 7 in relation to the conveyor belt 4 in such a way that between the decorating belt 10 and the ceramic product 2 the interference value I1 is defined.

**[0033]** The interference value I1 is selected by an operator on the basis of a desired contact pressure value that the decorating belt has to exert on the ceramic product 2.

**[0034]** The adjusting means 19 acts in such a way as to adjust the advance speed V and/or the driving speed B on the basis of the interference value I1 entered into the control unit 18.

**[0035]** The adjusting means 19 and the control unit 18 exchange a signal indicating the interference value I1.

**[0036]** In particular, the adjusting means 19 enables the ratio between the advancing speed V and the driving speed B to be adjusted.

**[0037]** The controlling means 17 thus enables to take into account the deformation to which the decorating belt 10 is subject by appropriately adjusting the advance speed V and/or the driving speed B (i.e. the ratio between the advance speed V and the driving speed B) in order that there is no substantial sliding in the contact zone Z1 between the decorating surface 11 and the upper surface 12.

**[0038]** In an embodiment, the transferring belt 4 moves at a substantially constant driving speed V.

**[0039]** The driving speed V is detected by a detecting device, for example an encoder, and communicated to the controlling means 17.

**[0040]** The adjusting means 19 varies the speeds of each of the second motors 16 in such a way that each of the decorating belts 10 moves at a driving speed B synchronised with the advance speed V.

**[0041]** The advance speed B of each decorating belt can be varied independently of the advance speeds B of the remaining decorating belts.

**[0042]** The driving speeds B can be the same as one another or different from one another, depending on the interference value of each decorating device 7.

**[0043]** In this way, in the case of an apparatus 1 comprising a plurality of decorating devices 7, the advancing speed V constitutes a reference for all the driving speeds B, i.e. for the driving speed B of the decorating belt 10 of each of the decorating devices 7.

**[0044]** Figure 3 shows schematically a portion of the decorating device 7 interacting with a ceramic product 2 in a second operating configuration Y.

**[0045]** With reference to Figure 3, if the pressing roller 9 is further moved nearer the conveyor belt 4, for example for decorating a ceramic product 2 that requires greater contact pressure, the decorating belt 10 undergoes greater compression deformation than is the case shown in Figure 2. In this case, the pressing roller 9 is at a further first distance E1 from the conveyor belt 4 and at a further second distance E2 from the upper surface 12 of the ceramic product 2.

**[0046]** In other words, between the decorating belt 10 and the ceramic product 2 an interference is defined having a further interference value I2.

**[0047]** In order to show the aforesaid interference, the decorating belt 10 - in undeformed condition - has been shown by a broken line in Figure 3.

**[0048]** A third point P3 of the decorating surface 11 is, at a given instant, in a further contact zone Z2 of the decorating belt 10 with the ceramic product 2, i.e. on a straight line passing through the axis O and perpendicular to the conveyor belt 4, in such a way as to be separated from the axis O by a third distance R3, that is less than the first distance R1. In order not to have relative sliding between the third point P3 and the ceramic product 2, the controlling means 17 acts on the second motor 16, and thus on the driving roller 8, in such a way as to vary the angular speed of the latter. In this way the pressing roller 9 is rotated at a second angular speed W2 that is greater than the first angular speed W1, in such a way that the product of the second angular speed W2 by the third distance R3 is substantially the same as the advance speed V. Alternatively, the controlling means 17 can, instead of varying the speed of the decorating belt 10, vary the speed of the conveyor belt 4, or simultaneously vary both the speed of the decorating belt 4 and that of the conveyor belt 4 in such a way as to coordinate them together.

**[0049]** In an embodiment, the apparatus 1 may comprise, instead of belt-type decorating devices, one or more decorating devices of the printing roller type. Each printing roller may comprise a cylindrically shaped decorating device and deformable material, for example elastomeric material, at the ends of which supporting flanges are provided. The supporting flanges are arranged to tension with a certain force the decorating body and for connecting the latter to driving members of the apparatus 1.

**[0050]** In a further embodiment, the printing roller may comprise a stiff supporting body, for example a metal core surrounded by a layer of spongy material and by a more outer layer, made for example of elastomers.

## Claims

1. Method, comprising advancing a product (2) on a conveying device (3) along an advance direction (A) at an advance speed (V), decorating said product (2) with deformable decorating means (10) that is brought into contact with said product (2) to deposit a decorating material on said product (2), said decorating comprising driving said deformable decorating means (10) at a driving speed (B), setting an interference value (I1; I2) between said deformable decorating means (10) and said product (2) on said conveying device (3), **characterised in that** it further comprises coordinating said advancing speed (V) and said driving speed (B) on the basis of said interference value (I1; I2) in such a way that said deformable decorating means (10) does not substantially slide on said product (2).

2. Method according to claim 1, wherein said coordinating comprises varying a ratio between said advance speed (V) and said driving speed (B).

3. Method according to claim 1, or 2, wherein said coordinating comprises varying said advance speed (V) and/or said driving speed (B).

4. Method according to any one of claims 1 to 3, wherein said coordinating comprises substantially maintaining said advance speed (V) constant and modifying said driving speed (B).

5. Method according to claim 4, wherein said deformable decorating means comprises a plurality of deformable decorating elements (10) arranged along said conveying device (3), said modifying comprising modifying the driving speed (B) of each of said deformable decorating elements (10) independently of the driving speeds (B) of the remaining deformable decorating elements (10).

6. Method according to any one of claims 1 to 5, wherein said product comprises a ceramic product (2).

7. Programme that comprises a code for implementing the method according to the preceding claims when the programme is run in a computer system.

8. Data carrier that is readable by a computer and carries a programme defined in claim 7.

9. Apparatus comprising a conveying device (3) for advancing a product (2) along an advance direction (A) at an advance speed (V), deformable decorating means (10) that is brought into contact with said product (2) to deposit a decorating material on said product (2), driving means (8, 9, 16) for driving said deformable decorating means (10) at a driving speed (B), control means for setting an interference value (I1; I2) between said deformable decorating means (10) and said product (2) on said conveying device (3), **characterised in that** it further comprises controlling means (17) arranged for coordinating said advance speed (V) and said driving speed (B) on the basis of said interference value (I1; I2) in such a way that said deformable decorating means (10) interacts with said product (2) substantially without sliding.

10. Apparatus according to claim 9, wherein said controlling means (17) comprises a control unit (18) arranged for receiving as input said interference value (I1; I2) .

11. Apparatus according to claim 10, wherein said control unit (18) controls said control means so that said control means mutually positions said deformable decorating means (10) and said conveying device (3) in such a way that between said deformable decorating means (10) and said product (2) said interference value (11; 12) is defined.

12. Apparatus according to any one of claims 9 to 11, wherein said controlling means (17) comprises adjusting means (19) for adjusting said advance speed (V) and/or said driving speed (B).

13. Apparatus according to claim 12, wherein said adjusting means (19) adjusts first motor means (15) that drives said conveying device (3) and/or second motor means (16) that drives said deformable decorating means (10).

14. Apparatus according to claim 12, or 13, wherein said adjusting means (19) varies a ratio between said advance speed (V) and said driving speed (B).

15. Apparatus according to any one of claims 12 to 14, wherein said adjusting means (19) maintains said advance speed (V) substantially constant and modifies said driving speed (B).

16. Apparatus according to claim 15, wherein said deformable decorating means comprises a plurality of deformable decorating elements (10) arranged along said conveying device (3), said adjusting means (19) modifying the driving speed (B) of each of said deformable decorating elements (10) independently of the driving speeds (B) of the remaining deformable decorating elements (10).

17. Apparatus according to any one of claims 12 to 16, as claim 12 is appended to claim 10, or 11, wherein said adjusting means (19) is operationally connected to said control unit (18).

**18.** Apparatus according to any one of claims 12 to 16, as claim 12 is appended to claim 10, or 11, or according to claim 17, wherein said adjusting means (19) and said control unit (18) exchange a signal indicating said interference value (I1; I2).

**19.** Apparatus according to any one of claims 9 to 18, wherein said deformable decorating means (10) comprises belt decorating means.

**20.** Apparatus according to any one of claims 9 to 18, wherein said deformable decorating means (10) comprises roller decorating means.

**21.** Apparatus according to any one of claims 9 to 20, wherein said product comprises a ceramic product (2).

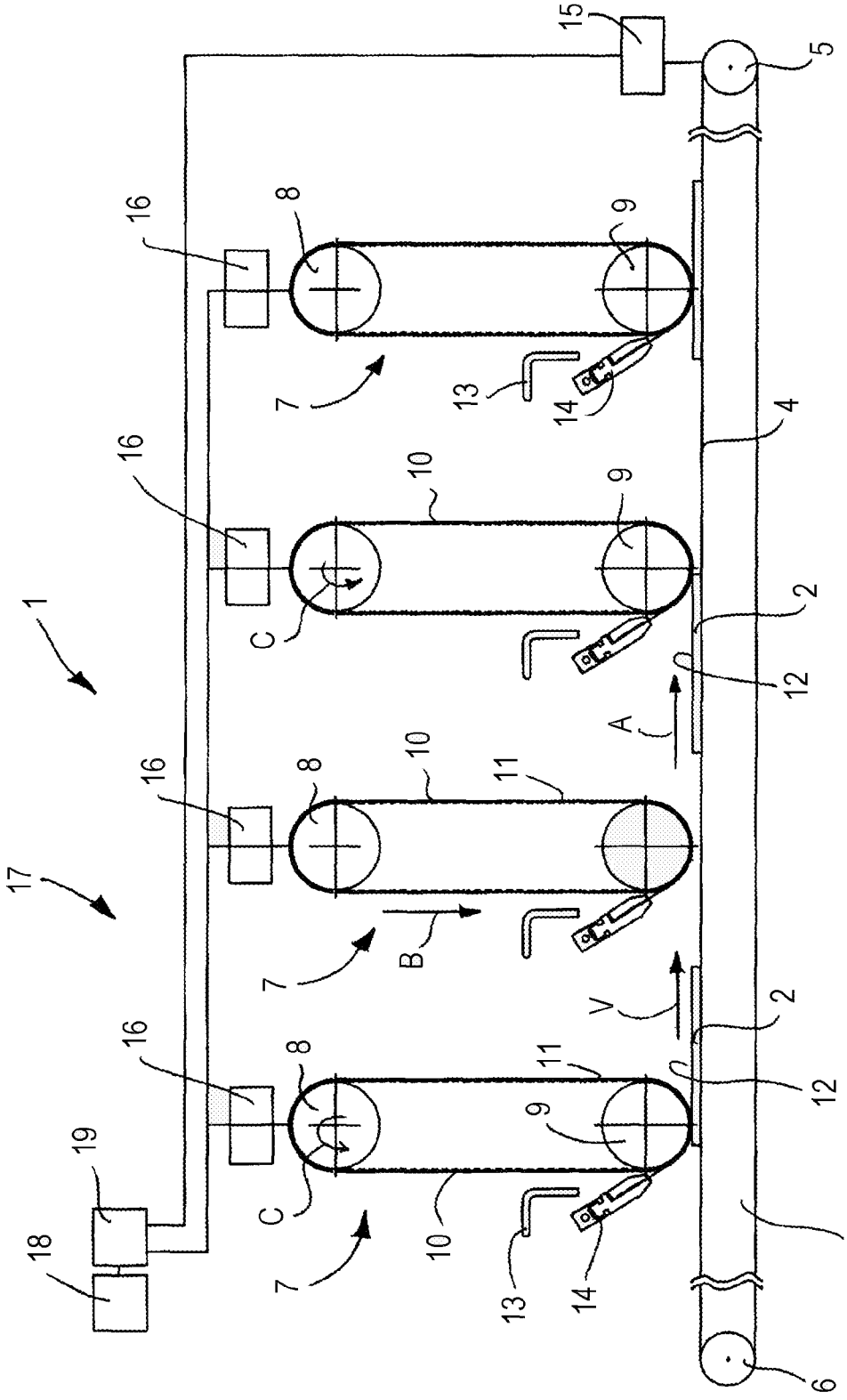


Fig. 1

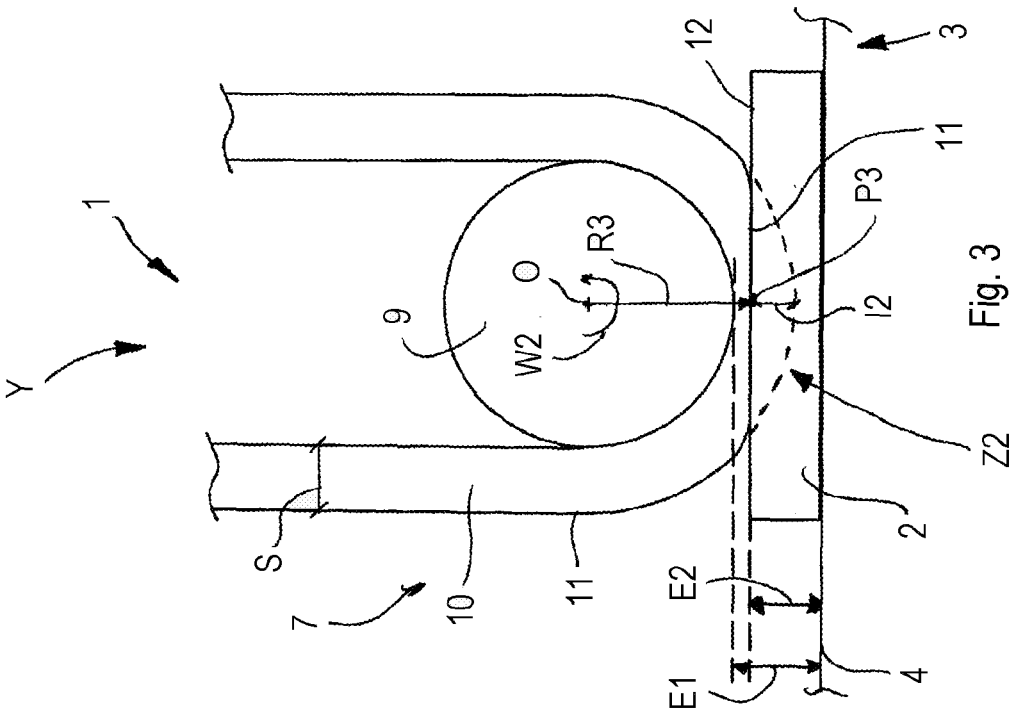
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Fig. 3

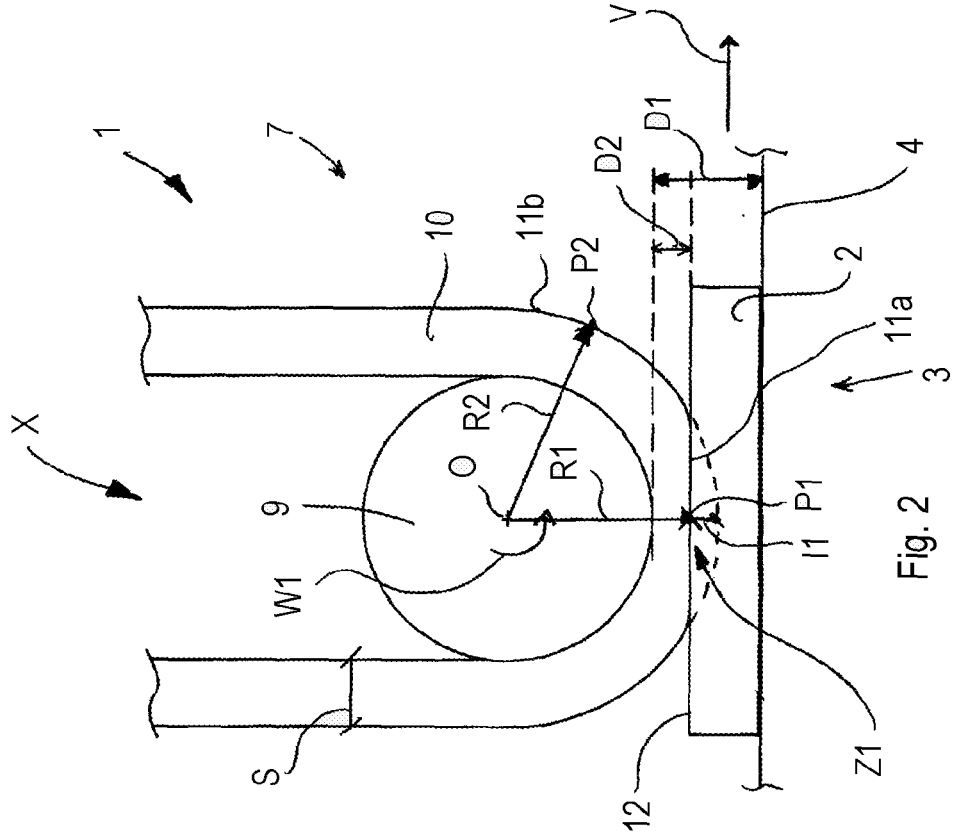
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Fig. 2