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(54) **UNIT AND METHOD FOR WETTING A WATER-SOLUBLE FILM AND MACHINE AND METHOD FOR PRODUCING UNIT DOSE ARTICLES**

(57) A wetting unit for a machine for producing unit dose articles, comprising a wetting roller (66) having an outer tubular element (68) made of an elastically deformable water-permeable material, which transmits water

from the inside to the outside and a pressure element (88) which compresses radially a portion of the outer surface (70) of the outer tubular element (68).

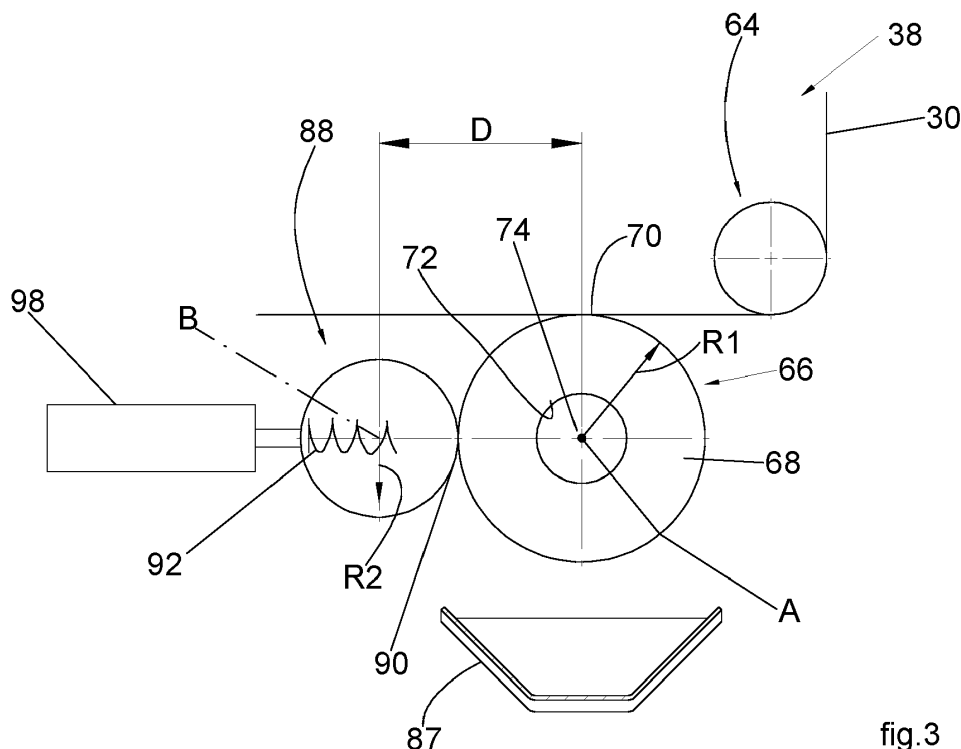


fig.3

Description

Field of the invention

[0001] The present invention relates to the production of unit dose articles filled with household care compositions, such as laundry detergents, dishwasher detergents, softeners, and other compositions used in household appliances.

[0002] In particular, the invention relates to a machine and method for producing unit dose articles.

[0003] According to another aspect, the invention relates to a unit and method for wetting a water-soluble film.

[0004] The invention was developed in particular in view to its application to the production of detergent pods formed by a one or more compositions enclosed between two water-soluble films.

[0005] In the following description, reference will be made to this specific field without however losing generality.

Prior art

[0006] Laundry and dishwasher detergent pods or tablets are water-soluble pouches containing highly concentrated laundry detergents, softeners, and other laundry products. Detergent pods are becoming increasingly popular in view of the ease of use for the user and the positive impact on sustainability as they are a way to reduce wasted use of powdered and liquid detergent by having precise measurements for a load.

[0007] Detergent pods are generally produced by forming recesses in a first water-soluble film, filling the recesses with compositions, applying a second water-soluble film over the first water-soluble film, and joining to each other the first and second water-soluble films so as to seal the compositions between the two water-soluble films.

[0008] The water-soluble films are typically made of polyvinylalcohol (PVA) or a derivative of PVA, which is designed to be soluble in cold water. Such water-soluble films are not heat-sealable as the thermoplastic films used for packaging food articles.

[0009] Joining of the water-soluble films is typically made by wetting one of the two water-soluble films and pressing together the films around the recesses containing the compositions.

[0010] The step of wetting the water-soluble film is a key point in the process for forming the detergent pods. Since the water-soluble films are specifically designed to dissolve in contact with water, it is critical that the water-soluble film is wetted by a precise amount of water which should be high enough for a correct sealing of the pouches which prevents spilling of the compositions but low enough to prevent dissolution of the water-soluble films.

[0011] In the prior art machines the wetting unit which carries out wetting of one of the water-soluble films comprises a wetting roller, rotating about a horizontal axis

and having an outer surface made of a hydrophilic material, typically by felt. A lower portion of the roller is immersed in water contained in a tray. The water-soluble film is made to advance in contact with the outer surface of the wetting roller. During the rotation of the wetting roller, the outer surface of the roller is periodically immersed in the water contained in the tray. The wetting roller collects water when it is immersed in the water contained in the tray. Some of the water which impregnates the outer surface of the wetting roller is released to the water-soluble film at the area in which the water-soluble film contacts the wetting roller.

[0012] This solution is affected by several problems, among which the following:

- the quantity of water which is released to the water-soluble film is strongly conditioned by the level of water in the tray, and it is difficult to ensure that in operation the level of water in the tray remains constant;
- the contact area between the water-soluble film and the wetting roller can not be below the wetting roller since the area below the wetting roller is occupied by the tray; therefore, such contact area has to be placed in a position which is not ideal regarding the efficiency of the transfer of water from the wetting roller to the water-soluble film;
- temporary stops of the rotation of the wetting roller, for instance during maintenance operations, tend to cause uneven concentrations of water along the periphery of the wetting roller, which in turn causes uneven wetting of the water-soluble film after a stop;
- prolonged stops of the machine cause drying and hardening of the outer surface of the wetting roller, which require a long start-up time and waste of material during the start-up of the machine.

[0013] The problems caused by the stop of the wetting roller are so serious that many manufacturers keep the wetting roller running even when the machine is stopped.

Object and summary of the invention

[0014] The object of the present invention is to provide a wetting unit and a method for wetting a film which overcome the problems of the prior art.

[0015] According to the present invention, this object is achieved by a wetting unit according to claim 1 and by a method according to claim 10.

[0016] According to another aspect, the invention relates to a machine for producing unit dose articles according to claim 9 and to a method for producing unit dose articles according to claim 15.

[0017] The claims form an integral part of the disclosure provided here in relation to the invention.

Brief description of the drawings

[0018] The present invention will now be described in detail with reference to the attached drawings, given purely by way of non-limiting example, wherein:

- Figure 1 is a schematic side view of a machine for producing unit dose articles according to the present invention,
- Figure 2 is a schematic cross-section according to the line II-II of figure 1 showing a wetting unit according to the present invention,
- Figures 3, 4, and 5 are schematic side views of different embodiments of a wetting unit according to the present invention, and
- Figure 6 is a schematic plan view of a part of a wetting unit according to the present invention.

[0019] It should be appreciated that the attached drawings are schematic and various figures may not be represented in the same scale. Also, in various figures some elements may not be shown to better show other elements.

Detailed description

[0020] With reference to figure 1, a machine for producing unit dose articles is indicated by the reference numeral 10.

[0021] The machine 10 comprises a forming surface 12 having a plurality of cavities 14, continuously movable in a machine direction MD. In the embodiment shown in figure 1 the forming surface 12 is the outer cylindrical surface of a drum 16 rotating about a horizontal axis A. In a possible embodiment, the forming surface 12 may be the outer surface of a closed-loop belt having a horizontal upper section and a lower return section.

[0022] The machine 10 comprises a first feeding assembly 18 configured for feeding a first continuous water-soluble film 20 on the forming surface 12. The first continuous water-soluble film 20 is unwound from a first reel 22 and is supplied to the forming surface 12 at a first position 24.

[0023] The first continuous water-soluble film 20 is retained on the forming surface 12 as it moves in the machine direction MD. The first continuous water-soluble film 20 may be retained on the forming surface 12 by mechanical retention elements acting on lateral edges of the first continuous water-soluble film 20, e.g. by belts which retain the lateral edges of the first continuous water-soluble film 20 on the outer surface of the drum 16.

[0024] The first continuous water-soluble film 20 is deformed into the cavities 14 of the forming surface 12 as it moves in the machine direction MD. The deformation of the first continuous water-soluble film 20 into the cavities 14 may be obtained by a suction system comprising a plurality of holes open on the surfaces of the cavities 14 and fluidically connected to a stationary suction cham-

ber 26 connected to a sub-atmospheric pressure source. The first continuous water-soluble film 20 is kept adherent to the walls of the cavities 14 by said suction system, so that in the first continuous water-soluble film 20 a plurality of recesses is formed, having the same shape as the cavities 14.

[0025] The machine 10 comprises a second feeding assembly 28 configured for feeding a second continuous water-soluble film 30 on the forming surface 12 at a second position 32 located downstream of said first position 24 with respect to the machine direction MD. The second continuous water-soluble film 30 is unwound from a second reel 34.

[0026] The machine 10 comprises a dosing apparatus 36 configured for dispensing dosed quantities of at least one fluid composition into the recesses of the first continuous water-soluble film 20, which are set at the cavities 14 of the forming surface 12. The dosing apparatus 36 is located in a position intermediate between the first position 24 and the second position 32. The dosing apparatus 36 fills the recesses of the first continuous water-soluble film 20 with one or more fluid compositions. After the recesses of the first continuous water-soluble film 20 have been filled with the fluid compositions, the second continuous water-soluble film 30 is applied over the first continuous water-soluble film 20, so as to enclose the dosed quantities of fluid compositions contained into the recesses between the first and second continuous water-soluble films 20, 30.

[0027] The dosing apparatus 36 comprises at least one dosing unit 50 having respective nozzles 58 connected to a fluid delivery system via a line 62.

[0028] The machine 10 comprises a wetting unit 38 configured for wetting a surface of the second continuous water-soluble film 30 upstream of said second position 32. The wetting unit 38 is configured for wetting the surface of the second continuous water-soluble film 30 which will be put in contact with the first continuous water-soluble film 20. The first and second continuous water-soluble films 20, 30 are water-sealed to each other in respective contact areas which surround the recesses containing the dosed fluid compositions.

[0029] The machine 10 comprises a longitudinal cutter 40 and a transverse cutter 42 which cut the first and second continuous water-soluble films 20, 30 so as to form individual unit dose articles which are collected on an output conveyor 44. The scraps of the water-soluble films originated by the longitudinal and transverse cuts are removed by a scrap aspirator 46.

[0030] The wetting unit 38 comprises a film guiding device 64 comprising at least one guide roller, which is configured for guiding the second continuous water-soluble film 30 as will be described in the following.

[0031] With reference to figure 2, the wetting unit 38 comprises a wetting roller 66 rotatable about a first axis A. The wetting roller 66 comprises an outer tubular element 68 having an outer surface 70 and an inner surface 72. The outer tubular element 68 is made of an elastically

deformable water-permeable material, for example polyvinylalcohol (PVA), which allows passage of water in a radial direction from the inner surface 72 to the outer surface 70.

[0032] The wetting roller 66 comprises an inner central element 74 formed for instance by a metal shaft, arranged coaxially inside the outer tubular element 68. The inner central element 74 is connected to a motor 86 which rotates the wetting roller 66 about the axis A.

[0033] The inner central element 74 has an inner channel 76 connected to a water supply line 78 via a rotating connector 80. The water supply line 78 is connected to a water reservoir 82. The inner channel 76 is connected to perforations open on the outer cylindrical surface of the inner central element 74, which are in liquid communication with the outer tubular element 68. A tubular perforated sleeve 84 may be set between the outer cylindrical surface of the inner central element 74 and the inner surface 72 of the outer tubular element 68, to uniformly distribute water in the longitudinal direction of the outer tubular element 68.

[0034] The wetting unit 38 may comprise a collecting tray 87 placed below the wetting roller 66 for collecting excess water dripping from the outer surface 70 of the outer tubular element 68.

[0035] With reference to figures 3-6, the wetting unit 38 comprises a pressure element 88 arranged for compressing radially a portion of the outer surface 70 of the outer tubular element 68. During the rotation of the wetting roller 66 around the axis A, the outer tubular element 68 is cyclically compressed in the area which is in contact with the pressure element 88. When the compressed area rotates out of contact with the pressure element 88 the previously compressed area expands under the intrinsic elasticity of the material forming the outer tubular element 68. The cyclical compression and expansion of the outer tubular element 68 generates a pumping action which draws the water which impregnates the outer tubular element 68 on the outer surface 70 thereof and distributes uniformly the water on the outer surface 70, thereby forming a uniform film of water on the outer surface 70 of the outer tubular element 68.

[0036] The pressure element 88 is made of a material which is more rigid than the material forming the outer tubular element 68. For instance, the pressure element 88 may be made of silicone and the outer tubular element 68 may be made of polyvinylalcohol (PVA).

[0037] In a possible embodiment the pressure element 88 may be formed by a pressure roller rotatable about a second axis B parallel to the first axis A and having an outer surface pressed against the outer surface 70 of the outer tubular element 68 in a contact area 90. The distance D between the first axis A and second axis B is less than the sum of the radii R1, R2 of the outer tubular element 68 and pressure roller 88 in undeformed conditions.

[0038] In a possible embodiment the pressure element 88 may be formed by a non-rotating bar or rod.

[0039] With reference to figures 3-5, the wetting unit 38 may comprise an elastic mechanism 92 configured for pressing elastically the pressure element 88 against the outer surface 70 of the outer tubular element 68. The elastic mechanism 92 may be adjustable to adjust the contact pressure applied by the pressure element 88 on the outer surface 70 of the outer tubular element 68.

[0040] With reference to figure 6, in a possible embodiment the pressure element 88 may have a length less than the length of the outer tubular element 68 and may be arranged so that two opposite lateral portions 94 of the outer tubular element 68 are not in contact with the pressure element 88. It has been found that this arrangement provides a better uniformity of the water film on the central portion of the outer tubular element 68, in that any excess of water is pushed axially towards the two opposite lateral portions 94, from where it drips in the collecting tray 87.

[0041] With reference to figure 3, in a possible embodiment the film guiding device 64 is configured for guiding the second continuous water-soluble film 30 on a portion of the outer surface 70 of the outer tubular element 68 which is not in contact with the pressure element 88. The second continuous water-soluble film 30 may be tangent to or wound with a certain angle on the outer surface 70 of the outer tubular element 68.

[0042] With reference to figure 4, in a possible embodiment the film guiding device 64 is configured for guiding the second continuous water-soluble film 30 through the contact area 90 between the pressure element 88 and the outer tubular element 68.

[0043] With reference to figure 5, in a possible embodiment the film guiding device 64 is configured for guiding the second continuous water-soluble film 30 on a portion of the outer surface of the pressure element 88 which is not in contact with the outer tubular element 68. In this embodiment, it is preferable that the pressure element 88 should be a rotating roller which receives a film of water from the outer tubular element 68 in the contact area and transfer the film of water to the second continuous water-soluble film 30. In this embodiment the peripheral speed of the pressure roller 88 may be greater than the linear speed of the second continuous water-soluble film 30. It has been found that there is an increase of the quantity of water which is transferred from the pressure roller 88 to the second continuous water-soluble film 30 which is proportional to the speed difference between the peripheral speed of the pressure roller 88 and the linear speed of the second continuous water-soluble film 30.

[0044] The embodiment of figure 5 may solve the problems linked to dripping of the wetting roller 66 and to a possible non-homogeneity of water transfer between the wetting roller 68 and the film due to the porosity of the wetting roller 66. The pressure roller 88 may be made of microporous hydrophilic material having the capacity to distribute very quickly the liquid on its surface thereby solving problems of non-uniformity of water distribution

due to the porosity of the wetting roller 66.

[0045] In operation, the second continuous water-soluble film 30 during the passage through the wetting unit 38 receives a quantity of water which depends on the time of contact between the second continuous water-soluble film 30 with the wet surface of the wetting roller 66 or pressure roller 88 and on the thickness of the water film formed on the wetting roller 66 or pressure roller 88.

[0046] A precise control of the water quantity applied to the second continuous water-soluble film 30 is critical to ensure that the first and second continuous water-soluble films 20, 30 are water-sealed to each other in the respective contact areas which surround the recesses containing the dosed fluid compositions without however losing their integrity.

[0047] The pressure element 88 pressed against the outer surface 70 of the outer tubular element 68 solves the problems linked to a possible difficulty in transferring water from the internal portion to the external surface of the wetting roller 66, both in terms of speed and homogeneity of distribution, in particular when the wetting roller 66 is dry (system startup condition). The cyclical compression/expansion of the outer surface 70 of the outer tubular element 68 improves the absorption and release of water (pumping effect) and improves the performance of the wetting unit 38 in terms of system startup speed and uniformity of water dispensing on the film. The possibility to adjust the contact pressure between the pressure element 88 and the outer surface 70 of the outer tubular element 68 provides an accurate control of the amount of water delivered to the continuous film.

[0048] The amount of water delivered to the film can be controlled through a control system including a flow meter 96 (figure 2) placed on the water supply line 78, and an actuator 98 (figures 3, 4 and 5) which controls the contact pressure between the pressure element 88 and the wetting roller 66. As the contact pressure increases, the amount of water dispensed also increases. The contact pressure and therefore the water delivered by the wetting roller 66 may thus be controlled based on the amount of water entering the wetting roller 66 measured by the flow meter 96.

[0049] Of course, without prejudice to the principle of the invention, the details of construction and the embodiments can be widely varied with respect to those described and illustrated, without thereby departing from the scope of the invention as defined by the claims that follow.

Claims

1. A wetting unit for a machine for producing unit dose articles, comprising:

- a film guiding device (64) configured for guiding a continuous film (30),
- a wetting roller (66) rotatable about a first axis

(A) and comprising an outer tubular element (68) having an outer surface (70) and made of an elastically deformable water-permeable material, and an inner central element (74) arranged coaxially inside and in liquid communication with said outer tubular element (68),

- a water supply line (78) connected to said inner central element (74) of the wetting roller (66) via a rotating connector (80), and

- a pressure element (88) arranged for compressing radially a portion of the outer surface (70) of the outer tubular element (68) in a contact area (90), so that in operation said outer tubular element (68) cyclically compresses and expands during the rotation of said wetting roller (66).

2. The wetting unit of claim 1, wherein said pressure element (88) is a roller rotatable about a second axis (B) parallel to said first axis (A) and having an outer surface pressed against the outer surface (70) of said outer tubular element (68) in said contact area (90).

3. The wetting unit of claim 1 or claim 2, wherein said film guiding device (64) is configured for guiding a continuous film (30) on a portion of the outer surface (70) of said outer tubular element (68) which is not in contact with said pressure element (88).

4. The wetting unit of claim 1 or claim 2, wherein said film guiding device (64) is configured for guiding a continuous film (30) through said contact area (90) between said pressure element (88) and said outer tubular element (68).

5. The wetting unit of claim 1 or claim 2, wherein said film guiding device (64) is configured for guiding a continuous film (30) on a portion of the outer surface of said pressure element (88) which is not in contact with said outer tubular element (68).

6. The wetting unit of any of claims 2-5, wherein the distance (D) between said first axis (A) and second axis (B) is less than the sum of the radii (R1, R2) of the outer tubular element (68) and pressure element (88) in undeformed conditions.

7. The wetting unit of any of the preceding claims, comprising an elastic mechanism (92) configured for pressing elastically the pressure element (88) against the outer tubular element (68).

8. The wetting unit of any of the preceding claims, wherein said pressure element (88) has a length less than the length of the outer tubular element (68) and is arranged so that two opposite lateral portions (94) of the outer tubular element (68) are not in contact

with the pressure element (88).

9. A machine for producing unit dose articles, comprising:

- a forming surface (12) having a plurality of cavities (14), continuously movable in a machine direction (MD),
- a first feeding assembly (18) configured for feeding a first continuous water-soluble film (20) on said forming surface (12) at a first position (24),
- a retaining system (26) configured for retaining said first continuous water-soluble film (20) adherent to said cavities (14) as it moves in said machine direction (MD),
- a dosing apparatus (36) comprising at least one dosing unit (50) configured for dispensing dosed quantities of at least one fluid composition into said cavities (14),
- a second feeding assembly (28) configured for feeding a second continuous water-soluble film (30) on said forming surface (12) at a second position (32) located downstream of said dosing unit (36) so as to enclose said dosed quantities of at least one composition between said first and second continuous water-soluble films (20, 30), and
- a wetting unit (38) according to any of the preceding claims configured for wetting a surface of said second continuous water-soluble film (30) upstream of said second position (32).

10. A method for wetting a continuous film, comprising:

- providing a wetting roller (66) rotatable about a first axis (A) and comprising an outer tubular element (68) having an outer surface (70) and made of an elastically deformable water-permeable material, and an inner central element (74) arranged coaxially inside and in liquid communication with said outer tubular element (68),
- supplying water to said inner central element (74) of the wetting roller (66) via a rotating connector (80),
- pressing a pressure element (88) against a portion of the outer surface (70) of said outer tubular element (68) in a contact area (90) during the rotation of said wetting roller (66), so that said outer tubular element (68) cyclically compresses and expands during the rotation of said wetting roller (66), and
- guiding a continuous film (30) on a wet surface of the outer tubular element (68) or pressure element (88).

11. The method of claim 10, comprising guiding a continuous film (30) on a portion of the outer surface

(70) of said outer tubular element (68) which is not in contact with said pressure element (88).

12. The method of claim 10, comprising guiding a continuous film (88) through said contact area (90) between said pressure element (88) and said outer tubular element (68).

13. The method of claim 10, comprising guiding a continuous film (30) on a portion of the outer surface of said pressure element (88) which is not in contact with said outer tubular element (68).

14. The method of any of claims 10 - 13, wherein said pressure element (88) has a length less than the length of the outer tubular element (68) so that two opposite lateral portions (94) of the outer tubular element (68) are not in contact with the pressure element (88).

15. A method for producing unit dose articles, comprising:

- providing a forming surface (12) having a plurality of cavities (14), continuously movable in a machine direction (MD),
- feeding a first continuous water-soluble film (20) on said forming surface (12) at a first position (24),
- retaining said first continuous water-soluble film (20) on said forming surface (12) as it moves in said machine direction (MD) and forming in said first continuous water-soluble film (20) a plurality of recesses by keeping the first continuous water-soluble film (20) adherent to said cavities (14),
- delivering dosed quantities of fluid products into said recesses through a plurality of nozzles (58),
- feeding a second continuous water-soluble film (30),
- wetting a surface of said second continuous water-soluble film (30) by a wetting method according to any of claims 1-14, and
- water-sealing to each other said first and second continuous water-soluble films (20, 30).

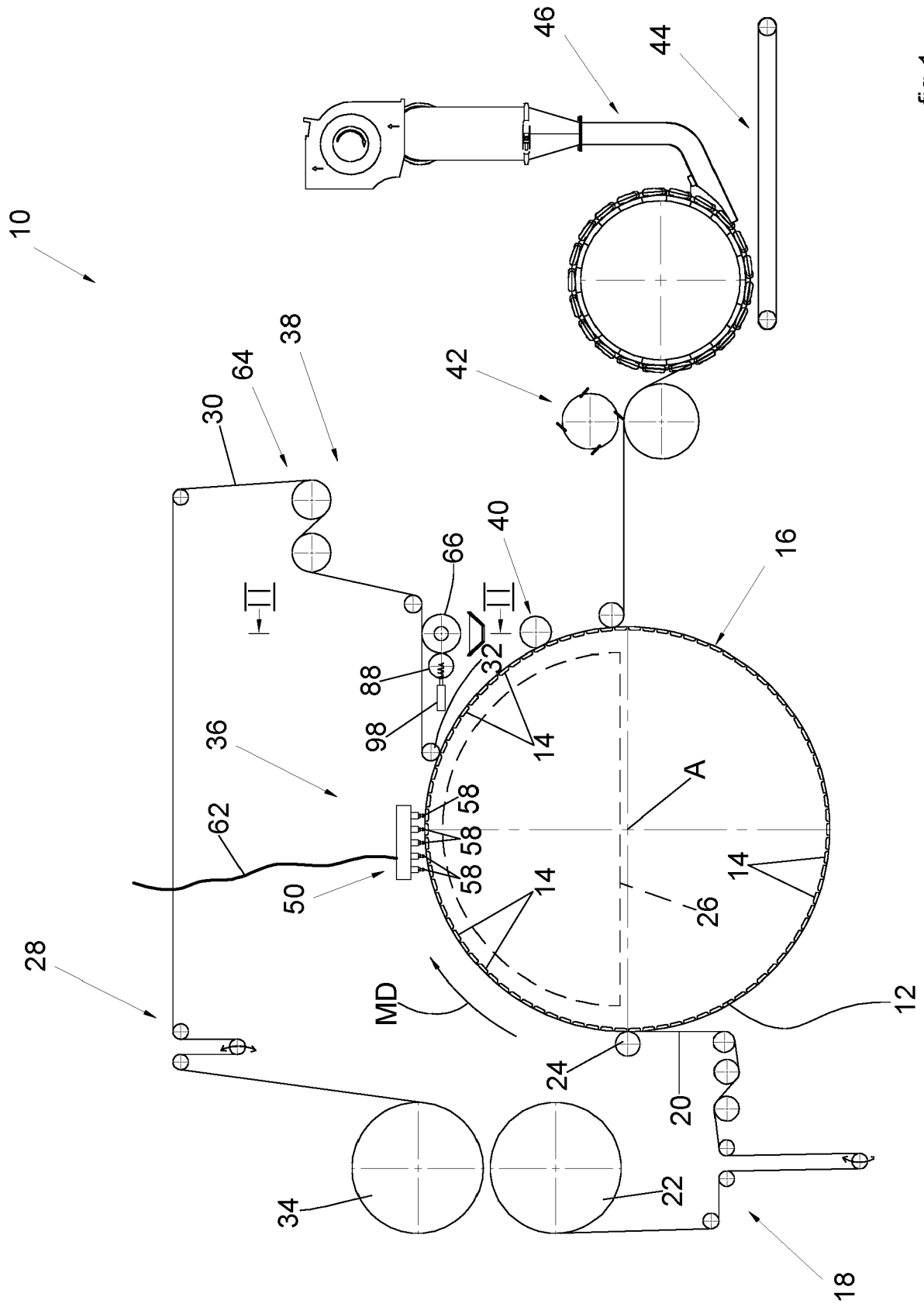


fig.1

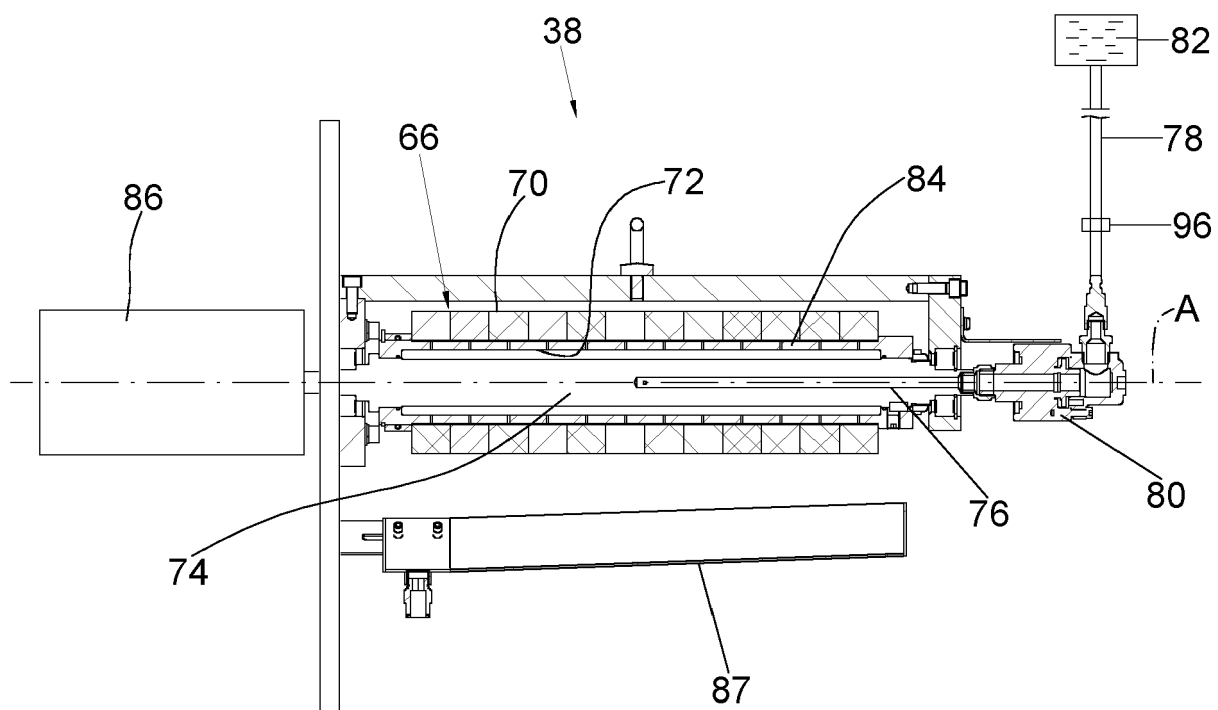


fig.2

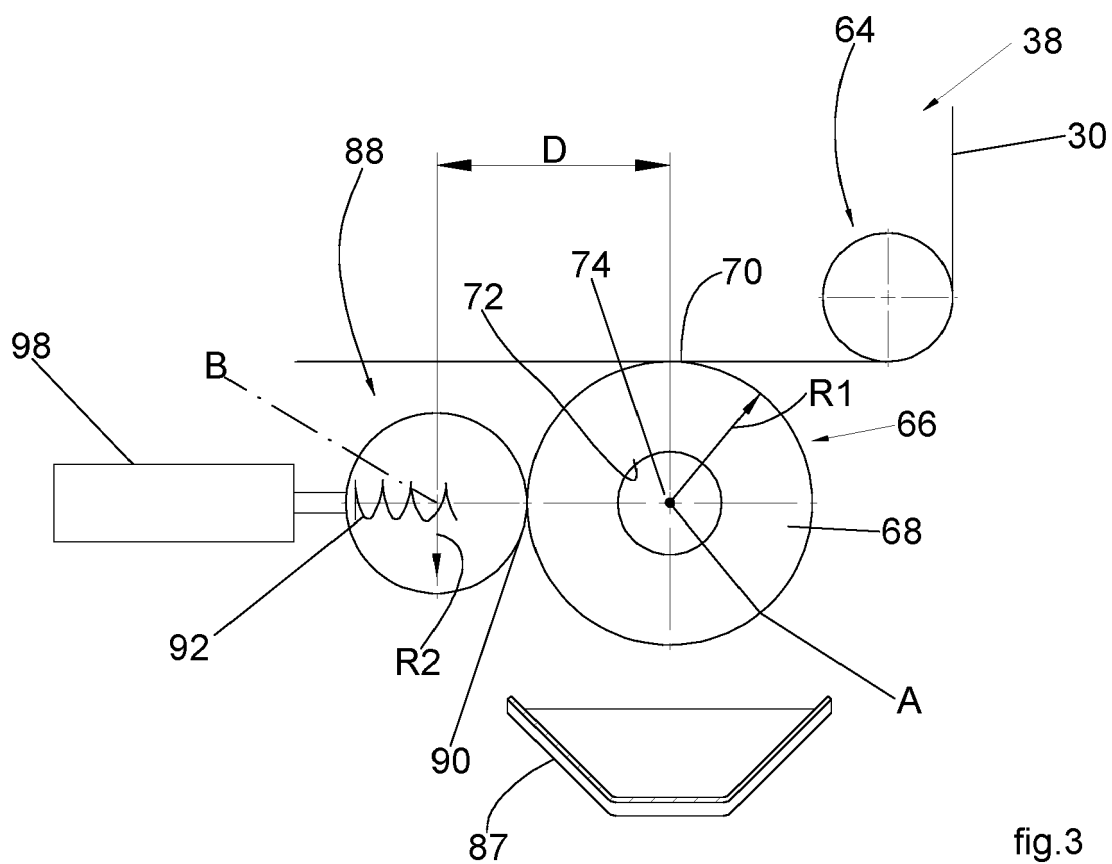


fig.3

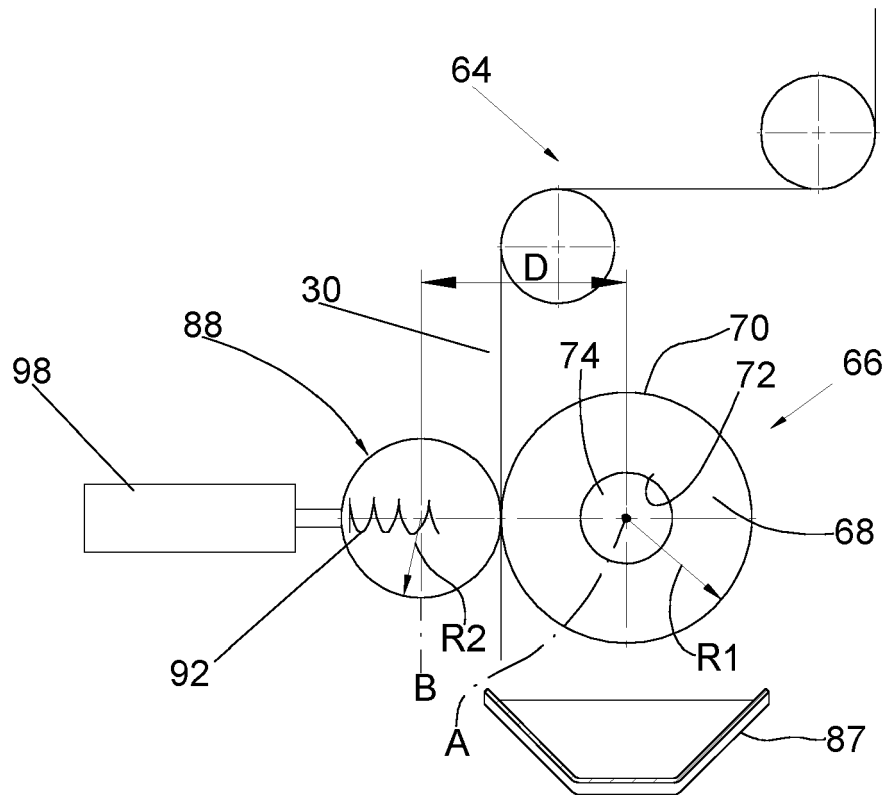


fig.4

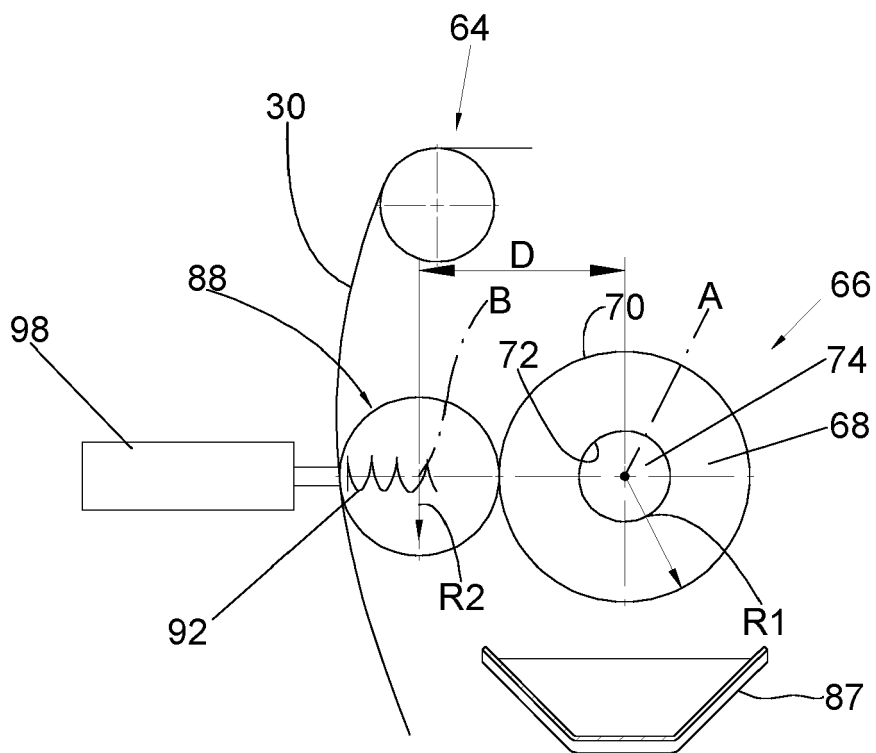


fig.5

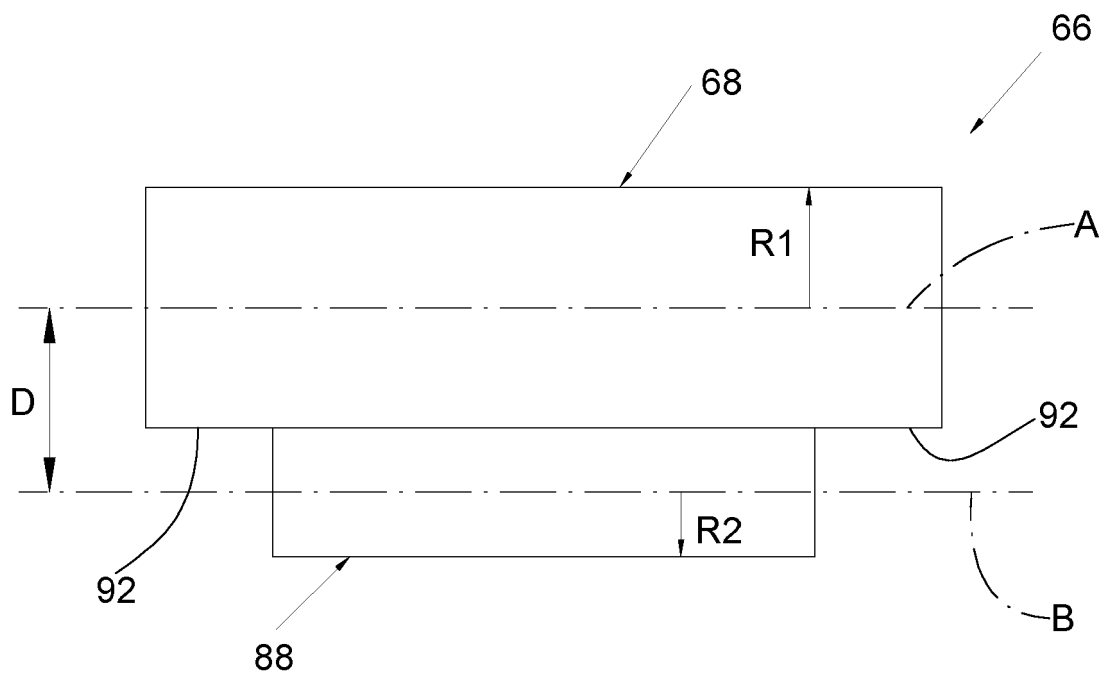


fig.6



EUROPEAN SEARCH REPORT

Application Number
EP 21 17 5387

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Place of search Munich		Date of completion of the search 22 October 2021	Examiner Paetzke, Uwe
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