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(54) **ADHESIVE APPLICATION PROCESS**

(57) Foam-adhesive application method in a paper bag production line, where said bag comprises two or more layers, where the paper material from which the bag is manufactured is continuously transported through the production line in a transport direction, where the bag production line comprises four stages:

- A first stage where a first foam-adhesive line is applied to the bag material in the transport direction, the amount of adhesive being 80% or less of a corresponding starch-based adhesive;
- A second stage where the two or more layers are superposed each other, and foam-adhesive is applied at least in a number of points distributed between the two

or more layers;

- Forming the two or more layers into a tubular form along the transport direction
- A third stage wherein foam adhesive, the amount of adhesive being 80% or less of a corresponding starch-based adhesive, is applied to the free end of the tubular form before the free end is subjected to a folding mechanism, creating a folded bottom in the end of the tubular form;
- A fourth stage where the tubular form is cut at a predetermined distance from the folded bottom thereby separating an open-ended bag from the tubular form;
- Repeating the third and fourth stage

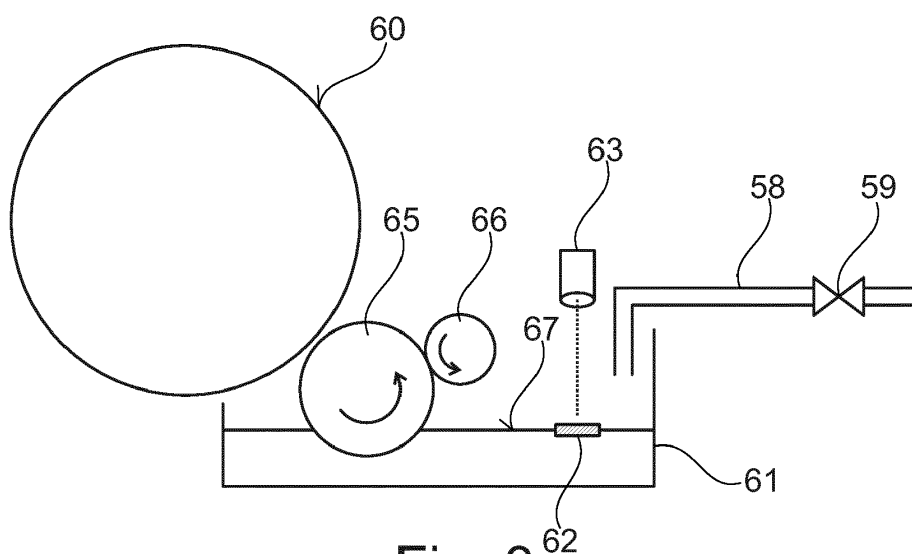


Fig. 3

Description

Field of the Invention

[0001] The present invention relates to an adhesive application process as well as a paper sack manufactured according to the novel and inventive adhesive application process.

Background of the Invention

[0002] In the industry of manufacturing paper bags or paper sacks which for the purpose of the present invention will be referred to as a similar type of product, i.e. a hollow package traditionally manufactured from a paper material where an adhesive is used to form the paper material into a closable sack or bag. In this industry it is normal to use a starch-based adhesive in order to make the various elements of the sacks stay in place. The adhesive is usually applied in a manufacturing process involving sack-forming machinery.

[0003] In the art it is known that the German manufacturer Windmüller und Hölscher provides suitable machines. The advantage of using starch-based adhesives lies in that during manufacture no harmful or critical solvents are present, and it is relatively easy to clean the machinery in that it may typically be carried out with the use of water and not other harmful solvents or disinfectants.

[0004] On the other hand, using starch-based adhesives where the solvent is water does provide a number of drawbacks, particularly when the sacks are to be used for foodstuffs in that the starch-based adhesive is organic and as such may form the basis for the growth of fungus or other organically based organisms which in the hygienic environment which is desirable for the handling/production of foodstuffs is very undesirable.

[0005] Furthermore, the use of a starch based adhesive increases the moisture in the paper materials from which the sack is manufactured from approximately 5-6% to 13-15%. Although this may be considered a slight increase in the moisture in the vicinity/region where adhesives are applied to the sack material this increase in moisture is relatively important with respect to the strength of the sack material in that area and thereby in the overall sack strength.

[0006] The paper strength (paper being the material from which the sack is manufactured) has its highest strength generally around 8-8.5% moisture such that at lower moisture levels the strength is slightly reduced but clearly at higher moisture contents the strength is severely diminished.

[0007] Consequently, for starch-based adhesives used for the manufacture of sacks which are to be loaded, it is quite customary to store the sacks before use in order to lower the moisture content in the sack and thereby recreate the strength of the paper material, such that the sacks may be handled without the risk of tearing apart

the materials.

[0008] Further, by using a foam-adhesive less adhesive is used. Typically the amount of adhesive is reduced by up to approx. 30%. Using a two-component foam adhesive and adapting the production line to the use of a foam adhesive require special arrangements. Typically the adhesives are applied to the paper by means of drums/cylinders, which rotate through a bath and thereafter is brought into contact with the paper (material) in order to apply the adhesive in the designated areas, i.e. the area of the drum where an adhesive is deposited in the bath and which is in contact with the paper. In order to apply the correct amount of adhesive it is important to be able to monitor and control the amount and level of adhesive in the bath. For normal liquid adhesives this is typically done by means of contactless sensors, such as for example laser or photocells. However, none of these contactless measuring methods are useful with the present invention, a primary reason being that the foam structure of the adhesive does not reflect the laser light or the light beam to the photocell in a sufficient intensity, such that reliable measurements may be performed.

[0009] A secondary effect - also related to the foam structure of the adhesive - is the fact that in the adhesive bath the adhesive moves, usually rotates around an axis parallel to the rotation axis of the drum or cylinder which the adhesive shall be transferred to on the adhesive's way to being applied to the paper. This movement further complicates a precise measurement of the adhesive level. The adhesive level influences the amount of adhesive applied to the paper, and is therefore of importance, not only in order to avoid applying too much adhesive, which may cause adhesives migrating uncontrolled outside the designated adhesive zones, but also from a cost perspective in that these types of adhesives are relatively expensive compared to ordinary starch-based alternatives.

Object of the Invention

[0010] It is therefore an object of the present invention to provide a foam adhesive application method in a paper bag production line, which alleviates and addresses the problems mentioned above, and results in paper bags particularly useful with the high hygienic requirements which are set in the food production industry.

Description of the Invention

[0011] The present invention achieves these objects by a foam-adhesive application method in a paper bag production line, where said bag comprises two or more layers, where the paper material from which the bag is manufactured is continuously transported through the production line in a transport direction, where the bag production line comprises four stages:

- A first stage where a first foam-adhesive line is ap-

plied to the bag material in the transport direction, the amount of adhesive being 80% or less of a corresponding starch-based adhesive;

- A second stage where the two or more layers are superposed each other, and foam-adhesive is applied at least in a number of points distributed between the two or more layers;
- Forming the two or more layers into a tubular form along the transport direction
- A third stage wherein foam adhesive, the amount of adhesive being 80% or less of a corresponding starch-based adhesive, is applied to the free end of the tubular form before the free end is subjected to a folding mechanism, creating a folded bottom in the end of the tubular form;
- A fourth stage where the tubular form is cut at a predetermined distance from the folded bottom thereby separating an open-ended bag from the tubular form;
- Repeating the third and fourth stage.

[0012] Particularly the fact that much less adhesive in comparison to traditional methods using starch based adhesives, is applied to the paper material during manufacture has great advantages.

[0013] The fact that the adhesive amount is defined as less than (in fact only 80 % or even less - often only 60%) what is used with starch based adhesives shall be seen in relation to the manufacturing process. It is foreseen as discussed above that the conversion process (from flat paper material on rolls to finished sacks) is carried out on large industrial installations, as for example supplied by Windmüller und Hölscher. When operating these installations the operator will, depending on the paper material being used, adjust the amount of adhesive to be used for that particular conversion process. The operator will naturally also adjust/control a number of other parameters which with respect to the present invention is of lesser importance.

In the process of obtaining a satisfying adhesion through the conversion process an amount of adhesive is selected to be applied. The amount is determined with respect to applying enough adhesive to the surfaces which are destined to be adhered together, and also minimizing the amount of adhesive, such that the adhesive does not spread to undesired places (such as for example outside the limitations of intended adhesive areas). Also from an economic point of view saving adhesive is important. Consequently, with the present invention, it has surprisingly been found that it is possible to use at least 80 % less adhesive, by using the foam adhesive as described above. In addition to the other advantages obtained by using less adhesive - as discussed in this description, the lesser amount of adhesive provides economic advantages, and the risk of polluting the paper outside designated adhesive areas is reduced dramatically.

Therefore the expression 80% less does convey a clear instruction to the skilled operator on how to implement the invention.

[0014] Typically at least 50 % (by weight) less adhesive is used.

[0015] When the paper materials to be adhered to each other are forced together, the still fresh adhesive will be squeezed, and thereby spread out into a substantially two dimensional plane substantially parallel to the plane of the paper in that particular region. Depending on the amount of adhesive, it may be difficult to control the adhesive in its designated area. With less adhesive the risk of the adhesive being squeezed out of the designated area is much less. As the adhesive is a foam, the adhesive will when squeezed deform, also into the area/volume occupied by the bubbles (air or gas) in the foam. Therefore, in addition to using less adhesive, the adhesive will also be more effectively distributed within the designated adhesive area, and further it is easier to control the adhesive within the designated area.

[0016] Any fresh adhesive which is not covered by paper, that is to say any adhesive which is not in the designated area, may give cause to an undesired adhesive contact, for example with another bag. Due to the very rapid manufacturing speed the adhesives have not hardened/cured by the time the paper bags leave the production line, and as such it is possible for excess adhesive to come into contact with another bag in the stack at the end of the production line, and thereby create further inconveniences when the bags are to be used.

[0017] Traditionally, these types of bags are used in an automated manufacturing and filling process, such that a robot or the like will take the bag from the stack and arrange it in a fill position whereby the products which the bags are to hold are automatically filled into the bag.

[0018] If the bag due to excess adhesive is glued to another bag or bags, these "extra" bags may interfere with the smooth running of first of all the bag manufacturing process, but also the further filling process by the user of the bags.

[0019] Consequently, it is important to use as little adhesive as possible without sacrificing the integral strength of the bag and at the same time to arrange and retain the adhesive in the designated adhesive areas in order to avoid excess adhesives not being covered by the paper material as was intended.

[0020] The amount of adhesive is also a source of moisture for the paper to which it is applied. As already briefly mentioned above the paper strength is the highest when the moisture content of the paper is the range 8-8.5%. When using a traditional starch-based adhesive by traditional manufacturing processes the moisture content in the area in the vicinity of where the adhesive is applied is increased to approx. 13-14%. This in turn results in a weakness of the paper in that area by approximately 15-20%.

[0021] However, by using a foam adhesive as is the case with the present invention the moisture content is kept around 8.5%. At this moisture content the paper retains its strength and has the highest TEA rate. This again facilitates that the finished product, i.e. the paper

sacks, may be used immediately after manufacture in that the moisture content in the sacks and thereby the strength of the adhesive connections is very high right after manufacture.

[0022] With the traditional starch-based glues the moisture as already mentioned is increased and thereby the strength is decreased such that by this type of manufacture the overall sack has a decreased strength. For this purpose the manufactured sacks are often stored in order to allow the sacks to dry thereby obtaining a moisture content around 8-9%.

[0023] In a still further advantageous embodiment of the invention the foam adhesive is a two-component adhesive, where the adhesive is mixed immediately before being deposited in an adhesive bath, where adhesive application rollers/cylinders are arranged in said bath, such that the periphery or part of the periphery of at least one roller is brought into contact with the paper material.

[0024] By using a two component adhesive it is possible to store the components of the adhesives for a long time and just mix them immediately prior to use. Also with the two component adhesives it is possible to design the adhesive such that superior strength compared to starch-based adhesives may be obtained.

[0025] As the method step foresees that the adhesive is mixed immediately prior to being placed in the adhesive bath and consequently such that there will be a constant use of adhesive requiring constant mixing and refilling of the bath, it is always ensured that a fresh adhesive having the correct and constant properties is always present in the bath. With one-component adhesives, such as for example starch-based adhesives which are traditionally used, the one-component adhesive may harden or draw a skin, i.e. a not so fluid surface layer, which makes the application of adhesives on the paper more inconsistent and unreliable.

[0026] In a still further advantageous embodiment of the invention non-contact detection means are provided for detecting a predetermined adhesive level in the adhesive bath, and where said means are connected to the means for mixing the two-component adhesive, such that the volume mixed is controlled by the detection means.

[0027] As already discussed above it is difficult to detect the exact level of the adhesive due to its foam characteristics. The foam will in an uneven manner absorb and/or reflect for example a laser beam or a light beam due to the open characteristics of the foam. Consequently, it is necessary to provide a different type of level measurement. Mechanical floaters or a combination of mechanical floaters together with a laser or radar measuring device reflecting off the mechanical floater have proved useful.

[0028] For better results the contactless sensor measuring the adhesive level, will typically register a level every $1/10^{\text{th}}$ of a second, and for practical purposes average measurements taken over for example 1 or 2 seconds. This average value is then used as an indication of the "true" level in the foam.

[0029] In a still further advantageous embodiment the foam adhesive has a density between 100 grams per liter to 900 grams per liter, more preferred 200 grams per liter to 600 grams per liter.

[0030] With this very light foam, i.e. the consistency of shaving foam, it is possible to create a relatively large adhesive area within the designated areas with very little use of adhesive due to the fact that part of the area which is covered will be covered by the bubbles in the foam and as such have no adhesive effect. When the two material layers are squeezed together, the liquid part of the adhesive will also be squeezed and flattened into a substantially 2D layer. A large part of the adhesive-free area within the designated adhesive area, will due to the bubbles be covered by the squeezed out adhesive. In this manner the amount of adhesive is used much more efficiently than for example a starch-based adhesive.

[0031] In a still further advantageous embodiment the foam characteristics are obtained by mechanical aeration during the mixing of the two components or by chemical reaction between the two components during the mixing of the two components.

[0032] Mechanical aeration means a process where the adhesive components during mixing are severely agitated, for example by a mixing wheel or propeller, such that although the components as such do not contain bubbles, a large amount of air is mixed into the adhesive prior to being placed in the adhesive bath and applied to the paper material.

[0033] Alternatively, the two components may be designed such that they will react with each other creating a chemical aeration whereby mechanical agitation is not necessary.

[0034] In a still further advantageous embodiment of the application method, in the third stage the adhesive is applied to the paper material by means of an adhesive cliché, which cliché is mounted on a roller such that a surface of the cliché is brought into contact with an opposing adhesive roller, said adhesive roller being in contact with an adhesive bath.

[0035] Again, due to the characteristics of the foam adhesive the actual amount of adhesive will be less although the volume may be the same or as in this invention reduced by at least 20% such that less adhesive is applied by the cliché to the paper. The paper will at this stage be subjected to a folding routine forming the closed end of the bag.

[0036] This is a very important aspect in that as the bag end is folded, there is a large risk that adhesive may be squeezed and positioned outside the designated area and thereby be uncovered by paper as the finished bag leaves the manufacturing process. This in turn increases the risk that a just finished bag may adhere to a previously finished bag or to the following finished bag. By minimizing the amount of adhesive the risk of having non-covered adhesive in the bag manufacturing process is altogether reduced. This also facilitates the possibility of reliably using separate non-adhered bags in the further processing,

i.e. filling with foodstuffs etc.

[0037] Furthermore, as the risk of adhesive outside the designated areas is significantly smaller with the present method, and the moisture content in the vicinity of the adhesive areas is also maintained within the limits where the paper is not weakened, it is not necessary to store the bags before use in order to let them dry, and furthermore the risk of bags sticking together when being used in further processing equipment is very low. Further, due to the inorganic nature of the adhesive the risk of fungus, bacteria growth or other harmful influences which is traditionally associated with organic adhesives, is also avoided, which further also requires storage and handling with different and less strict conditions as compared to traditional paper sacks.

Description of the Drawing

[0038] The invention will now be explained with reference to the accompanying drawings in which

- Figure 1 illustrates a usual adhesive supply system
 Figure 2 illustrates the set-up when using a foam adhesive and in particular a two-component foam adhesive
 Figures 3, 4, 5 illustrate examples of glue stations

Detailed Description of the Invention

[0039] In figure 1 is illustrated a usual adhesive supply system where in a first station 10 the adhesive is prepared, i.e. filled into the main supply tank. From the first station 10 a pipeline 20 is supplying the liquid adhesive to a distribution manifold 30 from which separate pipelines 32, 34, 36, 38 distribute the adhesive to each machine or production line 40.

[0040] For each production line or machine 40 the adhesive may be further sub-supplied by separate supply lines 42, 42' and 42" to the separate adhesive stations situated various places in the machines/production line.

[0041] In the described examples a certain number of pipelines, supply lines etc. are described, but in reality any number of lines may be used according to the same principle.

[0042] In figure 2 is illustrated the set-up when using a foam adhesive and in particular a two-component foam adhesive. The two foam adhesive components are supplied to a mixing unit 50 by separate supply lines 52, 54 such that the foam adhesive is only activated during the mixing in the adhesive mixing unit 50. From the adhesive mixing unit a pipeline 56 directs the mixed foam adhesive to pipelines 58', 58", 58''' connected to separate glue stations in the production line or each separate machine 40'. Each separate sub-supply line 58', 58" etc. may be supplied with valve means 59. These valve means 59 are typically connected to a sensor positioned at the glue stations such that by measuring the level of adhesive or

glue in the glue stations the valve means may regulate the opening and closing of the supply such that an optimum amount of adhesive is present at the desired adhesive stations. The sensors (not illustrated) are typically non-contact types such as radar based systems or a laser based systems.

[0043] However, due to the foam characteristics of the used adhesive it may be very difficult for these types of non-contact sensors to precisely determine the level of adhesive and therefore a float may be used which float is positioned such that it will float on the surface of the adhesive in the vicinity of the sensor, whereby the sensor will in fact measure the level/distance from the sensor to the float and thereby determine the amount of adhesive present in the adhesive/glue station.

[0044] During the manufacturing process of a paper sack the paper goes through various stations in order to be transformed/converted from a flat sheet of paper to a finished folded sack. This also requires different glue/adhesive stations in that the adhesive is applied to the paper in various patterns by various methods.

[0045] In figures 3, 4 and 5 are illustrated examples of glue stations where special means are adapted in order to be able to apply the foam adhesive in a paper sack manufacturing process.

[0046] In figure 3 is illustrated an adhesive station where adhesive is supplied to a large cylinder 60. The foam adhesive is supplied by pipeline 58 to an adhesive storage tank 61. On the surface of the adhesive 64 is placed a float superposed a non-contact sensor such that the sensor will be able to measure the distance between the sensor and the float 62 and thereby determine the level of adhesive in the adhesive container 61.

[0047] The measurement from the sensor 63 is used as input for a control device (not illustrated) controlling the valve 59 such that the valve will be opened or closed in order to maintain a certain predetermined level 64 in the adhesive container 61. A second roller 65 is rotatably arranged such that it will come into contact with the surface 64 of the adhesive in the adhesive container 61 and whereby a thin layer of adhesive will be applied to the roller 65. In order to minimize the layer a counter roller 66 is adjusted such that a desired minimum/maximum amount of adhesive is applied to the roller 65. As it is a foam adhesive with the characteristics discussed above the layer of adhesive on the roller 65 may be kept substantially thinner than regular starch-based adhesives.

[0048] In addition to the adhesive characteristics this provides advantages in that less adhesive is transferred from one roller to another thereby reducing the risk of pollution to the ambient environment. If too much adhesive is allowed to be attached to the rollers and the rollers are rotated at speed, the rollers may spray adhesive to the ambient surroundings thereby polluting the adhesive station and possibly the paper in positions where it is undesirable to have an adhesive applied to the paper. The large drum 60 is typically used in order to apply a long line of continuous adhesive to the paper in order to

convert the flat paper into a cylindrical shape during the sack-forming process.

[0049] Turning to figures 4 a and 4 b a further glue station for a different type of connection in the paper sack is illustrated. In this glue station two cylinders 70, 71 are counter rotated such that an adhesive pool 72 is maintained between the two cylinders 70, 71. And adhesive application rotator 73 is arranged above the adhesive pool such that adhesive application means 74 are rotated into the adhesive pool 72 before coming into contact with the paper 75 from which the sack is formed. Depending on the shape of the adhesive application means 74 various patterns, particularly discreet adhesive patterns may be applied to the paper 75. In figure 4b is illustrated an example of such a pattern where adhesive dots 76 have been applied to the paper 75 by the adhesive application means 74 arranged on the rotator 73. As the two component foam adhesive contains solvents, it is important to select the adhesive application means 74 from a material which is not dissolved by the solvents of the adhesive and at the same time are able to apply the adhesive to the paper 75, for example in a pattern as illustrated in figure 4 b. For many sacks it is undesirable to have discolouring arising from the interaction of paper and adhesive, particularly when the adhesive is polluted, for example by dissolving the adhesive application means 74. Traditionally rubber has been used as application means, but with the two component foam adhesive used with the present invention rubber will create a discolouring, particularly in a green colour which is undesirable.

[0050] The invention therefore uses application means 74 from various other materials such as for example neoprene, nylon or specifically chemically resistant nylons, i.e. modified nylons, or stainless steel.

[0051] Turning to figure 5 a further example of a specific glue station is illustrated. In this example two drums 80, 81 are counter-rotated. On the first drum 80 is arranged a block 82 and the second drum 81 is arranged in connection with a foam adhesive bath such that a film of foam adhesive 83 will be present on the surface of the drum 81. As the drum 81 comes into contact with the block 82 on the drum 80 a layer of adhesive will be transferred from the drum 81 to the block 82. In this example the block 82 will have shape as illustrated in figure 5b, i.e. a rectangular shape with some openings 82'. Due to the contact with the adhesive layer 83 on the drum 81 the block 82 will where it has edges facing the direction of rotation accumulate excessive adhesive 84. As the drum 80 and the block 82 is brought into contact with the paper on which it is desirable to apply the adhesive, the block 82 will provide a pattern as illustrated in figure 5c, see the dotted area 86. The excess amount of adhesive 84 would when using a normal starch-based adhesive create an undesirable adhesive surplus on the paper 75.

[0052] However, when using two component foam adhesive as is the case with the present invention, it is possible to reduce the layer thickness 83 of adhesive on the drum 81. The adhesive layer may only be 50% of the

normal layer (of starch adhesive) such that a substantially lower amount of adhesive is applied to the block 82 and thereby the undesirable accumulations 84, see figure 5b, are dramatically reduced or avoided altogether. This will result in an adhesive pattern 86 without the undesirable adhesive blotches which may otherwise arise with use of normal starch-based adhesives.

[0053] In reality the adhesive layer 83 on the drum 81 is reduced to approx. 0.1 mm or less. At the same time, when using starch-based adhesives having a layer of 0.2 mm or more when the adhesive pattern 86 is connected to a second piece of paper and forced together, the adhesives will be squeezed and thereby displaced in a plane parallel to the paper surface creating an adhesive pattern substantially larger than the intended pattern as illustrated by 86 in figure 5C.

[0054] As already discussed above, when using a foam based adhesive as is the case with the present invention the bubbles in the foam when being squeezed together will allow the non-foam part of the foam adhesive to expand into the space where the bubble is/was present, and thereby substantially keep the adhesive pattern 86 as illustrated in figure 5 c. In this manner a much more accurate adhesive application is obtained due to the use of a foam based adhesive.

Claims

1. Foam-adhesive application method in an industrialized paper bag production line, where said bag comprises two or more layers, where the paper material from which the bag is manufactured is continuously transported through the production line in a transport direction, where the bag production line comprises four stages:

- A first stage where a first foam-adhesive line is applied to the bag material in the transport direction, the amount of adhesive being 80% or less of a corresponding starch-based adhesive;
- A second stage where the two or more layers are superposed each other, and foam-adhesive is applied at least in a number of points distributed between the two or more layers;
- Forming the two or more layers into a tubular form along the transport direction
- A third stage wherein foam adhesive, the amount of adhesive being 80% or less of a corresponding starch-based adhesive, is applied to the free end of the tubular form before the free end is subjected to a folding mechanism, creating a folded bottom in the end of the tubular form;
- A fourth stage where the tubular form is cut at a predetermined distance from the folded bottom thereby separating an open-ended bag from the tubular form;
- Repeating the third and fourth stage

2. The foam-adhesive application method according to claim 1, wherein the foam adhesive is a two-component adhesive, where the adhesive is mixed immediately before being deposited in an adhesive bath, where adhesive application rollers/cylinders are arranged in said bath, such that the periphery or part of the periphery of at least one roller is brought into contact with the paper material. 5
3. The foam-adhesive application method according to claim 2, wherein detection means are provided for detecting a predetermined adhesive level in the adhesive bath, and where said means are connected to the means for mixing the two-component adhesive, such that the volume mixed is controlled by the detection means. 10 15
4. The foam-adhesive application method according to claim 1, wherein the foam adhesive has a density between 100 grams per liter to 900 grams per liter, more preferred 200 grams per liter to 600 grams per liter. 20
5. The foam-adhesive application method according to claim 1, wherein the foam characteristics are obtained by mechanical aeration during the mixing of the two components or by chemical reaction between the two components during the mixing of the two components. 25 30
6. The foam-adhesive application method according to claim 1, wherein in the third stage the adhesive is applied to the paper material by means of an adhesive cliché, which cliché is mounted on a roller such that a surface of the cliché is brought into contact with an opposing adhesive roller, said adhesive roller being in contact with an adhesive bath. 35

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pulver + vand

10

present piping setup of glue system

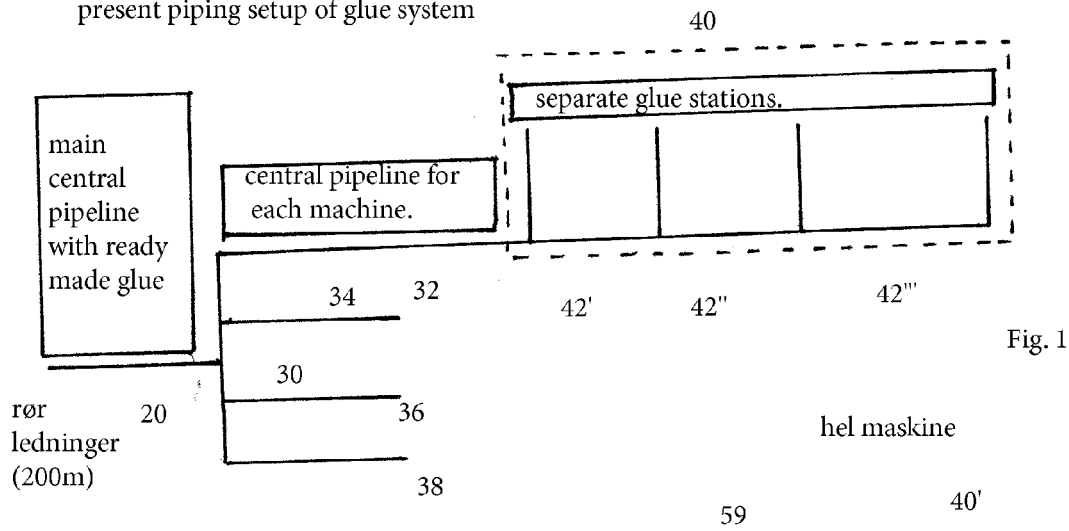


Fig. 1

Foam-adhesive glue system.

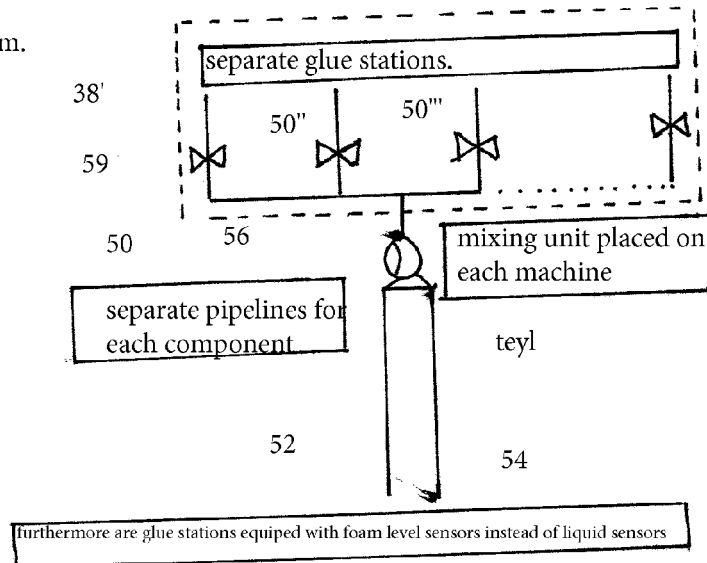
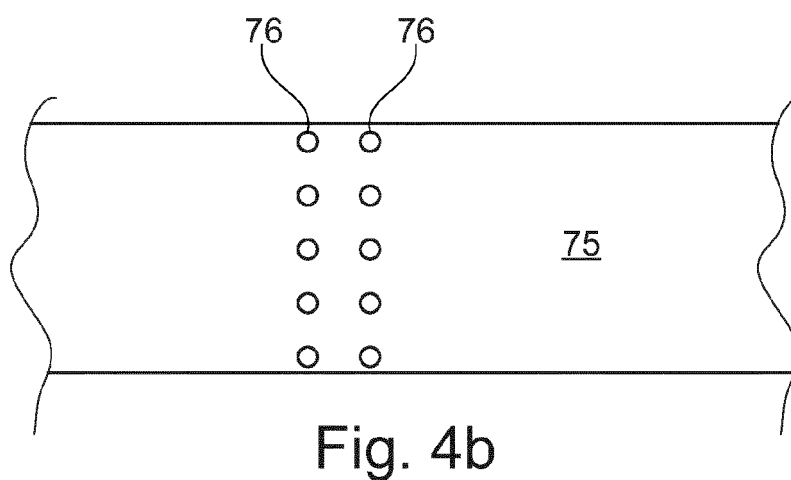
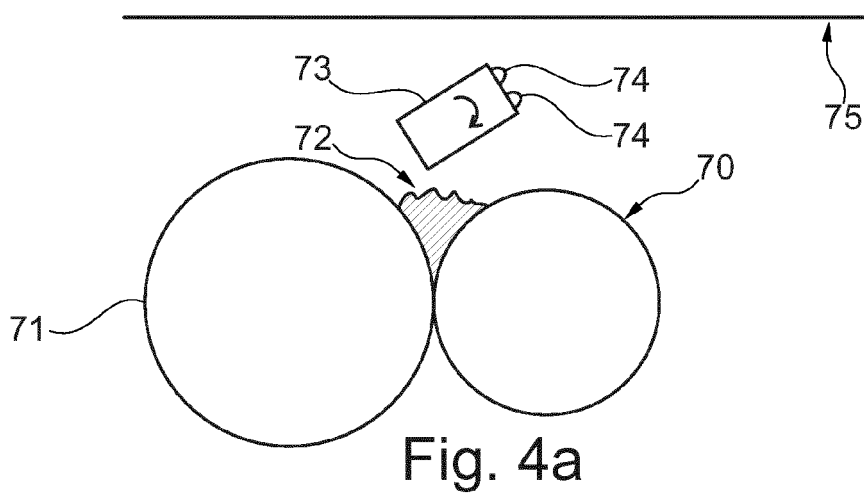
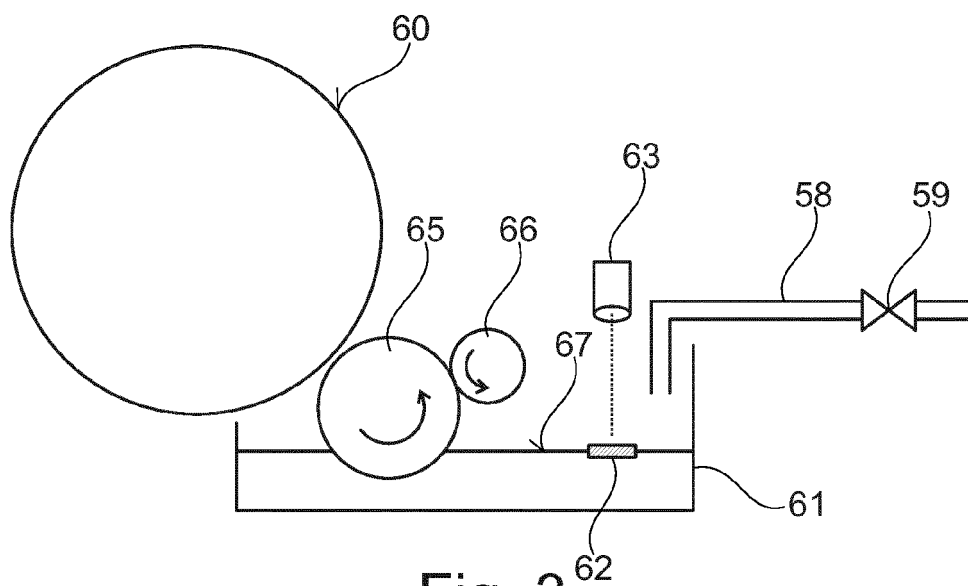


Fig. 2



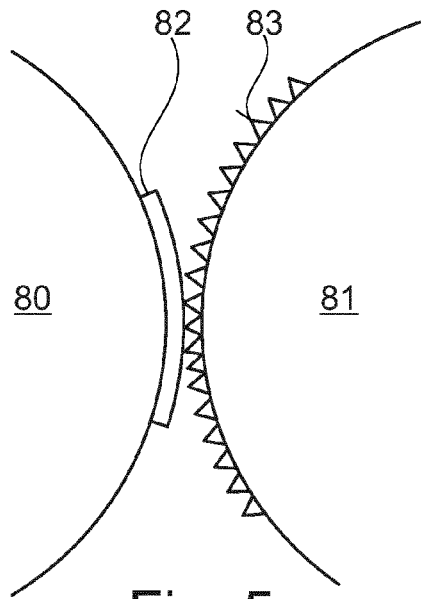


Fig. 5a

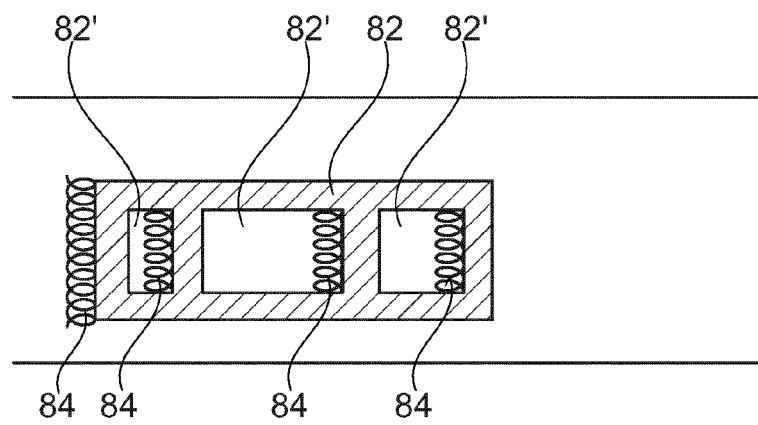


Fig. 5b

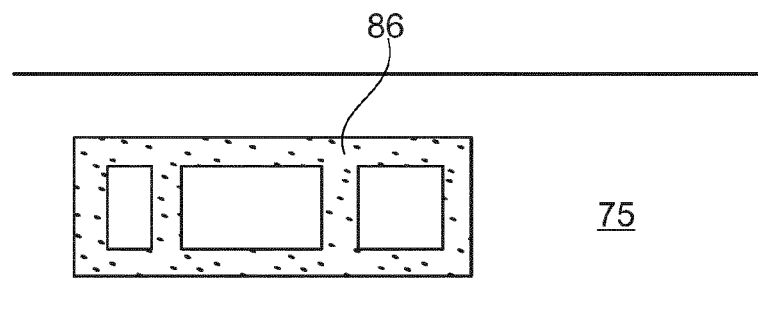


Fig. 5c



EUROPEAN SEARCH REPORT

Application Number
EP 17 16 8673

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2005/087293 A1 (COLGAN GEORGE P [CA]) 28 April 2005 (2005-04-28) * paragraphs [0008], [0009], [0022], [0024], [0025]; figure 2 *	1-6	INV. B31B70/62 B31B155/00 B31B160/10 B31B170/20 C09J5/08
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Y	US 4 634 414 A (HOLLMANN BERND [DE]) 6 January 1987 (1987-01-06) * claims 1, 7; figures 1A, 1B, 3, 4A, 4B *	1-6	
Y	US 2015/322301 A1 (ELLIS RICHARD [GB] ET AL) 12 November 2015 (2015-11-12) * paragraph [0016] *	1-6	
Y	US 2012/259448 A1 (RZONCA GARY [US] ET AL) 11 October 2012 (2012-10-11) * paragraph [0038]; claim 6 *	1-6	
			TECHNICAL FIELDS SEARCHED (IPC)
			B31B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 12 September 2017	Examiner Sundqvist, Stefan
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			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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