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(54) **Horizontal packaging machine including an unwinder with a splicing device for changing reels without stopping the machine, and a band supply unit applicable to said machine**

(57) The machine includes a band supply unit (100) with a splicing device (50) comprising a splicing table (9) on which a working band of sheet material (1) coming from a reel (6) circulates, an adhesive tape supply device (11) adjacent to an edge of the working band of sheet material (1), and holding devices (12, 13) for holding the end portion (1a) of the working band of sheet material (1) and an initial portion (2a) of a replacement band of sheet material (2) mutually superimposed on the splicing table (9), in which both are cut transversely at the same time by a cutting tool and, once excess cut portions are removed from both bands (1, 2), they are butt spliced by means of adhesive tape supplied from said adhesive tape supply device (11).

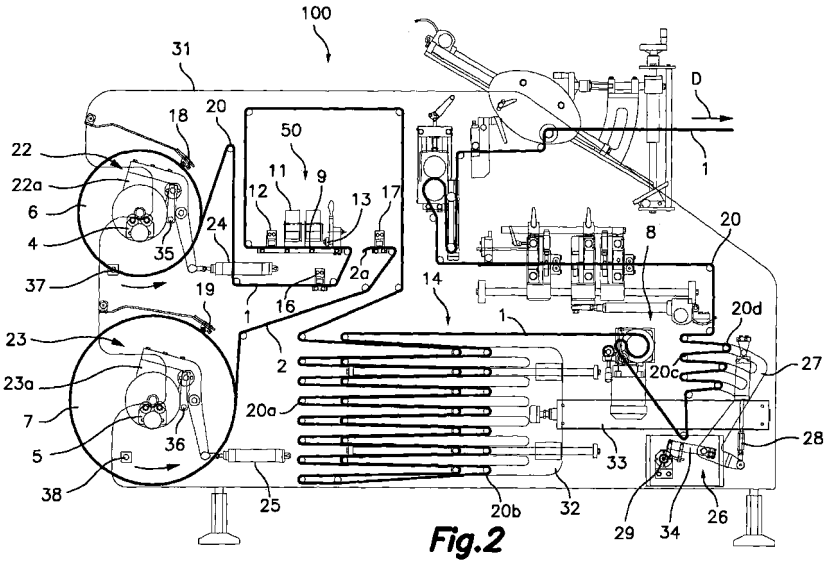

Fig.2

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Description

Field of the Art

[0001] The present invention relates to a horizontal packaging machine of the type comprising a band supply unit, a container forming unit, and a filling unit, in which the mentioned band supply unit includes an unwinder with two reels and a splicing device which allow changing reels without needing to stop the machine.

Background of the Invention

[0002] Horizontal packaging machines are known, which machines comprise a line for filling and closing pouch-type containers, also known in the art as pouches. The mentioned containers are generally made from a band of sheet material that is folded, heat-welded and cut, and some of the horizontal packaging machines incorporate, as an integral part thereof, a band supply unit for supplying said band of sheet material from a reel, a container forming unit, to form the containers from said band of sheet material, and a filling unit to fill the containers coming from said container forming unit.

[0003] In some machines, the band supply unit is configured to house a single reel, in which case, when the reel is used up it is necessary to stop the machine long enough to allow replacing the reel and splicing an initial portion of the sheet material of the replacement reel with an end portion of the sheet material of the used up reel. These operations can last about ten minutes.

[0004] In other machines, the band supply unit is configured to house two reels, one acting as a working reel from which the band of sheet material which is fed into the container forming unit is extracted and the other one acting as a replacement reel. If the unit does not include a splicing device, the time necessary for changing reels and splicing can be about 5 minutes, during which time the machine will be stopped.

[0005] Patent ES-A-2 275 381 discloses a device for splicing the end portions of the bands of sheet material during a change of reels applicable to a horizontal packaging machine provided with a band supply unit configured to house two reels without needing to stop the machine. The splicing device comprises a clamp formed by two planar jaws covering the entire width of the bands of sheet material. During normal operation of the machine, the clamp is open and the working band of sheet material passes between both jaws whereas an initial portion of the replacement band of sheet material is folded over one of the jaws, fixed thereto by means of clips and prepared with an adhesive material, such as two-sided adhesive tape, or flexible silicone. When the working reel is almost completely used up, a traction device, located between the splicing device and an accumulator device, stops and the clamp closes, adhering the initial portion of the replacement band of sheet material on the end portion of the working band of sheet material. A drawback of this type of splicing is that it leaves non-adhered excess initial and end portions adjacent to an overlapping and adhered region of the two bands of sheet material, which can cause catching and misalignments in the successive units of the machine which make it necessary to stop the machine in order to perform the corresponding arrangements and adjustments.

[0006] Dual-reel unwinders with an automatic splicing device are known on the market, and they can be coupled to any of the previously described horizontal machines. In these unwinders, end and initial ends of the bands of sheet material are also spliced by means of overlapping, generating the problems described above. Furthermore, being a unit that is independent from the machine they have the drawback that they take up more space than an unwinder built into the machine itself.

[0007] On the other hand, several types of reel brakes applicable to band supply devices for packaging machines are known. These brake devices comprise generally a brake shoe that is thrust against a corresponding surface of the core of the reel by a thrusting device, such as, for example, a mechanical spring applied on a brake lever without any type of regulation, or a pneumatic cylinder with manual pressure regulation but without any type of proportional control that can be adapted to the operating conditions of the packaging machine. A thrusting device formed by a pneumatic cylinder with proportional mechanical regulation is known, which device adapts to the tension of the band of sheet material, i.e., to the speed of the machine, but without any control over the inertia caused by the reel. In this case, given that the diameter of the reel decreases progressively as the band of sheet material is extracted therefrom, the inertia caused by the reel also decreases without this having any effect on the control of the braking force.

Summary of the Invention

[0008] The present invention contributes to overcoming the aforementioned and other drawbacks by providing a horizontal packaging machine including an unwinder with a splicing device for changing reels without stopping the machine. The machine of the present invention is of the type comprising a band supply unit for supplying a band of sheet material from a reel, a container forming unit for forming containers from said band of sheet material, and a filling unit for filling said containers coming from said container forming unit, closing them and delivering them to an outfeed conveyor, said units being arranged consecutively in the forward movement direction of the band of sheet material. The mentioned band supply unit comprises supports for rotatably supporting two reels which act alternately as a working reel and a replacement reel, and a plurality of rollers for directing one of the two bands of sheet material, more specifically a working band of sheet material coming from said working reel, to said container forming unit through a known type of accumulator device. Downstream of said accumulator device

there is arranged a traction device which pulls on said working band of sheet material for unwinding the working reel. Between the working reel and the accumulator device there is located a splicing device which serves for splicing an end portion of the working band of sheet material with an initial portion of a replacement band of sheet material coming from said replacement reel while the traction device extracts the working band of sheet material from the accumulator device. The machine of the present invention is **characterized in that** said splicing device comprises a splicing table on which the working band of sheet material circulates, with at least one adhesive tape supply device adjacent to an edge of the working band of sheet material, a working band holding device for holding an end portion of the working band of sheet material on said splicing table, and a replacement band holding device for holding an initial portion of said replacement band of sheet material on the splicing table, both initial and end portions of the working and replacement bands of sheet material being mutually superimposed in the splicing table. With this arrangement, both working and replacement bands of sheet material are cut transversely at the same time by a cutting tool and, once excess cut portions are removed from both bands of sheet material, they are butt spliced by means of adhesive tape supplied from said adhesive tape supply device.

[0009] The splicing performed by means of the splicing device of the machine of the present invention is clean and strong and has no overlapping and non-adhered portions of sheet material that can cause catching and misalignments in successive members or units of the machine. Furthermore, it can be done in a short period of time during which the working band of sheet material is extracted from the accumulator device, and therefore without needing to stop the machine.

[0010] In one embodiment, the mentioned working band holding device is operated by actuating means, and automatically activated in response to a signal generated by an end-of-reel detector arranged, for example, to detect the end of the reel, i.e., the absence of the working band of sheet material, whereas said replacement band holding device is operated manually and activated by an operator responsible for the splicing. Preferably, the splicing device furthermore comprises first and second auxiliary replacement band holding devices for alternately holding the initial portion of the band of sheet material coming from the one of the two reels acting as a replacement reel in a position prepared for splicing adjacent to the splicing table, such that the operator has fast and easy access to the initial portion of the replacement band of sheet material, which must be arranged on the splicing table and held against it by the replacement band holding device. These first and second auxiliary replacement band holding devices are operated by actuating means and activated in response to a control actuated by the operator. For example, the working band holding device and the first and second auxiliary replacement band holding devices can comprise known pneumatically operated inflatable holding membranes.

[0011] The splicing table preferably includes a cutting guide, for example in the form of a slit formed through the splicing table in a direction transverse to the forward movement direction of the working band of sheet material. This slit has a width sized to receive a cutting blade of the mentioned cutting tool, and a length greater than the width of the band of sheet material, such that the slit projects from both side edges of the working and replacement bands of sheet material. In one embodiment, the cutting tool is a knife or the like handled manually by the operator responsible for splicing. The machine preferably comprises a sound and/or light warning device which is activated in response to a signal generated by a diameter detector associated with the working reel and arranged to detect a diameter indicating that the end of the reel is approaching. The activation of said warning device indicates to the operator that he must be prepared to perform splicing.

[0012] Next, as soon as the working band holding device is activated in response to a signal generated by the previously mentioned end-of-reel detector, the operator has enough time to manually perform splicing, which is proportional to the amount of band of sheet material accumulated in the accumulator device. When the splicing is done, the operator manually releases the replacement band holding device and operates a push button which releases the working band holding device, such that the machine returns to normal operation extracting the working band of sheet material from the replacement reel, which now acts as the working reel. Then, the empty reel can be replaced and the initial portion of the replacement band of sheet material can be placed in said position prepared for splicing and held by the corresponding first or second auxiliary replacement band holding device.

[0013] When the operator places the initial portion of the replacement band of sheet material overlapping on the end portion of the working band of sheet material on the splicing table, he must match up respective marks indicating the sites where the band will be heat-welded and cut after being folded in the container forming unit. Downstream of the splicing device there is arranged a splice detector, for example, in the form of an optical detector arranged to detect, for example, the adhesive tape forming the splice. Downstream, for example in the filling unit, there are arranged means for rejecting a container formed by the initial and end portions of the working and replacement bands of sheet material joined by the adhesive tape in response to a signal coming from said splice detector. Accordingly, the splicing should not coincide with one of the sites where the band will be heat-welded and cut, since this could cause drawbacks in the container forming unit. To prevent this, the splicing table preferably has associated thereto a second cutting guide and a second adhesive tape supply device aligned with said second cutting guide, in which both first and second cutting guides are mutually parallel and are separated by a distance different from the separation between the sites

where the band will be heat-welded and cut, i.e., different from the width of the containers to be made. Therefore, if one of the cutting guides coincides with one of the sites where the band will be heat-welded and cut, the operator will choose the other cutting guide.

[0014] The horizontal packaging machine of the present invention likewise comprises brake devices for applying a brake to the rotation of that reel acting as the working reel during normal machine operation. Each of said brake devices comprises a brake shoe thrust against a corresponding surface of the core of the corresponding reel by a pneumatic actuator. The thrust force of the mentioned pneumatic actuator is controlled by an electropneumatic proportional pressure regulator which acts at least in response to a signal representative of the tension of the working band of sheet material and to a signal representative of the diameter of the working reel. The mentioned signal representative of the tension of the working band of sheet material is generated by a tension detector device arranged to detect the tension of the working band of sheet material downstream of the traction device.

[0015] In one embodiment, this tension detector device comprises a pivoting arm supporting one or more of the mentioned rollers on which the working band of sheet material passes, adjacent to other fixed rollers on which the working band of sheet material also passes. The pivoting arm is moved against the force of an elastic means due to the variations in the tension of the working band of sheet material, and the movements of the pivoting arm operate a positional detector, such as a potentiometer, arranged to generate said signal representative of the tension of the working band of sheet material. The signal representative of the diameter of the working reel is generated by at least one diameter detector arranged adjacent to the working reel to detect when, upon unwinding, such reel reaches a predetermined diameter that is less than the diameter of the complete working reel. It is known that the different diameters of the working reel correspond with different degrees of inertia thereof. Accordingly, the braking force is controlled depending on the tension of the working band of sheet material downstream of the traction device and on at least two degrees of inertia of the working reel. Obviously, by arranging a plurality of diameter detectors for detecting successive decreasing diameters of the working reel, the braking force could be controlled according to a plurality of degrees of inertia of the working reel.

Brief Description of the Drawings

[0016] The foregoing and other features and advantages will be more fully understood from the following detailed description of several embodiments with reference to the attached drawings in which:

Figure 1 is a schematic perspective view of a horizontal packaging machine including a dual-reel unwinder with a splicing device for changing reels without stopping the machine according to an embodiment of the present invention;

Figure 2 is a schematic side view of a band supply unit with the splicing device forming part of the machine of Figure 1;

Figure 3 is a perspective view of a splicing table forming part of the splicing device;

Figure 4 is a perspective view of a variant of the splicing table of Figure 3;

Figures 5, 6, 7 and 8 are cross section views showing a splicing method which is carried out by means of the splicing device of the machine of the present invention.

Detailed Description of Exemplary Embodiments

[0017] Referring first to Figure 1, the horizontal packaging machine of the present invention comprises, according to one embodiment, a band supply unit 100 for supplying a working band of sheet material 1 from a working reel 6, a container forming unit 200 for forming containers 3 from said working band of sheet material 1, and a filling unit 300 for filling said containers 3 coming from said container forming unit 200, closing them and delivering them to an outfeed conveyor 30. The three units mentioned are arranged consecutively one after the other in a forward movement direction of the working band of sheet material 1 indicated by means of an arrow D. The band supply unit 100 comprises an unwinder for a second reel 7, such that the two reels act alternately as a working reel 6 and a replacement reel 7, and includes a splicing device 50 which allows changing reels without stopping machine operation. The band supply unit 100 will be described in detail below in relation to Figure 2.

[0018] Still in connection with Figure 1, the container forming unit 200 comprises consecutively in the forward movement direction D, and as is known, a folding station 51 in which the working band of sheet material 1 is folded over itself in a V or W shape, a lower welding station 52 and a subsequent lower cooling station 53 in which a bottom for the containers is formed, a vertical welding station 54 and a subsequent ironing station 55 in which side edges for the containers are formed, an inspection station provided with at least one photocell 56, and finally a cutting station 58 in which the folded and heat-welded working band of sheet material 1 is cut for producing the individual containers 3, which are then delivered to the filling unit 300. The cutting station 58 makes vertical cuts between two vertical adjacent welding lines, which form opposite vertical edges of two consecutive containers 3. A traction device 57 is arranged immediately before the cutting station 58 for performing the forward movement of the working band of sheet material 1 along the container forming unit 200.

[0019] In the filling unit 300, the containers 3 are gripped, conveyed and handled individually by a series of sets of vises (not shown). The filling unit 300 comprises

consecutively in the forward movement direction D, and as is also known, a pouch opening station 59 in which an upper opening of the containers 3 is opened by means of suction devices cooperating with the vises gripping the containers 3, first, second and third metering stations 60, 61, 62 in which the containers 3 are filled with up to three products that can be identical or different, a drawing station 63 in which the containers are drawn for closing the upper opening thereof, and finally an upper welding station 64 and subsequent upper cooling stations 65, 66 in which the upper opening of the containers 3 is sealed by welding. The filled and sealed containers 3 are then delivered to an outfeed conveyor 30. Those defective containers 3 detected, for example, by the mentioned photocell 56 in the inspection station, or by other detection means, are rejected through a rejection ramp 67, such that they are not delivered to the outfeed conveyor 30.

[0020] Now in relation to Figure 2, the band supply unit 100 comprises a frame 31 in which supports 4, 5 are installed for rotatably supporting two identical reels 6, 7 of a band of sheet material, although from only one of them, which is the one acting as a working reel 6, the working band of sheet material 1 which will be supplied to the container forming unit 200 will be extracted, whereas the other reel acts as a replacement reel 7 providing a replacement band of sheet material 2. In Figure 1, the reel placed in the support 4 in the upper part of the drawing is the one acting as the working reel 6 and the reel placed in the support 5 in the lower part of the drawing is the one acting as the replacement reel 7, although when the working band of sheet material 1 coming from the working reel 6 in the upper support 4 is used up it will be replaced by the replacement band of sheet material 2 coming from the replacement reel 7 in the lower support 5, which will then act as the working reel 6, and the used up previous working reel 6 will be replaced by a new replacement reel 7 in the upper support 4, and so on and so forth, the two reels act alternately as a working reel 6 and a replacement reel 7. Throughout this description, working reel 6 shall refer to the reel supplying the working band of sheet material 1 and replacement reel 7 shall refer to the reel carrying the replacement band of sheet material 2, regardless of if they are installed in the upper or lower support 4, 5 of the machine.

[0021] A traction device 8 is arranged for unwinding the working reel 6 by pulling on said working band of sheet material 1 in a forward movement direction indicated by means of an arrow D, and the working band of sheet material 1 is directed by means of a plurality of rollers 20 to the container forming unit 200 passing through an accumulator device 14 of a known type. For example, this accumulator device 14 comprises a plurality of stationary rollers 20a alternating with a plurality of mobile rollers 20b installed in a mobile support 32, and the working band of sheet material 1 is passed over said alternating stationary and mobile rollers 20a, 20b, such that when the mobile support 32 keeps the mobile rollers 20b away from the stationary rollers a large amount of the working band of sheet material 1 is located in the accumulator device 14. The mentioned traction device 8 is arranged downstream of the accumulator device 14.

[0022] Between the working reel 6 and the accumulator device 14 there is arranged a splicing device 50 through which the working band of sheet material 1 passes freely during normal machine operation. The splicing device 50 comprises, among other members which will be described below, a splicing table 9 and first and second auxiliary replacement band holding devices 16, 17 for holding the initial portion 2a of the replacement band of sheet material 2 in a position prepared for splicing, adjacent to said splicing table 9. In the situation shown in Figure 1, the reel installed in the lower support 5 acts as the replacement reel 7 and the initial portion 2a of the replacement band of sheet material 2 is held in the position prepared for splicing by the second auxiliary replacement band holding device 17. In a reverse situation, i.e., with the replacement reel 7 installed in the upper support 4, the initial portion 2a of the replacement band of sheet material 2 would be held in the position prepared for splicing by the first auxiliary replacement band holding device 16.

[0023] The first and second auxiliary replacement band holding devices 16, 17 can include, for example, as is well known in the art, pneumatically inflatable holding membranes on one side of the band of sheet material and a fixed surface on the opposite side of the band of sheet material. When the membrane is deflated, the band of sheet material can pass freely between , the membrane and the fixed surface. When the membrane is inflated, the band of sheet material is held between the membrane and the corresponding fixed surface. The activation and deactivation of the auxiliary replacement band holding devices 16, 17 is optionally done by an operator responsible for splicing by acting on corresponding controls, for example push buttons (not shown). Therefore, during normal machine operation and while the traction device 8 extracts the working band of sheet material 1 from the working reel 6, the operator has more than enough time to install the replacement reel 7 in the corresponding support 4, 5, in order to pass a portion of the replacement band of sheet material 2 through corresponding rollers 20 and hold the initial portion 2a of the replacement band of sheet material 2 in the position prepared for splicing by means of the corresponding auxiliary replacement band holding device 16, 17.

[0024] Each support 4, 5 has associated therewith a corresponding diameter detector 35, 36 arranged to detect a diameter indicating the proximity of the end of the reel for that reel acting as the working reel 6. When said diameter detector 35, 36 detects that the working reel 6 is close to being used up, it generates a signal from which a sound and/or light warning device (not shown) is activated, which indicates to an operator that he must be prepared to splice an end portion 1a of the working band of sheet material 1 with an initial portion 2a of the replacement band of sheet material 2 by means of the splicing

device 50. Each reel 6, 7 has associated therewith an end-of-reel detector 18, 19, for example in the form of a photocell installed on a pivoting arm and arranged to detect the end of the reel or absence of working band of sheet material 1 in that reel acting as the working reel 6. When said end-of-reel detector 18, 19 detects the end of the reel it generates a signal from which a working band holding device 12 is activated, said working band holding device 12 being arranged for holding the working band of sheet material 1 against said splicing table 9 such that said end portion 1a of the working band of sheet material 1 is arranged on the splicing table 9.

[0025] From the time that the working band of sheet material 1 is held to the splicing table 9, the traction device 8, without stopping, starts to extract the working band of sheet material 1 from the accumulator device 14 while the mobile support 32 gradually approximates the mobile rollers 20b to the stationary rollers 20a, providing the operator with the time necessary to perform splicing by means of the splicing device 50 without the machine being stopped. The frame 31 of the band supply unit 100 has side windows (not shown) for providing comfortable access to the splicing device 50 for the operator responsible for splicing.

[0026] Figure 3 shows the mentioned splicing table 9, which has a surface 9a on which the working band of sheet material 1 circulates in the forward movement direction D during normal machine operation. At a downstream end of the splicing table 9 there is arranged the mentioned working band holding device 12, which can be of the type provided with one or more pneumatically inflatable holding membranes, similar to that described above in relation to the first and second auxiliary replacement band holding devices 16, 17. At an upstream end of the splicing table 9 there is arranged a replacement band holding device 13, which can be operated manually by the operator responsible for splicing for holding said initial portion 2a of the replacement band of sheet material 2 on the splicing table 9. The working and replacement band holding devices 12, 13 are located such that both initial and end portions 1a, 2a of the working and replacement bands of sheet material 1, 2 are, once held, mutually superimposed on a portion of the surface 9a of the splicing table 9 between the working and replacement band holding devices 12, 13, in which there is preferably located a cutting guide 10. In the illustrated example, the mentioned cutting guide 10 comprises a slit formed through the splicing table 9 in a direction transverse to the working band of sheet material 1. This slit has a width sized to receive a blade of a cutting tool 21 (Figure 6) and a length greater than the width of the working and replacement bands of sheet material 1, 2. In the splicing table 9 there is also an adhesive tape supply device 11 adjacent to an edge of the working band of sheet material 1 and aligned with the cutting guide 10.

[0027] The replacement band holding device 13 comprises, for example, a bar articulated at one end and connected at the opposite end to a cam mechanism that can be operated by a lever 13a. So, when the working band of sheet material 1 is held to the splicing table 9 by the working band holding device 12, the operator can deactivate the corresponding auxiliary replacement band holding device 16, 17, grip the initial portion 2a of the replacement band of sheet material 2 which is in the prepared position and pass it under the bar of the replacement band holding device 13 to place it in position on the splicing table, overlapping the end portion 1a of the working band of sheet material 1 previously held, and then operating the replacement band holding device 13 for holding the initial portion 2a of the replacement band of sheet material 2 to the splicing table 9.

[0028] Figure 5 shows the working and replacement bands of sheet material 1, 2 held to the splicing table 9 in the splicing position, with the initial portion 2a of the replacement band of sheet material 2 superimposed on the end portion 1a of the replacement band of sheet material 2. Then, as is shown in Figure 6, the operator will cut both initial and end portions 1a, 2a of the working and replacement bands of sheet material 1, 2 on the splicing table 9 inserting a cutting blade of the mentioned cutting tool 21 into the slit forming the cutting guide and moving it along the cutting guide 10, as is shown in Figure 6. The cutting tool 21 can be, for example, a manual tool, such as a cutter, handled by the operator. Then, the operator will remove overlapping excess cut portions 1b, 2b from both bands of sheet material 1, 2 such that the initial and end portions 1a, 2a of the working and replacement bands of sheet material 1, 2 will have abutting facing adjacent cut edges, as is shown in Figure 7. Finally, the operator will butt splice the initial and end portions 1a, 2a of the working and replacement bands of sheet material 1, 2 by means of a piece of adhesive tape 11a supplied from said adhesive tape supply device 11, as is illustrated in Figure 8. It must be taken into account that in Figures 5 to 8, the thicknesses of the working and replacement bands of sheet material 1, 2 and of the adhesive tape 11a are exaggerated for better clarity of the drawing.

[0029] Once the splicing has ended, the operator will act on a completed splice control (not shown), and as a consequence of a signal generated thereby the working band holding device 12 will be deactivated and the traction device 8 will start to extract the working band of sheet material 1 from the replacement reel 7, which now acts as the working reel 6, while the accumulator device 14 is gradually recovered under the action of an actuator 33 moving the mobile support 32 to move the mobile rollers 20b away from the stationary rollers 20a. Then, the empty previous working reel 6 can be replaced with a new replacement reel 7 in the upper support 4, and so on and so forth.

[0030] Figure 4 shows a splicing table 9 according to an alternative embodiment, which is similar to the one described above in relation to Figure 3, but with the addition of a second cutting guide 10 and a second adhesive tape supply device 11 aligned with said second cutting

guide 10. Both first and second cutting guides 10 are mutually parallel and are separated by a distance different from the width of the containers to subsequently be made in said container forming unit 200 from the working band of sheet material 1. Therefore, the operator will choose one or the other of the first and second cutting guides 10 so that the splice does not coincide with one of the sites where the band will be heat-welded and cut after being folded in the container forming unit so as to not create problems in the container forming unit 200. Accordingly, the splice will always be included in one of the containers 3. Therefore, one of the containers formed in halves by the initial and end portions 1a, 2a of the working and replacement bands of sheet material 1, 2 joined by adhesive tape 11 will be formed and filled like the others. A splice detector is arranged downstream of the splicing device 50, and said filling unit 300 has means for rejecting the container including the splice towards the mentioned rejection ramp 67 in response to a signal coming from said splice detector. The photocell 56, for example, arranged in the inspection station of the container forming unit 200 can be used as a splice detector.

[0031] A person skilled in the art will understand that the cutting guide 10, or each of the two cutting guides 10, may have other configurations, for example a rail along which a slide carrying the cutting tool 21 would shift. Alternatively, the cutting guide 10, or the two cutting guides 10, could be omitted if the surface 9a of the splicing table 9 was suitable for withstanding the action of the cutting blade of the cutting tool 21, such that a trained operator could make the transverse cut of the two end and initial portions 1a, 2a of the working and replacement bands of sheet material 1, 2 manually, given that the possible lack of straightness of the cut would be absorbed by the width of the adhesive tape 11a.

[0032] Again in reference to Figure 2, the band supply unit 100 comprises brake devices 22, 23 for applying a brake to the rotation of the reel acting as the working reel 6. Each of said brake devices 22, 23 comprises a brake shoe 22a, 23a, which is thrust against a surface of the core of the corresponding reel by the action of a corresponding pneumatic actuator 24, 25. The thrust force exerted by said pneumatic actuator 24, 25, and accordingly the braking force, is controlled by an electro-pneumatic proportional pressure regulator (not shown) configured to adapt the pneumatic pressure supplied to the pneumatic actuator 24, 25 to machine operating conditions during production work. To that end, the band supply unit 100 comprises a tension detector device 26 arranged to detect the tension of the working band of sheet material 1 downstream of the traction device 8 and a diameter detector 37, 38 arranged to detect a diameter of the partially unwound working reel 6 that is less than the diameter of the complete working reel 6, and the mentioned electro-pneumatic proportional pressure regulator adapts the braking force in response to a signal representative of the tension of the working band of sheet material 1 generated by said tension detector device 26 and to a signal representative of the diameter of the working reel 6 generated by said diameter detector 37, 38.

[0033] The tension detector device 26 comprises a plurality of stationary rollers 20c alternating with a plurality of mobile rollers 20d installed on a pivoting arm 27, and the working band of sheet material 1 is passed over said alternating stationary and mobile rollers 20c, 20d, such that the tension of the working band of sheet material 1 thrusts said pivoting arm 27 towards a direction which tends to move the mobile rollers 20d closer to the stationary rollers 20c, and elastic means 28, such as a pneumatic cylinder, are arranged to thrust the pivoting arm 27 towards the opposite direction. Variations in the tension of the working band of sheet material 1 cause swinging movements of the pivoting arm 27, and said movements of the mentioned pivoting arm 27 are transmitted, for example through a linkage 34, to a positional detector 29, which generates said signal representative of the tension of the working band of sheet material 1. The mentioned positional detector 29 can be, for example, a potentiometer.

[0034] The embodiment shown in Figure 2 shows one of said diameter detectors 37, 38 arranged in relation to each of the supports 4, 5 to detect the diameter of the working reel 6 regardless of the support 4, 5 on which it is installed. Each diameter detector 37, 38 can be, for example, a photocell facing a side surface of the working reel 6 formed by the successive layers of the working band of sheet material 1 and at a pre-determined distance from the axis of the reel. As the working band of sheet material 1 is extracted from the working reel 6, the diameter thereof decreases and when the side surface of the reel disappears from in front of the diameter detector 37, 38, the latter generates the mentioned signal representative of the diameter reached by the working reel 6. Two ranges of diameters of the reel are detected with a single diameter detector 37, 38: a first range between the diameter of the complete reel and the detected diameter; and a second range between the detected diameter and the diameter of the empty reel, and given that the different diameters are proportional to different degrees of inertia of the working reel 6, the braking force can be controlled depending on two degrees of inertia of the working reel 6 in addition to the degree of variable tension of the working band of sheet material 1. Alternatively, by installing a plurality of diameter detectors in relation to the working reel 6 the braking force could be controlled depending on a larger number of degrees of inertia.

[0035] In an alternative embodiment, the same diameter detectors 35, 36 used to detect the diameter indicating the proximity of the end of the reel can be used as diameter detectors for the control of the braking force.

[0036] A person skilled in the art will be able to make modifications and variations from the embodiments shown and described without departing from the scope of the present invention. For example, the splicing operations performed manually by an operator could be automated by applying elements and techniques well

known in the field of automatisms. Instead of being built into the horizontal packaging machine, the band supply unit 100 could be an independent unit that can be coupled to any container forming unit or horizontal packaging machine. The scope of the present invention is defined in the attached claims.

Claims

1. A horizontal packaging machine including an unwinder with a splicing device for changing reels without stopping the machine, of the type comprising a band supply unit (100) for supplying a band of sheet material (1, 2) from a reel, a container forming unit (200) for forming containers (3) from said band of sheet material (1, 2), and a filling unit (300) for filling said containers (3) coming from said container forming unit (200), closing them and delivering them to an outfeed conveyor, said units being arranged consecutively in the forward movement direction of the band of sheet material, in which said band supply unit (100) comprises:

   supports (4, 5) for rotatably supporting two reels which act alternately as a working reel (6) and a replacement reel (7);
   a plurality of rollers (20) for directing a working band of sheet material (1) coming from said working reel (6) to said container forming unit (200) through an accumulator device (14);
   a traction device (8) arranged downstream of said accumulator device (14) for unwinding the working reel (6) by pulling on said working band of sheet material (1); and
   a splicing device (50) located between the working reel (6) and the accumulator device (14) for splicing an end portion (1a) of the working band of sheet material (1) with an initial portion (2a) of a replacement band of sheet material (2) coming from said replacement reel (7) while said traction device (8) extracts the working band of sheet material (1) from the accumulator device (14),

   characterized in that said splicing device (50) comprises:

   a splicing table (9) on which the working band of sheet material (1) circulates, with at least one adhesive tape supply device (11) adjacent to an edge of the working band of sheet material (1);
   a working band holding device (12) for holding said end portion (1a) of the working band of sheet material (1) on the splicing table (9); and
   a replacement band holding device (13) for holding said initial portion (2a) of said replacement band of sheet material (2) on the splicing table (9), both initial and end portions (1a, 2a) of the working and replacement bands of sheet material (1, 2) being mutually superimposed on the splicing table (9),
   such that both working and replacement bands of sheet material (1, 2) are cut transversely at the same time by a cutting tool (21) and, once excess cut portions (1b, 2b) are removed from both bands of sheet material (1, 2), they are butt spliced by means of adhesive tape (11a) supplied from said adhesive tape supply device (11).

2. The machine according to claim 1, **characterized in that** the splicing device (50) further comprises first and second auxiliary replacement band holding devices (16, 17) for alternately holding the initial portion (2a) of the band of sheet material (2) coming from the one of the two reels acting as the replacement reel (7) in a position prepared for splicing, adjacent to the splicing table (9).

3. The machine according to claim 1, **characterized in that** said working band holding device (12) is operated and automatically activated in response to a signal generated by an end-of-reel detector (18, 19), and **in that** said replacement band holding device (13) is operated and manually activated by an operator.

4. The machine according to claim 2, **characterized in that** said first and second auxiliary replacement band holding devices (16, 17) are operated by actuating means and activated in response to a control actuated by an operator.

5. The machine according to claim 1, **characterized in that** the splicing table (9) has associated therewith at least one cutting guide (10) transverse to the working band of sheet material (1) and aligned with the adhesive tape supply device (11).

6. The machine according to claim 5, **characterized in that** the splicing table (9) has associated therewith a second cutting guide (10) and a second adhesive tape supply device (11) adjacent to an edge of the working band of sheet material (1) and aligned with said second cutting guide (10), both first and second cutting guides (10) being mutually parallel and separated by a distance different from the width of the containers to be made from the working band of sheet material (1) in said container forming unit (200).

7. The machine according to claim 1, 5 or 6, **characterized in that** a splice detector is arranged downstream of the splicing device (50) and said container forming unit (200) or said filling unit (300) has means

for rejecting a container formed by the initial and end portions (1a, 2a) of the working and replacement bands of sheet material (1, 2) joined by adhesive tape (11) in response to a signal coming from said splice detector.

8. The machine according to claim 5 or 6, **characterized in that** said cutting guide (10) comprises a slit formed through the splicing table (9) in a direction transverse to the working band of sheet material (1), said slit having a width sized to receive a blade of said cutting tool (21) and a length greater than the width of the working and replacement bands of sheet material (1,2).

9. The machine according to claim 1, **characterized in that** the cutting tool (21) is a manual tool handled by an operator.

10. The machine according to any previous claim, **characterized in that** it comprises a sound and/or light warning device which is activated in response to a signal generated by a diameter detector (35, 36) arranged to detect a diameter indicating the proximity of the end of the reel in the working reel (6).

11. The machine according to claim 1, **characterized in that** it comprises brake devices (22, 23) for applying a brake to the rotation of the reel acting as a working reel (6), each of said brake devices (22, 23) comprising a brake shoe (22a, 23a) thrust against a surface of the corresponding reel by a pneumatic actuator (24, 25) and an electro-pneumatic proportional pressure regulator arranged for controlling the thrust force of said pneumatic actuator (24, 25) in response to one signal representative of the tension of the working band of sheet material (1) and a signal representative of the diameter of the working reel (6).

12. The machine according to claim 11, **characterized in that** said signal representative of the tension of the working band of sheet material (1) is generated by a tension detector device (26) arranged to detect the tension of the working band of sheet material (1) downstream of the traction device (8), and **in that** said signal representative of the diameter of the working reel (6) is generated by at least one diameter detector (37, 38) arranged to detect a diameter of the partially unwound working reel (6) that is less than the diameter of the complete working reel (6), said diameters corresponding to different inertias of the working reel (6).

13. A band supply unit applicable to a horizontal packaging machine, of the type comprising:

supports (4, 5) for rotatably supporting two reels which act alternately as a working reel (6) and a replacement reel (7);
a plurality of rollers (20) for directing a working band of sheet material (1) coming from said working reel (6) to a subsequent unit through an accumulator device (14);
a traction device (8) arranged downstream of said accumulator device (14) for unwinding the working reel (6) by pulling on said working band of sheet material (1); and
a splicing device (50) located between the working reel (6) and the accumulator device (14) for splicing an end portion (1a) of the working band of sheet material (1) with an initial portion (2a) of a replacement band of sheet material (2) coming from said replacement reel (7) while said traction device (8) extracts working band of sheet material (1) from the accumulator device (14),

characterized in that said splicing device (50) comprises:

a splicing table (9) on which the working band of sheet material (1) circulates, with at least one adhesive tape supply device (11) adjacent to an edge of the working band of sheet material (1);
a working band holding device (12) for holding said end portion (1a) of the working band of sheet material (1) on the splicing table (9); and
a replacement band holding device (13) for holding said initial portion (2a) of said replacement band of sheet material (2) on the splicing table (9), being both initial and end portions (1a, 2a) of the working and replacement bands of sheet material (1, 2) mutually superimposed on the splicing table (9),
such that both working and replacement bands of sheet material (1, 2) are cut transversely at the same time by a cutting tool (21) and, once excess cut portions (1b, 2b) are removed from both bands of sheet material (1, 2), they are butt spliced by means of adhesive tape (11a) supplied from said adhesive tape supply device (11).

14. A splicing method for splicing bands of sheet material applicable to a band supply unit for a horizontal packaging machine, said band supply unit being of the type comprising:

supports (4, 5) for rotatably supporting two reels which act alternately as a working reel (6) and a replacement reel (7);
a plurality of rollers (20) for directing a working band of sheet material (1) coming from said working reel (6) to a subsequent unit through an accumulator device (14);
a traction device (8) arranged downstream of

said accumulator device (14) for unwinding the working reel (6) by pulling on said working band of sheet material (1); and
a splicing device (50) located between the working reel (6) and the accumulator device (14) for splicing an end portion (1a) of the working band of sheet material (1) with an initial portion (2a) of a replacement band of sheet material (2) coming from said replacement reel (7) while said traction device (8) extracts working band of sheet material (1) from the accumulator device (14),

characterized in that it comprises the steps of:

holding said end portion (1a) of the working band of sheet material (1) on a splicing table (9) in said splicing device (50);
holding said initial portion (2a) of said replacement band of sheet material (2) on said splicing table (9), both initial and end portions (1a, 2a) of the working and replacement bands of sheet material (1, 2) being mutually superimposed;
cutting at the same time both initial and end portions (1a, 2a) of the working and replacement bands of sheet material (1, 2) at the same time by means of a cutting tool (21) on the splicing table (9) along a cutting line transverse to the working and replacement bands of sheet material (1, 2);
removing excess cut portions (1b, 2b) from both bands of sheet material (1, 2); and
butt splicing the initial and end portions (1a, 2a) of the working and replacement bands of sheet material (1, 2) by means of adhesive tape (11a) supplied from said adhesive tape supply device (11).

15. The method according to claim 14, **characterized in that** it comprises using a cutting guide (10) associated with said splicing table (9) and a manually handled cutting tool (21) for said cutting step.

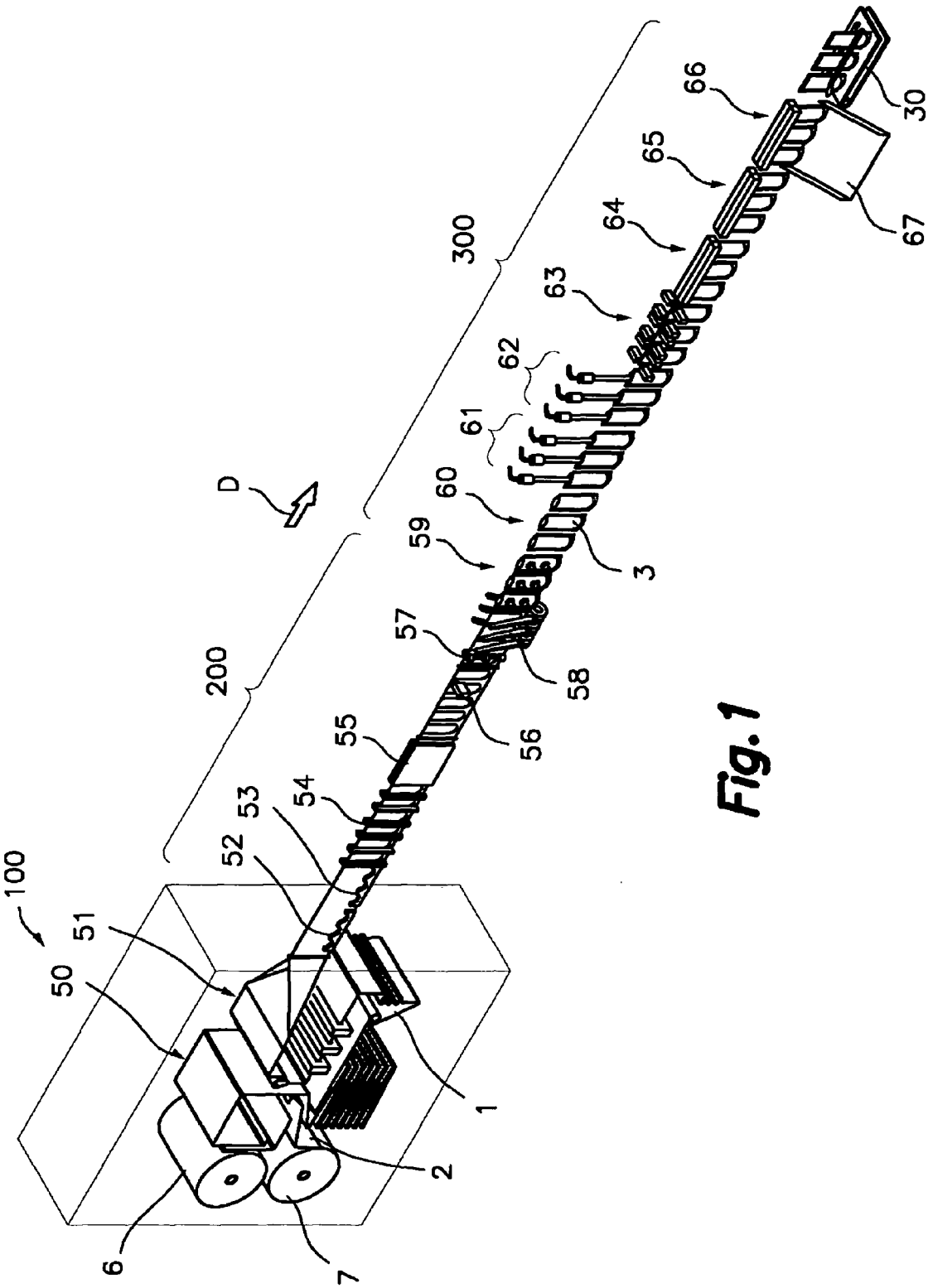
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Fig. 1

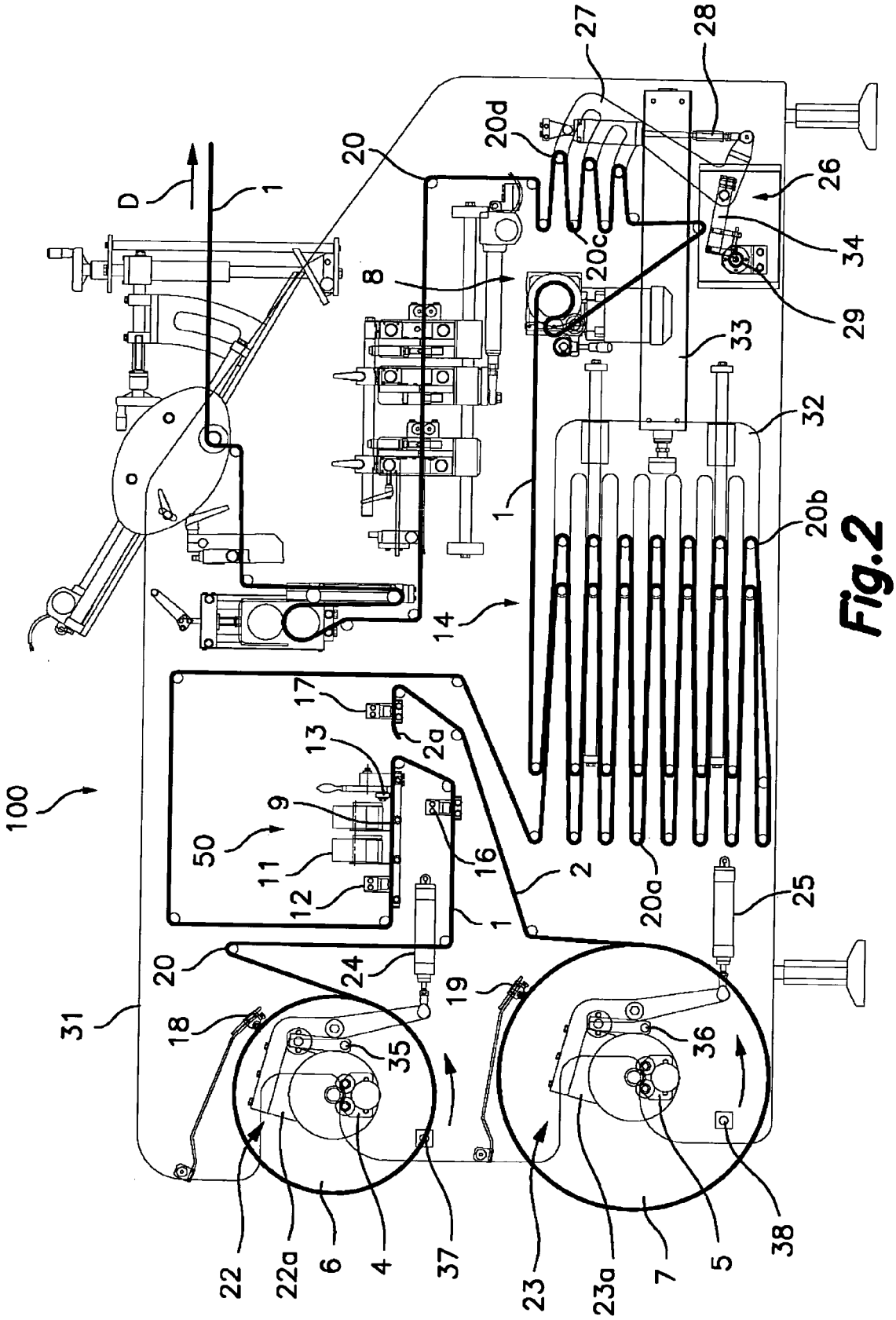
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Fig.2

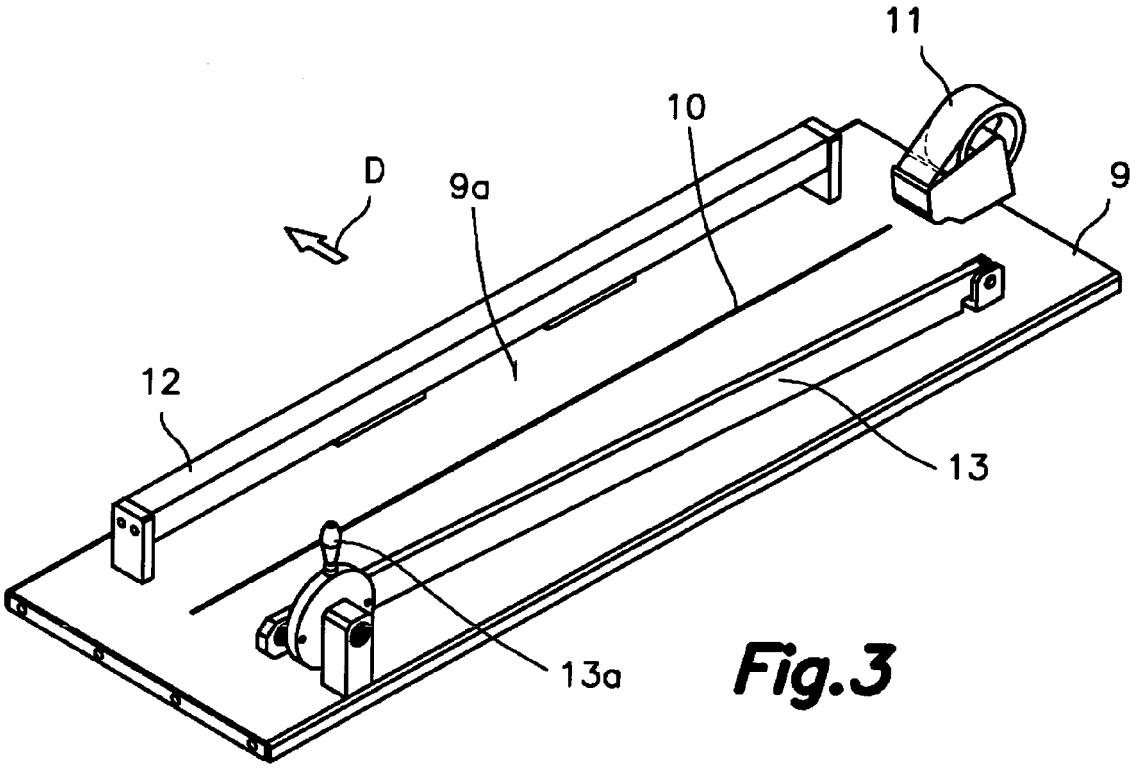

Fig.3

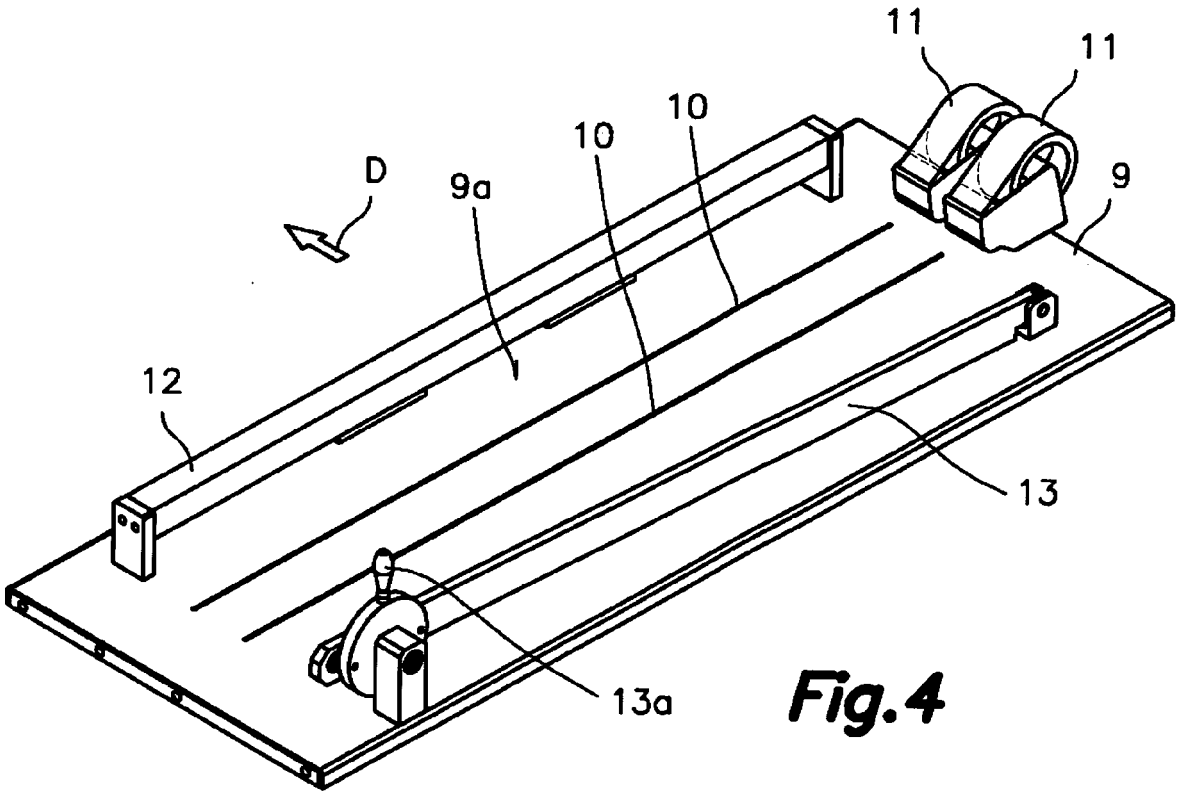

Fig.4

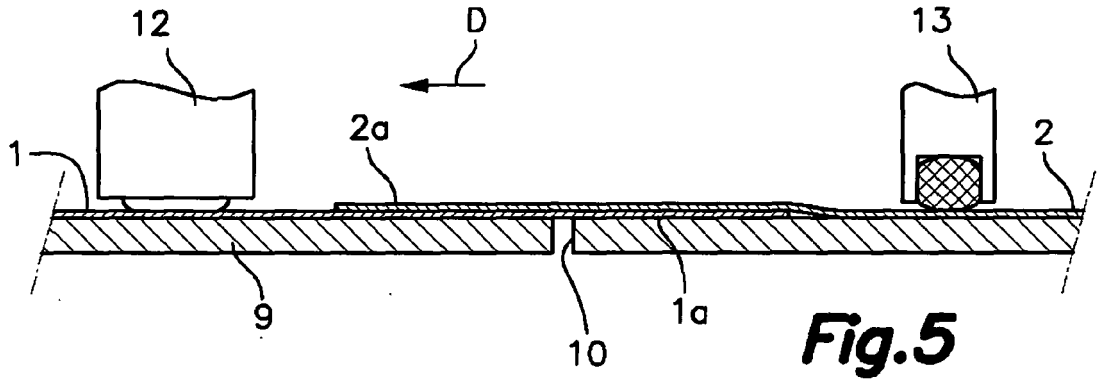

Fig.5

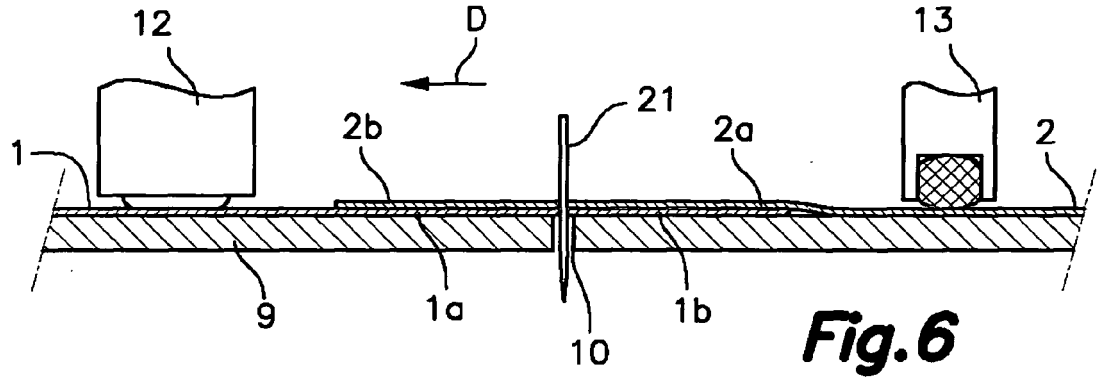

Fig.6

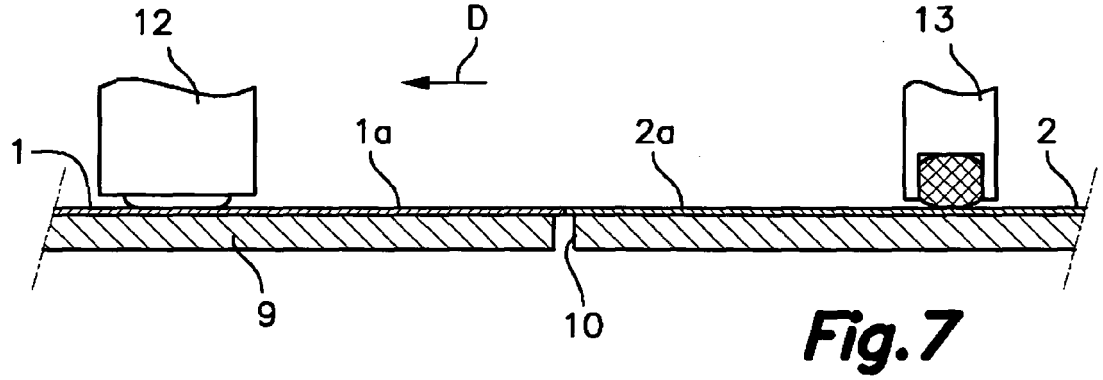

Fig.7

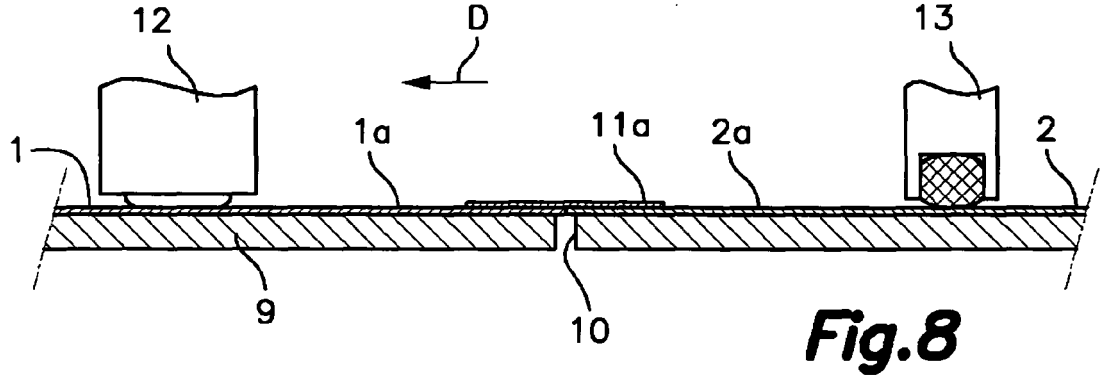

Fig.8

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EUROPEAN SEARCH REPORT

Application Number
EP 10 38 0030

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	EP 1 002 727 A2 (LANGEN PACKAGING INC [CA]) 24 May 2000 (2000-05-24) * paragraph [0037] - paragraph [0040]; figures 1,3 * -----	1,5,8,9, 13-15	INV. B65B1/02 B65H19/18
Y	US 2006/272763 A1 (TIEFEL RICK L [US] ET AL) 7 December 2006 (2006-12-07) * paragraph [0037] - paragraph [0046]; figures 6-20 * -----	1,5,8,9, 13-15	
A	JP 2005 272125 A (NIPPON SEIKI CO LTD) 6 October 2005 (2005-10-06) * the whole document * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC) B65B B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 July 2010	Lawder, M

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09-07-2010

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US 2006272763 A1	07-12-2006	NONE	
JP 2005272125 A	06-10-2005	JP 4402494 B2	20-01-2010

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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