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(54) **Machine and process for cutting easy-open seals from an adhesive tape**

VORRICHTUNG UND VERFAHREN ZUM SCHNEIDEN VON LEICHT-ZU-ÖFFNENDEN
VERSCHLÜSSEN AUS EINEM KLEBEBAND

APPAREIL ET PROCEDE POUR DECOUPER DES ELEMENTS DE FERMETURE A OUVERTURE
FACILE D' UN RUBAN ADHESIF

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US-A- 5 609 082 US-A- 5 862 968

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Description

[0001] The present invention relates to a machine that applies reclosable easy-open closing devices. These devices can be applied on packs and pouches, in particular to those used in food packaging.

[0002] Machines for application of reclosable easy open closing devices are known. US-A-5 862 968 discloses a separation device for processing linerless labels, see Fig. 1 thereof, from a web coming from a roll, said web having adhesive exposed along one side and a slick surface along the opposite side. The separating mechanism (10) includes a pair of infeed rolls (12) and (14) which are maintained in pressure contact with the web passing through the nip of the rolls. Downstream the infeed rolls there is provided a cutting mechanism formed by a cylinder assembly (37), on which it is mounted a fixed blade in opposition to a cylinder (38) mounting a transversely extending blade (42), movable with the cylinder (38) and having a slight helix orientation relative to the axis of the cylinder (38). Oil from a wicking roll prevents the build up of adhesive along the blade. A layout of a commercially available application machine is reported in Fig. 1, wherein (1) indicates the unwinding system of the adhesive tape roll from which the closing device is obtained, (2) indicates the tape cutting system, (3) is the tape centerfolding system. The tape cutting system depicted in (2) is constituted by:

- a pneumatically actuated blade (2a), positioned perpendicularly to the direction of unwinding of the tape roll. Tape cutting generates the formats (individual adhesive labels or closing devices) that constitute the reclosable closing device;
- a fixed counterblade (2b), installed onto an oscillating plate; the counterblade is kept in tight contact with the cutting blade by the action of a spring that pulls the counterblade against the cutting blade during machine operation.

[0003] The cutting blade (2a), as mentioned before, is positioned perpendicularly to the direction of unwinding of the tape. The cutting edge of the blade is positioned horizontally and is parallel to the counterblade. Fig. 1.1 depicts the layout of the blade from a different perspective, together with the pneumatic actuator and the counterblade.

[0004] The tape is transversally cut along its width. The movement of the blade is vertical with reference to the surface of the tape.

[0005] Since the tapes used to generate these closing devices are adhesive tapes, it is necessary to avoid machine jamming generated by the buildup of residues of adhesive material onto the blade and counterblade during continuous operation of the machine.

[0006] In order to avoid this, during the operation of the machine, lubricant oils are applied onto the part of the blade coming in contact with the adhesive material.

The application of said oils can be carried out by several techniques, e.g. by spraying. The use of lubricant oils has the disadvantage that they can contaminate both the label (closing device) and the pack onto which the label is applied. Moreover the use of lubricant oils is not acceptable for food packaging since these oils represent a critical source of contamination in the Hazard Assessment Critical Control Point Procedures (HACCP). In details, the HACCP procedures require that no oils should come in contact, directly or indirectly, with food or food packaging. Further, if the oil contaminates the adhesive coating of the closing device, the performance of the latter is greatly reduced. Said reduced performance of the closing device yields to the generation of further scraps, in addition to those generated by oil contamination during the application of said closing device, to packs or other objects.

The machine speed does not exceed 50 - 60 packs/min. Tests carried out by the Applicant have shown that the above described machine setup cannot operate without applying oil to the blade. During the normal operation of the machine, at a speed of 50 packs/min, frequent shutdowns are necessary, generally at intervals of about 2 - 4 hours, for the cleaning of the blade and counterblade from the adhesive and oil residues. The machine cannot be operated at higher speeds without jamming.

[0007] There was felt the need of an application machine that could overcome the disadvantages of the prior art, in particular there was a need of a machine that could operate at a speed higher than 60 packs/min, preferably at speeds equal or higher than 100 packs/min, and besides could operate continuously for extended periods of time, at least 10 days, and preferably 2 - 3 months, without the need of lubrication or shutdowns for cleaning of the blade and counterblade.

[0008] It has been surprisingly and unexpectedly found by the Applicant an application machine that allows to solve the technical problems mentioned above, and that operates consistently without the need of lubrication or shutdowns for blade cleaning during operation.

[0009] From the production viewpoint the application machine of the present invention, as herewith described, guarantees a productivity much higher than that of the commercially available machines.

[0010] An object of the present invention is a machine for applying reclosable easy-open self-adhesive closing devices, to be applied onto packs and pouches, especially food packs and pouches, said machine represented in Fig. 2, wherein the essential components are:

- (1) represents the unwinding system of the tape from which the closing device is obtained;
- (3) represents the centerfolding system, that in the machine according to the present invention is an optional part,
- (2) represents the cutting system, comprising:
 - a mobile cutting blade (2a), preferably pneu-

matically actuated by an actuator represented in the figure, said blade cutting the tape moving through the machine with its adhesive coated surface facing downwards, being the blade positioned perpendicularly to the direction of unwinding of the tape from which the formats (labels) constituting the reclosable closing device are then obtained,

- a fixed counterblade (2b), installed onto an oscillating plate; the counterblade is kept in tight contact with the cutting blade during machine operation, preferably by a spring pulling the counterblade against the cutting blade,

the cutting blade (2a), shown in the figure in its open position, has a cutting edge placed at an angle of 2 to 30 °, see Fig 2.1, with reference to the horizontal plane of the tape; during the cutting operation the blade moves vertically with a constant angle with respect to the tape surface, the contact point between the blade and the counterblade moves continuously across the tape to be cut; the blade and counterblade edges being coated with solid release coatings.

[0011] Besides the above indicated angle, the blade (2a) has a cutting edge that preferably shows in its vertical section a curvature having a radius comprised between 500 and 3000 mm, and preferably between 1500 and 2000 mm. See Fig. 2.2, where (2a) represents a front view of the blade and under the front view (2a) there is a plant sectional view of the blade.

[0012] The solid release coatings applied onto the blade and counterblade surfaces prevent the sticking onto said surfaces of the adhesive tape moving through the machine, thus avoiding machine jamming.

[0013] Said solid release coatings make thus the blade surfaces non-receptive to the tape adhesive, and minimize the tape sticking to the blade edges. To obtain said solid release coatings, materials based on silicones and fluoropolymers can for instance be used. As an example, and without limitation to the types herewith specified, it is possible to use commercially available coatings known as Plasma Coating® PC 918 F, PC 936, PC 915, PC 915S, PC 934, PC 934S, PC 932, PC 918-C, PC 434, PC 432.

[0014] A further object of the present invention is a cutting process using the machine described above for obtaining labels or individual formats for reclosable self-adhesive closing devices.

[0015] The tape is unwound by the system (1) of fig. 2 and conveyed through a system of rotating rollers, then passes horizontally and parallel to the counterblade (2b), then the cutting blade (2a), having an angle with respect to the tape surface comprised between 2° and 30°, cuts the tape with a definite length corresponding to the width of the individual closing devices. The definite length can be determined a priori by the required size of the individual format (closing device). When the tape is printed the size of the closing device is deter-

mined by the pitch or cut length of the printed artwork. For the exact positioning of the cutting position an optical reading system (photocell) is preferably used.

[0016] The tape from which the above mentioned formats are obtained has a thickness of 40 - 80 µm, preferably 50 - 60 µm.

[0017] The amount of adhesive coating applied onto the tape, calculated on a dry weight basis, ranges from 10 to 30 g/m², preferably from 15 to 18 g/m².

[0018] The preferred tape base used for the reclosable self-adhesive easy-open device is made of a plastic material; on one of its sides the adhesive is applied with a longitudinal pattern parallel to the unwinding direction of the tape, thus creating coated stripes or sections alternated with uncoated stripes or sections, said tape being wound in a mill-roll that is subsequently slit into smaller rolls, where an uncoated stripe or section is located on one of the edges of the adhesive tape side.

[0019] In particular, on the adhesive side of the tape there is one adhesive longitudinal section and an uncoated longitudinal area located on one of the tape edges, said uncoated area having a width that allows an easy manual handling of the closing device when this is applied onto the pack surface.

[0020] When one side of the tape has a full coverage of adhesive, the optional folding system (3) of figure 2 is used.

[0021] The reclosable self-adhesive easy-open device has a length preferably comprised between 25 and 50 mm, and it is obtained by cutting transversally the tape unwound from the tape roll according to a pitch corresponding to the width of the closing device.

[0022] Optionally, the tape or plastic film of the closing device can be printed. In this case, the dimensions of the printed artwork determine those of the closing system or closing device.

[0023] The plastic film tape base can be preferably made of a bioriented polypropylene, bioriented polyester, polyethylene, or a film laminate.

[0024] The adhesive material used for the tape is commercially available, and it is chosen among those that allow a removable reclosable closure to be obtained.

[0025] In particular, the adhesive material is preferably an acrylic based aqueous emulsion, preferably based on a C₃ - C₅ ester of the acrylic acid, for instance butyl acrylate, or a hot melt adhesive, generally consisting of conventional thermoplastic rubbers admixed with hydrocarbon resins, well known to those skilled in the art.

[0026] The process used for manufacturing the tape preferably used for the reclosable self-adhesive easy-open closing device, and the tape as such, are described in the European Patent Application filing number 00109288.1 in the Applicant's name.

[0027] The Applicant has found that when the closing system described in the aforementioned Patent Application is used, the application machine of the present

invention is further simplified, since the folding unit (3) of Fig. 2 is not necessary any more.

[0028] Optionally, when a printed tape is used for the closing system, the pitch of the printed artwork determines the size of the label, through an optical reading system (photocell) that determines the cutting position. The optical reading system is represented as (4) in Fig. 2.

[0029] The Applicant has found that the particular geometry and structure of the cutting blade of the present invention as above described avoids any buildup of adhesive residues both on the blade and on the counterblade, allowing a high speed of application of the closing device on the packs and avoiding machine shutdowns for cleaning.

[0030] The following examples illustrate the invention and are not limitative of the scope.

EXAMPLE 1

Preparation of the tape used for the closing system

[0031] A bioriented polypropylene film having a web width of 620 mm and a thickness of 50 μm , printed by rotogravure with a pitch of 45 mm, has been coated on one side with an aqueous acrylic adhesive Primal® PS 83D (butyl acrylate) manufactured by Rohm and Haas (concentration 53% by weight).

[0032] The dry weight of the adhesive coating, determined by weighing formats of known area, is of 28 g/m².

[0033] A doctor blade array removed the adhesive from the coated tape (before the drying of the acrylic emulsion), thus creating 12 uncoated longitudinal stripes, each one having a width of 10 mm, alternated with 12 longitudinal coated stripes, each one having a width of 40 mm, in addition to two uncoated edge trims on the outside of the web, each one having a width of 10 mm.

[0034] After the selective removal of the adhesive as above described, the adhesive emulsion on the tape was dried by passing the pattern coated web in a drying oven, at temperatures comprised between 80 and 120°C, then the tape was wound up in a mill roll.

[0035] Subsequently, the pattern coated mill roll was slit into smaller rolls having a width of 50 mm, in such a way that in correspondence of one of the two roll edges there was located the uncoated stripe.

[0036] The tape rolls thus obtained, having the above said longitudinal pattern adhesive coating on one side, were used to manufacture a reclosable self-adhesive easy-open device which was applied onto 500-g square bottomed packs of pasta, made from a 2-ply laminate composed of a reverse printed 20 μm bioriented polypropylene and a 25 μm cast polypropylene film.

[0037] The packs were obtained by heat sealing; the upper flap was then triple folded, and the application of the reclosable self-adhesive easy-open device described above was made on the folded upper flap of the

pack as described in ex. 2.

EXAMPLE 2

[0038] The application machine of Fig. 2 was used to apply the reclosable self-adhesive easy-open device obtained from the tape prepared as described in ex. 1. The application machine cut transversally the adhesive tape, as shown in Fig. 3 (3), obtaining tape strips or formats having the size of 30x75 mm (Fig. 3b), that were applied transversally onto the triple folding on the upper flap of the pack as described in ex. 1, leaving free the uncoated part of the strip or format, as shown in Fig. 3a, so that the self-adhesive closure could be easily opened by using the uncoated tape edge. The same self-adhesive closure could be repositioned on the pack even after repeated open/closing of the pack.

[0039] The application machine was continuously used for 30 consecutive working days in a food packaging line.

[0040] The release coating used was Plasma Coating® PC 918F; the blade formed an angle of 10 degrees with respect to the horizontal plane of the tape, and the cutting edge of the blade had a curvature radius of 1800 mm. The application machine worked at a speed of 90 packs/min during the 30 days of the test. The only machine downtime was that necessary for the installation of new tape rolls. No machine downtime occurred for the cleaning of the blade and counterblade, since they did not show any buildup of adhesive residues.

[0041] At the end of the test, the machine uptime (ratio between the net line production, excluding machine downtime for substituting the rolls, and the theoretical line production at the actual line speed) was of 98%.

EXAMPLE 3 (comparative)

[0042] Example 2 was repeated but using a commercially available application machine, as from Fig. 1 above described, Mod. PA 0963, manufactured by ARI di Villa Aurelio & Co. Snc, working at a speed of 60 packs/minute.

[0043] Without using lubricant oils, the machine jamming occurs soon after the starting of the machine operation.

[0044] By applying a lubricant oil to the blades, the machine worked for about 2 hours, than jammed due to the buildup of adhesive residues onto the cutting blade. This adhesive residues prevented the movement of the tape across the machine, so a shutdown was necessary to remove said residues.

[0045] Machine uptime in this case resulted much lower than that of the machine according to the present invention (ex. 2).

[0046] From the results of ex. 2 and of ex. 3 (comparative), it was concluded that the application machine of the present invention was superior in terms both of higher uptime, higher speed, and longer service life, since

there was no need of machine shutdown for maintenance.

Claims

1. Machine for applying reclosable easy-open self-adhesive closing devices, to be applied onto packs and pouches, especially food packs and pouches, said machine comprising:

- (1) an unwinding system of the tape from which the closing device is obtained;
- (2) a cutting system, comprising:
 - a mobile cutting blade (2a), cutting the tape moving through the machine with its adhesive coated surface facing downwards, being the blade positioned perpendicularly to the direction of unwinding of the tape from which the formats (labels) constituting the reclosable closing device are then obtained,
 - a fixed counterblade (2b), installed onto an oscillating plate; the counterblade is kept in tight contact with the cutting blade during machine operation,

characterized in that:

- the cutting blade (2a) has a cutting edge placed at an angle of 2 to 30 ° with reference to the horizontal plane of the tape;
- during the cutting operation the blade moves vertically with a constant angle with respect to the tape surface, the contact point between the blade and the counterblade moves continuously across the tape to be cut;
- the blade and counterblade edges being coated with solid release coatings;

the machine being optionally provided with a centerfolding system (3).

2. Application machine according to claim 1, wherein the blade (2a) has a cutting edge that shows in its vertical section a curvature.

3. Application machine according to claim 2 wherein said curvature has a radius comprised between 500 and 3000 mm, preferably between 1500 and 2000 mm.

4. Application machine according to claims 1-3 wherein materials based on silicones and fluoropolymers are used as the solid release coatings applied onto the blade and counterblade surfaces.

5. Cutting process for obtaining labels or individual for-

mats for reclosable self-adhesive closing devices wherein the tape is unwound by the system (1) of claim 1, conveyed through a system of rotating rollers, passes horizontally and parallel to the counterblade (2b),

characterized in that the cutting blade (2a) moves vertically with a constant angle with respect to the tape surface, the angle with respect to the tape surface comprised between 2° and 30°, the blade and counterblade edges being coated with solid release coatings.

6. Cutting process according to claim 5 wherein the tape from which the formats are obtained has a thickness of 40 - 80 µm, preferably 50 - 60 µm.

7. Cutting process according to claims 5-6 wherein the amount of adhesive coating applied onto the tape, calculated on a dry weight basis, ranges from 10 to 30 g/m², preferably from 15 to 18 g/m².

8. Cutting process according to claims 5-7 wherein it is used a tape base made of a plastic material on one side of which the adhesive is applied with a longitudinal pattern parallel to the unwinding direction of the tape, thus creating coated stripes or sections alternated with uncoated stripes or sections, said tape being wound in a mill-roll that is subsequently slit into smaller rolls wherein an uncoated stripe or section is located onto one of the edges of the tape.

9. Cutting process according to claims 5-8 for obtaining reclosable easy open self-adhesive closing devices for the application onto packs and pouches, preferably food packs and pouches.

Patentansprüche

1. Maschine zum Aufbringen von wieder-verschließbaren, leicht zu öffnenden, selbstklebenden Verschußmitteln, die auf Packungen und Beuteln, insbesondere Lebensmittelpackungen und -beuteln aufgebracht werden, wobei die Maschine enthält:

- (1) ein Abrollsystem für Klebeband, von welchem das Verschußmittel erhalten wird;

- (2) ein Schneidesystem, enthaltend:

- eine bewegliche Schneidklinge (2a), welche das Klebeband schneidet, das sich durch die Maschine bewegt, wobei die mit Klebemittel beschichtete Seite nach unten gerichtet ist, und wobei die Klinge senkrecht zu der Richtung des sich abrollenden Klebebands angeordnet ist, von dem die

Formate (Aufkleber), die das wieder-verschließbare Verschlusmittel bilden, erhalten werden,

- eine feste Gegenklinge (2b), die auf einer Schwingplatte befestigt ist; die Gegenklinge wird während des Maschinenbetriebs in engem Kontakt mit der Schneidklinge gehalten,

dadurch gekennzeichnet, daß

- die Schneidklinge (2a) einen Schneidrand aufweist, der unter einem Winkel von 2 bis 30° bezogen auf die horizontale Fläche des Klebebandes angeordnet ist;
- sich während des Schneidvorgangs die Klinge vertikal mit einem konstanten Winkel bezogen auf die Oberfläche des Klebebandes bewegt, wobei sich der Kontaktpunkt zwischen der Klinge und der Gegenklinge ständig über das zu schneidende Klebeband bewegt;
- die Ränder der Klinge und der Gegenklinge mit festen, lösenden Beschichtungen beschichtet sind;
- die Maschine optional mit einem Ausfallsystem (3) ausgestattet ist.

2. Aufbringmaschine nach Anspruch 1, wobei die Klinge (2a) einen Schneidrand hat, der in seinem vertikalen Schnitt eine Krümmung zeigt.

3. Aufbringmaschine nach Anspruch 2, wobei besagte Krümmung einen Radius zwischen 500 und 3000 mm, vorzugsweise zwischen 1500 und 2000 mm hat.

4. Aufbringmaschine nach einem der Ansprüche 1 bis 3, wobei Materialien, die auf Silikonen oder Fluorpolymeren basieren, als feste, lösende Beschichtungen verwendet werden, die auf die Oberflächen der Klinge und der Gegenklinge aufgebracht werden.

5. Schneidverfahren zum Erhalten von Aufklebern oder individuellen Formaten für wieder-verschließbare, selbstklebenden Verschlusmittel, wobei das Klebeband mit einem System (1) nach Anspruch 1 abgerollt wird, durch ein System aus rotierenden Rollen gefördert wird, horizontal und parallel zu der Gegenklinge (2b) läuft, **dadurch gekennzeichnet, daß** die Schneidklinge (2a) sich vertikal mit einem konstanten Winkel bezogen auf die Oberfläche des Klebebandes bewegt, der zwischen 2° und 30° liegt, wobei die Ränder der Klinge und

der Gegenklinge mit einer festen, lösenden Beschichtung beschichtet ist.

6. Schneidverfahren nach Anspruch 5, wobei das Klebeband, von welchem die Formate erhalten werden, eine Dicke von 40-80 µm, vorzugsweise 50-60 µm hat.

7. Schneidverfahren nach einem der Ansprüche 5 bis 6, wobei die Menge an Klebebeschichtung, die auf das Klebeband aufgebracht wird, berechnet auf der Basis des Trockengewichts zwischen 10 bis 30 g/m², vorzugsweise zwischen 15 bis 18 g/m² liegt.

8. Schneidverfahren nach einem der Ansprüche 5 bis 7, wobei ein Klebeband verwendet wird, das aus Kunststoffmaterial gefertigt ist, auf dessen einer Seite das Klebemittel mit einem longitudinalen Muster parallel zur Abrollrichtung des Klebebandes aufgebracht wird, wodurch beschichtete Streifen oder Abschnitte entstehen, die sich mit unbeschichteten Streifen oder Abschnitten abwechseln, wobei das Klebeband in einer Mühlenrolle gerollt wird, die nacheinander in kleinere Rollen geschlitzt wird, wobei ein unbeschichteter Streifen oder Abschnitt an einem der Ränder des Bandes angeordnet ist.

9. Schneidverfahren nach einem der Ansprüche 5 bis 8 zum Erhalten wiederverschließbarer, leicht zu öffnender, selbstklebender Verschlusmittel für die Verwendung auf Packungen und Beuteln, vorzugsweise Lebensmittel-Packungen und -beuteln.

Revendications

1. Machine pour appliquer des dispositifs de fermeture autoadhésifs, faciles à ouvrir, pouvant être refermés, destinés à être appliqués sur des paquets et des sachets, en particulier des paquets et des sachets de denrées alimentaires, ladite machine comprenant:

(1) un système dérouleur de la bande à partir de laquelle le dispositif de fermeture est obtenu ;

(2) un système coupant, comprenant:

- une lame coupante mobile (2a), coupant la bande se déplaçant à travers la machine avec sa surface couchée adhésive faisant face vers le bas, la lame étant positionnée perpendiculairement à la direction de déroulement de la bande à partir de laquelle les formats (étiquettes) constituant le dispositif de fermeture pouvant être refermé sont ensuite obtenus,
- une contre-lame fixe (2b), installée sur une

plaque oscillante ; la contre-lame étant maintenue en contact étroit avec la lame coupante pendant le fonctionnement de la machine ;

caractérisée en ce que :

- la lame coupante (2a) a un bord coupant placé à un angle de 2 à 30° par rapport au plan horizontal de la bande ;
- pendant l'opération de coupe, la lame se déplace verticalement avec un angle constant par rapport à la surface de la bande, le point de contact entre la lame et la contre-lame se déplace continuellement sur la bande à couper ;
- les bords de la lame et de la contre-lame étant recouverts de revêtements antiadhésifs solides ;

la machine étant en option équipée d'un système de pliage médian (3).

2. Machine d'application selon la revendication 1, dans laquelle la lame (2a) a un bord coupant qui présente dans sa section verticale une courbure.

3. Machine d'application selon la revendication 2, dans laquelle ladite courbure a un rayon compris entre 500 et 3000 mm. de préférence entre 1500 et 2000 mm.

4. Machine d'application selon les revendications 1 à 3, dans laquelle des matières à base de silicones et de fluoropolymères sont utilisées comme revêtements antiadhésifs solides appliqués sur les surfaces de la lame et de la contre-lame.

5. Procédé de coupe pour obtenir des étiquettes ou des formats individuels pour des dispositifs de fermeture autoadhésifs pouvant être refermés dans lequel la bande est déroulée par le système (1) de la revendication 1, transportée à travers un système de rouleaux rotatifs, passe horizontalement et parallèlement vers la contre-lame (2b),

caractérisé en ce que la lame coupante (2a) se déplace verticalement avec un angle constant par rapport à la surface de la bande, l'angle par rapport à la surface de la bande étant compris entre 2° et 30°, les bords de la lame et de la contre-lame étant recouverts de revêtements antiadhésifs solides.

6. Procédé de coupe selon la revendication 5, dans lequel la bande à partir de laquelle les formats sont obtenus a une épaisseur de 40 à 80 µm, de préférence de 50 à 60 µm.

7. Procédé de coupe selon les revendications 5 et 6,

dans lequel la quantité de revêtement adhésif appliqué sur la bande, calculée sur une base de poids sec, est comprise entre 10 et 30 g/m², de préférence entre 15 et 18 g/m².

8. Procédé de coupe selon les revendications 5 à 7, dans lequel il est utilisé une base de bande faite en une matière plastique sur un côté sur lequel l'adhésif est appliqué avec un motif longitudinal parallèle à la direction de déroulement de la bande, créant ainsi des bandes ou sections revêtues alternant avec des bandes ou sections non revêtues, ladite bande étant enroulée sur une bobine mère qui est subséquentement divisée en de plus petites bobines dans lesquelles la bande ou section non revêtue est située sur l'un des bords de la bande.

9. Procédé de coupe selon les revendications 5 à 8, pour obtenir des dispositifs de fermeture autoadhésifs, faciles à ouvrir, pouvant être refermés, à des fins d'application sur des paquets et des sachets, de préférence des paquets et des sachets de denrées alimentaires.

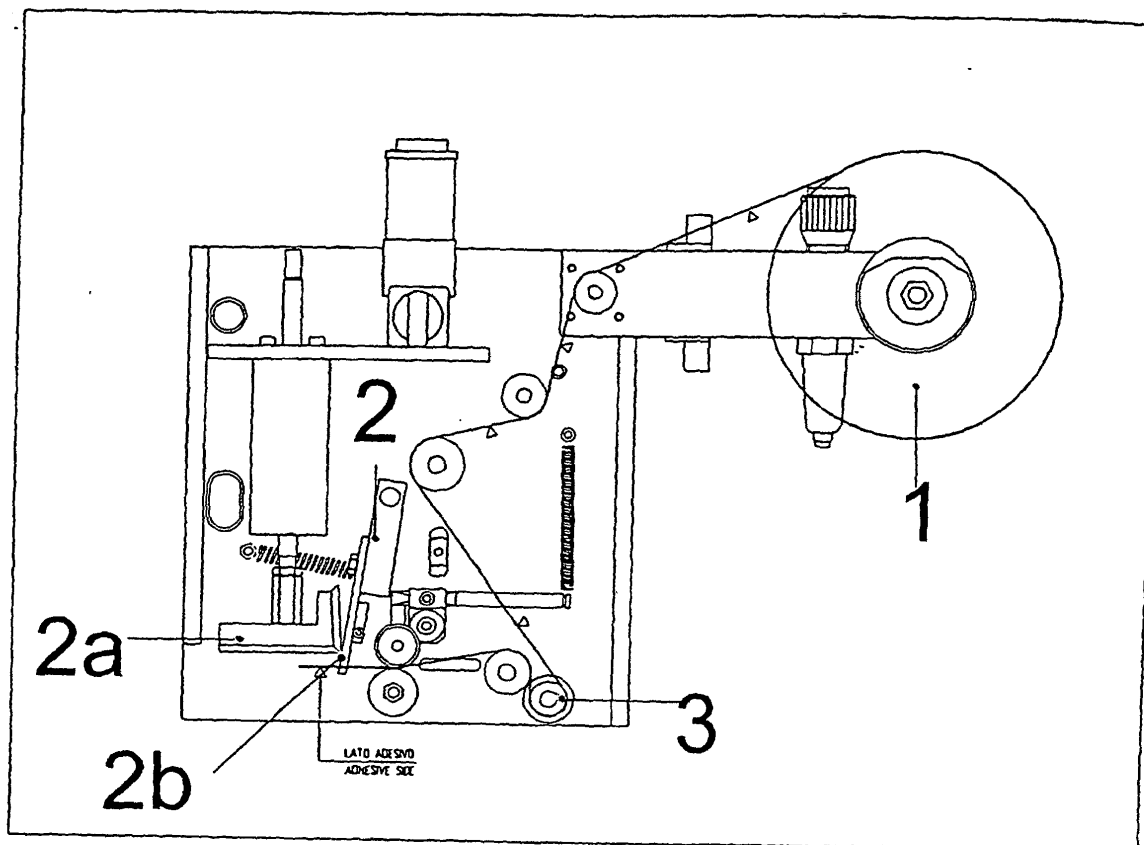


Fig. 1

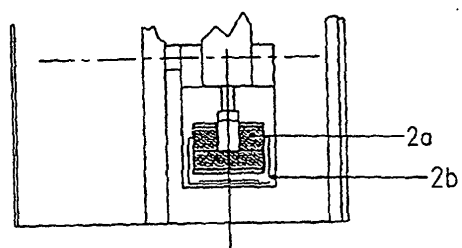


Fig. 1.1

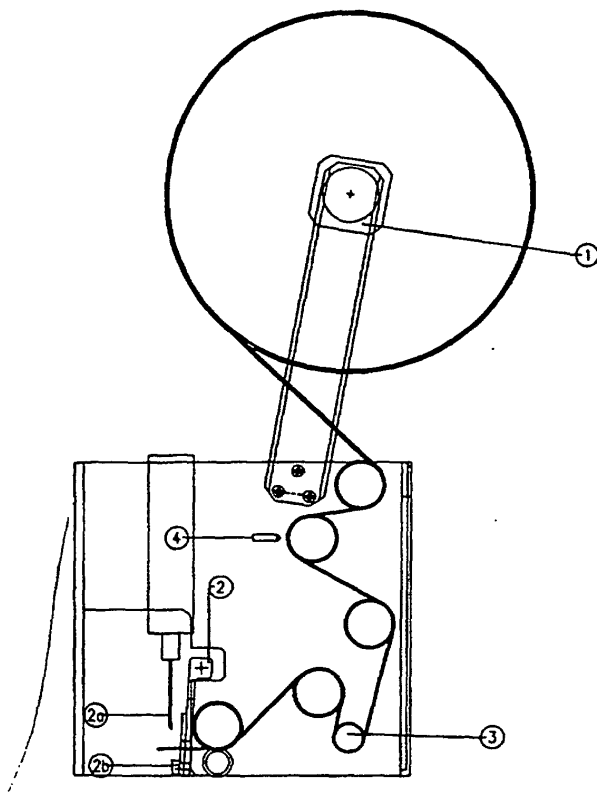


Fig. 2

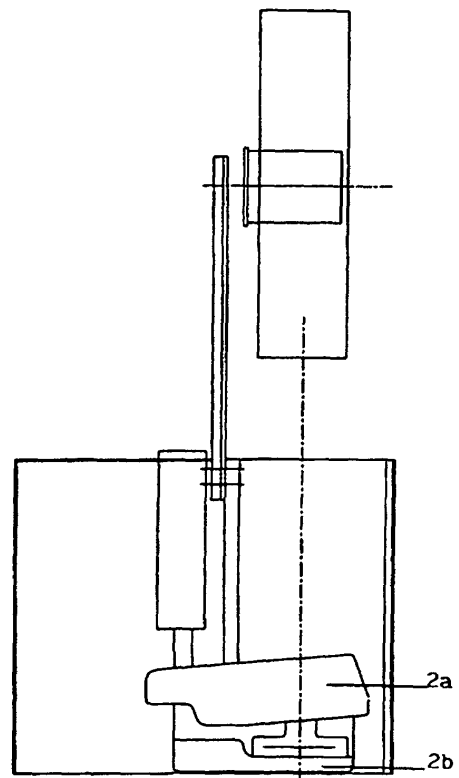


Fig. 2.1



Fig. 2.2

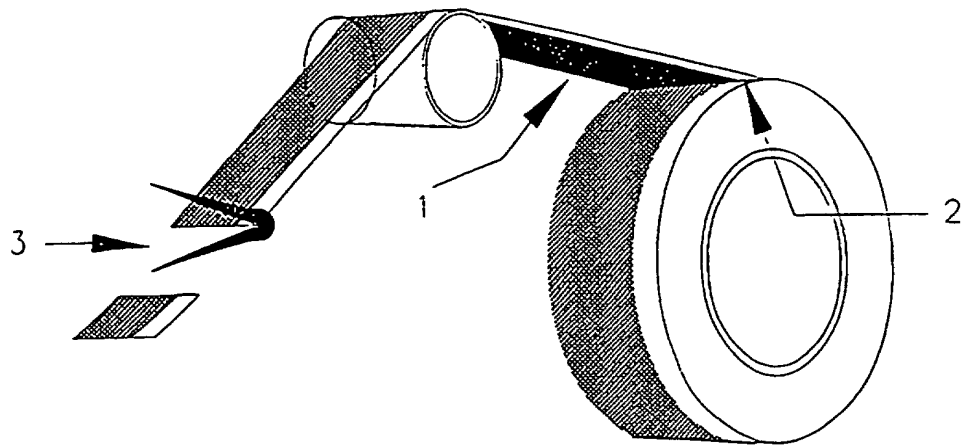


Fig. 3

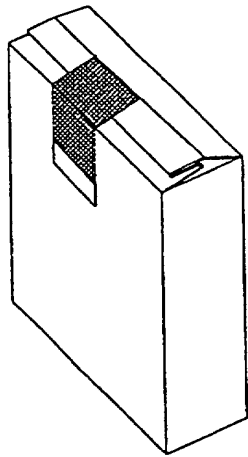


Fig. 3a

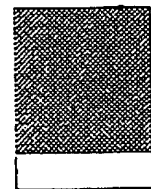


Fig. 3b