METHOD OF MAKING A TEAR-STRIP ENVELOPE

(57) Abstract

This invention teaches a method of making an envelope (12) with a tear-strip (11) formed thereon and more particularly a method of forming on envelope sheet with a tear-strip from flowable state material such as molten plastic (21). At certain preselected times during the envelope manufacturing process, a strip-shaped layer of flowable state material (21) is formed and placed on an envelope sheet. The layer's being in flowable state allows a prompt and intimate bonding between the layer and the sheet. The strip-shaped layer in flowable state subsequently completely hardens on the envelope sheet, and a solid state tear-strip (11) is formed on and securely bonded to the envelope sheet. This method assures a low cost and high speed production of regular paper envelope with tear-strip.
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METHOD OF MAKING A TEAR-STRIP ENVELOPE

BACKGROUND OF THE INVENTION

This is a continuation-in-part of application Serial No. 519,926, filed May 7, 1990.

This invention teaches a method of making an envelope with tear-strip and more particularly a method of forming a tear-strip from a flowable state material.

The idea of adding tear-strips to envelopes dates back several decades. However, the majority of regular-paper envelopes currently in use do not have tear-strips. This is mainly due to the fact that all previous tear-strip envelope inventions rely on methods economically unattractive for low-cost mass production. Prior methods call for attaching tear-strips to envelopes by means of gluing or mechanical securing. The major pitfall of such methods is that the process of adding pre-formed tear-strips greatly slows down the otherwise high-speed production of regular-paper envelopes, therefore raising the production cost above the price level acceptable to consumers.

SUMMARY OF THE INVENTION

In light of the above-mentioned shortcomings of prior tear-strip adding methods, it is desirable to have a method of making regular-paper envelopes with tear-strips at high speed and low cost, by integrating the strip-generation process into existing envelope production lines so that strips may be formed in situ and the speed of production does not decrease significantly. The present invention achieves this objective.

The present invention teaches a method for forming tear-strips on envelopes. The uniqueness of this method lies in the process of strip forming, in which certain substances such as polymers are in a flowable state on envelope sheet prior to the formation
of a solid state tear-strip. This method provides the distinct advantage that a quick and an intimate bonding is achieved between the surface of the sheet and the strip-forming material in flowable state, thus securing the attachment or even penetration of the material into the matrix structure of the envelope sheet. The resulted embedding and penetration of the material in the matrix structure of the envelope sheet assures a superior bonding, and generates a complex structure consisting of the strip-shaped material and the sheet bonded to it. Such a structure is much stronger in tensile strength and, when the tear-strip is pulled, the envelope will be severed along the boundary between the strip-bonded sheet and the flanking normal sheet, thereby achieving the goal of tearing the envelope effectively.

BRIEF DESCRIPTION OF THE DRAWINGS

Notwithstanding any other forms that may fall within its scope, the present invention will become more fully understood from the detailed description given hereinbelow and the drawings which are given by way of illustration only, and thus are not intended to limit the present invention, and wherein:

FIG. 1 is a back view of an envelope with a tear-strip, with the sealing flap of the envelope open;

FIG. 2 shows the same envelope with the flap closed and with part of the tear-strip pulled away from the envelope;

FIG. 3 is a back view of an envelope with a tear-strip. One end of the tear-strip extends beyond the width of the envelope;

FIG. 4 is a cross-sectional view of three tear-strips with different cross-sectional profiles on an envelope sheet;
FIG. 5 is a three dimensional view of an open-face contacting head for forming tear-strips on an envelope sheet;

FIG. 6 is a side view of FIG. 5's head pressed on an envelope sheet in the process of forming a tear-strip;

FIG. 7 is a cross-sectional view of the same;
FIG. 8 is a front view of FIG. 5's head;
FIG. 9 is a cross-sectional view of the same;
FIG. 10 is a side view of a material-dispensing head, continuously shooting flowable state material onto an envelope sheet in the process of forming a tear-strip;
FIG. 11 is a cross-sectional view taken along line F-F' of FIG. 10, showing an opening in the material-dispensing head. The opening gives the tear-strip a non-rectangular cross-sectional shape;
FIG. 12 is a top view of a material-dispensing head for intermittently shooting flowable state material onto an envelope sheet;
FIG. 13 is a side view of the same, with two tear-strips already formed on the sheet and the third strip in transit of traveling down onto the sheet;
FIG. 14 is a bottom view of the applicator head illustrated in FIGS. 12 and 13, showing an opening that defines a long and narrow tear-strip;
FIG. 15 is a side view of a material-dispensing head spraying flowable state material in a cone onto an envelope sheet in the process of forming a tear-strip;
FIG. 16 is a side view of a material-dispensing head draping a strip-shaped layer onto an envelope sheet in the process of forming a tear-strip;
FIG. 17 is a side cross-sectional view of printing tear-strips onto an envelope web by a gravure mechanism;

FIG. 18 is a side cross-sectional view of printing tear-strips onto envelope sheet by a gravure mechanism that includes a transfer roll; and

FIG. 19 is a side view of applying solid-state powder to an envelope sheet, melting the powder on the sheet, and forming a solid-state tear-strip on the envelope sheet.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

At certain times during the envelope manufacturing process, a strip-shaped layer of flowable state material is formed and placed on a sheet, which is either a part of an already formed envelope or is later converted into at least one envelope. The layer's being in a flowable state allows a prompt and an intimate bonding between the layer and the sheet. The flowable state material may also penetrate into the matrix structure of the envelope sheet. The strip-shaped layer of flowable state material later completely hardens on the sheet. Therefore a solid state tear-strip is formed on the sheet and securely bonded to the sheet. No additional adhesive is necessary. For certain high tensile strength materials such as polyester or nylon 66, a tear-strip of a few millimeters in width may be as thin as 1 mil, i.e., 1/1000 of an inch, and still give the tear strength of a few pounds, which is strong enough to tear open an envelope of regular paper. Due to the very thin thickness, the strip-shape layer of most flowable state material such as molten polyester hardens fast. The method of using flowable state material to directly form solid state tear-strips on envelope sheet assures high-speed and low-cost production for regular-paper commercial envelopes. The
completely hardened tear-strip may be rigid, or very pliable, as foldable as regular paper sheet.

The strip-shaped layer of flowable state material may be formed and placed on an envelope sheet by applying flowable state material to the sheet. The flowable state material may be applied by means of squeezing, shooting or jet printing, spraying, draping, printing including gravure printing, some other means, or a combination of these means. The layer of flowable state material may also be formed and placed on the sheet by converting into flowable state a certain configuration of solid state material already placed on the sheet or traveling onto the sheet. Such configuration may be a layer of powder, a strip of solid state material, or other forms.

FIG. 1 shows a back view of an envelope 10, made from sheet 12, with the sealing flap of the envelope open and a tear-strip 11 fully visible. FIG. 2 is the same envelope with the sealing flap closed and with the tear-strip 11 partially torn away from the envelope. To facilitate pulling, a pull tab 13 and a notch 14 may be made on one or both ends of the flap. FIG. 3 shows an envelope similar to that in FIG. 1 and FIG. 2, with one end of strip 11 and the accompanying pull tab 13 extending beyond the width of the envelope.

FIG. 4 is a cross-sectional view of three examples of different cross-sectional profiles of tear-strips 11 on envelope sheet 12.

It is not difficult for those skilled in related fields to work out a specific engineering design to apply the flowable state material to the sheet. Here an example is given for the squeezing application. FIG. 5 to FIG. 9 show an example of an open-face contacting head 20 for squeezing and forming tear-strips 11 on sheet 12. Molten plastic coming out of an extruder
flows into reservoir 21. The reservoir allows flowable state material to contact sheet 12 and to form an intimate bonding resulting from embedding and surface complementation between the sheet and the flowable state material, most of the time even causing part of the flowable state material penetrating the matrix structure of fibers constituting sheet 12. Strip-forming notch 22 allows the formation of strip 11, as head 20 and sheet 12 move in opposite directions with respect to each other as shown and as molten plastic under certain pressure in reservoir 21 is squeezed out or pulled out of notch 22. The sheet may move at a speed that is higher than the speed the material is squeezed out through notch 22, resulting in the "dragging out" of the flowable state material. The pulling action of "dragging out" may greatly increase the formation speed of the strip without requiring a substantial increase in the hydro-pressure in reservoir 21. Also advantageously, the dragging motion may promote a better molecular orientation within the strip so as to increase the tensile strength of the strip. Several applicator heads may be used to form a plurality of tear-strips on one or both sides of the envelope sheet.

As an example of applying molten material by means of shooting or jet printing, FIG. 10 shows a side view of the material-dispensing head 23, continuously shooting a thin stream of flowable state material onto a sheet 12 to form a tear-strip 11. FIG. 11 is a cross-sectional view taken along plane F-F' in FIG. 10, showing an opening 24 in the head. The shape of the opening 24 may be designed to achieve a desired cross-sectional profile for tear-strips. The stream coming out of opening 24 with certain momentum hits the web sheet 12 at a preferred angle. The relative motion between the head and the sheet may be achieved by either
having both the head and the sheet move or having one move and the other stationary. To form the strip non-
continuously, valves such as a needle valve inside the head may be employed.

FIG. 12 is a top view of another material-
dispensing head 23 for intermittently shooting separate strips of flowable state material onto envelope sheet
12. The relative movement between sheet 12 and head 23, coupled with intermittent shooting, results in the
formation of tear-strips 11. FIG. 13 shows a somewhat enlarged side view of the same components as in FIG. 12, illustrating a strip-shaped layer of flowable state material being shot from head 23 toward sheet 12, while two tear-strips are already formed on the sheet as shown. FIG. 14 shows the bottom view of the head 23 in FIG. 12 and FIG. 13, illustrating an opening 24 in the material-dispensing head. The opening gives the tear-
strip a long and narrow shape.

As an example of a spraying application, FIG.
15 shows a side view of spraying flowable material in a narrow cone from a material-dispensing head 23 onto sheet 12. The flowable state material sprayed and deposited on the envelope sheet forms a tear-strip 11, as the head and the envelope sheet move in opposite
direction as shown.

Still another means to apply flowable state material is draping. FIG. 16 shows a side view of one such embodiment where a material-dispensing head 23 extrudes a strip-shaped layer of flowable state material and drapes this layer onto a relatively-moving envelope sheet 12 to form a tear-strip 11. The draped layer and the envelope sheet have a preferred angle to achieve the best bonding result.

Still another means to apply molten material is printing, such as gravure printing. FIG. 17 and FIG.
18 show two embodiments. FIG. 17 is a side cross-sectional view of printing tear-strips 11 onto envelope web sheet 12 by a gravure mechanism. Sheet 12 moves with a web roll 25 and contacts an engraved roll 26 in the process. The engraved roll 26 has a plurality of strip-forming engravements 29 which, when passing through reservoir 21, pick up flowable state material. After excess material is removed by a wiping blade 28, a strip-shaped layer 11 is formed within the engravement 29 and is then transferred onto sheet 12. FIG. 18 is a side cross-sectional view of a process similar to that in FIG. 17, except that tear-strips 11 are printed onto sheet 12 by a gravure mechanism via a transfer roll 27. Using gravure printing mechanism, tear-strips with different orientation, length, width, and thickness can be easily formed on envelope sheet.

As an example of forming a strip-shaped layer of a flowable state material onto an envelope sheet by converting solid state material into flowable state, solid state powder may be transferred to an envelope sheet. The powder may be treated by melting means such as infrared or microwave radiation in order to convert into a flowable state, either during traveling onto the sheet or after deposit on the sheet. Powder may also be sprayed onto pre-heated areas on the sheet and melted in situ. FIG. 19 shows the side view of a material dispensing head 23 spraying solid state powder in a narrow cone onto envelope sheet 12. The strip-shape layer of power formed on sheet 12 goes through heat radiation emitted from converting source 30. The layer of powder turns into a layer of flowable state material, and subsequently hardens and forms the solid-state tear-strip 11 on envelope sheet 12. The powder may also be applied to envelope sheet by other application means.
The flowable state material may be molten materials such as molten plastics, or room temperature flowable materials. The material may be a compound, mixture of materials, or solutions. The material may be those that respond to or are sensitive to hardening means, such as ultraviolet radiation, catalysts, or cross-linking reagents.

During flowable state material's traveling in air or vacuum, such as in the shooting, gravure printing, draping, and spraying applications, a thin surface layer of the flowable state layer might harden before the material contacts the sheet. This thin surface layer's hardening does not in the end prevent a good bonding between the tear-strip and the sheet because the deposited strip-shaped layer as a whole is still in a flowable state. To improve bonding, various auxiliary means can be employed, such as adjusting flowable state material's viscosity, giving the material bigger momentum toward the sheet, exerting bigger hydro-pressure on the flowable state material, using pressing roller to roll over and press the flowable state strips on the sheet, and pre-heating the areas on the sheet where the material will be applied. To speed up the hardening process of the flowable-state strips on envelope sheet, various hardening means may be employed. For example, molten strips may be cooled by air ventilation, tiny-diameter water stream jetted on the strip, and heat-conducting pressing roller with a lower temperature than the molten strips. Radiations including ultraviolet light, ultrasound, and microwaves can all be used on those flowable-form materials that harden faster upon the radiations.

Before it completely solidifies, the flowable form strip's cross-sectional shape may deform a little bit. For example sharp corners may be rounded somewhat.
The word "flowable" in this file does not mean that the strip-shape layer of flowable form material must flow before it completely hardens. The layer may not change its position on the sheet before it completely hardens.

The application of flowable state material and the formation of the strip-shaped layer may be simultaneous such as in the squeezing application shown in FIG. 7. The strip-shape layer may also be formed first and then transferred to an envelope sheet as in the gravure printing case.

To facilitate tearing, embossing the tear-strip, weakening the sheet around the strip using mechanical or chemical means, making scored lines on the sheet around the strip, and perforating or partially cutting the sheet can all be used. Each strip may have a different width and thickness for different sections of the strip such as shown in FIG. 1 and FIG. 4. The tear strip may be on any flap of an envelope or on the front panel. The envelope sheet may be paper, plastic, or other materials. The sheet may be a multi-ply sheet, with different material for each ply.

Whereas preferred embodiments of the present invention have been illustrated and described in detail, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the scope or spirit of this invention.
WHAT IS CLAIMED IS:

1. A method of making envelope with tear-strips, including steps of:
   (a) forming a strip-shaped layer of flowable state material, said layer being placed at a pre-selected position on a sheet,
   (b) allowing said layer to bond to said sheet and to harden on said sheet,
   (c) converting said sheet into at least one envelope, each said envelope having at least one tear-strip thereupon at a preferred position.

2. A method as claimed in claim 1, wherein said layer is formed by squeezing said flowable state material through an opening onto said sheet.

3. A method as claimed in claim 1, wherein said layer is formed by shooting said flowable state material onto said sheet.

4. A method as claimed in claim 1, wherein said layer is formed by spraying said flowable state material onto said sheet.

5. A method as claimed in claim 1, wherein said layer is formed by draping said flowable state material onto said sheet.

6. A method as claimed in claim 1, wherein said layer is formed by printing said flowable state material onto said sheet.

7. A method as claimed in claim 6, wherein said printing is realized by means of a gravure mechanism.

8. A method of making envelope with tear-strips, including steps of:
   (a) forming a strip-shaped layer of flowable state material by converting a configuration of solid state material into a flowable state, said layer being placed at pre-selected position on a sheet,
(b) allowing said layer to bond to said sheet and to harden on said sheet,
(c) converting said sheet into at least one envelope, each said envelope having at least one tear-strip thereupon at a preferred position.

9. A method as claimed in claim 8, wherein said configuration is powder.
**INTERNATIONAL SEARCH REPORT**

**International Application No.** PCT/US91/03075

### I. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or to both National Classification and IPC

**IPC(5):** B31B 1/90
**US CL.:** 493/212, 216, 923

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Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched

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### IV. CERTIFICATION

**Date of the Actual Completion of the International Search**

24 JULY 1991

**Date of Mailing of this International Search Report**

07 AUG 1991

International Searching Authority

ISA/US

Signature of Authorized Officer

[Signature]

JACK W. LAVINDER

Form PCT/ISA2/210 (second sheet) (Rev.11-87)