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(54) Thermal seal product and process

(57) A heat sealable mailer form is provided comprising a sheet (10) which includes on at least one of its major surfaces a pattern of adhesive (16) which is not activated by the heat and pressure rolls of a non-impact printer but which is activated by the application of additional heat and pressure after printing of the sheet. The adhesive (16) comprises a thermoplastic adhesive and a filler and is preferably coated on the peripheral edges of the sheet. The sheet (10) is folded and sealed by the application of heat and pressure to the adhesive covered areas of the sheet.

EP 0 719 656 A2

Description

This invention relates to a method and apparatus for sealing mailers or other business forms, and more particularly to a single ply product containing a pattern of a heat activatable adhesive on one or both of its surfaces. After the sheet has been printed using an impact or non-impact printer, the sheet may be folded and sealed by the application of heat and pressure to the adhesive-covered areas of the sheet.

In recent years, mailers and other business forms have been developed for printing in high speed impact printers which use ribbons for printing. Such forms are typically single-ply continuous forms having variable information printed on one surface of the form. During the manufacture of such forms, hot-melt adhesive is typically applied at selected marginal edges of the forms for later use in sealing the forms. After printing, the forms are folded and then passed through a device which applies heat and pressure, activating the hot-melt adhesive and causing the folded plies to be sealed together along their common marginal edges.

However, with the advance of intelligent copier and printer technology, business forms and mailers are now printed on a wide variety of commercial printing devices which are faster, quieter, and more reliable than traditional mechanical impact printers. Laser printers are an example of a non-impact printing device. Such printers utilize a toner image which is fused onto paper by a combination of heat and pressure. However, mailers and business forms which utilize hot melt adhesives for sealing are not suitable for imaging in laser printers because the high temperatures required to fuse the toner particles to the paper also melt the adhesives on the paper, which then become tacky and stick to the surfaces of the printer's toner fusing roll and document transport systems, resulting in document jams and adhesive contamination of the printer.

An alternative method of sealing in the art involves the use of a water-based adhesive which is applied to selected marginal edges of a form or mailer just prior to folding. Another known method includes the use of a remoistenable adhesive which is applied to a form and then moistened prior to folding and sealing. Both of these methods give inconsistencies in seal quality due to inherent variations in applying liquids to paper and drying the product uniformly.

Another alternative method of sealing involves the use of a self-adhesive or pressure seal adhesive made from a natural rubber latex dispersed in water. When applied to a substrate surface and dried, a film is formed which will not bond on contact with paper and other surfaces, but will bond on contact with another film of the same material when moderate pressure is applied. Such adhesives are heat resistant and, if properly formulated, their surfaces do not become tacky when heated. However, pressure seal adhesives have not been widely used to seal mailers during in-line processing because silicone oil from the fuser rolls of non-impact printers is deposited on to the adhesive film surfaces, hindering the bond strength of one adhesive film to another. In-line processing encompasses the printing, folding, inserting of other documents and sealing of mailers in a continuous operation. But, because the deposited silicone oil is absorbed very slowly into the paper, it may require a wait of up to 24 hours before the mailer can subsequently be sealed. Chao, U.S. Patent No. 5,314,944 and Sakai, U.S. Patent No. 4,918,128, which teach pressure-seal adhesives, disclose the use of a filler such as silica to absorb the silicone oil. However, if too much filler is used, the self-adhesing strength of the adhesive is compromised, while too little results in insufficient oil absorption, also affecting adhesive strength.

More recently, a thermally activatable adhesive has been used to seal mailers or forms which may be activated by heat and pressure. Such an adhesive is disclosed in European Patent Nos. 291897 and 257545 to Drescher and comprises a thermoplastic adhesive and a filler. The adhesive is coated onto the entire surface of the form prior to the printing process, and can be processed through laser printers without activating the adhesive. The adhesive may then be activated after printing by the use of heat and pressure at selected areas, for example, at the edges of a folded mailer sheet. However, because the adhesive is fully coated over the entire surface of the sheet, when heat and pressure are applied, the sheet is sealed together wherever the adhesive is in contact with itself. For example, when an exterior edge is sealed, an interior folded surface beneath that edge also becomes sealed, resulting in undesired sealed portions which must be peeled apart when the mailer is opened. When peeling such sealed portions apart, printed information on the surface of the mailer may be damaged. In addition, the use of a full coat adhesive is not cost-effective as only a small portion of adhesive on the sheet is activated.

Accordingly, there is still a need in the art for a business form design and adhesive for use on a mailer or business form which may be processed in a non-impact printer without being activated by the heat and pressure rolls of the printer, which may be sealed in only selected areas during in-line processing, and which provides an effective bond only in the desired areas of the form.

The present invention meets that need by providing a heat sealable mailer form and method in which a thermal activated adhesive is applied in a pattern to a surface of the form so that the form may be printed in a non-impact printer and then sealed during in-line processing. The resulting adhesive bond is strong and tamper-resistant. The present invention is applicable to all non-impact printing processes, including but not limited to laser, magnetographic, ion deposition printing where heat and pressure is utilized to transfer or fuse toner particles to a substrate. Of course, it may also be used in other types of printing as well such as impact.

In accordance with one aspect of the present invention, a heat sealable mailer form adapted to be printed on a non-impact printer is provided comprising a sheet having first and second major surfaces. At least one of the major surfaces of the sheet has applied thereto a pattern of an adhesive which is applied over less than the entire surface of the sheet. The adhesive is not activated by the heat and pressure rolls of a non-impact printer, but is activated, after printing at least one of the surfaces of the form, by the application of additional heat and pressure which seals the adhesive-covered areas of the sheet to itself.

The adhesive preferably comprises a thermoplastic adhesive
selected from the group consisting of homopolymers or copolymers of vinyl acetate, copolymers of vinyl acetate-maleic acid-di-n-butyl ester, copolymers of vinyl chloride and vinyl acetate, copolymers of vinylidene chloride and acrylonitrile, and terpolymers of acrylonitrile, n-butyl acrylate and styrene. The adhesive also includes a filler selected from the group consisting of inorganic pigments, waxes, and starches. The filler functions to absorb silicone oil from the fuser rolls of a non-impact printer such as a laser printer so that the oil will not interfere with the bonding of the adhesive.

In a preferred embodiment of the invention, the adhesive as applied to the substrate comprises from about 30 to 40% by weight water, 5 to 15% talc, 10 to 20% by weight calcium carbonate, from 35 to 45% by weight of a terpolymer of acrylonitrile, n-butyl acrylate and styrene, and from 0.1 to 0.5% carboxymethylcellulose. Preferably, the pattern of adhesive is applied along the peripheral edges of the sheet. The sheet may then be folded and sealed along its peripheral edges by the application of heat and pressure.

The sheet may optionally include printed indicia on at least one of its major surfaces. The sheet may also include a cut out window with or without a transparent patch so that when it is folded and sealed, a portion of the printed indicia, such as address information, is visible through the cut out window.

In a preferred embodiment of the invention, the sheet comprises first, second and third sections which are separated by fold lines so that the sheet may be folded in thirds and sealed. Preferably, the pattern of adhesive is applied along at least one peripheral edge of the first and second sections of the sheet, and along at least one peripheral edge of the third section of the sheet such that the sheet may be folded along the fold lines and heat sealed at the peripheral edges of the sheet. In an alternative embodiment of the invention, the third section of the sheet may be removed from the form by tearing along a perforated fold line.

A method of making a sealed mailer product is also provided which generally comprises the steps of providing a sheet having first and second major surfaces, and applying to at least one of the major surfaces a pattern of an adhesive which is not activated by the heat and pressure rolls of a non-impact printer but which is activated after printing at least one of the surfaces by the application of additional heat and pressure to seal the sheet to itself. After the adhesive has dried, at least one major surface of the sheet may be printed using a non-impact printer with fusible toner which is then fused to the sheet. The sheet is then folded and sealed by applying heat and pressure to the adhesive covered areas of the sheet. The resulting adhesive bond provides a strong, tamper-proof seal which prevents the mailer from being resealed once it has been opened.

Accordingly, it is a feature of the present invention to provide a heat sealable mailer form having a pattern of adhesive applied to its surface which enables the form to be printed in a non-impact printer without being activated and which may be sealed thereafter by the application of additional heat and pressure. It is a further feature of the invention to provide a method of making a sealed mailer product having a strong adhesive bond. These, and other features and advantages of the present invention will become apparent from the following detailed description, the accompanying drawings, and the appended claims.

In order that the invention may be more readily understood, reference will now be made by example to the accompanying drawings, in which:

Figs. 1 and 1A are plan views of a sheet product in accordance with the present invention;
Fig. 2 is a front plan view illustrating the folded, sealed mailer product of the present invention;
Fig. 3 is a schematic representation of the printing, folding and sealing steps of the present invention; and
Fig. 4 is a schematic perspective view of a device for folding and sealing the sheet product of the present invention.

The preferred heat sealable mailer form of the present invention is illustrated in Figs. 1 and 1A and comprises a sheet 10. The sheet has first and second major surfaces 12 and 14 which are illustrated respectively by Figs. 1 and 1A. At least one of the major surfaces of the sheet has applied thereto a pattern of an adhesive 16. As shown, that pattern may comprise lines of adhesive located along peripheral edges of the sheet.

The adhesive comprises a thermoplastic adhesive which may include homopolymers or copolymers of vinyl acetate, copolymers of vinyl acetate-maleic acid-di-n-butyl ester, copolymers of vinyl chloride and vinyl acetate, copolymers of vinylidene chloride and acrylonitrile, and terpolymers of acrylonitrile, n-butyl acrylate and styrene. The adhesive also includes a filler selected from the group consisting of inorganic pigments, waxes, and starches. The filler functions to absorb silicone oil from the fuser rolls of a non-impact printer such as a laser printer so that the adhesive seals immediately upon the application of heat and pressure. Suitable fillers

include calcium carbonate, titanium dioxide, barium sulphate, magnesium carbonate, aluminum oxide, talc, clay, calcium silicates, cellulose powder, carboxyl methyl cellulose, starch, polyethylene waxes, polyolefin waxes, and ester waxes.

The preferred adhesives for use in the present invention are taught in European Patent No. 257545 to Drescher, the disclosure of which is hereby incorporated by reference. The preferred adhesive composition comprises from about 30 to 40% by weight water, 5 to 15% talc, 10 to 20% by weight calcium carbonate, from 35 to 45% by weight of a terpolymer of acrylonitrile, n-butyl acrylate and styrene, and from 0.1 to 0.5% carboxymethylcellulose.

Such self-adhesives are resistant to sticking to printer contact surfaces when exposed to temperatures used for fusing toner particles in a non-impact printing device, but may thereafter be heat activated by the applications of additional heat and pressure in a sealing apparatus in order to be self adhering.

As shown in Figs. 1 and 1A, the adhesive 16 is preferably applied to the peripheral edges of the sheet in a pattern such that less than 5% of the paper surface is covered with the adhesive. A preferred method of applying the adhesive is through the use of a flexographic applicator (i.e., a flexographic print station) followed by an in-line dryer to evaporate moisture from the adhesive. By printing the adhesive as a pattern rather than a full coat, significantly less adhesive is required, and an effective bond is achieved without sealing undesired portions of the mailer together. This arrangement also allows the sheet to be easily sealed by folding the sheet so that its peripheral edges align, and applying heat and pressure to the peripheral edges. Further, the pattern of applied adhesive may be readily changed depending upon the design of the mailer.

However, while the drawings in Figs. 1 and 1A show the adhesive at the peripheral edges of a "Z" fold mailer, it should be appreciated that the adhesive may be applied in a number of different patterns on any convenient areas of the sheet consistent with the design and use of the forms or mailers.

As shown in Fig. 1, the sheet preferably includes perforations 18 located inside at least one of the peripheral edges of the sheet so that the sealed edges may be removed for opening of the mailer. The sheet may also include printed indicia 20 on at least one of its major surfaces. In addition, the sheet may include a cut out window 30 (see Fig. 2) so that when it is folded and sealed, a portion of the printed indicia, such as address information, is visible through the cut out window.

In a preferred embodiment of the invention, the sheet comprises first, second and third sections 22, 24 and 26 which are separated by fold lines 28 so that the sheet may be folded in thirds and sealed. As shown in Fig. 1, the adhesive 16 is preferably applied along both peripheral edges of the first and second sections 22, 24 of the sheet as well as one end of the sheet. As shown in Fig. 1A, the adhesive 16 is also applied along both peripheral edges of the third section 26 on the second surface 14 of the sheet. By applying adhesive in this manner to portions of the first and second surfaces of the sheet, the sheet may be folded in thirds along the fold lines and sealed at its peripheral edges.

In one embodiment of the invention, the third section 24 of the sheet 10 may be removed from the form by tearing along the perforated fold line. For example, the third section may contain printed information which is to be retained by the originator of the form. The remaining portion of the sheet may then be folded in half along fold line 28 and sealed.

Fig. 2 illustrates one embodiment of the folded and sealed mailer product of the present invention. As shown, the mailer includes an optional cut out window 30 through which printed indicia 20 containing address information is visible.

Fig. 3 illustrates a method of making one embodiment of the sealed mailer product of the present invention which comprises the steps of providing a sheet 10 having first and second major surfaces, and applying to at least one of the major surfaces a pattern of adhesive 16. The adhesive is preferably applied by a flexographic applicator at a coating weight of about 8 g/m^2. The adhesive may then be dried in-line by a number of conventional methods including radio frequency, hot roll, infrared, or forced hot air. At least one major surface of the sheet is then printed with indicia 20 using most commonly a non-impact printer 34 having fusible toner. If desired, the sheet may be passed through the printer a second time to print additional indicia such as address information on the second surface of the sheet. The toner is then fused to the sheet. The sheet is then passed through a folding apparatus 36 which folds the sheet along the folding lines 28. Finally, a sealing apparatus 38 applies heat and pressure to the adhesive covered peripheral edges of the sheet to activate the adhesive and seal the sheet.

Fig. 4 schematically illustrates a typical folding and sealing apparatus which may be used for the sheet product of the present invention. The sheet 10 having indicia (not shown) already printed thereon is advanced through a folding station 40, and is then advanced between Teflon® covered shoes 42 which are heated to a temperature of about 120°C to activate and soften the adhesive. The sheet is then sealed by advancing the sheet through feed rollers 44 and 46, which apply a pressure of about 200 Newtons for about 1 second to seal the folded sheet. The folded sheet is then rotated and passed through a second set of shoes 42 and feed rollers 48 to seal the remaining peripheral edges of the mailer.

The sheet product of the present invention may have a variety of potentially useful applications. For example, the present invention may be used to seal mailers or business forms printed with a laser or other non-impact printer without the need for conventional hot melt

adhesives or pressure seal adhesives. The adhesive forms a strong bond which can only be broken through fiber tearing of the paper.

While certain representative embodiments and details have been shown for purposes of illustrating the invention, it will be apparent to those skilled in the art that various changes in the methods and apparatus disclosed herein may be made without departing from the scope of the invention, which is defined in the appended claims.

Claims

1. A heat and pressure sealable mailer form adapted to be printed on a non-impact printer, said form comprising a sheet (10) having first and second major surfaces (12,14), at least one of said major surfaces having a pattern of an adhesive (16) applied thereto which covers less than the entire surface of said sheet (10), said adhesive (16) not being activated by the heat and pressure rolls of a non-impact printer and not adhering to any parts of said non-impact printer during printing of said sheet but sealing to itself upon the application of heat and pressure after said form is folded to present at least one adhesive to adhesive surface.

2. A mailer form as claimed in claim 1 wherein said adhesive (16) comprises a thermoplastic adhesive selected from the group consisting of homopolymers or copolymers of vinyl acetate, copolymers of vinyl acetate-maleic acid-di-n-butyl ester, copolymers of vinyl chloride and vinyl acetate, copolymers of vinylidene chloride and acrylonitrile, terpolymers of acrylonitrile, n-butyl acrylate and styrene, and a filler selected from the group consisting of inorganic pigments, waxes, and starches.

3. A mailer form as claimed in claim 1 wherein said adhesive (16) is applied as an aqueous solution comprising from about 30 to 40% by weight water, 5 to 15% talc, 10 to 20% by weight calcium carbonate, from 35 to 45% by weight of a terpolymer of acrylonitrile, n-butyl acrylate and styrene, and from 0.1 to 0.5% carboxymethylcellulose and then dried.

4. A mailer form as claimed in claim 1 wherein said pattern of said adhesive (16) is applied along the peripheral edges of said sheet (10), and wherein said sheet is folded and sealed along its peripheral edges.

5. A mailer form as claimed in claim 1 wherein said sheet (10) includes a window (30) and printed indicia (20) on at least one major surface thereof, and wherein said sheet (10) is folded and sealed along at least one peripheral edge thereof such that a portion of said printed indicia (20) is visible through said window (30).

6. A mailer form as claimed in claim 1 wherein said sheet (10) comprises first, second and third sections (22,24,26) which are separated by perforated fold lines (28).

7. A mailer form as claimed in claim 6 wherein said first major surface (12) of said sheet (10) has applied thereto a pattern of said adhesive (16) along at least one peripheral edge of said first and second sections (24,26) of said sheet.

8. A mailer form as claimed in claim 7 wherein said second major surface (14) of said sheet (10) has applied thereto a pattern of said adhesive (16) along at least one peripheral edge of said third section (26) of said sheet.

9. A mailer form as claimed in claim 8 wherein said sheet (10) is folded along said fold lines (28) and heat sealed at the peripheral edges of said sheet.

10. A mailer form as claimed in claim 6 wherein said third section (26) of said sheet (10) is removable from said form by tearing along a perforated fold line (28).

FIG -1

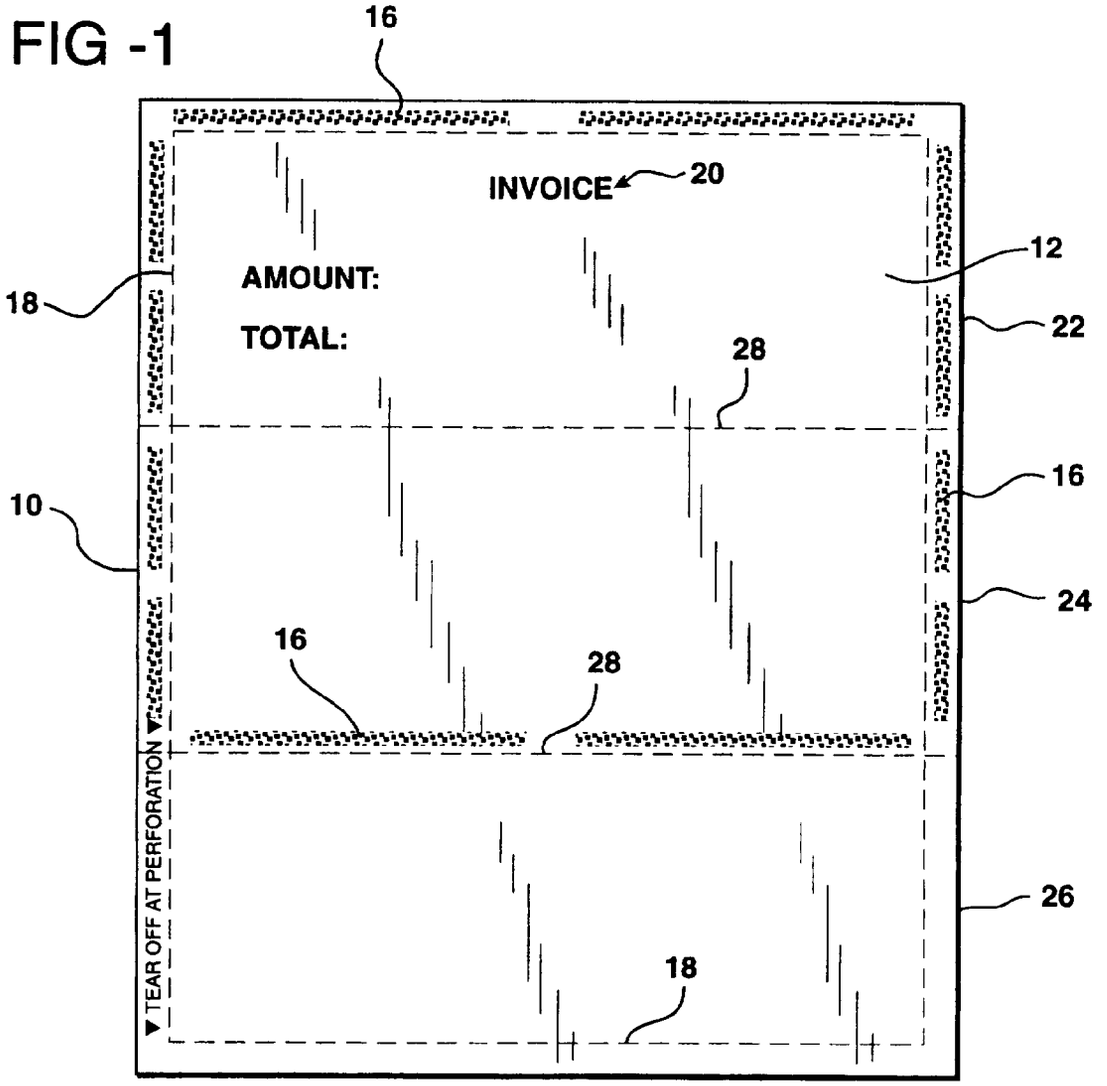

16
INVOICE
20
AMOUNT:
TOTAL:
12
18
22
28
10
16
24
16
28
▼TEAR OFF AT PERFORATION▼
26
18

FIG -2

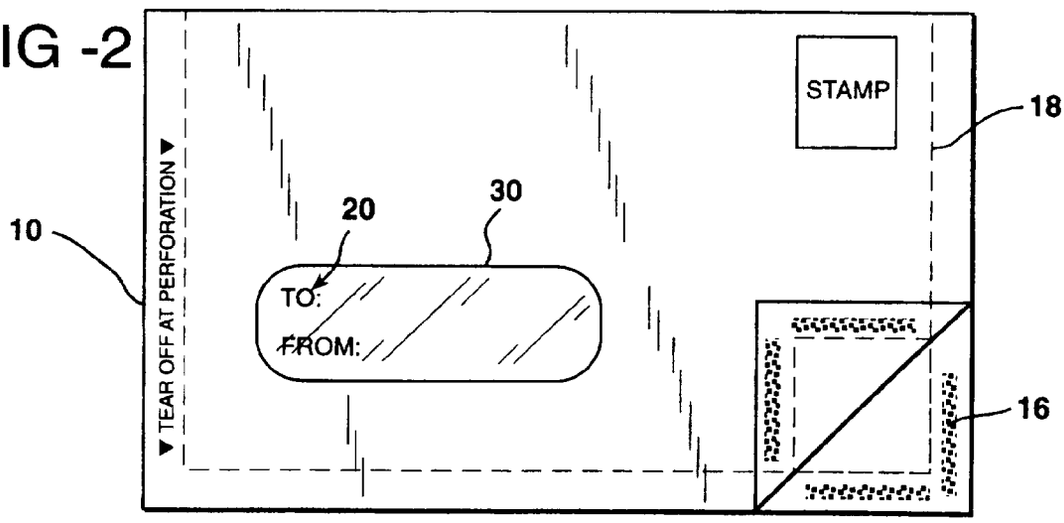

STAMP
18
30
20
10
TO:
FROM:
▼TEAR OFF AT PERFORATION▼
16

FIG -1A

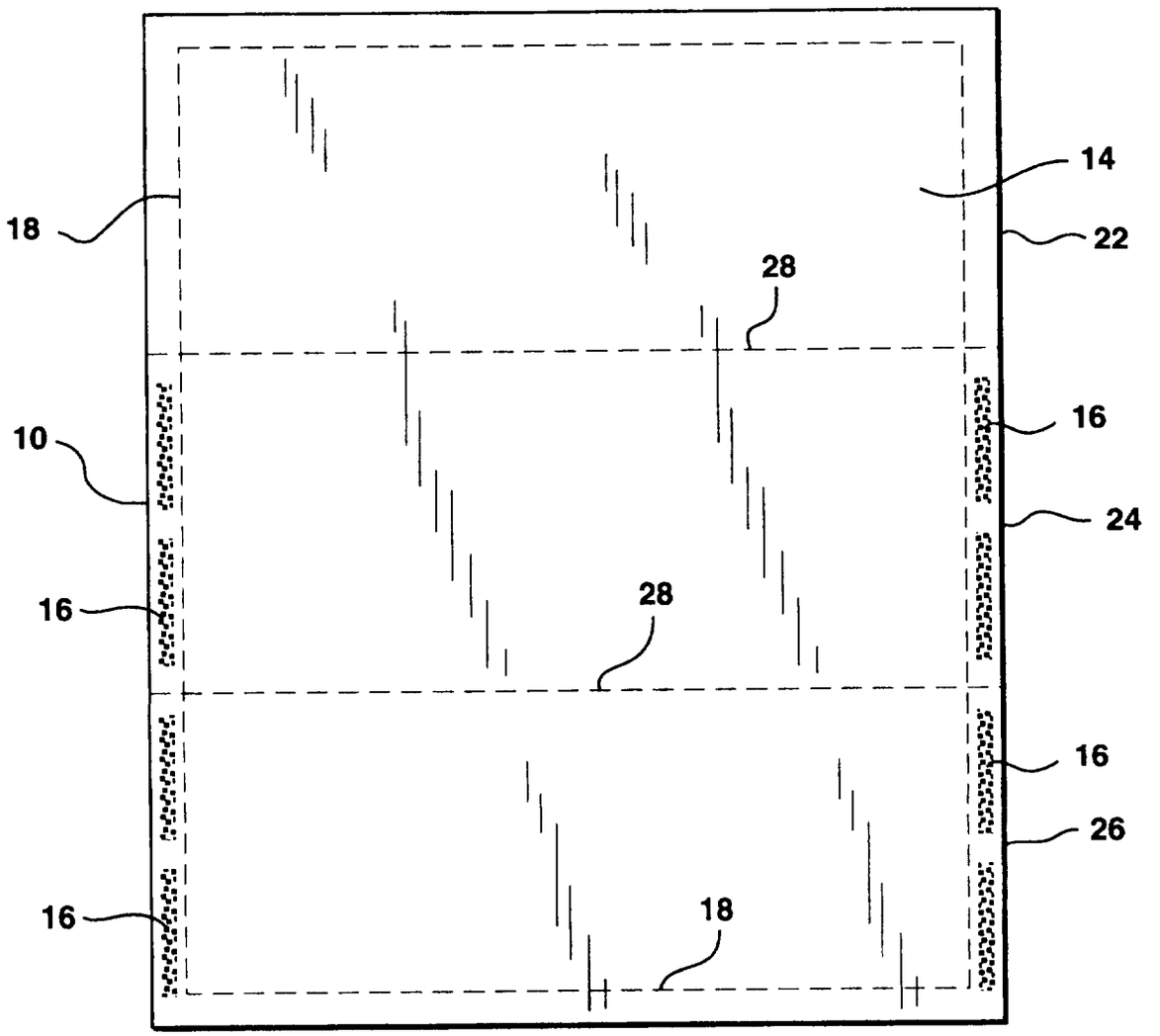
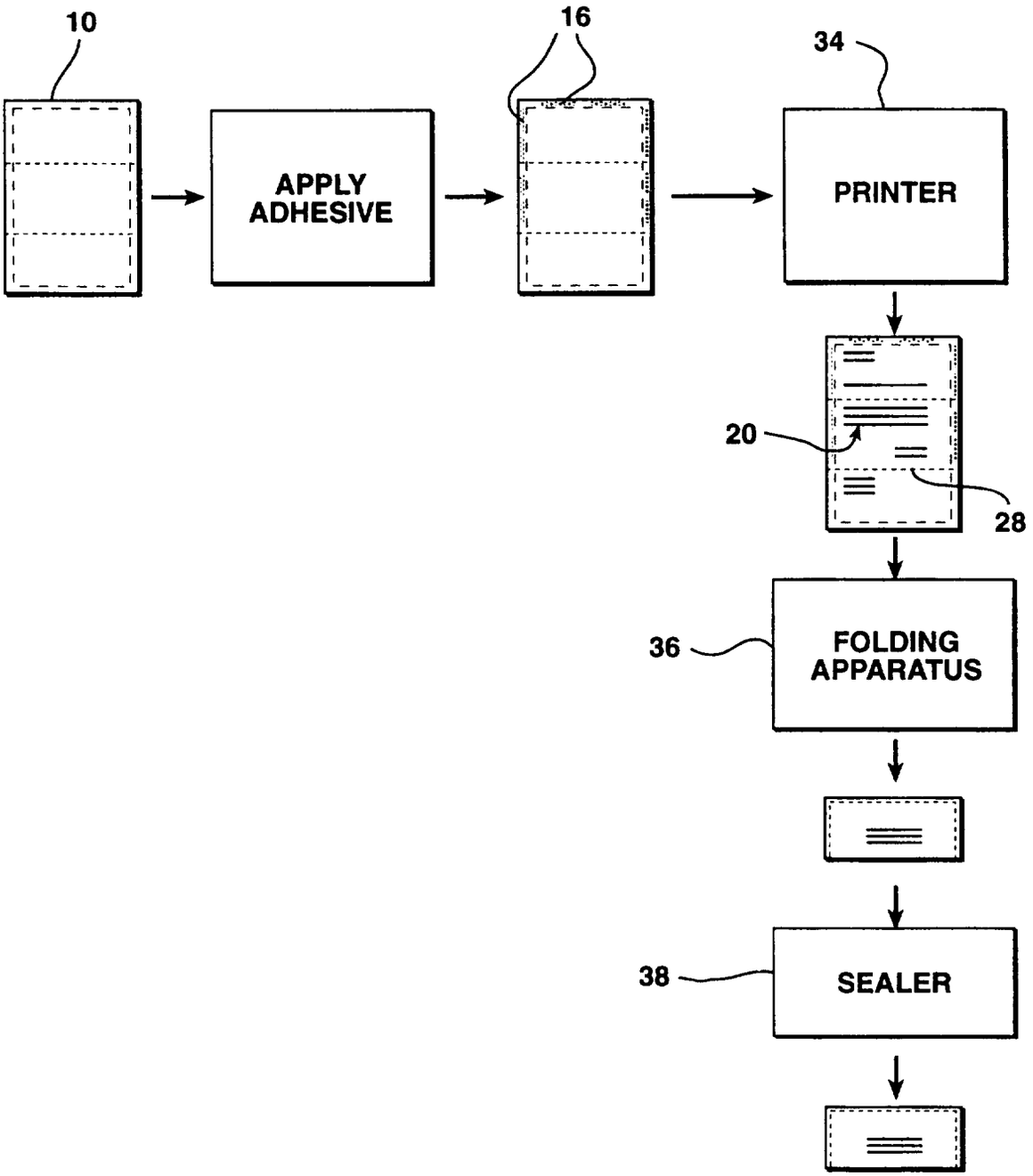


FIG -3


10
APPLY ADHESIVE
16
34
PRINTER
20
28
36
FOLDING APPARATUS
38
SEALER

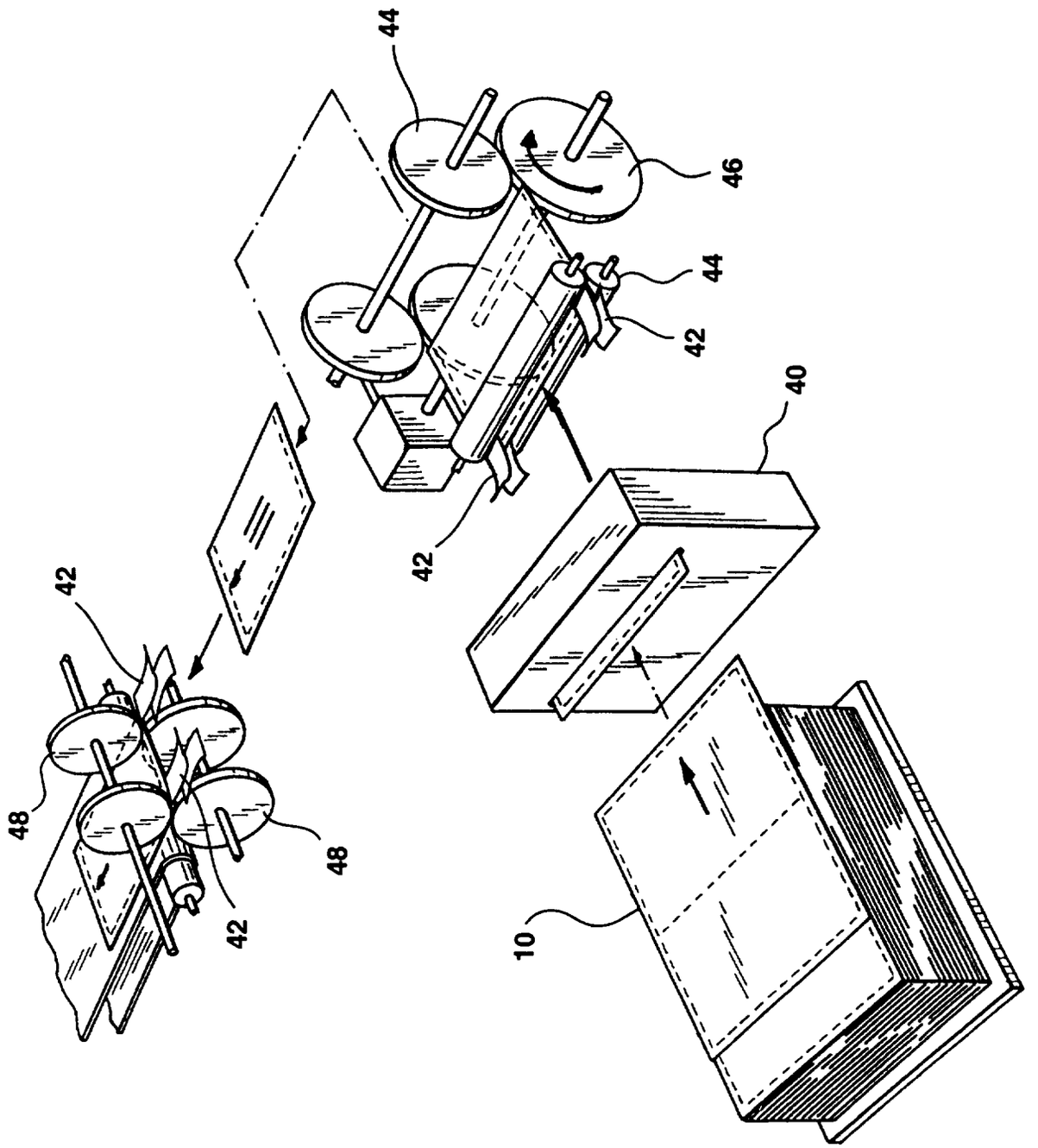


FIG -4