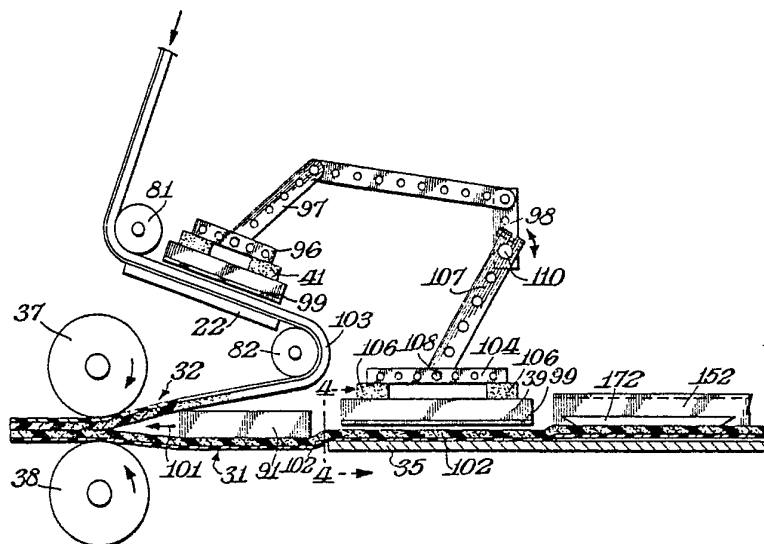


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(54) Title: WRAPPING



(57) Abstract

Heat sealing of wrapper laminates (31, 32) made of foam (102) supported by a porous substrate sheet is improved by coating on the foam-engaging face of the substrate a barrier layer such as polyvinylalcohol to keep the foam (102) when melted from bleeding through the substrate. The support for the foam can alternatively be non-porous film such as polyethylene terephthalate. In a cold sealing embodiment the foam face of supported foam wrappers has a cohesive-nonadhesive layer which can contain improved volatile corrosion inhibitor and/or antistat compositions that do not shorten its shelf life below about six months. One such composition is a mixture of dicyclohexylamine with 2-amino-2-lower-alkylpropadiol-1,3. Protective colloid such as polyvinylpyrrolidone is preferably also added to improve the compatibility of the volatile corrosion inhibiting composition with the rubber latex that provides the cohesive-nonadhesive characteristics. Heat sealing of wrapper can be effected with the help of hot melting shoes (39 and 41).

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WRAPPING

The present invention relates to packaging techniques and particularly to materials suitable for use in wrapping and protecting articles, as well as means for sealing such packaging materials.

Among the objects of the present invention is the provision of improved packaging materials.

Additional objects include novel packaging techniques for sealing packages with the packaging materials.

The foregoing, as well as still further objects of the present invention, will be more fully understood from the following description of several of its exemplifications, reference being made to the accompanying drawings in which:

FIG. 1 is an enlarged side view of one embodiment of a wrapper according to the present invention, partly assembled;

FIG. 2 is an enlarged side view of a different embodiment of a wrapper of the present invention;

FIG. 3 is a side view of a heat-sealing apparatus of the present invention;

FIG. 4 is a sectional detailed view of the apparatus of FIG. 3, taken along line 4-4;

FIG. 5 is a broken away plan view detail of the apparatus of FIGS. 3 and 4; and

FIG. 6 is detail view of a slitting technique of the present invention.

Pursuant to one aspect of the present invention a supported foam packaging laminate such as described in U.S. Patent No. 4,321,297 in which the foam layer is laminated to a backing sheet such as ordinary paper which is sufficiently porous to permit the bleed-through of melt when the laminate is subjected to a heat-sealing operation, has applied to the internal face of the backing sheet a barrier layer of solid

resin which melts at a temperature at least about 10°C higher than the foam does.

The foam is preferably polypropylene or polyethylene or polystyrene, with closed microcells, and the barrier resin can be polyvinylalcohol or polytrichloromonofluoroethylene, or teflon. Polyvinylalcohol is particularly desirable in that it is inexpensive, yet not significantly softened by molten polypropylene or the other resins.

The foam layer provides suitable packaging cushioning in thicknesses as small as about one millimeter and as large as about 7 millimeters. Foam layer thicknesses greater than about 5 millimeters are not preferred. The backing layer is generally not over about 1 millimeter thick, and can be as thin as 6 microns and still provide sufficient tensile strength to give the laminate good packaging characteristics. Where the backing layer is Kraft paper, it is preferably at least about 0.1 millimeter thick. Where the backing layer is a particularly strong material such as polyethylene terephthalate, it can be as thin as 6 microns and generally need not be thicker than about 25 microns. The thickness of the backing layer should be less than half the thickness of the foam, preferably less than one-third the foam thickness.

The barrier layer is not needed when the backing layer is non-porous like polyethylene terephthalate, but when used can be applied as a solution in a volatilizable solvent, or as a hot melt, or even by cementing a pre-formed film in place. Such a pre-formed film can have one of its surface flame-softened and then pressed against a paper backing sheet to anchor the softened face in the surface fibers of a paper backing sheet. Another technique for applying the barrier resin is to coat the backing sheet with a dispersion of colloidal resin particles in a volatilizable liquid, and then volatilizing away the liquid to leave the resin particles adhered to the fibers of a paper backing sheet. The use of a carrier liquid like water which soaks into the paper sheet is preferred inasmuch as this carries some of the colloidal resin particles into the pores of the paper, where they provide the desired barrier function even though the resin particles are not coalesced.

A barrier coating need only weigh about 1 milligram per square decimeter, and in the interest of economy is preferably less than 10 milligrams per square decimeter. A typical combination is:

EXAMPLE 1

A 30-pound Kraft paper (weighing 30 pounds per ream) is first coated with an 8% by weight solution of high molecular weight polyvinylalcohol in water, and the coating dried to leave a dry coating weight of about 3 milligrams per square decimeter. The resulting sheet is then laminated to 2-millimeter thick microcellular polypropylene foam using hot melt amorphous polypropylene as the laminant. The foam-paper wrapper thus manufactured is illustrated in FIG. 1 where the Kraft substrate is shown at 10, the polyvinylalcohol coating at 12, the laminant at 14, and the foam layer at 16. This laminate heat seals to itself very well using the apparatus of PCT Application No. US85/00399 (Publication No. W085/04150), without bleeding of melt through either of the backing sheets. The melting point of the polyvinylalcohol is at least as high as 130°C.

While the barrier coating need only be applied at wrapper locations where heat-sealing is to take place, it is usually more convenient to apply such coating over the entire surface of the wrapper. The barrier coating also acts as a good vapor barrier if it is applied over that entire surface. Barrier films of resin having molecular weights number averaging about 50,000 or more are particularly effective for this purpose.

Similarly desirable heat sealings are effected when the wrapper laminate has its outer foam surface coated with volatile corrosion inhibitor ("VCI") and/or antistat, as described in Patent No. 4,321,297.

According to another aspect of the present invention particularly desirable supported foam wrapper laminates are cold-sealed, as described in U.S. Patent No. 4,086,384. Prior art volatile corrosion inhibitors, including those described in U.S. Patent No. 4,321,297, have an adverse effect on the cohesive-nonadhesive latexes generally used for cold-sealing, in that the cold-sealing effectiveness gradually diminishes and in a few weeks becomes unsuitable when the volatile corrosion inhibitor is mixed with the cold-sealing latex.

It has now been discovered that dicyclohexylamine and/or 2-amino-2-alkyl-propadiol-1,3 can be mixed with stabilized natural rubber latex to provide a combined cohesive-nonadhesive layer that contains VCI and has a shelf life of at least four months even at elevated temperatures. To this end the latex should be protected with a protective colloid like casein in a concentration from about 4% to about 10% by weight of the dry

natural rubber in the latex. Other stabilizers like KOH in an amount about $\frac{1}{2}\%$ to about 2% by weight of the dry natural rubber in the latex can also be used but are not essential.

An antioxidant such as 2,5-ditertiarybutyl hydroquinone or similar hindered phenol should also be used in a concentration of about $\frac{1}{2}\%$ to about 1% by weight of the dry natural rubber content.

The following is a very effective exemplification:

EXAMPLE 2

A cohesive-nonadhesive coating solution is prepared by taking 170 parts by weight of natural rubber latex having 60% non-volatiles by weight, and adding to it a cooked solution of 10 parts by weight casein, 1 part by weight KOH, and $\frac{1}{2}$ part by weight of 2,5-ditertiarybutyl hydroquinone in 19 parts by weight of water. The addition is made slowly with very gentle stirring.

There is then prepared a VCI solution of four parts polyvinylpyrrolidone in 52 parts by weight of water, and to that VCI solution is added four parts by weight of 2-amino-2-ethyl-1,3-propadiol-1,3, followed by four parts by weight of dicyclohexylamine, with vigorous stirring. The resulting VCI solution is slowly added to the stabilized latex solution to make a coating composition having about 50% non-volatiles.

A roll coater is set up to apply at room temperature the 50% non-volatiles aqueous dispersion to the foam surface of a paper-foam laminate. There is fed to the coater a previously prepared laminate of $1\frac{1}{2}$ -millimeter thick microcellular closed-cell polypropylene foam laminated to a support of 30-pound Kraft paper. The coating mixture is dried at about 60°C after it is applied to the laminate, to leave a dry coating weight of about 10 grams per square decimeter. The resulting product is illustrated in FIG. 2 where 18 is the pre-prepared laminate of the foam layer 20 to the Kraft sheet 22, and 24 is the coating of VCI and cohesive-nonadhesive.

A wetting agent such as tetramethyl decynediol can be added to the coating composition if necessary to improve the wetting of the foam surface, as well as to reduce the tendency of the composition to foam during the coating operation. Only about $\frac{1}{2}\%$ of such agent based on the dry weight of the natural rubber is adequate. Thickening agents such as hydroxyethyl cellulose or polyacrylic acid can also be added in such small

amounts to improve the flow of the coating composition onto the foam surface. These agents also help stabilize the latex against breaking of the dispersion.

The coating composition can also be modified by the addition of resin dispersions or solutions that increase the aggressiveness of the cohesive function of the coated wrapper. A typical resin for such purpose is partially or fully hydrogenated wood rosin or partially or fully hydrogenated wood rosin esters, such as the Staybelite resins of Hercules, Inc., emulsified in water. Also synthetic isoprene, neoprene, butyl rubber or chloroprene latex can be substituted for some or all of the natural rubber latex.

Excellent corrosion protection is provided by the combination of the dicyclohexylamine and the 2-amino-2-ethyl-propadiol-1,3 inhibitors when in combined amounts of from about 0.3 to about 2 grams per square decimeter. Other lower-alkyl groups such as methyl, propyl and butyl can be used in place of the ethyl group at carbon numbered 2 of the propadiol molecule.

While equal proportions of the two inhibitors are preferred, the proportion of the dicyclohexylamine can be increased from about 50% by weight to about 95% by weight. It can also be increased to 100% by weight with only a small decrease in long-term corrosion prevention. The dicyclohexylamine is not very soluble in water and is preferably first dispersed in water with the help of a dispersing agent such as the polyvinylpyrrolidone, and the dispersion then slowly added to the latex. However, merely permitting the latex to stand in contact with the dicyclohexylamine for 24 hours or more will cause sufficient of the inhibitor to dissolve in the latex to provide significant corrosion inhibition. Other additives such as antioxidants can also be added by the foregoing techniques.

The amine diol is quite soluble in water and can be directly dissolved in the latex, but again is preferably first dissolved in water and that water solution slowly added to the latex.

The foregoing inhibitor-coated foam-paper laminates have a shelf life of at least six months, even when stored at 60°C and exposed to indoor daylight. The shelf life at lower storage temperatures is substantially longer. Similar results are obtained when the foregoing coatings are applied to paper which is not laminated to foam.

The foregoing latexes, with or without the added corrosion inhibitors, can also be given antistatic characteristics so that when coated on substrates they rapidly dissipate any static electrical charge to which they may be exposed. Thus, a natural rubber latex having about 50% to about 60% non-volatiles by weight and containing 1% KOH by weight of those non-volatiles, can have dissolved in it a humectant in which the KOH is soluble to form a humectant solution not completely miscible with the rubber of the latex. Polyethylene glycols having molecular weights from about 150 to about 800 are suitable humectants. Other suitable humectants are glycerine and polyethylene glycol esters of wood rosin or of hydrogenated wood rosin, and a typical antistatic preparation is:

EXAMPLE 3

To a 50% non-volatiles natural rubber latex containing 1% KOH based on the weight of non-volatiles, is slowly added a mixture of polyethylene glycols ranging in molecular weights from about 300 to about 500, until 10% by weight of the foregoing non-volatiles has been added. The thus-modified latex is then coated on a packaging laminate of 2-millimeter thick foam on 40-pound Kraft paper, to leave after drying a coating weight of about 8 grams per square decimeter.

Sheets of the finished product readily adhere to each other when pressed together with their coatings face-to-face, and a substantial force is needed to then pull them apart. The adhesion fails primarily by tearing apart of the foam. The sheets, before or after adhesion, show a static discharge time of less than 0.4 seconds, and so are acceptable for packaging electronic parts such as circuit boards which are sensitive to static electric fields.

After storage for six months at 60°C exposed to interior daylight, the sheets show only slight loss of adhesion bonding when pressed together, and still have a static discharge time of less than 0.4 second.

Substituting potassium carbonate or NaOH for the KOH provides essentially the same results. Potassium and sodium acetates can also be used, but should be used more sparingly or should be used with more stabilized latexes, and are not as effective. The same results are obtained from simple foam-free wrapping papers and plastic films that are correspondingly coated.

Volatile corrosion inhibitors can be added to the latexes containing antistatic agents to provide coating compositions that simultaneously have corrosion inhibition, antistatic protection and cohesive-nonadhesive characteristics. A suitable composition of this type is:

EXAMPLE 4

The latex of Example 3 containing KOH and polyethylene glycol, is further modified by adding to it 2-amino-2-methyl-propadiol-1,3 in an amount 1% by weight of the non-volatiles. The resulting composition can be coated on ordinary wrapping paper, or on paper-foam wrapping laminates, or even on transparent flexible polyvinyl chloride films to give cold-sealable packaging materials very suitable for wrapping objects such as electronic components which are sensitive to both corrosion as well as to static electric fields. Dry coating weights of about 6 to about 12 grams per square decimeter are preferred.

Dicyclohexylamine can be substituted for some or all of the 2-amino-2-methyl-propadiol-1,3 in Example 4, but is preferably added as an aqueous dispersion stabilized with polyvinylpyrrolidone or other stabilizer.

Where the cohesive-nonadhesive function is not needed, the latex can be omitted and the volatile corrosion inhibitor merely mixed with the antistatic material to provide an aqueous solution or dispersion suitable for coating on the desired substrate. Thus, any of the quarternary antistatic agents such as those referred to in U.S. Patent No. 4,321,297 can be mixed with a volatile corrosion inhibitor described in that patent or in U.S. Patents Nos. 2,829,080, 2,987,374, 3,836,077, 3,871,823, 4,051,066, 4,130,524, 4,131,583 and 4,290,912. The proportion of antistat to corrosion inhibitor is preferably about 1:1 by weight, but can range from about 1:5 to about 5:1 by weight. The mixture is preferably as concentrated as practical, so that very water-soluble corrosion inhibitors like triazole are particularly helpful. Dicyclohexylamine and other inhibitors that are not very soluble in water are preferably solubilized as with the help of polyvinylpyrrolidone or other dispersing agent. The quarternary antistats also have some dispersing effect.

Preferred coating formulations according to the present invention are:

EXAMPLE 4

	<u>Parts by Weight</u>
Natural rubber latex, ammonia stabilized	100.0
61% solids by weight	
45% KOH solution in water by weight	1.0
Water	7.0
Polyvinylpyrrolidone solid	3.4
2-amino-2-methyl-propadiol-1,3	3.4
Toluene	1.0
Tetramethyl decynediol	0.1
2,5-di(tertiary amyl) hydroquinone	1.0
Dicyclohexylamine	3.4
Triton-X-100	0.2

The KOH solution is first slowly mixed with the latex, the water is mixed with the next two listed ingredients to make an aqueous dispersion which is then slowly added to the latex-KOH mixture, and finally the last five ingredients mixed with each other to form a solution that is then slowly stirred into the mixture of the first five ingredients. The final product is slowly stirred until uniform, and then filtered to remove coagulated rubber, after which it is ready for coating as in Example 2 to make a high-quality cold-sealing wrapping laminate that very effectively prevents corrosion of corrodible metals it is wrapped around.

By adding to the Example 4 formulation about 6 parts by weight polyethylene glycol having an average molecular weight of about 350, the formulation is converted into one which deposits a coating that is antistatic as well as corrosion-preventing. However, the thus-modified coating tends to readily block and adhere to the adjacent turn of a roll of coated laminate. The blocking tendency can be reduced or completely eliminated by further adding to the formulation about 10 parts by weight of finely divided filler powder such as calcium silicate, talc, wollastonite or clay.

The foregoing is further illustrated by the following examples:

EXAMPLE 5

	<u>Parts by Weight</u>
Natural rubber latex, ammonia stabilized	
60% solids by weight	100.0
Water	22.8
Xanthan gum	0.4
45% KOH solution by weight in water	1.1
Tetramethyl decynediol	0.2
Water	16.7
Polyvinylpyrrolidone	3.5
PEG 400	7.7
2-amino-2-methyl-1-propanol	
95% by weight solution in water	0.9

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	<u>Parts by Weight</u>
Sodium di-octyl sulfosuccinate	
40% by weight solution in water	0.2
Xanthan gum	0.6
Toluene	1.0
Tetramethyl decynediol	0.1
2,5-di (tertiary amyl) hydroquinone	1.0
Sorbitol	3.4
70% by weight solution in water	
Delaminated clay	22.0
Water	16.7

This formulation is prepared like that of Example 4, avoiding violent stirring or rapid mixing with the latex. The second, third and fourth ingredients are pre-mixed before slowly adding to the latex; the fifth ingredient is then added to the thus-modified latex followed by a pre-mix of all the remaining ingredients. The last pre-mix is preferably prepared by first mixing the last three of the listed ingredients, then adding it to a mixture of the toluene and the two ingredients following it, and finally adding the resulting combination to a mixture of the sixth, seventh, eighth, ninth, tenth and eleventh listed ingredients.

Coatings of the Example 5 formulations show very satisfactory antistat characteristics and can be applied over the foam face of foam-paper wrapper laminates, or of foam-aluminum foil-paper laminates, or over plain paper, or foil-paper laminates or polypropylene film. Where the foil is intended to protect wrapped materials from strong electric fields, it is best about 17 to about 25 microns thick.

EXAMPLE 6

	<u>Parts by Weight</u>
Natural rubber latex, ammonia stabilized	
59% solids	100.0
PEG 500	4.0
Water	3.8
45% KOH solution in water by weight	0.6
Polyvinylpyrrolidone solid	1.8
Picconol A-600 resin emulsion, 55% solids	20.0
Toluene	1.0
Tetramethyl decynediol	0.1
2,5-di (tertiary butyl) hydroquinone	1.0

The ingredients are combined in the order listed, except that the last three ingredients are pre-mixed. Coatings formed from this formulation are very good antistat self-sealing. The Picconol resin is a blend of ethylene/vinyl acetate copolymer and an aliphatic petroleum resin and can be replaced by other resins that increase the aggressiveness of the bonding as described, supra.

The above formulations can also be thickened, if desired, with polyacrylate or cellulose ether thickeners, and defoamers such as silicones can also be added. Acrylic resin latexes can be substituted for the natural rubber latex, but this reduces the antistat effectiveness so the antistat ingredients should then be doubled.

While closed-cell microcellular polypropylene foam is a highly desirable packaging substrate, particularly when laminated to a paper support, closed-cell microcellular polyethylene foam is also suitable, and can also be laminated to a paper support. Hot melt amorphous polypropylene is a very effective laminant for adhering such polyethylene foam to paper, even when that foam is not treated, as by corona-discharge, to increase its normal poorly adherent nature. However, latex and other coatings do not adhere well to polyethylene foam unless that foam has its adherent nature increased by corona treatment or the like.

When a quaternary antistatic agent is coated onto a microcellular polypropylene or polyethylene foam, the thus-treated foam will be securely bonded to a paper backing by a lamination operation using the amorphous polypropylene as hot melt laminant. The addition of volatile corrosion inhibitor to the antistat does not detract from such bonding. However, the heat sealing of one sheet of either of such bonded and coated foams to another such sheet, does not result in good foam-to-foam heat-seal bonding.

Acceptable bonding of such sheets is obtained according to the present invention by having the polypropylene or polyethylene microfoams laminated to their paper support with a pressure-sensitive adhesive as described in the following examples:

EXAMPLE 7

A standard two-ply roll-type hot melt laminator has its hot melt trough applicator loaded with Basic Adhesives, Inc. pressure-sensitive adhesive HM-83-2686, a plasticized ethylene/vinyl acetate type pressure-sensitive adhesive, and the load is heated to 177°C to 182°C. The temperature is maintained by appropriately setting the automatic heating control.

The feed to the trough applicator is loaded with a roll of 30-pound Kraft paper, and the laminator is also loaded with a roll of 3.2 millimeters thick microcellular closed-cell polypropylene foam described in U.S. Patent No. 4,263,360. That foam is presently marketed by Ametek, Inc.

The laminant coating thickness doctor is adjusted to leave an adhesive layer weighing about 0.6 grams per square decimeter on the paper, and the pressure at the laminating web against the coated paper is adjusted to the minimum -- about 23 kilograms for a 15.2 centimeter diameter roll and a 1.8 meter wide web. The lamination proceeds smoothly and can be effected at speeds as high as 150 meters per minute.

Figure 1 of the drawings shows the product of Example 7, the paper backing at 10, the pressure-sensitive adhesive at 12 and the foam-cushioning layer at 14. The thicknesses of these layers are distorted a bit in the interest of clarity.

EXAMPLE 8

The process of Example 7 is modified by using as the pressure-sensitive adhesive, the product marketed by National Starch Co. under its designation 34-2881, this being a wax-containing adhesive. The melt temperature is adjusted to 185°C to 190°C, the adhesive coating to about 0.7 grams per square decimeter, a 40-pound Kraft paper is used, the foam roll replaced by a roll of 2.4 millimeter thick microcellular polyethylene foam which has not been corona-treated, and the laminating pressure increased to 68 kilograms. A very good cushiony packaging laminate is produced.

EXAMPLE 9

The process of Example 7 is modified as follows:

The adhesive is a mixture of three parts by weight of the alkylaryl resinous plasticizer Piccovar AP-25 marketed by Hercules Incorporated and having a melt viscosity of one poise at 108°C, with one part by weight of the solid styrene-butadiene block polymer thermo-plastic rubber Stereon 840A marketed by Firestone Synthetic Rubber & Latex Company, having a number average molecular weight of about 60,000 and also having about 43 weight % bound styrene. The foam to be laminated has been filmed on both faces with a quarternary antistatic agent as described in U.S. Patent No. 4,321,297 to show a charge dissipation time of less than 0.2 seconds. The adhesive application is set for 0.8 grams per square decimeter and the laminating pressure to 91 kilos. A very securely bonded laminate is produced, well suited for wrapping articles that need protection against static charges.

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EXAMPLE 10

The process of Example 9 is modified by substituting for the paper lamination a paper-backed aluminum foil in which the foil is about 0.3 mil thick and its backing a previously adhered 20-pound Kraft paper. The molten adhesive is first applied to the exposed face of the foil at a concentration of about 0.55 grams per square decimeter, and the antistatic foam applied after the adhesive coating has cooled for about two seconds.

EXAMPLE 11

The process of Example 9 is modified by substituting a volatile corrosion inhibitor filming pursuant to U.S. Patent No. 3,080,211 for the antistatic filming of the foam, and substituting a metallized 30-pound Kraft paper for the backed foil. The metallizing metal is aluminum.

The presence or absence of a metal foil, or a metallized layer, between the antistat foam and its backing seems to have no effect on the bonding of that foam to its support as well as on its heat sealing to a different layer of that foam. However, for some reason which is not understood, the switching from a hardening laminant to a pressure-sensitive laminant in laminating the foam to its support makes a world of difference in the heat-sealability of the resulting antistat foam. The presence or absence of volatile corrosion inhibitor with the antistat on the foam does not change these heat-sealing characteristics.

A volatile corrosion inhibitor coating which does not contain antistat or similar hygroscopic material does not interfere with the heat sealing regardless of the laminant used to adhere the foam layer to its support.

Where a translucent wrapper is desired, the foam should be free of pigment and the backer sheet should be essentially transparent, such as glassine paper, re-generated cellulose or polyethylene-terephthalate resin film. Polyethylene-terephthalate films have exceptionally high tensile strength and can be very effectively used in thicknesses as small as 15 to 20 microns, even with foam thicknesses of 3 to 6 millimeters. Because the polyethylene terephthalate has a very high softening point, it is readily laminated to polypropylene or polyethylene foam with a hot melt laminant such as amorphous polypropylene. The molten hot-melt laminant can be first applied as a very thin layer to the

polyethylene terephthalate backing sheet, and the foam applied to the very thin hot melt layer. By the time the foam engages the laminant, that laminant has been cooled somewhat by the polyethylene terephthalate backing sheet so it is less likely to overheat the foam, yet is still sufficiently tacky to form a very tight bond between the foam and the backing, particularly where relatively low-melting foam such as polyethylene foam is used. A pressure-sensitive laminant can be used inasmuch as such a laminant can be applied at temperatures much lower than needed for the usual hot-melt hardening laminants.

The polyethylene terephthalate film is desirably metallized on one or both of its surfaces with an exceedingly thin film of aluminum or other metal. Such a metallized film can be laminated to the foam at a metallized or unmetallized surface. Although such a metallized layer which can be only about 1 to 2 microns thick provides very good protection of packaged electronic devices against static electricity and other electric fields, the exposed faces of the foams can be coated with any of the foregoing cohesive-nonadhesive and/or antistat and/or VCI coatings.

Another modification of the present invention is a foam-surfaced wrapper laminate of unusually high strength, and particularly high resistance to puncture by sharp objects. To this end the foam is backed by a layer at least 1/4 millimeter thick of felted fibers at least 10 millimeters long. The fibers are preferably quite thin, less than 120 microns thick, made of strong fibers such as nylon or polyethylene terephthalate or glass or minerals such as asbestos or aluminum silicate, densely felted and bonded together as by a laminant that will not be totally destroyed by heat.

A pressure-sensitive laminant or regular hardening laminants can be used to laminate the foam layer, which is preferably 1/2 to 2 millimeters thick, to the felted backing. The backing can, in turn, be backed by lamination to a supporting film such as a very thin (e.g., 20 to 40 microns thick) film of polyethylene or polyethylene terephthalate or other highly tear-resistant film. The three-layer laminate cannot be manually torn and is almost impossible to puncture. Also, a strong polyethylene film can thus be hot-melt laminated to the long-fiber layer and the combination to the foam layer without risking damage to the polyethylene. The hot melt is applied to the long-fiber layer first so it

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cools slightly before the polyethylene film is applied to the hot-melt-coated layer. Similarly, the foam can also be laminated by first applying hot-melt laminant to the other face of the long-fiber layer so low-melting foam like polyethylene foam is not apt to be damaged.

Although the heat sealing of supported foam packaging can be accomplished in any desired way, it is preferably carried out in the packaging apparatus of the present Figs. 3, 4 and 5. That apparatus is a modification of the apparatus of PCT Publication No. WO85/04150 dated September 26, 1985, and has a fixed table 35 along which is fed in the direction of arrow 101, a first elongated length 31 of a backed sheet of foam 102, with its foam face up. Side guides 152 guide the sheet 31 so its side edges will be received by spaced sets of pinching rolls, one set of which, 37 and 38, is shown.

Another elongated sheet 32 of backed foam 103 is fed from overhead with its foam face down, to the same sets of pinching rolls, guided by idler rolls 81 and 82 and a fixed table 22. The pinching rolls are driven and press both side edges of the sandwiched sheets 31 and 32 together while they pull the sandwiched sheets to move them through the apparatus.

A pair of edge hold-downs 172 can be used to help assure that the edges of sheet 31 do not curl up but remain accurately aligned by side guides 152. A spaced series of articles 91 to be packaged are placed on sheet 31, each article preferably centered on the sheet between side guides 152. A centering means can be used as described in connection with Fig. 5.

Sheet 31 then passes under a pair of heated edge melting shoes, 39. Each shoe is held by ceramic insulators 106 on a bar 104 which in turn is pivotally held at 108 on an operating arm 107 clamped to an actuating shaft 110 that rotates to raise and lower the set of melting shoes.

Another set of melting shoes 41 is similarly held over packaging sheet 32 where it passes over table 22. Bar 96 and arms 97 and 98 connect shoes 41 to operating shaft 110, and can be hollow and perforated as can bar 104 and arm 106, to lighten their weight. Table 22 can be tilted up to about 45° with respect to the horizontal or can be made horizontal, as desired, so that the melting shoes 41 engage foam layer 103 in about the same manner as the melting shoes 39 engage foam layer 102.

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The upper and lower sets of melting shoes accordingly have about the same melting action on both layers of foam and can both have their temperatures controlled by a single thermostat. Electrical heating of the shoes is accordingly simplified.

According to the present invention the melting action of the melting shoes is improved by slightly relieving the outer edges of those shoes. Thus, as shown in Fig. 3 a shallow rabbet 99 is cut in the outer edge of the lower face of each melting shoe. The rabbet extends about $3/4$ millimeter up from the face of the shoe that engages the foam, and about 3 millimeters into the face, although both dimensions can be varied. Thus, the height of the rabbet can be as little as about $1/2$ millimeter and as much as about $1-1/2$ millimeters, and the rabbet can extend into the shoe faces from about 2 millimeters to about 5 millimeters. The relieving can be tapered, as in an edge bevel.

Because of the relieving, the foams 102 and 103 are not melted as much at the outermost portions of their side edges as they are in the balance of the melting zones. Those zones can have a total width of about 8 to about 15 millimeters, and melting of that much foam can cause substantial quantities of foam to be squeezed out by pinch rollers 37 and 38 beyond the side edges of the packaging sheets where that squeezed out melt can gum up the apparatus and look unsightly.

The relieving of the shoe faces lessens the melting action at the very edges of the packaging sheets and thus permits the foam edges there to remain partly unmelted. This unmelted material keeps most or all of the melted foam from being squeezed out the sides of the packaging sheets, and yet does not prevent the tight heat sealing of those sheets to each other. This advantage is obtained whether the faces of foam layers 102 and 103 are free of coatings, or whether they contain a VCI coating or an antistat coating or a combined VCI-antistat coating, such as the VCI and/or antistat mixtures of the foregoing examples without the latex.

The application of the transverse heat seals with the foregoing heat-sealing apparatus is made with two sets of cross bars. Each set has one of its cross bars above the sandwich to be heat sealed, and its second bar below the sandwich. The first set that operates on the sandwich has both of its cross bars heated to heat up the foam layers to heat-sealing temperature, and the second set has a cutter blade in one of its bars, to cut the sandwich into individual packages. It is desirable to

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cool the blade-free cross bar of the second set, as by a water-cooling line or by a fan that blows cool air against that bar or against a finned extension of that bar. This arrangement is particularly effective when heat sealing laminates having thick paper supporting layers such as 42-pound liner board. Heating such sandwich for heat sealing causes the support to retain so much heat that it keeps the foam too hot. Accordingly, at the time of the cutting by the second set of cross bars, the foam is too hot to set properly when no cooling is applied.

The above-described cooling enables proper setting of the transverse heat seals.

Fig. 5 shows a feed arrangement for the lower wrapping laminate 31. A pair of Z-section side guides 151 and 152 are positioned on table 35 to guide laminate 31 to the lower melting shoes 39, 39. For this purpose, the central web 155 of each Z is vertically oriented, the lower webs 157 horizontally directed toward each other, and the upper webs 159 horizontally directed away from each other. Sets of mounting blocks 161 are secured to the outsides of the central webs and have downwardly directed mounting screws 163 which pass down through positioning slots 165 and are locked in position by nuts threaded on their lower ends. Four such mounting arrangements are preferably provided, two for each side guide.

To help assure that the side edges of wrapping laminate 31 are not curled away from the side guides as they approach the melting shoes, holddown bars 171 and 172 can be secured to the inner surfaces of the vertical webs of the side guides and fitted a short distance above their lower webs.

Also shown in Fig. 5 is a loading locator 175 adjustably fitted to the upper webs 159 of the side guides. This locator has a transversely extending rod 176 which adjustably carries a rear stop 177 and a side stop 178. These stops extend downwardly toward and end just above the foam face of laminate 31, and are used to help rapidly and accurately locate the position in which is to be placed an article to be wrapped and heat sealed, while the wrappers pause in a step-wise heat sealing operation. The loading position is determined to be intermediate the locations of the transverse heat seals, and those positions vary as the articles to be wrapped vary in length in the machine direction. Thus, for a series of articles to be packaged, the loading locator 175 is adjusted to the proper location along the side guides, the apparatus then set in

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operation, and a fresh article placed against the loading stops every time the wrapping laminates pause during a transverse heat sealing step.

The upper wrapping laminate 32 is shown as guided toward the upper melting shoes by a pair of offset rollers 81 and 82 that receive the laminate from an overhead spool. Further guiding can also be provided as for the lower laminate, but generally it is sufficient to hold the overhead spool accurately aligned, and with spool heads that keep the laminate from sidewise shifting on the spool.

Because the wrapping laminates can be as much as 6 millimeters thick, they can be spooled up to a diameter of 0.9 meter or more, even on a small spool hub. Where such a spool is so positioned that there is only a small angular difference in take-off locations when the spool is full and empty, only a single feed roller 81 or 82 is needed. A similar dual or single feed roller arrangement can be provided for the lower laminate 31.

It is also helpful to apply a little friction to the laminate supply spools, to keep them from prematurely unwinding.

Where the foam backing sheet is paper and the paper-foam laminate 31 and/or 32 has been slit from a wider sheet of laminants, the slitting should be done in a manner that forms little or no dust. Fig. 6 shows a slitting technique very effective to eliminate dust generation. Here, a simple foam-paper cushioning laminate 66 is fed through a conventional slitter with its paper face 68 applied against the slitter's back-up roll 70. The foam layer 72 of laminate 66 is exposed to the action of slitting cutters, one of which is illustrated at 74. Cutter 74 is a steel wheel having a tapered periphery that ends with an essentially flat cutting face 78 about one millimeter wide. The wheel is rotatably mounted on a shaft 80 which is urged as by bias springs toward the surface of backing roll 70. The surface of roll 70 is made very hard and that roll is essentially unyielding. The biasing of cutter 74 causes its narrow edge 78 to cut through both the foam layer 72 and the paper layer 68 as the laminate 66 is fed through. This slitting action has been found to produce little or no dusting, whereas feeding the laminate through with its layers reversed in position causes it to be slit with substantial dust generation.

The heat sealing of the present invention can also be carried out with a single wrapping laminate that is folded along its longitudinal axis and fed through a load station and then to melting shoes

which melt the foam edge at both folds but on only one side edge of the desired package. Alternatively, two wrapping laminates can be used as in Figs. 3 and 4 with both laminates wide enough to receive two spaced rows of articles, with an extra longitudinal heat sealing between the rows.

The heat sealing equipment of the present invention can also be used for packaging and sealing articles with wrappers that have not been antistat treated, or are coated with cold sealing adhesive such as cohesive-nonadhesive latex layers as described in U.S. Patent No. 4,086,384. For such cold sealing the melting shoes are kept retracted so they do not engage the wrapping sheets. However, it is desirable to effect the transverse cutting and sealing with some heat applied to the transverse cutter blade. This reduces the build-up of foam resin on the cutter blade when "cold" sealing.

Such cold sealing and packaging can also be effected with wrapping sheets that have no foam, and are merely cohesive-nonadhesively coated paper or metal foil or unfoamed plastic or metallized paper or plastic, or combinations of these materials.

Where heat is used for fusing foam being sealed to another layer of foam or to a layer of paper, metal foil or plastic film, the heat can also be supplied by ultrasonic vibration, as in U.S. Patent Nos. 3,580,793, 3,874,963, 4,026,000, 4,169,751, 4,373,979 and 4,490,199. Thus, the side edge seals as well as the transverse seals can be made by appropriately fitted ultrasonically driven welding horns and anvil bars.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

CLAIMS

1. In the process of packaging articles between two elongated wrapping laminates each having a layer of foam laminated to a backing web and the foam layer of one laminate is heat sealed to the foam layer of the other laminate while the elongated laminates are advanced by side edge rollers through a heat sealing zone as articles to be heat sealed are sandwiched between them, the improvement according to which the laminates are prepared for the heat sealing by melting the foam at the side edges of both laminates at their heat sealing sites, and the laminates with the melted foam edges are pressed together to heat seal them together after an article is sandwiched between them.
2. The combination of claim 1 in which the melting is effected by applying hot melting shoes directly to the foam at the sealing sites.
3. The combination of claim 1 in which transverse heat sealings are applied to the sandwiched assembly between successive articles by transverse heat sealing bars.
4. The combination of claim 1 in which the foam is a hydrophobic antistat.
5. The combination of claim 1 in which the foam layers are laminated to their backing layers with a pressure-sensitive adhesive.
6. The combination of claim 4 in which the foam is a hydrophobic foam coated with a very thin layer of liquid antistat agent.
7. The combination of claim 1 in which the foam layers are adhered to metal foil layers and the metal foil layers adhered to paper layers.
8. The combination of claim 1 in which the backing web is metallized polyethylene terephthalate not over about 25 microns thick.
9. An electronic device subject to damage when exposed to static electricity generated in handling; the device being cushioned in a wrapper of a sheet of resilient foam about 1 to about 7 millimeters thick laminated to a backing film of metallized polyethylene terephthalate not over about 25 microns thick.
10. In a supported foam packaging laminate in which the foam is a layer not over about 7 millimeters thick, heat-sealable at temperatures below about 250°C, and is laminated to a backing sheet not over about 1 millimeter thick and sufficiently porous to permit the bleed-

through of melt when the laminate is subjected to a heat-sealing operation, the improvement according to which the bleed-through is essentially eliminated by a barrier of solid resin coated on the internal face of the backing sheet, said barrier resin having a melting point of at least about 10°C higher than that of the foam.

11. The combination of claim 9 in which the backing is a sheet of Kraft paper and the barrier resin is polyvinylalcohol.

12. In a layer of packaging foam having a surface coated with cohesive-nonadhesive so that the coated layer can be cold-sealed to another such coated layer by merely pressing the layers together with their coatings face-to-face, the improvement according to which the cohesive-nonadhesive layer also contains a volatile corrosion inhibitor composition which does not prevent the cold-sealing and does not reduce the cohesive sealing shelf life of the coating to less than about six months.

13. The combination of claim 12 in which the cohesive-nonadhesive is natural rubber latex and the volatile corrosion inhibitor composition is the combination of a hydrophilic film-former with a hydrophobic volatile corrosion inhibitor.

14. The combination of claim 13 in which the hydrophobic volatile corrosion inhibitor is dicyclohexylamine.

15. The combination of claim 14 in which the volatile corrosion inhibitor composition also contains a hydrophilic volatile corrosion inhibitor.

16. The combination of claim 14 in which the hydrophilic inhibitor is 2-amino-2-ethyl-propadiol-1,3.

17. The combination of claim 13 in which the layer also contains a latex-stabilizing amount of potassium hydroxide.

18. The combination of claim 17 in which the layer also contains a polyglycol solvent for the potassium hydroxide and the proportions are adequate to form an antistatic solution of the potassium hydroxide in the polyglycol on the surface of the dried layer.

19. A natural rubber latex containing dissolved alkali metal hydroxide in a concentration of from about 1/4% to about 2% by weight, and also containing a polyglycol solvent for the alkali metal hydroxide, the polyglycol being in a concentration of about 1/4% to about 5% by weight.

20. The combination of claim 19 in which the latex also contains a volatile corrosion inhibitor in a concentration of about 3% to about 12% by weight.

21. A natural rubber latex containing from about 1/4% to about 3% by weight of dicyclohexylamine.

22. The combination of claim 21 in which the latex also contains sufficient added protective colloid to remain stable through a roll-coating operation.

23. The combination of claim 21 in which the latex also contains from about 1/4% to about 3% by weight of 2-amino-2-ethyl-propadiol-1,3.

24. The combination of claim 22 in which the added protective colloid is polyvinylpyrrolidone.

Fig. 6.

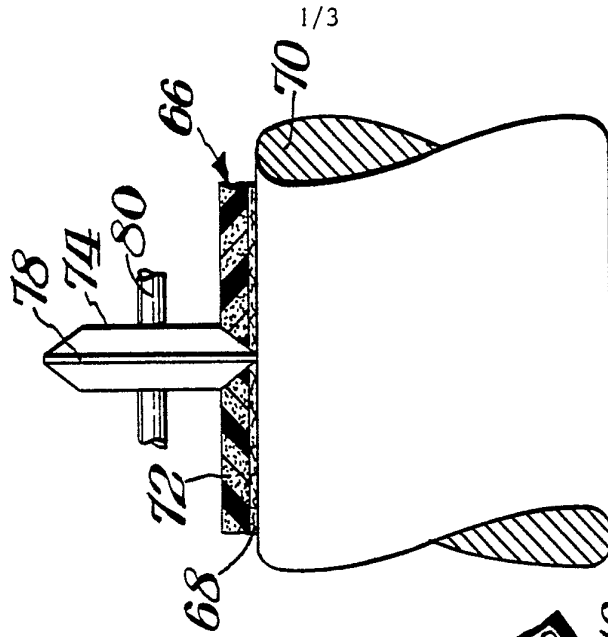


Fig. 2.

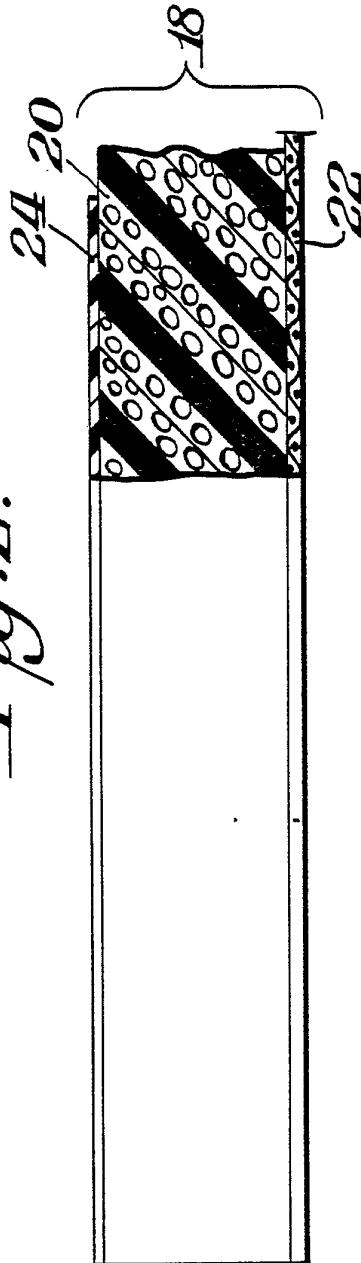


Fig. 1.

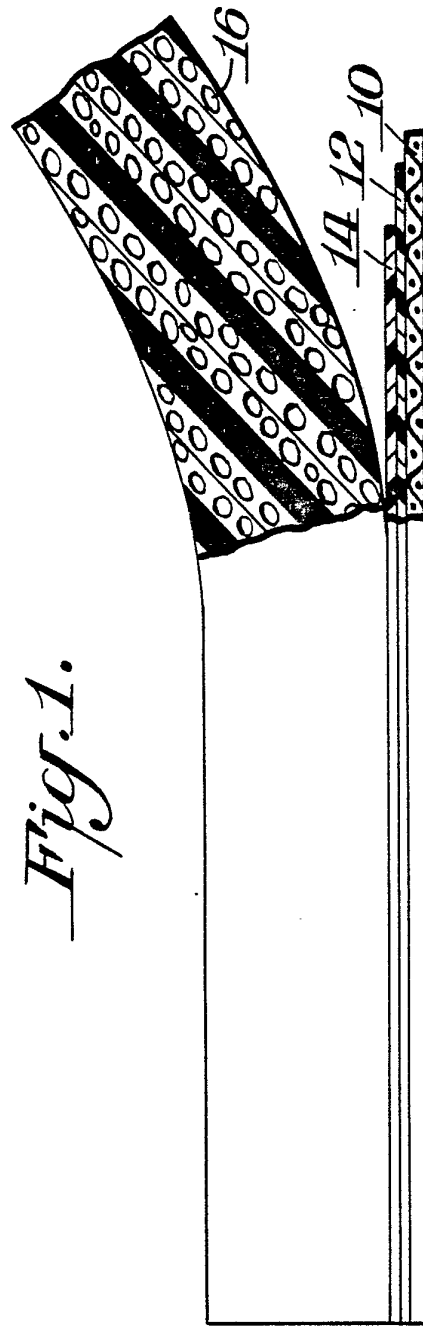
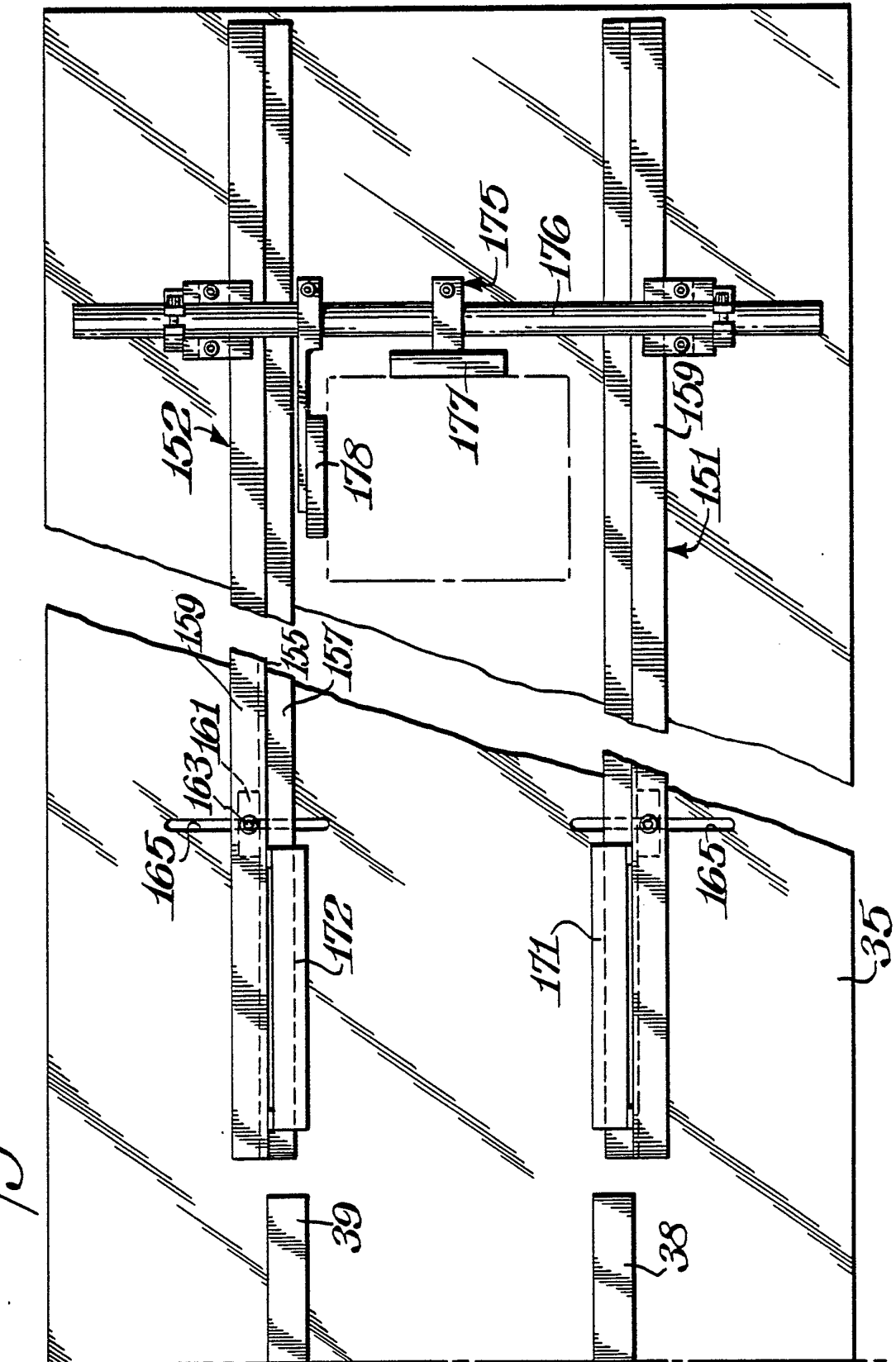


Fig. 5.



INTERNATIONAL SEARCH REPORT

International Application No PCT/US86/01731

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC (4): B65B 9/02, 51/14, 23/00, 23/22		
U.S. CL. 53/450, 463, 472; 206/328; 428/304.4; 318.4; 523/137		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
U.S.	53/472, 450, 463, 477, 553, 141, 373, 555; 156/78, 320; 383/109; 428/71, 317.1, 317.3, 317.7, 304.4, 318.4, 319.3; 206/523, 328, 215, 400, 410, 521, 523;	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		523/137.
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category ⁶	Citation of Document, ¹⁵ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
Y	US, A, 3,411,263 (Smolderen) 19 November 1968 See the entire document. Note welding dies 34, 35.	1-3,
Y	US, A, 2,167,634 (Calvert) 01 August 1939 See the entire document. Note page 1, column 1, lines 1-16; page 2, column 1, lines 4-18; and page 2, column 1, lines 36-40.	1-3
Y	US, A, 4,302,272 (Phillips et al) 24 November 1981 See column 3, lines 12-20.	1-3
Y	US, A, 4,379,008 (Gross et al) 05 April 1983 See column 2, lines 9-14.	1-3
Y	US, A, 4,471,872 (Dedow) 18 September 1984 See the entire document.	9
P,Y	WO 85/04150 (The Crowell Corporation) 26 September 1985. See the entire document.	1-21, 23
A	US, A, 3,735,551 (Pratt) 29 May 1973. Note heated dies 17, 18, in Figures 1 and 2.	
¹⁵ Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ¹		Date of Mailing of this International Search Report ²
05 November 1986		04 DEC 1986
International Searching Authority ¹		Signature of Authorized Officer ²⁰
ISA/US		<i>Horace M. Culver</i> Horace M. Culver

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No ¹⁸
A	US, A, 4,396,447 (Firth) 02 August 1983 Note heated die 45 in Figure 1.	
A	US, A, 2,340,260 (Clunan) 25 January 1944 See the entire document.	
A	US, A, 4,074,505 (Keren et al) 21 February 1978. See entire document.	
Y	US, A, 4,253,892 (D'Angelo et al) 03 March 1981. See the entire document.	9, 10, 11
A	US, A, 4,086,384 (Adelman et al) 25 April 1978, See the entire document.	
<u>X</u>	US, A, 4,321,297 (Adelman)	<u>12</u>
Y	23 March 1982, See the entire document.	13-21, 23
P,Y	US, A, 4,584,225 (Adelman) 22 April 1986, See the entire document.	13-21, 23
Y	US, A, 2,752,221 (Wachter) 26 June 1956 See column 2, lines 56-68, and column 3, lines 1-6, claim 1 and claim 7.	13-21, 23
A	US, A, 4,263,360 (Adelman) 21 April 1981, See the entire document.	
A	US, A, 2,739,872 (Senkus) 27 March 1956 See the entire document.	
A	US, A, 2,829,080 (Fessler et al) 1 April 1958, See the entire document.	
A	US, A, 3,080,211 (Fessler et al) 5 March 1963, See the entire document.	
A	US, A, 4,130,524 (Boerwinkle et al) 19 December 1978, See the entire document.	
A	US, A, 4,275,835 (Miksic et al) 30 June 1981, See the entire document.	
A	US, A, 4,051,066 (Miksic et al) 27 September 1977, See the entire document.	
A	US, A, 4,131,583 (Boerwinkle) 26 December 1978, See the entire document.	
A	US, A, 4,036,675 (Amberg et al) 19 July 1977, Note heated dies 36, 37, in Figure 3.	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A US, A, 4,036,675 (Amberg et al) 19 July 1977
Note heated dies 36, 37, in Figure 3.

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

I. Claims 1-8, drawn to a packaging process, class 53, subclass 450.

II. Claim 9, drawn to a package (product) which may be made by the above process, class 206, subclass 328.

III. Claim 10, drawn to a foam laminate, class 428, subclass 304.4.

IV. Claims 12-18, drawn to a foam laminate, class 428, subclass 318.4.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.

PCT/US86/01731

V. Claims 19-20, drawn to natural rubber latexes, class 523,
subclass 137.