

Oct. 22, 1974

D. F. DREHER
DRY DRY TRANSFER

3,843,480

Original Filed Dec. 4, 1967

3 Sheets-Sheet 1

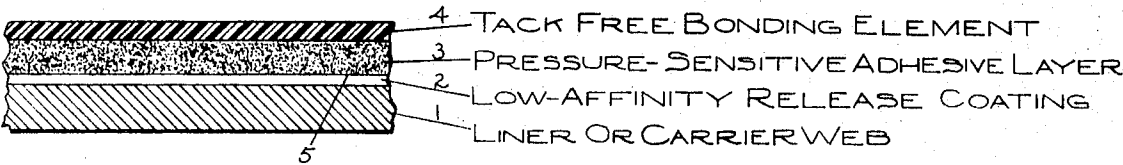


FIG. 1

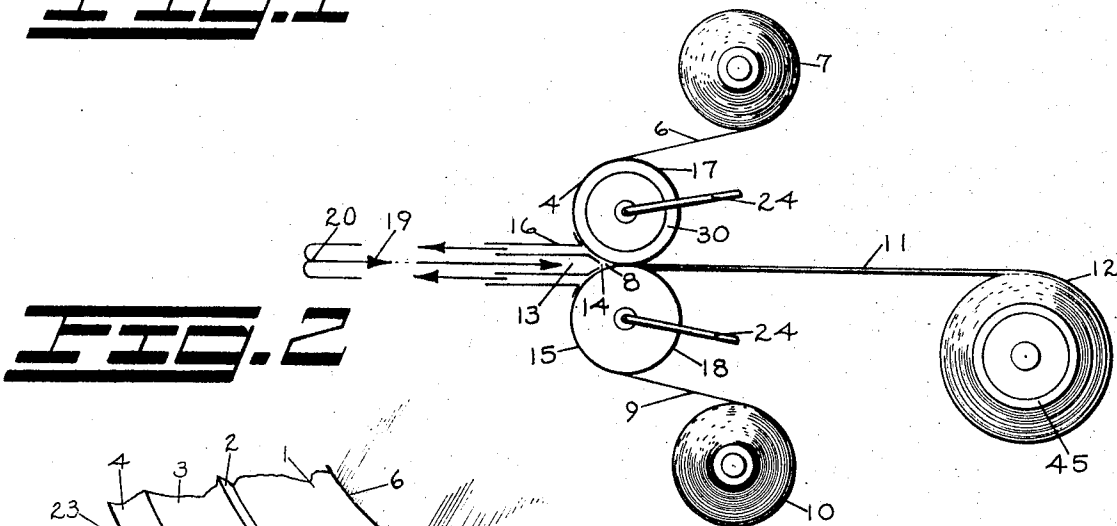


FIG. 2

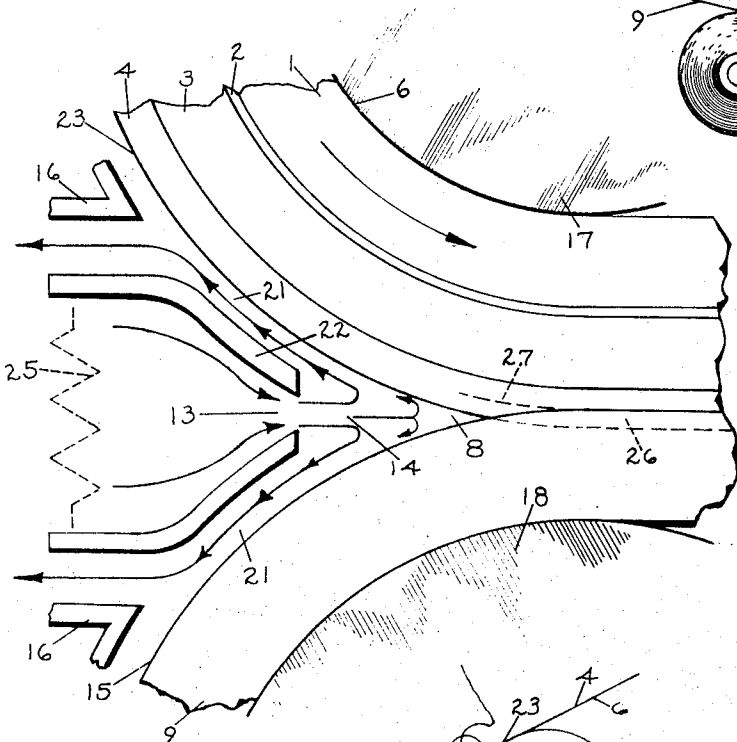
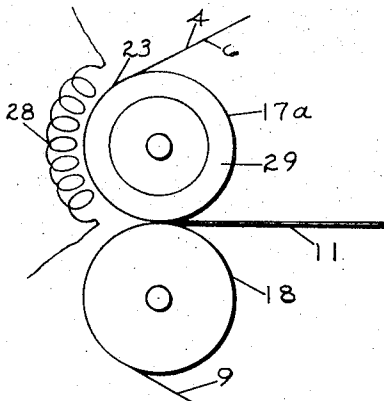


FIG. 3

FIG. 4



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2 Sheets-Sheet 2

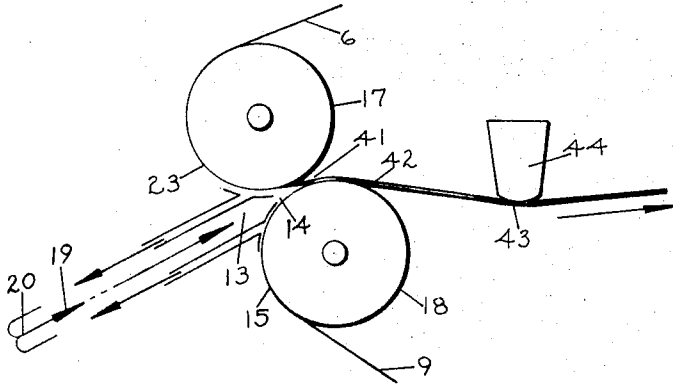


FIG. 6

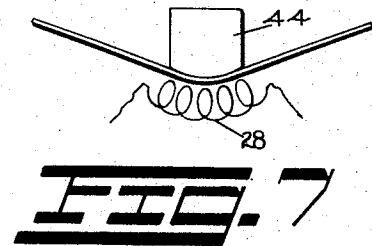


FIG. 7

FIG. 5

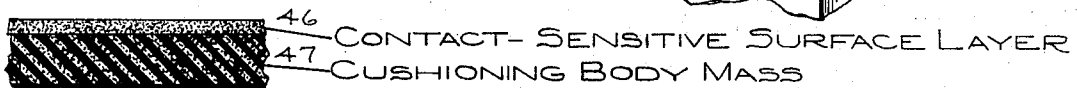
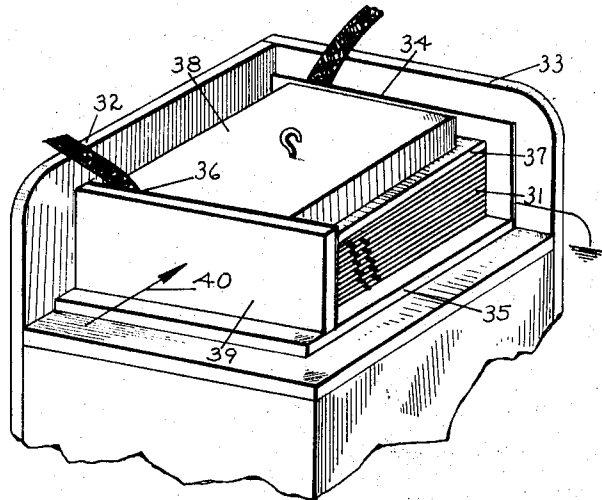


FIG. 8

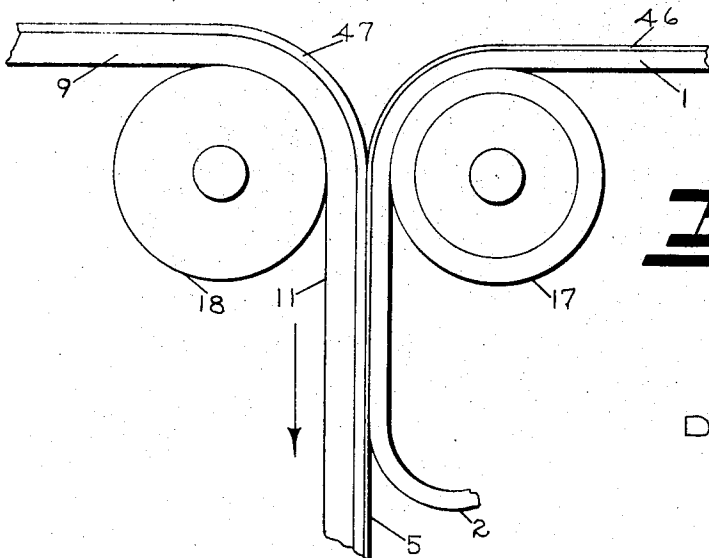


FIG. 9

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1

3,843,480

DRY DRY TRANSFER

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Continuation of application Ser. No. 687,532, Dec. 4, 1967, which is a continuation-in-part of application Ser. No. 327,312, Dec. 2, 1963, which in turn is a continuation of application Ser. No. 305,231, Aug. 28, 1963, all now abandoned. This application Dec. 10, 1971, Ser. No. 206,967

Int. Cl. B41m 5/02; C08c 11/70

U.S. Cl. 161—167

11 Claims

ABSTRACT OF THE DISCLOSURE

Laminates are produced for use in label printing, roll printing, lithographic sheet printing and in other arts by laminating a selected substrate with a special transfer web having one surface adapted to be activated and adhered to said substrate. The special web and substrate, for example in the form of rolls, are brought in impingement relation between a pair of rollers so that said surface of the special web is brought in contact with a surface of the substrate and prior to said impingement intensively activating said surface of the web but in shallow depth, for example by heating, and thereby effecting the adherence of said web to said substrate in said impingement.

CROSS REFERENCES TO RELATED APPLICATIONS

This is a continuation of application Ser. No. 687,532 filed Dec. 4, 1967, now abandoned, which is a continuation-in-part of my co-pending application Ser. No. 327,312, filed Dec. 2, 1963, now abandoned, which in turn discloses certain subject matter disclosed in my application Ser. No. 562,406, filed July 1, 1966, now U.S. Pat. No. 3,342,325, granted Sept. 19, 1967, a continuation of my application Ser. No. 305,231, filed Aug. 28, 1963, now abandoned.

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to the transfer gumming of paper, film and the like, and more particularly concerns a method called "Dry Dry Transfer." The process comprises the preparation of a surface-detackified layer of pressure-sensitive adhesive carried releasably upon a backing material or supporting liner. This product may be stacked in sheets, or wound in rolls from which it later may be unwound freely without adhesional resistance and thereafter attached to an overlaid material or substrate such as printed paper, film plastic sheeting and the like by activating the detackified surface of said layer.

DESCRIPTION OF THE PRIOR ART

The use of transfer techniques in the pressure-sensitive adhesive field is old, and such techniques are utilized advantageously in the attachment of adhesive deposits to a miscellany of materials and surfaces upon which direct application would be impossible, disadvantageous or undesirable. Such applications include the gumming of fabrics and other deeply cavitated, porous or highly absorbent materials such as felt, solvent-distortable elements such as rubber, and materials which may be adversely affected by the heat of drying or difficult to handle over the spanning required in coating and drying. This type of processing is usually accomplished by using the wet transfer technique, by which is meant that the adhesive deposit is applied to a carrier web, passed through a drier beyond

2

which it is laminated to the desired material or objects, and there wound or sheeted. This process may be defined as the direct transfer method.

In the indirect or known "dry" transfer process, a pressure-sensitive adhesive layer is applied to a liner or carrier web, thereafter dried and interwound into a roll. By having release-coated both surfaces of the liner or carrier web the material may be unwound from the roll and self-adhesively attached to paper, cloth, film or other object; thereafter the previously release-coated liner or carrier web may be peeled from the adhesive layer, which, after a sufficient period of time, will have transferred or affinity itself to such object in a manner appearing not unlike its having been deposited originally on such object. Such a product in the form of transfer tape is used widely in the graphic arts, especially in the strip-gumming of advertising material following its imprinting.

Although the known dry transfer method theoretically could accomplish some of the same ends as are accomplished by the instant invention, its practical utility usually is limited to narrow-width applications such as that just described. Nor is this without reason. The reliability with which the releasable layer of the pressure-sensitive adhesive may be unwound is not a certain thing. It demands complete physical contact throughout its entire surface area within the wound roll, the achievement of which accelerates in difficulty as its width is increased. Such difficulty is aggravated by the relatively hard-compositioned materials which are used as releasable liners or protection backings, these normally being glassine, parchment or hard-finished kraft, which often are dimensionally distorted in supercalendering and tend to be quite inelastic when contrasted with less firm paper stocks. Additionally, it demands release-coating of both surfaces of the carrier, which necessarily involves additional cost and technical problems associated with optional curing of release compositions such as silicone resins. Certain of these double-faced liners may be differentially surface-affinitied for the adhesive, such approach normally being needful if the product is to be unwound with the adhesive surface facing inward, since its inclination is outward. In consequence of such differential release, whether intended to permit its unnatural unwinding or to alleviate some of the difficulties previously described, the releasability of that surface from which the adhesive layer ultimately must be separated will be lessened and thus potentially marginal at its final point of use.

The terms "dry dry transfer" as applied to the process of the present invention becomes meaningful when considered in relation to its described predecessors, in that its unmasked surface is detackified and non-blocking, and thus drier than "dry" in terms of pressure-sensitivity. Its motivating purpose is to extend the advantages of the transfer technique into various useful areas which heretofore has not been feasible, by permitting the over-all pressure-sensitive gumming of virtually any material or adaptable object at the most ideal location and in that point in its processing which is most suitable. This is made possible by changing the actual application of the pressure-sensitive adhesive layer to the desired article from a coating and drying operation to one of simple lamination.

By such means a label printer may convert any roll of base material in his inventory to pressure-sensitive label stock on his own premises and at any time he chooses without having had to anticipate each specific demand and/or to have protected himself by an unwarranted increase in the amount and variety of his inventory. Thus he is able to service his customers most expeditiously, while at the same time avoiding accumulation of high-cost special-purpose inventory with consequent risk of loss often encountered in such material.

Also, in the printing and die cutting of pressure-sensitive labels which usually involves stripping the lattice-like matrix which surrounds the shaped finished labels, the affinity relationship between adhesive and liner or releasable backing is most critical. Variation in such adherence often presents exceedingly difficult problems in separation of the matrix. Sizable variations occur both in time and as a function of type and treatment of the label substrate to which the adhesive deposit is attached. By means of the dry dry transfer technique, as hereinafter will be explained more fully, such variations stemming from differences in the adhesive-coated substrate may be eliminated, permitting the label printer to work with materials of known consistency and thereby to achieve higher levels of production efficiency in the manufacture of such products.

A second example is that of a roll printer of display advertising material which is to be coextensively or partially pressure-sensitive adhesive coated. Similarly as with the label printer he may choose any base material from his inventory, and in this case he may print it from the original roll and follow such printing by lamination to the new pressure-sensitive adhesive element, either separately or in tandem with the roll-printing operation, or if he chooses he may reverse the sequence.

A third example is that of a printer or lithographer who handles his product in sheet form. Every such printer who has handled pressure-sensitive gummed sheets, each of which is a lamination of paper or other substrate coated with a layer of adhesive mass and backed with a protective covering, has experienced many difficulties, much of his trouble stemming from the simple fact that pressure-sensitive adhesive compositions are sticky, and that even though sandwiched between protecting sheets, the reliability of their containment is uncertain. Means for alleviating some of these difficulties are described in my above-mentioned patent stemming from application Ser. No. 305,231, filed Aug. 18, 1963. Application of such techniques as are therein described does not eliminate the problem completely, however, since exudation of such pressure-deformable compositions will persist, especially when the sheets are subjected to compression of their own weight when stacked. Thus in handling such pressure-sensitive sheet stacks the printer is forced to limit the height of each lift in order to minimize the consequences of stacking pressure. Since standard papers and the like, by utilizing the techniques described herein, may be converted later to pressure-sensitive laminates, the printer is permitted to handle the kinds of material for which his presses originally were designed, and to which they are best adapted, and thus he may avoid the difficulties encountered in the handling of obstreperous material. Similarly as was the case with the two prior examples, he may choose any stock available either from his own inventory or from that of his local paper supplier, rather than being limited to the use of such pressure-sensitive coated material as he may find immediately available.

The significance of the instant invention is more than that of simple improvement upon prevailing methods. For example, it could well result in sizable impact upon that portion of the established industry which supplies the graphic arts with much of their pressure-sensitive adhesive product.

BRIEF SUMMARY OF INVENTION

The present invention comprises improvements in the lamination of materials to produce a dry dry transfer, including combining two continuously moving webs into a laminate in which the surface of one of the webs is heat actively adhesionable to the other web. The improved method comprises the steps of continuously advancing the two webs in impingement relation between a pair of rollers, so that said surface of the one web is brought into contact with the other web. In this basic procedure the improvement covered by the invention com-

prises heating said surface superficially within the impingement nip to effect activation thereof, and controlling the heating to cause intensive activation only in shallow depth and then adhering said surface to said other web.

The heating specified in the above outline is also advantageously applied to the adjacent surface of the other web, by injecting heated air into the impingement area or by electrical induction heating applied selectively. The adherence between the two webs may be induced and/or augmented by subjecting the laminates to a high frequency vibration. In the foregoing operative procedure, the surface of one of said webs facing the opposite web advantageously carries a layer of pressure-sensitive adhesive adapted to be secured peripherally to the other web. Also, a layer of some other material may be provided on the surface of the layer of pressure-sensitive adhesive, and this adhesive web composite may be wound into a roll and the composite delivered continuously therefrom for lamination with the other web.

The special transfer web employed in the foregoing method includes a layer of pressure-sensitive adhesive and a supporting liner therefor, wherein one surface of said layer is attached adhesively to but is separable from the supporting liner and its other surface is adapted to be adhered preferentially to said selected substrate, thereby to form the laminate with the layer of pressure-sensitive adhesive interposed between the liner and the substrate. In this structure said other surface of the layer of pressure-sensitive adhesive includes or carries adhesion-preventing disparate material, such as a powder inert with respect to the ingredients of the adhesive, said material having the property of rendering said other surface essentially tack free so that the liner carrying the layer of pressure-sensitive adhesive may be wound into a roll and unwound therefrom without adhesional restraint between said other surface and the liner. Nevertheless the resulting modified surface of the layer of pressure-sensitive adhesive is adapted to be and is activated adhesively and subsequently joined laminarily with said selected substrate.

In preparing a roll of the liner and adhesive the exposed surface of the adhesive is dusted with a mineral powder of approximately 25 microns, for example, at ambient temperature and the non-adhering dust is blown off. The exact proportion of adhering powder particles to adhesive can be determined by simple tests so that with each selected material the amount carried by the adhesive is such that the modified adhesive surface prevented the bonding of the liner to itself when wound into a roll, but said amount being such, however, that the modified adhesive surface will bond to a substrate when heated to an activating temperature and pressed onto the surface of a substrate. In this form of the invention the heating or other activating action is done to soften the surface of the adhesive and permit the particles of powder to embed as the liner and adhesive is pressed onto the substrate.

The primary object of the invention is so to simplify the application of pressure-sensitive adhesives to selected materials of the character described as to permit affixing the adhesive in the most optimal sequence and at time and place most convenient.

That which first derives from such achievement, being a further object of the instant invention, is reduction in both direct and indirect manufacturing cost of the final product. Elements which contribute to cost reduction include: economical coating runs of standardized product as contrasted with much smaller and often custom production lots, elimination of the coating converter's procurement, handling, spoilage and markup on base stock with which only the final processor or printer need be concerned, lessened value of spoilage incident to such processing, elimination of additional spoilage and damage to printing plates and blankets caused by machine mishandling of tacky-edged material, higher production speeds of equipment together with a lessened amount of non-operating machine time, the elimination of man-hours

5

involved in attempted clean-up and/or detackification of sticky-edged material, simplification in inventory with consequent reduction in working capital so invested, and the corollary savings in potential loss from deterioration.

A further object of the instant invention, which is of practical import both to printer and customer is the great variety in finished product obtainable from a simplified basic inventory of standard materials, from any of which primary elements pressure-sensitive products, e.g., labels, bumper strips, emergency or correcting overlays, badges, display advertising material, etc., may be produced.

Means by which these and other worthwhile objectives may be achieved will be apparent from the further developing description together with the accompanying drawings in which:

FIG. 1 is a diagrammatic greatly enlarged segmental cross-sectional view showing the combination of elements which make up one form of the product designated herein as dry dry transfer,

FIG. 2 is a diagram showing an illustrative system for the laminating of a dry dry transfer roll unit to a continuously moving web of paper, film or the like, wherein the bonding element is activated by the jetting of hot air directly into the nip of a wringer,

FIG. 3 is a enormously enlarged segmental cross-sectional view of the laminating nip of FIG. 2, showing in detail the area of superficial heat transference,

FIG. 4 is a segmental diagram showing an operation similar to that of FIG. 2 in which activation of the bonding surface is accomplished by eddy currents induced within the transfer unit,

FIG. 5 is a perspective view illustrating the application of dielectric heating to a stack of paper interleaved with sheets of dry dry transfer units, the stack being under vertical contact pressure and subjected to internal heating preferential to the anchoring strata, thus causing interfacial bonding of the laminates with minimal introduction of heat and mean temperature rise as the heat disseminates throughout the mass following thermal activation of the bonding layers,

FIG. 6 is an illustrative diagram of the laminating portion of a continuous web system wherein interfacial bonding may be accomplished or aided by high frequency vibratory excitation, and also showing junction of the webs passing through an open nip and being defectively compressed by web tension,

FIG. 7 is a segmental illustration showing web-defective bonding wherein vibratory excitation and inductive heating combinedly activate the bonding element,

FIG. 8 is a greatly enlarged cross-sectional representation of a bi-compositioned pressure-sensitive adhesive element, and

FIG. 9 is a diagrammatic view showing the joining of separately-coated webs to form a finished laminate following the teaching of FIG. 8.

Referring to FIG. 1, a liner or carrier web 1, having one of its surfaces release coated 2 in such manner as to be relatively impervious to and controllably low-affinitied for an applied layer of pressure-sensitive adhesive composition 3, combined with a dusted, treated, coated and/or laminated overlaid tack-free element or material 4, permits the composite adhesive-bearing product or transfer unit, as shown in FIG. 1 to be wound upon itself or sheeted and stacked as readily as if it were non-adhesive paper, and thus capable of being unwound or freely separable from a stack without blocking or adhesional interference. Additionally, the outermost material 4, or the combination thereof with the adhesive composition 3, may be attached to another surface such as that of printing paper, film or plastic sheeting, which hereinafter will be designated "substrate," thereby forming a laminated construction within which is sandwiched the layer of pressure-sensitive adhesive composition 3, from which adhesive layer 3 the release-coated liner or protective back-

6

ing 1, 2 may be peeled when desired, exposing the thus-protected adhesive surface 5 and permitting attachment present in the aqueous phase, to the evaporative surface, of the remaining elements of the laminate to another surface or object in the form of a pressure-sensitive adhesive label or other appliqué as befits its intended purpose.

Except insofar as special applications may require, the basic demands which must be met by the liner or carrier web 1 in effectively performing its principal function as hereinbefore described are minimal, including merely its capacity to be properly and economically release-coated 2 and to be adequately strengthened and properly flexible so as to permit its foolproof release from the adhesive surface 5 of the then-substrate-supported assemblage. Composition of both the release coating 2 and the adhesive mass 3 may follow established practice, the dry dry transfer technique herein described being applicable to any normal combination of such elements without known exception.

Whereas these three elements 1, 2, 3 may be in strict accordance with their well-established counterparts in the existing art, the inclusion and use of the detackifying outermost surface element or material 4 therewith distinguishes the instant invention from its predecessors, and may become highly specialized and purposeful in a number of respects in addition to that of simple or reactivatable detackification. This element 4 may comprise different forms, e.g., finely divided particles, a surface coating or a continuous film, these three basic forms implying application respectively by means of dusting, fluid deposit or lamination.

In its elemental form, detackification may be accomplished by means of dusting the surface with inert powdery material such as clay, talc or other similar substance, each of which may be categorized as a particulate material which ultimately may function as filler within the adjacent stratum of the adhesive layer following activation. The choice of suitable materials or combinations thereof and the selection of particle size will be dictated largely by the behavioral characteristics of the pressure-sensitive adhesive composition, especially as concerns its cold flow properties and taking into consideration the conditions of temperature, pressure, vibration and duration to which the product may be subject prior to its surface activation and lamination to the intended substrate. The use of zinc stearate, soaps and other materials inherently resistant to physical incorporation by the adhesive mass may be beneficial in broadening the range of adhesive compositions adaptable to powder detackification, materials of this nature being usable either independently or in combination with particulate fillers as above described.

Since particulate materials in general may be readily entrained when the supporting surface is fluidized, it will be apparent that the composition of the outer stratum of the adhesive layer may be modified, e.g., by the inclusion of filler as suggested above. Since fillers tend to stiffen and may increase cohesion within elastomeric adhesive compositions it may well be anticipated, in direct consequence of such envelopment, that the interfacial anchorage between the adhesive mass and a mechanically keyable surface such as that of paper could be measurably improved. Thus it follows that powder detackification may be used for multiple and diverse purpose, and may include many types of finely-particled substances and combinations thereof. Among those which are intended to combine fully with the outer stratum of the adhesive layer are:

- (a) substances which are inert and retain their particulate identity as in the case of fillers.
- (b) those which may be reactive with the adhesive composition and cause its chemical structure to be altered following activation, and
- (c) those which fluidize when activated and cross-blend with said stratum, e.g., an adhesive-enhancing resin having good compatibility with the adhesive composition.

It will be understood, as above suggested, that combinations of materials often may be used to considerable advantage. It also will be apparent that the extent of combination may be affected importantly by the intensity and kind of agency utilized in the activating process.

Somewhat more challenging and potentially expansible is the concept of partial incorporation into the next adjacent stratum of the adhesive mass, wherein the interfacial anchorage to the substrate comprises solely or essentially the detackifying substance(s) per se, from which contacting interface it may crossblend gradingly with the adhesive composition, such basic principle being well known and manifestly operable.

Powder detackification may also include noncompatible thermoplastic film formers, the fusing of which in some cases may be aided by meltable solid plasticizers and/or resins, the latter potentially contributing to increased adhesion and improved interfacial bond between the substrate and the adhesive layer. Similarly, microencapsulable combinational arrangements may be usefully adapted to this technique. Later discussed means by which activation and bonding may be accomplished, wherein inordinately high interfacial surface temperatures may be developed almost instantaneously, and thereby limitable to exceedingly shallow depth, may permit the use of melt and fusion points far in excess of those normally applicable to heat-sealing techniques. Thus the range of usable materials may be broadened and the capacity for positive anchorage considerably enhanced.

The reactivatable surface element 4 may also comprise a fluidly-deposited composition applied in solution, dispersion or emulsion form and thereupon dried, or it may be a hot-melt coating, or an extruded or curtain-coated thermoplastic element. Certain of the teachings hereinbefore described similarly may be applicable to fluidly-deposited compositions.

A further basic form of application of the surface element 4 is by means of lamination with a previously prepared film.

FIG. 2 shows an illustrative system adapted to the laminating of dry dry transfer product, as shown in FIG. 1, with a continuously moving substrate, thereby accomplishing one of the end-purposes of the instant invention. An adhesive-bearing composite unit 6 tensionally travels from its pre-wound roll 7 through the nip 8 of wringer rollers 17 and 18, where its surface material 4 mergingly contacts the surface 15 of a symmetrically threaded substrate 9 delivering from its prewinding 10, the wringer-joined laminate 11 thence being wound at 12. Hot air 13 is jetted at 14, at high velocity into the wringer nip 8, thus heating and activating the previously-detackified surface material or element 4 and the adhesive layer 3 of the adhesive-bearing composite 6, and simultaneously heating the mating surface 15 of the incoming substrate 9. It is preferable in such an activating system that the hot air be recycled, as indicated schematically by suction pickups 16 positioned in contoured proximity to the wringer rollers 17, 18, and the forceful hot air return at 19 by a blower 20.

A more detailed examination of the behavior of the hot air activating system will be aided by reference to FIG. 3 which shows in enlarged detail the critical area of heat transfer immediately adjacent the nip 8. The heated air 13 from a heater 25 is jetted turbulently into the nip 8 from nozzle 22 as a jet 14, from whence it flows laminarly outward from the nip through the restricted passages 21 between the opposed outer surfaces of the nozzle 22 and the surfaces of the incoming composite unit and substrate 6, 9. By such means it will be apparent that the mating surfaces 23, 15 of the two members 6, 9 may be convectionally heated by the counter-directional flow of hot air, that the rate of heat transfer to such surfaces 23, 15 is subject to control as a function of temperature differential and relative air velocity, that the air-heated outermost surfaces 23, 15 of the merging members 6, 9

will increase in temperature as they approach contact with each other, and that the depth of heat penetration into the members 6, 9 may be controlled as a function of the rate of heat transfer and the interval of exposure.

It further will be apparent that interfacial bonding of the character here involved is not needful of heat penetration in depth, and that, in point of fact, minimal penetration is highly desirable. Thus, two mating members whose surfaces were weldably heated one micron in depth at the instant of contact would be bondable by application of a small quantity of superficial heat at the selected temperature.

EXAMPLE I

In accordance with this example, the dry dry transfer unit 6 of the roll 7, as shown in FIG. 2, is made up of a paper liner 1, which is release coated at 2 as in FIG. 1, which release coat carries a pressure-sensitive adhesive of the type which consists essentially of a polyvinyl chloride/acetate copolymer such as Vinyllite VYNS-3 and a polyester plasticizer such as Flexol R2H in approximate proportion of 1:4 and including the customary amounts of stabilizers. This type of adhesive is prepared by dispersing the resin in the plasticizer, heating and stirring the composition until homogeneous, thence preferably casting the desired layer 3 on the release coated liner 1, 2 at a thickness of .002-.003 inch and cooling the composite web. In order to complete the unit 6 so that it may be wound into the roll 7 the exposed surface is dusted with talc comprising particles in the range of 20-30 microns, the application of which may be air propulsioned and the excess not adhering removed by suction, which leaves the surface of the adhesive with an apparent covering of the talc. This covering corresponds to the material 4 identified in FIG. 1. As the unit 6 is made up in this way, it is wound into a roll such as the roll 7.

The volume of talc attached to the surface of the pressure-sensitive adhesive will range from 60 to 80% of a theoretically perfect single layer of such material due to its random placement. Given an average particle size of 25 microns, the deposit therefore may be expected to range from $\frac{3}{4}$ to 1 cu. cm./sq. ft. Nonetheless the volume retained is sufficient to detackify the adhesive layer in the wound roll 7 or when sheets of the composite unit 6 are stacked one upon the other.

The dry dry transfer in roll form is used by a printer or other processor who transfers the adhesive layer along with the line to a printing paper thereby forming a pressure-sensitive laminate. This is accomplished by the procedure described in connection with FIG. 2 in which the printing paper, substrate 9, and the dry dry transfer unit 6 are passed through the heating zone 8 at a speed of about 2 feet per second. The adjacent surface of the transfer unit is heated superficially and rapidly to a temperature of about 315° F. by the air jetted into the nip 8. This heating is applied to the talc and also to the adhesive which is softened to a depth of from 15 to 25 microns. The printing paper is, of course, also heated and it and the composite 6 come together between the rolls 17 and 18, and the talc particles are embedded and enveloped in the adhesive layer, so that the pressure applied by the rolls firmly adheres the adhesive layer to the printing paper.

In the case of roll or continuous web printing the laminate may be formed as described either before or after printing, or at any point most suitable in processing the finished article. The liner serves as a protective covering for the exposable adhesive surface and normally is removed therefrom by the ultimate user of the finished article.

The dry dry transfer process is adapted ideally to thermoplastic film substrates which are used extensively in pressure sensitive laminates and labels. Since films of this character are normally heat-activatably adhesional in their own right, this quality permits their being utilized either solely or combinationally as the interfacial bonding ele-

ment. One exemplary application is that in which the detachifying material 4 consists of a fibrous tissue or a layer of flocking, to which a thermosensitive film substrate may be self-adhesively attached in accordance with the herein described principles. Furthermore, the bonding interface may be gradingly cross-blended when the merging surfaces are suitably compositioned and solublized superficially at their conjunction. This technique is especially significant when attempting adhesional anchorage to compositional films such as plasticized vinyl or acetate sheeting wherein the surface may comprise an exuded modifier rather than resin, to which bonding anchorage is often futile. Such a surface may be made amorphous by solubilization, and thereby rendered adhesionable and combinable gradingly even with minimally compatible or miscible materials.

EXAMPLE II

A dry dry transfer product different from that described in Example I is prepared by coating the releasable surface 2 of the liner 1 with a pressure-sensitive adhesive composition 3 of the type described in Pat. No. 2,553,816, such compositions having relatively high adhesional properties and being "eucohesive," i.e., even more cohesive and adhesive. The adhesive composition is applied in solution form and the web passed through a drier to remove the solvents. The detachifying material 4 is deposited at a point intermediate in the drying process and thence to complete the removal of the solvent, thereby permitting the detachifying particles to be embedded somewhat more deeply, with roughly half the diameter of a particle protruding above the surface. The detachifying material 4 in this Example consists of a polyethylene powder, i.e., Microthene FN-510 having an average particle size of 30 microns, with which an anti-caking agent is intermixed in order to improve its dry flow properties and facilitate its application. The powder is applied in sufficient excess to insure complete random coverage and the unattached particles removed prior to winding the completed unit 6.

Lamination utilizing this transfer unit 6 is accomplished by a procedure similar to that of Example I except that the substrate 9 comprises a polyethylene film. The two webs are passed through the heating zone 8 at a speed of about 10 feet per second, the various factors affecting the transfer of heat from the high-velocity air streams to the intermingling web surfaces being so adjusted as to effect nip contact at about 250° F, or sufficient to fuse the interface web surfaces.

The indicated speed is much higher than in the prior example, one purpose of which is to maximize the temperature gradient abruptly proximate the interface and to discourage even moderate heat penetration in depth, thereby so minimizing the quantity of heat absorbed by the webs that the mean temperature rise therein will be barely discernable and the welded interface solidified almost instantly as the heat is conducted into the adjacent material and thence disseminated throughout the entire mass. Whereas in Example I it was necessary to soften the adhesive layer in sufficient depth to permit envelopment of the detachifying material 4 as filler and to permit sufficient migration of the adhesive composition through the network of particles to make adhesional contact with the paper substrate, in the present example the material 4 was originally embedded sufficiently in the adhesive layer for purposes of good anchorage and that in this instance the adhesive composition 3 is not relied upon for interfacial bonding. In fact in this application it is intended that the adhesive layer be substantially undisturbed, thereby permitting a simple and ideal weldment between essentially identical substances.

The lamination as described in Examples II may be altered in a number of particulars. For example, the film 9 may be reverse printed so as to be readable from its unprinted or outer surface and the printed surface juxtaposed

against the fusible layer 4, following the customary practice in printing transparent films in general, but one which often is avoided when pressure sensitive laminates are involved due to the additional cost and time required for custom gumming following imprinting. It also is noted that by disproportionate heating of the intermingling surfaces, e.g., by heating the layer 4 more or less intensively, its optical characteristics may be altered markedly from almost clear to diffused since the unfused particles herein specified appear white. When heated more intensively such particles will be fused, in fact into a continuous film, thereby permitting the development of a membranous barrier in accordance with one of the desired objects of the invention.

EXAMPLE III

Referring again to FIG. 3 of the drawing and recalling the foregoing feature of controlled depth heat penetration, reference is now made to the materials processed by the heating procedure. While the activating procedure illustrated in FIG. 3 is applicable to the transfer of a pressure-sensitive adhesive layer which had been detachified by being dusted or powdered with a material of the type referred to above, this Example and FIG. 3 illustrate the use of an extruded or dry laminated film 4', that is, 1 mil thick polyethylene, overlaying an adhesive layer 3 of polyisobutylene pressure-sensitive adhesive preferably one of the known types and formulations thereof which are quite commonly used in graphic arts applications.

The elements 1 and 2 of the dry dry transfer 6' shown in FIG. 3 are the same as those referred to in Example I. In this special case the dry dry transfer is joined by hot air heat activation to an extremely porous substrate 9' having a relatively open structure of matted fibers, such as that found in a very weak book paper or news print. In the particular instance, the substrate 9' is an extremely porous printing paper, so that when its outer surface and the surface of the polyethylene film 4' are rapidly heated to a temperature of 112° C., or that sufficient to soften the polyethylene film is sufficient depth, that portion is embedded into the porous printing paper 9', e.g., to the extent of approximately 50% of the thickness of the film, as indicated in FIG. 3 by the reference numeral 26.

The showing of the thickness of the elements 1, 2, 3, 4' and 9', and the embedment 26 is greatly exaggerated in FIG. 3. In order for such embedment 26 freely to have taken place, the polyethylene overlay 4' would have to have been made quite fluid at its outer surface 23, the temperature thereof being much higher than the softening or welding point as indicated above, and at least readily deformable at its midway laminar plane 27. Such a temperature gradient may be developed reliably by adjustment of the controllable variables: hot air temperature and volume, design and impingement adjustment of nozzle 22, and machine speed. By such partial embedment of a flexible elastomeric film, as in Example III, several of the previously listed specialized objects of the instant invention may be achieved, including the barriering of adhesive plasticizer, and reinforcement of the substrate.

In some applications the use of a solvent is advantageous either in lieu of or in combination with heat and/or other activating means whereby the joining of elements 4 and 9 as in FIG. 2 may be accomplished. One technique which is well adapted to combinational treatment is by hot vapor impingement, whereby both heat transfer and solvent attack may be made most rapid. This also permits uniform application of wet-condensed solvent in such exceedingly small amount as to be contained within the partially-solvated surface, thereby providing such surface with immediate adhesional capacity.

Proceeding now to FIG. 4, the illustration shows the combining portion of a web laminating arrangement like that of FIG. 2, but differing with respect to the method by which activation is accomplished. Positioned around a

portion of the upper wringer roller 17a, and in contoured proximity to the pressure-sensitive adhesive-bearing web unit 6, is a high-frequency hairpin coil 28, designed to induce myriad alternating eddy currents selectively in the outermost layer 4 of the transfer unit 6, causing said layer to be heated and the surface of the transfer web 6 thereby to be activated at its conjunction with the substrate 9. It will be understood that the electrical characteristics of the layer 4 in this type of application are suited to inductive heating in the described manner.

In FIG. 4 the upper wringer roller 17a differs from that shown in FIG. 2 by being more deeply faced at 29 with a non-inductively-excitable composition, so as to prevent its being heated by the hairpin coil 28. Similarly as with the elastomeric facing 30 of the upper roller 17 in FIG. 2, it is preferable that pairs of pressure-laminating rollers be differently surfaced, the usual combination being rubber opposing steel, so that there may be relatively uniform nip pressure with sufficient cushioning to allow for the undulating imperfection of papers and the like.

Whereas in the hot air activating technique previously described, surface heating was accomplished in close proximity to the nip and maximized at the junction of the two webs, or at a point very close to such junction, it is impractical to attempt induction heating in such location. In effect, however, it will be observed that a similar phenomenon may be achieved by inductive means, as implied in the example given above, wherein the heat may be first developed in dispersed metallic particles and therefrom transferred to the surrounding adhesionable composition, such transfer requiring an interval of time during which the subject composition is approaching nip contact with the substrate. Thus, heat transfer to the composition per se is designedly continuing during this interval and ideally apexing at the point of contact.

In applications wherein potential supercooling of the bonding interface by contact with an upheated substrate may be encountered, an additional reservoir of transferable heat may be provided at or near the contacting surface of the bonding layer 4, e.g., by having enlarged the inductively-heated particles and thus increased the ratio of their heat capacity to their surface-conducting area, or by altering inductive input and/or machine speed in order similarly to provide heat capacity sufficient to offset and/or to remedy such supercooling as may have occurred at the initial point of contact. If desired, it is also possible to preheat the intermating surface of the substrate by separate means, e.g., by contact with a suitable roller or heated element, which may be done simply and effectively when handling heat-insensitive substrates such as paper, or by supplemental transfer from heated air to thermo-sensitive substrates.

The lamination of dry dry transfer to printed substrates in sheet form, to which prior reference has been made, or to a variety of individual objects such as die cut or preferred shapes, may be accomplished by any of the means hereinbefore described which may be suitably adapted to the handling of such separate sheets or objects. For such application the adhesive-bearing composite may be used in continuous web form, or it may have been preheated and/or die cut while in its detackified state, and in such dimensioned or shaped form activated and thence applied.

The lamination of sheets, such as printed paper and the like, may be done on a flow basis as indicated above, utilizing either continuous web or mating sheets of dry dry transfer. Alternatively, a batch process may be used as illustrated in FIG. 5, wherein similar sheets of substrate and adhesive-bearing composite units are alternately laid up in a stack 31, and therein carefully jogged into upright juxtaposition against the backboard 32 and an end-positioning sideboard 33, which is faced with a grounded metal plate 34 serving as an electrode. For convenience in handling, the stack of sheet stock 31 has been laid on a base panel 35, which additionally supports an opposed

high voltage electrode 36, said base panel being satisfactorily compositioned with respect to its dielectric proportion. A similarly compositioned panel 37 rests atop, and applies vertical pressure to, the stack 31, gravitationally developed by the surmounted weight 38. Beans 39, 40 is provided for fixing the placement of the opposing electrode 36 against the vertical end face of the stack 31, in order that its intimacy therewith may be established and maintained. By means of such arrangement and provision for the generation of high-frequency electrical energy, each of the adjacent pairs of sheeted substrate and dry dry transfer may be joined together by application of dielectric heating to the stack 31, the interfacial bonding element(s) preferably being so compositioned as to be selectively heated in maximal differentiation to the substrate per se and the other layered elements of the adhesive-bearing composite.

Dielectric heating also may be applied in a manner similar to that which is used in the bonding of high pressure thermosetting laminates, in which the high voltage electrode 36 is a relatively thin plate positioned horizontally at the center plane of the stack 31, with two grounded plate electrodes 34 placed externally immediately underneath and atop the stack 31.

FIG. 6 shows another method by which suitably compositioned webs may be joined together, wherein the mating surfaces of the webs 6, 9 are superficially air-heated at 13, 14 in the manner hereinbefore described, the webs being passed through a clearance or open nip 41 and tensionally merged at 42 against one of the supporting rollers such as 18, and thence tension-opposedly at 43 and subjected to a high frequency vibrator 44, at which point the heat-modified interfaced surfaces 23, 15 are excitedly commingled and thereby securely bonded and/or welded together.

By means of tensionable open-nip laminating, certain problems of mechanically-applied nip pressure may be by-passed advantageously, and the linear proportioning of the mating elements 6, 9 tailored to suit the desired requirements. This may be accomplished by proportional adjustment of incoming web tensions, the sum of these two tension forces being matched by that of the down-web winding 12, FIG. 1, and by variably deflective curvature(s) 42, 43 (FIG. 6) to which the mating webs 6, 9 are subjected prior to their being curvilinearly stressed in the winding per se. Additionally it is preferable that laminates 11 of this general character, as indicated in FIG. 2, be wound at 12 upon a larger core or mandrel 45, in order to minimize shear at the freshly-bonded interface, to lessen set curvature of the laminate, and to permit sound winding at minimal tension whenever necessary or desirable.

The second teaching associated with FIG. 6 concerns the use of vibratory means 44, whereby suitable compositioned and/or immediately preactivated surfaces may be intermated and thereby reliably joined together. Physical oscillation is used effectively to induce the commingling of fluid or semi-fluid compositions. Rapid impactive pulsations impress semi-mobile compositions into fibrous semi-porous substrates such as paper. In the exemplary illustration, the frequency of the applied oscillation may range from low or simple mechanical vibration upward to sonic and thence into the ultrasonic range. As a general rule, the lower the frequency the more needful it is that one or the other or both subject surfaces be preactivatably mobilized, e.g., by superficial air heating at 13, 14 or by inductive heating by element 28 as shown in FIG. 4.

FIG. 7 shows a combinational arrangement not unlike that which was just described in reference to FIG. 6, but differing from it with respect to the placement of an inductive heating coil 28, outside the substrate, in juxtaposition to the vibrator 44, such positioning being designed to permit instantaneous interactivation and excitation at the bending interface.

EXAMPLE IV

This example of dry dry transfer is similar to that of Example I, except that the layer 4 includes a compatible resin such as Santolite MHP which has been pulverized and intermixed with the talc and an anti-caking agent such as Attacote in the proportion of 60:40:1, the resin having a particle size comparable to that of the talc. The purpose of the resin additive is to enhance the adhesion of the mergable surface of the adhesive layer 3 since compositions of the character described including, the specified type of vinyl copolymer, tend to be deficient in bonding properties. It therefore is desired that the adherence to the paper substrate be made more secure. The process of manufacture is the same as described in Example I but in addition thereto and immediately following the merging of the two webs, the composite laminate is passed defectively over the vibratory means 44 as shown in FIG. 6, the frequency of which need be only in the sub-sonic range since its purpose is manipulative in this instance.

Different types of adhesive compositions 3 were used in Examples I, II and III, each being combined with a different kind or form of detackifying material 4, the selection of which was dictated partly by characteristics inherent in the adhesive. For example, the vinyl copolymer composition of Example I is characterized by relatively low surface or contact adhesion after the material has achieved its final set which usually takes place in a matter of hours after being cased. It is of greater instant significance however that in spite of its plasticity and relative deformability its resistance to cold flow is inordinately high, and partially in consequence thereof its hold-out capability is of sufficiently high order to prevent occlusion of a material such as talc, for which many rubbery compositions seem almost devouringly attracted. In addition it has been observed that manipulation often is required to activate the talced surface completely even at elevated temperature, that which is developed in a wringer nip normally being adequate for this combination. It was this characteristic, however, which suggested the use of the same adhesive composition in Example IV, wherein manipulation was made certain by use of the vibratory means 44.

The adhesive composition of Example II is exceedingly aggressive adhesionwise, even higher in cohesion, relatively firm and non-distortable. Upon purely physical grounds its hold-out capability is at least reasonably good and therefore adapted to particulate detackification in the manner described.

The polyisobutylene compositions of Example III tend to be median in adhesion and somewhat variable in plasticity. In general however they require, and are capable of absorbing a considerable amount of plasticizer when contrasted with natural rubber. Partially in consequence thereof their cold flow properties tend to be rather high and often quite troublesome, e.g., by exudation at exposed edges especially when subjected to stacked or wound pressure. Since the use of powder or particulate detackification applied to this general class would be less desirable, a continuous film was specified in this example as the detackifying material, such a material being further advantageous as a barrier against the migration of plasticizer(s) into the absorbent substrate.

FIG. 8 relates to division of the orthodox pressure-sensitive mass into two differently-compositioned layers, each of which may be maximally capacitated with respect to its ideal functions and thus its compositioning unencumbered by the instant demands required of its opposite, which in the customary treatment of the adhesive composition must be compromisingly combined in a single mass. Observing critically the basic factors involved in

the making of an effective pressure-sensitive adhesive element, these include its surface or contact-adhering qualities, its cushionability which normally is demanding of depths in the coated layer, and its cohesive capacity. From this set of elementary requirements it is observed that, except for the adhesive's attachment to its supporting substrate to which more positive anchorage often is required, its contact-adhering qualities are needful only at the exposed outer surface and most assuredly not in depth as such. Cushioning, on the other hand, tends to be a function of depth and softness, and in itself is not necessitous of tack.

Bearing in mind the elementary factors which should be incorporated in a pressure-sensitive adhesive mass, attention is again directed to FIG. 8 wherein a minimally thickened contact-sensitive surface layer 46 is supported by a differently and cushionably compositioned layer 47 of sufficient thickness and planar deformability as to permit complete physical contact of the ever-tacky surface composition 46, when the bicompositioned element 46, 47 has been securely attached to a substrate and the resulting combination comprising an attachable tape or label, with another surface or object to which such tape or label is intended to be affixed. By so structuring a combinational adhesive element and specialisedly compositioning separately its outer adhesional contact layer 46 and its inner cushionable mass 47, the more desirable physical characteristics of each cross-sectional zone may be maximally developed in the complementary compounds with minimal concern for the other's requirements and provide a unit which can replace layer 3 or even layers 3 and 4 of FIG. 1.

As regards the contact-sensitive surface layer 46, the instant invention claims no contribution to the art of its compositioning, but is concerned more importantly with the supporting body mass 47 which, by being relieved of its ever-tacky surface requirement, may be more ideally formulated not only with respect to planar deformation, cohesion and cold flow, but additionally to provide barrier qualities, anchorage to the substrate, to be non-tacky and to complement the surface element 46. In consequence of having introduced separate treatment of the zoned layers, proportional thickness becomes an added and significant variable.

Among the advantageous contributions deriving from bicompositioning of the adhesive element, the most significant is the independent development of surface and internal characteristics in such manner as to permit full and instant utilization of the total adhesive surface, accomplished by having provided independent cushioning in the underlying body mass; and to the extent that such cushioning may be developed, the need for pressurable application in order to establish intimate adhesional contact will be reduced. Corollary to such achievement is the increased latitude permitted in the compositioning of the ever-tacky surface element 46 and its more ideal formulation; and further, by having reduced the volume of that portion of the adhesive mass in which some cold flow may be either unavoidable or advantageous, the deleterious effects of such mobility may be minimized.

Additionally, the power cutting and trimming of sheeted laminates may be aided materially by minimizing the thickness and consequent volume of the tacky composition, it being further apparent that each cushioning layer will tend to squeegee the troublesome back face of the guillotine and thereby tend to prevent accumulation of rolling crumb-like masses of adhesive which are a constant source of trouble and concern.

Also in the manufacture of die-cut labels, the tendency for butt-edge readherance along the lines of severance between a label and the waste surrounding it often makes separation of the matrix or lace-like lattice most difficult. Considerable improvement in this operation has been demonstrated with as little as 50% of the combinationai thickness comprising the non-tacky supporting layer 47.

Another feature, which may be incorporated into the cushionable body mass 47 of a dually-zoned pressure-sensitive adhesive composite, may be accomplished by making such mass non-absorptive of migratable plasticizers with which it may have contact. This is especially significant with respect to plasticizers present in the ever-tacky surface layer 46, the loss of which could have sizable effect upon its initial wet grab adherence and ultimately upon the ease with which it is removable. Conversely, a designed rate of plasticizer exchange from the surface layer 46 to the body mass 47 could be purposeful, thereby permitting a permanent label to be wettedly and conformingly affixed to a very rough surface and thereafter firming in its keyed attachment thereto. Additionally the cushioning body mass 47 may serve to protect the outer adhesive layer 46 from plasticizers emanating from the substrate.

The bi-compositioning concept may be advantageously incorporated in the dry dry transfer of this invention. So incorporated, the bi-compositioned layers 46, 47 would replace the indicated single adhesive layer 3 as shown in FIGS. 1 and 3. Interposition of the body mass layer 47 could alter the detackifying element 4 with respect to certain of its functions and/or its composition, or permit its elimination, wherein each and all of its original functions are transferable to the body mass layer 47. Such a combination, for example, may comprise a release-coated liner or carrier web 1, 2, the thin contact-sensitive adhesive layer 46, and a planarly-deformable surface-heat-activatable body mass 47, the exposed surface of which has a low affinity for the liner and permits ready unrolling when rolled up into a roll.

FIG. 9 shows a substrate 9, to which a body mass layer 47 has been applied, and a release-coated liner 1, 2 carrying a thin contact-sensitive adhesive layer 46. These two webs are combined in a closed-nip wringer having rollers 17, 18, to form a pressure-sensitive adhesive laminate 11' from which the release-coated liner 1, 2 subsequent may be peeled exposing the outer surface 5' of the contact-sensitive layer 47. Thus is illustrated another method by which a pressure-sensitive laminate may be produced, the adhesive element being bi-compositioned in the manner hereinbefore described. Such method similarly may be adapted to the manufacture of open-faced pressure-sensitive adhesive tape stock, either by substituting a negatively-surface-affinitied endless belt for the liner 1, 2, or by the temporary formation of a standard laminate 11' and subsequent separation of the reusable release-coated liner 1, 2 from the tape stock. Furthermore, a dry dry transfer unit 6 may be processed in a related manner by substituting a transient conveyance means in place of the substrate 9, forming thereon the disparate material layer 4 which coincidentally could comprise as well the body mass layer 47 serving dual function as detackifier 4 and cushioner 47, joining together layers 3 and 4 or alternatively layers 46 and 47, thence stripping the transfer composite 6 from the substituted conveyance 9 and winding into a roll 7.

In the event that interfacial anchorage requires activation of the junctioning surfaces of the body mass 47 and the contact-sensitive adhesive layer 46, one or more of the previously-described combining methods may be so applied; or by utilizing means for superficial activation, the intermating surface of the contact-sensitive adhesive layer 46, such surface having been detackified and thus comprising in a sense a dry dry transfer composite, may be joined to the body-mass-layered substrate 9, 47. Nor is it entirely inconceivable that certain substrates might not be suitably capacited in their own right to include all or a portion of the functions required of the body mass layer 47. Thus the interdependent and complementary nature of the several functions descriptively assigned to various of the laminar element, wherein body mass cushioning, for example, may be additively complemented by the detackifying layer 4 of the dry dry transfer composite 6, 75

and/or by planar-deformable characteristics of the substrate 9 itself or of an inwardly-oriented portion of it.

The manufacture of pressure-sensitive adhesive laminates in the manner illustrated in FIG. 9, and therein utilizing the bi-layered concept described in connection with FIG. 8, may be especially advantageous when either or both of the separately-laid layers comprise certain aqueous dispersions of water-insoluble compositions. The simple drying of such a coating causes a reduction in tackiness of the dried surface over the value obtainable upon its opposite surface. Quoting Mohr Pat. No. 2,477,196, "This effect is apparently caused by migration of water-soluble or water-carried dispersing agents, hydrophyllic colloidal agglutinants, and the like, which are initially present in the aqueous phase, to the evaporative surface, where they are deposited in a nontacky surface film on evaporation of the water." Whereas Mohr developed his unadulterated pressure-sensitive surface by splitting the double-thickness adhesive mass through its center plane, in the direct coating of substrates rather than using a releasable liner, the method herein described tends to draw the adulterants to the interface between the separately deposited and dried layers, thereby causing the web-contacting outwardly-oriented surfaces to be relatively free of such adulterants. Nor is the stated phenomenon exclusive to aqueous dispersions, for surface blooming often occurs both in solvent and hot-melt coatings in consequence of partial, transitory or basic incompatibility; and not infrequently such characteristic is utilized purposefully and advantageously, except that when applied to the development of contact-sensitive-adhesion surfaces the effect tends to be a lessening of the desirable properties. Nonetheless it is not inconceivable that the bi-layered concept of the pressure-sensitive adhesive composite herein described may be achieved successfully in a single-coated deposit, e.g., when coated directly on the substrate. Such techniques similarly may be applicable to the manufacture of dry dry transfer, thereby to develop opposed surface characteristics which may be advantageous both in its original manufacture and in the quality of finished product.

Air Heating Control

In order to approach an ideal air-activating system least consumptive of heat one should use maximal air temperatures and velocity with minimal interval of exposure, the latter requirement being favorably demanding of high web speed, as described above in connection with FIG. 3. Thus, when utilizing heated air for lamination, machine speed would be the limitation in practical application rather than the capacity for heat transfer. Similarly it will be noted that fusion or activation temperatures far in excess of those normally possible in heat-sealing applications may be attained and used safely when combined with short-intervaled exposures and shallowly-depted penetration. By means of short-intervaled intensive superficial heating, and the concomitant development of a steeply inclined temperature gradient through the immediately adjacent laminar planes of the structure, the conduction of heat away from the interface is accelerated, thus causing a rapid drop in temperature and consequent solidification and/or freezing of the bonded interface.

It also will be apparent that the temperature gradient, amount the minisculely-conceived strata of the heated surface, would be increased if the total web structure were chilled; which coincidentally would hasten the subsequent drain of heat away from the bonding interface and cause even more immediate seizure of the joined surfaces. For such purpose, either or both of the wringer rollers 17, 18, as well as other web-contacting media, may be chilled as schematically indicated by means 24 in FIG. 2. It also should be noted that such web cooling may facilitate the tensionable handling of heat-sensitive substrates 9 and that, by so firming the pressure-sensitive adhesive layer 3, greater nip pressure may be applied if desired. Addition-

ally, even though the wringer rollers 17, 18 are effectively insulated from the jetted hot air 13, 14 by the members 6, 9 when being run at high speed, absorption of some heat at lesser speeds, especially during startup and initial acceleration, may be offset by roller cooling, as similarly that which may develop adjacent the edges of the webs particularly when narrow margins are being run.

Since efficient application of this technique presupposes the use of exceptionally high air temperatures and the continuous recycling of the heated air, provision should be made for closed-circuit warm-up of the air system. In practical application, and in order to permit rapid acceleration from startup to optimal laminating speed, the air temperature should be held constant due to the sizable amount of heat which must be reservoired in the structure of the air system and to the lag inherent is attempted rapid rise in the delivered air temperature above that at which the heat-capacited structure has been equilibrated. Since high-velocity air flow aids heat exchange from the original heating source 25, which may indeed be necessitous when using high-density heating elements, and further contributes to stabilized equilibria throughout the air-handling structure, the air volume similarly should be maintained relatively constant. In addition to means for closed-circuit warm-up of the air system, provision for variably-clearanced hot air impingement into the nip contributes favorably to machine startup and operation. It will be observed that as the nozzle assembly 22, 16 is brought closer to the wringer nip, heat exchange from the air 13, 14 to the web surfaces 23, 15 is increased as functions of turbulence 14 in the nip 8 and of velocity through the restricted passages 21. By moving the nozzles assembly 22, 16 inward toward the nip 8 in calculated relationship to machine speed, the amount of heat absorbed by the members 6, 9 is subject to control, thus permitting effective lamination at selective machine speeds within a given design range. Additionally it is interesting to note that, when the prewarming closed-circuiting element is withdrawn at initial machine startup and the nozzle assembly 22, 16 is positioned for weak impingement and thus widely clearanced from the merging webs 6, 9, some of the jetted hot air will escape and be replaced at the suction pickups 16. This defect in perfect recycling, by causing an immediately sensible drop in temperature, may be utilized to signal full input of energy into the heating element. Such feedback happily anticipates the coming increase in demand and thus may serve to minimize the lag inherent in such systems. The dual increase in operational heat efficiency, resulting from improvement in recycling perfection as the nozzle assembly intrusionaly approaches its optimal running position, and that deriving from lesser-depted penetration into the traveling webs in consequence of the shortened interval of exposure, permits rapid acceleration to optimal running speed and minimizes the amount of potentially marginal or substandard product laminated by such equipment. Additionally, the inherent self-compensating factors hereinbefore described tend to place less sophisticated demands upon the necessary control circuitry.

What is claimed is:

1. An article of manufacture described as a dry dry transfer element adapted to be combined laminarily with a flexible substrate such as paper, film and the like to form a pressure-sensitive adhesive laminate having an interface at the plane of conjunction,

(a) said transfer element comprising a composite adhesive layer and a supporting liner to which said layer is attached but from which it is separable cleanly following formation of said laminate,

(b) said composite layer including a pressure-sensitive adhesive composition, whose operable surface lies next adjacent said liner, and a disparate material which constitutes the obverse face of said transfer

element designedly contiguous said plane of conjunction,

(c) said operable surface being pressure-sensitive and inherently self-adherent to various objects upon contact,

(d) said disparate material being dry, substantially non-migrant to adjacent substances at normal ambient temperature and conditions of storage, and incorporable in said laminate proximate said interface,

(e) said obverse face being essentially tack-free to permit said transfer element to be wound into a roll and later to be unwound undisturbedly therefrom without adhesional restraint,

(f) and wherein at least one substance proximate said interface is activatable adhesionaly to secure said layer to said substrate.

2. The article of manufacture as claimed in claim 1, wherein said disparate material is selected from the group consisting of substances,

(a) inert with respect to said adhesive composition but incorporable as filler in the adjacent stratum thereof,

(b) combinable chemically with said stratum when activated,

(c) immiscible in said composition but fusible superficially when activated.

3. The article of manufacture as claimed in claim 1, wherein said disparate material is selected from the group consisting of:

(a) finely divided solid particulate material,

(b) a micro-encapsulated compound,

(c) a liquefiable composition formed *in situ*.

4. The article of manufacture as claimed in claim 1, wherein said disparate material comprises a thermosensitive particulate composition adapted to form a continuous film barrier when combined laminarily with said substrate.

5. The article of manufacture as claimed in claim 1, wherein said disparate material includes metallic particles adapted to be heated inductively.

6. The article of manufacture as claimed in claim 1, consisting of a wound roll of said article.

7. A combination including the article of manufacture as claimed in claim 1 and said substrate, said combination comprising said laminate.

8. The combination as claimed in claim 7, wherein said disparate material is selected from the group consisting of:

(a) finely divided solid particulate material adapted to dusting application,

(b) a micro-encapsulated compound,

(c) a liquefiable composition formed *in situ*,

(d) a processed film joined by lamination,

(e) intercalated fibers in the form of tissue,

(f) chopped segments in the form of flocking.

9. The combination as claimed in claim 7, wherein said disparate material consists essentially of intercalated fibers and said substrate comprises a thermoplastic film.

10. The combination as claimed in claim 7, wherein said disparate material comprises a second composition characterized as being more deformable than, and having a thickness at least equal to, the first.

11. An article of manufacture described as a pressure-sensitive adhesive laminate comprising, and in combination,

(a) a substrate such as paper, plastic film and the like,

(b) a pressure-sensitive adhesive composition,

(c) a protective liner attached to, but peelable cleanly from, said composition, and

(d) a disparate layer interposed between said substrate and said composition;

wherein said layer is more deformable than, and at least equal in thickness to, said composition.

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