(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 November 2001 (22.11.2001)

PCT

(10) International Publication Number
WO 01/87543 A2

(51) International Patent Classification[7]: B24D

(21) International Application Number: PCT/US01/15228

(22) International Filing Date: 11 May 2001 (11.05.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/203,734 12 May 2000 (12.05.2000) US
09/852,505 10 May 2001 (10.05.2001) US

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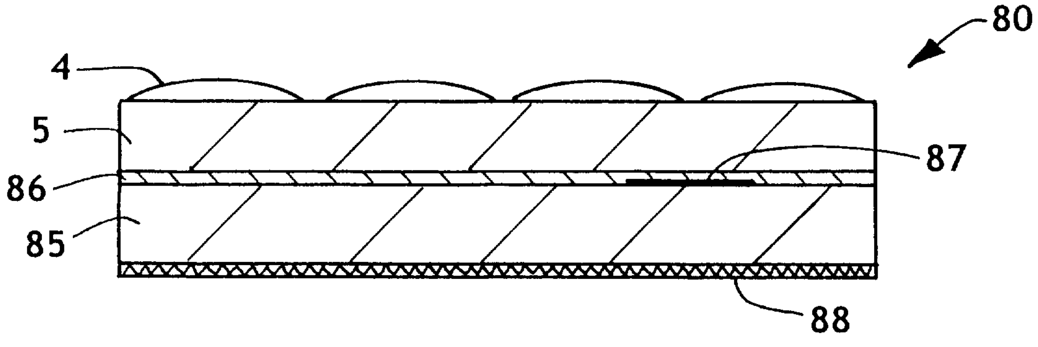
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** COLORED LOOP SUBSTRATE FOR RELEASABLY ATTACHABLE ABRASIVE SHEET MATERIAL



(57) **Abstract:** A colored loop material suitable for use with a hook-and-loop fastening system, wherein the loop material includes a first fibrous nonwoven web having a first surface and a second surface and includes side by side bicomponent spunbond fibers in which the fibers have a melting point differential of at least about 15 °C and in which said bicomponent spunbond fibers are comprised of a polypropylene component including at between about 2 % to 4 % by weight of a coloring formulation, and a copolymer component. The first fibrous nonwoven web has a thickness of at least about 0.15 mm and a basis weight of at least about 20 grams per square meter; a pattern on the first surface thereof of continuous bonded areas defining a plurality of discrete unbonded areas formed by the application of heat and pressure, wherein individual fibers within the discrete unbonded areas have at least a portion thereof extending into and bonded within the continuous bonded areas; and a percent bonded area of from about 20 to about 50 percent. If desired, a film layer may be bonded to the second surface of the first fibrous nonwoven web. Alternatively, a second fibrous nonwoven web may be bonded or laminated to the second surface of the first fibrous nonwoven web. The loop material is particularly suitable for the preparation of a releasably attachable abrasive sheet material.

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COLORED LOOP SUBSTRATE FOR RELEASABLY ATTACHABLE ABRASIVE SHEET MATERIAL

Field of the Invention

The present invention relates to substrates for use with a hook-and-loop fastening systems as part of releasably attachable abrasive sheet materials, and laminates produced therefrom.

Background of the Invention

Abrasive sheet materials are widely used for a variety of applications and include, by way of illustration only, sandpaper, emery cloths, sanding discs for rotary sanders, and sanding strips for orbital and belt sanders. By utilizing very fine abrasive materials, such abrasive sheet materials also can be used for polishing operations. Abrasive sheet materials most often comprise a layer of an abrasive, i.e., a layer of abrasive particles or grit, which is attached to a substrate or base of varying thickness and basis weight by means of one or more adhesives.

In some instances, the abrasive sheet material is used by itself or wrapped by hand around a block or pad. In other instances, the abrasive sheet material is attached at distal ends by mechanical means to a motorized sanding tool having a disc or pad. Because of the rapid movement of such a motorized sanding tool, the unattached edges of the abrasive sheet material are easily damaged or torn. It is, therefore, desirable that the abrasive sheet material is substantially completely attachable to the disc or pad of the sanding tool. Furthermore, for many applications, the abrasive sheet materials need to be readily exchanged for other sheets, either to replace worn-out sheets, or to change to finer or coarser grit.

Abrasive sheet materials, which are substantially completely attachable to and readily removable from a sanding tool, are known. In some embodiments, a pressure-sensitive adhesive attaches these materials to the sanding tool. In other embodiments, the materials include a looped fabric having a paper sheet attached to the back thereof by an adhesive, to form an abrasive sheet material laminate. The free surface of the paper typically has an abrasive attached thereto by means of an adhesive. The looped fabric is attachable to a hook-type attachment means on the sander, well known to those in the art. For instance, such sanders include rotary or orbital-type sanders.

Abrasive sheet material laminates based on a hook-and-loop attachment mechanism have several advantages over abrasive sheet materials that are attached to a sanding tool by means of a pressure-sensitive adhesive. For example, the former, unlike pressure-sensitive adhesive types, remains firmly attached even when heated or cooled excessively, conditions which typically result from the friction associated with sanding. In addition, they are easily and cleanly removed after use, or allow for simple reattachment, if a variety of sandpaper grit sizes are needed for a particular sanding operation. However, because they are made from two separate layers that have been laminated together, they are costly to manufacture. Moreover, delamination can occur, particularly under conditions of high stress or temperature. Conditions of high stress also can result in unacceptable stretching of the loops in a loop material that is attached to a sanding tool by a hook-type attachment means. This can result in the separation of the sheet from the tool during use, or prevent reattachment of the sheet after temporary removal. In either case, the useful life of the sheet can be significantly reduced. Accordingly, there is a need for an improved loop material, which will reduce or eliminate such problems, particularly for abrasive sheet materials to be used in high stress sanding applications.

Another problem associated with loop material for use with abrasive sheet materials is its costs of manufacture. Generally, woven materials are costly for use as part of a loop substrate. While it has been suggested that bonded carded nonwoven webs produce an effective loop material, specifically for use with an abrasive sheet material, such as that described in WO 98/38369 to Deka et al., published September 3, 1998, such bonded carded webs can be a more costly nonwoven material to produce, when compared with webs formed from other nonwoven processes. However, webs produced from other nonwoven processes have proven inadequate as part of a loop material/ abrasive sheet laminate. Accordingly, there is a need for a loop material which allows for cost efficient production and use with an abrasive sheet material, and which demonstrates strength attributes sufficient to withstand the stresses imposed by sanding operations.

Still another problem associated with loop material used to bind an abrasive sheet material in a hook and loop system, is the opacity of the loop material. Nonwoven loop material often contains titanium dioxide for processing rationale, and is therefore white/opaque in color and appearance. Typically, manufacturers of abrasive sheeting, such as rotary sanding discs, print a product code and/or brand name (trademark) on the backside (nontextured side) of the abrasive sheet material. Such labeling is used to aid the consumer in selecting material grades/product codes, and as a source/brand identifier. For instance, if a sanding operation will require use of multiple sandpaper grades during a sanding operation, the printed grit sizes on the sheets will provide needed information to the operator during the process. When a loop material is attached to the imprinted abrasive sheet material, the loop material tends to block or interfere with the visual perception of the product code /brand name, resulting in a blurred image when reading this information through the loop material. This problem has been previously identified in U.S. Patent 4,437,269 to Shaw. While the Shaw reference discloses the use of translucent textile materials in order to allow the viewing of printed indicia on a sandpaper backing (through the textile material surface), such materials are typically produced using costly weaving techniques. Accordingly, there is a need for an improved nonwoven loop material which allows for the easier visual perception of product codes/brand names on the back side of abrasive sheet materials, through less costly loop materials.

Yet another problem associated with loop material produced from nonwoven webs, is the potential for nonuniformity in the manufacture of the nonwoven webs. It is not unusual for nonwoven webs to appear splotchy or irregular in appearance. In fact, by the very random nature of certain nonwoven web manufacturing processes, a splotchy or uneven appearance may be routinely produced. Such a splotchy appearance, while not necessarily affecting performance of the web, is undesirable from a consumer perspective, as it conveys an impression of a product with holes, or one that may demonstrate non-uniform strength. By increasing the basis weight of a nonwoven web, much of the splotchy appearance in a web can be eliminated. However, a nonwoven web with increased basis weight could obscure the image of a product code or brand name printed on the back side of an abrasive sheet material, if it were to be laminated to such a nonwoven material. Furthermore, such an increase in basis weight would likely add to the cost of manufacturing a final product produced from the nonwoven web. Accordingly, there is also a need for an improved loop material which allows for the easy viewing of product codes/brand names on the backside of the abrasive sheet material, through the loop material, and which does not exhibit an irregular or splotchy appearance.

Summary of the Invention

The present invention addresses some of the difficulties and problems discussed above by providing a colored loop material suitable for use with a hook-and-loop fastening system as part of a releasably attachable abrasive sheet material. The loop material includes at least a first fibrous nonwoven web having a first surface and a second surface and includes spunbond fibers. Desirably, the nonwoven web is produced from side-by-side bicomponent spunbond fibers. Desirably, the side-by-side bicomponent fibers comprise polypropylene and copolymer components. The first fibrous nonwoven web desirably has a thickness of at least about 0.15 mm and a basis weight of at least about 20 grams per square meter (or about 1.5 ounces per square yard); a pattern on the first surface thereof of continuous bonded areas defining a plurality of discrete unbonded areas formed by the application of heat and pressure, wherein individual fibers within the discrete unbonded areas have at least a portion thereof extending into and bonded within the continuous bonded areas; and a percent bonded area of from about 15 to about 50 percent. Desirably, the first fibrous layer includes within its polypropylene components a coloring formulation, which matches the color of an abrasive sheet material backing layer with which it will be used. For instance, the coloring formulation may be beige in color, so as to match the color of a beige sandpaper sheet backing material. The coloring formulation is desirably present in the polypropylene component in the range of between about 2 to 4% by weight.

By way of example only, the thickness of the first fibrous nonwoven web may be at least about 0.2 mm. As another example, the thickness of the first fibrous nonwoven web may be from about 0.2 mm to about 1 mm. As still another example, the first fibrous nonwoven web may have a percent bonded area of from about 35 to about 45 percent. Desirably, the basis weight of the first nonwoven layer is between about 1.5 and 2.0 osy. It should be noted that in order to convert an "osy" designation to a "gsm" designation, it is necessary to multiply the osy number by 33.91.

The first fibrous nonwoven layer is patterned on one side, i.e. the first surface. For the purposes of this application, the side opposite the patterned side, the second surface, shall also be referred to as the smooth side.

If desired, a film layer may be bonded or laminated to the second surface of the first fibrous nonwoven web. Alternatively, a second fibrous nonwoven web may be bonded or laminated to the second surface of the first fibrous nonwoven web. If a second fibrous nonwoven layer is bonded to the second surface of the first fibrous nonwoven web, it is desirably a spunbond layer having a basis weight between about 0.35 osy and 1.0 osy, and is desirably comprised of between about 95-100% polypropylene spunbond made in accordance with processes known to those skilled in the art, and described hereinafter. If a second spunbond web is laminated to the second surface of the first fibrous nonwoven web, the total basis weight of the nonwoven webs is desirably between about 1.5 and 3.0 osy. More desirably, the total basis weight of the nonwoven webs is between about 1.5 and 2.5 osy.

Desirably the second fibrous layer also includes the coloring formulation that matches the color of the abrasive sheet material backing. Desirably, the coloring formulation is included in each of the two nonwoven layers (the polypropylene components) at about 2 % by weight in each layer. If a second nonwoven layer is included in the structure, the coloring formulation may be left out of the second nonwoven layer, but included in the first nonwoven layer polypropylene component (since it is the outermost layer in the final laminate product) in a range of between about 2 and 4% by weight. In a further alternative embodiment, a film layer may be bonded or laminated to the second surface of the second fibrous nonwoven web.

The loop material of the present invention is particularly suitable for the preparation of a releasably attachable abrasive sheet material, described hereinafter. Some embodiments, however, may be used as part of a hook-and-loop fastening system in such disposable products as diapers, incontinent products, medical garments, and the like. Such embodiments typically do not require the presence of a second layer, such as a film or another nonwoven web as described above.

The present invention further provides a releasably attachable abrasive sheet material, which includes at least a colored first fibrous nonwoven web as described hereinabove. Such sheet material also includes a material-backing layer bonded to the second surface of the first fibrous nonwoven web and a layer of abrasive particles bonded to the material-backing layer. The material-backing layer may be imprinted with a brand name or product code (indicia) on the side opposite the side having abrasive particles. The imprinting is generally done with an ink-based image.

The layer of abrasive particles may be bonded to the backing layer by a layer of adhesive. The layer of abrasive particles may also further be coated with a layer of adhesive. The imprinted side of the backing substrate is laminated to the smooth side of the nonwoven web, and is capable of being visually perceived through the non-woven web.

The present invention also provides a releasably attachable abrasive sheet material, which includes a first fibrous nonwoven web as described hereinabove. A second fibrous nonwoven web as described hereinabove is bonded to the second surface of the first fibrous nonwoven web and a film is bonded to the second fibrous nonwoven web. Finally, a layer of abrasive particles is bonded to the film to form a textured side opposite the side bonded to the nonwoven web. By way of example only, the layer of abrasive particles may be bonded to the film by a layer of adhesive. Also by way of example, the layer of abrasive particles may be coated with a layer of adhesive. Any printed indicia on the nontextured side of the film (the side opposite the textured side) is capable of being visually perceived through the nonwoven loop substrate.

The present invention further provides a releasably attachable abrasive sheet material, which includes a first fibrous nonwoven web as described hereinabove. A second fibrous nonwoven web as described hereinabove is bonded to the second surface of the first fibrous nonwoven web. An abrasive material backing layer is bonded to the second fibrous nonwoven web and a layer of abrasive particles is bonded to the material-backing layer. As before, the layer of abrasive particles may be bonded to the backing layer by a layer of adhesive. Also by way of example, the layer of abrasive particles may be coated with a layer of adhesive. The second fibrous nonwoven web may be a spunbonded web or a web of carded staple fibers. Again, any printed indicia on the abrasive material backing layer (non textured side) is capable of being visually perceived through the nonwoven web.

These and other features and advantages of the present invention will become apparent after a review of the following detailed description of the disclosed embodiments and the appended claims.

Brief Description of the Drawings

FIG. 1 is a schematic side view of an exemplary process and apparatus for producing a spunbond bicomponent nonwoven web of the present invention.

FIG. 2 is a diagrammatic, top elevation view of the first fibrous nonwoven web of the present invention.

FIG. 3 is a diagrammatic cross-sectional side view of the first fibrous nonwoven web of FIG. 2.

FIG. 4 is a schematic side view of a process and apparatus for pattern bonding the first fibrous nonwoven web of the present invention.

FIG. 5 is a partial perspective view of a pattern roll that may be used in accordance with the process and apparatus of FIG. 4.

FIG. 6 is a cross-sectional view of a laminate made in accordance with the present invention.

FIG. 7 is a cross-sectional view of an alternate embodiment of a laminate made in accordance with the present invention.

Detailed Description of the Invention

Definitions:

The term "nonwoven web" is used herein with respect to the fibrous nonwoven web(s) to mean web(s) having a structure of individual fibers which are interlaid in a generally random manner, not in an identifiable manner as in a knitted fabric, and is intended to include any nonwoven web. For example, the term includes those prepared by such well-known melt-extrusion processes as meltblowing, coforming, and spunbonding, although those prepared by spunbonding are desirable. Such processes are exemplified by the following references, each of which is incorporated herein by reference:

(a) meltblowing references include, by way of example, U.S. Patent Nos. 3,016,599 to R. W. Perry, Jr., 3,704,198 to J. S. Prentice, 3,755,527 to J. P. Keller et al., 3,849,241 to R. R. Butin et al., 3,978,185 to R. R. Butin et al., and 4,663,220 to T. J. Wisneski et al. See, also, V. A. Wente, "Superfine Thermoplastic Fibers", Industrial and Engineering Chemistry, Vol. 48, No. 8, pp. 1342-1346 (1956); V. A. Wente et al., "Manufacture of Superfine Organic Fibers", Navy Research Laboratory, Washington, D.C., NRL Report 4364 (111437), dated May 25, 1954, United States Department of Commerce, Office of Technical Services; and Robert R. Butin and Dwight T. Lohkamp, "Melt Blowing - A One-Step Web Process for New Nonwoven Products", Journal of the Technical Association of the Pulp and Paper Industry, Vol. 56, No.4, pp. 74-77 (1973);

(b) coforming references include U.S. Patent Nos. 4,100,324 to R. A. Anderson et al. and 4,118,531 to E. R. Hauser.

Other methods for preparing nonwoven webs are known and may be employed. For example, the term also includes nonwoven webs prepared from relatively short fibers to form a web or sheet. Methods employed to prepare such webs include air laying, wet laying, carding (as in bonded carded webs), and the like. In some cases, it may be either desirable or necessary to stabilize the nonwoven web by known means, such as thermal pattern bonding (i.e., pattern bonding by the application of heat and pressure, through-air bonding, and hydroentangling.)

Spunbond nonwoven webs are made from melt-spun filaments. As used herein, the term "melt-spun filaments" refers to small diameter fibers and/or filaments which are formed by extruding a molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries of a spinerette, with the diameter of the extruded filaments then being rapidly reduced, for example, by non-eductive or eductive fluid-drawing or other well known spunbonding mechanisms. The production of spunbond nonwoven webs is described in U.S. Pat. No. 4,340,563 to Appel et al., U.S. Pat. No. 3,692,618 to Dorschner et al., U.S. Pat. No. 3,802,817 to Matsuki et al., U.S. Pat. Nos. 3,338,992 and 3,341,394 to Kinney, U.S. Pat. No. 3,502,763 to Hartmann, U.S. Pat. No. 3,276,944 to Levy, U.S. Pat. No. 3,502,538 to Peterson, and U.S. Pat. No. 3,542,615 to Dobo et al., all of which are incorporated herein by reference. The melt-spun filaments formed by the spunbond process are generally continuous and have diameters larger than 7 microns, more particularly, between about 10 and 30 microns. Another frequently used expression of fiber or filament diameter is denier, which is defined as grams per 9000 meters of a fiber or filament. The spunbond filaments usually are deposited onto a moving foraminous belt or forming wire where they form a web. Spunbond filaments generally are not tacky when they are deposited onto the collecting surface.

Spunbond fabrics made from spunbond webs, typically are stabilized or consolidated (pre-bonded) in some manner immediately as they are produced, in order to give the web sufficient integrity to withstand the rigors of further processing into a finished product. This stabilization (pre-bonding) step may be accomplished through the use of an adhesive applied to the filaments as a liquid or powder which may be heat activated, or more commonly, by compaction rolls.

As used herein, the term "compaction rolls" means a set of rollers above and below the web used to compact the web as a way of treating a just-produced, melt-spun filament, particularly spunbond web, in order to give the web sufficient integrity for further processing, but not the relatively strong bonding of secondary bonding processes, such as through-air bonding, thermal bonding, ultrasonic bonding and the like. Compaction rolls slightly squeeze the web in order to increase its self-adherence and thereby its integrity.

An alternative means for performing the pre-bonding step employs a hot air knife, as described in detail in the commonly assigned U.S. Pat. 5,707,468 which is incorporated herein by reference. Briefly, the term "hot air knife" means a process of pre-bonding a just produced melt-spun filament, particularly spunbond web, in order to impart the web with sufficient integrity, i.e., increase the stiffness of the web, for further processing, but not via use of a relatively strong secondary bonding process such as a thermal bonding roll. A hot air knife is a device that focuses a stream of heated air at a very high flow rate, generally from about 300 to about 3000 meters per minute (m/min.), or more particularly from about 900 to about 1500 m/min., directed at the nonwoven web immediately after its formation. The air temperature usually is in the range of the melting point of at least one of the polymers used in the web, generally between about 90°C and about 290°C for the thermoplastic polymers commonly used in spunbonding. The control of air temperature, velocity, pressure, volume and other factors helps avoid damage to the web while increasing its integrity. The hot air knife's focused stream of air is arranged and directed by at least one slot of about 3 to about 25 millimeters (mm) in width, particularly about 9.4 mm, serving as the exit for the heated air towards the web, with the slot running in a substantially cross-machine direction over substantially the entire width of the web. In other embodiments, there may be a plurality of slots arranged next to each other or separated by a slight gap. The slot usually, but not necessarily, is continuous, and may be comprised of, for example, closely spaced holes. The hot air knife has a plenum to distribute and contain the heated air prior to its exiting the slot. The plenum pressure of the hot air knife usually is between about 2 to about 22 mmHg, and the hot air knife is positioned between about 6.35 mm and about 254 mm, and more particularly from about 19.05 to about 76.20 mm above the forming surface. In a particular embodiment, the hot air knife plenum's cross-sectional area for cross-directional flow (i.e., the plenum cross-sectional area in the machine direction) is at least twice the total slot exit area. Since the foraminous wire onto which spunbond polymer is formed, generally moves at a high rate of speed, the time of exposure of any particular part of the web to the air discharge from the hot air knife typically is less than a tenth of a second and generally about one hundredth of a second, in contrast with the through-air bonding process, which has a much longer dwell time. The hot air knife process has a great range of variability and control over many factors, including air temperature, velocity, pressure, and volume, slot or hole arrangement, density and size, and the distance separating the hot air knife plenum and the web.

The term "carded web" is used herein to mean a nonwoven web prepared from staple fibers which are usually purchased in bales. The bales are placed in a picker which separates the fibers. Next, the fibers are sent through a combing or carding unit which further breaks apart and aligns the staple fibers in the machine direction so as to form a machine direction-oriented fibrous nonwoven web. Once the web has been formed, it is then bonded by one or more of several bonding methods.

As used herein, the term "bonded carded web" means a carded web as described above, in which the fibers of which the web is composed have been bonded together to form a plurality of interfiber bonds.

The term "through-air bonding" is used herein to mean a process of bonding a nonwoven bicomponent fiber web. The process involves winding the web at least partially around a screen-covered drum, which is enclosed in a hood. Air which is sufficiently hot to melt one of the polymers of which the fibers of the web are made (e.g., the sheath polymer of bicomponent thermoplastic polymer fibers) is forced from the hood, through the web and into the perforated roller. The air velocity may be, by way of example, between 100 and 500 feet per minute and the dwell time may be as long as 6 seconds. The melting and resolidification of the polymer provide the bonding. The term "through air bonding" also includes the use of a hot air knife as earlier described.

The phrases "pattern bonding by the application of heat and pressure" or "point bonding" means any process by which a nonwoven web is passed through a nip formed by a pair of opposed rolls. Either or both rolls may have a regular or irregular surface pattern of continuous lands and grooves or isolated (discontinuous) projections. For example, the nonwoven web may be pattern bonded by the application of heat and pressure in the ranges of from about 80°C to about 180°C and from about 150 to about 1,000 pounds per linear inch (from about 59 kg/cm to about 178 kg/cm), respectively, employing a pattern with from about 10 to about 1,000 bond regions/inch^2 (from about 1 to about 155 bond regions/cm^2) covering from about 5 to about 50 percent of the web surface area. Representative of known pattern bonding procedures are, by way of example only, U. S. Design Patent No. 239,566 to Vogt, U.S. Design Patent No. 264,512 to Rogers, U.S. Patent No. 3,855,046 to Hansen et al., and U.S. Patent No. 4,493,868 to Meitner.

As used herein, the terms "layer" and "web" when used in the singular can have the dual meaning of a single element or a plurality of elements. As used herein, the term "laminate" means a composite material made from two or more layers or webs of material which have been attached or bonded to one another.

As used herein, the term "bicomponent spunbond fibers" refers to spunbond fibers which have been formed from at least two thermoplastic polymers extruded from separate reservoirs but spun together to form one fiber. The polymers are arranged in substantially constantly positioned distinct zones across the cross-section of the bicomponent fibers and extend continuously along the length of the bicomponent fibers.

The configuration of such a bicomponent fiber may be, for example, a sheath/core arrangement wherein one polymer is surrounded by another or may be a side by side arrangement, that is, an arrangement where the polymers are extruded adjacent one another, and the overall polymer streams having a generally circular or oval total cross-section. Other arrangements include a pie arrangement or an "islands-in-the-sea" arrangement. The fibers may also have shapes such as those described in U.S. Patent 5,277,976 to Hogle et al., U.S. Patent 5,466,410 to Hills and 5,069,970 and 5,057,368 to Largman et al., which describe fibers with unconventional shapes. Bicomponent (or conjugate) fibers are taught in U.S. Patent 5,108,820 to Kaneko et al., U.S. Patent 4,795,668 to Krueger et al. and U.S. Patent 5,336,552 to Strack et al. Bicomponent fibers are also taught in U.S. Patent 5,382,400 to Pike et al. and may be used to produce crimp in the fibers by using the differential rates of expansion and contraction of the two (or more) polymer components. For two polymer component fibers, the polymers may be present in ratios of 75/25, 50/50, 25/75 or any other desired ratios. Each of the foregoing patents are incorporated by reference herein.

The term “melting point differential” as used herein, is simply the melting point, expressed in degrees Celsius, of the polymer of which one of the side by side components is composed minus the melting point, also expressed in degrees Celsius, of the polymer of which the other side by side component is composed.

By way of definition, the term “pattern-unbonded nonwoven loop material” as used herein is intended to refer to a loop or female component for a hook and loop fastening system that includes, in its simplest form, a nonwoven fabric or web having continuous bonded areas that define a plurality of discrete, dimensionally-stabilized unbonded areas.

For the purposes of this application, the terms "match", "matches" or "matching" shall be used interchangeably with the phrase "similar to", and be defined in the following manner. In order for there to be a match of the color of the nonwoven web and that of the sandpaper/ sheet backing to which it is to be laminated, it is desirable that the perceived color of the nonwoven web demonstrate a Delta (Δ)E* of between 0 and 3 units, when compared to the sandpaper/ sheet backing substrate to which it is to be applied. More desirably, the perceived color of the nonwoven web demonstrates a ΔE *of between about 0 to about 1.25 units when compared to the sheet backing substrate.

Since, the nonwoven loop material includes a pattern- unbonded area on its surface, it may also be desirable to ascertain a color match of the nonwoven material to the sheet backing via the use of a second nonwoven material with a less textured surface, in addition to the match using the pattern--unbonded surface. Such a less textured nonwoven material may be produced for example via a Hansen Penning bond roll pattern through thermal point bonding (which has a textured surface of smaller indentations), and then compared with the color of the backing sample to be matched. Such a secondary review allows for consideration of the role that the pattern-produced shading (from the hills and valleys of the pattern-unbonded pattern) plays in the Delta E* value.

The loop material of the present invention, for use as a substrate for releasably attachable abrasive sheet material, desirably includes at least a fibrous nonwoven web (also referred to as a first fibrous nonwoven web) having a first surface and a second surface. While the first fibrous nonwoven web can be made from any of a variety of nonwoven materials, such as for example, bonded carded webs or spunbonded webs, spunbonded webs are desirable. It is desirable that such spunbond webs include spunbond bicomponent fibers in which the fibers have a melting point differential of at least about 15°C between their individual components. The first fibrous nonwoven web desirably has a thickness of at least about 0.15 mm and a basis weight of at least about 20 grams per square meter; a pattern on the first surface thereof of continuous bonded areas defining a plurality of discrete unbonded areas formed by the application of heat and pressure, wherein individual fibers within the discrete unbonded areas have at least a portion thereof extending into and bonded within the continuous bonded areas; and a percent bonded area of from about 20 to about 50 percent. By way of example only, the thickness of the first fibrous nonwoven web may be at least about 0.2 mm. As another example, the thickness of the first fibrous nonwoven web may be from about 0.2 mm to about 1 mm. As still another example, the first fibrous nonwoven web may have a percent bonded area of from about 35 to about 45 percent.

Desirably, the configuration of such a bicomponent fiber is a side by side arrangement wherein one polymer component is extruded adjacent to another. Desirably, the side by side bicomponent fibers are comprised of polypropylene and copolymer resin components. Desirably, the copolymer resins are random copolymer resins. Such polypropylene components are available from Exxon and Amoco, under the designations Exxon 3155 Polypropylene, having an on- set melting temperature of 266°F (130°C) and a peak melting point temperature of 333°F (167°C), and Amoco 7954 Polypropylene, having an on-set melting temperature of 266°F (130°C) and a peak melting point temperature of 331°F (166°C) respectively. Such random copolymer components are available from the Union Carbide Corporation under the designation 6D43, having an on-set melting temperature of 230°F (110°C) and a peak melting point temperature of 300°F (149°C)

As has been stated, the polymer components may be present in any desired ratio, although desirably the range of between 55-65 % polypropylene and 45 to 35 % copolymer is preferred for the first layer (or top layer in a two spunbond layer material) with approximately 95-100% polypropylene for the bottom layer in a two spunbond layer material.

The first fibrous nonwoven web includes a colorant, desirably a pigment concentrate, which matches the backing sheet to which it is to be laminated to. Essentially the contrast between the color of the backing and nonwoven web has been reduced or eliminated. If the first nonwoven web is comprised of polypropylene components, the polypropylene components of the nonwoven material include the coloring formulation. Desirably such coloring formulation includes pigments, the formulation being matched to the colors of abrasive sheet materials (either film or sheet backings such as paper) which are to be laminated to the nonwoven material, in an amount of between about 2-4 % by weight, desirably about 2 % by weight. This amount (or feed rate) may vary by the color desired to be obtained in the nonwoven material. It has been found that pigments are desirable as colorants, so as to prevent leaching of the colorant during use, since the pigments are entrapped within the polymeric material. In either case, the color matching between the nonwoven and film or paper sheet backing, allow the visual perception of printed indicia on the nontextured side of the abrasive sheet.

It has been found that if there is a perceived color difference between the backing material and the nonwoven surface, an image printed on the sandpaper, such as a grit size indicator, becomes blurred. This effect appears to be amplified with the sole use of a white pigment, such as that of titanium dioxide. The exception to this observation is the use of white pigment on a nonwoven, with a white colored backing material. It should be appreciated for the purposes of this application, that the backing material can be either a film that is covered with abrasive material on one side, or a non-film sheet backing such as paper. For the purposes of this application, the Delta E* and color measurements are based on the following.

Color Measurements

L* a* b* color values measurements (CIE 1976 Commission Internationale de l'Eclairage) and optical density were made of the colored nonwoven substrates and prospective sandpaper backing sheets using a CS-5 Datacolor Chroma Sensor spectrophotometer (of Datacolor International of Lawrenceville, N.J.), using the standard filters (D65/10^{o}), in accordance with the procedures outlined in the operator's manual. However, the nonwoven material was folded into eight (8) layers for testing on 4 random locations on the material, in order to offer a fair representation of color distribution on the material. Average optical densities were taken of these four measurements. Delta E* is calculated in accordance with the following equation:

$$\Delta E^* = SQRT\ [(L^*standard - L^*\ sample)^2 + (a^*standard - a^*\ sample)^2 + (b^*standard - b^*\ sample)^2]$$

The higher the Delta E*, the greater the change in color intensity. A detailed description of spectrodensitometer testing is available in <u>Color Technology in the Textile Industry</u>, 2nd Edition, Published 1997 by AATCC (American Association of Textile Chemists & Colorists). For the purposes of the testing samples, the samples were tested using a single layered spunbond (folded in 8 layers) of 10 osy Exxon 3155 (35 melt flow rate) polypropylene that had been bonded using thermal point bonding, and in particular the Hansen Pennings

Pattern, as well as pattern-unbonded material made in accordance with the process described further herein.

As used herein and as previously described, the term "thermal point bonding" involves passing a fabric or web of fibers to be bonded between a heated calender roll and an anvil roll. The calender roll is usually, though not always, patterned in some way so that the entire fabric is not bonded across its entire surface, and the anvil roll is usually flat. As a result, various patterns for calender rolls have been developed for functional, as well as aesthetic reasons. One example of a pattern has points and is the Hansen Pennings or "H&P" pattern with about a 30% bond area with about 200 bonds/square inch as taught in U.S. Patent 3,855,046 to Hansen and Pennings. The H&P pattern has square point or pin bonding areas wherein each pin has a side dimension of 0.038 inches (0.965 mm), a spacing of 0.070 inches (1.778 mm) between pins, and a depth of bonding of 0.023 inches (0.584 mm). The resulting pattern has a bonded area of about 29.5%. Another typical point bonding pattern is the expanded Hansen Pennings or "EHP" bond pattern which produces a 15% bond area with a square pin having a side dimension of 0.037 inches (0.94 mm), a pin spacing of 0.097 inches (2.464 mm) and a depth of 0.039 inches (0.991 mm). Another typical point bonding pattern designated "714" has square pin bonding areas wherein each pin has a side dimension of 0.023 inches, a spacing of 0.062 inches (1.575 mm) between pins, and a depth of bonding of 0.033 inches (0.838 mm). The resulting pattern has a bonded area of about 15%. Yet another common pattern is the C-Star pattern which has a bond area of about 16.9%. The C-Star pattern has a cross-directional bar or "corduroy" design interrupted by shooting stars. Other common patterns include a diamond pattern with repeating and slightly offset diamonds with about a 16% bond area and a wire weave pattern looking as the name suggests, e.g. like a window screen, with about a 19% bond area. Typically, the percent bonding area varies from around 10% to around 30% of the area of the fabric laminate web. As is well known in the art, the spot bonding holds the laminate layers together as well as imparts integrity to each individual layer by bonding filaments and/or fibers within each layer.

For the purposes of examples which follow, relating to color match testing, sandpaper backings were used without adhesive and/or grit upon their surfaces. The sandpaper backings were obtained from the Kimberly-Clark Corporation under the Duraflex brand abrasive sheet product line. The grade was 6259R0, a 125 gsm beige color abrasive backing. Essentially, the sandpaper backing sheets were the "standards" for comparison of color for matching purposes. It should be recognized that paper colors will vary.

It is desirable that the loop material include two nonwoven layers. In particular it is desirable that the two layers be comprised of spunbond nonwoven material with the outermost lofty layer including between about 2.0 to 4.0 % by weight of a coloring formulation (colorant) that matches (as previously defined) the color of an abrasive sheet material backing to be laminated thereto. The bottom layer or second fibrous nonwoven web desirably consists of smaller denier fibers than the top layer, such as between 2.8 and 3.5 denier, so as to give more fibers per unit area. The top layer denier is desirably between 4.0 and 5.0. The bottom or second fibrous layer is desirably made of polypropylene or polypropylene and copolymer bicomponent spunbond.

More desirably, such spunbond loop material preferably contains the coloring formulation at about 2.0 % by weight, which has been added to each of the two layers of spunbond material. However, such coloring formulation may be added in an amount of between about 2-4 % by weight only to the first fibrous layer, since it is the top layer that is visible in a final product.

It has been found that the incorporation of this coloring formulation into the spunbond layer(s) allows for a clearer appearance of imprinted images on the back sides of abrasive sheet material by users, as well as creates a more uniform appearance of the overall loop and abrasive sheet material composite. In particular, when such coloring formulation is employed (as opposed to merely including titanium dioxide for a white/opaque appearance) in the nonwoven material, the images printed on the backside of the abrasive sheet material to which it is laminated, are readily visible over comparative samples without the matching coloring formulation.

Such matching coloring formulations may be obtained from the Standridge Color Corporation of Social Circle, GA and may include color concentrates. Such color concentrates typically include a mixture of various inorganic pigments and other components. For example a beige coloring formulation is available under the designation SCC # 20255.

Additionally blue and pink coloring formulations may be used to match blue and pink substrates. Such coloring formulations are identified by SCC # 3185 and SCC # 4331 respectively. In practice, coloring formulations are added at a given ratio in a polypropylene-based resin until a desired color is achieved. In particular, the color is matched by combining individual pigments to form the concentrate. The coloring formulations, which include the color concentrates, are desirably dry-blended with polymers and compounded on 1 inch extruders to obtain feed stocks. By adjusting the feed rate (that is, the percentage of colorant in the polymer/colorant mix) the color intensity can be adjusted. As an example, one such feed rate of colorant may be about 2 %, as previously described.

Alternatively, such fibrous nonwoven web(s) (i.e. spunbond layer(s)) can be bonded to a polymeric film layer. Such film layer can then be bonded directly or indirectly via adhesive, to a paper substrate (sandpaper sheet backing). In the alternative, abrasive particles may be bonded directly to the side of the film layer that is not bonded to the nonwoven layer(s), in the absence of paper.

A suitable process for forming bicomponent spunbond nonwoven webs is described in U.S. Pat. No. 5,418,045 to Pike et al., which is incorporated herein by reference in its entirety.

Referring to FIG. 1 hereof, an extrusion process line 10 (or bicomponent extrusion bank) for forming such bicomponent filaments and resultant webs, includes the use of a pair of extruders 12a and 12b for separately supplying both the polymers, for example polypropylene and copolymer, from hoppers 14a and 14b, respectively, to a bicomponent spinneret 18. For the present invention the coloring formulation is added to the polypropylene hoppers in order to dry blend the coloring formulation with the polymers. Spinnerets for producing bicomponent filaments are well known in the art and, therefore, are not described herein in detail. Generally, the spinneret 18 includes a housing, containing a spin pack, which includes a plurality of vertically stacked plates having a pattern of openings arranged to create flow paths for directing the high melting temperature and low melting temperature polymers separately to the fiber-forming openings in the spinneret. The spinneret 18 has openings arranged in one or more rows and the openings form a downwardly extending curtain of filaments when the polymers are extruded through the spinneret. As the curtain of filaments exit the spinneret 18, they are contacted by a quenching gas from one or both (not shown) sides of the filament curtain, which at least partially quenches the filaments and develops a latent helical crimp in the filaments extending from the spinneret 18. Typically, the quenching air will be directed generally perpendicularly to the length of the filaments at a velocity of from about 30 to about 120 meters per minute and at a temperature of about 7° C to about 32° C.

A fiber draw unit or aspirator 22 is positioned below the spinneret 18 to receive the quenched filaments. Fiber draw units or aspirators for use in melt spinning polymers are also well known in the art, as noted above. Exemplary fiber draw units suitable for use in this process include a linear fiber aspirator of the type shown in U.S. Pat. No. 3,802,817 to Matsuki et al., and eductive guns of the type shown in U.S. Pat. Nos. 3,692,618 to Dorschner et al. and 3,423,266 to Davies et al., the disclosures of which are incorporated herein by reference in their entirety. The fiber draw unit 22 in general has an elongated passage through which the filaments are drawn by aspirating gas flowing through the passage. The aspirating gas may be any gas, such as air, that does not adversely interact with the polymers of the filaments. A heater 24 supplies hot aspirating gas to the fiber draw unit. As the aspirating gas draws the quenched filaments and ambient air through the fiber draw unit 22, the filaments are heated to a temperature that is required to activate the latent crimping therein. The temperature required to activate the latent crimping within the filaments will range from about 43° C to a maximum of less than the melting point of the low melting component polymer which, in the example case, is the copolymer. Generally, a higher air temperature produces a higher number of crimps per unit length of the filament. Alternatively, the curtain of filaments exiting the spinneret 18 may be drawn at ambient temperature, consequently forming a web of substantially straight or non-crimped spunbond filaments.

The drawn and crimped filaments exit the fiber draw unit 22 and are deposited onto a continuous forming surface 26 in a random manner (traveling around rolls 28), generally assisted by a vacuum device 30 placed underneath the forming surface. The purpose of the vacuum is to eliminate the undesirable scattering of the filaments and to guide the filaments onto the forming surface 26 to form a uniform unbonded nonwoven web of bicomponent filaments. If desired, the resultant web can be lightly compressed by compaction/compression rolls 32 or a hot air knife (not shown) before the web is subjected to the pattern-unbonding assembly 64 (FIG. 4) as further described herein below. The web is then either directed towards further processing or stored on storage roll 66.

In an alternative embodiment of the present invention, a second extrusion bank, shown in phantom as 23, may be added to the process to ultimately provide a two layer nonwoven web. Desirably, the second extrusion bank is a spunbond bank known to those skilled in the art for extruding a single polymer spunbond material. It is desirable that if a second bank is added to the spunbond process, the second bank precede the bicomponent extrusion bank, so as to allow the bicomponent extrusion bank to be the top layer (or first fibrous web) in the finished web.

Surprisingly, it has been found that while the bicomponent spunbond material described in the examples of U.S. Patent Number 5,858,515 to Ty J. Stokes et al. which patent is incorporated by reference herein in its entirety, is less desirable for the specific use as the first layer of a loop material composite to be attached to an abrasive sheet material, spunbond material comprised of bicomponent side by side polypropylene and copolymer is highly effective as a loop material.

The first fibrous nonwoven web utilized in the present invention desirably has continuous bonded areas, which define a plurality of discrete unbonded areas (formed by a pattern-unbonded assembly as will be hereinafter described). Even though such nonwoven web is prepared from spunbonded fibers, it is surprisingly effective as a loop material in a hook-and-loop fastening/engagement system specifically for an abrasive sheet material.

A suitable process for forming the first fibrous nonwoven web or loop material of the present invention includes providing a nonwoven fabric or web such as that produced in accordance with the above spunbonding method, providing opposedly positioned first and second calender rolls and defining a nip therebetween, with at least one of the rolls being heated and having a bonding pattern on its outermost surface having a continuous pattern of land areas defining a plurality of discrete openings, apertures or holes, and passing the nonwoven fabric or web within the nip formed by the rolls. Each of the openings in the roll or rolls defined by the continuous land areas, forms a discrete unbonded area in at least one surface of the nonwoven fabric or web in which the fibers or filaments of the web are substantially or completely unbonded. Stated alternatively, the continuous pattern of land areas in said roll or rolls forms a continuous pattern of bonded areas that define a plurality of discrete unbonded areas on at least one surface of the nonwoven fabric or web. Alternative embodiments of the aforesaid process include pre-bonding the nonwoven fabric or web before passing the fabric or web within the nip formed by the calender rolls, or providing multiple nonwoven webs to form a pattern-unbonded laminate.

Referring now to FIGS. 2 and 3, an embodiment of the first fibrous nonwoven web 4 of the present invention is illustrated showing the pattern-unbonded material. Within the continuous bonded areas 6, the fibers or filaments of the nonwoven web are thoroughly bonded or fused together, and desirably are non-fibrous, whereas within the unbonded areas 8 the fibers or filaments of the nonwoven fabric or web are substantially or completely free of bonding or fusing and retain their fibrous structure. The terms "pattern unbonded" and "loop" are not intended to limit the loop material of the present invention to only nonwoven materials; rather, the loop material of the present invention can be advantageously employed in alternative embodiments in which, for example, the pattern-unbonded nonwoven fabric or web is attached or bonded to a layer of film material. Nor is use of the term “loop” intended to limit the loop material of the present invention to only materials in which discrete, separately formed loops of material are employed to receive and engage the hook elements of a complementary hook material; rather, the loop material of the present invention includes fibrous nonwoven fabrics or webs in which the individual fibers or filaments function to engage the hook elements without such fibers or filaments being formed into discrete loops.

After the nonwoven web is initially formed, as previously described with respect to bicomponent spunbond in FIG. 1, the pre-bonded or unbonded web is passed through a suitable process and apparatus to form the pattern-unbonded nonwoven loop material of the present invention. Referring now to FIGS. 4 and 5, a process and apparatus (pattern-unbonded assembly) for forming the pattern-unbonded nonwoven loop material of this invention is represented generally as element 64. The apparatus includes a first web unwind 66 for a first web 68. Optionally, one or more additional web unwinds 67 (shown in phantom) for additional webs or layers 69 may be employed in forming multi-layer pattern-unbonded laminates. It should be understood that although the apparatus shown in FIG. 4 illustrates a web unwind 66, the pattern-unbonding assembly 70 may be placed in a continuous (in-line) process with the nonwoven web forming equipment described above. If such were the case, the pattern unbonding assembly would be desirably placed at "A" shown in FIG. 1.

As used herein, the term “pattern-unbonding assembly” should not be construed as an apparatus for disassembling, destroying or removing existing bonds, if any, in web 68; rather, pattern-unbonding assembly refers to an apparatus that continuously bonds or fuses the fibers or filaments forming web 68 in specified areas of the web, and prevents bonding or fusing of the fibers or filaments of web 68 in other specified areas of the web, such areas being referred to herein as bonded areas and unbonded areas, respectively.

In operation, first web 68 (or simply "web" if only one unwind is used) is taken off the unwind 66 and passed into a pattern-unbonding assembly 70 that includes a first or pattern roll 72 and a second or an anvil roll 74, both of which are driven by conventional drive means, such as, for example, electric motors (not shown). Pattern roll 72 is a right circular cylinder that may be formed of any suitable, durable material, such as, for example, steel, to reduce wear on the rolls during use. Pattern roll 72 has on its outermost surface a pattern of land areas 76 that define a plurality of discrete openings or apertures 78. The land areas 76 are designed to form a nip with the smooth or flat outer surface of opposedly positioned anvil roll 74, which also is a right circular cylinder that can be formed of any suitable, durable material.

The size, shape, number and configuration of openings 78 in pattern roll 72 can be varied to meet the particular end-use needs of the pattern-unbonded nonwoven loop material being formed thereby. In order to reduce the incidence of fiber pullout in the resulting loop material, the size of openings 78 in pattern roll 72 should be dimensioned to reduce the likelihood that the entire length of the filaments or fibers forming an unbonded area will lie within a single unbonded area. Stated differently, fiber length should be selected to reduce the likelihood that the entire length of a given fiber or filament will fall within a single unbonded area. On the other hand, the desirability of restricting the size of the openings 78 in pattern roll 72, and the unbonded areas 8 formed thereby in the pattern-unbonded nonwoven loop material 4, is counter-balanced by the need for the unbonded areas 8 to have sufficient size to provide the required engagement areas for the hook elements of a complementary hook material. Circular openings 78 as shown in FIG. 5 hereof having an average diameter ranging from about 0.05 inch (about 0.13 cm) to about 0.25 inch (about 0.64 cm), and more specifically, from about 0.13 inch (0.33 cm) to about 0.16 inch (0.41 cm), and a depth measured from the outermost surface of pattern roll 72 of at least about 0.02 inch (about 0.05 cm), and more particularly at least about 0.06 inch (0.15 cm), are considered suitable in forming the pattern-unbonded nonwoven material of the present invention. While openings 78 in pattern roll 72 as shown in FIG. 5 are circular, other shapes, such as ovals, squares, diamonds and the like can be advantageously employed.

The number or density of openings 78 in pattern roll 72 also can be selected to provide the requisite amount of engagement areas for hook elements, without unduly limiting the size of the continuous bonded areas and giving rise to increased incidence of fiber pull-out. Pattern rolls having an opening density in the range of from about 1 opening per square centimeter (cm^2) to about 25 openings/cm^2, and more particularly from about 5 to about 7 openings/cm^2, may be utilized to advantage in forming the pattern-unbonded loop material of the present invention.

Moreover, the spacing between individual openings 78 can be selected to enhance the hook engagement functionality of the resulting pattern-unbonded loop material, without overly reducing the portion of the pattern-unbonded loop material occupied by continuous bonded areas, which serve to lessen fiber pull-out. Suitable inter-opening spacings for the embodiment shown can range from about 0.13 inch (about 3.3 mm) to about 0.22 inch (about 5.6 mm), centerline-to-centerline, in the machine and cross-machine directions. As used herein, the term "machine direction" or MD means the length of a material or fabric in the direction in which it is produced (from left to right in FIG. 4). The term "cross-machine direction" or CD means the width of a material or fabric, i.e., a direction generally perpendicular to the MD.

The particular arrangement or configuration of openings 78 in pattern roll 72 is not considered critical, so long as in combination with the opening size, shape and density, the desired levels of surface integrity, durability and hook element engagement are achieved. For example, as shown in FIG. 5, the individual openings 78 are arranged in staggered rows (see also FIG. 2). Other different configurations are considered within the scope of the present invention.

The portion of the outermost surface of the pattern roll 72 occupied by continuous land areas 76 likewise can be modified to satisfy the contemplated end-use application of the pattern-unbonded material. The degree of bonding imparted to the pattern-unbonded nonwoven loop material by the continuous land areas 76 can be expressed as a percent bond area, which refers to the portion of the total plan area of at least one surface of pattern-unbonded nonwoven loop material 4 (see FIG. 2) that is occupied by bonded areas 6. Stated generally, the lower limit on the percent bond area suitable for forming the pattern-unbonded nonwoven loop material 4 of the present invention is the point at which fiber pull-out excessively reduces the surface integrity and durability of the pattern-unbonded material. The required percent bond area will be affected by a number of factors, including the type(s) of polymeric materials used in forming the fibers or filaments of the nonwoven web, whether the nonwoven web is a single- or multi-layer fibrous structure, whether the nonwoven web is unbonded or pre-bonded prior to passing into the pattern-unbonding assembly, and the like. Pattern-unbonded nonwoven loop materials having percent bond areas ranging from about 25% to about 50%, and more particularly from about 35% to about 50%, have been found suitable.

The temperature of the outer surface of pattern roll 72 can be varied by heating or cooling relative to anvil roll 74. Heating and/or cooling can affect the features of the web(s) being processed and the degree of bonding of single or multiple webs being passed through the nip formed between the counter rotating pattern roll 72 and anvil roll 74. In the embodiment shown in FIG. 4, for example, both pattern roll 72 and anvil roll 74 are heated, desirably to about the same bonding temperature. The specific ranges of temperatures to be employed in forming the pattern-unbonded nonwoven loop material hereof are dependent upon a number of factors, including the types of polymeric materials employed in forming the pattern-unbonded material, the inlet or line speed(s) of the nonwoven web(s) passing through the nip formed between pattern roll 72 and anvil roll 74, and the nip pressure between pattern roll 72 and anvil roll 74.

Anvil roll 74 as shown in FIG. 4 has an outer surface that is much smoother than pattern roll 72, and preferably is smooth or flat. It is possible, however, for anvil roll 74 to have a slight pattern on its outer surface and still be considered smooth or flat for purposes of the present invention. For example, if anvil roll 74 is made from a softer material or has a softer surface, such as resin impregnated cotton or rubber, it will develop surface irregularities, yet it will still be considered smooth or flat for purposes of the present invention. Such surfaces are collectively referred to herein as "flat." Anvil roll 74 provides the base for pattern roll 72 and the web or webs of material to contact. Typically, anvil roll 74 will be made from steel, or materials such as hardened rubber, resin-treated cotton or polyurethane.

Alternatively, anvil roll 74 may be replaced with a pattern roll (not shown) having a pattern of continuous land areas defining a plurality of discrete, apertures or openings therein, as in the above-described pattern roll 72. In such case, the pattern-unbonding assembly would include a pair of counter-rotating pattern rolls which would impart a pattern of continuous bonded areas defining a plurality of discrete unbonded areas on both the upper and lower surfaces of the pattern-unbonded nonwoven loop material. Rotation of the opposedly positioned pattern rolls can be synchronized, such that the resulting unbonded areas on the surfaces of the pattern-unbonded material are vertically aligned or juxtaposed.

Referring again to FIG. 4, pattern roll 72 and anvil roll 74 are rotated in opposite directions to one another so as to draw the nonwoven web (or webs) through the nip area defined there between. Pattern roll 72 has a first rotational speed measured at its outer surface and anvil roll 74 has a second rotational speed measured at its outer surface. In the embodiment shown, the first and second rotational speeds are substantially identical. However, the rotational speeds of the pattern and anvil rolls can be modified to create a speed differential between the counter-rotating rolls.

The locations of the opposedly positioned pattern roll 72 and anvil roll 74 may be varied to create a nip area 80 between the rolls. The nip pressure within nip area 80 can be varied depending upon the properties of the web itself or webs themselves and the degree of bonding desired. Other factors that will allow variances in the nip pressure will include the temperatures of the pattern roll 72 and anvil roll 74, the size and spacing of openings 78 in pattern roll 72, as well as the types of polymeric materials used in forming the pattern-unbonded nonwoven material. With respect to the degree of bonding to be imparted to the pattern-unbonded nonwoven loop material within the continuous bonded areas, the pattern-unbonded material desirably is thoroughly bonded or melt-fused in the bonded areas, such that the polymeric material is rendered non-fibrous. This high degree of bonding is important in stabilizing the portions of the fibers or filaments within the unbonded areas extending into the continuous bonded areas and reducing fiber pull-out when hook elements are disengaged from the discrete unbonded areas.

As previously alluded to, a film layer may be bonded to the second surface of the first fibrous nonwoven web or the second fibrous nonwoven web (as illustrated in FIG. 7). The film may serve as a barrier, or as a backing sheet shich holds the abrasive particles. In general, the film may be prepared from any polymer. For example, the polymer may be a thermosetting or a thermoplastic polymer. As used herein, the term "thermosetting polymer" refers to a polymer, which solidifies or "sets" irreversibly when heated. This property is almost invariably associated with a crosslinking reaction of the molecular constituents induced by heat or irradiation. In many cases, it is necessary to add curing agents such as organic peroxides or (in the case of natural rubber) sulfur to achieve crosslinking. For example, thermoplastic linear polyethylene can be cross-linked to a thermosetting material either by radiation or by chemical reaction.

Examples of thermosetting polymers include, by way of illustration only, alkyd resins, such as phthalic anhydride-glycerol resins, maleic acid-glycerol resins, adipic acid-glycerol resins, and phthalic anhydride-pentaerythritol resins; allylic resins, in which such monomers as diallyl phthalate, diallyl isophthalate diallyl maleate, and diallyl chlorendate serve as nonvolatile cross-linking agents in polyester compounds; amino resins, such as aniline-formaldehyde resins, ethylene urea-formaldehyde resins, dicyandiamide-formaldehyde resins, melamine-formaldehyde resins, sulfonamide-formaldehyde resins, and urea-formaldehyde resins; epoxy resins, such as cross-linked epichlorohydrin-bisphenol A resins; phenolic resins, such as phenol-formaldehyde resins, including Novolacs and resols; and thermosetting polyesters, silicones, and urethanes.

As used herein, the term "thermoplastic polymer" refers to a polymer that softens when exposed to heat and returns to its original condition when cooled to room temperature. Natural substances, which exhibit this behavior, are crude rubber and a number of waxes. More generally, examples of thermoplastic polymers include, by way of illustration only, end-capped polyacetals, such as poly(oxymethylene) or polyform-aldehyde, poly(trichloroacetaldehyde), poly(n-valeraldehyde), poly(acet-aldehyde), and poly(propionaldehyde); acrylic polymers, such as polyacrylamide, poly(acrylic acid), poly(methacrylic acid), poly(ethyl acrylate), and poly(methyl methacrylate); fluorocarbon polymers, such as poly(tetrafluoroethylene), perfluorinated ethylenepropylene copolymers, ethylene-tetrafluoroethylene copolymers, poly(chlorotrifluoroethylene), ethylene-chlorotrifluoroethylene copolymers, poly(vinyl-idene fluoride), and poly(vinyl fluoride); polyamides, such as poly(6-aminocaproic acid) or poly(e-caprolactam), poly(hexa-methylene adipamide), poly(hexamethylene sebacamide), and poly(11-aminoun-decanoic acid); polyar-amides, such as poly(imino-1,3-phenyleneiminoisophthaloyl) or poly(m-phenylene isophthal-amide); parylenes, such as poly-p-xylylene and poly(chloro-p-xylylene); polyaryl ethers, such as poly(oxy-2,6-dimethyl-1,4-phenylene) or poly(p-phenylene oxide); polyaryl sulfones, such as poly(oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenyleneisopropyli-dene-1,4-phenylene) and poly(sulfonyl-1,4-phenylene-oxy-1,4-phenylenesulfonyl-4,4'-biphenylene); polycarbonates, such as poly(bisphenol A) or poly(carbonyldioxy-1,4-phenyleneisopropylidene-1,4-phenylene); polyesters, such as poly(ethylene tere-phthalate), poly(tetramethylene terephthalate), and poly-(cyclohexyl-ene-1,4-dimethyl-ene terephthalate) or poly(oxymethylene-1,4-cyclohexylenemethyleneoxyterephthal-oyl); polyaryl sulfides, such as poly(p-phenylene sulfide) or poly(thio-1,4-phenylene); polyimides, such as poly(pyromellitimido-1,4-phenylene); polyolefins, such as poly-ethylene, polypropylene, poly(1-butene), poly(2-butene), poly(1-pentene), poly(2-pentene), poly(3-methyl-1-pentene), and poly(4-methyl-1-pentene); vinyl polymers, such as poly(vinyl acetate), poly(vinylidene chloride), and poly(vinyl chloride); diene polymers, such as 1,2-poly-1,3-butadiene, 1,4-poly-1,3-butadiene, polyisoprene, and poly-chloroprene; polystyrenes; copolymers of the foregoing, such as acrylonitrile-butadiene-styrene (ABS) copolymers; and the like.

As a practical matter, the film layer desirably will be a thermoplastic film layer. For example, a preformed film may be laminated by known means to the second surface of the first fibrous nonwoven web or the second fibrous nonwoven web (on the surface not bonded to the first nonwoven web). Known means for laminating the film to the first fibrous nonwoven web include adhesives and thermal bonding, including thermal point bonding. Alternatively, a film may be formed on the second surface of the fibrous nonwoven web by melt extrusion. If a film is present in an embodiment including an imprinted abrasive sheet backing paper, it is desirably a clear film so that its presence does not affect the ability to view printed images on the backside of the abrasive sheet backing. Such a film, if present is desirably less than 1.5 mm in thickness. Likewise, if the film is the backing sheet for holding the abrasive particles, it is also desirably less than 1.5 mm in thickness.

As previously described, in lieu of a film layer on the first fibrous nonwoven web, a second fibrous nonwoven web may be bonded or laminated to the second surface of the first fibrous nonwoven web, again by known means. Such web may be prepared from any polymer as described above for films. The web desirably will be prepared from a thermoplastic polymer.

Desirably, both the first and second fibrous nonwoven webs will be prepared from a thermoplastic polyolefin. In general, the term "thermoplastic polyolefin" is used herein to mean any thermoplastic polyolefin, which can be used, for the preparation of nonwoven webs. In addition, such term is meant to include blends of two or more polyolefins and random and block copolymers prepared from two or more different unsaturated monomers. Because of their commercial importance, the more desired polyolefins are polyethylene and polypropylene. Desirably, if the nonwoven webs are comprised of two spunbond layers, the total basis weight of the nonwoven webs is between about 1.5 and 3.0 osy, more desirably between about 1.5 and 2.5 osy. Desirably the top to bottom layer basis weight ratio is approximately 60:40. Desirably, the top layer contains crimped fibers as well to assist in forming the attachment loops.

The present invention also provides a releasably attachable abrasive sheet material, which includes a first fibrous nonwoven web as described hereinabove. A film, abrasive sheet material backing, or a second fibrous nonwoven web is bonded to the second surface of the first fibrous nonwoven web, and a layer of abrasive particles is bonded to the film, abrasive sheet material backing or second fibrous nonwoven web respectively, to form a textured surface. Alternatively, two webs and a film are bonded to a separate abrasive sheet backing. The color of the film or abrasive sheet material backing matches the coloring formulation in the first nonwoven fibrous web. The film or abrasive sheet material backing may be imprinted on its nontextured side with product indicia or some other form of marking. Desirably, such first nonwoven fibrous web includes a coloring formulation (which is in effect a color concentrate) in an amount between about 2 and 4 % by weight, and in particular, in its polypropylene component. For the purposes of this application, the use of the phrase "about", in connection with coloring formulation is indicative of a level of +/-.5%. If a second fibrous nonwoven web is included, it is desirably a web comprised of a single component spunbond material, desirably polypropylene. Desirably such second fibrous web includes such coloring concentrate in an amount at about 2 % by weight. Therefore, a desirable two layer loop material includes a top layer of about 58-59% % polypropylene and 40 % random copolymer with about 2 % coloring formulation in the polypropylene component, and a bottom layer of about 98 % polypropylene and about 2 % coloring formulation. The colors of the two layers desirably match.

By way of example only, the layer of abrasive particles may be bonded to the film, abrasive sheet material backing or second fibrous nonwoven web by a layer of adhesive. Also by way of example, the layer of abrasive particles may be coated with a second layer of adhesive. If the releasably attachable abrasive sheet material includes an abrasive sheet material backing, such as paper, the nonabrasive/nontextured side of the abrasive sheet material backing is also adhesively bonded to the second surface of the first fibrous nonwoven web (or the second fibrous nonwoven web in a two layered web structure, or in the alternative, a film layer if one is present). Essentially, the imprinted side of the sandpaper is bonded to the second surface of the first fibrous nonwoven web or other layer.

Any of the known types of adhesives can be used to bond the abrasive particles or the layers of the releasably attachable abrasive sheet backing. For example, the adhesive may be thermosetting adhesives, such as, by way of illustration only, epoxy resins, phenolics, polyurethanes, polyesters, and alkyds. Water-based dispersions such as an ammonia-dispersed ethylene-vinyl acetate copolymer also can be employed. The selection of adhesive typically is dictated by the end use, but the adhesive must be compatible with the polymer or substrate over which it is applied. Phenolics are most useful for very tough, coarse abrasive products for rough finishing or shaping, especially where the product needs to be waterproof as well. More flexible adhesives such as epoxy resins and alkyds are also waterproof and are desirable for fine-finishing products.

In general, any of the commonly employed abrasive materials known to those having ordinary skill in the art can be used. Such materials can vary from very coarse to very fine. Exemplary abrasive materials include silicon carbide, aluminum oxide, garnet, and diamond, by way of illustration only.

As previously indicated, if desired, one or more layers of an adhesive or other material can be formed over the layer of abrasive particles as a size coat. Such a layer can serve to better anchor all of the abrasive particles to the abrasive sheet material, thereby reducing abrasive loss during use and increasing the life of the abrasive sheet backing material or film.

Any generally accepted means of applying adhesive to a sheet material can be employed, including such methods as roll, reverse roll, gravure, and Meyer rod coating or melt spraying. It generally is desirable to avoid placing the material under significant tension in order to minimize distortion, especially when the adhesive is being heat cured. Curing temperatures desirably will be kept below about 125°C, as higher temperatures also tend to distort the backing. It is also desirable that the adhesive between the nonwoven web and the film, abrasive backing be noncolored and clear when dry, so as to help reduce blurriness of the imprinted image on the abrasive backing.

If the backing is to be a traditional abrasive sheet backing, such as a paper substrate (as opposed to a film with particles adhering to the film surface, or a nonwoven with particles adhering to the nonwoven surface), such as is known in the art, such backing sheet may be, but is not limited to cellulosic/paper materials and/ or combinations of cellulosic and synthetic fibrous materials. Such materials may also be saturated or impregnated with binders and additives as are known in the art.

FIG. 6 illustrates a cross-sectional illustration of an abrasive sheet material backed laminate made in accordance with the present invention. In FIG. 6 the laminate 80 includes a pattern-unbonded layer 4 as described earlier, bonded to an abrasive sheet material backing 85. An optional second nonwoven layer **5** is included in the laminate between the pattern-unbonded layer 4 and the abrasive sheet material backing 85. A layer of adhesive 86 bonds the abrasive material backing to the pattern unbonded layer 4, or alternatively, to the second nonwoven layer 5, depending on the number of nonwoven layers in the laminate. A printed image 87 may appear on the non-abrasive/nontextured side of the abrasive sheet material backing layer 85, facing the pattern unbonded layer 4. Abrasive materials 88 are shown attached via adhesive to the abrasive sheet material backing layer 85. A second layer of adhesive (not shown) may be situated over the abrasive sheet material layer.

In an alternate embodiment, as illustrated in Fig. 7, a top loop layer 91 is shown having the pattern- unbonded pattern on a first surface. A bottom loop layer 92 is shown attached to the second surface of the first loop layer. A film layer 93 is shown attached to the second loop layer followed by an adhesive layer 94 and a paper substrate 95. Finally, an adhesive and grit layer is shown attached the other side of the paper substrate 96. Alternatively, the adhesive and grit layer may include a second adhesive layer over the grit layer.

The present invention is further described by the trial examples, which follow. Such examples, however, are not to be construed as limiting in any way either the spirit or the scope of the present invention.

Trial 1

In this and all other examples, each sample of the first fibrous nonwoven web (or pattern-unbonded nonwoven loop material) was formed using the process and apparatus described herein, and illustrated in FIGS 1 and 4. In forming each first fibrous nonwoven web, the spunbond web was passed through the nip formed between two counter-rotating thermal bonding rolls including a pattern roll and an anvil roll. The outer surface of the pattern roll included a pattern of land areas defining a plurality of discrete openings. The land areas occupied about 36% of the total area of the pattern roll outer surface. The openings in the pattern roll were circular, arranged in staggered rows, had an average diameter of 0.16 inch (about 0.41 cm), had a depth of 0.06 inch (about 0.15 cm), and had a density of about 5 openings/cm^2 Centerline-to-centerline spacing between openings was 0.165 inch (about 0.41 cm) in the machine direction and 0.19 inch (about 0.48 cm) in the cross-machine direction. The outer surface of the anvil roll was substantially smooth.

The first fibrous nonwoven web in this trial was a spunbond web. The spunbond web employed was prepared from bicomponent fibers having a side by side configuration. The fibers were comprised of polypropylene and random copolymer components obtained respectively from Exxon under the designation 3155 and the Union Carbide Corporation under the designation 6D43. In particular, a two-bank extrusion process was used as described in

FIG. 1. Extrusion Bank 1 consisted of 98 % polypropylene and 2 % beige coloring formulation from Standridge Color Corporation under the designation SCC # 20255, while Extrusion Bank 2 (which forms the top layer/ pattern unbonded layer) consisted of polypropylene including 2 % beige coloring formulation (as previously described), and random copolymer. The ratio of polypropylene to random copolymer in the bicomponent spunbond top layer (Bank 2) was approximately 60/40 unless otherwise noted.

The fibers gave a nonwoven web having a basis weight of 62-65 grams per square meter (gsm) or about 1.8 osy. The specific pattern unbonding operating conditions are illustrated in Table 1, which follows.

Table 1

	1	2	3	4	5	6	7	8	9	10
B.W. osy	**1.8**	**1.8**	**2.0**	**2.0**	**1.7**	**2.1**	**1.8**	**1.8**	**1.8**	**1.8**
BK1 ratio	**65/35**	**100/0**	**100/0**	**100/0**	**100/0**	**100/0**	**100/0**	**100/0**	**100/0**	**100/0**
BK2 ratio	**60/40**	**60/40**	**60/40**	**60/40**	**60/40**	**60/40**	**60/40**	**60/40**	**60/40**	**60/40**
BK1/ BK2 ratio	**50/50**	**60/40**	**60/40**	**70/30**	**70/30**	**60/40**	**60/40**	**60/40**	**70/30**	**70/30**
Colr	**W**	**W**	**W**	**W**	**W**	**W**	**W**	**B**	**B**	**W**
Cal. Pres.	**1440/ 1480**	**1440/1 480**	**1440/1 480**	**1440/1 480**	**1440/1 480**	**1440/1 480**	**1440/1 480**	**1440/1 480**	**1440/1 480**	**1440/1 480**
BK2 Man. Tmp	**330°F**	**330°F**	**330°F**	**330°F**	**330°F**	**330°F**	**330°F**	**330°F**	**330°F**	**280°F**

In the above Table 1, the abbreviation "B.W." represents total basis weight in ounces per square yard of the nonwoven material, "BK1" represents the polymer ratio of the first bank of spunbond material, "BK2" represents the polymer ratio of the second bank of polymer material, "Colr" represents the color of the material, with "W" representing white (obtained from just titanium dioxide coloring) and "B" representing beige (obtained from Beige coloring as hereinbefore described). For comparative samples that were white, the samples were made in accordance with the previously described process. However, the formulation of the polymers were as follows. In the white substrate, Extrusion Bank 1 extruded 98 % Polypropylene and 2 % titanium dioxide in spunbond. Extrusion Bank 2 extruded random copolymer spunbond in a side by side arrangement with one side having 98 % polypropylene and 2 % titanium dioxide and the other side having 100 % random copolymer. In the colored samples (which are noted with a B), Extrusion Bank 1 extruded 98 % Polypropylene and 2 %

coloring formulation in spunbond. Extrusion Bank 2 extruded random copolymer spunbond in a side by side arrangement with one side having 98 % polypropylene and 2 % coloring formulation and the other side having 100 % random copolymer. The coloring formulation was the beige pigment previously identified of the Standridge Color Corporation. Where a ratio is shown for Bank 1 other than 100/0, the first number represents polypropylene and the second number represents copolymer. The abbreviation "Cal. Pres." represents the calender pressure applied by compressing the anvil roll into the pattern roll through hydraulic cylinders with the first number representing the front side and the second number representing the backside of the machine. The units of measurement are in psi (pounds per square inch). The pressure applied during bonding was between 880 pounds per linear inch (pli) to 915 pli. The bonding temperatures of the rolls were approximately 336°F for the top pattern roll and approximately 339°F for the bottom anvil roll. The abbreviation "BK2 Man. Tmp" represents the manifold temperature of spunbond extrusion Bank 2. The manifold temperature of spunbond extrusion Bank 1 was 80° F. The quench air temperature below the spinnerets was about 55°F (12.8°C), and the draw air temperature entering the fiber draw unit was about 80°F (26.7°C) for the bottom layer and 430°F (221.1°C) for the top layer. The line speed of the bicomponent spunbond web entering the nip was about 250 feet per minute (about 75.8 meters per minute). Additionally, a hot air knife was used as earlier described, under the following conditions. Pressure: 1.0 – 1.5 pounds per square inch, Temperature of Air Stream: 305 – 370°F (151.6°C - 187.8°C) and Distance from web: 2.5 inches.

The basis weights of various materials described herein were determined by weighing 8 to 12 sheets of 5 inch X 10 inch individually and averaging the result, and converting the result to ounces per square yard.

The primary requirements of the loop substrate of the present invention for abrasive hook applications are peel strength, shear strength, the absence of fiber lint when disengaged from the hook attachment, improved appearance of uniformity of the spunbond material, and improved appearance of brand name/product code on the backside of abrasive sheet materials through the nonwoven material. Each of these variables were visually observed.

These nonwoven materials were then laminated to commercially available abrasive sheet materials, i.e sandpapers. Sandpaper samples for use in the example trials were obtained from the Home Depot Corporation, under the designation 180 grit all-purpose dry sanding paper. Finished sandpaper was coated with polyurethane adhesive using a Number 44 Meyer rod. The adhesive was obtained from Basic Adhesives Inc. of Brooklyn, NY under the designation BU-4927-1M. To accomplish this, a sheet of the paper was placed in an oven at 90°C for 30 seconds. The sample was removed from the oven and the loop material was laid over the sandpaper sheet. A release liner was then placed on top of the loop material and rolled with a rubber roller. The sheet was then set on a blotter and placed in a hand press at between about 100 to 120 psi for 5 minutes. The sample was then removed from the press and the sheet was laid in an oven, grit side down with blotter. A steel plate was placed on top of the blotter with a weight on it. The oven temperature was set on 90° C for 20 minutes. The weight, plate and blotter were removed and the sample was left in the oven for another 5 minutes. The sample was then removed from the oven to cool. 5 inch diameter discs were cut from the sample and sanded using a Quicksand # 333 random orbit sander obtained from PorterCable through the Home Depot Corporation.

Evaluation of the samples showed that a pigmented bicomponent spunbond material demonstrated improved visual appearance when applied to an imprinted abrasive sheet backing. Evaluation for the appearance of material uniformity was conducted by holding 12 inch by 10 foot sections of the pigmented nonwoven web material (without sandpaper backing) against a black backdrop. Elimination of the color contrast between the nonwoven loop material and the substrate backing layer produced a seemingly improved visual image of the imprinted product codes/ company names. Furthermore, the pattern unbonded surface appeared less splotchy and more uniform. It was determined that this particular technique worked particularly well with images printed on abrasive sheet material backing by offset, gravure, inkjet, and laser printers. This technique is preferable for fonts above 16. Coloring the nonwoven web/loop material to match a backing layer therefore allowed for the substrate to be manufactured at 12-15 % less basis weight without loss of appearance of uniformity and with seemingly improved visual appearance of product codes/brand names.

Example of Matching of Colors to Sheet Backing

In evaluating whether the color of a nonwoven loop material matched that of the sandpaper backing material, a sample of Kimberly-Clark Duraflex brand paper (as previously described) was analyzed with a spectrophotometer. The color of the paper was set as the standard for comparison, and a variety of samples of nonwoven spunbond materials with and without the pattern- unbonded pattern (the 1.8osy basis weight material previously described), were evaluated/compared. Samples of the spunbond were also compared that had been formed using the Hansen Pennings bonding technique, as previously described. An example of samples which were produced which successfully matched the sandpaper material, and which also later aided in the reduction of the splotchy appearance of the nonwoven material (with the pattern- unbonded pattern), without blurring printed indicia, is listed below. The measurements were taken with D65 and 10 deg. Illumination. For the purposes of the comparison, the HP represents the Hansen Pennings spunbond samples (which have been previously described) which retained a beige coloring. The PUB represents the pattern-unbonded spunbond samples (which have been previously described) which retained a beige coloring.

L*a*b* Test Results

	Delta E *	Delta L *	Delta a *	Delta b *
HP SP. Beige1	**1.68**	**-1.16**	**-1.10**	**-0.51**
HP SP Beige2	**2.17**	**-0.95**	**-0.13**	**-1.95**
HP SP Beige3	**1.93**	**0.31**	**-0.87**	**-1.70**
PUB SP Beige4	**2.17**	**-0.67**	**-1.22**	**-1.67**

While the specification has been described in detail with respect to specific embodiments thereof, it will be appreciated by those skilled in the art, upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of, and equivalents to these embodiments. Accordingly, the scope of the present invention should be assessed as that of the appended claims and any equivalents thereto.

WHAT IS CLAIMED IS:

1. A loop substrate suitable for use with a releasably attachable abrasive sheet material comprising:

at least a first fibrous nonwoven web having a first surface and a second surface wherein the first fibrous nonwoven web has:

a pattern on the first surface thereof of continuous bonded areas defining a plurality of discrete unbonded areas formed by the application of heat and pressure, wherein individual fibers within the discrete unbonded areas have at least a portion thereof extending into and bonded within the continuous bonded areas; and

a percent bonded area of from about 20 to about 50 percent; and further, wherein said first fibrous web includes a colorant that matches the color of an abrasive sheet material with which it is to be used.

2. The loop substrate of claim 1 wherein the coloring of said first fibrous web has a Delta E* of between 0 and 3 when compared to the color of the abrasive sheet material with which it is to be used.

3. The loop substrate of claim 2 wherein the coloring of said first fibrous web has a Delta E* of between 0 and 1.25 when compared to the color of the abrasive sheet material with which it is to be used.

4. A releasably attachable abrasive sheet material which comprises:
a loop substrate of at least a first fibrous nonwoven web, having a first surface and a second surface, wherein the first fibrous nonwoven web has:

a pattern on the first surface thereof of continuous bonded areas defining a plurality of discrete unbonded areas formed by the application of heat and pressure, wherein individual fibers within the discrete unbonded areas have at least a portion thereof extending into and bonded within the continuous bonded areas; and

a percent bonded area of from about 20 to about 50 percent; and further wherein said first fibrous web includes a colorant; and

a backing or film layer, either bonded to the second surface of the first fibrous nonwoven web, or to a second fibrous nonwoven web that has been bonded to the second surface of the first fibrous nonwoven web, said backing or film layer of a color that matches the colorant of the first fibrous nonwoven web; and having

a layer of abrasive particles bonded thereto.

5. The releasably attachable abrasive sheet material of claim 4 wherein said coloring of said first fibrous web has a Delta E* of between 0 and 3 when compared to the color of the backing or film layer.

6. The releasably attachable abrasive sheet material of claim 5 wherein said coloring of said first fibrous web has a Delta E* of between 0 and 1.25 when compared to the color of the backing or film layer.

7. A loop material suitable for use with a releasably attachable abrasive sheet material, the loop material comprising:

at least a first fibrous nonwoven web having a first surface and a second surface and comprised of side by side bicomponent spunbond fibers in which the fibers have a melting point differential of at least about 15°C, and in which said bicomponent spunbond fibers are comprised of a polypropylene component including about 2 % by weight of a coloring formulation that matches the color of the releasably attachable abrasive sheet material to which it is to be used with, and a copolymer component; and wherein the first fibrous nonwoven web has:

a thickness of at least about 0.15 mm and a basis weight of at least about 20 grams per square meter;

a pattern on the first surface thereof of continuous bonded areas defining a plurality of discrete unbonded areas formed by the application of heat and pressure, wherein individual fibers within the discrete unbonded areas have at least a portion thereof extending into and bonded within the continuous bonded areas; and

a percent bonded area of from about 20 to about 50 percent.

8. The loop material of claim 7, in which the copolymer component is a random copolymer.

9. The loop material of claim 7, in which the thickness of the first fibrous nonwoven web is at least about 0.2 mm.

10. The loop material of claim 9, in which the thickness of the first fibrous nonwoven web is from about 0.2 mm to about 1 mm.

11. The loop material of claim 7, in which the first fibrous nonwoven web has a percent bonded area of from about 35 to about 45 percent.

12. The loop material of claim 7 which further comprises a film layer laminated to the second surface of the first fibrous nonwoven web.

13. The loop material of claim 7 which further comprises a second fibrous nonwoven web which is laminated to the second surface of the first fibrous nonwoven web.

14. A releasably attachable abrasive sheet material which comprises:

a first fibrous nonwoven web having a first surface and a second surface and comprised of side by side bicomponent spunbond fibers in which the fibers have a melting point differential of at least about 15°C and in which said bicomponent spunbond fibers are comprised of a polypropylene component including about 2 % by weight of a coloring formulation, and a copolymer component;

a backing layer bonded to the second surface of the first fibrous nonwoven web, said backing layer of a color that matches the coloring formulation of said first fibrous nonwoven web; and

a layer of abrasive particles bonded to the backing layer;

wherein the first fibrous nonwoven web has:

a thickness of at least about 0.15 mm and a basis weight of at least about 20 grams per square meter;

a pattern on the first surface thereof of continuous bonded areas defining a plurality of discrete unbonded areas formed by the application of heat and pressure, wherein individual fibers within the discrete unbonded areas have at least a portion thereof extending into and bonded within the continuous bonded areas; and

a percent bonded area of from about 20 to about 50 percent.

15. A releasably attachable abrasive sheet material which comprises:

a first fibrous nonwoven web having a first surface and a second surface and comprised of side by side bicomponent spunbond fibers in which the fibers have a melting point differential of at least about 15°C and in which said bicomponent spunbond fibers are comprised of a polypropylene component including about 2 % by weight of a coloring formulation, and a copolymer component;

a second fibrous nonwoven web bonded to the second surface of the first fibrous nonwoven web;

a film bonded to the second fibrous nonwoven web, said film being colored; and

a layer of abrasive particles bonded to the film;

wherein the first fibrous nonwoven web has:

a thickness of at least about 0.15 mm and a basis weight of at least about 20 grams per square meter;

a pattern on the first surface thereof of continuous bonded areas defining a plurality of discrete unbonded areas formed by the application of heat and pressure, wherein individual fibers within the discrete unbonded areas have at least a portion thereof extending into and bonded within the continuous bonded areas; and

a percent bonded area of from about 20 to about 50 percent, and further wherein said film has a colorant that matches the color of the first nonwoven web.

16. The releasably attachable abrasive sheet material of claim 15, in which the layer of abrasive particles is bonded to the film by a layer of adhesive.

17. The releasably attachable abrasive sheet material of claim 15, in which the layer of abrasive particles is coated with a layer of adhesive.

18. The releasably attachable abrasive sheet material of claim 15, in which the copolymer is a random copolymer.

19. The releasably attachable abrasive sheet material of claim 15, in which the thickness of the first fibrous nonwoven web is at least about 0.2 mm.

20. The releasably attachable abrasive sheet material of claim 19, in which the thickness of the first fibrous nonwoven web is from about 0.2 mm to about 1 mm.

21. The releasably attachable abrasive sheet material of claim 15, in which the first fibrous nonwoven web has a percent bonded area of from about 35 to about 45 percent.

22. A releasably attachable abrasive sheet material which comprises:

a first fibrous nonwoven web having a first surface and a second surface and comprised of side by side bicomponent spunbond fibers in which the fibers have a melting point differential of at least about 15°C and in which said bicomponent spunbond fibers are comprised of a polypropylene component including at between about 2 % to 4 % by weight of a coloring formulation, and a copolymer component;

a second fibrous nonwoven web bonded to the second surface of the first fibrous nonwoven web;

a backing layer bonded to the second fibrous nonwoven web, and having a color that matches the coloring formulation of the first fibrous web; and a layer of abrasive particles bonded to the backing layer;

wherein the first fibrous nonwoven web has:

a thickness of at least about 0.15 mm and a basis weight of at least about 20 grams per square meter;

a pattern on the first surface thereof of continuous bonded areas defining a plurality of discrete unbonded areas formed by the application of heat and pressure, wherein individual fibers within the discrete unbonded areas have at least a portion thereof extending into and bonded within the continuous bonded areas; and

a percent bonded area of from about 20 to about 50 percent.

23. The releasably attachable abrasive sheet material of claim 22, in which the layer of abrasive particles is bonded to backing layer by a layer of adhesive.

24. The releasably attachable abrasive sheet material of claim 22, in which the layer of abrasive particles is coated with a layer of adhesive.

25. The releasably attachable abrasive sheet material of claim 22, in which the second fibrous nonwoven web is comprised of spunbond fibers.

26. The releasably attachable abrasive sheet material of claim 25, in which the second fibrous nonwoven web is comprised of spunbond polypropylene fibers.

27. The releasably attachable abrasive sheet material of claim 26, in which the second fibrous nonwoven web is comprised of spunbond polypropylene fibers, and in which said spunbond polypropylene fibers include about 2 % by weight of a coloring formulation.

28. The releasably attachable abrasive sheet material of claim 22, in which the thickness of the first fibrous nonwoven web is at least about 0.2 mm.

29. The releasably attachable abrasive sheet material of claim 28, in which the thickness of the first fibrous nonwoven web is from about 0.2 mm to about 1 mm.

30. The releasably attachable abrasive sheet material of claim 22, in which the first fibrous nonwoven web has a percent bonded area of from about 35 to about 45 percent.

31. A releasably attachable abrasive sheet material which comprises:

a loop substrate of at least a first fibrous nonwoven web, said first nonwoven web having a first surface and a second surface, wherein the first fibrous nonwoven web includes a colorant;

a backing or film layer, bonded to the second surface of the first fibrous nonwoven web, said backing or film layer of a color that matches the colorant of the first fibrous nonwoven web; and having

a layer of abrasive particles bonded thereto.

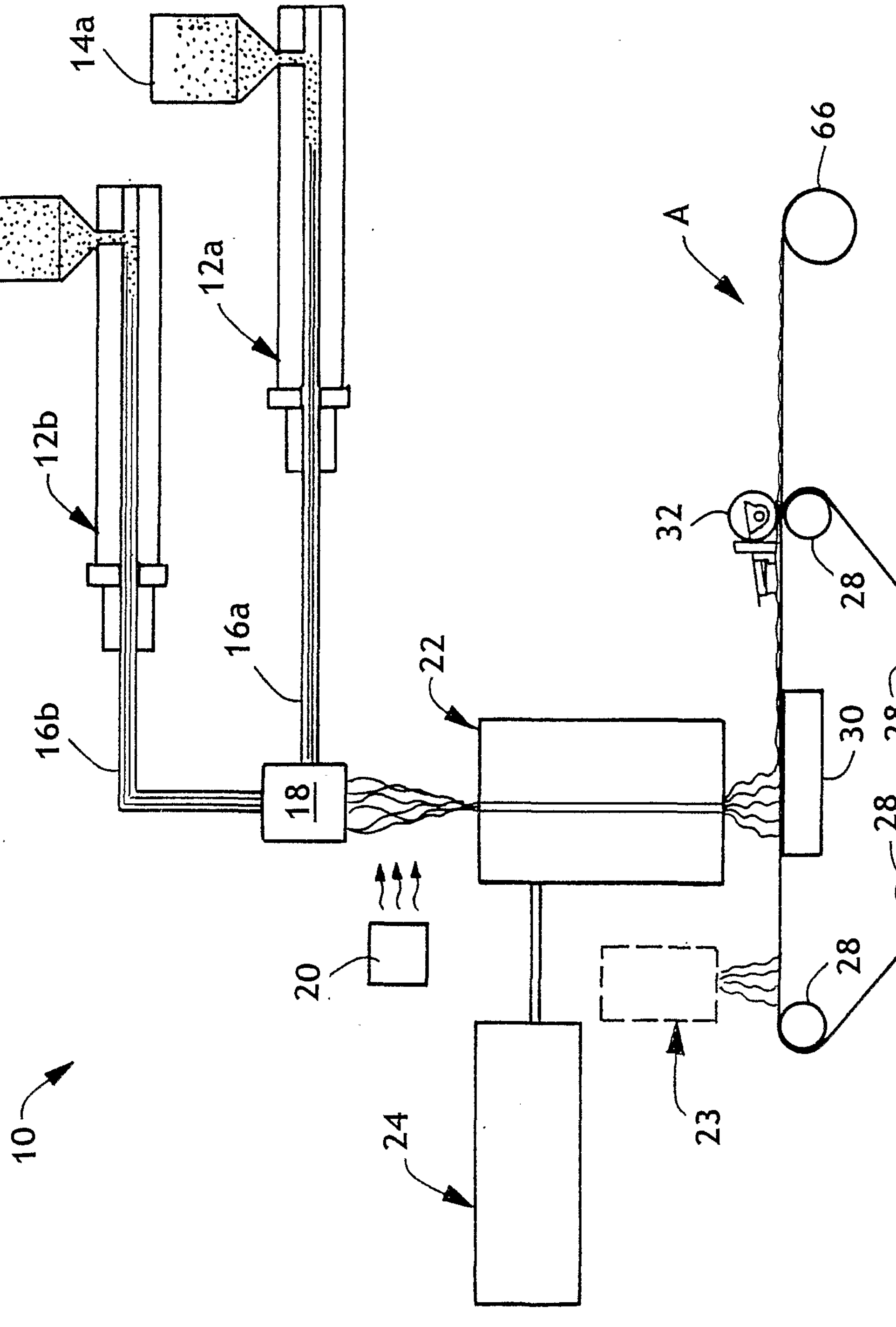

FIG. 1

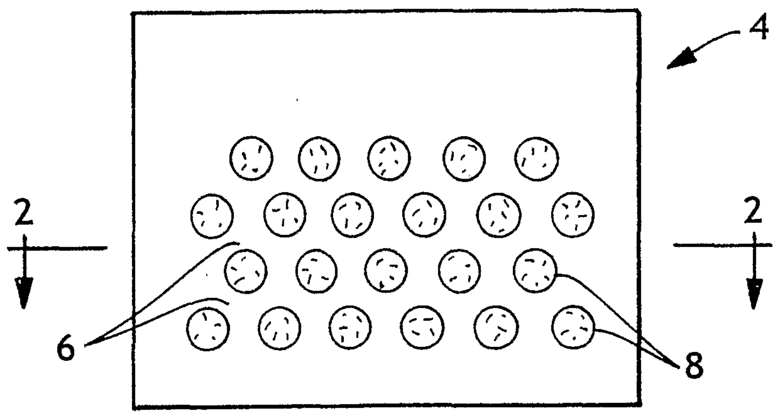

FIG. 2

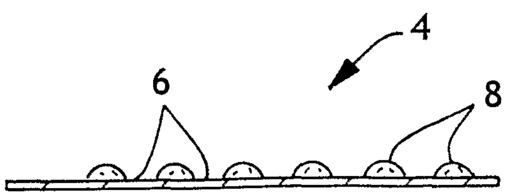

FIG. 3

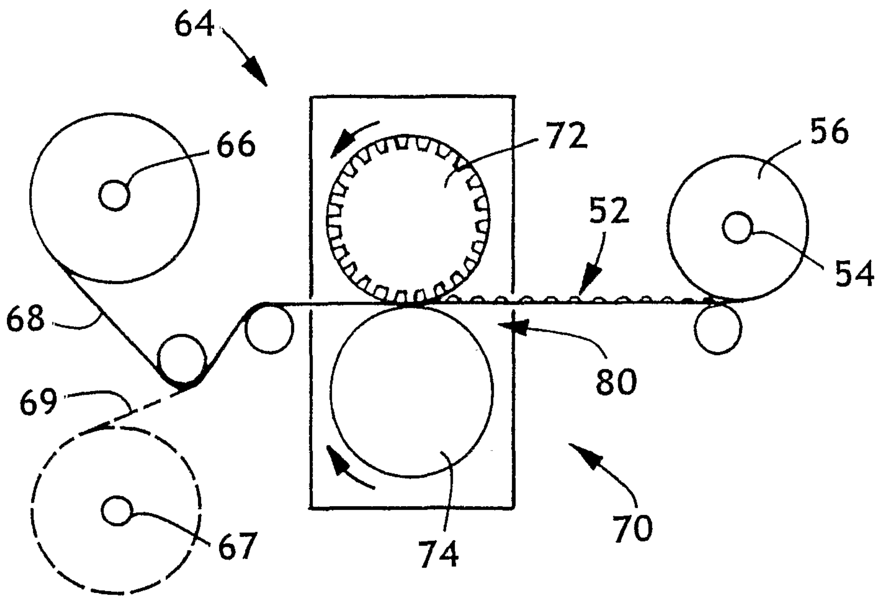

FIG. 4

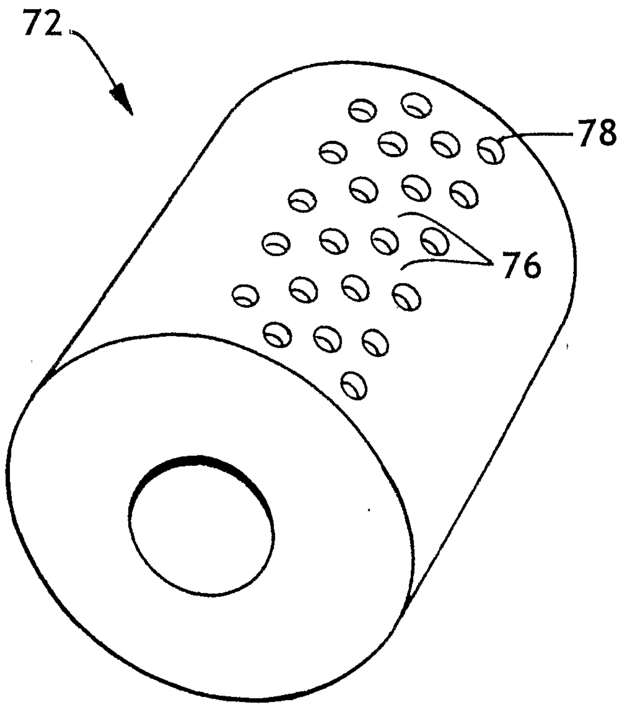

FIG. 5

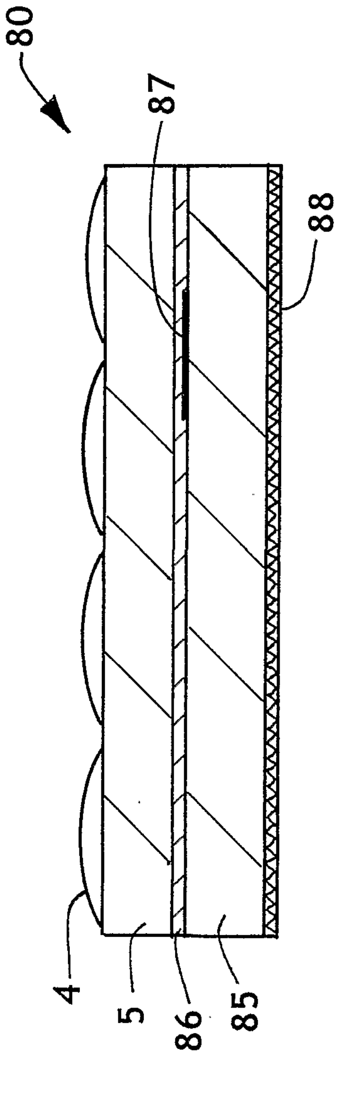

FIG. 6

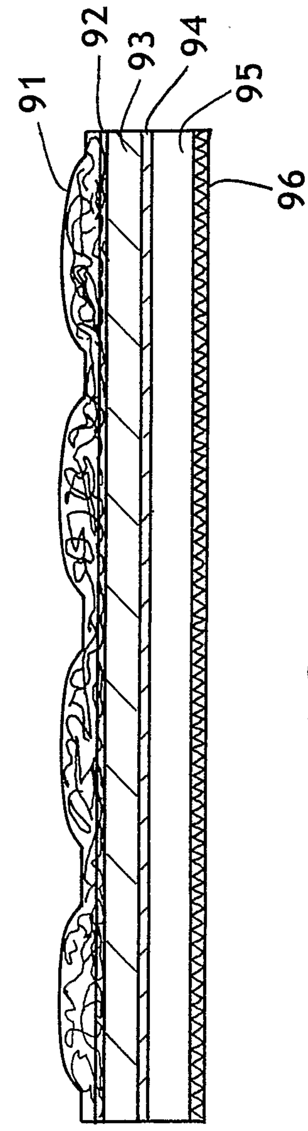

FIG. 7