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(71) Applicant: **3M INNOVATIVE PROPERTIES COMPANY** [US/US]; 3M Center, Post Office Box 33427, Saint Paul, MN 55133-3427 (US).

(72) Inventors: **BRAUNSCHWEIG, Ehrich J.**, 3M Center, Post Office Box 33427, Saint Paul, MN 55133-3427 (US). **WOO, Edward J.**, 3M Center, Post Office Box 33427, Saint Paul, MN 55133-3427 (US). **OWEN, Ian R.**, 3M Center, Post Office Box 33427, Saint Paul, MN 55133-3427 (US). **RAMBOSEK, Thomas W.**, 3M Center, Post Office Box 33427, Saint Paul, MN 55133-3427 (US).

(74) Agent: **FRANZEN, Rick L.**, 3M Center, Office of Intellectual Property Counsel Post Office, e Box 33427, Saint Paul, MN 55133-3427, (US).

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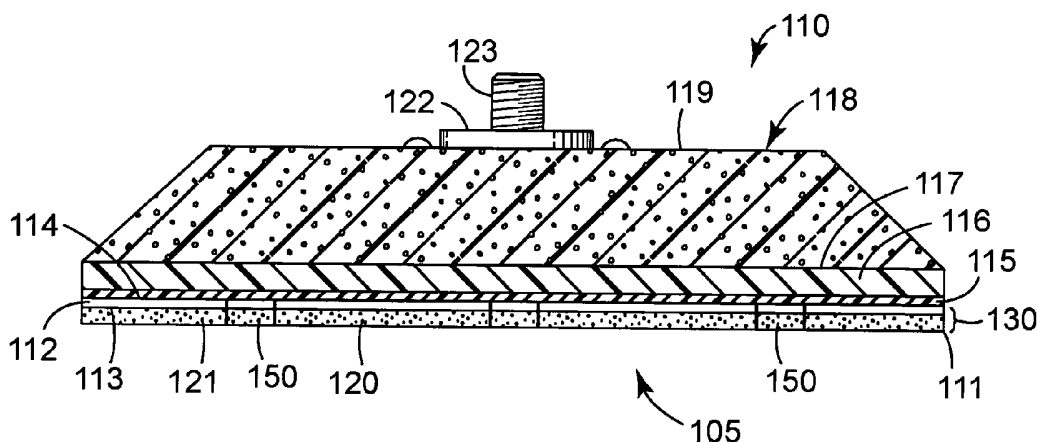
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(54) Title: NON-LOADING ABRASIVE ARTICLE



(57) Abstract: An abrasive article (105) and methods of making and using the same are disclosed. The abrasive article includes a particle impermeable back-up pad (110) attached to an abrasive disc (130). The abrasive disc (130) includes a plurality of perforations therethrough. When the abrasive article is moved and contacted against a workpiece, debris from the workpiece is captured between the back-up pad (110) and workpiece.



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NON-LOADING ABRASIVE ARTICLE

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Field

The present disclosure relates generally to abrasive articles, and more particularly to back-up pad/abrasive disc combinations.

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Background

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Back-up pads are used in the abrasives field to support an abrasive article, such as a disc or sheet during abrading. These abrasive articles can be in various forms, such as a disc, a sheet, or a polygon and, may optionally, contain holes or slits to aid in dust extraction. The back-up pad includes a generally planar major surface, to which the abrasive article, such as a disc or sheet, may be attached. Although back-up pads may be hand held, back-up pads are more commonly used in conjunction with a powered abrading apparatus such as electric or pneumatic sanders.

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Abrasive discs and sheets (hereinafter collectively "discs") may be attached to a back-up pad in various ways. One attachment method includes an abrasive disc having pressure sensitive adhesive (PSA) on one surface thereof, such that the abrasive disc may be adhered to the major surface of the back-up pad. The major surface of the back-up pad may have, for example, a smooth foam, vinyl, or cloth surface to facilitate attachment of the abrasive disc. An example of such a back-up pad is available from 3M Company of St. Paul, MN, under the designation "STIKIT" brand back-up pad. An example of an abrasive disc for attachment to that back-up pad is available from the same company under the designation "STIKIT" brand abrasive disc.

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A second type of back-up pad includes a major surface having a plurality of hooks projecting therefrom. The hooks are adapted to engage certain structures provided on the back face of an abrasive disc to releasably attach the disc to the back-up pad. An example of such a back-up pad is available from the 3M Company of St. Paul, MN, under the designation "HOOKIT" brand back-up pad, and an example of an abrasive disc for attachment to that back-up pad is available from the same company

under the designation "HOOKIT" brand abrasive disc. Alternatively, the back-up pad major surface can include engaging structures to cooperate with hooks on an abrasive disc. An example of such an assembly is available from 3M Company under the designation "HOOKIT II" brand back-up pad and abrasive disc.

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Summary

An aspect of the present disclosure is directed to an article having a back-up pad including a particle impermeable major surface. The article further includes an abrasive disc removably attached to the impermeable major surface. The abrasive disc includes a plurality of perforations therethrough. In some embodiments, the perforations are distributed over the entire disc. In other embodiments, the perforations are substantially uniformly distributed over the entire disc. In other embodiments, the perforations are distributed over an annular section of the disc. In other embodiments, the disc is attached to the back-up pad via a hook and loop arrangement.

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Another aspect of the present disclosure is directed to a method of sanding. The method includes providing an article comprising a back-up pad having a particle impermeable major surface, and an abrasive disc removably attached to the impermeable major surface, wherein the abrasive disc includes a plurality of perforations therethrough. The method further includes moving the abrasive article and contacting a workpiece with the moving abrasive article.

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Brief Description of the Drawing

The present disclosure will be further explained with reference to the appended Figures, wherein like structures are referred to by like numerals throughout the several views, and wherein:

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FIG. 1 is a section view of an example embodiment of a back-up pad and abrasive disc combination according to the present disclosure;

FIG. 2 is an example embodiment of a disc according to the present disclosure;

FIG. 3 is example embodiment of a disc according to the present disclosure;

FIG. 4 an example embodiment of a disc according to the present disclosure;

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FIG. 5 an example embodiment of a disc according to the present disclosure;

FIG. 6 an example embodiment of a disc according to the present disclosure

FIG. 7 an example embodiment of a disc according to the present disclosure;

and

5 **FIG. 8** an example embodiment of a disc according to the present disclosure.

Detailed Description

Generally, the invention of the present disclosure is directed to an abrasive article including a back-up pad removably attached to an abrasive disc. Within the context of this
10 disclosure, removably attached means that the disc is secured to the back-up such that it will not detach during an abrading operation, but can be removed from the back-up pad via manual means, e.g., taken off by hand. The abrasive disc includes a plurality of perforations or holes therethrough for allowing passage of debris (swarf, dust, particles, metal, etc.) from a workpiece into the area or volume between the back-up pad and the
15 abrasive disc.

FIG. 1 illustrates an exemplary article **105** including back-up pad **110** with an abrasive article **130** attached thereto. Abrasive layer **111** of article **130** comprises a plurality of abrasive particles **120** attached to a flexible backing **112** by adhesive coating **121**. The backing **112** has a front side **113** and a backside **114**. Attachment layer **115** is
20 provided as a pressure sensitive adhesive layer (PSA) to releasably attach the abrasive article **130** (layers **111** and **112**) to the facing layer **116** provided on the front surface **117** of molded foam layer **118**. Foam layer **118**, on its rear surface **119**, is attached to a rigid metal backing plate **122**. A threaded stud **123** is fixed in a known manner to the back side of the rigid backing plate **122** to allow attachment of the back-up pad **110** to a suitable tool
25 or drive means (not shown) capable of, for example, rotatably driving the pad **110** and the article **130** around the longitudinal axis of threaded stud **123**. The back-up pad **110** is substantially impermeable to matter that is removed during the abrading process.

Various perforation (interchangeably, also holes) configurations in the abrasive disc can be used with the particle impermeable back up pad. Figure 2 illustrates a 5-hole
30 disc **230**, which is typically 3-8 inches (76.2-203.2 mm) in diameter. The holes **250** are spaced-regularly around the disc **230**, at about 72 degree intervals. Such discs are

available under the trade designation "DUST-FREE SANDING DISCS - 5 HOLE," from 3M Company, St. Paul, Minnesota. Figure 2 illustrates an 8-hole disc **330**, which is typically 3-8 inches (76.2 - 203.2 mm) in diameter. The holes **350** are spaced-regularly around the disc **330**, at about 45 degree intervals. Such discs are available under the trade designation "DUST-FREE SANDING DISCS - 8 HOLE," from 3M Company, St. Paul, Minnesota.

While the above-described discs include circular holes (or perforations), other shapes can be used, either singly or in combination. Referring to Figure 4, an exemplary disc **420** includes alternating rectangular shaped perforations **452** arranged regularly around the disc **420**. Triangular perforations **452** are placed between the rectangular perforations near the periphery of the disc **420**.

Figure 5 illustrates an 8- perforation disc **520**, which is typically 3-8 inches (76.2 - 203.2 mm) in diameter. The perforations **550** are spaced-regularly around the disc **520**, at about 45-degree intervals. The perforations **550** have an end **551** near the periphery of the disc **520** and extend inwardly along a diameter of the disc **520** to a second end **553** near the center of the disc **520**.

Figure 6 illustrates an 8- perforation disc **630**, which is typically 3-8 inches (76.2 - 203.2 mm) in diameter. The perforations **650**, **652** are spaced-regularly around the disc **630**. The perforations **650**, **652** are arcuate and have a circularly-shaped end **651**, **653** near the periphery of the disc **630** and extend inwardly to a second cusp-shaped end **655**, **657** near the center of the disc **630**.

Figure 8 illustrates a 13-perforation disc **820**, which is typically 3-8 inches (76.2 - 203.2 mm) in diameter. Eight perforations **850** are spaced-regularly around the disc **820** near the disc **820** periphery, at about 45-degree intervals. The remaining five perforations **850** include a center hole and an X-shaped layout of the remaining four perforations surrounding the center hole.

Other possible arrangements include the holes or perforations distributed over the entire disc, both uniformly and non-uniformly. The holes or perforations can also be distributed over annular sections of the disc. The perforations on a given disc can be of uniform size, or can be of various shapes and sizes.

To increase the amount of debris that can be accommodated between the disc and the back-up pad, means for accumulating the debris can be optionally included. For example, the back-up pad can have an undulating surface, wherein the low points in the surface will allow more debris to be trapped. The back-up pad can also include cavities, which allows debris to be trapped. An interface pad can also be included between the back-up pad and the disc, adding further debris holding capacity. An exemplary interface pad is available under the trade designation "SOFT INTERFACE PAD," available from 3M Company, St. Paul, Minnesota.

The back-up pad of the invention can be used in any of a variety of desired abrading applications so long as it is properly designed to meet the requirements of the given abrading application. The foam material and mixing proportions of the components of the foam should be formulated to meet the needs of the desired abrading application.

It is within the capability of one of ordinary skill in the art to select the back-up pad to meet the requirements of the abrading for which the pad is used. It is to be understood that the term abrading, and its variants, as used herein are meant to include operations used to reduce or refine a workpiece surface through frictional contact between the workpiece surface and an abrasive article, such as grinding, sanding, finishing, cleaning or polishing operations. These abrading applications can vary widely from final polishing of ophthalmic lenses to heavy stock removal of metal parts. These abrading applications can also involve either abrading by hand or abrading with a machine as the mode of driving the abrasive article in motion. The abrading motions may include a linear motion, random motion, rotary motion, oscillation, random orbital motion, combinations thereof or the like.

The shape of the foam back-up pad may be a square, triangle, rectangle, oval, circle, pentagon, hexagon, octagon, polygon, or any other suitable shape. The diameter for a circular back-up pad ranges from about 0.5 to 50 inches (1.25 cm to 127.0 cm), typically 1 to 30 inches (2.5 cm to 76.2 cm). The length and/or width of the back-up pad can range from about 0.05 to 50 inches (0.13 cm to 127.0 cm), typically 1 to 30 inches (2.5 cm to 76.2 cm). In some instances, a coated abrasive article will overhang the back-up pad by a very slight amount, i.e., typically less than 0.1 inches (0.25 cm), preferably less than 0.05 inches (0.13 cm). The thickness of the foam body member generally will range from

between about 0.2 cm to 7.0 cm typically 0.5 cm to 5.0 cm, and preferably between 1.0 cm. to 3.0 cm.

The foam back-up layer, as used in most abrading applications, will be molded to present a pair of substantially parallel spaced major surfaces or faces. Referring to **Fig. 1**,
5 the front face **117** of the foam back-up pad **110** provides a surface upon which a pad-facing layer **116** can be provided. Examples of materials useful for forming the front facing layer include cloth, nonwoven substrates, treated cloth, treated nonwoven substrates, polymeric films and the like. Examples of preferred front facing materials include loop fabric, cloth sheeting, vinyl sheeting, hooks, nylon coated cloths, vinyl coated
10 nonwovens, vinyl coated cloth, hook faced materials, and the like. The loop fabric can be a knitted loop, brushed loop, a chenille stitched loop, and the like. The polyurethane material of the foam layer **118** is bonded to the pad-facing layer **116** and can be hardened in-situ on the pad facing. For instance, a polyurethane material can be foamed directly to the back side of a pad facing such as loop fabric, thereby adhering to the pad facing.
15 Alternatively, the front facing material can be adhesively bonded to the polyurethane foam. If the polyurethane is foamed onto the front facing material, the front facing material preferably is first sealed to prevent undesired excessive penetration of the foam therethrough.

If the foam back-up pad is intended to be used in machine driven applications, it
20 will typically have some type of mechanical attachment system opposite the side of the loop fabric to secure the back-up pad to the machine. One such system comprises rigid backing plate **122** fixed to the rear surface **119** of the foam back-up pad **110** with threaded stud **123** fixed to the plate **122** (e.g., by welding) for attachment of the foam pad **110** to a drive motor, such as described in U.S. Pat. No. 4,844,967 (Goralski), incorporated herein
25 by reference. Backing plate **122** is affixed (e.g., by rivets) to a larger diameter fiberglass plate (not shown) or an equivalent member, and the foam surface **119** is bonded directly to the fiberglass to thereby affix the mounting system to the back-up pad **110**. Any of a variety of systems or means can be provided for detachable coupling of the foam pad **110** to different types of drive motor assemblies. Such means are known in the art and may
30 include, for example, central concentric openings extending through the foam and the backing plate and accommodating the threaded end of a headed bolt, with the bolt head

abutting the surface of the backing plate affixed to the foam with the head of the bolt positioned in the central opening of the foam and the threaded end of the bolt engaging the drive member of a drive motor assembly. For random orbital applications, the support member may contain a threaded stud or other attachment system for mounting onto the machine. Other means that can be provided to adapt the back-up pad for operation with drive mechanisms include those disclosed in U.S. Pat. No. 4,631,220 (Clifton), incorporated herein by reference. It will be understood that the invention is not limited by the specific mounting system employed, and those skilled in the art will appreciate that the specific mounting system employed for use with a specific back-up pad will depend on the type of tool to be used with the pad.

For manual abrasive operations held in the hand, various shapes or configurations of foam back-up pads may be utilized. Two such types include hand pads and foamed back-up pads used on long planing boards. The strength and other physical properties required for these manual abrasive operations is less than those for random orbital applications where the strength and physical property requirements of the foam become much more significant. The physical properties of the foam depend on the end use application. As the back-up pad is used in abrading applications, there can be a manual grip handle associated with it.

In some instances, it is preferred to incorporate a pressure sensitive adhesive onto the backside of the abrasive article so that the backing of the abrasive article can be secured to the facing layer of the foam back-up pad. Representative examples of pressure sensitive adhesives suitable for this invention include latex crepe, rosin, acrylic polymers and copolymers e.g., polybutylacrylate, polyacrylate ester, polyvinyl ethers, e.g. polyvinyl n-butyl ether, alkyd adhesives, rubber adhesives, e.g., natural rubber, synthetic rubber, chlorinated rubber, and mixtures thereof. The preferred pressure sensitive adhesive is an isooctylacrylate: acrylic acid copolymer.

Alternatively, a hook and loop type attachment system may be employed to secure the abrasive article to the facing of the foam back-up pad. The hook fabric may be on the backside of the abrasive article with hooks on the front side of the back-up pad.

Otherwise, the hooks may be on the backside of the abrasive article with the loops on the front side of the back-up pad. This hook and loop type attachment system is further

described in U.S. Pat. Nos. 4,609,581 (Ott); 5,254,194 (Ott et al.); 6,579,162 (Chesley et al.); 5,505,747 (Chesley et al.); 5,607,345 (Barry et al.); and U.S. patent publication No. 03-0159363-A1 (Chesley et al.); each of which is incorporated herein by reference. The opposite exposed front side of the abrasive article has an abrasive coating that is responsible for the abrading action.

Examples

The following materials were obtained from 3M Company, Saint Paul, MN. As noted, some materials were subsequently modified for evaluation purposes.

"AD1": A P320 grade alumina, resin bonded, 5-inch (12.7 cm) diameter abrasive disc, commercially available under the trade designation "210U P320 STIKIT DISC";

"AD2": A 5-hole P320 grade alumina, resin bonded, 5-inch (12.7 cm) diameter abrasive paper disc, commercially available under the trade designation "210U P320 STIKIT DUST-FREE DISC", wherein a single center-hole, 1-3/8 inch (3.5 cm) diameter, was die punched out of the abrasive film disc;

"AD3": A P400 grade alumina, resin bonded, 5-inch (12.7 cm) diameter abrasive disc, commercially available under the trade designation "210U P400 STIKIT DISC";

"AD4": A 5-hole P400 grade alumina, resin bonded, 5-inch (12.7 cm) diameter abrasive paper disc, commercially available under the trade designation "210U P400 STIKIT DUST-FREE DISC", wherein a single center-hole, 1-3/8 inch (3.5 cm) diameter, was die punched out of the abrasive film disc;

"AD5": A P400 grade alumina, resin bonded, 5-inch (12.7 cm) diameter abrasive paper disc, commercially available under the trade designation "210U P400 HOOKIT II DISC";

"AD6": A 5-hole P400 grade alumina, resin bonded, 5-inch (12.7 cm) diameter abrasive paper disc, commercially available under the trade designation "210U P400 HOOKIT II DUST-FREE DISC", wherein a single center-hole, 1-3/8 inch (3.5 cm) diameter, was die punched out of the abrasive film disc;

- "AD7": A P400 grade alumina, resin bonded, 6-inch (15.2 cm) diameter abrasive paper disc, having a stearate antiload supersize, commercially available under the trade designation "216U P400 FRE-CUT HOOKIT II DISC";
- 5 "AD8": A 6-hole P400 grade alumina, resin bonded, 6-inch (15.2 cm) diameter abrasive paper disc, having a stearate antiload supersize, commercially available under the trade designation "216U P400 FRE-CUT HOOKIT II DUST-FREE DISC"
- 10 "AD9": A 9-hole P400 grade alumina, resin bonded, 6-inch (15.2 cm) diameter abrasive paper disc, having a stearate antiload supersize, commercially available under the trade designation "216U P400 FRE-CUT DUST-FREE HOOKIT II DISC";
- "AD10": A P500 grade alumina, resin bonded, 5-inch (12.7 cm) diameter abrasive film disc, commercially available under the trade designation "360L P500 HOOKIT II";
- 15 "AD11": As per "AD10", wherein a single center-hole, 1-3/8 inch (3.5 cm) diameter, was die punched out of the abrasive film disc;
- "AD12": A 5-hole P500 grade alumina, resin bonded, 5-inch (12.7 cm) diameter abrasive film disc, commercially available under the trade designation "360L P500 HOOKIT II DUST-FREE DISC", wherein a single center-hole, 1-3/8 inch (3.5 cm) diameter, was die punched out of the abrasive film disc;
- 20 "AD13": A P1000 grade alumina, resin bonded, 6-inch (15.2 cm) diameter abrasive film disc, commercially available under the trade designation "260L P1000 HOOKIT II DISC";
- "AD14": A 6-hole P1000 grade alumina, resin bonded, 6-inch (15.2 cm) diameter abrasive film disc, commercially available under the trade designation "260L P1000 HOOKIT II DUST-FREE DISC";
- 25 "AD15": A P1000 grade alumina, resin bonded, 6-inch (15.2 cm) diameter abrasive film disc, commercially available under the trade designation "260L P1000 STIKIT DISC";

- "AD16": A 6-hole P1000 grade alumina, resin bonded, 6-inch (15.2 cm) diameter abrasive film disc, commercially available under the trade designation "260L P1000 STIKIT DUST-FREE DISC";
- 5 "AD17": A P1000 grade alumina, resin bonded, 6-inch (15.2 cm) diameter abrasive film disc, commercially available under the trade designation "260L P1000 HOOKIT DISC";
- "AD18": A 6-hole P1000 grade alumina, resin bonded, 6-inch (15.2 cm) diameter abrasive film disc, commercially available under the trade designation "260L P1000 HOOKIT DUST-FREE DISC";
- 10 "AD19": A P320 grade alumina, resin bonded, 5-inch (12.7 cm) x 3-inch (7.6 cm) rectangular abrasive paper sheet, commercially available under the trade designation "334U P320 HOOKIT II";
- "AD20": As per "AD19", wherein 13 holes of 1/8-inch (0.32 cm) diameter, in an evenly distributed 3x3/2x2 array, were die punched out of the abrasive
15 sheet, having the hole pattern as illustrated in **FIG. 8**;
- "BP1": Back-up pad having pressure sensitive adhesive as a means for attaching abrasive discs, available under the trade designation "STIKIT LOW PROFILE DISC PAD";
- "BP2": Back-up pad having hooks as a means for attaching abrasive discs in a hook
20 and loop mechanical fastener system, available under the trade designation "HOOKIT LOW PROFILE DISC PAD";
- "BP3": Back-up pad having loops as a means for attaching abrasive discs in a hook and loop mechanical fastener system, available under the trade designation "HOOKIT II DISC PAD";
- 25 "BP4": As per backup pad BP1, wherein a polypropylene mask having a pressure sensitive adhesive coated macro structure, 0.317 mm x 0.317 mm x 0.35 mm height, and 0.156 mm channels between macro structures, was laminated to the face of the back up pad;
- "BP5": Hand-held back-up pad having pressure sensitive adhesive as a means for
30 attaching abrasive discs, available under the trade designation "HOOKIT II CENTER WATER FEED FOAM DISC PAD";

- “BP6”: A hard hand sanding block, 2¾-inch (7.0 cm) x 5-inch (12.7 cm), commercially available under the trade designation “HOOKIT II HAND BLOCK”;
- 5 “TP1”: A mild steel test panel coated with a grey primer, commercially available under the trade designation “URO 1140S” from E. I. DuPont de Nemours Company, Wilmington, DE;
- “TP2”: A mild steel test panel coated with a powder primer, commercially available under the trade designation “PCV 70118” from PPG Industries, Pittsburgh, PA;
- 10 “TP3”: A mild steel test panel coated with a urethane clearcoat, commercially available under the trade designation “DCU 2021” from PPG Industries;
- “TP4”: A mild steel test panel coated with a primer, commercially available under the trade designation “TAUPE U28RW035K” from BASF Automotive Refinish Technologies, Inc., Southfield, MI;
- 15 “TP5”: A mild steel test panel coated with black primer, commercially available under the trade designation “SIKKENS COLORBUILD BLACK” from Akzo Nobel Coatings Inc., Norcross, GA.

Test Methods

- 20 The following test methods were used.

Off-Hand Abrasion Test.

- An abrasive disc was secured to the appropriate size backup pad according to the respective attachment system. The disc pad was then attached to a dual action sander, commercially available as model number “57015”, from the Dynabrade Company,
- 25 Clarence, N.Y. Abrasion tests were run for up to 138 seconds, in various intervals, over three adjacent sections of the test panel, at an air pressure of up to 620.5 kPa (90 Psi) and a disc-to-panel angle of 0-2.5 degrees.

Surface Finish

- Surface finish (Rz) is the average individual roughness depths of a measuring
- 30 length, where an individual roughness depth is the vertical distance between the highest point and the lowest point. The surface finish of abraded test panels were measured using a

profilometer under the trade designation "PERTHOMETER MODEL M4P-127527" from Mahr Corporation, Cincinnati, OH. Surface finish values were measured at five points within each of the three abraded sections of the test panel at the end of the third sanding interval.

5 Cut Rate

Cut-rate refers to the ability of the abrasive article to remove stock material or surface particles from the workpiece. The cut rate is the amount of weight loss of the test panel during the sanding operation. The test panel was weighed with an accurate electronic balance before the sanding test began. Using the sample test fixture the painted panel was sanded as described above. After each sanding cycle the test panel was cleaned of accumulated swarf by blowing with compressed air. The test panel was re-weighed to establish the weight loss (cut) during each sanding interval. The cumulative weight loss for each sanding interval was then recorded. The tests were run in triplicate.

15 Stiction

Sanding a smooth abrasive coating may create what is known in the industry as "stiction", whereby the abrasive coating may stick to the workpiece surface, with unwanted results. It is preferred to minimize stiction in fine finishing applications.

20 Examples 1-5 & Comparatives A-D

Samples of test panel TP1 were sanded according to the method described above at a pressure of 620.5 kPa (90 Psi). Results are listed in Table 1.

TABLE 1

	Abrasive Disc	Back-up Pad	Sanding Interval (seconds)	Cut Rate (grams)	Total Cut (grams)
Example 1	AD2	BP1	30, 60, 90	Not Measured	6.0
Comparative A	AD1	BP1	30, 60,90	Not Measured	6.6

Example 2	AD2	BP4	30, 60, 90	Not Measured	7.2
Comparative B	AD1	BP4	30, 60, 90	Not Measured	6.1
Example 3	AD4	BP1	30, 60, 90	1.79, 1.68, 1.51	5.0
Example 4	AD4	BP4	30, 60, 90	2.08, 1.92, 1.66	5.7
Comparative C	AD3	BP1	30, 60, 90	1.84, 1.53, 1.46	4.8
Example 5	AD6	BP3	30, 60, 90	Not Measured	5.2
Comparative D	AD5	BP3	30, 60, 90	Not Measured	3.6

Examples 6-8 & Comparatives E-G

Samples of test panel TP2 were sanded according to the method described above at a pressure of 620.5 kPa (90 Psi). Results are listed in Table 2.

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TABLE 2

	Abrasive Disc	Back-up Pad	Sanding Interval (seconds)	Total Cut Improvement
Example 6	AD6	BP3	30, 60, 90, 120	148%
Comparative E	AD5	BP3	30, 60, 90, 120	100%
Example 7	AD6	BP3	30, 60, 90, 120	144%
Comparative F	AD5	BP3	30, 60, 90, 120	100%
Example 8	AD8	BP3	30, 60, 90, 120	150%

			120	
Comparative G	AD7	BP3	30, 60, 90, 120	100 %

Example 9 & Comparative H

5 Samples of test panel TP1 were sanded according to the method described above at a pressure of 620.5 kPa (90 Psi). Results are listed in Table 3.

TABLE 3

	Abrasive Disc	Back-up Pad	Sanding Interval (seconds)	Cut Rate (grams)	Total Cut (grams)	Finish (micro-inches)/ (micrometers)
Example 9	AD9	BP3	30,60,90,120	1.86, 1.42, 1.34, 1.24	5.86	146/125 (3.71/3.18) @30/120s
Comparative H	AD7	BP3	30,60,90,120	1.36, 0.95, 1.01, 0.95	4.26	147/130 (3.73/3.30) @30/120s

Examples 10-11 & Comparative I

10 Samples of test panel TP1 were sanded according to the method described above at a pressure of 620.5 kPa (90 Psi). Results are listed in Table 4.

TABLE 4

	Abrasive Disc	Back-up Pad	Sanding Interval (seconds)	Cut Rate (grams)	Total Cut (grams)	Finish (micro-inches)/ (micrometers)
Example 10	AD11	BP3	30,60,90,120	1.82, 1.31, 1.16, 1.13	5.42	104/88 (2.64/2.24) @30/120s
Example 11	AD12	BP3	30,60,90,120	1.88, 1.40, 1.25, 1.23	5.76	106/92 (2.69/2.34) @30/120s
Comparative I	AD10	BP3	30,60,90,120	1.50, 1.10, 1.11, 1.02	4.73	108/90 (2.74/2.29) @30/120s

Examples 12-14 & Comparatives J-L

Samples of test panel TP3 were sanding according to the method described above at a pressure of 248.2 kPa (36 Psi). An interface pad, commercially available under the trade designation "HOOKIT II SOFT INTERFACE PAD" from 3M Company, was applied between the abrasive disc and the back-up pad. Results are listed in Table 5. Three different lots of "260L P1000 HOOKIT II DISC" and "260L P1000 HOOKIT II DUST-FREE DISC" were evaluated.

TABLE 5

	Abrasive Disc	Back-up Pad	Sanding Interval (seconds)	Total Cut (grams)	Finish (micro-inches)/ (micrometers)
Example 12	AD14, Lot 1	BP3	23, 46, 69, 92, 115, 138	0.30	76.8 (1.95)
Comparative J	AD13, Lot 1	BP3	23, 46, 69, 92, 115, 138	0.35	81.0 (2.06)
Example 13	AD14, Lot 2	BP3	23, 46, 69, 92, 115, 138	0.35	89.1 (2.26)

Comparative K	AD13, Lot 2	BP3	23, 46, 69, 92, 115, 138	0.33	87.3 (2.22)
Example 14	AD14, Lot 3	BP3	23, 46, 69, 92, 115, 138	0.21	53.3 (1.35)
Comparative L	AD13, Lot 3	BP3	23, 46, 69, 92, 115, 138	0.25	56.4 (1.43)

Examples 15-16 & Comparatives M-N

Samples of test panel TP2 were sanded according to the method described above at a pressure of 275.8 kPa (40 Psi) using a STIKIT disc pad. Results are listed in Table 6.

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TABLE 6

	Abrasive Disc	Back- up Pad	Sanding Interval (seconds)	Cut Rate (grams)	Finish (micro- inches)/ (micrometers)
Example 15	AD16	BP1	23, 46, 69, 92, 115, 138	0.16, 0.27, 0.42, 0.54	36.9 (0.94)
Comparative M	AD15	BP1	23, 46, 69, 92, 115, 138	0.19, 0.35, 0.51, 0.65	33.5 (0.85)
Example 16	AD16	BP4	23, 46, 69, 92, 115, 138	0.22, 0.44, 0.64, 0.85	30.8 (0.78)
Comparative N	AD15	BP4	23, 46, 69, 92, 115, 138	0.21, 0.47, 0.69, 0.84	31.5 (0.80)

Example 17 & Comparative O

Samples of test panel TP4, moistened with a thin film of water, were hand sanded using HOOKIT II discs attached to hand HOOKIT II center water feed back up pad. Results are listed in Table 7.

TABLE 7

	Abrasive Disc	Back-up Pad	Sanding Interval (seconds)	Total Cut (grams)	Stiction
Example 17	AD6	BP5	30	30.3	Low stiction
Comparative O	AD5	BP5	30	33.3	High stiction

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Example 18 & Comparative P

Samples of test panel TP5, were dry hand sanded using HOOKIT II sheets attached to hard hand sanding block BP6, in a series of 4 intervals of 5 strokes (backward-forward) each. Cut performance and stiction ratings, as an average of triplicate samples, are listed in Table 8.

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TABLE 8

	Abrasive Disc	Back-up Pad	Cut Rate (grams)	Stiction
Example 18	AD20	BP6	0.47, 1.05, 1.34	No stiction
Comparative P	AD19	BP6	0.49, 1.02, 1.24	High stiction

Examples 19-21 & Comparatives Q-S

Samples of test panel TP3 were sanded according to the method described above at a pressure of 248.2 kPa (36 Psi). With respect to Example 20 and Comparative R, an interface pad, commercially available under the trade designation "HOOKIT SOFT INTERFACE PAD" from 3M Company, was applied between the abrasive disc and the

15

back-up pad. With respect to Example 21 and Comparative S, an interface pad, commercially available under the trade designation "HOOKIT II SOFT INTERFACE PAD" from 3M Company, was applied between the abrasive disc and the back-up pad. Results are listed in Table 9.

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TABLE 9

	Abrasive Disc	Back-up Pad	Sanding Interval (seconds)	Cut Rate (grams)	Finish (micro-inches)/ (micrometers)
Example 19	AD16	BP1	30, 60, 120	0.40, 0.69, 1.02,	84.8 (2.15)
Comparative Q	AD15	BP1	30, 60, 90, 120	0.33, 0.58, 0.97	78.9 (2.00)
Example 20	AD18	BP2	30, 60, 90, 120	0.32, 0.67, 1.25	74.2 (1.89)
Comparative R	AD17	BP2	30, 60, 90, 120	0.31, 0.62, 1.12	73.4 (1.86)
Example 21	AD14	BP3	30, 60, 90, 120	0.30, 0.62, 1.12	71.5 (1.82)
Comparative S	AD13	BP3	30, 60, 90, 120	0.31, 0.62, 1.10	73.7 (1.87)

Examples 22-24 & Comparatives T-V

Samples of test panel TP2 were sanded according to the method described above at a pressure of 275.8 kPa (40 Psi). With respect to Examples 23-24 and Comparatives U-V, interface pads, as described previously, were applied between the abrasive disc and the back up pad. Results are listed in Table 10.

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TABLE 10

	Abrasive Disc	Back-up Pad	Sanding Interval (seconds)	Cut Rate (grams)	Finish (micro-inches)/ (micrometers)
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Example 22	AD16	BP1	15, 30, 45, 60	0.25, 0.38, 0.62	40.1 (1.02)
Comparative T	AD15	BP1	15, 30, 45, 60	0.16, 0.36, 0.69	48.0 (1.22)
Example 23	AD18	BP2	15, 30, 45, 60	0.22, 0.46, 0.82	33.3 (0.85)
Comparative U	AD17	BP2	15, 30, 45, 60	0.20, 0.36, 0.63	43.0 (1.09)
Example 24	AD14	BP3	30	0.17, 0.38, 0.77	38.1 (0.97)
Comparative V	AD13	BP3	30	0.17, 0.40, 0.68	39.4 (1.00)

The abrasive disc, the means for the attachment of the article to the back-up pad, the foam facing layer, the rigid backing plate and threaded stud, as mentioned above in connection with the discussion above, while useful and necessary from a practical standpoint to the present invention, can be supplied by known means and constructions in the field and thus should require no further details than that provided herein to be understood by one of ordinary skill in the art.

What is claimed is:

1. An article comprising:
a back-up pad having a particle impermeable major surface; and
an abrasive disc removably attached to the impermeable major surface, the abrasive
5 disc including a plurality of perforations therethrough.
2. The article of claim 1, wherein the perforations are distributed over the entire disc.
3. The article of claim 2, wherein the perforations are substantially uniformly
10 distributed over the entire disc.
4. The article of claim 1, wherein the perforations are distributed over an annular
section of the disc.
- 15 5. The article of claim 1, wherein the perforations are of substantially uniform size.
6. The article of claim 1, wherein the disc is attached to the back-up pad via a hook
and loop arrangement.
- 20 7. The abrasive article of claim 6, wherein the hooking members are on the back-up
pad and the loop members are on the disc.
8. The article of claim 1, further including an adhesive layer between the back-up pad
and disc.
25
9. The article of claim 1, further including accumulating means between the back-up
pad and the disc.
10. The article of claim 9, wherein the accumulating means is an arrangement of
30 cavities on the back-up pad.

11. The article of claim 1, wherein the plurality of perforations is less than 14.

12. A method of sanding comprising:

5 providing an article comprising a back-up pad having a particle impermeable major surface; an abrasive disc removably attached to the impermeable major surface, the abrasive disc including a plurality of perforations therethrough;
moving the abrasive article; and
contacting a workpiece with the abrasive article.

10 13. The method of claim 12, wherein the perforations are distributed over the entire disc.

14. The method of claim 13, wherein the perforations are substantially uniformly distributed over the entire disc.

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15. The method of claim 12, wherein the perforations are distributed over an annular section of the disc.

16. The method of claim 12, wherein the perforations are of substantially uniform size.

20

17. The method of claim 12, wherein the disc is attached to the back-up pad via a hook and loop arrangement.

25 18. The method of claim 17, wherein the hooking members are on the back-up pad and the loop members are on the disc.

19. The method of claim 12, further including an adhesive layer between the back-up pad and disc.

30 20. The method of claim 12, further including accumulating means between the back-up pad and the disc.

21. The method of claim 20, wherein the accumulating means is an arrangement of cavities on the back-up pad.

5 22. The method of claim 20, wherein the accumulating means is an arrangement of undulating features on disc.

23. The method of 12, wherein the method of sanding includes wet sanding.

10 24. The method of claim 12, wherein the method of sanding includes dry sanding.

25. The method of claim 12, wherein said moving the abrasive article includes manually moving the abrasive article.

15 26. The method of claim 12, wherein said moving the abrasive article includes moving the abrasive article with a powered device.

27. A method of making an article comprising:
removably attaching a particle impermeable back-up pad to a disc, wherein the disc
20 includes a plurality of perforations therethrough.

28. The method of claim 27, wherein the perforations are distributed over the entire disc.

25 29. The method of claim 28, wherein the perforations are substantially uniformly distributed over the entire disc.

30. The method of claim 27, wherein the perforations are distributed over an annular section of the disc.

30

31. The method of claim 27, wherein the perforations are of substantially uniform size.

32. The method of claim 27, wherein the disc is attached to the back-up pad via a hook and loop arrangement.

5 33. The method of claim 32, wherein the hooking members are on the back-up pad and the loop members are on the disc.

34. The method of claim 32, further including an adhesive layer between the back-up pad and disc 1.

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35. The method of claim 27, further including accumulating means between the back-up pad and the disc.

15 36. The method of claim 35, wherein the accumulating means is an arrangement of cavities on the back-up pad.

37. The method of claim 36, wherein the powered device is an electric sander.

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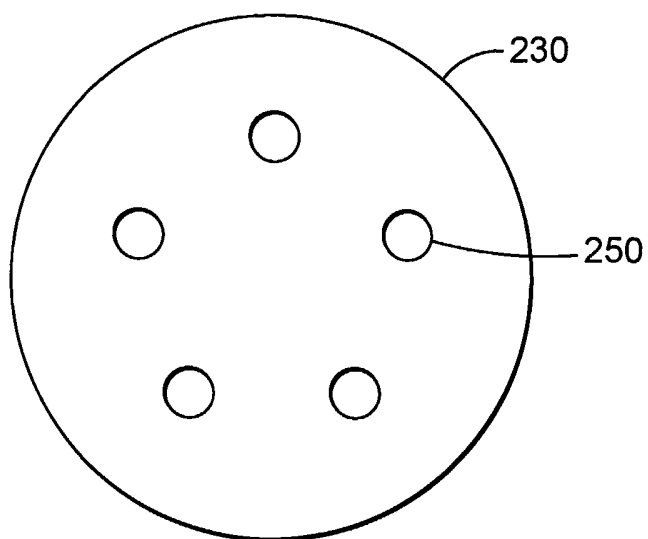


FIG. 2

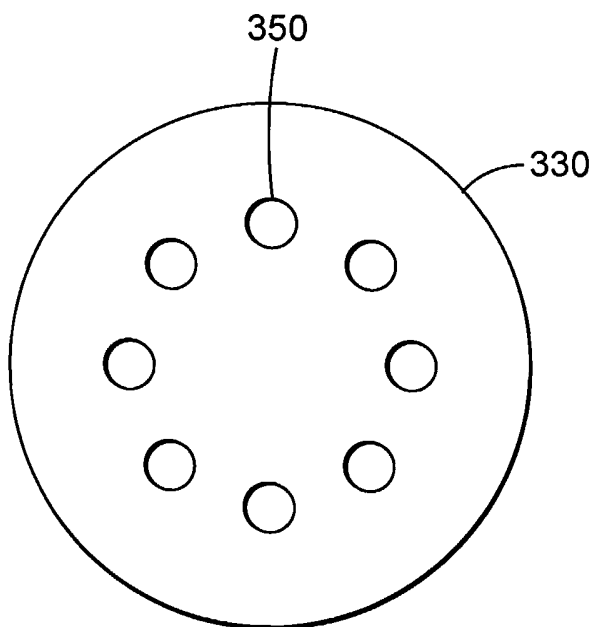


FIG. 3

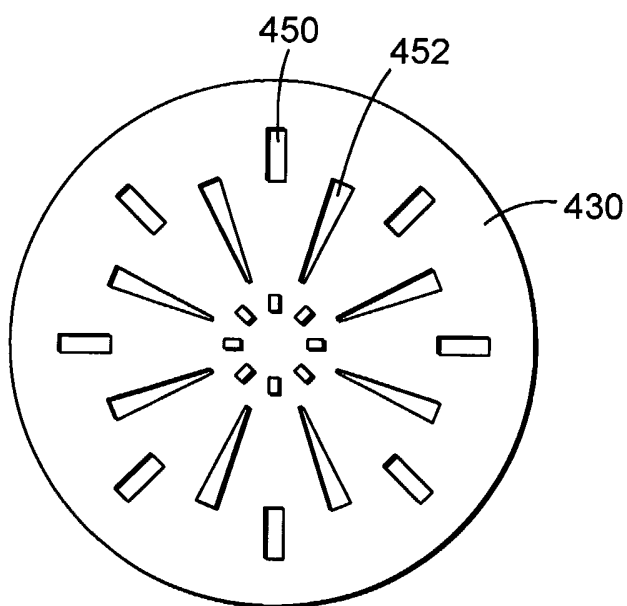


FIG. 4

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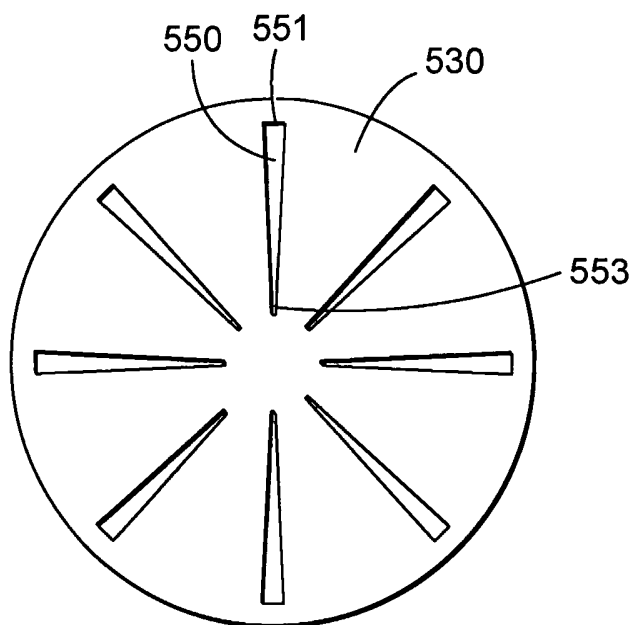


FIG. 5

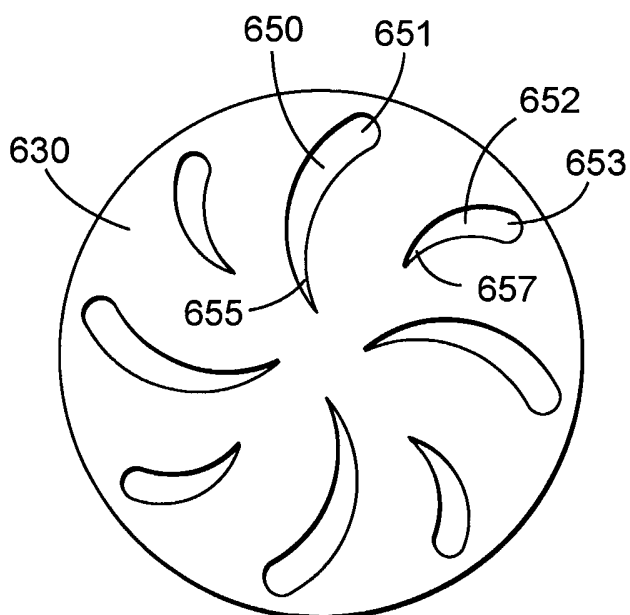
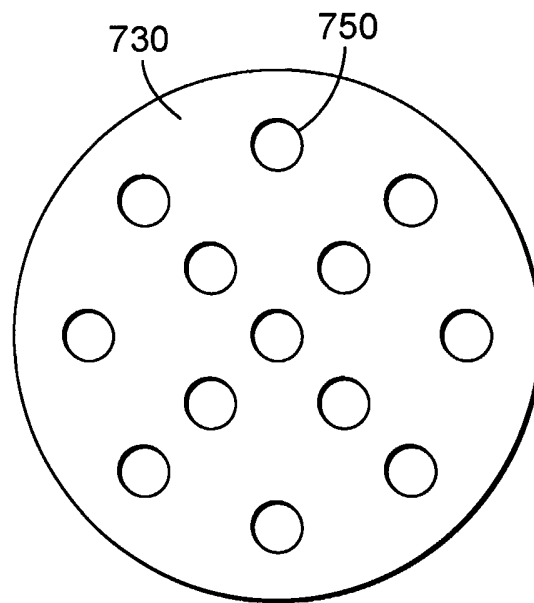
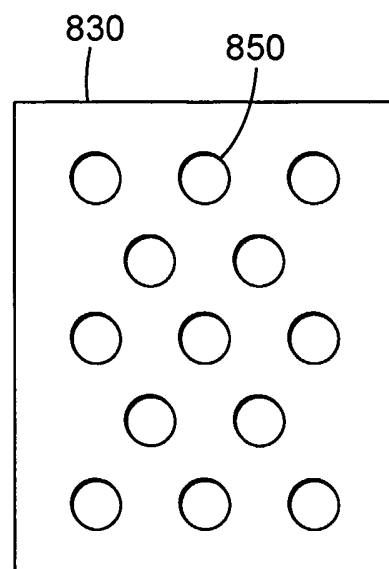


FIG. 6

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*FIG. 7**FIG. 8*

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US2005/022104

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B24D9/08 B24D9/10 B24B55/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B24D B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 158 935 A (ROBERT, JEAN H P) 26 June 1979 (1979-06-26) column 3, line 14 - column 4, line 29; figures -----	1-37
X	US 4 920 702 A (KLOSS ET AL) 1 May 1990 (1990-05-01) column 6, lines 5-46; figures -----	1, 12, 27
X	US 5 810 650 A (JOEST ET AL) 22 September 1998 (1998-09-22) column 4, lines 11-36; figure 3a -----	1, 12, 27



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Date of the actual completion of the international search

8 September 2005

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14/09/2005

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
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Garella, M

INTERNATIONAL SEARCH REPORT

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