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(54) SANDING TOOL WITH MOLDING INTERFACE PAD

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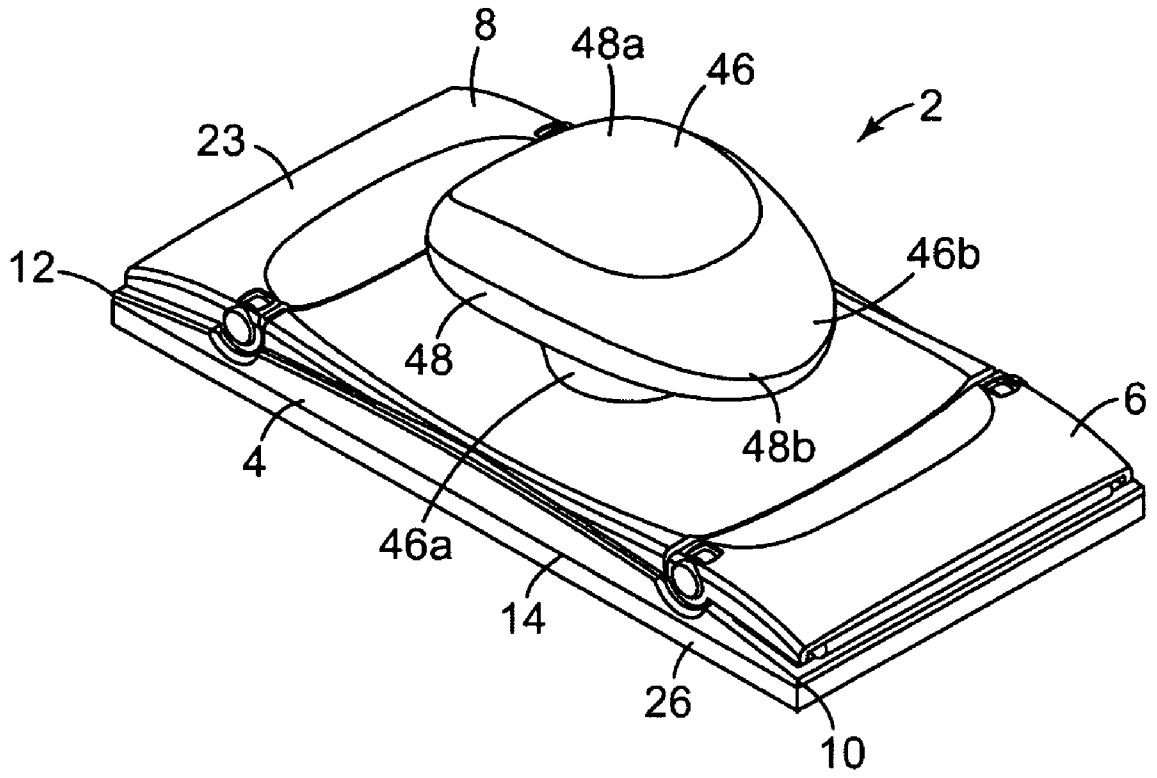
(57) **ABSTRACT**

A hand-held, manually-operated, sanding tool for use with a replaceable sheet-like abrasive material, such as sandpaper, includes a base member, a molded interface pad provided on the base member to define a working face against which the sheet-like abrasive material is arranged, and a retaining mechanism arranged to maintain the sheet-like abrasive material in operative relation with the interface pad. The base member is formed of a first material and the molded interface pad is formed of a second injection moldable material



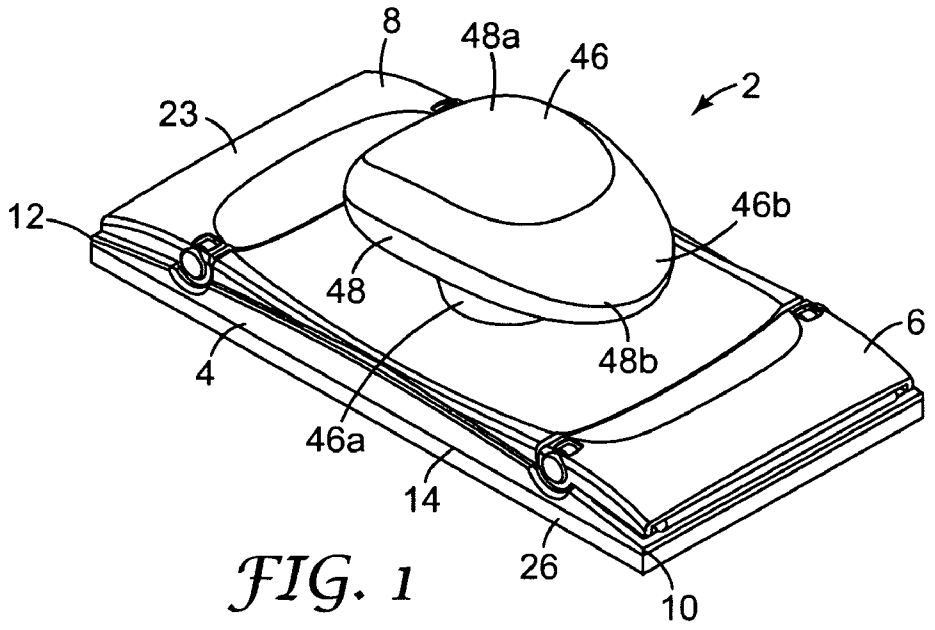

8
48a
46
2
23
12
46b
48
6
4
48b
46a
14
26
10

FIG. 1

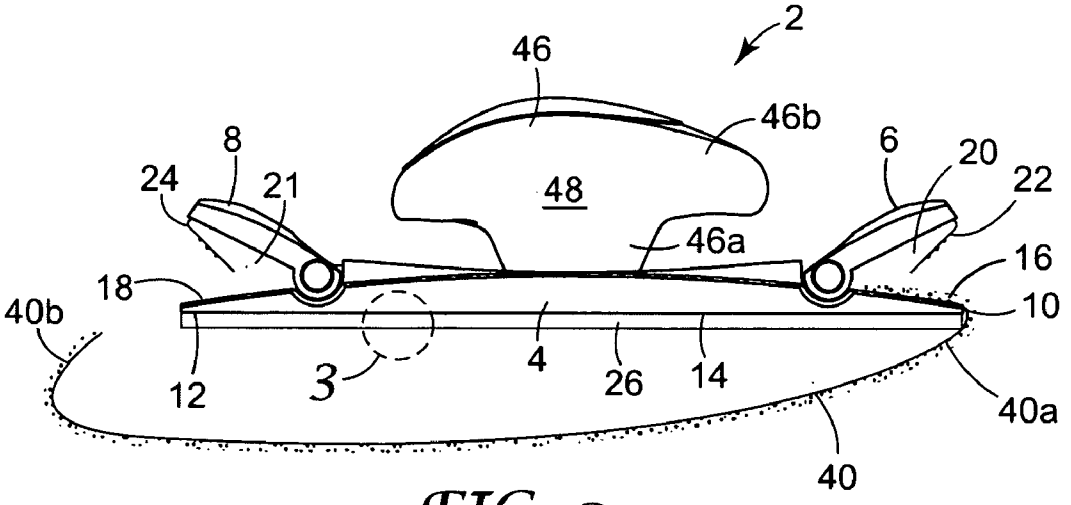

2
46
46b
8
6
20
24
21
48
22
46a
16
18
10
40b
3
4
26
14
40a
12
40

FIG. 2

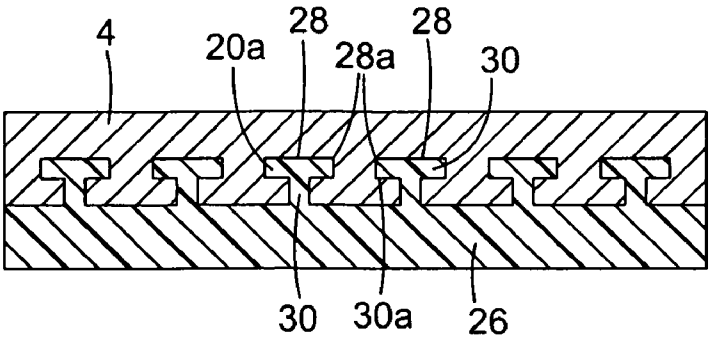


FIG. 3

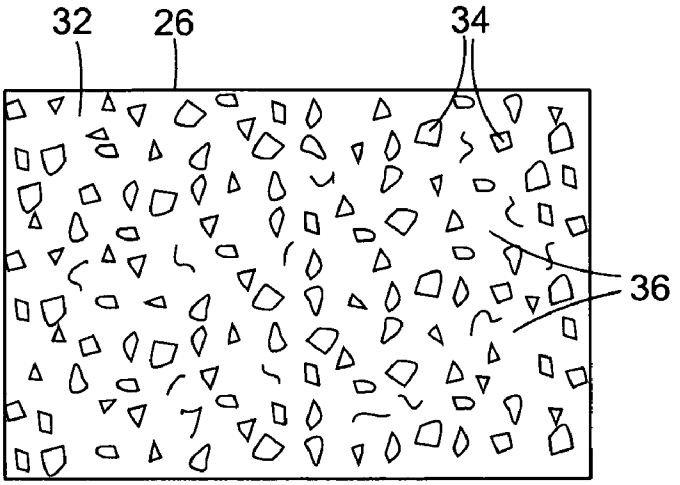


FIG. 4a

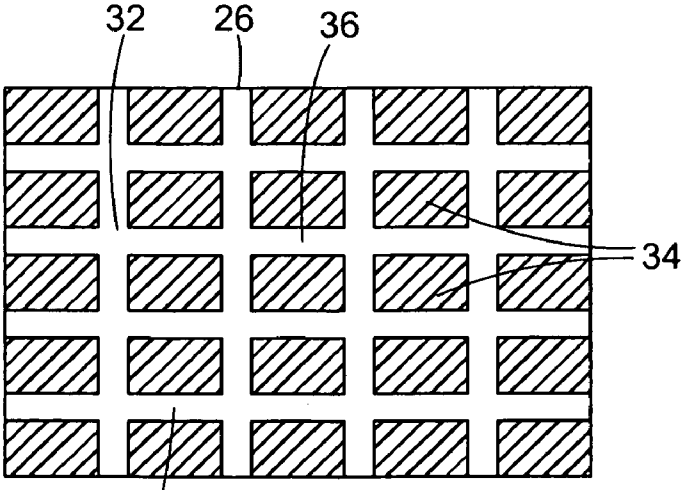


FIG. 4b

SANDING TOOL WITH MOLDING INTERFACE PAD

BACKGROUND

[0001] The present invention relates generally to hand-held, manually-operated, sanding tools that use a sheet of abrasive material such as sandpaper.

[0002] Manually-operated hand sanding tools, such as sanding blocks, are commonly used with abrasive sheets, such as conventional sandpaper, to hand sand or finish a work surface. A commercially available sanding block is the 3M™ Rubber Sanding Block available from 3M Company, St. Paul, Minn. Hand sanding tools may include a foam interface pad that is adhesively bonded to the working face of the sanding tool. Such interface pads, however, suffer from one or more drawbacks or shortcomings. It would be desirable to provide a hand-held, manually-operated, sanding tool that includes an interface pad that overcomes the drawbacks and shortcomings of sanding tools having adhesively bonded foam interface pads.

SUMMARY

[0003] The present invention provides a hand-held, manually-operated, sanding tool for use with a replaceable sheet-like abrasive material that includes a base member formed of a first material, a molded interface pad formed of a second injection moldable material provided on the base member, thereby defining a working face against which the sheet-like abrasive material is arranged, and a retaining mechanism arranged to maintain the sheet-like abrasive material in operative relation with the interface pad.

[0004] In one aspect, the first material has a Shore hardness that is greater than the Shore hardness of the second material (i.e. the interface pad is softer than the base member). In a more specific aspect, the first material has a Shore D hardness of greater than about 30, and the second material has a Shore A hardness of less than about 95.

[0005] In one embodiment, the interface pad is a polymeric material. In a more specific embodiment, the interface pad is an elastomeric material. In another aspect, the interface pad includes a textured working surface opposite the base member. In more specific aspects, the interface pad working face includes a macroscopically three-dimensional surface topography. The surface topography may comprise a random three-dimensional surface topography or it may comprise a regular non-random pattern defined by raised regions and recessed regions.

[0006] In another aspect, the base member contains slots and the interface pad includes extensions extending into the slots, thereby to form a secure connection between the base member and the interface pad.

[0007] In yet another aspect, the present invention provides a method of making a hand-held, manually-operated, sanding tool for use with a replaceable sheet-like abrasive material comprising a base member formed of a first material, a molded interface pad formed of a second injection moldable material provided on the base member, thereby defining a working face against which the sheet-like abrasive material is arranged, and a retaining mechanism arranged to maintain the sheet-like abrasive material in operative relation with the interface pad, wherein the method comprises the steps of providing a sanding tool including a base member having a working face, and forming an interface pad on the base member by injection molding an elastomeric material over the working face.

[0008] Advantages of certain embodiments of the invention include improved sanding capability, improved product design flexibility (that is, the product design can be more easily tailored or adapted to a specific end-use application), easier and less expensive manufacturing, and a sanding tool that is easier and more comfortable to use.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The present invention will be further described with reference to the accompanying drawings, in which:

[0010] FIG. **1** is a perspective view of a hand-held, manually-operated, sanding tool having a molded interface pad according to the invention;

[0011] FIG. **2** is a side view of the sanding tool of FIG. **1**;

[0012] FIG. **3** is a detailed view of the base member and the interface pad; and

[0013] FIGS. **4***a* and **4***b* are plan views showing alternate three-dimensional surface topographies for the interface pad.

DETAILED DESCRIPTION

[0014] Referring now to the drawings, wherein like reference numerals refer to like or corresponding parts throughout the several views, FIGS. **1** and **2**, show a hand-held, manually-operated sanding tool or sanding block **2** for use with a flexible, replaceable, sheet-like abrasive material **40**. The term "manually-operated" refers to the fact that the tool **2** is not a power tool. That is, all of the power for the tool is provided by the user and the tool itself does not include a motor. The term "sheet-like abrasive material" refers to thin, flexible, typically square or rectangular sheets of abrasive material having discrete ends that can be attached to a sanding block. Such sheet-like abrasive materials include, for example, conventional sandpaper, flexible sanding scrims, non-woven abrasive materials such as Scotch-brite™ available from 3M Company, St. Paul, Minn., and thin flexible abrasive sheet materials such as those described in U.S. Pat. No. 6,613,113 (Minick et al.), the entire contents of which are hereby incorporated by reference. The tool may also find use with non-abrasive sheet-like materials such as dust removing tack cloth materials. The term, however, does not include endless belts of abrasive material commonly used on power sanding tools, or die cut sheets that are sold pre-cut to match the size and shape of a particular sanding tool as is commonly done for power detail sanding tools.

[0015] The sanding tool **2** shown and described herein is described more fully in U.S. patent application Ser. No. 11/117,932 filed Apr. 29, 2005, the entire contents of which are hereby incorporated by reference. For the present invention, however, the sanding tool **2** generally is not particularly significant as long as it is capable of including an interface pad and includes certain basic features such as the ability to receive and retain a sheet-like abrasive material. Thus, it will be understood that the sanding tool **2** shown and described below is intended to represent any sanding tool capable of having a molded interface pad.

[0016] The sanding tool **2** includes a base member **4** and a pair of clamping mechanisms **6**, **8** connected with opposed ends of the base member **4**. Although the sanding tool **2** is shown with clamping mechanisms **6**, **8** at both ends, it will be recognized that one or both of the clamping mechanisms **6**, **8** may be replaced with a conventional mechanism for securing the abrasive sheet-like material **40** to the tool. It will also be recognized that although the base member **4** is shown as being rectangular, it may also be square or other shapes that lend themselves for use with conventional abrasive sheets.

[0017] The base member **4** has first **10** and second **12** opposed ends and a generally planar bottom surface **14**. Each end **10**, **12** of the base member **4** has an inclined or angled contact surface **16**, **18**, respectively, opposite the bottom surface **14**. In this manner, the contact surfaces **16**, **18** and bottom surface **14** form an acute angle relative to the associated adjacent end **10**, **12**, respectively.

[0018] Each clamping mechanism **6**, **8** is pivotally connected with opposite ends **10**, **12** of the base member **4** adjacent the contact surface **16**, **18**, respectively, thereby defining a jaw into which the ends **40***a*, **40***b* of a sheet-like abrasive material **40** may be inserted. Each clamping mechanism **6**, **8** is movable between a closed position shown in FIG. **1**, and an open position shown in FIG. **2**. In the closed position, the clamping mechanisms **6**, **8** are fully actuated toward the associated contact surfaces **16**, **18**, respectively, and, when no abrasive material is present, are arranged adjacent to the contact surfaces **16**, **18**, respectively. In the open position, the clamping mechanisms **6**, **8** are spaced from the associated contact surfaces **16**, **18**, thereby defining gaps **20**, **21**, respectively, between the base member **4** contact surfaces **16**, **18** and the clamping mechanisms **6**, **8**.

[0019] Each clamping mechanism **6**, **8** includes a flexible tensioning member **22**, **24** arranged to face the associated contact surface **16**, **18**. Arranged in this manner, as the clamping mechanisms **6**, **8** are lowered toward the base member **4** to secure the abrasive material **40** to the tool **2**, the terminal edges of the tensioning members **22**, **24** slidably engage the contact surfaces **16**, **18**. Thus, when an end **40***a*, **40***b* of the abrasive sheet **40** is inserted in the gap **20**, **21** between the base member **4** and a clamping mechanism **6**, **8**, and the clamping mechanism is moved from its open position to the closed position, the edge of the tensioning members **22**, **24** will frictionally engage the end **40***a*, **40***b* of the sheet of abrasive material **40**.

[0020] As the clamping mechanisms **6**, **8** are further urged toward the contact surfaces **16**, **18**, the tensioning members **22**, **24** grip the respective ends of the abrasive sheet **40***a*, **40***b* and move it upwardly along the inclined contact surfaces **16**, **18** away from the associated end **10**, **12**, thereby drawing the sheet of abrasive material further into the gap **20**, **21**. In addition, as the clamping mechanisms **6**, **8** are urged against the contact surfaces **16**, **18**, the tensioning members **22**, **24** bow or flex such that the bowed surface of the tensioning members **22**, **24** will engage the contact surfaces **16**, **18**, thereby increasing the overall contact surface area between the tensioning members **22**, **24** and the sheet of abrasive material **40**. In this manner, slack in the abrasive sheet **40** is taken up, thereby tightening the fit of the abrasive sheet **40** against the bottom **14** of the base member **4**.

[0021] In the illustrated embodiment, the tensioning members **22**, **24** are thin flexible strips of metal, such as a leaf spring, that generally return to their original positions when the applied force is released. Other materials such as a stiff resilient rubber or synthetic plastic material may also be used. To distribute the force applied by the tensioning members **22**, **24** to the ends abrasive sheet **40***a*, **40***b* evenly (both during the installation of the abrasive sheet **40** onto the tool and while the abrasive sheet is being held onto the tool), the tensioning members **22**, **24** extend continuously across the entire width of the clamping mechanisms **6**, **8**. By distributing the force in this manner, the tensioning members **22**, **24** have a reduced tendency to tear or otherwise damage the abrasive sheet material **40**.

[0022] To further reduce the likelihood that the ends of the tensioning members **22**, **24** will dig into the abrasive sheet **40**, and thereby possibly damage the abrasive sheet, in an alternative embodiment, the tensioning members **22**, **24** may be curved or bowed inwardly such that the tensioning members **22**, **24** have curved surfaces that face the contact surfaces **16**, **18**, and engage the contact surfaces when the clamping mechanisms **22**, **24** are closed.

[0023] In accordance with a characterizing aspect of the sanding tool **2**, a molded interface pad **26** is provided on the bottom surface of the base member **4**. The interface pad **26** defines the surface against which the sheet-like abrasive material **40** is secured. By providing a molded interface pad **26**, the base member **4** and interface pad **26** form an integrally molded body including an upper portion defined by the base member **4**, and a lower portion defined by the interface pad **26**. The base member **4** is typically formed of a first polymeric material, and the interface pad **26** is typically formed of a second polymeric material. The second polymeric material used to form the interface pad **26** is typically softer than the material used to form the base member **4**. The molded interface pad **26** may be formed of any moldable material but is typically a soft, resiliently-flexible, elastomeric, injection moldable material. Suitable injection moldable materials include natural and synthetic rubbers including latex and butyl rubber, thermoplastic elastomers such as polyurethane elastomers, thermoplastic vulcanizate, and thermoplastic rubber. Suitable materials for the interface pad **26** typically have a Shore A hardness of less than about 95 and, more typically, less than about 70. A suitable material for the molded interface pad **26** is available from Advanced Elastomer Systems, an affiliate of Exxon-Mobil Chemical, under the trade designation Santoprene.

[0024] Generally, the base member **4** is formed of a material having a Shore hardness that is greater than the Shore hardness of the material used to form the interface pad. Suitable materials for the base member include hard synthetic plastic materials, typically thermo set or thermoplastic materials such as ABS (acrylonitrile butadiene styrene), polypropylene, polyethylene, and blends containing such materials. Suitable materials for the base member **4** typically have a Shore D hardness of greater than about 30. A suitable material for the base member **4** is available from GE Plastics under the trade designation Cycolac and Cycoloy (an ABS polycarbonate blend).

[0025] FIG. **3** is a detailed view showing the interconnection between the base member **4** and interface pad **26**. In the illustrated embodiment, the base member **4** contains recesses or slots **28** and the interface pad **26** includes extensions **30** that extend into the slots **28**. In this manner,

a mechanical connection, which resists dissociation, is formed between the base member **4** and the interface pad **26**. To further enhance the interconnection between the interface pad **26** and the base member **4**, and thereby prevent the interface pad **26** from separating from the base member **4**, the slots **28** include optional flared end regions **28***a*, and the extensions **30** include flared terminal portions **30***a* that extend into the flared end regions **28***a* of the slots **28**. Other structural features for forming the mechanical attachment between the base member **4** and the interface pad **26** are contemplated in connection with the present invention. The mechanical connection may be formed, for example, by a single protrusion, which may have a variety of shapes, that mates with a cooperating recess. The protrusion and recess may be formed in either the base member **4** or the interface pad **26**.

[**0026**] Alternatively, base member **4** and the interface pad **26** may be formed via a chemical bond. When attached by a chemical bond, the interface between the base member **4** and the interface pad **26** may be generally planar (i.e. the base member **4** and the interface pad **26** each include generally planar surfaces that are attached to each other) or the interface may include structural features such as those described above to further enhance the interconnection between the base member and the interface pad **26**. The chemical bond is formed by selecting compatible materials that form a strong chemical bond.

[**0027**] As shown in FIG. **4**, the exposed working face of the interface pad **26** (i.e. the surface of the interface pad **26** opposite the base member **4** against which the abrasive sheet **40** is arranged) may include a textured surface **32** having a three-dimensional surface topography. The three-dimensional surface topography is typically macroscopic meaning the height differential between the raised regions and the recessed regions is greater than about 1 millimeter. As shown in FIG. **4***a*, the textured surface **32** may be a random pattern of raised regions **34** separated by recessed regions **36** or, as shown in FIG. **4***b*, the textured surface may be a regular repeating pattern of raised regions **34** and recessed regions **36**. Other surface geometries are contemplated in connection the present invention. For example, the size and shape of the raised and recessed regions may be varied or tailored depending on the type of abrasive sheet used and/or depending on the specific end use application for the tool.

[**0028**] The combination of the base member **4** and the interface pad **26** may be formed, for example, using known multi-material injection molding techniques including co-injection molding, overmolding, and multi-shot molding. For example, the base member **4** may be formed by injection molding a suitable material, such as ABS, into a mold to form the base member **4**, and the interface pad **26** may be formed by injection molding a suitable material, such as Santoprene, to form the interface pad **26**. Alternatively, the base member **4** may be formed by casting or other known techniques.

[**0029**] Injection molding the interface pad **26** offers a number of advantages over the use of conventional interface pads, which are foam pads that are adhesively bonded to the sanding tool **2**. First, because the molded interface pad is injection molded, the additional steps of die cutting a foam sheet to the appropriate size and adhesively bonding the foam pad to the bottom of the base member **4** are eliminated. This simplifies the assembly process and also eliminates the raw material costs associated with the foam pad and adhesive. Injection molding the interface pad **26** also reduces the likelihood of failures between the interface pad and the base member **4** (i.e. injection molding provides a chemical and/or mechanical bond between the interface pad **26** and base member **4** that is unlikely to allow the interface pad **26** to inadvertently separate from the base member **4**). The injection molded interface pad **26** may also include a variety of textures and/or patterns, it may be formed of any number of suitable moldable polymer materials depending on the desired durability and conformability properties, and it may be formed in a variety of colors or thicknesses, thereby greatly increasing the design options and design flexibility of the tool, and further allowing the tool design to be easily tailored for specific end uses.

[**0030**] The sanding tool **2** also includes a handle **46**. In the illustrated embodiment, the handle **46** includes a neck portion **46***a* that extends upwardly from a central region of the base member **4**, and includes an enlarged head portion **46***b* located at the end of the neck **46***a* that defines a knob **48** that can be readily grasped by a user to maneuver and control the movement of the tool **2**. To provide the user with a more comfortable grip, the knob **48** portion of the handle **46** preferably comprises an interior region **48***a* formed of a relatively hard first material and a peripheral region **48***b* formed of a relatively soft rubber-like second material that is easier to grip and thereby provides the user with improved handling. The first relatively hard material, may be, for example, a hard synthetic plastic, and the relatively soft second material may be, for example, a thermoplastic elastomer, rubber, rubber-like materials or foam.

[**0031**] The tool **2**, including the base member **4**, clamping mechanisms **6**, **8** and handle **46**, may be formed of any suitable material including, for example, wood, metal, synthetic plastic, or a stiff rubber.

[**0032**] Those of ordinary skill in the art may appreciate that various changes and modifications may be made to the invention described above without deviating from the inventive concept. For example, it will be recognized that the size of the tool may be adapted so it can be used with the various standard sizes of commercially available abrasive sheets. Thus, the scope of the present invention should not be limited to the structures described in this application, but only by the structures described by the language of the claims and the equivalents of those structures.

1. A hand-held, manually-operated, sanding tool for use with a replaceable sheet-like abrasive material, comprising:

(a) a base member;

(b) a molded interface pad provided on the base member to define a working face against which the sheet-like abrasive material is arranged; and

(c) a retaining mechanism arranged to maintain the sheet-like abrasive material in operative relation with the interface pad;

wherein the base member is formed of a first material and the molded interface pad is formed of a second, injection moldable, material.

2. A sanding tool as defined in claim 1, wherein the first material has a Shore hardness that is greater than the Shore hardness of the second material.

3. A sanding tool as defined in claim 2, wherein the second material has a Shore A hardness of less than about 95.

4. A sanding tool as defined in claim 3, wherein the first material has a Shore D hardness of greater than about 30.

5. A sanding tool as defined in claim 1, wherein the interface pad is a polymeric material.

6. A sanding tool as defined in claim 5, wherein the interface pad is an elastomeric material.

7. A sanding tool as defined in claim 6, wherein the interface pad is formed from at least one of a thermoplastic elastomer, a thermoplastic vulcanizate, and a thermoplastic rubber.

8. A sanding tool as defined in claim 1, wherein the base member is formed of an injection moldable synthetic plastic material and the interface pad is formed of an injection moldable material that is softer than the material used to form the base member.

9. A sanding tool as defined in claim 1, wherein the interface pad includes a textured surface.

10. A sanding tool as defined in claim 1, wherein the interface pad working face includes a macroscopically three-dimensional surface topography.

11. A sanding tool as defined in claim 6, wherein the surface topography comprises a regular non-random pattern defined by raised regions and recessed regions.

12. A sanding tool as defined in claim 1, wherein the base member contains slots, and the interface pad includes extensions extending into the slots, thereby to form a secure connection between the base member and the interface pad.

13. A method of making the sanding tool of claim 1, comprising the steps of:

(a) providing a sanding tool including a base member having a working face; and

(b) forming the interface pad on the base member by injection molding an elastomeric material over the working face.

14. A sanding tool as defined in claim 1, wherein the retaining mechanism is configured to releasably retain the sheet-like abrasive material.

15. A sanding tool as defined in claim 1, wherein the retaining mechanism comprises at least one clamping mechanism arranged to secure the sheet-like abrasive material to the sanding tool.

16. A sanding tool as defined in claim 1, wherein the retaining mechanism comprises two clamping mechanisms pivotally connected on opposite ends of the base member to secure the sheet-like abrasive material to the sanding tool.

17. A sanding tool as defined in claim 1, wherein the interface pad is molded to the base member.

18. A sanding tool as defined in claim 1, wherein the sanding tool is user-powered without a motor.

19. A sanding tool as defined in claim 1, characterized by an absence of adhesive between the base member and the interface pad.

20. A sanding tool as defined in claim 1, wherein the interface pad is directly affixed to the base member.

* * * * *