ABRASIVE TOOL FOR COLLECTING DUST

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ABSTRACT

An abrasive tool for collecting dust, comprising:
an abrasive material in sheet form having not less than 20
dust collecting holes; and

a backup pad, including: a base material having a first major
surface, a second major surface opposite to the first major
surface, and at least one hole for collecting dust penetrating
through the first major surface and the second major surface;
and a ventilative member connected to the first major
surface of the base material, having an attaching surface to
which the abrasive material is attached, and a plurality of
holes extending from the attaching surface towards the first
major surface of the base material; the ventilative member
working jointly with the base material and making dust flow
out from the attaching surface to the second major surface of
the base material.
FIG. 8

FIG. 9
FIG. 14
ABRASIVE TOOL FOR COLLECTING DUST

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Japanese Application No. 2006-112204, filed on Apr. 14, 2006, the disclosure of which is incorporated by reference in its entirety herein.

TECHNICAL FIELD

[0002] The present invention relates to an abrasive tool for collecting dust having an abrasive material in sheet form with holes for collecting dust and a backup pad for supporting abrasive materials which has a ventilative member.

BACKGROUND

[0003] Soft coated film, pate and the like are abraded in automobile repairing work and the like. When a soft coated film, pate or the like is abraded, a large amount of abraded dust or swarf is created, and therefore, it is necessary to properly discharge the abraded swarf to prevent clogging of the ventilation system. Therefore, in conventional abrasive tools it is known to have openings for collecting dust.

[0004] Such abrasive tools are generally formed of an abrasive material in sheet form (abrasive cloth or the like) and a backup pad for supporting the sheet. About 6 or 7 holes for collecting dust having a diameter of approximately 10 mm are created at certain points in the abrasive material and in the backup pad. Thus, the abrasive material in sheet form is mounted on the surface for attaching an abrasive material of the backup pad, so that the holes overlap, and openings which penetrate through to the rear side are formed in the abrasive surface of the abrasive tool.

[0005] Abrading work is carried out by attaching a sander having a sucking function to the rear surface of the abrasive tool, and abraded swarf is sucked through the openings in the abrasive surface and discharged.

[0006] In the present specification, “effective openings” in the abrasive surface means the portions where dust collecting holes in an abrasive material and holes in the surface for attaching an abrasive material of the backup pad overlap. That is to say, “effective openings in the abrasive surface” are holes which penetrate through the abrasive surface of the abrasive tool to the rear surface, and have the function of sucking abraded swarf when the sander absorbs. In addition, “holes” means through holes, excluding recesses.

[0007] “Dust collecting holes” and “holes for collecting dust” are holes which have at least the function of collecting abraded swarf. In an abrasive material in donut form, for example, the hole in the center portion which has no relation to the collection of abraded swarf is not included in “holes for collecting dust.”

[0008] When an abrasive material is mounted on the backup pad, the work of attaching the abrasive material while confirming the position of the holes in the pad and in the abrasive material by the eye and positioning the holes is required, which is troublesome. In the case where the position of the holes in the abrasive material does not match with the position of the holes in the backup pad, the number of dust collecting holes having effective openings becomes small in the abrasive surface, and therefore, sufficient dust collecting performance cannot be obtained. Therefore, when the type of abrasive material is changed, and the position of the holes for collecting dust or the form of the holes changes, it becomes necessary to change the backup pad accordingly.

[0009] In order to solve this problem, for example, the holes for collecting dust in the backup pad may be made in annular groove form, so that the time and effort for matching the position of the holes is reduced. However, support of the abrasive material in portions with annular grooves becomes insufficient. In addition, in the case where the holes are not created along concentric circles in the abrasive material, the positions of the holes do not match the holes in annular groove form, and thus, the problem is not sufficiently solved.

[0010] In other applications, the dimensions of the holes in the backup pad are made larger than the dimensions of the holes in the abrasive material in order to make positioning easier. In this case also, it is possible that the position of the holes of the abrasive material will not match that of the backup pad, thus, this too is an imperfect solution.

[0011] Meanwhile, further increase in the abrading performance, for example, the shaving performance and the abrading durability, has been desired in abrasive tools for collecting dust. In order to achieve this, it is helpful to increase the dust collecting performance of the abrasive surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a cross sectional diagram showing the structure (portion) of an abrasive material in sheet form having dust collecting holes.

[0013] FIG. 2 is a diagram showing the abrasive surface of an abrasive material in sheet form used in the present invention.

[0014] FIG. 3 is a diagram showing an example of a surface and a side for attaching a sander of a base material.

[0015] FIG. 4 is a diagram showing an example of a surface and a side for attaching an abrasive material of a ventilative member.

[0016] FIG. 5 is a diagram showing another example of a surface and a side for attaching an abrasive material of a ventilative member.

[0017] FIG. 6 is a plan diagram showing an example of the opening structure of a ventilative member.

[0018] FIG. 7 is a plan diagram showing an example of the opening structure of a ventilative member.

[0019] FIG. 8 is a cross sectional diagram showing a backup pad according to one embodiment of the present invention.

[0020] FIG. 9 is a cross sectional diagram showing a backup pad according to another embodiment of the present invention.

[0021] FIG. 10 is a plan view illustrating the form and arrangement of bridge piers.

[0022] FIG. 11 is a cross sectional diagram showing a backup pad according to another embodiment of the present invention.

[0023] FIG. 12 is a diagram showing the surface for attaching an abrasive material of a backup pad according to another embodiment of the present invention, and a cross section along A-A'.

[0024] FIG. 13 is a diagram showing the surface for attaching an abrasive material of a backup pad according to another embodiment of the present invention, and a cross section along B-B'.
FIG. 14 is a diagram showing the surface for attaching an abrasive material of a backup pad according to another embodiment of the present invention, and a cross section along C-C.

FIG. 15 is a diagram showing the surface for attaching an abrasive material of a backup pad and the abrasive surface of an abrasive tool for collecting dust according to Example 1.

FIG. 16 is a diagram showing the surface for attaching an abrasive material of a backup pad and the abrasive surface of an abrasive tool for collecting dust according to Example 2.

FIG. 17 is a diagram showing the surface for attaching an abrasive material of a backup pad and the abrasive surface of an abrasive tool for collecting dust according to Example 3.

FIG. 18 is a diagram showing the surface for attaching an abrasive material of a backup pad and the abrasive surface of an abrasive tool for collecting dust according to the comparative example.

FIG. 19 is a diagram showing the abrasive surface of an abrasive material in sheet form used in the present invention.

FIG. 20 is a diagram showing the abrasive surface of an abrasive material in sheet form used in the present invention.

FIG. 21 is a diagram showing the abrasive surface of an abrasive material in sheet form of comparative example.

DISCLOSURE OF THE INVENTION

The present invention provides an abrasive tool for collecting dust having an abrasive material in sheet form having not less than 20 dust collecting holes, and a backup pad for supporting the abrasive material. The backup pad includes a base material having a first major surface, a second major surface opposite to the first major surface, and at least one hole for collecting dust penetrating through the first major surface and the second major surface; and a ventilative member connected to the first major surface of the base material, having an attaching surface to which the abrasive material is attached, and a plurality of holes extending from the attaching surface towards the first major surface of the base material. The ventilative member works jointly with the base material and makes dust flow out from the attaching surface to the second major surface of the base material. With the backup pad and abrasive material disclosed herein, it is unnecessary to match the position of the holes when the abrasive material is attached to the backup pad. In this way, labor is reduced and dust collection performance is not compromised by mistakes.

An abrasive tool for collecting dust according to embodiments disclosed is a combination of an abrasive material in sheet form having a large number, not less than 20, of dust collecting holes, and a backup pad having a ventilative member, characterized in that matching of the position of the holes when the two are attached to each other becomes unnecessary; and good dust collecting performance on an abrasive surface at an arbitrary attachment position, can be secured.

Here, in order to effectively implement the abrasive tool for collecting dust having the above described characteristics, it is preferable to set the respective opening structures of the abrasive material in sheet form and the backup pad in such a manner that when the abrasive material in sheet form is attached to the surface for attaching an abrasive material of the backup pad, the ratio of the number of dust collecting holes in the abrasive material in sheet form having effective openings where the dust collecting holes of the two overlap (hereinafter referred to as “ratio of the number of effective openings””) becomes not less than approximately 30% of the total number of dust collecting holes in the abrasive material in sheet form.

The ventilative member of the backup pad preferably has not less than 15 dust collecting holes and has a total opening area of not less than 15% based on the whole abrasive material contacting area.

In the following, respective embodiments of the abrasive material in sheet form and the backup pad, as well as an embodiment of the abrasive tool for collecting dust where the two are combined are described.

Abrasive Material in Sheet Form

FIG. 1 is a cross sectional diagram showing the structure of an abrasive material in sheet form having dust collecting holes. The surface of base 101 is coated with a binder 102, and abrasive grains 103 are made to adhere to base 101 by means of binder 102. A large number of dust collecting holes 104, 104... are provided in the abrasive material.

It is preferable for the edge of the holes on the abrasive surface side to be cut off. This is because in the case where the edge of the holes on the abrasive surface side is sharp or protrudes, there is a risk that the surface to be abraded may be scratched.

The holes are preferably formed by carrying out a punching process on an abrasive material in sheet form. When an abrasive material is punched, it is preferable for the blade to enter in the direction from the abrasive surface to the rear surface of the base. As a result of this, the edge of the holes on the abrasive surface side is cut off. In addition, the holes may be formed by punching out the base in advance.

The base may be any material which is conventionally used as a base for an abrasive material in sheet form. For example, a polymer film, a woven cloth, a non-woven cloth, a sheet of paper, an impregnated sheet of paper, a polymer coated sheet of paper, an elastomer in foam form or the like can be used. Particularly preferable bases are oil impregnated sheets of paper, polymer coated sheets of paper, polyester films, such as polyethylene terephthalate, and such sheets of paper and films on which a metal has been vapor deposited. The thickness of the base in one embodiment is 12 μm to 5000 μm, and in a further embodiment is 38 μm to 3000 μm.

Abrasive grains are made to adhere to the surface of the base by means of a binder. As for the binder, binders which can secure sufficient adhesive strength and are conventionally used for an abrasive material for repairing automobiles are used. Phenol resin, epoxy resin, polyester resin, urethane resin, acrylic resin, urea resin and the like can be cited as examples.

Many materials may be appropriate for making the abrasive grains, for example, aluminum oxide, cerium oxide, silicon carbide, diamond, alumina oxide, including melt alumina, ceramic alumina (including sol-gel alumina) and the like can be cited. In addition, the abrasive grains may be fine particles made of plastic, such as polymethacrylate.
ester, polystyrene, polyolefin and the like. As for the dimensions of the abrasive grains, the average grain diameter is in one embodiment approximately 500 μm to 0.45 μm. That is to say, the average grain diameter is approximately 500 μm (JIS #36) to 0.45 μm (#20000), and in a further embodiment the average grain diameter is approximately 5 μm (#2500) to 300 μm (#60).

[0044] The abrasive material may be formed from a coated abrasive material wherein the abrasive surface is flat and is manufactured using a base having no dust collecting holes, and after that, a number of dust collecting holes are formed in the surface of the base, and thereby, the abrasive material in sheet form can be manufactured. Alternatively, a number of dust collecting holes may be formed in the surface of the base, and this base may be coated with a binder and abrasive grains, and then heated, so that the binder hardens, and thereby, the abrasive material in sheet form may be manufactured.

[0045] FIG. 2 is a diagram showing the abrasive surface of the abrasive material in sheet form that is used in an embodiment of the present invention. A large number of dust collecting holes 204 and 204' are provided in the abrading surface of this abrasive material in sheet form 200. The number of dust collecting holes 204 is at least not less than 20, preferably not less than 30, and more preferably not less than 50. In the case where an abrasive material in sheet form having at least not less than 20 dust collecting holes is combined with the backup pad according to the below described present embodiment, the ratio of the number of effective openings of not less than approximately 30% can be obtained at an arbitrary matching position, that is to say, effective openings can be obtained for approximately 30% of all of the dust collecting holes in the abrasive surface of the abrasive material in sheet form.

[0046] Here, it is not always necessary for the dust collecting holes to be uniformly arranged throughout the entirety of the abrasive surface, and they may be placed only in the center portion, as shown in FIG. 2. As described above, in the case where an area with openings where dust collecting holes are gathered is arranged and a hole area is arranged at the periphery, the area with openings and the hole area can be used separately, in accordance with the state of the material to be abraded. In an abrading finish process, where the discharged amount of abraded swarf is small and high precision is required on the abrading surface, for example, in some cases, it is desirable to abrade mainly with the hole area.

[0047] The ratio of the total area of the dust collecting holes to the total area of one surface of the abrasive material (the ratio of the area of dust collecting holes) is not less than 1%, preferably 3% to 50%, and more preferably 5% to 40%. In the case where the ratio of the area of the dust collecting holes is less than 1%, it becomes difficult to secure a sufficient effective opening area on the abrasive surface, making the dust collecting performance of the abrasive surface poor. In the case where the ratio of the area of the dust collecting holes exceeds 50%, the abrading performance of the abrasive surface becomes poor.

[0048] The area per dust collecting hole is in one embodiment 0.5 mm² to 350 mm². In the case where the area of the dust collecting holes is within this range, the form of the holes may be any form, including circular, elliptic, polygonal, fan-shaped, leaf shaped, arched or the like. In the case where the area per dust collecting hole is not greater than 0.5 mm², it becomes easier for abraded swarf in lump form to clog, making the performance of discharging abraded swarf poor.

[0049] In the case where the area per dust collecting hole is not less than 350 mm², the sucking force per hole becomes weak, and abraded swarf cannot be efficiently discharged, particularly when the abrasive material is used by being mounted on a sander having sucking function. As a result, no increase is obtained in the cutting performance. Here, the same is not true for the area of a large hole in the center portion of an abrasive material in donut form. In the case where the area per dust collecting hole is 1 mm² to 80 mm², an additional increase in the cutting performance can be obtained.

[0050] The distance between end portions of adjacent dust collecting holes is in one embodiment 1 mm to 20 mm, preferably 3 mm to 10 mm. In the case where the distance between end portions of adjacent dust collecting holes is not greater than 1 mm, the sheet strength between the holes becomes weak, causing breaking of the sheet. In addition, warping is caused in the portion having many holes, due to the inconsistency in the stress within the sheet, and the quality of the abrasive material is negatively affected. As a result of this, no increase in the cutting performance can be obtained. In the case where the distance between end portions of adjacent dust collecting holes is not less than 20 mm, the frequency at which the holes encounter abraded swarf in the abrading movement of the abrasive material becomes low, and abraded swarf cannot be efficiently discharged. As a result of this also, no increase in the cutting performance can be obtained.

[0051] An appropriate form in a plan view and the dimensions of the abrasive material in sheet form may be determined in accordance with the application. Disc form or square sheet form, for example, are generally used. This is also true for the below described backup pad.

Backup Pad

[0052] Next, the configuration of a backup pad which is appropriate for use in an abrasive tool for collecting dust according to the present disclosure is described. The backup pad for supporting an abrasive material has a base material and a ventilative member connected to the base material, having a surface to which an abrasive material is attached, as its main constitution. The base material has a first major surface (major surface) to which the ventilative member is attached, and a second major surface to which a sander is attached.

[0053] FIG. 3 is a diagram showing an example of a surface and a side for attaching a sander of a base material. A bolt 2 for attaching a sander is mounted in the center portion of base material 1, and holes 3, 3' . . . for collecting dust which penetrate through to the main surface are provided.

[0054] The configuration of the base material allows abraded swarf to be sucked from the main surface side of the surface for attaching a sander, and in addition, is enough to support a ventilative member as that described below on the main surface, and is not limited to the example of FIG. 3. The number of holes for collecting dust may be, for example, increased or decreased. That is to say, the number of holes for collecting dust may be 1, or a multiple hole
structure or a mesh structure where a number of holes for collecting dust are gathered to form an opening structure may be provided.

[0055] It is preferable for the base material to be formed of a rigid material. This is so that the driving force of the sander can be efficiently conveyed to the abrasive material. As for the material for the base material, plastic, fiber reinforced plastic, metal and the like are used. As the plastic, thermoplastic resins such as polyethylene, polypropylene, polystyrene, acrylonitrile/styrene resin, ABS resin, methacrylate resin, vinyl chloride, polyaniline, polyurethane, high molecular weight polyethylene, polyethylene terephthalate, polybutylene terephthalate, poly(methyl pentene), polycarbonate, modified polyphenylene ether, polyphenylene sulfide, polyether ether ketone, polytetrafluoroethylene, polyether imide, polylactide, polysulfone, polyether sulfone and polyamide imide, as well as thermosetting resins such as phenol resin, urea resin, melamine resin, unsaturated polyester resin, alkyd resin, epoxy resin and diallyl phthalate resin, can be cited as examples. As for the reinforcing fibers of the fiber reinforced plastic, glass fibers and carbon fibers, aramid fibers and metal fibers, can be cited, and can be used for reinforcing plastic, as described above. In addition, an antioxidant, any of a variety of pigments, an ultraviolet ray absorbent, a filler and the like may be added to this plastic in order to increase durability, strength and the like. As for the metal, stainless steel, an aluminum alloy and a magnesium alloy can be cited.

[0056] FIG. 4 is a diagram showing an example of a surface and a side for attaching an abrasive material of a ventilative member. The ventilative member is in sheet form or plate form, and the surface for attaching the abrasive material has an open structure. The form of the holes for collecting dust that form the opening structure is not particularly limited, as long as the function of making abraded swirl pass through without hindrance is provided. It may, for example, be polygonal such as triangular and hexagonal, rectangular, rhombic, star-shaped or elliptical in addition to circular through holes 21 as shown in FIG. 4(a) and square through holes 22 as shown in FIG. 4(b).

[0057] The dimensions, number and arrangement of the dust-collecting holes is determined in such a manner that the abraded material can be supported at the time of the abrading work and the opening ratio of the abrasive surface for allowing abraded swirl to pass through without hindrance can be achieved. Appropriate and preferable values and modes for these are determined taking the material of the ventilative member and the like into consideration, and it is desirable for a large number, at least not less than 15, and in some embodiments not less than 20, dust collecting holes to be provided.

[0058] FIG. 5 is a diagram showing another example of a surface and a side for attaching an abrasive material of a ventilative member. The abrasive material fitting surface as shown in FIG. 5(a) has corrugated mesh structure 31. The abrasive material fitting surface as shown in FIG. 5(b) has grid mesh structure 32. The mesh structure comprises a plurality of through holes assembled in its opening structure.

[0059] The opening structure of the ventilative member allows abraded swirl to pass through and is sufficient as a structure to which an abrasive material can be attached, and thus, is not limited to the above described example. FIGS. 6 and 7 are plan diagrams showing other examples of the opening structure of the ventilative member. A plurality of openings 41, 51 is assembled in the abrasive material fitting surface 40, 50 in every structural example.

[0060] FIG. 6 illustrates circular sheet-like abrasive materials, wherein (a) is structure made of parallel array of octagonal holes, (b) is structure such that hexagonal holes are combined with a grid, (c) is structure made of a diffusive array of hexagonal holes, (d) is structure made of an array of different sized holes, (e) is structure made of a plurality of concentric circumferential holes, (f) is structure made of a plurality of corrugated linear holes. FIG. 7 illustrates rectangular sheet-like abrasive materials, wherein (a) is a structure made of a parallel array of hexagonal holes, (b) is a structure wherein linear holes are alternately arranged, (c) is structure made of a plurality of corrugated linear holes, (d) is a structure made of a parallel array of square holes.

[0061] The ratio of the total opening area on the abrasive material attaching surface of the ventilative member, based on the whole abrasive material contacting area (hereinafter referred to as “hole area ratio”) is not limited to, but preferably is not less than 15%, and, in one embodiment 30% to 80%, and in a further embodiment, 50% to 70%. In the case where the ratio of the hole area is less than 15%, it becomes difficult to secure the ratio of the number of effective openings in the abrasive surface of the abrasive material in sheet form, making the dust collecting performance of the abrasive surface poor. In the case where the ratio of the hole area exceeds 70%, support of the abrasive material becomes difficult.

[0062] The “whole abrasive material contacting area” means the total area on the backup pad which contacts with the abrasive material as an abrasive material is attached to the ventilative member. So when the annular support or the annular wall surrounding the abrasive material attaching surface of the ventilative member, described as follows, are present, the area on the annular support or the annular wall which contacts with an abrasive material are also comprised in the area.

[0063] The ventilative member may be formed of a material having a sufficient strength to support an abrasive material and implement abrading function. As the material of the ventilative member, one or more types from among, for example, thermoplastic resins such as polyethylene, polypropylene, polystyrene, acrylonitrile/styrene resin, ABS resin, methacrylate resin, vinyl chloride, polyamide, polyacetal, ultrahigh molecular weight polyethylene, polyethylene terephthalate, polybutylene terephthalate, poly(methyl pentene), polycarbonate, modified polyphenylene ether, polyphenylene sulfide, polyether ether ketone, polytetrafluoroethylene, polyether imide, polylactide, polysulfone, polyether sulfone and polyamide imide, thermosetting resins such as phenol resin, urea resin, melamine resin, unsaturated polyester resin, alkyd resin, epoxy resin, diallyl phthalate resin, as well as elastomers which are natural or synthetic rubber elastomers such as polyurethane, natural rubber, polybutadiene, polyisoprene, EPDM polymer, polyvinyl chloride (PVC), polychloroprene, nitrile rubber, silicone rubber, fluorine rubber and styrene/butadiene copolymer, are used. The ventilative member is formed of one or more types from among non-woven cloths made of molded products of these materials, foamed materials having open cells or closed cells and natural fibers, and thermoplastic resins. In addition, an antioxidant, any of a variety of pigments, an ultraviolet ray absorbent, a filler and the like may be added.
to these sheet materials for attaching an abrasive material, in order to increase the durability, the strength and the like.

[0064] The ventilative member is supported on the main surface of the base material so as to form a backup pad.

[0065] In a preferred embodiment, the ventilative member is supported so as to be approximately parallel to the main surface with a gap vis-à-vis the main surface in a supporting structure. In this manner, a space is formed between the base material and the ventilative member, and this space connects the opening structure of the ventilative member to holes for collecting dust in the base material.

[0066] As a result, abraded swarf that is created during the abrading work is sucked into dust collecting holes in the abrasive material, and can be freely moved toward any of the holes for collecting dust in the base material after passing through the opening structure, and thus, the efficiency of dust collection is increased. The space which connects the holes for collecting dust of the base material to become ventilative channel (cavity pocket) is referred to as the dust pocket in the present specification.

[0067] The dust pocket connects, for example, at least two holes which form the opening structure of the ventilative member to at least one hole for collecting dust of the base material. Preferably, the dust pocket connects essentially all of the holes that form the opening structure of the ventilative member to at least one hole for collecting dust of the base material. Here, essentially all of the holes mean holes where the connection of air is maintained in a state where the backup pad is completed. That is to say, the meaning excludes holes which are clogged by making contact with a structural material or a binder for supporting the ventilative member.

[0068] The dust pocket may be divided into a number of spaces. However, the dust pocket preferably forms one space, and all the holes that form the opening structure of the ventilative member are connected to an arbitrary hole for collecting dust in the base material.

[0069] FIG. 8 is a cross sectional diagram showing a backup pad according to one embodiment of the present invention. This backup pad has a base material 1 and a ventilative member 4. The base material 1 has holes for collecting dust 3, 3', . . . and ventilative member 4 has an open structure including holes 11, 11' . . .

[0070] FIG. 9 is a cross sectional diagram showing a backup pad according to another embodiment of the present invention. This backup pad has a base material 1 having an annular support that is formed and integrated with the outer peripheral portion, a rigid sheet material 8 which is placed over the annular support, and a ventilative member 4. The base material 1 has holes for collecting dust 3, 3', . . . and the ventilative member 4 and the rigid sheet material 8 have an open structure of matching holes 11, 11' . . .

[0071] The ventilative member 4 is supported by the annular support of the base material 1 and the rigid sheet material 8 so as to be approximately parallel to the main surface with a gap vis-à-vis the main surface. In addition, a dust pocket 7 for connecting the holes for collecting dust from the open structure of holes 11 is formed so as to be adjacent to the main surface of base material 1.

[0072] Ribs (not shown) may be formed on the surface of the base material 1 or the rigid sheet material 8, in order to enhance the rigidity. In addition, bridge piers may be made on the main surface of the base material 1, in order to support the rigid sheet material 8 and counteract the pressure at the time of abrading work.

[0073] FIG. 10 is a plan diagram showing the form and the arrangement of the bridge piers. FIG. 10(a) to (e) are plan views exemplifying form and disposition of bridge piers. A plurality of bridge piers 81 is erected on the major surface 80 of the substrate sheet material in every example. FIG. 10 shows disposition of bridge piers, of diffusive linear walls in (a); circumferential cylinders in (b); diffusive curved walls in (c); circumferential square poles in (d); and circumferential curved walls in (e). Furthermore, dust collecting holes 12, 12' . . . may be provided on the sidewalls of the backup pad so as to enhance the effects of dust collection.

[0074] The bridge piers may be formed of the same material as, for example, the base material, the rigid sheet material or the ventilative member, or may be formed so as to be integrated with the base material or the rigid sheet material. Appropriate properties for the bridge piers, for example, elasticity and strength, may be adjusted, and the bridge piers may be formed of a rigid material, such as a metal.

[0075] FIG. 11 is a cross sectional diagram showing a backup pad according to another embodiment of the present invention. This backup pad has a base material 1, an annular support 9, a rigid sheet material 8 that is placed over the annular support 9, and a ventilative member 4. The base material 1 has holes for collecting dust 3, 3', . . . and the ventilative member and the rigid sheet material has an open structure of matching holes 11, 11' . . .

[0076] The ventilative member 4 is supported by the annular support 9 and the rigid sheet material 8 so as to be approximately parallel to the main surface with a gap vis-à-vis the main surface. In addition, a dust pocket 7 for connecting the holes for collecting dust from the open structure is formed so as to be adjacent to the main surface of base material.

[0077] The supporting structure is made of a bridge and bridge girder in the embodiments shown in FIGS. 9 and 11, and the bridge corresponds to the annular support 9 and the bridge girder corresponds to the rigid sheet material 8. The rigid sheet material 8 has a diameter size that is not shorter than the inner diameter size of the annular support and not longer than the outer diameter size. The thickness of the rigid sheet material is determined taking the strength of this material into consideration, so that the ventilative member 4 can be appropriately supported.

[0078] The annular support 9 may have any form, for example, it may have a cylindrical form or a form of which the cross section is trapezoid, as long as it holds the rigid sheet material 8. In addition, the annular support may be formed of, for example, the same material as the bridge pier. Appropriate properties of the annular support, for example, elasticity and strength, may be adjusted.

[0079] As the material of the rigid sheet material 8, one or more types from among, for example, thermoplastic resins such as polyethylene, polypropylene, polystyrene, acrylonitrile/styrene resin, ABS resin, methacrylate resin, vinyl chloride, polyamide, polyacetal, ultrahigh molecular weight polyethylene, polyethylene terephthalate, polybutylene terephthalate, polymethyl pentene, polycarbonate, modified polyphenylene ether, polyphenylene sulfide, polyether ether ketone, polytetrafluoroethylene, polyether imide, polyallylate, polysulfone, polyether sulfone and polyamide imide, thermosetting resins such as phenol resin, urea resin,
melamine resin, unsaturated polyester resin, alkid resin, epoxy resin, diallyl phthalate resin, and fiber reinforcing resins obtained by reinforcing these resins with long fibers and short fibers of, for example, glass fibers, carbon fibers, aramid fibers and metal fibers, as well as elastomers which are natural or synthetic rubber elastomers, such as polyurethane, natural rubber, polybutadiene, polyisoprene, EPDM polymer, polyvinyl chloride (PVC), polychloroprene, nitrile rubber, silicone rubber, fluorine rubber and styrene/butadiene copolymer, in addition to metals such as stainless steel, aluminum alloys and magnesium alloys, are used. In addition, an antioxidant, any of a variety of pigments, an ultraviolet ray absorbent, a filler and the like may be added in order to increase the durability, the strength and the like.

The opening structure of the rigid sheet material is not limited, as long as it can appropriately support the ventilative member, and has a ratio of openings for allowing abraded swirl to pass through without hindrance. The form of the holes may be, for example, a lattice form having a side of not less than 0.5 mm, a circular form having a diameter of not less than 0.5 mm, a rectangle, a diamond, a triangle, a quadrilateral, a polygonal, a star shape, a circle, an ellipse or the like. In addition, the opening structure may be a mesh structure.

Rib, bridge pier, dust collecting holes in the sidewalls and the like may further be provided to the embodiment of FIG. 11, in the same manner as the embodiment shown in FIG. 9.

FIG. 12 is a diagram showing a surface for attaching an abrasive material of a backup pad according to one embodiment of the present invention, and a cross section along A-A'. This backup pad has a base material I having holes for collecting dust, a number of bridge piers 6, 6'... which are secured to the top of the main surface, and ventilative member 4 which is supported by the bridge piers. An annular wall 5 is provided around the outer periphery of the ventilative member 4. A dust pocket 7 for connecting the holes for collecting dust to the opening structure is formed between the base material and the ventilative member.

FIG. 13 is a diagram showing a surface for attaching an abrasive material of a backup pad according to another embodiment of the present invention, and a cross section along B-B'. This backup pad has a base material I having holes for collecting dust, an annular support 9 that is secured along the outer peripheral portion of the main surface, a rigid sheet material 8 that is placed over the annular support, and a ventilative member 4 that is secured to the rigid sheet material. An annular wall 5 is provided around the outer periphery of the ventilative member 4.

FIG. 14 is a surface for attaching an abrasive material of a backup pad according to another embodiment of the present invention, and a cross section along C-C'. In this embodiment, rigid sheet material 8, which is a bridge girder, is supported by a number of supports in pillar form 10, 10'... which are bridge piers in the backup pad shown in FIG. 13. As a result of this, the strength of the rigid sheet material 8 for supporting a ventilative member 4 is further increased. At this time, ventilative member 8 made of a metal or a resin is provided irrespectively of the dimensions of an annular support 9. In addition, the annular support 9 may have any form, including a cylindrical form or a form of which the cross section is a trapezoid. An appropriate arrangement pattern, number and material of the supports in pillar form may be determined.

Abrasive tool for Collecting Dust

An abrasive material in sheet form as that described above is secured to a surface for attaching an abrasive material of a backup pad, and thereby, an abrasive tool for collecting dust according to the present embodiment is obtained. Conventional members for fixing an abrasive material may be used. As for a useful member for fixing an abrasive material, surface fasteners and adhesives can be cited as examples. In the case where a surface fastener is used, a clearance is created between the abrasive material and the backup pad, and this clearance functions as a channel for collecting abraded swirl, and therefore, the efficiency of dust collection can further be increased. In the case where a surface fastener is used, a surface fastener in loop form is attached to either of the rear surface of the sheet abrasive material for collecting dust and the surface for attaching an abrasive material of a backup pad, and a surface fastener in hook form is attached to the other. The height of the clearance can be adjusted using the height of the loops, and it can be made to be not smaller than 0.5 mm, preferably not smaller than 1 mm to 2 mm, in order to make it function as a channel for collecting dust.

In the abrasive tool for collecting dust according to the present embodiment, it is not necessary to make an abrasive material in sheet form match in position with the holes when it is attached to the backup pad. The ratio of the number of effective openings of the abrasive surface, that is to say, the ratio of the number of dust collecting holes having effective openings to the total number of dust collecting holes of the abrasive material is not less than 30%, preferably not less than 40%. That is to say, whichever the direction in which the abrasive in sheet form for collecting dust is placed, the area of the effective openings in the abrasive surface can be secured so as to have not less than a certain value, and the dust collecting performance of the abrasive surface is maintained. This is because the abrasive material in sheet form has an area ratio of dust collecting holes which is not less than a certain value, and the surface for attaching an abrasive material of the backup pad has an open structure where a number of holes are gathered, and therefore, the dust collecting holes of the abrasive material and the holes in the surface for attaching an abrasive material of the backup pad easily overlap. Here, in the case where the ratio of the number of effective openings is less than 30%, the increase in the dust collecting performance of the abrasive surface becomes insufficient.

Though the present invention is concretely described using the following examples, the present invention is not limited to these.

EXAMPLES

Example 1

Holes were created in an abrasive material "Disc Unicut P400" having a diameter of 125 mm, made by Sumitomo 3M Ltd., and thereby, the opening structure shown in FIG. 2 was formed. The area per dust collecting hole that forms the opening structure was 19.6 mm²; the distance between end portions of adjacent dust collecting holes was 5 mm, the number of holes is 69, and the area ratio of the dust collecting holes was 1%.
Holes were created in a sheet material made of synthetic leather with a surface fastener made of nylon having a thickness of 1 mm to 2 mm, and this was used as a ventilative member, and thereby, a backup pad having an opening structure in the surface for attaching an abrasive material was fabricated. FIG. 15(a) is a plan diagram showing this surface for attaching an abrasive material. The area per hole that forms the opening structure was 52.6 mm², the distance between end portions of adjacent holes was 4 mm, the number of dust collecting holes was approximately 65, and the area ratio of the holes was 28%.

The above described abrasive material in sheet form was secured to the surface for attaching an abrasive material of the backup pad using a surface fastener, so that the clearance became 2 mm, and thus, an abrasive tool for collecting dust was obtained. It is not necessary to match the position of the holes of the abrasive material when the abrasive material is attached, and the work of attachment was easy.

FIG. 15(b) is a plan diagram showing an example of an abrasive surface of an abrasive tool for collecting dust. The openings of the abrasive surface are shown as dark regions. In the case where the abrasive material in sheet form and the backup pad are attached to each other in a state where the center of the two approximately overlaps at an arbitrary rotational position, the ratio of the dust collecting holes having effective openings from among the dust collecting holes of the abrasive surface, that is to say, the ratio of the number of effective openings, was always not less than 75%, irrespectively of the rotational position.

This abrasive tool for collecting dust was mounted on a double action sander “PN3965,” made by Sumitomo 3M Ltd., and a pate (“LUC Poly-Putty,” made by Kansai Paint Co., Ltd.) was abraded. Continuous abrading for 3 minutes was carried out six times, and the weight of the pate that was abraded off was added up as the abraded amount. The results of the abrading test are shown in Table 1. In the table, the abraded amount is shown as a value that is calculated so that the abraded amount in the comparative example becomes 100%.

Next, an abrasive tool for collecting dust was obtained in the same manner as described above, except that an adhesive was used instead of a surface fastener as a member for fixing an abrasive material, and then, a abrading test was carried out. The results of the abrading test are shown in Table 1.

In this case, the ratio of the number of effective openings of the abrasive surface was always not less than 61%, irrespectively of the position of attachment between the abrasive material and the backup pad. The results of the abrading test are shown in Table 1.

Example 3

Holes were created in a sheet material of which the thickness and the material were the same as those in Example 1, and this was used as a ventilative member, and a backup pad having an opening structure on the surface for attaching an abrasive material was fabricated. FIG. 17(a) is a plan diagram showing this surface for attaching an abrasive material. The area per hole that forms the opening structure was 42.3 mm², the distance between end portions of adjacent holes was 4 mm, and the area ratio of the holes was 24%.

An abrasive tool for collecting dust was obtained in the same manner as in Example 1, except that this backup pad was used, and a abrading test was carried out. FIG. 17(b) is a plan diagram showing an example of the abrasive surface of the abrasive tool for collecting dust. The effective openings of the abrasive surface are shown as dark regions. In this case, the ratio of the number of effective openings of the abrasive surface was always not less than 54%, irrespectively of the position of attachment between the abrasive material and the backup pad. The results of the abrading test are shown in Table 1.

Example 4

Holes were created in an abrasive material “Disc Unicat P400” having a diameter of 125 mm, made by Sumitomo 3M Ltd., and thereby, the opening structure shown in FIG. 19 was formed. The area per dust collecting hole that forms the opening structure was 19.6 mm², the distance between end portions of adjacent dust collecting holes was 7 mm, the number of holes is 57, and the area ratio of the dust collecting holes was 9%.

An abrasive tool for collecting dust was obtained in the same manner as in Example 1, except that this abrasive material in sheet form was used, and an abrading test was carried out. In this case, the ratio of the number of effective openings of the abrasive surface was always not less than 52%, irrespectively of the position of attachment between the abrasive material and the backup pad. The results of the abrading test are shown in Table 1.

Example 5

Holes were created in an abrasive material “Disc Unicat P400” having a diameter of 125 mm, made by Sumitomo 3M Ltd., and thereby, the opening structure shown in FIG. 20 was formed. The area per dust collecting hole that forms the opening structure was 38.5 mm², the distance between end portions of adjacent dust collecting holes was 7 mm, the number of holes is 32, and the area ratio of the dust collecting holes was 10%.

An abrasive tool for collecting dust was obtained in the same manner as in Example 1, except that this abrasive material in sheet form was used, and an abrading test was carried out. In this case, the ratio of the number of effective openings of the abrasive surface was always not less than 88%, irrespectively of the position of attachment between
the abrasive material and the backup pad. The results of the abrading test are shown in Table 1.

Comparative Example 1

[0102] A backup pad ("Disc Pad 5595, 5581") made by Sumitomo 3M Ltd. was prepared. FIG. 18(a) is a plan diagram showing the surface for attaching an abrasive material. The area per hole was 95 mm², the distance between end portions of adjacent holes was 27 mm, the number of holes was 6, and the area ratio of the holes was 5%.

[0103] An abrasive tool for collecting dust was obtained in the same manner as in Example 1, except that this backup pad was used, and an abrading test was carried out. FIG. 18(b) is a plan diagram showing an example of the abrasive surface of the abrasive tool for collecting dust. The effective openings of the abrasive surface are shown as dark regions. In this case, the ratio of the number of effective openings of the abrasive surface was 10%. The results of the abrading test are shown in Table 1.

Comparative Example 2

[0104] Holes were created in an abrasive material "Disc Unicut P400" having a diameter of 125 mm, made by Sumitomo 3M Ltd., and thereby, the opening structure shown in FIG. 21 was formed. The area per dust collecting hole that forms the opening structure was 38.5 mm², the distance between end portions of adjacent dust collecting holes was 12 mm (linear direction), the number of holes is 17, and the area ratio of the dust collecting holes was 5%.

[0105] An abrasive tool for collecting dust was obtained in the same manner as in Example 1, except that this abrasive material in sheet form was used, and a abrading test was carried out. In this case, the ratio of the number of effective openings of the abrasive surface was always not less than 88%, irrespectively of the position of attachment between the abrasive material and the backup pad. The results of the abrading test are shown in Table 1.

1. An abrasive tool for collecting dust, comprising: an abrasive material in sheet form having not less than 20 dust collecting holes; and a backup pad, including: a base material having a first major surface, a second major surface opposite to the first major surface, and at least one hole for collecting dust penetrating through the first major surface and the second major surface; and a ventilative member connected to the first major surface of the base material, having an attaching surface to which the abrasive material is attached, and a plurality of holes extending from the attaching surface towards the first major surface of the base material; the ventilative member working jointly with the base material and making dust flow out from the attaching surface to the second major surface of the base material.

2. The abrasive tool for collecting dust according to claim 1, wherein said abrasive material in sheet form and said backup pad are formed in such a manner that when said abrasive material in sheet form is attached to said surface for attaching an abrasive material of said backup pad, the number of dust collecting holes which have effective openings, where dust collecting holes in the two overlap, is not less than 30% of the total number of dust collecting holes in said abrasive material in sheet form.

3. The abrasive tool for collecting dust according to claim 1, wherein said abrasive material in sheet form has an area of openings of said dust collecting holes of not less than 1% in the abrasive surface.

4. The abrasive tool for collecting dust according to claim 1, wherein said abrasive material in sheet form is attached to said surface for attaching an abrasive material of said backup pad by means of a surface fastener.

5. The abrasive tool for collecting dust according to claim 1, wherein the ventilative member has a plurality of discrete vents defined with a plurality of ventilative walls.

6. The abrasive tool for collecting dust according to claim 1, wherein the ventilative member has a total open area on

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>x, 1</th>
<th>Ex. 2</th>
<th>Ex. 3</th>
<th>Ex. 4</th>
<th>Ex. 5</th>
<th>C. Ex. 1</th>
<th>C. Ex. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of dust collecting holes of dust collecting abrasive sheet</td>
<td>69</td>
<td>69</td>
<td>69</td>
<td>57</td>
<td>32</td>
<td>69</td>
<td>17</td>
</tr>
<tr>
<td>Number of dust collecting holes of surface for attaching abrasive material of backup pad</td>
<td>About</td>
<td>About</td>
<td>About</td>
<td>About</td>
<td>About</td>
<td>6</td>
<td>About 65</td>
</tr>
<tr>
<td>Area ratio of holes of backup pad</td>
<td>28%</td>
<td>33%</td>
<td>24%</td>
<td>28%</td>
<td>28%</td>
<td>5%</td>
<td>28%</td>
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<tr>
<td>Minimum ratio of number of effective openings of abrasive surface of abrasive tool for collecting dust</td>
<td>75%</td>
<td>61%</td>
<td>54%</td>
<td>52%</td>
<td>88%</td>
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<td>Abraded amount (fixed with surface fastener)</td>
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<td>143%</td>
<td>122%</td>
<td>123%</td>
<td>113%</td>
<td>100%</td>
<td>107%</td>
</tr>
<tr>
<td>Abraded amount (fixed with adhesive)</td>
<td>121%</td>
<td>114%</td>
<td>109%</td>
<td>—</td>
<td>—</td>
<td>100%</td>
<td>—</td>
</tr>
</tbody>
</table>
the attaching surface of not less than 15% based on the whole abrasive material contacting area.

7. The abrasive tool for collecting dust according to claim 1, wherein the backup pad has a cavity pocket between the ventilative member and the base material.

8. The abrasive tool for collecting dust according to claim 1, wherein the ventilative member has at least 15 discrete vents.

9. The abrasive tool for collecting dust according to claim 1, wherein said abrasive material has a first abrasive surface region having said open structure and a second abrasive surface region having no hole structure on the abrasive surface.