A rotary tool (T) has a rotary segment (10) with an opposed surface opposed to a work surface and a plurality of cutting parts (20) arranged on the opposed surface. Some cutting parts (20) include tips (24a) made of a sintered material harder than the grinding tool segment, and the respective cutting parts (20) are arranged such that the tips (24a) are located at positions more outward than the tips (22a) with respect to radial directions of the rotary segment.
FIG. 2

11
10
17
18
14
12
0
22a
24a
20
22 23 24
20
20
FIG. 10

ROTATING DIRECTION OF TOOL
FIG. 11A

ROTATING DIRECTION OF TOOL

FIG. 11B
ROTARY TOOL AND ITS CUTTING PART

TECHNICAL FIELD

[0001] The present invention relates to a rotary tool and a cutting part thereof for working outer surfaces of walls and floors of buildings, ships, bridges and the like to remove paints, adhesives and the like adhered to the outer surfaces.

BACKGROUND ART

[0002] A rotary grinder in which a plurality of grinding tool segments are arranged at the outer periphery of a saucer-shaped rotary segment is known as a tool for working surfaces such as floor surfaces and wall surfaces of various structures. The respective grinding tool segments used to form this grinder are obtained by sintering, for example, a mixture of a certain amount of diamond abrasive grains and a metal binder. A work surface can be abraded by bringing the respective grinding tool segments provided on the grinder into contact with the work surface while rotating the entire grinder at high speed.

[0003] However, in the case of using the above grinder to remove old films adhered, for example, to floor surfaces and wall surfaces (particularly rubber-made elastic paints and adhesives) in a repair and renovation work or the like for a concrete structure, the films and the like may be thermally fused and melt by friction heat created between the films and the respective grinding tool segments to consequently cause adhesion to the grinding tool segments, with the result that a satisfactory removing work may not be able to be performed. Further, there is a problem of being difficult to produce a longer tool life because the abrasion speed of the grinding tool segments is relatively high.

[0004] Japanese Unexamined Patent Publication No. 7-185923 discloses a rotary tool in which a plurality of cutting devices made of sintered diamond are peripherally fixed at even intervals on a cutting-device mounting surface defined at the outer periphery of a saucer-shaped rotary segment. According to this tool, a work surface can be smoothly removed without the adhesion by pressing the respective cutting devices against the work surface while the rotary segment is mounted on a drive shaft of a motor and rotated at high speed.

[0005] However, the tool disclosed in the above publication has a problem that tips made of the sintered diamond deeply cut into the work surface since the tips have good cutting quality. Such excessive cutting-in of the tips leaves cutting marks even in the substrate of the work surface and shortens the tip life due to a damage or breakage by giving an unnecessary load to the tips.

[0006] Accordingly, an object of the present invention is to enable a satisfactory removing work by preventing an occurrence of heat adhesion while avoiding excessive cutting-in of tips.

DISCLOSURE OF THE INVENTION

[0007] In order to solve the above object, the present invention adopts the follow construction.

[0008] Specifically, the present invention is directed to a cutting part of a rotary tool provided on an opposed surface of a rotary segment of the rotary tool opposed to a work surface and having a tip for scratching off a surface portion of the work surface when the rotary segment is pressed against the work surface while being drivingly rotated about an axis extending in a direction normal to the opposed surface, wherein an inner part of the tool segment with respect to a radial direction is made of a grinding tool segment obtained by binding abrasive grains by a metal binder and an outer part of the tip with respect to the radial direction is made of a sintered material harder than the grinding tool segment (claim 1).

[0009] In this cutting part, the radially outer part of the tip, i.e. a part thereof performing more cutting work due to its higher peripheral speed, is made of the hard sintered material having a sharp cutting quality. Thus, the surface portion of the work surface can be lightly removed at high speed by this part, thereby preventing an occurrence of heat adhesion. On the other hand, the radially inner part of the tip, i.e. a part thereof performing less cutting work due to its lower peripheral speed, is made of the grinding tool segment (grinding tool segment obtained by binding the abrasive grains by the metal binder) having a relatively dull cutting quality due to its lower hardness than the sintered material. This can prevent the entire tip from cutting in excessively deep.

[0010] Further, by making the radially outer part of the tip performing more cutting work of the sintered material while making the radially inner part thereof performing less cutting work of the grinding tool segment, the wear speed of the tip can be made uniform over the entire radial direction. Thus, unlike the prior technology cutting part whose tool segment is entirely made of the same material, wear of the radially outer part of the tool segment prior to the radially inner part thereof can be prevented from occurring. As a result, the entire tool life can be extended.

[0011] Further, surface residues of the covering materials which could not be removed by the tip part made of the hard sintered material can be supplementarily ground off by the grinding edges made of the grinding tool segment. Furthermore, even if the removal by the tip part made of the sintered material leaves scratches on the work surface, such scratches can be ground-off or finished by the grinding edges made of the grinding tool segment.

[0012] For example, cemented carbide, ceramic, cermet and the like may be used as the hard sintered material. However, a polycrystalline diamond sintered material (PCD) and a polycrystalline cubic boron nitride sintered material (PCBN) are particularly preferable (claim 2). By using such a particularly hard sintered material, adhesion can be more securely prevented from occurring and a longer tool life can be given.

[0013] Further, Diamond abrasive grains and CBN abrasive grains are preferably used as the abrasive grains to be bound by the metal binder.

[0014] Japanese Unexamined Utility Model Publication No. 3-74770 discloses a cutter bit in which metal-bonded diamond grinding tool segments and cemented carbidies are alternately arranged in order to cut reinforced concrete. Since the grinding tool segments and the cemented carbides are arranged in peripheral direction (not in radial directions), an effect of preventing an occurrence of adhesion while preventing excessive cutting-in of the tip as in the present invention cannot be obtained.
According to the present invention, not only the radially inner part of the tip, but also the entire tip excluding the tip part made of the sintered material are more preferably made of a grinding tool segment obtained by binding abrasive grains by a metal binder (claim 3). With such a tip, the aforementioned effects can be obtained while the construction of the entire cutting part is simplified.

According to the present invention, a ratio of the length of the tip part (radially outer part) made of the hard sintered material to that of the remaining part (radially inner part) may be suitably selected based on the materials and rotating speeds of the respective parts. Generally, the length of the tip made of the sintered material is preferably set within a range of 1% to 67% of the entire length of the tip in order to enjoy both the adhesion preventing effect and the excessive cutting-in preventing effect (claim 4).

The present invention is also directed to a rotary tool, comprising: a rotary tool segment having an opposed surface opposed to a work surface, and a plurality of cutting parts arranged on the opposed surface and each having a tip for scratching off a surface portion of the work surface in a peripheral direction, the rotary tool scratching off the surface portion of the work surface by pressing the respective cutting parts against the work surface while the rotary tool segment is drivenly rotated about an axis extending in a direction normal to the opposed surface, wherein a grinding tool segment obtained by binding abrasive grains by a metal binder is arranged on the opposed surface; the cutting parts include tips made of a sintered material harder than the grinding tool segment; and the tips made of the sintered material are provided at positions more outward than the grinding tool segment with respect to radial directions of the rotary tool (claim 5).

With this rotary tool, while the tips made of the hard sintered material and having a sharp cutting quality lightly remove the surface coverings of the work surface at high speed to prevent an occurrence of heat adhesion, the presence of the grinding tool segment having a lower hardness than the sintered material and a relatively dull cutting quality suppresses deep cutting-in of the tips. Further, the removing work by the tips made of the hard sintered material, such scratches can be ground off or finished by the tips made of the grinding tool segment.

As a specific embodiment of this rotary tool, some cutting parts include tips made of the grinding tool segment and the other cutting parts include tips made of the sintered material harder than the grinding tool segment, and the respective cutting parts are arranged such that the tips made of the sintered material are located at positions more outward than the total made of the grinding tool segment with respect to radial directions of the rotary tool segment (claim 6). As another specific embodiment, the grinding tool segment has such a shape continuous along a peripheral direction of the rotary segment, and the cutting parts having the tips made of the sintered material are provided at positions more outward than the grinding tool segment with respect to radial directions of the rotary segment (claim 7).

The present invention is further directed to a rotary tool, comprising a rotary segment having an opposed surface opposed to a work surface, and a plurality of cutting parts arranged on the opposed surface and each having a tip for scratching off a surface portion of the work surface in a peripheral direction, the rotary tool scratching off the surface portion of the work surface by pressing the respective cutting parts against the work surface while the rotary segment is drivenly rotated about an axis extending in a direction normal to the opposed surface, wherein at least a part of the cutting parts are cutting parts according to any one of claims 1 to 4 (claim 8).

With this rotary tool, while the tips made of the hard sintered material and having a sharp cutting quality lightly remove the surface portion of the work surface at high speed to prevent an occurrence of heat adhesion, the presence of the tips made of the grinding tool segment having a lower hardness than the sintered material and a relatively dull cutting quality suppresses deep cutting-in of the tips. Further, the removing work by the tips made of the hard sintered material is assisted by the tips made of the grinding tool segment. If the work surface is scratched by the removing work by the tips made of the sintered material, such scratches can be ground off or finished by the tips made of the grinding tool segment.

In the rotary tool according to claim 8, all the cutting parts of the rotary tool may not be necessarily cutting parts according to any one of claims 1 to 4. However, if all the cutting parts are cutting parts according to any one of claims 1 to 4 and peripherally arranged at even intervals (claim 9), a smoother removing work can be realized by making the cutting ability peripherally uniform.

Further, if the rotary tool comprises at least first cutting parts having tips made of the sintered material and second cutting parts having tips made of the grinding tool segment, and the second cutting parts are arranged such that the tips thereof are located at positions more inward than the tips of the first cutting parts made of the sintered material with respect to the radial directions of the rotary segment (claim 10), both the backing preventing effect and the excessive cutting-in preventing effect can be enjoyed.

FIG. 1 is a perspective view of a rotary tool according to a first embodiment of the present invention when viewed from bottom;

FIG. 2 is a perspective view of the rotary tool when viewed from above;

FIG. 3 is a side view of the rotary tool;

FIG. 4 is a perspective view showing an exemplary driving device on which the rotary tool is mounted;

FIG. 5 is a perspective view of the rotary tool of the embodiment of the present invention constructed to work painted floors when viewed from bottom;

FIG. 6 is a perspective view of a rotary tool according to a second embodiment of the present invention when viewed from bottom;

FIG. 7 is a bottom view of the rotary tool of FIG. 6;

FIG. 8 is a perspective view of a rotary tool according to a third embodiment of the present invention when viewed from bottom;
FIG. 9 is a bottom view of the rotary tool of FIG. 8;

FIG. 10 is a bottom view of a rotary tool according to a fourth embodiment of the present invention; and

FIGS. 11A and 11B are a bottom view and a front view in section of a rotary tool according to a fifth embodiment of the present invention.

BEST MODES FOR CARRYING OUT THE INVENTION

A first embodiment of the present invention is described with reference to the accompanying drawings. Although a case where a film is applied to the outer surface of a work surface S is to be removed is illustrated in this embodiment, working according to the present invention is not limited thereto. The present invention is also widely applicable to removal of other “films” such as adhesives, resin sheets and resin tiles adhered to work surfaces or work surfaces made of other materials.

A rotary tool T shown in FIGS. 1 to 4 is comprised of a rotary segment 10 made of a metallic plate and a plurality of cutting parts 20 mounted on the rotary segment 10.

The rotary segment 10 integrally includes an outer peripheral portion 11 in the form of a flat plate 11 and an inner portion 12 formed inside the outer peripheral portion 11.

The inner portion 12 bulges out upward substantially in the form of a cone from the inner edge of the outer peripheral portion 11, and a flat portion 14 parallel with the outer peripheral portion 11 is formed in a middle part of the inner portion 12. A driving-shaft insertion hole 18 is formed in the center of the flat portion 14, and a driving shaft of an unillustrated driving source is mounted in the insertion hole 18 to drive the entire rotary tool about a center axis O (see FIG. 2) together with the driving shaft. A plurality of through holes 17 are peripherally formed at an outward-bulging portion (i.e. a portion between the center axis O and the outer peripheral portion 11) radially outward of the flat portion 14.

The bottom surface of the outer peripheral portion 11 is a surface (hereinafter, merely “opposed surface”) opposed to the work surface S shown in FIG. 3 in parallel therewith, and a plurality of cutting parts 20 are peripherally arranged on this opposed surface. In the shown example, eight cutting parts 20 are peripherally arranged at even intervals, and secured to the opposed surface by means of brazing and screwing.

Each cutting part 20 includes a cutting-part main body 22 and a hard sintered material partially secured to the cutting-part main body 22 via a cemented carbide 23.

Each cutting-part main body 22 is in the form of a block obtained by combining abrasive grains (e.g. diamond abrasive grains or CBN abrasive grains) by a metal binder (e.g. iron, cobalt, tungsten, or the like). In the shown example, each cutting-part main body 22 has an outer peripheral surface substantially arcuate in bottom view and extending along the outer periphery of the outer peripheral portion 11, an inner peripheral surface substantially arcuate in bottom view and extending along the inner periphery of the outer peripheral portion 11, and opposite side surfaces straight in bottom view and extending in radial directions of the tool T, and has uniform thickness in its entirety. In each cutting-part main body 22, a part located at a downstream side with respect to rotating direction and at an outer side with respect to radial direction locally is cut off, and the cemented carbide 23 and the hard sintered material 24 shaped to complement for a cut-off part are secured to this cut-off part.

It is sufficient to make the hard sintered material 24 of a sintered material harder than the cutting-part main body 22. For example, cemented carbide, ceramic, cermet or the like may be used. Particularly preferably used are a polycrystalline diamond sintered material having excellent hardness and a polycrystalline cubic boron nitride sintered material having hardness next to the former material. A preferable method for forming such hard sintered materials 24 and securing them to the cutting-part main bodies 22 is, for example, such that diamond powder as a raw material of the hard sintered material 24 is placed on the outer surface of a substrate made by the cemented carbide 23 and pressurized, whereby the entirety is integrally sintered to produce a tool material made of diamond sintered material, and this tool material is cut to a shape corresponding to the cut-off part and a surface of the cut tool material at the side of the cemented carbide 23 is secured to the cutting-part main body 22 by brazing.

With the hard sintered material 24 secured to the cutting-part main body 22, a bottom edge 24a of the hard sintered material 24 at a downstream side with respect to radial direction and a bottom edge 22a of the cutting-part main body 22 at a downstream side with respect to radial direction are aligned in a straight line. The bottom edge 24a of the hard sintered material 24 forms an outer part of a tip with respect to radial direction, whereas the bottom edge 22a of the cutting-part main body 22 forms an inner part of the tip with respect to radial direction.

Although a tip angle is 90° and a rake angle is 0° in the shown example, these angles may be suitably set according to the specific material and application of the cutting-part.

A ratio of entire tip length Lo to length Ls of the bottom edge 24a as shown in FIG. 1 depends on the material of the hard sintered material 24. This ratio is preferably 1% to 67% if the hard sintered material 24 is made of a polycrystalline diamond material or polycrystalline cubic boron nitride sintered material. There is a high chance of adhesion if this ratio is below 1%, whereas problems caused by excessive cutting-in are likely to occur if this ratio exceeds 67%.

Although the thickness of the hard sintered material 24 may be smaller than that of the cutting-part main body 22, the lift of the cutting part 20 can be maximally extended by equally setting the two thicknesses.

Next, the use and functions of this tool T are described.

1) Mounting onto a Driving Device

First, the tool T is mounted onto a driving device. A portable driving device 30 is shown in FIG. 4 as an example. This driving device 30 includes a grip 32 and a tool
The rotary segment 10 is connected and fixed at the leading end of the drive shaft, for example, by inserting the drive shaft of this driving device 30 through the insertion hole 18 formed in the tool T and mounting a nut on an externally threaded portion formed at the leading end of the drive shaft. In this way, the entire tool T is mounted in the tool cover 36 shown in FIG. 4 and has its rear side (side opposite from the work surface S) covered by the tool cover 36.

[0051] 2) Working by the Tool T

[0052] The grip 32 of the driving device 30 is gripped while the drive shaft and the tool T are integrally rotated at high speed and air is exhausted inside the tool cover 36 via an unillustrated exhaust pipe, and the respective cutting parts 20 are pressed against the work surface (e.g. wall surface) S and moved along the work surface S. In this way, the coverings on the work surface S is scratched off by the tips of the respective cutting parts 20 rotating at high speed.

[0053] Here, since the outer part of the tip with respect to radial direction, i.e. part performing more cutting work due to higher peripheral speed is formed by the hard sintered material 24 having a sharp cutting quality, the coverings on the work surface S can be lightly removed by this part, whereby adhesion of the coverings due to thermal fusion can be prevented. On the other hand, an occurrence that the entire tips deeply cut in can be suppressed since the inner parts of the tips with respect to radial directions, i.e. parts performing less cutting work due to their low rotating direction are made of metal bound grinding tool segment (grinding tool segment forming the cutting-part main parts 22) having a relatively dull cutting quality due to its smaller cutting edges than the sintered material.

[0054] Whereas the radially outer parts of the tips performing more cutting work are formed by the hard sintered materials 24, the radially inner parts of the tips performing relatively less cutting work are formed by the above grinding tool segment (the one forming the cutting-part main bodies 22), whereby the wear speed of the tips can be made uniform over the entire radial direction. Unlike the prior art cutting parts in which the entire tips are made of the same material, the radially outer parts of the tips can be prevented from abrasion prior to the radially inner parts thereof. As a result, the entire tool life can be extended longer.

[0055] Further, the removing work by the tips formed by the bottom edges 24a of the hard sintered materials 24 (hereinafter, “hard sintered material tips 24a”) can be assisted by the tips formed by the cutting-part main bodies 22 made of grinding tool segment (grinding tool segment tips 22a). For example, in the case of using this tool to remove a covering, the coverings which cannot be scratched off by the hard sintered material tips 24a can be supplementarily scratched off by the grinding tool edges 22a. Further, in the case of making a scratch upon the removing work by means of the hard sintered material tips 24a, an effect of grinding off or finishing such a scratch can be expected by the grinding tool edges 22a.

[0056] Cutting dust produced by such scratching is sucked to the side of the tool cover 36 (side opposite from the work surface S) via the respective through holes 17.

[0057] Although the tool T used by being mounted on the portable driving device 30 is shown in FIGS. 1 to 4, the present invention is not limited thereto. For example, in the case of working a so-called “painted floor”, the film can be efficiently removed in a comfortable posture by mounting the tool T on a hand-push type processing device or ridable processing device which can run on the floor. One example of the tool T for such an application is shown in FIG. 5. In a rotary tool T shown, a rotary segment 10 is formed into a simple disk shape, and a plurality of cutting parts 20 are arranged at an outer peripheral portion thereof. Although a cutting-part main body 22 is formed to be triangular in bottom view in the shown cutting part 20, it is quite similar to the one shown in FIGS. 1 to 4 in that a sintered material 24 is locally provided at a radially outer part.

[0058] The work surfaces to be processed according to the present invention are not limited to the walls and floors of buildings. For example, the present invention can be effectively applied, for example, to repair the paints of ships and bridges.

[0059] Although the metal binder grinding tool segment forming the radially inner part of the tip constitutes the cutting-part main body 22 in the shown cutting part 20, the present invention is not limited thereto. For example, the cutting-part main body may be made of a different material (cemented carbide, etc.), and a hard sintered material forming the radially outer part of the tip and a grinding tool segment (grinding tool segment obtained by combining abrasive grains by a metal binder) forming the radially inner part of the tip may be secured side by side to this cutting-part main body.

[0060] According to the present invention, a plurality of cutting parts may be arranged in two or more inner and outer rows (i.e. arranged on a plurality of concentric circles) on an opposed surface.

[0061] In the rotary tool according to the present invention, all the cutting parts may not include the grinding tool segment 22a and the hard sintered material tip 24a as the cutting parts 20 do. First cutting parts at least including a tip made of a hard sintered material and second cutting parts whose tip is entirely made of grinding tool segment obtained by combining abrasive grains by a metal binder may be provided in a mixed manner on an opposed surface.

[0062] For example, as shown in FIGS. 6 and 7 as a second embodiment, cutting parts (first cutting parts) 20 each including both the grinding tool segment tip 22a and the hard sintered material tip 24a may be peripherally intermittently arranged, and cutting parts (second cutting parts) 26 each including only a tip 26a of the grinding tool segment (grinding tool segment obtained by binding abrasive grains by a metal binder) may be arranged between adjacent cutting parts 20. Further, as shown in FIGS. 8 and 9 as a third embodiment, if a circumcircle C touching tips 26a of cutting parts 26 is located inwardly of hard sintered material tips 24a with respect to the radial directions of the arbitrary segment 10, loads on the grinding tool segment tips 22a of the respective cutting parts 20 can be mitigated by the respective cutting parts 26.
Specifically, as shown in FIG. 10 as a fourth embodiment, even in such a construction that cutting parts each including only the hard sintered material tip 24a are provided at positions radially more outward than the cutting parts 26 (cutting parts made by the hard sintered materials 24 are secured in recesses 16 formed in the opposed surface of the rotary segment 10 in the shown example), i.e. even in such a construction that the grinding tool segment tips 22a shown in FIG. 1 and other figures are deleted, the tips 26a of the cutting parts 26a made of the grinding tool segment can suppress excessive cutting-in, assist cutting by the tips 24a and grind off or finish scratches caused by the cutting by the tips 24a.

Further, as shown in FIG. 11 as a fifth embodiment, the rotary tool may be such that a grinding tool segment 28 having a shape continuous along a peripheral direction of the rotary segment 10 (ring shape in the shown example) is provided, and cutting parts each including the hard sintered material tip 24a are provided at positions more outward than this grinding tool segment 28 with respect to the radial directions of the rotary segment 10. In this way, even if the grinding tool segment 28 has no tip, it can assist the cutting by the hard sintered material tips 24a by its abrading action, and the abrasion thereby can grind off or finish scratches formed by cutting by the hard sintered material tips 24a. Of course, an effect of preventing excessive cutting-in can also be given.

However, if all the cutting parts are those according to the present invention and peripherally arranged at even intervals as in the first embodiment, cutting ability can be made uniform along peripheral direction, thereby obtaining advantages of realizing a smoother removing work and a longer life for the tool.

1. A cutting part for use in a rotary tool including a rotary segment having an opposed surface opposed to a work surface, comprising a tip for scratching off a surface portion of the work surface when the rotary segment is pressed against the work surface while being drivenly rotated about an axis extending in a direction normal to the opposed surface, wherein an inner part of the tip with respect to a radial direction is made of a grinding tool segment obtained by binding abrasive grains by a metal binder and an outer part of the tip with respect to the radial direction is made of a sintered material harder than the grinding tool segment.

2. A cutting part according to claim 1, wherein the outer part of the tip with respect to the radial direction is made of a polycrystalline diamond sintered material or polycrystalline cubic boron nitride sintered material.

3. A cutting part according to claim 1, wherein the entire tip excluding the tip part made of the sintered material is made of a grinding tool segment obtained by binding abrasive grains by a metal binder.

4. A cutting part according to claim 1, wherein the length of the tip made of the sintered material is set within a range of 1% to 67% of the entire length of the tip.

5. A rotary tool, comprising:

   a rotary segment having an opposed surface opposed to a work surface; and

   a plurality of cutting parts arranged on the opposed surface and each having a tip for scratching off a surface portion of the work surface in a peripheral direction, the rotary tool scratching off the surface portion of the work surface by pressing the respective cutting parts against the work surface while the rotary segment is drivingly rotated about an axis extending in a direction normal to the opposed surface,

   wherein:

   the opposed surface is arranged with a grinding tool segment obtained by binding abrasive grains by a metal binder;

   each of the cutting parts includes a tip made of a sintered material harder than the grinding tool segment; and

   the tip made of the sintered material is provided at a position more outward than the grinding tool segment with respect to radial direction of the rotary segment.

6. A rotary tool according to claim 5, wherein some cutting parts include tips made of the grinding tool segment and the other cutting parts include tips made of the sintered material harder than the grinding tool segment, and the respective cutting parts are arranged such that the tips made of the sintered material are located at positions more outward than the tips made of the grinding tool segment with respect to the radial directions of the rotary segment.

7. A rotary tool according to claim 5, wherein the grinding tool segment has such a shape continuous along a peripheral direction of the rotary segment, and the cutting parts having the tips made of the sintered material are provided at positions more outward than the grinding tool segment with respect to the radial directions of the rotary segment.

8. A rotary tool, comprising:

   a rotary segment having an opposed surface opposed to a work surface; and

   a plurality of cutting parts arranged on the opposed surface and each having a tip for scratching off a surface portion of the work surface in a peripheral direction, the rotary tool scratching off the surface portion of the work surface by pressing the respective cutting parts against the work surface while the rotary segment is drivingly rotated about an axis extending in a direction normal to the opposed surface, the plurality of cutting parts including at least one cutting part having a tip whose inner part with respect to the radial direction is made of a grinding tool segment obtained by binding abrasive grains by a metal binder and whose outer part with respect to the radial direction is made of a sintered material harder than the grinding tool segment.

9. (canceled)

10. A rotary tool according to claim 8, wherein the plurality of cutting parts include a first cutting part having a tip made of sintered material and a second cutting part having a tip made of grinding tool segment, the second cutting part being arranged such that the tip thereof is located at a position more inward than the tip of the first cutting part made of sintered material with respect to the radial direction of the rotary segment.

11. A rotary tool according to claim 8, wherein all the cutting parts of the rotary tool are cutting parts have a tip whose inner part with respect to the radial direction is made of a grinding tool segment obtained by binding abrasive grains by a metal binder and whose outer part with respect to the radial direction is made of a sintered material harder than the grinding tool segment.
12. A rotary tool according to claim 11, wherein the outer part of the tip with respect to the radial direction is made of a polycrystalline diamond sintered material or polycrystalline cubic boron nitride sintered material.

13. A rotary tool according to claim 11, wherein the entire tip excluding the tip part made of the sintered material is made of a grinding tool segment obtained by binding abrasive grains by a metal binder.

14. A rotary tool according to claim 11, wherein the length of the tip made of the sintered material is set within a range of 1% to 67% of the entire length of the tip.

15. A rotary tool according to claim 11, wherein all the cutting parts having a tip whose inner part with respect to the radial direction is made of a grinding tool segment obtained by binding abrasive grains are peripherally arranged at even intervals.

16. A rotary tool according to claim 8, wherein the outer part of the tip with respect to the radial direction is made of a polycrystalline diamond sintered material or polycrystalline cubic boron nitride sintered material.

17. A rotary tool according to claim 8, wherein the entire tip excluding the tip part made of the sintered material is made of a grinding tool segment obtained by binding abrasive grains by a metal binder.

18. A rotary tool according to claim 8, wherein the length of the tip made of the sintered material is set within a range of 1% to 67% of the entire length of the tip.

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