BRUSH ASSEMBLY

Description:

The invention relates to a brush assembly comprising a support rotatable about an axis and an annular brush essentially consisting of a brush band and an array of radially outwardly projecting bristles connected to it and forming a bristle ring. The object of the invention also relates to a rotary brush tool provided with such a brush assembly and a method of machining a surface of a workpiece using this brush assembly.

In the case of a known and generic brush assembly of the structure described above in accordance with EP 1,834,733 B1 [US 9,554,642], the bristles are decelerated for a certain time with the aid of a stop extending into the rotating bristle array. After release of the bristles by passing the stop, the kinetic energy stored by this action, i.e. by the bristles and/or a brush band holding the bristles, can be used. The kinetic energy is used for striking and machining a surface of the workpiece with the aid of the bristles. This achieves comparable effects as in so-called sandblasting. The advantage of the known method according to EP 1,834,733 B1 with respect to sandblasting is that it works without abrasives in such a way that the technical effort is significantly reduced. Environmental pollution caused by the abrasive can also be avoided. In addition, a particularly cost-effective structure and an efficient approach are observed. This has proven its worth.

In the further generic prior art according to WO 2012/038537 A1 [US 9,918,544] the stop engaged in the rotating bristle array is also formed as an abrasive for the bristles. A distinction can be made between the two functions, i.e. the stopping function and the grinding

function, in accordance with a rotational direction of the ring brush and/or an adjusting position of the stop with respect to the bristle array. In fact, the stop is adjustable with respect to the bristle array. The adjustment of the stop is carried out radially and/or tangentially. Eccentric adjustment of the stop is also possible. In addition, the stop can be adjusted by the driven bristles.

Prior art has proven itself in principle with regard to the machining of the surface of the workpiece with the aid of the bristles and the roughness achieved as a result. However, in the previous approaches, the surface of the workpiece is not uniformly provided with "craters" caused by the bristles. Although comparable and also adjustable roughness levels as is the case with sandblasting are achieved in such a way that a subsequent coating, a welding process, etc. of the relevant surface of the workpiece is successful without any problems. However, the roughness profile is subject to fluctuation, so it has a certain anisotropy in prior art. For many applications, however, an isotropic and uniform roughness of the surface of the treated workpiece is required.

The anisotropy or lack of uniformity of the roughness profile observed in the prior art can be attributed basically to the fact that the bristles are typically anchored in the brush band. Since the bristles are often also formed as U-shaped bristles, the brush band carrying the bristles in its circumferential direction is provided with bristle rows and axial spaces in between, created by the U-shape of the bristles for example. These spaces between the individual bristle rows now lead to the generated roughness profile being uneven during the striking machining of the workpiece surface. In practice, this is countered

by the user moving the brush assembly or a rotary brush tool provided with it back and forth over the surface for example.

Apart from the fact that such a movement is exhausting and cannot necessarily provide the required uniformity, such procedures cannot be implemented and implemented directly in the case of, for example, mechanical processing of the surface of the workpiece with a machine, for example, a robotic arm. In addition, the state of the art requires even more effective machining of the surface of the workpiece. Here, the invention in its entirety intends to remedy the situation.

The object of invention is to further develop such a brush assembly in such a way that the roughness profile generated in this manner on the surface of the workpiece processed here has increased uniformity with respect to the previous prior art. At the same time, the possibility of increasing roughness if necessary is to be opened up.

To attain this object within the scope of the invention, in the case of a generic brush assembly, the invention proposes that the brush band with its longitudinal extension and thus also the bristle array are connected to the support extending at an angle to the axis deviating from a perpendicular orientation with respect to the axis of the support.

In this context, usually, the longitudinal extension of the brush band and the axis of the support form an acute angle of about 60° to less than 90°. Preferably, in this context, acute angles of about 70° to 85° are observed. Particularly preferred in this context, angles of about 85° have proven to be favorable.

Due to this "angling" of the brush band and consequently also of the bristle array with respect to the axis of the rotatably driven support, a particularly uniform processing of the surface of a workpiece is ensured. This is because the bristle array that runs diagonally with respect to the axis of the support, ultimately ensures a staggering rotative impingement of the surface of the workpiece. The staggering movement is explained by the bristles of the bristle array running diagonally with respect to the axis of the support. If one now considers a turn of the bristle array, this corresponds in a lateral view of the support to the fact that the bristles in relation to the surface of the workpiece do not follow a single radial circle during rotation of the support and consequently process the surface, on average, at one point or, in reality, along a more or less pronounced line. Rather, the inclined position of the brush band and thus also of the bristle array when the support rotates with respect to the workpiece oppositely fixed in position with its surface ensures that the bristles in question axially pass over a certain area of the surface of the workpiece in a lateral view on the support, a so-called machining zone.

This back-and-forth movement of the bristles in a lateral view is interpreted in the context of the present application as a staggering movement. Because if one imagines the bristle array as a disk that is embedded diagonally in relation to the axis of the support, the disk of the bristle array in question performs a staggering movement in a lateral view or in a front view on the support because the rotational axis belonging to the disk in question performs a change of rotational direction of the bristle array, as explained in more detail below with reference to this embodiment. In any case, there is a staggering rotative impingement of the surface of the workpiece, which ensures a particularly

uniform machining of the surface. In particular, any inhomogeneities as in prior art are expressly not observed.

According to a further favorable embodiment, the brush band is guided around the axis of the support in more than one turn and is connected to it. In addition, the brush band encloses the support as a helix. Here, the brush band generally runs in a spiral shape about the axis of the support at a constant pitch; consequently, the spiral described by the brush band runs regularly with respect to the axis of the support. In principle of course, an irregular progression is also conceivable.

Due to this additionally helical design of the shape of the brush band with respect to the axis of the support, effectively a plurality of disks of the bristle array are defined. These perform respective staggering movements around their imaginary rotational axes. As a result, individual axial work areas or the processing zones that are formed by the staggering movement and swept over by the respective bristle overlap each other. This mutual overlap then has the overall consequence that the workpiece to be machined in this way is provided with a roughness profile on its surface that has homogeneity not yet observed, i.e. where the individual craters belonging to the roughness profile are evenly distributed across the surface with mostly the same depth and spacing from one another.

In order to ensure the helical shape of the brush band with respect to the axis of the support concretely and in individual cases, in detail, the support has a helical guide groove in its outer surface that holds the brush band. This is usually done in such a way that the brush band essentially engages laterally without play into the groove in question. The groove is delimited by the respective groove walls.

These groove walls are generally perpendicular to an outer cylindrical surface of the support. In fact, it has proven to be particularly favorable if the support including groove and groove walls is designed as a plastic molded part and in particular plastic injection-molded part.

In order to fix the brush band in the respective groove, the brush band is at least connected to the support at points. The connection is generally established mechanically and/or adhesively. As a rule, the brush band is formed as a fabric tape, for example, as a polyamide fabric tape.

The described brush assembly can also be favorably provided with an additional stop in the rotating bristle array. With the aid of the stop, the roughness can be affected in a particularly favorable and positive manner, as described in detail in EP 1,834,733 B1 of applicant. In principle, such a stop can of course also be dispensed with.

The object of the invention also relates to a rotary brush tool as described in detail in Claim 13 and a method for machining the surface of the workpiece in question according to Claims 14 and 15.

In the following the invention is described in more detail with reference to a drawing showing only one embodiment. Therein:

FIG. 1 is a perspective view of the brush assembly according to the invention in a perspective view together with a rotary brush tool,

FIG. 2 is a detail view of the support according to the invention, and

FIG. 3 is a side view of the support during the processing of a surface of a workpiece and the staggered rotative impingement of the relevant surface provided according to the invention.

FIG. 1 shows in dot-dash lines a rotary brush tool provided with a machine housing 1 and a drive 2 for a brush assembly 3 accommodated within it. The brush assembly 3 has a support 4 rotatable about an axis A. The support 4 is shown in detail in FIG. 2.

Furthermore, an annular brush 5, 6 essentially consists of a brush band 5 and an array 7 of bristles 6 connected to and projecting radially outwardly therefrom. Particularly in the schematic side view in accordance with FIG. 3 one can see how the individual bristles 6 are anchored in the brush band 5. The individual bristles 6 can be U-shaped and inserted through respective pairs of mounting holes 5a in the brush band 5. This is only shown in FIG. 3.

According to the invention, the assembly is made in such a way that a longitudinal extension L of the brush band 5 indicated in FIG. 2 and 3 and thus also of the bristle array 7 extends on the support 4 at an angle to its axis A, obliquely to a perpendicular to the axis A of the support 4. In fact, in this embodiment and in accordance with FIGS. 2 and 3, an acute angle α is formed between the longitudinal extension L of the brush band 5 on the one hand and the central rotation axis A of the support 4 on the other. In accordance with this embodiment, the acute angle α in question lies within a range of about 70° to 85° and is in any case less than 90°. In most cases, an angle α in the range of about 85° is used here, which of course is only an example.

Due to this inclination of the brush band 5 and thus also of the bristle array 7 or the bristles 6 projecting outward from the brush band 5 with respect to axis A of the support 4, the surface 9 of a workpiece shown in FIG. 3 is rotatively impinged in a staggering manner. This can best be seen in FIG. 3.

If one assumes at this point B fictitiously B that the brush band 5 and the bristles 6 connected to it and thus also the bristle array 7 as a whole describe a disk, then the disk in question moves on rotation of the support 4 around its axis A in a rotation indicated in FIG. 3 around its own rotational axis R. Due to the rotation of the support 4 and the inclined position of the disk, the associated and fictitious rotational axis R now undergoes a change of direction indicated in FIG. 3. In the end, a precession or staggering movement of the assumed disk is observed that manifests itself on the basis of the different orientations of the rotational axis R of the assumed disk.

This staggering movement and the associated staggering rotative impingement of the surface 9 of the workpiece by the ring brush 5, 6 now has the consequence that each bristle 6 not only impinges the relevant surface 9 of the workpiece in a point-specific manner during its rotation, but rather passes over an axially extended machining zone B on the surface 9 of the workpiece as indicated in FIG. 3.

Since the bristles 6 are usually U-shaped and consequently are at a slight spacing from one another, this results in the surface 9 of the workpiece in question no longer being impinged B as in prior art B by the individual bristles 6 practically in a straight line, but rather the individual machining zones B of the bristles 6 overlap each other and thus overall provide for a particularly homogeneous roughness profile on the surface 9 of the workpiece being surface treated. This type of result and roughness profile has not yet been observed.

The brush band 5 is now not only guided around the support 4 in one turn, but in more than one turn around the axis A of the support 4 that it is connected to. In fact, the brush band 5 forms a helix

surrounding the support 4. Overall, the design is such that the helical brush band 5 centered on the axis A of support 4 has a constant pitch, i.e. the angle indicated in FIG. 2 between the longitudinal extension L of the brush band 5 and the axis A of the support 4 is the same along its full length. It is therefore a uniform helix in which the brush band 4 is guided around the relevant axis A.

In addition, the design is made in such a way that the brush band 4 essentially engages laterally without play in a groove 10 formed in the support outer surface as shown in FIG. 2. The groove 10 is delimited by walls 11 projecting from a cylindrical outer support surface. Overall, the support 4 together with the groove 10 and the groove walls 11 defining the groove 10 is a plastic part and preferably a plastic injection-molded part. The groove 10 and the groove walls 11 can also be printed via 3D printing. It is also conceivable to machine the groove 10 as well as the groove walls 11, for example, by milling a cylindrical plastic part.

The brush band 5 is at least connected to the support 4 at at least one point. The punctual connection can be established mechanically and/or adhesively. In addition, the design is usually made in such a way that the brush band 4 is a fabric tape made in particular from a polyamide fabric. In addition, a stop 12 positioned in the rotating bristle array 7 (only indicated in FIG. 1) and is mounted on a wall 13 of the rotary brush tool shown there or its machine housing 1.

As the support 4 rotates around its axis A, it comes into the staggered rotative impingement with the surface 9 of the associated workpiece already mentioned. In addition, each individual bristle 6 or each spiral of the brush band 4 on the surface 9 of the workpiece processes the axially extended machining zone B already mentioned, as

shown in FIG. 3. This results is an overlap of the individual machining zones B and the fact that the surface 9 is provided with a particularly homogeneous roughness profile. In accordance with this embodiment, the individual bristles 6 are made of steel. In principle, of course, other materials such as e.g. plastic or combinations are also conceivable.

Claims

1. A brush assembly (3) comprising a support (4) rotatable about an axis (A) and an annular brush (5, 6) essentially consisting of a brush band (5) and an array (7) of bristles (6) connected thereto and projecting radially therefrom, characterized in that

the brush band (5) and thus the bristle array (7) extend on the support (4) obliquely to a perpendicular to the axis (A) of the support (4).

2. The brush assembly (3) according to claim 1, characterized in that the longitudinal extension (l) of the brush band (5) and the axis (A) of the support (4) form an acute angle (α) of about 60" to less than 90E, preferably 70E to 85E, and particularly preferably about 85E.

3. The brush assembly (3) according to claim 1 or 2, characterized in that the brush band () 5 is wound in more than one turn about the axis (A) of the support (4) and is fixed thereto.

4. The brush assembly (3) according to one of claims 1 to 3, characterized in that the brush band (5) if wound helically around the support (4).

5. The brush assembly (3) according to claim 4, characterized in that brush band wound is wound at a uniform angle helically around the axis (A) of the support (5)

6. The brush assembly (3) according to one of claim 1 to 5, characterized in that the support (4) is formed with a radially outwardly open groove (2) in which the brush band (5) is received.

7. The brush assembly (3) according to claim 6, characterized in that the brush band (5) fits snugly without play in the groove (10).

8. The brush assembly (3) according to claim 6 or 7, characterized in that the groove (10) has walls (11) extending from a cylindrical outer surface of the support (4).

9. The brush assembly (3) according to one of claim 1 to 8, characterized in that the brush band (5) is fixed at least at points to the support (4).

10. The brush assembly (3) according to claim 9, characterized in that the connection is mechanical and/or adhesive.

11. T he brush assembly (3) according to one of claim 1 to 10, characterized in that the brush band (4) is a plastic textile strip formed on the support (4).

12. The brush assembly (3) according to one of claim 1 to 11, characterized in that a stop (12) is provided engaged into the rotating bristle array (7).

13. A rotary brush tool having a housing (1), a drive (2) and a brush assembly,
characterized in that
the brush assembly is as defined in one of claim 1 to 13.

14. A method of working a surface (9) of a workpiece with a brush assembly (3) according to one of claim 1 to 12, where the bristle array (7) of the ring brush (5, 6) projecting obliquely to the axis (A) from the support (4) impinges the surface (9) at successively offset locations.

15. The method according to claim 14, characterized in that individual impingement zones (B) of each turn of the bush band (5) overlap at edges.