BRUSH ASSEMBLY, ROTARY BRUSH TOOL, AND METHOD OF WORKING A SURFACE OF A WORKPIECE WITH A BRUSH ASSEMBLY

The invention relates to a brush assembly comprising a brush holder rotatable about an axis and a brush ring that is mechanically coupled or couplable to the brush holder and that essentially comprises a brush body and bristles connected thereto, forming an annular bristle array and projecting radially outward, the bristles extending at an angle to the axis of rotation of the brush holder.

Such brush assemblies are described in various ways in the prior art. For example, reference is made to EP 1 834 733 [US 9,554,642] of applicant. Using the above-mentioned brush assemblies, surfaces of materials or workpieces can for example be processed in order to subsequently apply coatings to the workpiece. For this purpose, the prior art referred to above according to EP 1 834 733 proposes a stop that engages into the rotating annular bristle array. The stop slows down the bristles for a certain period of time so that, after their release, the kinetic energy stored in this way is used for additional impact processing of the surface of the workpiece by the bristles. This creates craters on the surface..

The known teachings assume that the bristles in the brush body, which is designed as a brush band, absorb the deformation energy introduced by the stop, store it as kinetic energy, and release it after passing the stop. This has proven to be effective in principle.

As a rule, the state of the art is such that the bristles are anchored in the brush band transversely to the longitudinal extension of the brush band and consequently form rows of bristles running transversely to the longitudinal extension of the brush band. The brush

band is in turn coupled together at its ends into an annulus mechanically connected to the brush holder. For this purpose, the brush holder may have a spacer sleeve mounted inside the ring-shaped brush band and two end plates, which are held in a spaced position by the spacer sleeve and thus form rows of bristles running transversely to the longitudinal extension of the brush band. In addition, the brush holder in the known design has on its end plates axial webs that overlap the brush band in the area of gaps in the annular bristle array..

In principle, however, it is also possible to use a brush body made, for example, of a solid elastic material to which the bristles are attached on its surface. In this case, the rotatably drivable brush holder may be coupled in a rotationally secure manner to the then, for example, solidly formed brush body, so that in any case rotational movement acting on the brush holder is transmitted to the brush ring because the brush holder is mechanically coupled to the brush ring..

In the generic and, in this respect, closest prior art according to EP 4 218 494 [US 2023/0232975], the procedure is such that, first of all, a brush band with bristles anchored in it is used as the brush body. The brush band is connected to the brush holder with its longitudinal extension deviating from a vertical orientation relative to the axis of the brush holder, running at an angle to the axis. The same applies to the annular bristle array. The same then also applies to the annular bristle array. In most cases, the brush band is arranged to surround the brush holder in question in a helical shape. For this purpose, the brush holder has a groove running around its circumference to accommodate the brush band. The brush band essentially engages in the groove laterally without play..

In this way, a roughness profile with increased uniformity is observed when machining the surface of a workpiece. This can be attributed to the fact that the annular bristle array, which runs at

an angle to the axis of the brush holder, and the bristles, which also run at an angle, ultimately ensure a wobbling rotary action on the surface of the workpiece. This is associated with a back-and-forth movement of the bristles in side view, which corresponds to the wobbling motion. This has proven to be fundamentally effective..

However, based on the state of the art outlined above, improvements are still possible and unchanged. This is because the known brush assembly usually requires a specially manufactured brush holder with a helical groove running around its circumference. In addition, the brush band must be designed accordingly so that it can generally be accommodated in the groove in question without lateral play. This means that the brush holder or the groove realized at this point and the brush band must be matched to each other.

This means that conventional brush holders, such as those described in EP 1 834 733 or those covered by DE 43 26 793 [US 5,524,315], cannot be combined with the brush band in question. Conversely, the brush holder according to EP 4 218 494 cannot be combined with the brush bands that are typically designed for use with and in conjunction with brush holders as described in the above-mentioned EP 1 834 733 or DE 43 26 793. This consequently leads to incompatibilities and acceptance problems in the market.

The object of the invention is to remedy this situation as a whole. The invention is based on the technical problem of further developing such a brush assembly in such a way that, while retaining the specific advantages according to the generic state of the art as described in EP 4 218 494 and the roughness profile produced in this way on the surface of a workpiece, compatibility problems do not (or no longer) occur.

To solve this technical problem, the invention proposes, in a generic brush assembly, that the bristles are arrayed on the brush

body in inclined attachment lines on its surface when viewed parallel to the axis or direction of rotation of the brush body along its width. As a result, the bristles also define oblique rows of bristles relative to the transverse direction of the brush body..

This means that, in contrast to the prior art, according to the invention, the bristles are not anchored to the brush body in rows extending along the axis or in the rotational direction of the brush body or along the width of the brush body and consequently transverse to the longitudinal extension of the brush body..

Rather, the invention expressly refers to an oblique position of the bristles relative to the axis at this point. In this context, the bristles consequently define, when viewed along the width of the brush body, respective lines of attachment from bristle to bristle, which, according to the invention, are inclined relative to the axis or direction of rotation of the brush body, thus generally forming an acute angle with the axis in question..

The brush body can basically be solid and made of an elastic plastic material. Brush bodies in the shape of a ring disc have generally proven to be particularly advantageous. The bristles are now arranged on the surface of this ring disc or anchored in this surface, as described, for example, in GB 2 268 682 A.

Within the scope of the invention, the bristles in the axis of the brush body or the direction of rotation of the ring disc define the inclined attachment lines in question, which extend diagonally relative to the axis of the brush body along the surface and in the width direction.

In general, however, a brush band is used as the brush body. This brush band is designed in a preassembled or prefabricated state as a longitudinal strip and is coupled together at both ends so that the brush band can be held and placed in the brush holder in a ring

shape. For this purpose, the brush holder may be constructed in a manner comparable so that, for this purpose, the brush holder may be constructed in a manner comparable to that described in EP 1 834 733. This means that the brush holder is advantageously composed of two end plates connected to each other and holding the brush band in a ring shape between them. In addition, a spacer sleeve may be provided, which is gripped by the brush band arranged in a ring shape in the assembled state and accommodates the brush band. In addition, the spacer sleeve ensures that the two end plates of the brush holder are held in a spaced position, as will be explained in more detail in this embodiment example. In principle, of course, a spacer sleeve in this context is only to be regarded as an option and is therefore superfluous.

In any case, the two end plates of the brush holder allow the brush ring to be held in a removable and therefore replaceable manner. This allows the brush ring to be mechanically coupled with the brush holder or is mechanically coupled with it.

In the described and advantageous design with the brush body formed as a brush band, the design is such that the bristles In the described and advantageous design with the brush body formed as a brush band, the design is such that the bristles on the surface of the brush band define the inclined attachment lines. The attachment lines extend along the width of the brush band, i.e., in the transverse direction of the generally rectangular brush band. As a result, the respective attachment lines form an acute angle with the axis or direction of rotation of the brush band in its ring shape as held in the brush holder.

This means that as soon as the brush band is held in the brush holder in ring form, the respective attachment lines are oriented on its surface, taking into account the acute angle relative to the axis of the brush band. This axis of the brush band and, consequently, of

the brush body as a whole generally coincides with the axis of rotation of the brush holder.

This means that the brush holder and the brush ring mechanically coupled to the brush holder define a matching axis and axis of rotation of the brush holder, which determines the rotational movement of the brush assembly realized in this way.

According to an advantageous design, the inclined attachment lines of the bristles on the surface of the brush band generally enclose an equal acute angle with the axis of the brush band accommodated in ring form in the brush holder. In principle, however, it is also possible to work with different acute angles at this point. For reasons of simple manufacturing, however, a uniformly equal acute angle will be used here for the respective inclined attachment lines in comparison to the axis.

In this context, it has proven effective to set the acute angle in question between 5° and 45° relative to the axis. Preferably, angles between 5° and 10° are observed at this point. Of course, this is only an example and should not be understood as restrictive.

The bristles themselves generally extend radially relative to the axis of rotation of the brush holder, which corresponds to the axis or direction of rotation of the brush body and, consequently, of the brush band held in the brush holder in a ring shape. The bristles are generally U-shaped and made of steel and/or plastic, for example. This depends on the surface of the workpiece to be machined. In principle, bristles made of metal can also be used, for example those made of brass, copper, etc. If the surface of the workpiece is to be processed, it is advisable to use plastic bristles. Here, plastics such as polyamide, polyester or even Teflon (polyethylene terephthalate) can be used.

In connection with the manufacture of the brush ring, the general procedure is to insert the U-shaped bristles into the mounting

holes of the brush band and anchor them there. In this way, the U-shaped bristles define the corresponding attachment line with their respective U-bases. The respective U-bases can run along this attachment line and be oriented accordingly.

In general, the respective U-bases of the bristles are largely aligned in the axis of the brush body and/or perpendicular to it and run along the attachment lines with a respective offset. In general, the U-shaped bristles are spaced at equal intervals, i.e., with the same offset, along the respective attachment line.

In this way, the Brush assembly can be used with relatively low contact pressures in comparison to the surface of the workpiece to be processed, which can be 10 N or less, for example. Of course, depending on the contamination, surface coatings, etc. to be removed, higher pressing forces of several tens of Newtons are also possible and conceivable. In any case, the surface of the workpiece treated in this way develops a particularly uniform structure, which generally consists of craters resulting from the impact of the bristles. The special feature of the crater surface achieved in this way, within the scope of the invention, is that the craters and thus the surface profile of the workpiece are relatively oriented in randomized directions on the surface of the workpiece, i.e., no particular direction of the craters on the surface of the workpiece is observed. This means that in this way, a respective surface profile with a randomized direction of the craters is created on the workpiece. This is of particular importance in that it allows a subsequently applied coating to bond particularly closely to the surface prepared in this way, and any coating detachment or spalling is significantly reduced compared to the prior art.

According to a further advantageous embodiment, a stopping means can additionally be provided which is engaged in the rotating annular bristle array. Similar to the teaching of EP 1 834 733, this

stopping means ensures that the bristles are braked for a certain time so that, after their release, the kinetic energy stored in this way is used for additional impact treatment of the surface of the workpiece by the bristles. In this context, it is even possible to work with a stop that has a noncircular cross-section, as described in detail in EP 4 238 451 of the applicant.

The invention also relates to a rotary brush tool equipped with a machine housing and a drive, as detailed in claim 14. For this purpose, the rotary brush tool is equipped with a Brush assembly rotated by the drive, which has been described in detail above. The invention also relates to a method of processing a surface of a workpiece using the previously described brush assembly. This results in the previously described surface profile with randomized direction of individual craters on the surface of the workpiece.

The result is a brush assembly, a rotary brush tool, and a method of processing the surface of a workpiece using the brush assembly, which utilize a specially designed brush body and, in particular, a brush band with bristles attached to it. The brush body or brush band is typically made of plastic in order to provide the necessary elasticity for processing the surface.

In fact, a brush band can be used, for example, which makes use of a fabric (made of polyamide) in combination with a polyurethane coating. After its manufacture and fitting with the bristles, the brush band in question is formed into a ring by coupling its ends together, for example by connecting them with clips. The brush band thus formed into a ring is then in turn held in the brush holder, so that the brush holder, which is rotated by the drive, simultaneously rotates the brush ring mechanically coupled to it, enabling the bristles to abrade the surface of the workpiece as desired.

Due to the fact that the bristles define oblique attachment lines on the surface of the brush body along its width in the axis, the bristles do not impact the surface of the workpiece in a row next to each other, but rather impact the surface in question one after the other due to the oblique position. If the brush assembly is then moved back and forth over the surface either manually or mechanically, the surface profile with a randomized direction of the bristles generated in this way is automatically created. The randomization of the direction of the bristles is achieved by the fact that the Brush assembly is moved back and forth over the surface either manually or mechanically. If the brush assembly is then moved back and forth over the surface either manually or mechanically, the surface profile with a randomized direction of the craters created in this way is automatically established. This means that, in contrast to the state of the art, no particular preferred directions are observed in the formation of craters. This is where the main advantages lie..

The invention is described in more detail below with reference to a drawing that is merely an example of one embodiment. Therein:

FIG. 1 is a schematic perspective overview of the brush assembly according to the invention in conjunction with a rotary brush tool,

FIG. 2 is an exploded view of the assembly according to FIG. 1 in an exploded view with its individual parts,

FIG. 3 is a side view of the brush holder, and

FIG. 4A, 4B, 4C show the brush band with the U-shaped bristles anchored therein schematically in three exemplary variants..

FIG. 1 shows a rotary brush tool equipped with a machine housing 1 and a drive 2 for a brush assembly 3, which is only indicated and accommodated therein. The brush assembly 3 has a brush ring 4, 5, that, according to this embodiment and without limitation, consists of an annular brush body 4 designed as a brush belt 4 and bristles 5 connected

thereto and projecting radially outward. The bristles 5 projecting radially outward thus define an annular bristle array 8..

Furthermore, it can also be seen that the bristles 5 extend radially relative to a direction of rotation or rotation axis 6 of the brush body 4 or its axis 6, which in this embodiment coincides with the rotation axis 6 of a brush holder 10, 11 to be described in more detail below. It can be seen that the bristles 5 as a whole define the annular bristle array 8 with gaps 9. The brush ring 4, 5 is carried by the brush holder 10, 11, which is rotated by the drive 2. In addition, the brush ring 4, 5 is mechanically coupled to the brush holder 10, 11. The brush ring 4, 5 can be replaced if necessary..

The exploded view in FIG. 2 shows that, in this embodiment and without limitation, the brush holder 10, 11 comprises two end plates 10 held in a spaced position relative to each other by a spacer bushing 11. The spacer bushing 11 is also dispensable in this context. A comparison of the preassembled state of the brush band 4 realized at this point according to the illustration in FIG. 3 and FIG. 4A, 4B, and 4C with the assembled state in FIG. 2 shows that the brush band 4 in the assembled state according to FIG. 2 is accommodated when formed into a ring in the brush holder 10, 11. For this purpose, the respective ends 4a and 4b of the rectangular brush band 4, which can be seen in FIG. 3, are coupled to each other. This can be done by an inserted clip or in some other way..

According to the invention and as shown in FIGS. 1, 2, and 3, the bristles 5 are arrayed along the axis 6 of the brush body 4 or the ring-shaped brush band 4, which coincides with the rotation axis 6 additionally indicated in FIG. 3, oriented such that rows of the bristles 5 extend at an angle to the axis 6 of the brush body 4 along its width, as shown in FIG. 3. It should be noted that the two end plates 10 are equipped with axial webs 12 that extend through the brush ring 4, 5

or the brush band 4 in the area of the gaps 9. This forms the rows of bristles 5 that are inclined in the axis 6 or transverse direction of the rectangular brush band 4. The brush holder 10, 11 is driven by a drive pin 13 that is rotated by the drive 2 of the rotary brush tool. The drive pin 13 runs along the axis of rotation or axis 6..

In any case, the special design of the invention is such that the bristles 5 shown in FIG. 3 are arranged along the axis 6 of the brush body or the brush band 4 along its width, i.e., in its transverse direction, and define respective oblique attachment lines 14. As a result, the brush ring 4, 5 is mechanically coupled to the brush holder 10, 11..

For this purpose, the bristles 5 are arranged so that they define the inclined attachment lines 14 on the surface of the brush band 4, which each enclose an acute angle α with the axis 6 of the brush band 6 in its ring shape accommodated in the brush holder 10, 11. It can be seen that, according to this embodiment, the individual attachment lines 14 are arranged equidistantly across the surface of the brush band 4 and, moreover, each form an equal acute angle α with the axis 6 of the brush band 4. In fact, the acute angle α in this embodiment has values between 5° and 45°. In most cases, values between 5° and 10° are observed to be particularly favorable..

As already explained, the bristles 5 each extend radially relative to the rotation axis 6 of the brush holder 10, 11 and thus of the brush band 4 in the installed state, i.e., in the ring shape defined in this way. The bristles 5 can themselves be U-shaped and made of metal, for example steel, as can be seen by comparing FIGS. 4 and 3. For this purpose, the U-shaped bristles 5 are each inserted into the mounting holes in the brush band 4, which can be seen in the enlarged view in FIG. 3. With the aid of their respective U-bases 5a, the U-shaped

bristles 5 define the respective attachment lines 14, as can be seen from FIG. 4..

For this purpose, the design shown in FIG. 4A is such that the respective U-bases 5a of the bristles 5 are largely aligned in the axis 6 of the brush body or brush band 4 and run along the attachment lines 14 (cf. FIG. 3). In each case, a lateral offset A can be observed between the individual bristles 5 along the attachment lines 14, which is of equal size according to this embodiment. This means that the U-shaped bristles 5 are spaced equally along the respective attachment lines 14 and offset from each other..

In the variant according to FIG. 4B, the U-bases 5a of the bristles 5 run along and on these attachment lines 14 and consequently at an angle to the axis 6. In the variant according to FIG. 4C, the bristles 5 or their U-bases 5a extend largely perpendicular to the axis 6 and again along the attachment lines 14. As described, the U-bases 5a each define the attachment lines 14 and are arranged with offset A relative to each other or at a constant spacing A relative to each other according to the example shown in each case..

To machine the surface of a workpiece W, which is only indicated in FIG. 2, an exemplary contact pressure of 10 N or even less is used. Finally, an additional stop 15 can be seen, which is engaged in the rotating annular bristle array 8 and is only shown in FIG. 1. The stop 15 ensures that the bristles 5 are slowed down in their rotational movement for a certain period of time. As a result, after the stop 15 releases the bristles 5, the kinetic energy stored in this way can be used by the bristles 5 to additionally impact the surface of the workpiece W. It can be seen that the stop 15 is designed to be rod-shaped or cylindrical in the illustration in FIG. 1. In principle, the stopping means 15 can also have a noncircular cross-section, as is additionally and supplementarily indicated in FIG. 1..

Patent claims:

1. A brush assembly (3) comprising a brush holder (10, 11) rotatable about an axis (6) and a brush ring (4, 5) mechanically coupled or couplable to the brush holder (10, 11), consisting essentially of a brush body (4) and bristles (5) connected thereto, forming an annular bristle array (8) and projecting radially outward, the bristles (5) extending at an angle to the axis of rotation (6) of the brush holder (10, 11), characterized in that the bristles (5) are arrayed widthwise and along the axis (6) on a surface of the brush body (4) in oblique attachment lines (14).

2. The brush assembly (3) according to claim 1, characterized in that an axis (6) of the brush body (4) and the axis of rotation (6) of the brush holder (10, 11) are coaxial..

3. The brush assembly (3) according to claim 1 or 2, characterized in that the brush body (4) is designed as an elongated brush band formed into an annulus and held in the brush holder (10, 11)..

4. The brush assembly (3) according to claim 3, characterized in that the attachment lines (14) formed by the bristles (5) on the surface (14) are inclined at an acute angle (α) with the axis (6) of the annular brush band (4) in the brush holder (10, 11)..

5. The brush assembly (3) according to claim 4, characterized in that the oblique attachment lines (14) of the bristles (5) on the surface of the brush band (4) each form an acute angle (a) of equal size with the axis (6).

6. The brush assembly (3) according to claim 4 or 5, characterized in that the acute angle (a) is between 5° and 45°, preferably between 5° and 10°..

7. The brush assembly (3) according to one of claims 1 to 6, characterized in that the bristles (5) each extend radially relative to the axis of rotation (6) of the brush holder (10, 11).

8. The brush assembly (3) according to one of claims 1 to 7, characterized in that the bristles (5) are U-shaped and made of metal, for example steel and/or plastic.

9. The brush assembly (3) according to claim 8, characterized in that the U-shaped bristles (5) are inserted into holes in the brush body (4) and define the attachment lines (14) with their respective U-bases (5a).

10. The brush assembly (3) according to claim 9, characterized in that the respective U-bases (5a) of the bristles (5) are largely aligned in the axis (6) of the brush body (4) and/or perpendicular thereto and run along the attachment lines (14).

11. The brush assembly (3) according to claim 10, characterized in that the U-shaped bristles (5) are arranged at equal spacings (spacing A) along the respective attachment lines (14) offset from each other.

12. The brush assembly (3) according to one of claims 1 to 11, characterized in that a stop (15) is additionally provided and is engaged in the rotating annular bristle array (8).13. A rotary brush

tool comprising a machine housing (1), a drive (2) and a brush assembly (3), characterized in that the brush assembly (3) is designed according to one of claims 1 to 12.

14. A method of machining a surface of a workpiece (W) using a brush assembly (3) according to one of claims 1 to 12, characterized in that bristles (5) arrayed on fastening lines (4) extending obliquely to the axis (6) of the brush body (4) produce a surface profile with a randomized array of craters.