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(71) Applicant *(for all designated States except US)*: **VOOR-WOOD COMPANY** [US/US]; 2350 Barney Street, Anderson, CA 96007 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **HAWKINS, James, H.** [US/US]; 19 La Colina Terrace, Anderson, CA 96007 (US).

(74) Agent: **O'BANION, John, P.**; O'Banion & Ritchey LLP, 400 Capitol Mall, Suite 1550, Sacramento, CA 95821 (US).

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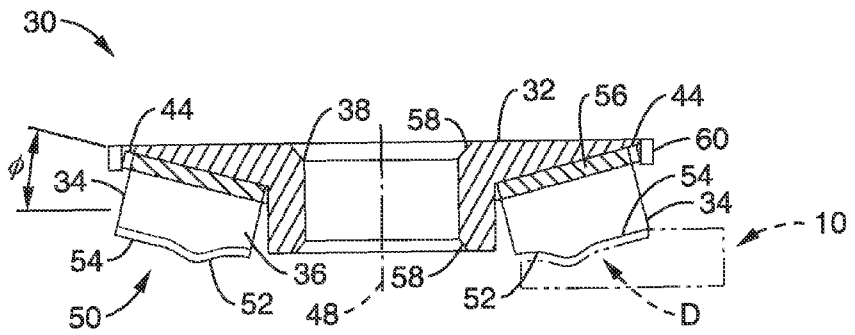


FIG. 4

(57) Abstract: A flap sander is disclosed for use with a workpiece having a nonlinear profile. The flap sander comprises a cylindrical rotary head including a central hub concentric with an axis of rotation of the rotary head, and an inclined surface extending radially outward from the central hub. A plurality of abrasive flaps are detachably secured to the inclined surface of the rotary head and are aligned in a radial array radiating outward from central hub to the periphery of the rotary head. Each of the abrasive flaps comprises an unsecured working edge having a nonlinear profile that substantially matches the profile of the workpiece to provide an even sanding distribution across the workpiece profile independent of the shape of the profile.

ABRASIVE FLAP WHEEL WITH CUSTOM PROFILES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from U.S. provisional application serial number 61/035,676, filed on March 11, 2008, incorporated herein by reference in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC

[0003] Not Applicable

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BACKGROUND OF THE INVENTION

1. Field of the Invention

[0005] This invention pertains generally to sanding apparatus, and more particularly to a flap sanding apparatus.

2. Description of Related Art

[0006] Flap wheel sanding has been used in a number of different applications and on many different types of substrates. In the wood working industry, flap sanding is used widely in sanding and finishing the surface of various shapes, such as turned columns and spindles, curved/uneven furniture parts etc. The flap sander, by design, is very flexible allowing it to easily conform to various shaped surfaces.

[0007] FIGS. 1 and 2 illustrate a prior art flap sander applied to typical cross sections 10 and 20 of a raised panel door for a kitchen cabinet, and outside edge profile of a door. The flap sander 12 generally comprises of a rotary head that retains and positions individual strips 14 of mineral abrasive, commonly called sand paper, that is attached to a flexible carrier or backing. The abrasive strips extend in a radial manner and are generally evenly spaced around the circumference of the head. The strips generally comprise a plurality of slits 16 that allow the straight linear working edge 18 of the sander to conform to the varying profile of the surface to be treated.

[0008] By design, existing flap sanders are not specific to any particular shape and can adapt to many different shapes. The advantage of the flexibility is lost, however, in its ability to uniformly finish a specific shaped area in that the finished results can be too aggressive on protruding areas of a surface (e.g. locations A and B in FIGS. 1and 2) too light in recessed areas of a surface.

[0009] Accordingly, an object of the present invention is a flap sander that provides even sanding across a specific non-liner profile work surface.

BRIEF SUMMARY OF THE INVENTION

[0010] An aspect of the invention is a sanding apparatus for use with a workpiece to be finished, the workpiece having a substantially nonlinear profile. The apparatus includes a plurality of abrasive flaps secured to a rotary head. The abrasive flaps are generally aligned in a radial array radiating outward from an axis of rotation of the rotary head. Each of the abrasive flaps comprises an unsecured working edge having a nonlinear profile that substantially matches the profile of the workpiece.

[0011] In one embodiment of the current aspect, a plurality of support members are secured to the rotary head, each support member being positioned radially adjacent and parallel to a corresponding abrasive flap and comprising an unsecured end substantially matching the working end of the abrasive flap.

[0012] In a preferred embodiment, the working edge of the flap is uninterrupted across the length of the flap, i.e. slits in the flap are not required for the flap to conform to the profile of the workpiece. Accordingly, the working edge of the flap is configured to evenly distribute pressure across the length of the workpiece profile.

[0013] In another preferred embodiment, the abrasive flaps are releasably mounted to the rotary head for ease of replacement with a new flap (e.g. non-worn) or different flap having a different profile to work on a different workpiece. In one mode, each abrasive flap slideably engages a radial slot in the rotary head.

[0014] In another embodiment, the working edge profile comprises a first segment having a first path and a second segment having a second path different from the first path. Any number of segments and different paths may make up the profile. The segments may have curves of differing curvilinear or linear shapes or having different slopes to correspond to features of the workpiece profile.

[0015] Another aspect is a flap sander for use with a workpiece to be finished, said workpiece having a substantially nonlinear profile. The sander has a cylindrical rotary head comprising a central hub concentric with an axis of oration of the rotary head, and an inclined surface extending radially outward from the central hub. A plurality of abrasive flaps are secured to the inclined surface of the rotary head, and aligned in a radial array radiating outward from central hub to the periphery of the rotary head. Each of the abrasive flaps comprises an unsecured working edge having a nonlinear profile that substantially matches the profile of the workpiece.

[0016] In one embodiment, the inclined surface forms a conical surface radiating outward from the central hub, and the hub extends as a cylinder a specified length beyond the conical surface.

[0017] Another aspect is a method of sanding a workpiece, comprising: providing a rotary head having a plurality of abrasive flaps having an unsecured working edge with a nonlinear profile that substantially matches the profile of the workpiece; positioning a rotary head adjacent the workpiece such that at least one of the abrasive flaps substantially lines up with the workpiece profile; and rotating the rotary head to sand the profile with substantially even pressure across the profile.

[0018] In one embodiment of the current aspect, the plurality of abrasive flaps are aligned in a radial array radiating outward from an axis of rotation of the rotary head along with a plurality of support members secured to the rotary head; wherein each support member is positioned radially adjacent and parallel to a corresponding abrasive flap; and wherein each support member comprises an unsecured end substantially matching the working end of the abrasive flap to support the abrasive flap as the flap is applied to the workpiece.

[0019] In another embodiment, the unsecured end of the abrasive flap curves over the support member when applied to the workpiece to form a curvilinear sanding work surface in contact with the workpiece.

[0020] Further aspects of the invention will be brought out in the following portions of the specification, wherein the detailed description is for the purpose of fully disclosing preferred embodiments of the invention without placing limitations thereon.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0021] The invention will be more fully understood by reference to the following drawings which are for illustrative purposes only:

[0022] FIG. 1 is sectional view of a prior art flap sander applied to a raised panel door profile.

[0023] FIG. 2 is sectional view of a prior art flap sander applied to an edge profile.

[0024] FIG. 3 is a plan view of the flap sander of the present invention.

[0025] FIG. 4 is a sectional view of the flap sander shown in FIG. 3, shown adjacent to a raised panel door profile.

[0026] FIG. 5 is a sectional view of an alternative embodiment of the flap sander of the present invention, shown adjacent to a door edge profile.

DETAILED DESCRIPTION OF THE INVENTION

[0027] Referring more specifically to the drawings, for illustrative purposes the present invention is embodied in the apparatus generally shown in FIG. 3 through FIG. 5. It will be appreciated that the apparatus may vary as to configuration and as to details of the parts, and that the method may vary as to the specific steps and sequence, without departing from the basic concepts as disclosed herein.

[0028] FIG. 3 illustrates a plan view of the underside of flap sander rotary head 30 of the present invention. The flap sander 30 comprises a head body 32 having a plurality of abrasive flaps 34 radially disposed generally perpendicular to the lower angled surface of the head body 32.

[0029] Referring to the sectional view of FIG. 4, the abrasive flaps are coupled to a flexible backing or carrier 56 that slides into on of a plurality of radially oriented slots 44 in the rotary head body 32. In a preferred embodiment, the abrasive flap 34 and carrier 56 may be interchangeably disposed in slot 44 by placing the carrier 56 at the outside circumference 42 of the head body 32 and slideably translating the carrier 56 and flap 34 radially inward along the slot 44 until the carrier 56 is fully retained within the slot. A retaining ring 60 may then be placed around outer periphery 42 to retain the flaps 34 in place.

[0030] The slot 44 and carrier 56 may comprise a dovetail configuration that retains the carrier 56 and flap 34 retained in the head body 32 even in the presence of a tensile load place on the flap 34.

[0031] Adjacent to one side of each abrasive flap 34 is a support member 36 that provides lateral support for the flaps 34 while the sander is treating a

surface. The support member 36 generally comprises a compliant, resilient material that increases the lateral stiffness of the abrasive flap 34 in the direction of the sanding force. Support member 36 may comprise a variety of different materials, such as a brush, foam, extruded polymer, or the like.

[0032] The support member 36 trails each of the abrasive flaps 34 in the direction of the sander (as shown in FIG. 3, the rotation of the head is clockwise). As shown in FIG. 4, the support member 36 follows the profile of the flap 34, but does not extend outward as far as the flap 34. This allows the flap 34 to bend and form a rounded working surface around the support member 36 when applied to the surface to be treated.

[0033] The embodiment of FIG. 3 shows a series of 16 abrasive flaps 34 and support members 36 disposed radially within 16 slots 44. However, it is appreciated that any number of slots 44 or flaps 34 may be used (e.g. 8 or 24 slots). The sander 30 may also be run with some of the slots 44 empty (e.g. abrasive flaps only positioned in every other slot 44).

[0034] Referring to FIG. 4, the head body 32 comprises a central hub 40 with a large diameter bore 38 for retaining a rotary shaft and collet (not shown). The central hub is substantially coincident with the axis of rotation 48 of the head body 32. The bore 38 may also have a conical taper 58 to facilitate attachment to the rotary shaft. The additional rotational mass at the center of the head body 32 provides stability at high speeds.

[0035] The bottom surface of the head body 32 may be sloped at angle θ with respect to the hub axis, i.e. comprise a conical shape, to conform to the desired work surface. The slope of the conical surface, defined by angle Θ in FIG. 4, may vary from 0^o to 90^o, and is generally fixed with each head body 32 (e.g. a kit of head bodies may be provided with varying increments (e.g. 5 degree increments) from 0^o to $90^{o)}$.

[0036] As seen in FIG. 4, the edge profile 50 matches, or substantially matches, the profile D of the cross-section 10 to be treated. Generally, edge profile 50 comprises a nonlinear edge having a first section or feature 52 having a path with a different slope or curve than a second profile feature 54.

The support element 36 preferably follows the profile 50 (at a lesser extension from the head body 32) of the flap 34 so as to provide support for the flap 34 conforming to the treatment surface D. As shown in FIG. 4, the first part 52 of profile 50 curves concavely radially inward, and second part 54 curves concavely radially outward. The edge profile 50 may be varied to form any number of edge shapes having segments that are curved or at varying angles with respect to each other to substantially match the profile to be sanding. In this configuration, the abrasive flap 34 sands evenly across the profile 10 without putting undue pressure or abrasion on any particular section.

[0037] For purposes of this description, a "nonlinear path" is a path that does not follow a straight line across the length of the flap profile 50 as a whole. While first and second sections 52, 54 are shown as curvilinear paths, it is appreciated that one, or both, of the paths of sections 52, 54 may comprise a linear path. For example, the paths of sections 52, 54 may each be straight lines that are at different slopes with respect to each other, thus creating a nonlinear profile across the length of the flap profile50. It is also appreciated that any number of differently shaped sections may be used to generate a profile.

[0038] While it is appreciated that the features of the present invention are particularly advantageous for use on work pieces having nonlinear profiles, it is also appreciated that the rotary head 32 may be used with flaps that have a linear profile to match the shape of a planar work surface to be treated.

[0039] FIG. 5 shows an additional embodiment of flap sander 70 having a larger working angle φ, and abrasive flaps 74 having an edge profile 90 shaped to match the sectional profile of a door's outside edge. Support element 76 sharing a similar profile may also be positioned adjacent each flap 74.

[0040] In this configuration, the carriers 86 holding abrasive flaps 74 are installed from a radially inward location adjacent to central bore 78, and translated radially outward along slot 84 until the carrier 86 is fully seated within the slot 84. Cap 96 may then be installed over the bottom chamfered

portion 80 of bore 78 to retain the flaps 74 in place.

[0041] As seen in FIG. 5, the profile 90 of the abrasive flap 74 is generally nonlinear and substantially matched to the profile E of the door edge cross-section 20. The profile in this case has a concave curve 92 radially inward and adjacent to convex curve 94. This edge profile provides an even abrasive distribution across the surface of the area to be treated.

[0042] It is appreciated that while two different edge profiles are detailed above, the edge profile of the abrasive flaps of the present invention may be modified to substantially match any number of different surface features. In addition, it is appreciated that various feature of each of the embodiments listed above may be interchangeably combined.

[0043] Although the description above contains many details, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. Therefore, it will be appreciated that the scope of the present invention fully encompasses other embodiments which may become obvious to those skilled in the art, and that the scope of the present invention is accordingly to be limited by nothing other than the appended claims, in which reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." All structural, chemical, and functional equivalents to the elements of the above-described preferred embodiment that are known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the present claims. Moreover, it is not necessary for a device or method to address each and every problem sought to be solved by the present invention, for it to be encompassed by the present claims. Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. 112, sixth paragraph, unless the element is expressly recited using the phrase "means for."

CLAIMS

What is claimed is:

1. A sanding apparatus for use with a workpiece to be finished, said workpiece having a substantially nonlinear profile, comprising:

a rotary head;

a plurality of abrasive flaps secured to the rotary head;

wherein the plurality of abrasive flaps are aligned in a radial array radiating outward from an axis of rotation of the rotary head;

wherein each of the plurality of abrasive flaps comprises an unsecured working edge;

wherein the working edge comprises a nonlinear profile that substantially matches the profile of the workpiece.

2. An apparatus as recited in claim 1, further comprising:

a plurality of support members secured to the rotary head;

wherein each support member is positioned radially adjacent and parallel to a corresponding abrasive flap;

wherein each support member comprises an unsecured end substantially matching the working end of the abrasive flap.

3. An apparatus as recited in claim 1, wherein the working edge of the flap is uninterrupted across the length of the flap.

4. An apparatus as recited in claim 3, wherein the working edge of the flap is configured to evenly distribute pressure across the length of the workpiece profile.

5. An apparatus as recited in claim 1, wherein the abrasive flaps are releasably mounted to the rotary head.

6. An apparatus as recited in claim 5, wherein each abrasive flap slideably engages a radial slot in the rotary head.

7. An apparatus as recited in claim 1, wherein:

the working edge profile comprises a first segment having a first path and a second segment having a second path; and

wherein the path of the first segment is different from the path of the second segment.

8. An apparatus as recited in claim 7, wherein one or more of the first and second paths is curvilinear.

9. An apparatus as recited in claim 7, wherein the path of the first segment has a different slope from the path of the second segment.

10. An apparatus as recited in claim 7, wherein the paths of the first and second segments correspond to features of the workpiece profile.

11. A flap sander for use with a workpiece to be finished, said workpiece having a substantially nonlinear profile, comprising:

a cylindrical rotary head;

the rotary head comprising a central hub concentric with an axis of rotation of the rotary head, and an inclined surface extending radially outward from the central hub.

a plurality of abrasive flaps secured to the inclined surface of the rotary head;

wherein the plurality of abrasive flaps are aligned in a radial array radiating outward from central hub to the periphery of the rotary head;

wherein each of the plurality of abrasive flaps comprises an unsecured working edge;

wherein the working edge comprises a nonlinear profile that substantially matches the profile of the workpiece.

12. A flap sander as recited in claim 11, further comprising:

a plurality of support members secured to the rotary head;

wherein each support member is positioned radially adjacent and parallel to a corresponding abrasive flap;

wherein each support member comprises an unsecured end substantially matching the working end of the abrasive flap.

13. A flap sander as recited in claim 11, wherein the working edge of the flap is uninterrupted across the length of the flap.

14. A flap sander as recited in claim 13, wherein the working edge of the flap is configured to evenly distribute pressure across the length of the workpiece profile.

15. A flap sander as recited in claim 11, wherein the abrasive flaps are releasably mounted to the rotary head.

16. A flap sander as recited in claim 15, wherein each abrasive flap slideably engages a radial aligned slot in the rotary head.

17. A flap sander as recited in claim 11, wherein:

the working edge profile comprises a first segment having a first path and a second segment having a second path; and

wherein the path of the first segment is different from the path of the second segment.

18. A flap sander as recited in claim 17, wherein one or more of the first and second paths is curvilinear.

19. A flap sander as recited in claim 17, wherein the path of the first segment has a different slope from the path of the second segment.

20. A flap sander as recited in claim 17, wherein the paths of the first and second segments correspond to features of the workpiece profile.

21. A flap sander as recited in claim 17:

wherein the inclined surface forms a conical surface radiating outward from the central hub; and

wherein the hub extends in a cylinder a specified length beyond the conical surface.

22. A method of sanding a workpiece, comprising:

providing a rotary head having a plurality of abrasive flaps;

wherein each of the plurality of abrasive flaps comprises an unsecured working edge;

wherein the working edge comprises a nonlinear profile that substantially matches the profile of the workpiece;

positioning a rotary head adjacent the workpiece such that at least one of the abrasive flaps substantially lines up with the workpiece profile; and

rotating the rotary head to sand the profile with substantially even pressure across the profile.

23. A method as recited in claim 22:

wherein the plurality of abrasive flaps are aligned in a radial array radiating outward from an axis of rotation of the rotary head;

wherein a plurality of support members secured to the rotary head;

wherein each support member is positioned radially adjacent and parallel to a corresponding abrasive flap;

wherein each support member comprises an unsecured end substantially matching the working end of the abrasive flap to support the abrasive flap as the flap is applied to the workpiece.

24. A method as recited in claim 23, wherein the unsecured end of the abrasive flap curves over the support member when applied to the workpiece to form a curvilinear sanding work surface in contact with the workpiece.

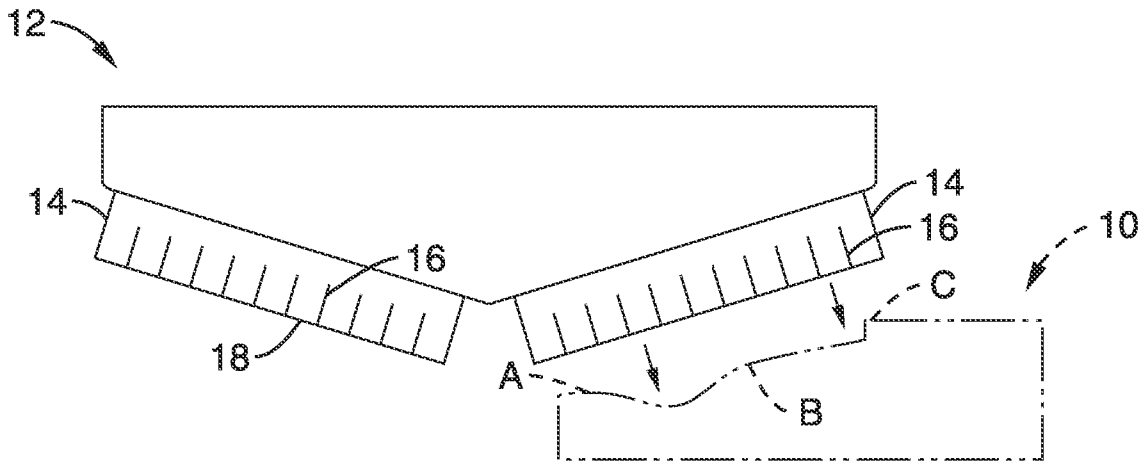


FIG. 1
(Prior Art)

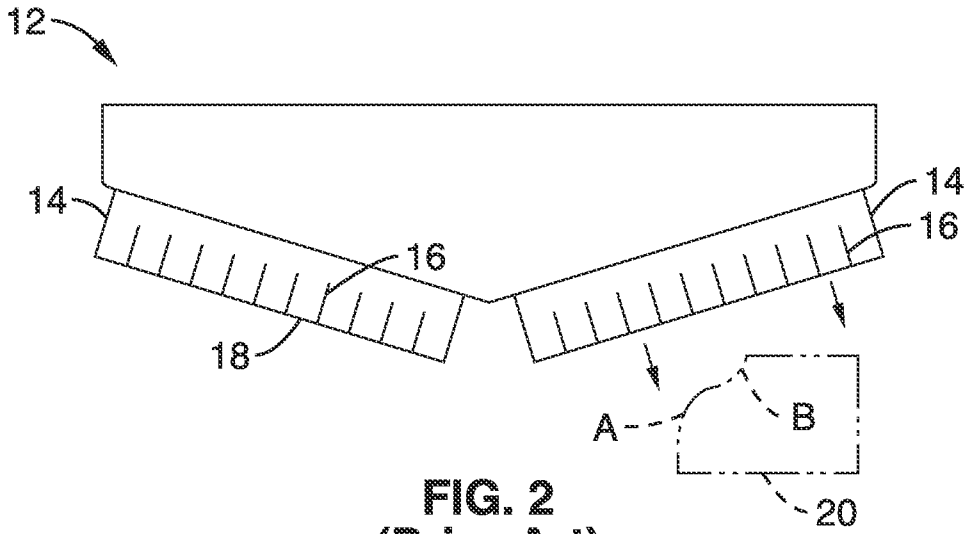


FIG. 2
(Prior Art)

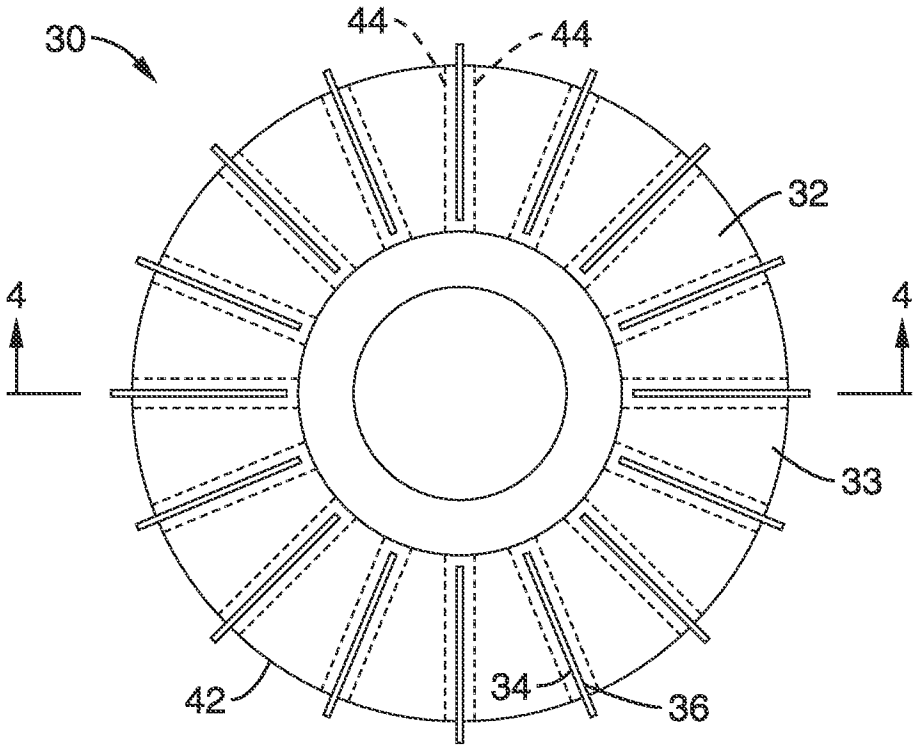

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FIG. 3

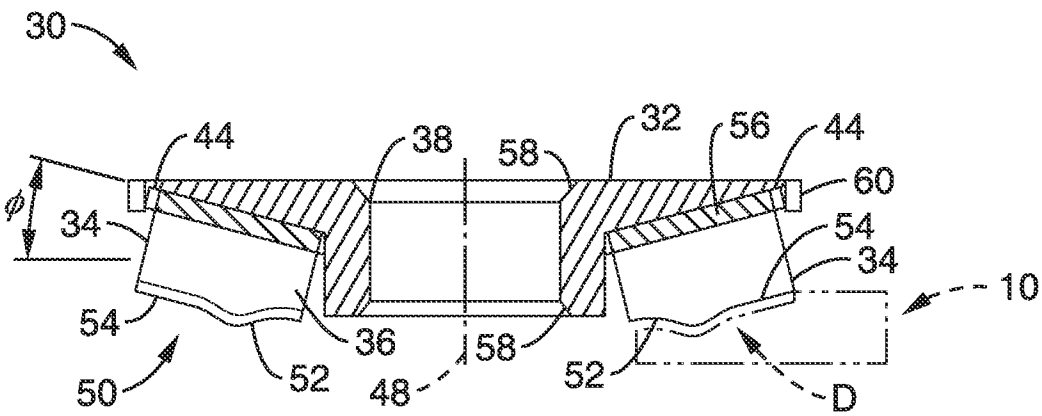

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FIG. 4

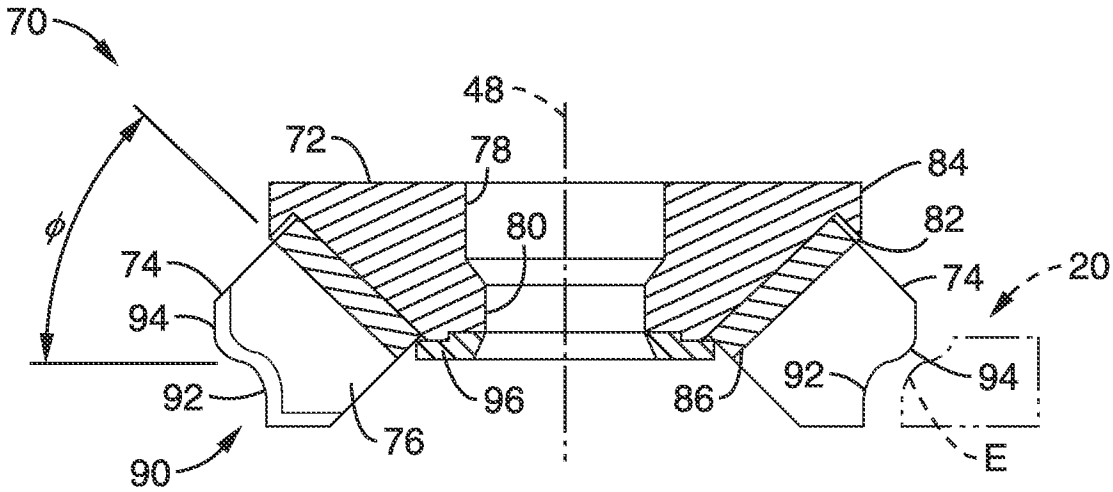


FIG. 5