

(12) STANDARD PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 2002363312 B2**

(54) Title
A paint roller

(51) International Patent Classification(s)
B05C 17/025 (2006.01) **B05C 17/02** (2006.01)

(21) Application No: **2002363312** (22) Date of Filing: **2002.10.15**

(87) WIPO No: **WO03/039762**

(30) Priority Data

| (31) Number | (32) Date | (33) Country |
|-------------------|-------------------|--------------|
| 10/234,921 | 2002.09.04 | US |
| 10/040,652 | 2001.10.19 | US |

(43) Publication Date: **2003.05.19**

(43) Publication Journal Date: **2003.07.24**

(44) Accepted Journal Date: **2007.02.01**

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(56) Related Art
US 5795279 (SHIEH)
US 6098240 (TAYLOR)

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



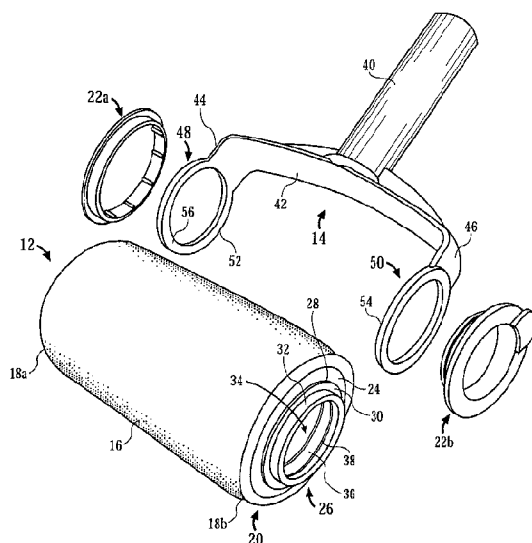
(43) International Publication Date
15 May 2003 (15.05.2003)

PCT

(10) International Publication Number
WO 03/039762 A1

- (51) International Patent Classification⁷: B05C 17/025
- (21) International Application Number: PCT/SG02/00236
- (22) International Filing Date: 15 October 2002 (15.10.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
10/040,652 19 October 2001 (19.10.2001) US
10/234,921 4 September 2002 (04.09.2002) US
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- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:**
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A PAINT ROLLER



(57) Abstract: A paint roller (10) has a paint applicator (12), two holder mounts and an applicator holder (14). The paint applicator (12) has a cylindrical outer surface (16) and two opposite ends (18a, 18b). The two holder mounts, respectively associated with the two opposite ends (18a, 18b), each has a base surface (24). A journal (26) and one or more holder abutments protrude from the base surface (24) in a direction away from the paint applicator (12). The applicator holder (14) has a handle (40) and a fork (42) having opposite sides (44, 46). Each of the opposite sides (44, 46) has a journal engagement portion (52, 54). Other embodiments are also described for the paint roller (10).



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A PAINT ROLLER

Field of the Invention

5 [0001] The present invention relates to apparatus for applying fluids over surfaces. In particular, the present invention relates to a paint roller for storing and applying paint.

Background of the Invention

10 [0002] Paint rollers for applying paint onto surfaces are known. Typically, such paint rollers have paint-absorbing surfaces that are dipped into paint containers and then rolled over surfaces that are to be painted. For example, US Patent No. 6,098,240, issued to Taylor, describes a roller paint applicator with a cylindrical body and that is secured to an applicator holder for rotation around a spindle using an end cap. However, rotation of the paint roller
15 described in US Patent No. 6,098,240 is a problem when excessive force is applied to the applicator holder. Such a force can dent the paint applicator towards the spindle and undesirably restrict rotation of the spindle.

20 [0003] Another type of paint roller is described in US Patent No. 6,098,240 in which internal storage or container space is provided to store paint. The paint is then transferred from the internal storage or container space through permeable members onto surfaces. An example of such an improvement to paint rollers is disclosed in US Patent No. 3,588,264, issued to Mallindine and that describes a container-type paint roller with a roller assembly. The
25 roller assembly is rolled along a surface by means of a forked handle that is coupled to journals of end-closure members disposed at opposite ends of the roller assembly.

30 [0004] However, rotation of the roller assembly of US Patent No. 3,588,264 can be a problem as the end-closure members contacts the entire surface of

sides of the forked handle. Consequently, frictional resistance between the sides and the end-closure members impedes the rotation of the roller assembly to some extent. Furthermore, any unevenness of the surface of the end closure members also impedes the rotation. Such unevenness is difficult
5 to avoid or eliminate in mass production of the end-closure members or the forked handle.

[0005] Therefore, a need clearly exists for a container-type paint roller that enables easier rotation of a paint applicator by reducing frictional resistance
10 between rotating elements. Such a container-type paint roller should have covers that secure tightly to the paint applicator or an applicator holder without, or at least alleviating, undesired dislodging of such covers during use.

15 **Brief Summary of the Invention**

[0006] The present invention seeks to provide a paint roller having a paint applicator and two holder mounts respectively associated with two opposite ends of the paint applicator, and an applicator holder for the paint roller.

20 [0007] Accordingly, in one aspect, the present invention provides a paint roller comprising:

a paint applicator having a cylindrical outer surface and two opposite ends; and

two holder mounts, respectively associated with the two opposite
25 ends, each of the holder mounts having:

a base surface;

a journal, protruding from the base surface in a direction away from the paint applicator;

and

30 one or more holder abutments, protruding from the base surface in the direction.

[0008] In another aspect, the present invention provides a paint roller comprising:

- 5 a paint applicator having a cylindrical outer surface and two opposite ends;
- two holder mounts, respectively associated with the two opposite ends, each of the holder mounts having:
 - a base surface;
 - and
 - 10 a journal, protruding from the base surface in a direction away from the paint applicator;
- and
- an applicator holder having:
 - 15 a handle;
 - and
 - a fork having opposite sides, each of the opposite sides having:
 - 20 a journal engagement portion;
 - and
 - a plurality of applicator abutments, protruding from a surface of the journal engagement portion in a direction towards the paint applicator.

[0009] In a further aspect, the present invention provides an applicator holder for a paint roller with at least one journal, the applicator holder comprising:

- 25 a handle;
- and
- a fork having opposite sides, each of the opposite sides having:
 - 30 a journal engagement portion;
 - and
 - a plurality of applicator abutments, protruding from a

surface of the journal engagement portion in a direction towards the at least one journal.

Brief Description of the Drawings

5 **[0010]** A preferred embodiment and alternate embodiments of the present invention are described, by way of example, with reference to the drawings of which:

10 **[0011]** FIG. 1 is a perspective view of a paint roller having a paint applicator and an applicator holder in accordance with the preferred embodiment of the invention;

[0012] FIG. 2 is an exploded view of the paint roller of FIG. 1;

15 **[0013]** FIG. 3 is a side view of a holder mount associated with one end of the paint applicator of FIG. 1;

[0014] FIG. 4 is a side view of a cover for one end of the paint applicator of FIG. 1;

20 **[0015]** FIG. 5 is a plan view of a holder mount in accordance with one alternate embodiment of the invention;

[0016] FIG. 6 is a side view of an end portion of the holder mount of FIG. 5;

25 **[0017]** FIG. 7 is an exploded view of the paint roller of FIG. 1 in accordance with another alternate embodiment of the invention;

30 **[0018]** FIG. 8 is a plan view of a holder mount associated with one end of a paint applicator of the paint roller of FIG. 7;

[0019] FIG. 9 is a side view of the holder mount of FIG. 8;

[0020] FIG. 10 is an exploded view of the paint roller of FIG. 1 in accordance with yet another alternate embodiment of the invention;

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[0021] FIG. 11 is a side view of a holder mount associated with one end of a paint applicator of the paint roller of FIG. 10;

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[0022] FIG. 12 is a plan view of a journal engagement portion of an applicator holder for the paint roller of FIG. 10; and

[0023] FIG. 13 is a side view of the journal engagement portion of FIG. 12.

Detailed Description of the Drawings

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[0024] A paint roller having a paint applicator and two holder mounts for coupling to an applicator holder in accordance with a preferred embodiment and alternate embodiments of the invention are described. In the following description, details are provided to describe these embodiments. However, it shall be apparent to one skilled in the art that the invention may be practiced without such details. Some of these details may not be described at length so as not to obscure the invention.

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[0025] There are many advantages of the embodiments of the invention. One advantage of the embodiments is that frictional resistance between abutting surfaces of the holder mounts and the applicator holder is reduced. Consequently, the embodiments enable a more effective rotation of the paint applicator when held by the applicator holder during use of the paint roller.

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[0026] Another advantage of the embodiments of the invention is that ridges of a cover and of one of the holder mounts enable a tight capping of the holder mount. These ridges are formed on an inner wall of a channel or on an

internal wall of a cylindrical protrusion forming the channel. Consequently, paint is stored more securely within the paint applicator without, or at least alleviating, accidental spills due to dislodging of the cover during use of the paint roller.

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[0027] Referring now to FIG. 1, a perspective view of a paint roller 10 in accordance with the preferred embodiment of the invention is illustrated. The paint roller 10 comprises a paint applicator 12 and an applicator holder 14 for holding the paint applicator 12. The paint applicator 12 has a cylindrical outer surface 16 and two opposite ends 18a,18b. The paint applicator 12 is preferably made of a paint absorbent material such as, for example, foam or sponge.

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[0028] The paint roller 10 further comprises two holder mounts, respectively associated with the two opposite ends 18a,18b. A holder mount 20, associated with the opposite end 18b, is shown in the exploded view of the paint roller 10 in FIG. 2. Also shown in FIG. 2 are two covers 22a,22b for respectively capping the two holder mounts.

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[0029] The holder mount 20 has a base surface 24 and comprises a journal 26 that protrudes from the base surface 24 in a direction away from the paint applicator 12. The journal 26 comprises a holder abutment 28 having a planar abutment surface 30. The journal 26 further comprises a cylindrical protrusion 32 forming a channel 34 through which paint is channeled for storage within, or for removal from, a chamber (not shown) of the paint applicator 12. In the preferred embodiment of the invention, the holder abutment 28 forms a ring surrounding the cylindrical protrusion 32. An inner wall 36 of the channel 34 has a circumferential ridge 38. For the journal 26, the planar abutment surface 30 has a total area that is smaller than an axial cross-section of the holder mount 20.

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[0030] The applicator holder 14 has a handle 40 and a fork 42 having opposite sides 44,46. Each of the opposite sides 44,46 has, respectively, a journal engagement portion 48,50. Each of the journal engagement portions 48,50 comprises, respectively, a loop 52,54. The loop 54 couples to the cylindrical protrusion 32 at the opposite end 18b, and the loop 52 couples to a cylindrical protrusion (not shown) at the opposite end 18a, to enable rotation of the paint applicator 12 during use. In coupling to the cylindrical protrusion 32, each loop 52,54 encircles the cylindrical protrusion 32 at each of the opposite ends 18a,18b.

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[0031] The loop 54 has a mount abutment surface (not shown) with an area larger than the total area of the planar abutment surface 30. The mount abutment surface for the loop 54 is similar to a mount abutment surface 56 for the loop 52. Hence, contact area between the planar abutment surface 30 and the mount abutment surface of the loop 54 is, at most, the area of the planar abutment surface 30. Consequently, only frictional resistance of respective contact areas, and not the entire area of the mount abutment surfaces of the loops 52,54, impedes rotation of the paint applicator 12 when held by the applicator holder 14.

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[0032] FIG. 3 is a side view of the holder mount 20 showing position of the holder abutment 28 for the journal 26 relative to the base surface 24. The planar abutment surface 30 is substantially aligned on a common plane 60. In the preferred embodiment, the common plane 60 is planarly parallel to a base plane 62 of the base surface 24 and spaced apart from the base plane 62 by the thickness of the holder abutment 28.

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[0033] Referring now to FIG. 4, a side view of the cover 22b for capping the holder mount 20 is illustrated. The cover 22b comprises a cylindrical portion 64 having two perimeter ridges 66,68 and a flange 70. The flange 70 extends beyond a perimeter 72 of the cylindrical portion 64. The cover 22b further

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comprises a flange extension 74 to enable removal of the cover 22b to thereby replenish paint within, or empty paint from, the chamber of the paint applicator 12.

5 **[0034]** The two perimeter ridges 66,68 are engageable with the circumferential ridge 38 of the inner wall 36 to enable a tight capping of the holder mount 20 by the cover 22b. Specifically, the diameter of the cylindrical portion 64 is made slightly larger than the diameter of the channel 34 to provide a secure fitting. This secure fitting is enhanced by engagement
10 between the perimeter ridges 66,68 and the circumferential ridge 38 when capping the holder mount 20. Hence, a force applied to cap the cover 22b onto the holder mount 20 has to overcome abutting of the cylindrical portion 64 and the inner wall 36 of the channel 34 as well as abutting of the perimeter ridges 66,68 and the circumferential ridge 38.

15 **[0035]** FIG. 5 is plan view of a holder mount 100 in accordance with the alternate embodiment of the invention. In the holder mount 100, a journal 102 comprises a cylindrical protrusion 104 extending from a base surface 106 of the holder mount 100 and one or more holder abutments 108. The cylindrical
20 protrusion 104 forms a channel 110 through which paint is channeled for storage within or removal from the paint applicator 12. FIG. 5 also shows the area of the mount abutment surface of the loop 54 in dotted outline.

25 **[0036]** The holder abutment 108 corresponds to a plurality of arc-shaped members. FIG. 5 shows four arc-shaped members 108a,108b,108c,108d disposed around the cylindrical protrusion 104. Each of the four arc-shaped members 108a,108b,108c,108d has a planar abutment surface 112a,112b,112c,112d. As illustrated, the mount abutment surface of the loop 54 has an area larger than total area of the planar abutment surfaces
30 112a,112b,112c,112d. Also, the total area of the planar abutment surfaces

112a,112b,112c,112d is smaller than an axial cross-section of the holder mount 100.

5 [0037] In FIG. 6, a side view of an end portion of the holder mount 100 from a direction indicated by an arrow 114 shows the planar abutment surfaces 112a,112b,112d of, respectively, the arc-shaped members 108a,108b,108d. The planar abutment surfaces 112a,112b,112d are substantially aligned to each other on a common plane 116. Although not shown, the planar abutment surface 112c is also similarly aligned. In this alternate embodiment, the
10 common plane 116 is planarly parallel to a base plane 118 of the base surface 106 and spaced apart from the base plane 118 by the thickness of the four arc-shaped members 108a,108b,108c,108d.

15 [0038] Referring now to FIG. 7, an exploded view of the paint roller of FIG. 1 in accordance with another alternate embodiment of the invention is shown. In this alternate embodiment, a holder mount 200 has a base surface 224 and comprises a journal 226 that protrudes from the base surface 224 in a direction 228 away from the paint applicator 12. The holder mount 200 comprises a plurality of holder abutments 230 that protrudes from the base
20 surface 224 in the direction 228.

25 [0039] The journal 226 comprises a cylindrical protrusion 232 forming a channel 234 through which paint is channeled for storage within, or for removal from, a chamber (not shown) of the paint applicator 12. In this alternate embodiment of the invention, the plurality of holder abutments 230 surrounds the cylindrical protrusion 232. The cylindrical protrusion 232 has an internal wall 236 with a channel ridge 238 formed thereat. In coupling to the cylindrical protrusion 232, each of the loops 52,54 encircles the cylindrical protrusion 232 at each of the opposite ends 18a,18b.
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[0040] Each of the loops 52,54 has a mount abutment surface. A mount abutment surface 56 for the loop 52 is indicated. The mount abutment surface (not shown) for the loop 54 is similar to the mount abutment surface 56 for the loop 52.

5

[0041] The cover 22b in this alternate embodiment comprises a wall engagement portion 260 for engaging the internal wall 236. The wall engagement portion 260 has a cover ridge 262 for coating with the channel ridge 238. The cover 22b further comprises a flange 264 extending beyond a perimeter of the wall engagement portion 260 and a flange extension 266. The flange extension 266 enables removal of the cover 22b to thereby replenish paint within, or empty paint from, the chamber of the paint applicator 12 via the channel 234.

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[0042] The remaining journal (not shown) that is associated with the holder mount at the opposite end 18a does not have a channel. However, this remaining journal can be modified to have such a channel as the journal 226. Consequently, the cover 22a caps the journal (not shown) at the opposite end 18a to retain the loop 52 to the mount holder (not shown).

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[0043] Coaction between the cover ridge 262 and the channel ridge 238 provides a snap fit that serves as an audible indication that the cover 22b has properly covered the opening of the channel 234. The coaction also enables a tight capping of the holder mount 200 by the cover 22b. Specifically, the diameter of the wall engagement portion 260 is made slightly larger than the diameter of the channel 234 to provide a secure fitting when capping the holder mount 200 with the cover 22b. Hence, a force applied to cap the cover 22b onto the holder mount 200 has to overcome abutting of the wall engagement portion 260 and the channel 234 as well as abutting of the cover ridge 262 and the channel ridge 238.

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[0044] FIG. 8 is a plan view of the holder mount 200 associated with the opposite end 18b of the paint applicator 16 and looking into the channel 234 in a direction 268.

5 [0045] FIG. 9 is a side view of the holder mount 200 showing position of the plurality of holder abutments 230 relative to the base surface 224 and the cylindrical protrusion 232. The plurality of holder abutments 230 is substantially aligned to provide an abutment plane 270. In the preferred embodiment, the abutment plane 270 is planarly parallel to a base plane 272
10 provided by the base surface 224 and spaced apart from the base plane 272 by the thickness of the holder abutments 230.

[0046] As the mount abutment surfaces of the loops 52,54 only contact
15 specific surface areas of the plurality of holder abutments 230 providing the abutment plane 270, frictional resistance between the holder mounts at both ends 18a,18b and the loops 52,54 is reduced. Consequently, rotation of the paint applicator 12 when held by the applicator holder 14 is easier compared with existing container-type paint rollers.

20 [0047] In the alternate embodiment as shown in FIG. 7, FIG. 8 and FIG. 9, each of the plurality of holder abutments 230 is hemispherical. However, it is to be noted that other shapes are also possible for the plurality of holder abutments 230 to reduce contact areas and, hence, reduce frictional resistance between the two holder mounts of the paint roller 10 and the loops 52,54. For
25 example, each of the plurality of holder abutments 230 can have a flat surface that, collectively, are substantially aligned along the flat surface relative to each other to thereby provide the abutment plane 270. Otherwise, in the absence of the plurality of holder abutments 230, there would be full surface contact between the base surface 224 and the mount abutment surfaces of the
30 loops 52,54, which results in more frictional resistance.

[0048] Referring now to FIG. 10, an exploded view of the paint roller 10 in accordance with yet another alternate embodiment of the invention is shown. For this alternate embodiment, the paint roller 10 comprises two holder mounts at each of the two opposite ends 18a,18b of the paint applicator 12. As shown in FIG. 10, a holder mount 300 for the end 18b comprises a base surface 302 and a journal 304.

[0049] As in the preferred embodiment, the journal 304 comprises a cylindrical protrusion 306 that extends from the base surface 302 and forms a channel 308 through which paint is channeled for storage within the paint applicator 12 or removal therefrom. The cylindrical protrusion 306 has an internal wall 310 with a channel ridge 312 formed thereat.

[0050] An applicator holder 314 for the alternate embodiment of the paint roller 10 has a handle 316 and a fork 318 having opposite sides 320,322. Each of the opposite sides 320,322 has, respectively, a journal engagement portion 324,326. Each of the journal engagement portions 324,326 comprises, respectively, a loop 328,330. The loop 330 couples to the cylindrical protrusion 306 at the opposite end 18b, and the loop 328 couples to a cylindrical protrusion (not shown) at the opposite end 18a, to enable rotation of the paint applicator 12 during use.

[0051] Each of the journal engagement portions 324,326 has a mount abutment surface. A mount abutment surface 332 for the loop 328 is indicated. Protruding out from the mount abutment surface 332 in a direction towards the paint applicator 12 is a plurality of applicator abutments 334. The mount abutment surface (not shown) for the loop 330 also has a plurality of applicator abutments (not shown).

[0052] The two covers 22a,22b for this alternate embodiment function similarly as in the preferred embodiment. Hence, in the alternate

embodiment, respective features of each of these two covers 22a,22b coast with respective features of the mount holders of this alternate embodiment.

5 [0053] FIG. 11 is a side view of the holder mount 300 in which a holder abutment plane 336 formed by the base surface 302 is indicated.

[0054] FIG. 12 is a plan view of the journal engagement portion 326 and indicating relative disposition of the plurality of applicator abutments 334 on the mount abutment surface 332. FIG. 13 is a side view of the journal
10 engagement portion 326 showing the plurality of applicator abutments 334 being substantially aligned to provide an abutment plane 328.

[0055] The base surfaces 302 of the holder mounts only contact the plurality of applicator abutments 334 that provides the abutment plane 328. Thus,
15 frictional resistance between the holder mounts at both ends 18a,18b of the paint applicator 12 and the loops 328,330 is reduced. Consequently, rotation of the paint applicator 12 when held by the applicator holder 314 is easier compared with existing container-type paint rollers.

20 [0056] In the alternate embodiment as shown in FIG. 10, FIG. 12 and FIG. 13, each of the plurality of applicator abutments 334 is hemispherical. However, as with the preferred embodiment, other shapes of the applicator abutments 334 are also possible to reduce contact areas with the base surface 302 of each of the two holder mounts. For example, each of the plurality of
25 applicator abutments 334 can have a flat surface that, collectively, are substantially aligned along the flat surface relative to each other to thereby provide the abutment plane 328. The plurality of applicator abutments 334 therefore reduces contact with the base surface of each of the two holder mounts and thereby reduces contact frictional resistance thereat.

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5 [0057] The present invention therefore provides the paint roller 10 having a paint applicator 12 and two holder mounts that are respectively associated with two opposite ends 18a,18b of the paint applicator 12, and the applicator holders 14,314 for the paint roller 10 to overcome, or at least alleviate, the problems of the prior art.

10 [0058] While the present invention has been described in detail for the above embodiments with reference to FIGs. 1 to 13, it should be understood that FIGs. 1 to 13 are illustrative of the embodiments without limiting the invention. Accordingly, persons skilled in the art can make various modifications and improvements without departing from the spirit and the scope of the present invention.

THE CLAIMS DEFINING THE INVENTIONS ARE AS FOLLOWS:

1. A paint roller comprising:
 - a paint applicator having a cylindrical outer surface and two opposite ends and two holder mounts, respectively associated with said two opposite ends, each of said holder mounts having:
 - a base surface;
 - a journal, protruding from said base surface in a direction away from said paint applicator; and
 - one or more holder abutments, protruding from said base surface in said direction.
2. The paint roller as claimed in Claim 1, wherein each of said one or more holder abutments has a planar abutment surface substantially aligned on a common plane.
3. The paint roller as claimed in Claim 2, wherein total area of said planar abutment surface for each of said journal is smaller than an axial cross-section of each of said holder mounts.
4. The paint roller as claimed in Claim 1, wherein said one or more holder abutments is substantially aligned to provide an abutment plane.
5. The paint roller as claimed in Claim 1, wherein said journal further comprises a cylindrical protrusion.
6. The paint roller as claimed in Claim 5, wherein said one or more holder abutments surrounds said cylindrical protrusion.

7. The paint roller as claimed in Claim 5, wherein said one or more holder abutments forms a plurality of arc-shaped members disposed around said cylindrical protrusion.
8. The paint roller as claimed in Claim 5, wherein said cylindrical protrusion forms a channel with an inner wall having at least one circumferential ridge.
9. The paint roller as claimed in Claim 5, wherein said cylindrical protrusion of at least one of said journal forms a channel, said cylindrical protrusion having an internal wall with at least one channel ridge formed thereat.
10. The paint roller as claimed in Claim 8 or 9, and further comprising at least one cover for capping at least one of said holder mounts and having a wall engagement portion for engaging said inner wall or said internal wall.
11. The paint roller as claimed in Claim 10, wherein said wall engagement portion comprises at least one cover ridge for co-acting with said at least one circumferential ridge or said at least one channel ridge.
12. The paint roller as claimed in Claim 10, wherein said at least one cover comprises a cylindrical portion having at least one perimeter ridge.
13. The paint roller as claimed in Claim 1, and further comprising an applicator holder having:
 - a handle; and

a fork having opposite sides, each of said opposite sides having a journal engagement portion.

14. The paint roller as claimed in Claim 13, wherein said journal engagement portion comprises a loop for coupling to said journal.
15. The paint roller as claimed in Claim 14, wherein said loop comprises a mount abutment surface for abutting said one or more holder abutments.
16. The paint roller as claimed in Claim 15, wherein said mount abutment surface has an area smaller than an axial cross-section of each of said holder mounts.
17. A paint roller comprising:
 - a paint applicator having a cylindrical outer surface and two opposite ends;
 - two holder mounts, respectively associated with said two opposite ends, each of said holder mounts having:
 - a base surface; and
 - a journal, protruding from said base surface in a direction away from said paint applicator; and
 - an applicator holder having:
 - a handle; and
 - a fork having opposite sides, each of said opposite sides having:
 - a journal engagement portion; and
 - a plurality of applicator abutments, protruding from a surface of said journal engagement portion in a direction towards said paint applicator.

18. The paint roller as claimed in Claim 17, wherein said plurality of applicator abutments is substantially aligned to provide an abutment plane.
19. The paint roller as claimed in Claim 17, wherein said journal further comprises a cylindrical protrusion.
20. The paint roller as claimed in Claim 19, wherein said cylindrical protrusion of at least one of said journal forms a channel, said cylindrical protrusion having an internal wall with at least one channel ridge formed thereat.
21. The paint roller as claimed in Claim 20, and further comprising at least one cover, each of said at least one cover having a wall engagement portion for engaging said internal wall.
22. The paint roller as claimed in Claim 21, wherein said wall engagement portion comprises at least one cover ridge for coacting with said at least one channel ridge.
23. The paint roller as claimed in Claim 17, wherein said journal engagement portion comprises a loop for coupling to said journal.
24. The paint roller as claimed in Claim 1, further comprising an applicator holder, said applicator holder comprising:
 - a handle; and
 - a fork having opposite sides, each of said opposite sides having:
 - a journal engagement portion; and
 - a plurality of applicator abutments, protruding from a surface of said journal engagement portion in a direction towards said at least one journal.

25. The paint roller as claimed in Claim 24, wherein said plurality of applicator abutments is substantially aligned to provide an abutment plane.
26. The paint roller as claimed in Claim 25, wherein each of said plurality of applicator abutments comprises a flat surface, substantially aligned relative to each other, to thereby provide said abutment plane.
27. The paint roller as claimed in Claim 24, wherein each of said plurality of applicator abutments is hemispherical.
28. The paint roller as claimed in Claim 24, wherein said journal engagement portion comprises a loop for coupling to said at least one journal.

Dated this 10TH day of January 2007

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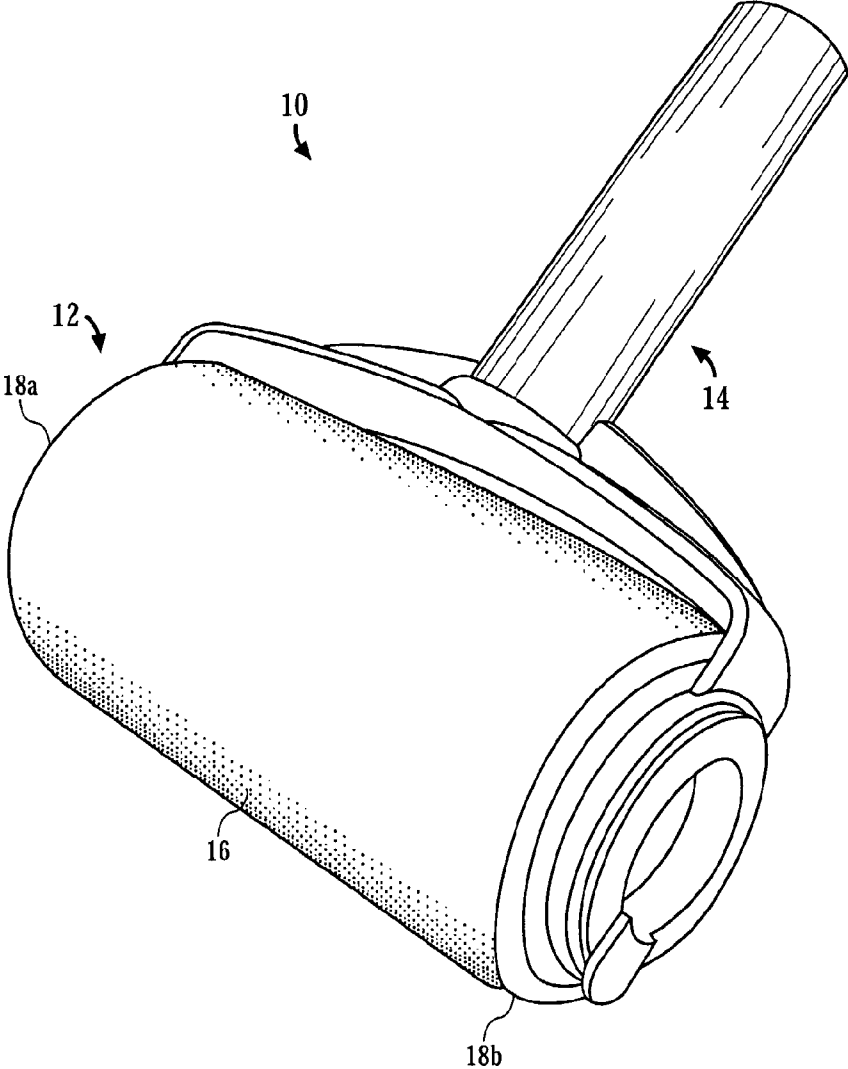


FIG. 1

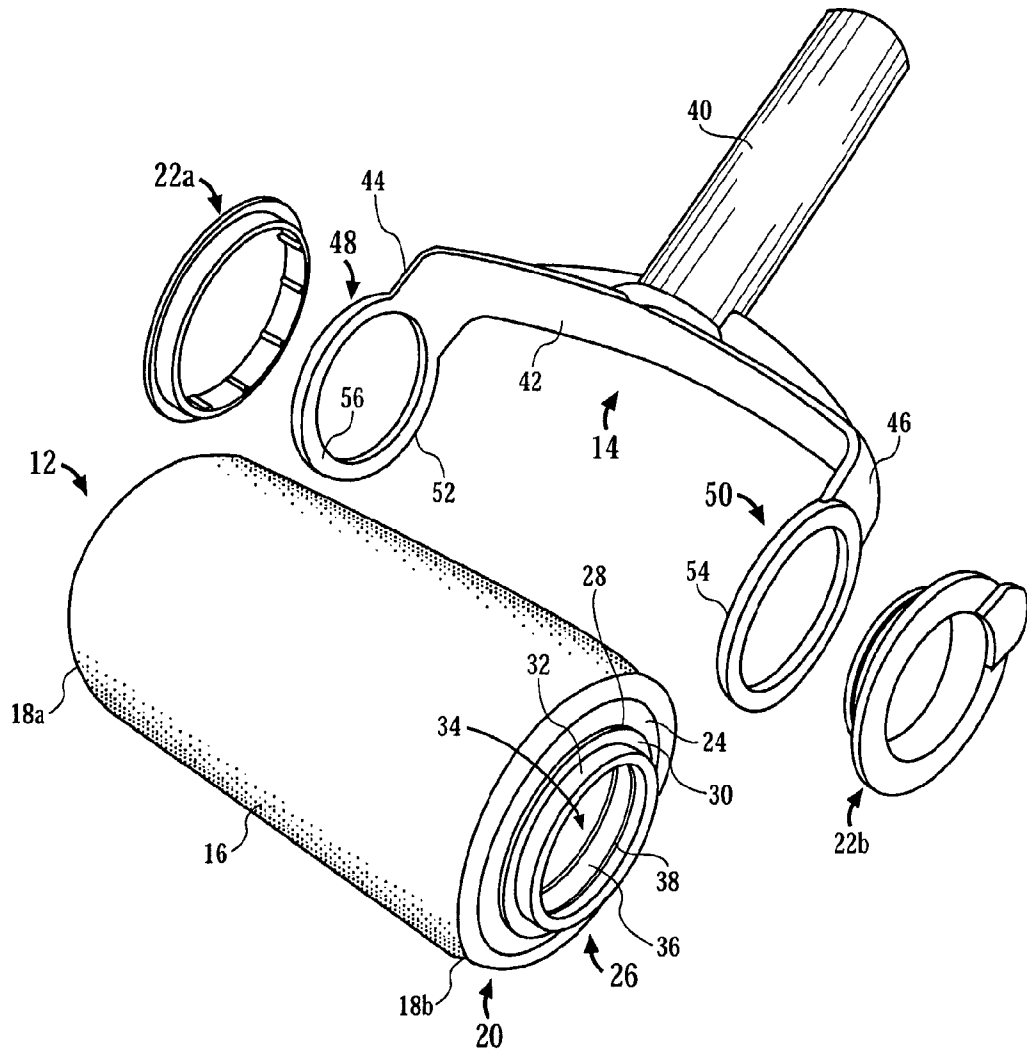


FIG. 2

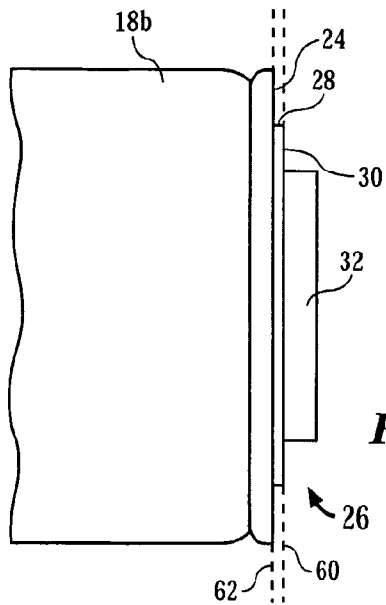


FIG. 3

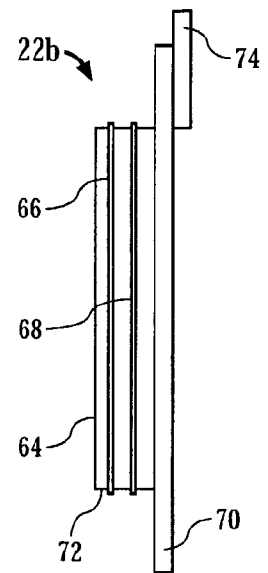


FIG. 4

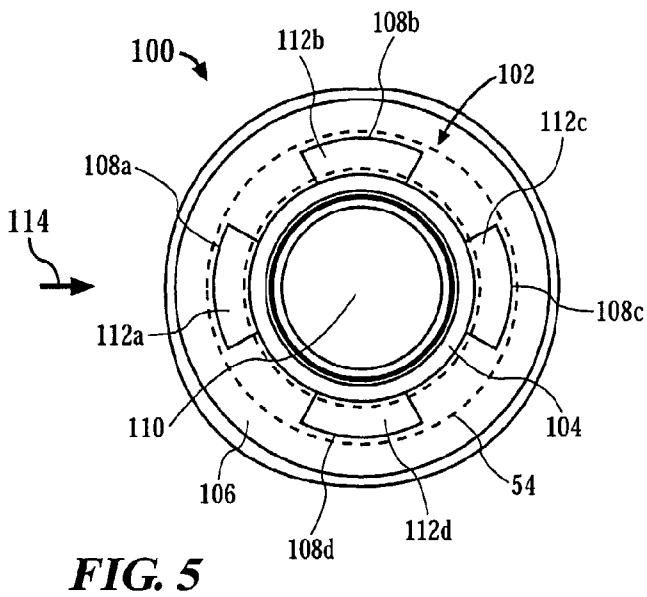


FIG. 5

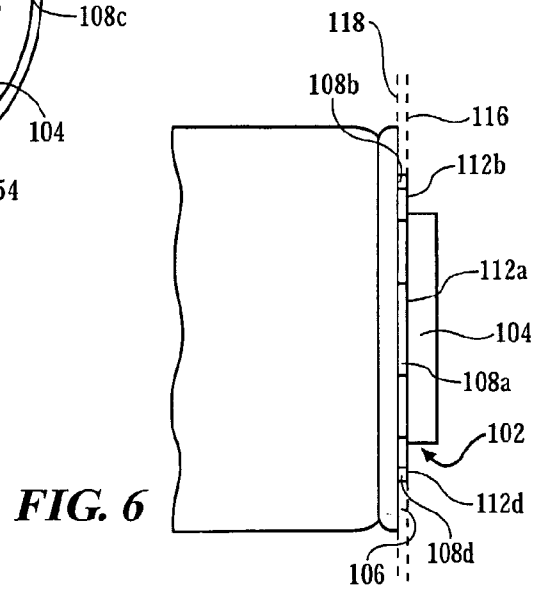


FIG. 6

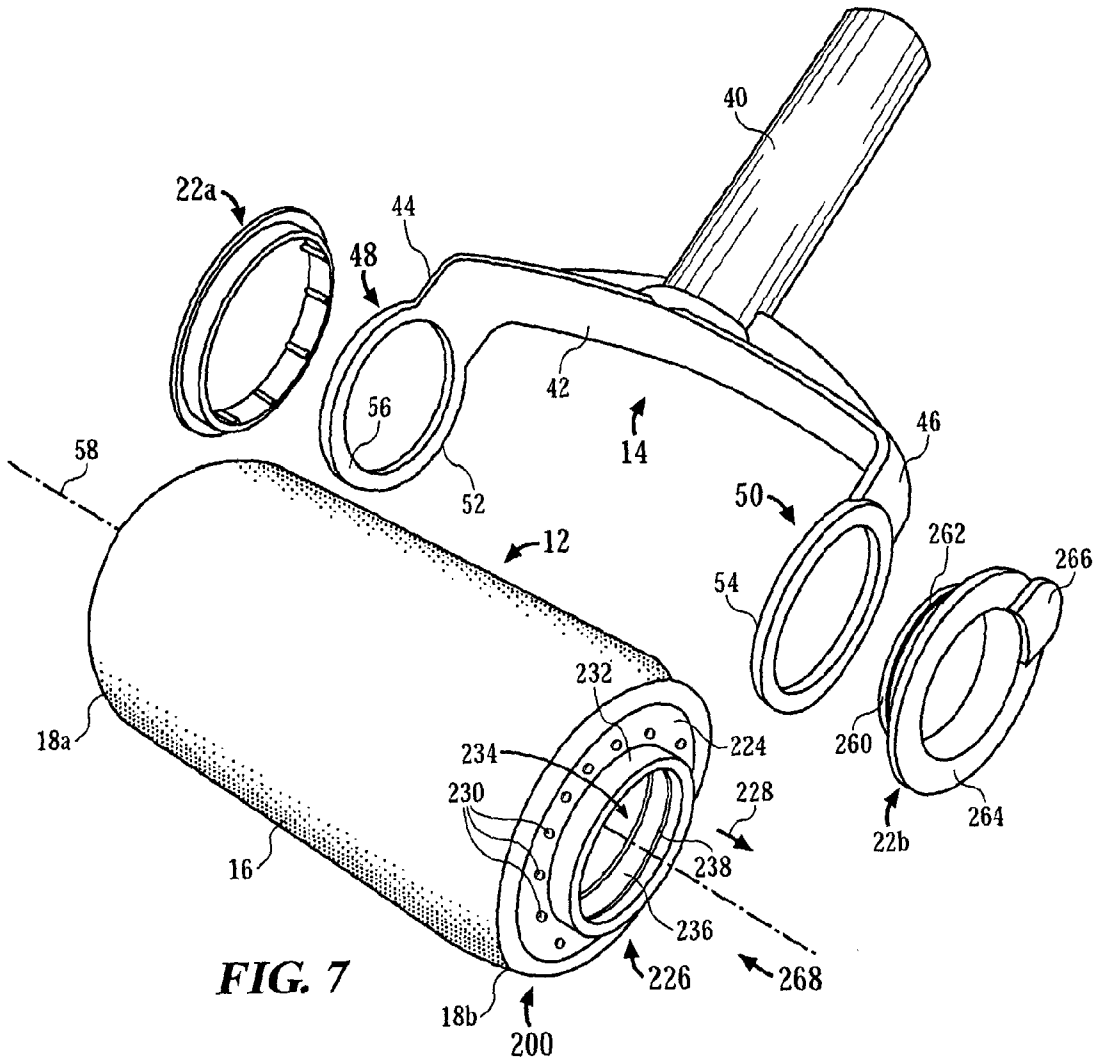


FIG. 7

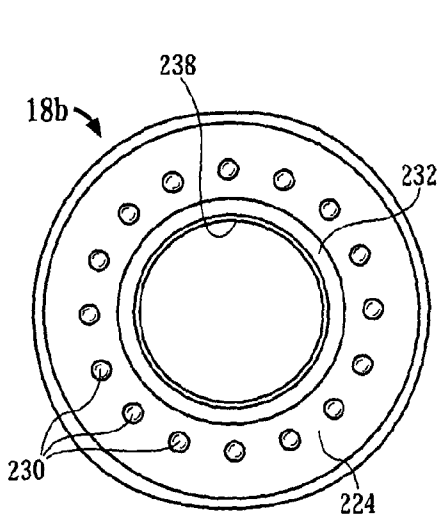


FIG. 8

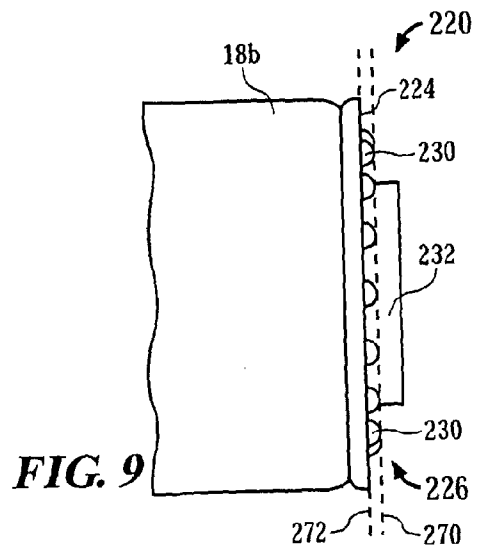


FIG. 9

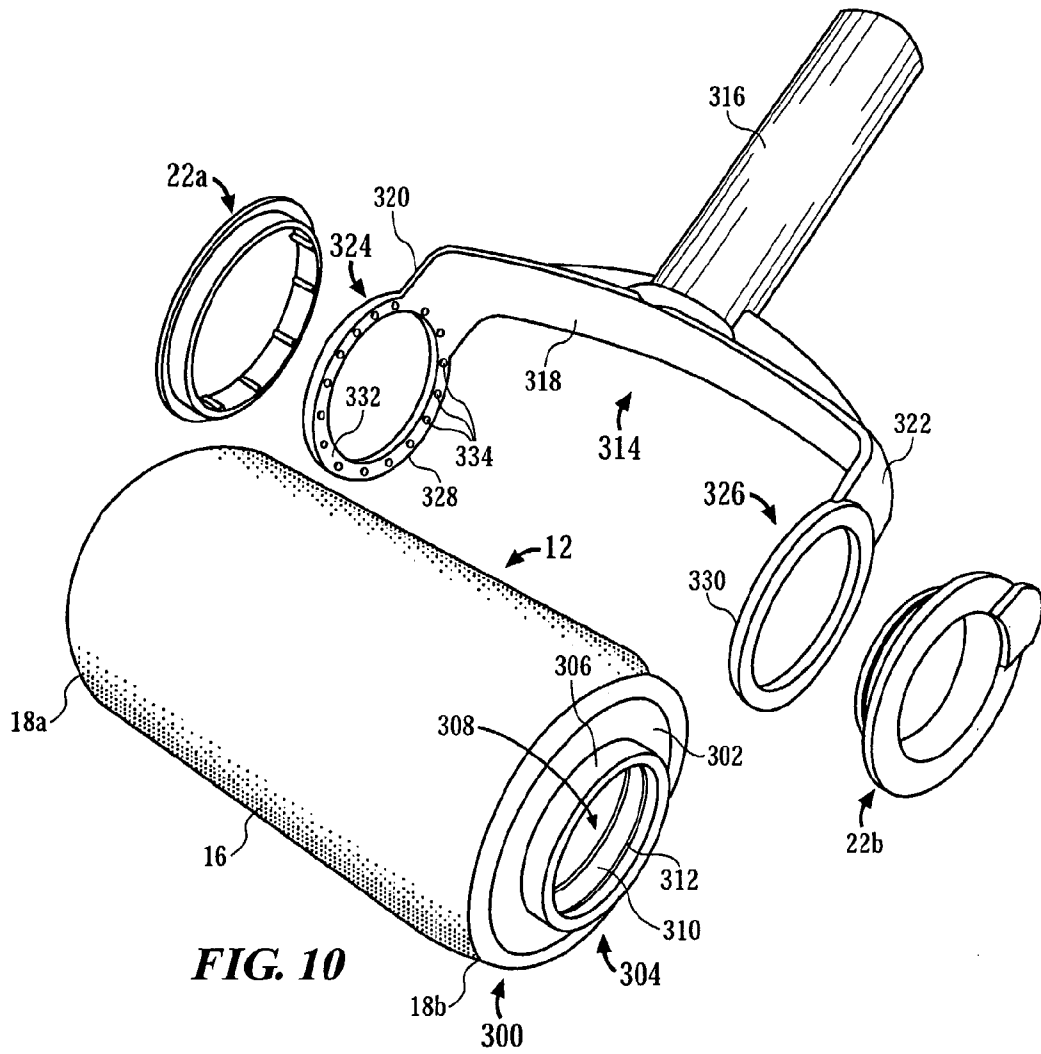


FIG. 10

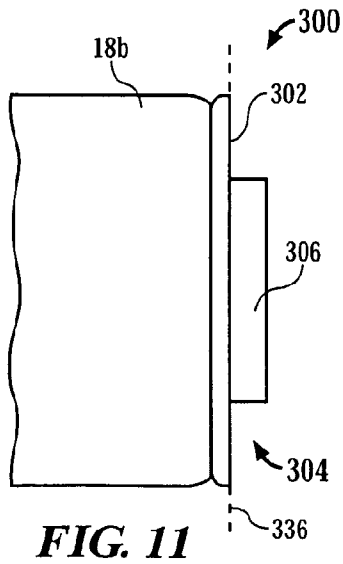


FIG. 11

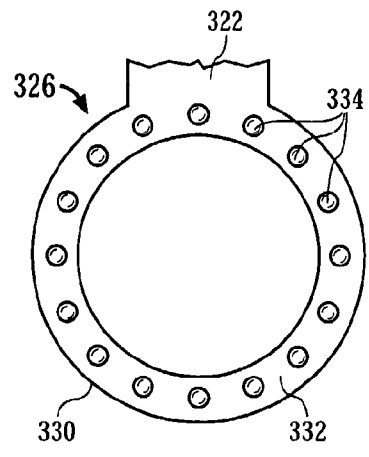


FIG. 12

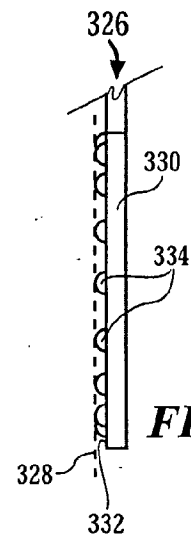


FIG. 13