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(54) Title: SAFETY RAZOR WITH FILAMENT GUARD

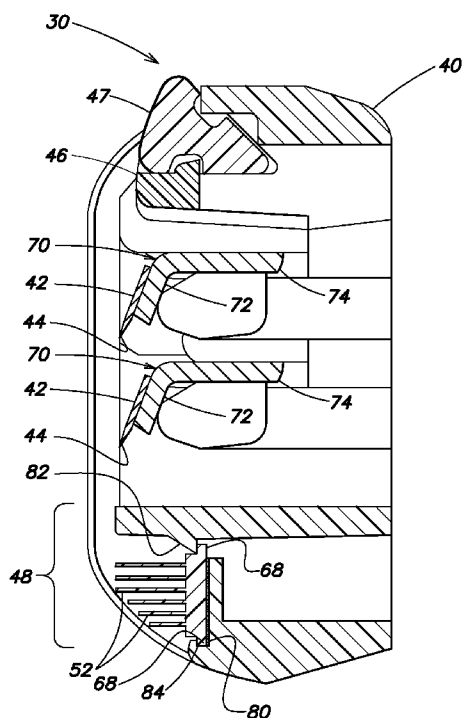


FIG. 8A

(57) Abstract: A razor cartridge (30) is provided with a skin engaging structure (50) at the cap and/or guard surface of the razor cartridge. The skin engaging structure has an array of closely spaced elongated protrusions (52) integrally formed with a substrate (54). In use, the protrusions produce a pleasant tactile sensation tending to reduce shaving discomfort. The protrusions are formed by closely packed molded flexible filaments that can be less than 0.25 mm wide and have spacing between adjacent protrusions less than 0.2 mm. The protrusions can have a density greater than 5 protrusions per mm<sup>2</sup>. The skin engaging structure can be molded from e.g. an olefin polymer. The substrate can be integrally formed with a housing (40) of the razor cartridge.

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## SAFETY RAZOR WITH FILAMENT GUARD

## CROSS REFERENCE TO RELATED APPLICATIONS:

This application claims the benefit of U.S. Provisional Patent Application serial  
5 number 60/918,744, filed March 19, 2007.

## BACKGROUND OF THE INVENTION

## TECHNICAL FIELD

10 This invention relates generally to shaving devices, and more specifically to razor  
cartridges having skin engaging structures that include molded filament-like protrusions.

## BACKGROUND INFORMATION

Many modern safety razors include a disposable razor cartridge adapted to be  
15 selectively connected to a reusable handle. The cartridge includes a housing having at least  
one razor blade with a sharpened cutting edge disposed therein. The housing includes a guard  
positioned to engage the user's skin in advance of the cutting edge of the blade, and a cap  
positioned aft of the cutting edge. The cartridge can be adapted for shaving in a single  
direction or multiple directions, most usually bi-directionally, ie in to and fro directions.  
20 Other modern safety razors include a razor cartridge permanently connected to the handle  
that can be disposed of as a single unit.

The present invention resides broadly in providing improved skin engaging guard  
and/or cap surfaces with structures that gently stretch the skin of the user to optimally erect  
the hair in advance of cutting edge(s). The structures can also provide a secondary function of  
25 promoting pleasant tactile sensations which tend to mask the sensations caused by contact of  
the blade edge(s) with the skin and more significantly with the hairs as they are severed.  
Many modern razor cartridges include guard structures that can have multiple rows of  
flexible thermoplastic elastomer (TPE) fins. These structures are disclosed in many  
publications including U. S. Patents number 5,191,712 to Crook et al. and number 7,043,840  
30 to Walker et al. and U.S. Patent application publication number 2005/0223568. Further  
structures comprising multiple generally non-fin-like TPE protrusions are disclosed in the  
'712 patent, above and U.S. Patents including number 6,298,557 to Gilder and number  
6,516,518 to Garraway et al. The TPE structures of the aforementioned publications that do  
not include straight or curved fins have protrusions that are relatively large, heights that are

relatively low, aspect ratios (ie height to base width ratio) that are relatively low and spacings between adjacent protrusions that are relatively large resulting in a comparatively low protrusion density expressed as protrusions per  $\text{mm}^2$  of substrate. Many of these disadvantages are caused by the known technical limits of the injection molding process employed, the known technical limits of the injection mold-making process employed and the known technical limits of the TPE materials employed especially in regard to the material completely filling the mold cavity and the molded form being ultimately removable from its mold cavity at the end of a molding cycle. The '712 patent in particular discloses an aspect ratio in the range of 2:1 to 5:1 and an inter-protrusion spacing between 0.6 mm and 1.5 mm for the TPE upstanding pillar protrusions described therein. Furthermore, typical TPE materials that can typically be employed in a guard structure are somewhat more expensive compared to commodity olefin polymers such as low density polyethylene (LDPE), high density polyethylene (HDPE) or polypropylene (PP). The environmental stability of many TPE materials, including their ability to withstand chemical attack from typical soaps and some other shaving preparations can also be generally inferior to PP and the PE derivatives noted above.

#### SUMMARY:

The present invention has for its objective to eliminate, or at least substantially alleviate the limitations of the prior art razor cartridge skin engaging structures. In accordance, the object of the present invention is to provide a skin engaging structure for a razor cartridge that comprises a plurality of filament-like protrusions integrally formed with a substrate. The protrusions can be molded from a suitable thermoplastic material that can not necessarily be a TPE. As a result of their length and width, the protrusions can have a similar or better flexibility than known TPE protrusions under forces applied when the razor cartridge is drawn along the user's skin in normal use. The skin engaging structure can impart enhanced shaving characteristics to its razor cartridge.

Embodiments of a razor cartridge of the present invention comprise a housing having at least one razor blade having a cutting edge disposed therein. The housing has a skin engaging structure that includes a plurality of elongated protrusions extending from a substrate integrally formed therewith. The skin engaging structure comprises a molded thermoplastic polymer that can be PP, a derivative of PE or other suitable polymer, such as ABS. The protrusions can be about 1 mm or more in height and can have a width less than 0.25 mm and a spacing between adjacent protrusions less than 0.2 mm, preferably about 0.15

mm resulting in a protrusion density greater than 5 protrusions per mm<sup>2</sup>. The protrusions can have a generally constant transverse cross section along their length or can be tapered or stepped. The cross section of the protrusions can be generally circular, oval or polygonal. The substrate can be integrally formed with the housing or can be permanently attached by  
5 suitable means such as by application of an adhesive or by permanently deforming a portion of the housing over a portion of the substrate, e.g. an edge extension of the substrate. The skin engaging structure can be one or both the guard and cap of the razor cartridge or a portion thereof.

Embodiments of a safety razor of the present invention can comprise a razor cartridge  
10 as previously described, connected to a handle. The connection can be permanent to provide a so-called disposable razor or the cartridge can be selectively removable by the user when appropriate to do so.

Embodiments of the invention can include one or more of the following advantages. The safety razor has excellent shaving characteristics. The skin engaging structure has  
15 manufacturing advantages.

The above features and advantages of the present invention will be more fully understood with reference to the following detailed description when taken in conjunction with the accompanying drawings.

## 20 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an isometric view of an embodiment of a safety razor of the present invention.

Fig. 2 is an isometric view of an embodiment of a razor cartridge of the present invention.

25 Figs. 3-4 are respectively top and front views of a portion of an embodiment of a skin engaging structure of the present invention.

Fig. 5-7 are respectively top, front and side views of portions of further embodiments of the skin engaging structure of the present invention.

Fig. 8A is a sectional view taken on lines 8-8 of Fig. 2.

30 Fig. 8B is a partial sectional view similar to Fig. 8A of another embodiment of the present invention.

Fig. 9A is a sectional view of a portion of the skin engaging structure of Figs 5-7 shown with its respective mold cavity.

Fig. 9B is an enlarged view of the tip portion of the skin engaging structure of Fig. 9A.

#### DETAILED DESCRIPTION

5 Referring now to the drawings and in particular Figs. 1 – 2, a safety razor 10 is illustrated in Fig. 1, comprising a handle 20 having a razor cartridge 30 attached thereto. As illustrated in Fig. 2 the razor cartridge comprises a housing 40. As is well known in the art, the housing 40 can be formed from a single part or a number of individual molded parts joined together. The housing is preferably manufactured by injection molding and preferably  
10 comprises ABS or other suitable polymeric materials selected for characteristics that can include impact and chemical resistance and dimensional stability. The housing has razor blades 42, each having a cutting edge 44. In the embodiment depicted the housing has two razor blades facing in a common direction however the present invention is not limited in regard to the number or arrangement of the razor blades and can comprise three, four or more  
15 razor blades and the razor blades can face in opposing directions. The housing has a cap surface 46 disposed aft of the razor blade cutting edges relative to the direction of motion of the razor cartridge in normal use. The cap 46 can include a lubricious shaving aid material 47 (depicted in Figs. 8A and 8B) as is well known in the art. The housing has a guard surface 48 disposed in advance of the cutting edges. One or both the guard and cap, preferably the  
20 guard, is provided with a skin engaging structure 50.

Referring additionally now to Figs. 3-4, a portion of a skin engaging structure 50 of the housing is depicted at an enlarged scale. The skin engaging structure comprises a number of closely packed, upstanding filament-like protrusions 52, extending from and integrally formed with a substrate 54. The protrusions are preferably about 1 mm or more in height and  
25 have a width less than about 0.25 mm. In the context of the present invention width defines the largest dimension across a protrusion measured at its root and excluding any fillet radius between the protrusion and the substrate. These protrusions preferably have a spacing of less than about 0.2 mm, preferably about 0.15 mm between adjacent protrusions. The resultant protrusion density can be more than 5 protrusions per mm<sup>2</sup>.

30 The skin engaging structure is preferably a discrete component part having its substrate portion permanently joined to the cartridge housing by suitable and well known means. Referring additionally to Fig. 8A the permanent joining can be by a layer of suitable adhesive 80. In a further embodiment, the substrate can also be provided with tabs 68 (see also Figs. 3 and 4) integrally formed with, and extending from, the substrate. In this

embodiment the permanent joining can be by one or more snap-fit features 82 of the housing engaging the tabs or portions of the substrate or by portions of the housing 84 being permanently deformed to at least partially envelop the tabs 68 or portions of the substrate in order to secure the substrate to the housing.

5           The skin engaging structure can also be integrally formed with the cartridge housing or one of the molded parts of the cartridge housing. Fig. 8B depicts an exemplary embodiment where the filament-like protrusions 52 are integrally formed with the cartridge housing 40. In this arrangement, as the cartridge housing is preferably molded from ABS as previously described, the filament-like protrusions will be similarly formed. The surface from  
10           which the filaments protrude has a length 48L (in Fig. 2) and a width 48W and thus a surface area can be defined. In an exemplary embodiment, a generally rectangular surface has a length 48L about 35 mm and width 48W about 2.5 mm, thus defining an area of about 87.5 mm<sup>2</sup>, however the present invention is not limited in this regard and other dimensions or areal shapes may be employed. For the embodiment described, between about 230 and 650  
15           filament-like protrusions, preferably about 436 protrusions can be usefully provided using the mold manufacturing process described as follows. The resultant protrusion density is thus between about 2.63 protrusions per mm<sup>2</sup> to about 7.43 protrusions per mm<sup>2</sup>, preferably about 5.0 protrusions per mm<sup>2</sup>.

          As depicted in Figs. 8A and 8B, the filament-like protrusions can diminish in height  
20           in the vicinity of the forwardmost portion of the guard 48. The filaments can also have a generally common height as depicted in Figs. 6 and 7.

          The skin engaging structure is preferably manufactured by a nano-injection molding process under typical process parameters in a suitable mold having cavities manufactured by a nano-mold making process. The skin engaging structure is preferably manufactured from a  
25           thermoplastic material having a relatively high shrinkage, more preferably an olefin polymer such as PP or a PE derivative, but materials such as TPE, polyamide (PA) and polyoxymethylene (POM) can also be employed as well as ABS. Olefin polymers in particular are selected for characteristics that include: impact and chemical resistance; relatively high shrinkage rate and low surface energy that both in turn aid removal of the part  
30           from the mold cavity at the end of the molding cycle and relatively low elastic modulus compared to so-called engineering polymers such as polyamide etc. that in turn provides preferred flexibility of the protrusions. As a result of their length and width in conjunction with the mechanical properties of the preferred material, the protrusions can have a similar or

better flexibility than known TPE protrusions under forces applied when the razor cartridge is drawn along the user's skin in normal use.

Continuing to refer to Figs. 8A and 8B, at least two (2) razor blades 42 are mounted in the housing 40. The razor blades can be generally planar or can include a bent portion as is well known in the art. Generally planar razor blades having sharpened cutting edges 44 are mounted on bent supports 70. The supports have a support portion 72 and a base portion 74. The base portions 74 of the supports 70 are mounted in respective slots in the housing. In further embodiments alternative means for mounting the razor blades within the housing can be employed. Alternative means for mounting blades within the housing can include: using adhesive to secure the blades as is disclosed in US Patent number 5,481,802 to Lembke; insert molding the blades within the housing as is disclosed in US Patent number 5,141,694 to Butlin et al; mounting the blades on an intermediate blade carrier component that is then mounted within the housing as is disclosed in US Patent application serial number 10/765,549 or mounting the blades on posts that project from the cap as is disclosed in US Patent number 3,724,070 to Dorion, or that project from the guard. The means for mounting the blades within the housing is well known to one of skill in the art and the present invention is not limited in this regard.

Referring additionally now to Figs 5-7, portions of further embodiments of the skin engaging structure are depicted at an enlarged scale. For convenience of illustration, multiple protrusion types are shown in combination however one of skill in the art will understand an entire skin engaging structure can comprise all one type of protrusion or multiple types in combination. Fig. 5 shows protrusions that can be circular, 102, oval, 104 and polygonal 106 and that can be arranged in a plurality of parallel rows as depicted in Figs 3 and 5. The protrusions can also be randomly distributed as depicted in Fig. 2. Fig 6 shows protrusions that can have substantially parallel sides 110 but are preferably tapered (i.e. drafted) 112, most preferably at about 3° per side to assist removal of the protrusions of the skin engaging structure from their respective mold cavities. The protrusions can also be stepped 114. Fig. 7 shows protrusions that can extend perpendicularly from the substrate 120 or can extend at an angle to the substrate 122.

Referring additionally now to Figs. 9A and 9B, a sectional view of a portion of a preferred skin engaging structure 50 shown with a portion of its respective mold cavity 200 for forming the protrusions and a portion thereof is shown at an enlarged scale. To assist with venting, i.e. the removal of entrapped air from the mold cavity during the injection phase of the molding cycle the mold cavity preferably comprises at least two plates 202, 204 including



a sieve plate 202 having through holes. The through holes are preferably manufactured by drilling a start hole having a diameter in the range about 0.05mm to 0.1mm in plate 202, followed by a high speed milling operation to provide the desired form. The desired form can also be provided by one or more erosion operations. The tip portions of the protrusions  
5 formed in such a mold cavity can include a flat portion 210 and a chamfered or rounded portion 212. The mold cavity can also be manufactured by providing suitable blind holes in a single mold plate.

Although the invention has been described and illustrated with reference to specific illustrative embodiments thereof, it is not intended that the invention be limited to those  
10 illustrative embodiments. Those skilled in the art will recognize that variations and modifications can be made without departing from the true scope of the invention as defined by the claims that follow. For instance, features disclosed in connection with any one embodiment can be used alone or in combination with each feature of the respective other  
15 embodiments. Those skilled in the art will further recognize that variations and modifications can be made within the scope of the invention.

## CLAIMS

What we claim is:

1. A skin engaging structure for a razor cartridge comprising:  
a plurality of elongated filament-like protrusions comprising a thermoplastic polymer, the protrusions extending from a substrate integrally formed with the protrusions;
- 5                   wherein the protrusions have a width less than 0.25 mm and a spacing between adjacent protrusions that is one of less than 0.2 mm and about 0.15 mm.
2. The skin engaging structure of claim 1, wherein the thermoplastic polymer is a non-elastomeric material.
3. The skin engaging structure of claim 2, wherein the thermoplastic polymer is a polyolefin.
4. The skin engaging structure of any of claims 1, 2 or 3, wherein a transverse cross-section of any one protrusion is one of circular, oval and polygonal.
5. The skin engaging structure of any of claims 1-4, wherein any one protrusion has substantially parallel sides.
6. The skin engaging structure of any of claims 1-4, wherein any one protrusion is tapered.
7. The skin engaging structure of any of claims 1-4, wherein any one protrusion has stepped sides.
8. The skin engaging structure of any of claims 1-7, wherein protrusions are arranged in a plurality of parallel rows.
9. The skin engaging structure of any of claims 1-7, wherein the protrusions are randomly distributed.

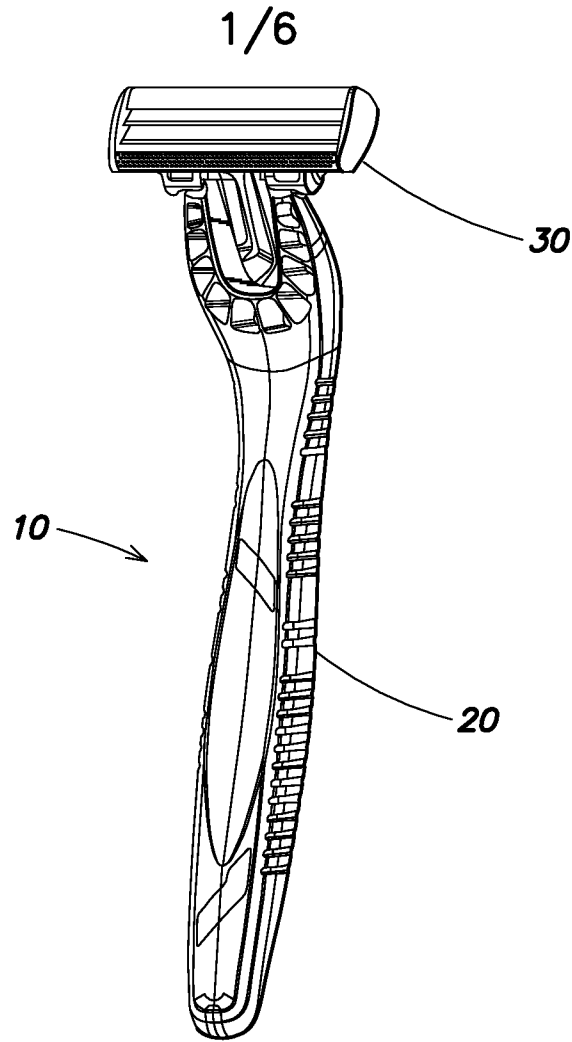
10. The skin engaging structure of any of claims 1-9, wherein the protrusions have a density greater than 5 protrusions per mm<sup>2</sup>.
11. A razor cartridge, comprising:
  - a housing having at least one razor blade disposed therein, the razor blade having a cutting edge; and
  - a skin engaging structure;
- 5 wherein the skin engaging structure includes a plurality of elongated filament-like protrusions comprising a thermoplastic polymer, the protrusions extending from a substrate integrally formed with the protrusions; and
  - wherein the protrusions have a width less than 0.25 mm and a spacing between adjacent protrusions that is one of less than 0.2 mm and about 0.15 mm.
12. The razor cartridge of claim 11, wherein the thermoplastic polymer is a non-elastomeric material.
13. The razor cartridge of claim 12, wherein the thermoplastic polymer is a polyolefin.
14. The razor cartridge of any of claims 11-13, wherein a transverse cross-section of any one protrusion is one of circular, oval and polygonal.
15. The razor cartridge of any of claims 11-14, wherein any one protrusion has substantially parallel sides.
16. The razor cartridge of any of claims 11-14, wherein any one protrusion is tapered.
17. The razor cartridge of any of claims 11-14, wherein any one protrusion has stepped sides.
18. The razor cartridge of any of claims 11-17, wherein protrusions are arranged in a plurality of parallel rows.
19. The razor cartridge of any of claims 11-17, wherein the protrusions are randomly distributed.

20. The razor cartridge of any of claims 11-19, wherein the protrusions have a density greater than 5 protrusions per mm<sup>2</sup>.

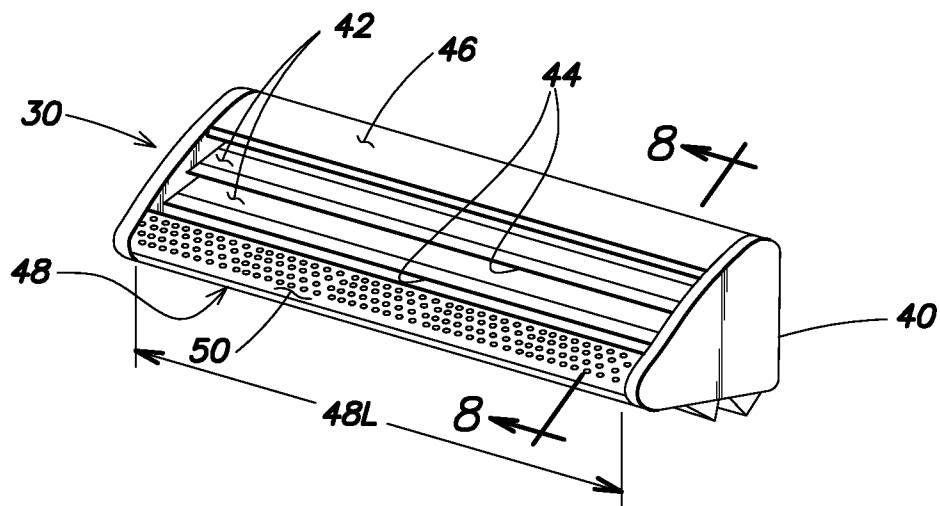
21. The razor cartridge of any of claims 11-20, further including means to permanently attach the substrate to the housing.

22. The razor cartridge of any of claims 11-20, wherein the substrate is integrally formed with the housing.

23. The razor cartridge of any of claims 11-22, wherein the razor cartridge includes a handle attached to the razor cartridge

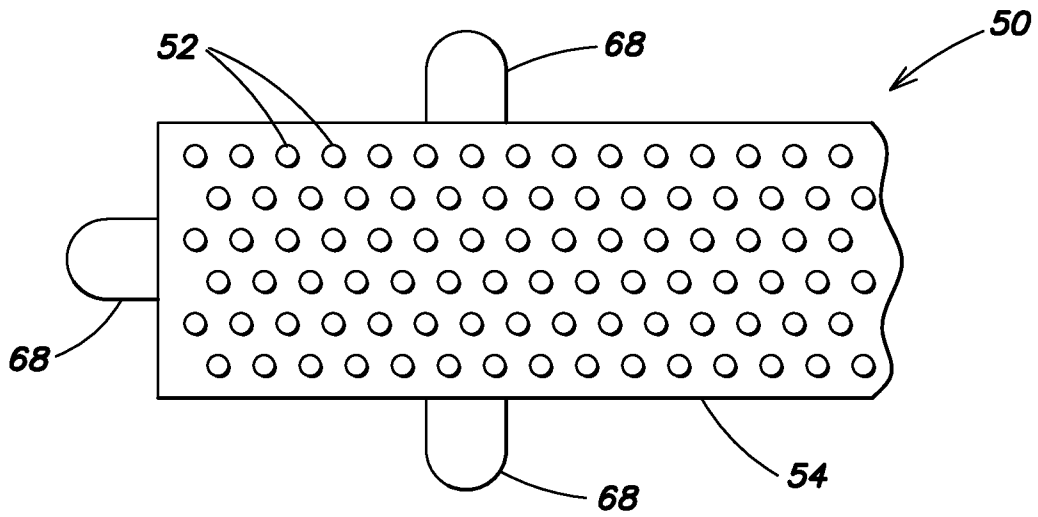


**FIG. 1**

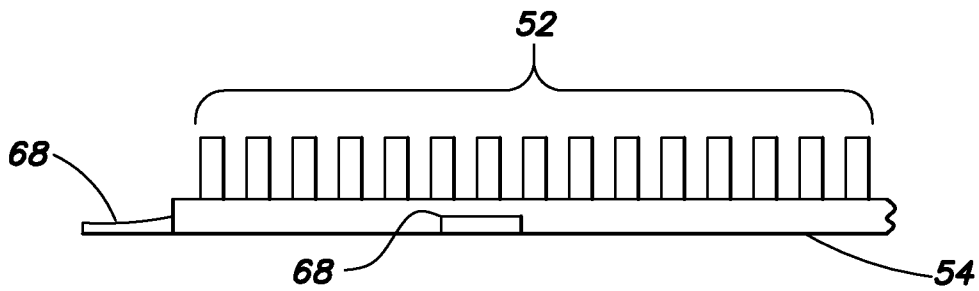


**FIG. 2**

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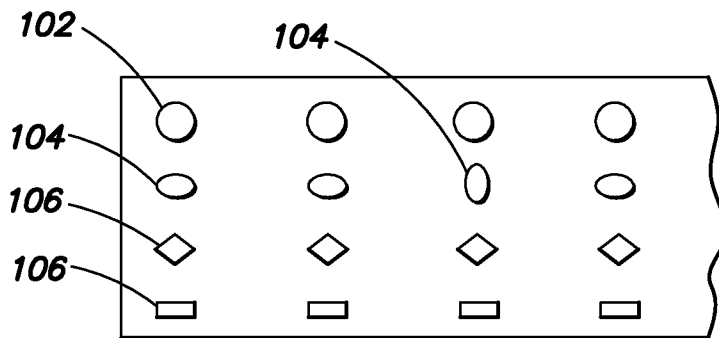


**FIG. 3**

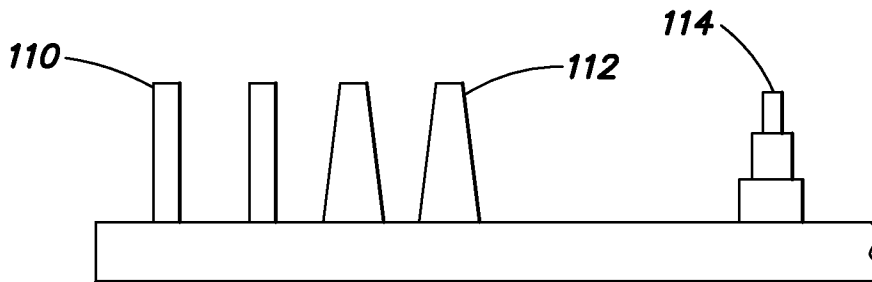


**FIG. 4**

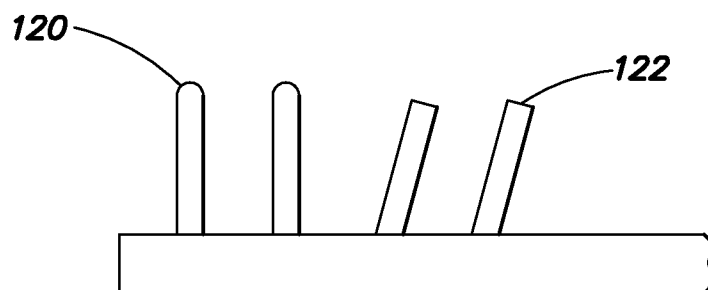
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**FIG. 5**

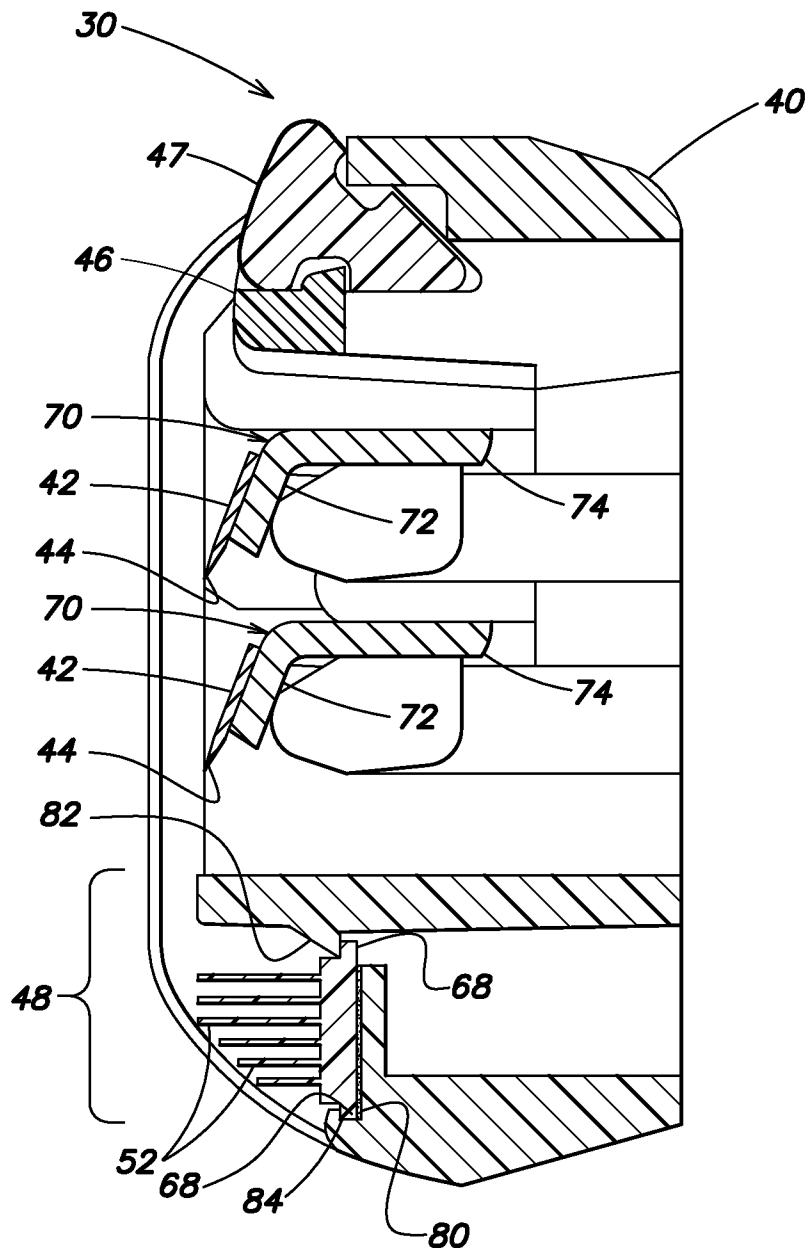


**FIG. 6**



**FIG. 7**

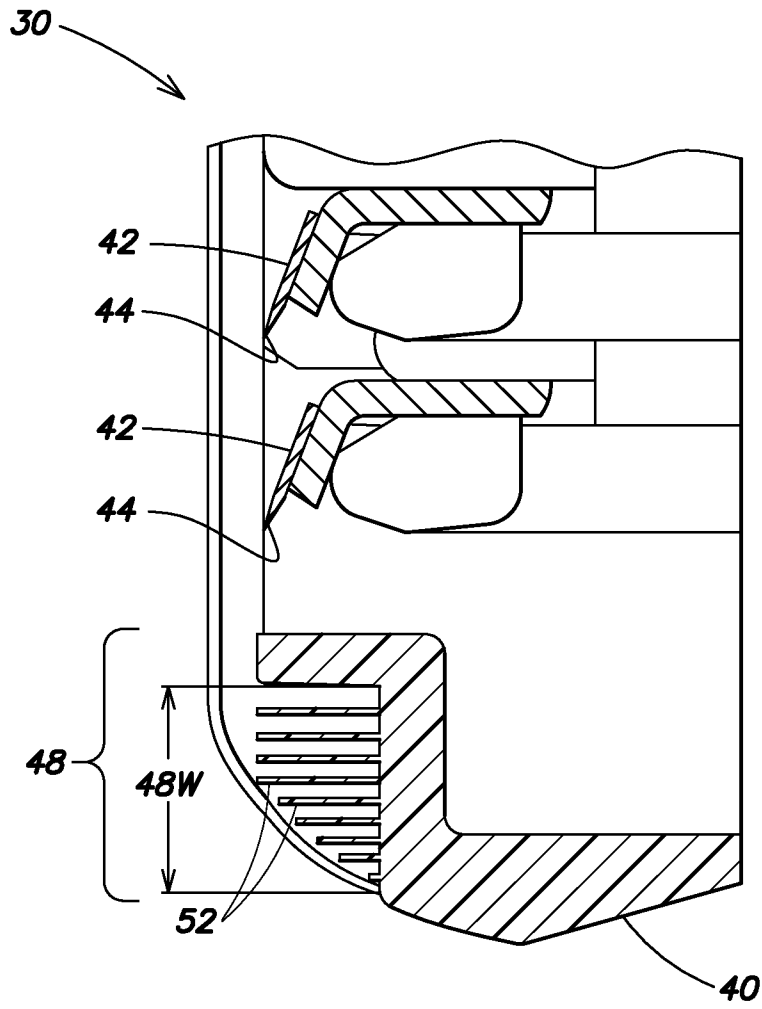
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**FIG. 8A**

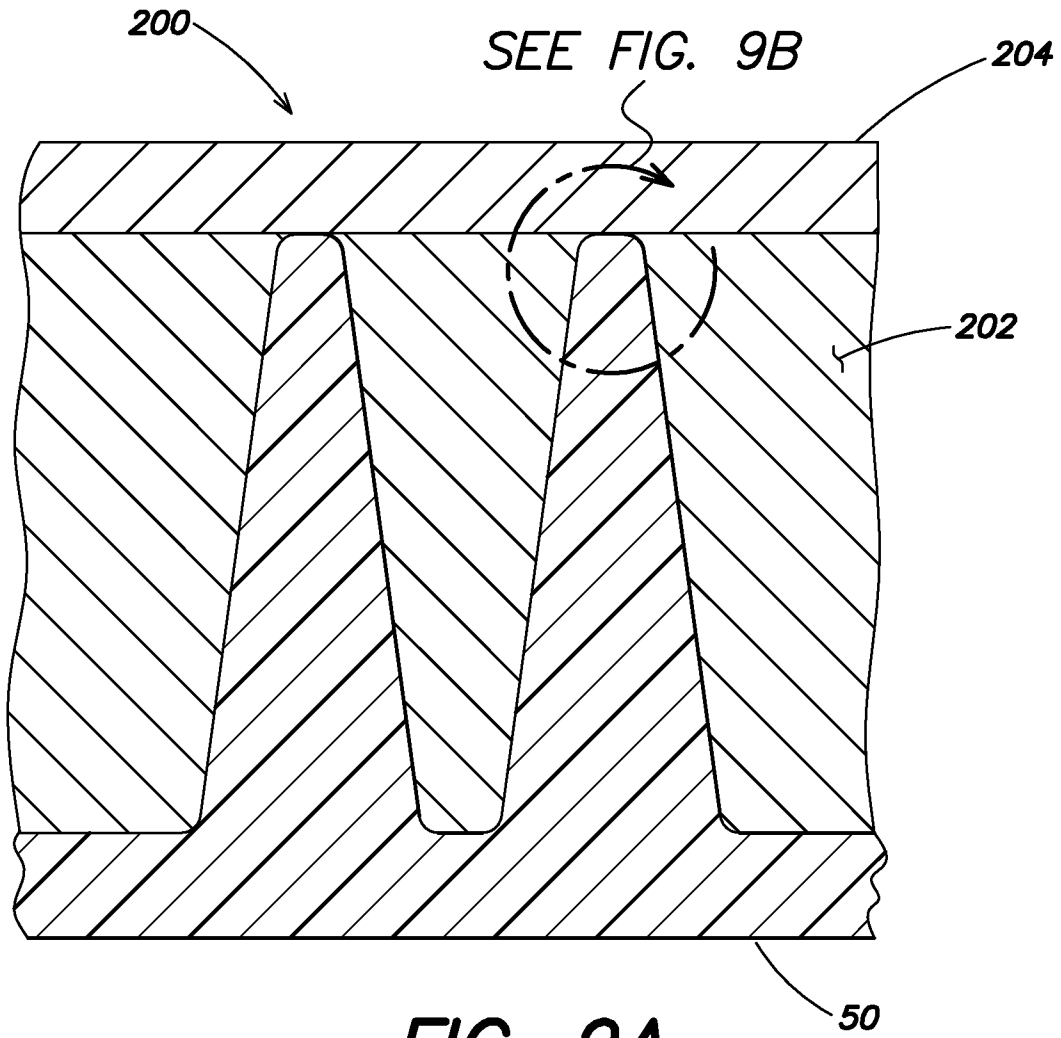


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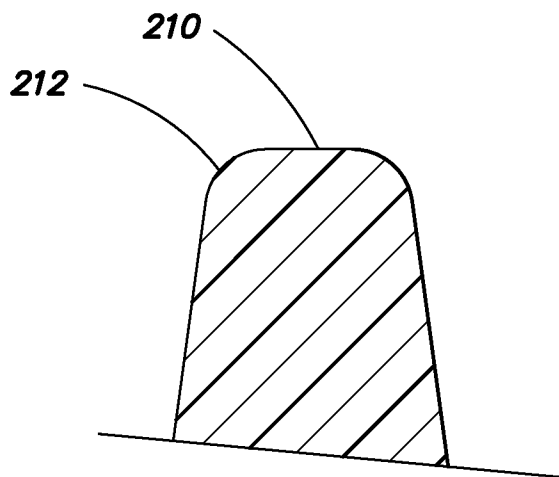


**FIG. 8B**

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**FIG. 9A**



**FIG. 9B**

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2008/057391

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. B26B21/40		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) B26B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 953 819 A (SIMMS GRAHAM JOHN [GB] ET AL) 21 September 1999 (1999-09-21)  column 1, line 63 - column 2, line 36 column 3, lines 15-27; figure 5	1-5, 10-15, 18,20, 21,23
Y	US 5 191 712 A (CROOK ALAN [US] ET AL) 9 March 1993 (1993-03-09) cited in the application column 1, lines 44-62; figure 8	1-6,8, 11-16, 18,21-23
Y	US 7 043 840 B2 (WALKER VINCENT P [US] ET AL WALKER JR VINCENT P [US] ET AL) 16 May 2006 (2006-05-16) cited in the application column 3, lines 3-9; figures 3,4	1-6,8, 11-16, 18,21-23
-/--		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <span style="margin-left: 200px;"><input checked="" type="checkbox"/> See patent family annex.</span>		
* Special categories of cited documents :		
*A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *&* document member of the same patent family	
Date of the actual completion of the international search  <p style="text-align: center;">24 June 2008</p>	Date of mailing of the international search report  <p style="text-align: center;">04/07/2008</p>	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer  <p style="text-align: center;">Rattenberger, B</p>	

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International application No

PCT/US2008/057391

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

International application No  
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