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(54) Title: HEADGEAR FOR FIRST RESPONDERS

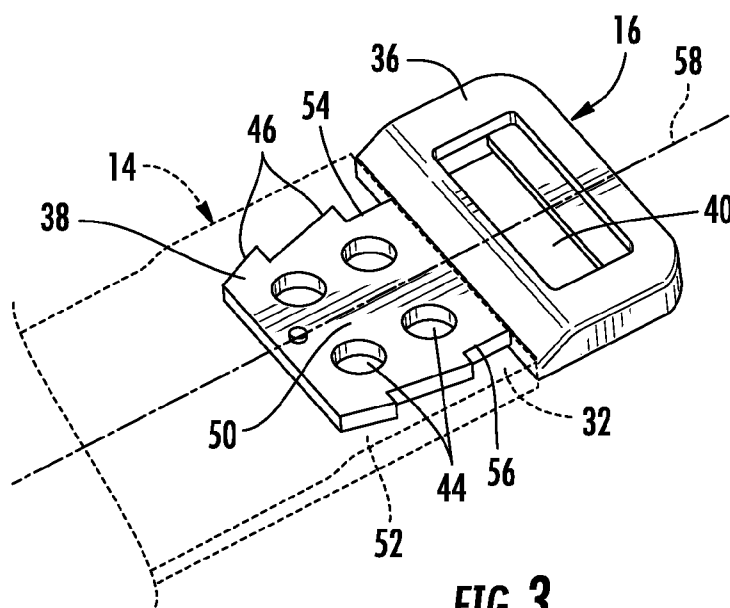


FIG. 3

(57) Abstract: A face seal (12) for a respirat-  
or mask (10) includes an integrated strap  
(14) with a buckle (16). The integrated strap  
(14) is overmolded onto the buckle (16) to  
secure the buckle (16) to, and at least par-  
tially within, the strap (14). A respirator  
mask (10) includes a body (18) and a face  
seal (12). A method of manufacturing a face  
seal (12) for a respirator mask (10) includes  
overmolding a material of at least a portion  
of an integrated strap (14) onto a body por-  
tion (38) of a buckle (16) such that a head  
portion (36) of the buckle (16) is exposed  
from the integrated strap (14), the buckle  
body portion (38) including a plurality of  
structural features (46) that enhances bond-  
ing between the buckle body portion (38)  
and the overmolded material.



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## HEADGEAR FOR FIRST RESPONDERS

### TECHNICAL FIELD

The present invention relates to personal protective equipment, and in particular to a method and a face seal having straps that allow attachment of the straps to other elements of personal protective equipment.

### BACKGROUND

Personal protective equipment masks, such as respirator masks are used in environments where individuals are exposed to hazardous materials, such as gases, vapors, aerosols (e.g., dusts, mists, and/or biological agents), and/or the like. Respirator masks come in a large variety of types and sizes, ranging from cheaper, disposable masks to higher cost, reusable masks that include replaceable filtration cartridges. Most respirator masks include a face seal that seals against the user's face. For example, face seals may include flexible lips, gaskets, cushions, and/or the like that engage in physical contact with the user's face to create the seal.

A face seal typically includes one or more integrated straps that can be attached to additional straps for securing the mask to the user's head. For example, the integrated straps may be connected to a harness configured to hold the mask to the user's head. However, the integrated straps are made of the same flexible material as the face seal, and it may be difficult to achieve a secure connection between the face seal straps and the additional straps.

Additionally, currently known face seals include straps that have holes or apertures within the straps, which provide means for attachment to the additional straps. However, including such a hole in the strap may compromise the structural integrity of the flexible strap.

Finally, using connection mechanisms such as buckles increases the thickness of the face seal straps and/or the additional straps, which can be uncomfortable to the user when the mask is used with a helmet, hood, and/or other headgear and/or other items of personal protective equipment.

## SUMMARY

The present invention advantageously provides a method and face seal for securely attaching the face seal of a respirator mask to a harness or other straps for securing the respirator mask to a user's head. In one embodiment, a face seal for use  
5 with a respirator mask includes an integrated strap and a buckle, the integrated strap being overmolded onto at least a portion of the buckle.

In one aspect of the embodiment, the buckle includes a body portion and a head portion, the body portion being within the integrated strap. In one aspect of the embodiment, the buckle body portion includes at least one aperture, a first at least  
10 substantially planar surface, and a second at least substantially planar surface opposite the first at least substantially planar surface, the at least one aperture extending between the first and second at least substantially planar surfaces.

In one aspect of the embodiment, the integrated strap is composed of a first material and the buckle is composed of a second material, the first material being  
15 overmolded onto the second material such that the first material extends through the at least one aperture.

In one aspect of the embodiment, the body portion includes a plurality of ridges. In one aspect of the embodiment, the buckle body portion further includes a first lateral surface and a second lateral surface opposite the first lateral surface, the  
20 plurality of ridges including a first set of ridges on the first lateral surface and a second set of ridges on the second lateral surface, each of the first and second lateral surfaces being located between the first and second at least substantially planar surfaces.

In one aspect of the embodiment, the integrated strap includes a longitudinal  
25 axis, each of the plurality of ridges including a surface that extends from the longitudinal axis in a direction that is at least substantially orthogonal to the longitudinal axis. In one aspect of the embodiment, the surface of each of the plurality of ridges is a first surface, each of the plurality of ridges further including a second surface that extends from the longitudinal axis in a direction that is at an angle of less  
30 than approximately 90° to meet the first surface.

In one aspect of the embodiment, the integrated strap and the face seal are composed of the first material.

In one aspect of the embodiment, the second material has a greater durometer than the first material.

In one aspect of the embodiment, the integrated strap has a maximum thickness of no more than 0.2 inches.

5           In one embodiment, a respirator mask includes: a body; and a face seal coupled to the body, the face seal including: at least one integrated strap; and at least one buckle, the at least one integrated strap being overmolded onto at least a portion of a corresponding one of the at least one buckle.

10           In one aspect of the embodiment, the at least one buckle includes a body portion and a head portion, the at least one integrated strap being overmolded onto the body portion of the corresponding one of the at least one buckle.

In one aspect of the embodiment, the body portion includes at least one aperture.

15           In one aspect of the embodiment, the body portion includes: a first at least substantially planar surface and a second at least substantially planar surface opposite the first at least substantially planar surface; and a first lateral surface and a second lateral surface opposite the first lateral surface, the first and second lateral surfaces being between the first and second at least substantially planar surfaces.

20           In one aspect of the embodiment, the body portion further includes: a plurality of apertures extending between the first and second at least substantially planar surfaces; and a first set of ridges on the first lateral surface and a second set of ridges on the second lateral surface.

25           In one aspect of the embodiment, the integrated strap includes a longitudinal axis, each of the plurality of ridges including a surface that extends from the longitudinal axis in a direction that is at least substantially orthogonal to the longitudinal axis. In one aspect of the embodiment, the surface of each of the plurality of ridges is a first surface, each of the plurality of ridges further including a second surface that extends from the longitudinal axis in a direction that is at an angle of less than approximately 90° to meet the first surface.

30           In one aspect of the embodiment, the integrated strap has a maximum thickness of no more than 0.2 inches.

In one embodiment, a method of manufacturing a face seal for a respirator mask, the face seal having at least one integrated strap, includes: positioning a buckle within a mold for the face seal such that the buckle is located at a distal end of the at least one integrated strap, the buckle being composed of a first material, the buckle  
5 having a head portion and a body portion, the body portion having at least one aperture and a plurality of structural features; and overmolding a second material onto the buckle body portion such that the buckle head portion is exposed from the distal end of the at least one integrated strap and the second material flows through the at least one aperture and around the plurality of structural features, the plurality of  
10 structural features being configured to retain the buckle body portion within the at least one integrated strap.

#### BRIEF DESCRIPTION OF THE DRAWINGS

15 A more complete understanding of the present invention, and the attendant advantages and features thereof, will be more readily understood by reference to the following detailed description when considered in conjunction with the accompanying drawings wherein:

FIG. 1 shows a front perspective view of a respirator face mask having a face  
20 seal and integrated straps with buckles;

FIG. 2 shows a perspective view of an end portion of an integrated strap having a buckle;

FIG. 3 shows the perspective view of FIG. 2, with an internal portion of the buckle visible through the integrated strap; and

25 FIG. 4 shows a flow chart for an exemplary method of manufacturing a face seal.

#### DETAILED DESCRIPTION

The invention advantageously provides a face seal for an item of personal  
30 protective equipment, such as a respirator mask, that has at least one integrated strap with a buckle. Each integrated strap is overmolded onto the buckle to secure the buckle to, and at least partially within, the strap. Each integrated strap is relatively thin (as

compared with known straps), thereby giving the integrated strap a low profile that enhances user comfort when the respirator mask is worn beneath a helmet, hood, and/or other headgear and/or with another item of personal protective equipment.

Before describing in detail exemplary embodiments that are in accordance with the disclosure, it is noted that components have been represented where appropriate by convention symbols in drawings, showing only those specific details that are pertinent to understanding the embodiments of the disclosure so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein.

As used herein, relational terms, such as “first,” “second,” “top” and “bottom,” and the like, may be used solely to distinguish one entity or element from another entity or element without necessarily requiring or implying any physical or logical relationship or order between such entities or elements. The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the concepts described herein. As used herein, the singular forms “a,” “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises,” “comprising,” “includes” and/or “including” when used herein, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. It will be further understood that terms used herein should be interpreted as having a meaning that is consistent with their meaning in the context of this specification and the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

Referring now to the drawing figures in which like reference designations refer to like elements, an embodiment of a respirator mask for providing respiratory protection that includes a face seal constructed in accordance with the principles of the invention is shown in the figures and generally designated as “10.” Referring to FIG. 1, the mask 10 is a respirator mask configured to be worn by a user in environments

where the user is exposed to hazardous materials, such as, but not limited to, gases, vapors, aerosols (such as dusts, mists, and/or biological agents), and/or the like. The mask 10 includes a face seal 12 having integrated straps 14 with buckles 16. Integrated as used herein means that the face seal 12 is manufactured to include the straps 14, such as by molding the face seal 12 and straps 14 as a single integrated piece. Thus, the straps 14 are extensions of the main portion of the face seal 12. The mask 10 includes other components, depending on the conditions and purpose for which the mask 10 is used. As a non-limiting example, the mask 10 generally includes a body 18, a faceplate or fenestra 20 with an aperture 22 to which a respirator can be attached (not shown), and a nose cup 24 within the interior of the mask 10.

The body 18 is composed of any suitable material(s), such as a rigid or semi-rigid plastic. The face seal 12 may be attached to the mask body such that the face seal 12 is configured to create a seal around at least a portion of the user's face when the mask is worn (e.g., the user's mouth and nose). The face seal 12 and integrated straps 14 may be composed of a material having a lower durometer than the body 18. As a non-limiting example, the body 18 may be composed a rigid plastic, such as high-density polyethylene (HDPE), whereas the face seal 12 and integrated straps 14 may be composed of silicone rubber, thermoplastic elastomer (TPE), rubber (either natural or synthetic), and/or other material that is more flexible than the body 18. Although FIG. 1 shows all of the integrated straps 14 having overmolded buckles 16, it will be understood that fewer than all of the integrated straps 14 may include overmolded buckles. For example, the integrated strap 14 that is positioned over the user's forehead during use may include the overmolded buckle 16, whereas the other integrated straps 14 may include different means for attachment between the straps 14 and harness straps. Also, the invention is not limited to the quantity of straps shown in the drawing figures. It is contemplated that fewer or more straps than are shown may be implemented.

Referring now to FIGS. 2 and 3, the integrated straps 14 and buckles 16 are shown in more detail. Each integrated strap 14 generally includes a first or proximal end 30 and a second or distal end 32 opposite the proximal end 30. The first end 30 is the portion of the strap 14 that meets the main portion of the face seal 12. The second end 32 includes the buckle 16. During manufacture, the strap 14 is overmolded onto



the buckle 16. Overmolding processes are known in the art and are beyond the scope of the instant disclosure. The buckle 16 is composed of one or more rigid materials, such as metal, plastic, HDPE, or other suitable material that will not fracture or break when tension is exerted on the buckle during use, such as by the additional strap that is attached to the buckle 16.

As shown in FIG. 3, the buckle 16 includes a head portion 36 and a body portion 38. The head portion 36 is exposed from the strap 14 and includes an aperture 40 through which an end of an additional strap, such as a harness strap, may be passed to secure the additional strap to the integrated strap 14. The body portion 38 includes one or more structural features that facilitate or enhance bonding between the strap material and the buckle 16 when the strap 14 is overmolded onto the buckle 16. As a non-limiting example, in one embodiment the body portion 38 includes a plurality of apertures 44 (in some embodiments, at least one aperture 44) through which the strap material may flow during the overmolding process, and a plurality of ridges or teeth 46 that help prevent the buckle 16 from being pulled from within the strap 14 when a force is exerted on the buckle 16 in a direction away from the strap second end 32, such as may be exerted by a harness strap when the mask 10 is in use. Further, the body portion 38 has a first at least substantially planar surface 50 and a second at least substantially planar surface 52 opposite the first surface 50. The apertures 44 extend all the way between the first 50 and second 52 surfaces. A first set of ridges 46 is located along a first edge or lateral surface 54 of the body portion 38 between the first 50 and second 52 surfaces, and a second set of ridges 46 is located along a second edge or lateral surface 56 opposite the first edge of the body portion 38 between the first 50 and second 52 surfaces. The buckle 16 defines a longitudinal axis 58 that is coaxial with the longitudinal axis of the strap 14, and each set of ridges 46 extends along a distance that is parallel to the longitudinal axis 54. Although the flow of the overmolded material through the plurality of apertures 44 will help retain the buckle 16 within the strap 14, the ridges 46 may be configured to further resist linear movement of the body portion 38 within the strap 14 toward the strap second end 32. In one embodiment, the ridges 46 are configured like barbs to help keep the buckle 16 in place, with each ridge 46 having a first surface 62 that extends from the longitudinal axis 58 in a direction that is at least substantially orthogonal to the

longitudinal axis 58 and a second surface 64 that extends from the longitudinal axis 58 in a direction that is at an angle of less than approximately 90° to meet the first surface 62.

In one embodiment, the body portion 38 may have a thickness such that the  
5 maximum thickness  $T_{\max}$  of the strap 14 is approximately 0.2 inches or less. This  
thinness of the strap, in addition to the softness of the strap material, may reduce  
pressure exerted by the strap 14 and buckle 16 on the user's head (for example, on the  
user's forehead) when the mask 10 is worn, and particularly when the mask 10 is  
worn with additional headgear, such as a helmet, that may compress the strap 14  
10 and/or buckle 16 against the user's head.

Referring now to FIG. 4, an exemplary method of manufacturing a face seal is  
shown. A face seal mold is used to create the face seal 12 having at least one  
integrated strap 14. The mold may have, and therefore the face seal 12 may be  
manufactured to have, any number of integrated straps 14. Further, all or fewer than  
15 all of the integrated straps 14 may be overmolded onto a buckle 16. For simplicity,  
the exemplary method will be discussed as though the face seal 12 includes a single  
buckle 16 in one of the integrated straps 14. In a first step 100, a buckle 16 is  
positioned within the mold such that the buckle 16 will be located at a second or distal  
end 32 of an integrated strap 14 created by the mold. In a second step 102, a first  
20 material used to create the integrated straps 14 is poured into the mold such that it not  
only forms the face seal 12 and integrated straps 14, but is also overmolded onto the  
buckle 16. Thus, the first material flows through the apertures 44 and around the  
ridges 46. As discussed above, the presence of the first material within the apertures  
44 and the configuration of the ridges 46 both help retain the buckle body 38 within  
25 the strap 14. The face seal 12 is then removed from the mold and attached to an item  
of personal protective equipment, such as a respirator mask 10.

In one embodiment, a face seal 12 for use with a respirator mask 10 includes  
an integrated strap 14 and a buckle 16, the integrated strap 14 being overmolded onto  
at least a portion of the buckle 16.

30

In one aspect of the embodiment, the buckle 16 includes a body portion 38 and  
a head portion 36, the body portion 38 being within the integrated strap 14. In one

aspect of the embodiment, the buckle body portion 38 includes at least one aperture 44, a first at least substantially planar surface 50, and a second at least substantially planar surface 52 opposite the first at least substantially planar surface 50, the at least one aperture 44 extending between the first 50 and second 52 at least substantially planar surfaces.

In one aspect of the embodiment, the integrated strap (14) is composed of a first material and the buckle (16) is composed of a second material, the first material being overmolded onto the second material such that the first material extends through the at least one aperture (44).

In one aspect of the embodiment, the body portion 38 includes a plurality of ridges 46. In one aspect of the embodiment, the buckle body portion 38 further includes a first lateral surface 54 and a second lateral surface 56 opposite the first lateral surface 54, the plurality of ridges 46 including a first set of ridges 46A on the first lateral surface 54 and a second set of ridges 46B on the second lateral surface 56, each of the first 54 and second 56 lateral surfaces being located between the first 50 and second 52 at least substantially planar surfaces.

In one aspect of the embodiment, the integrated strap 14 includes a longitudinal axis 58, each of the plurality of ridges 46 including a surface 62 that extends from the longitudinal axis 58 in a direction that is at least substantially orthogonal to the longitudinal axis 58. In one aspect of the embodiment, the surface 62 of each of the plurality of ridges 46 is a first surface 62, each of the plurality of ridges 46 further including a second surface 64 that extends from the longitudinal axis 58 in a direction that is at an angle of less than approximately 90° to meet the first surface 62.

In one aspect of the embodiment, the integrated strap 14 and the face seal 12 are composed of the first material.

In one aspect of the embodiment, the second material has a greater durometer than the first material.

In one aspect of the embodiment, the integrated strap 14 has a maximum thickness  $T_{\max}$  of no more than 0.2 inches.

In one embodiment, a respirator mask 10 includes: a body 18; and a face seal 12 coupled to the body 18, the face seal 12 including: at least one integrated strap 14;

and at least one buckle 16, the at least one integrated strap 14 being overmolded onto at least a portion of a corresponding one of the at least one buckle 16.

In one aspect of the embodiment, the at least one buckle 16 includes a body portion 38 and a head portion 36, the at least one integrated strap 14 being  
5 overmolded onto the body portion 38 of the corresponding one of the at least one buckle 16.

In one aspect of the embodiment, the body portion 38 includes at least one aperture 44.

In one aspect of the embodiment, the body portion 38 includes: a first at least  
10 substantially planar surface 50 and a second at least substantially planar surface 52 opposite the first at least substantially planar surface 50; and a first lateral surface 54 and a second lateral surface 56 opposite the first lateral surface 54, the first 54 and second 56 lateral surfaces being between the first 50 and second 52 at least substantially planar surfaces.

15 In one aspect of the embodiment, the body portion 38 further includes: a plurality of apertures 44 extending between the first 50 and second 52 at least substantially planar surfaces; and a first set of ridges 46 on the first lateral surface 54 and a second set of ridges 46 on the second lateral surface 56.

In one aspect of the embodiment, the integrated strap 14 includes a  
20 longitudinal axis 58, each of the plurality of ridges 46 including a surface 62 that extends from the longitudinal axis 58 in a direction that is at least substantially orthogonal to the longitudinal axis 58. In one aspect of the embodiment, the surface 62 of each of the plurality of ridges 46 is a first surface 62, each of the plurality of ridges 46 further including a second surface 64 that extends from the longitudinal axis  
25 58 in a direction that is at an angle of less than approximately 90° to meet the first surface 62.

In one aspect of the embodiment, the integrated strap 14 has a maximum thickness  $T_{\max}$  of no more than 0.2 inches.

In embodiment, a method of manufacturing a face seal 12 for a respirator  
30 mask 10, the face seal 12 having at least one integrated strap 14, includes: positioning a buckle 16 within a mold for the face seal 12 such that the buckle 16 is located at a distal end 32 of the at least one integrated strap 14, the buckle 16 being composed of a

first material, the buckle 16 having a head portion 36 and a body portion 38, the body portion 38 having at least one aperture 44 and a plurality of structural features 46; and overmolding a second material onto the buckle body portion 38 such that the buckle head portion 36 is exposed from the distal end 32 of the at least one integrated strap 14 and the second material flows through the at least one aperture 44 and around the plurality of structural features 46, the plurality of structural features 46 being configured to retain the buckle body portion 38 within the at least one integrated strap 14.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described herein above. In addition, unless mention was made above to the contrary, it should be noted that all of the accompanying drawings are not to scale. A variety of modifications and variations are possible in light of the above teachings without departing from the scope and spirit of the invention, which is limited only by the following claims.

What is claimed is:

1. A face seal (12) for use with a respirator mask (10), the face seal (12) comprising:  
an integrated strap (14); and  
5 a buckle (16), the integrated strap (14) being overmolded onto at least a portion of the buckle (16).
2. The face seal (12) of Claim 1, wherein the buckle (16) includes a body portion (38) and a head portion (36), the body portion (38) being within the integrated  
10 strap (14).
3. The face seal (12) of Claim 2, wherein the body portion (38) includes at least one aperture (44), a first at least substantially planar surface (50) and a second at least substantially planar surface (52) opposite the first at least substantially planar  
15 surface (50), the at least one aperture (44) extending between the first (50) and second (52) at least substantially planar surfaces.
4. The face seal (12) of Claim 3, wherein the integrated strap (14) is composed of a first material and the buckle (16) is composed of a second material, the  
20 first material being overmolded onto the second material such that the first material extends through the at least one aperture (44).
5. The face seal (12) of Claim 3, wherein the buckle body portion (38) includes a plurality of ridges (46).  
25
6. The face seal (12) of Claim 5, wherein the buckle body portion (38) further includes a first lateral surface (54) and a second lateral surface (56) opposite the first lateral surface (54), the plurality of ridges (46) including a first set of ridges (46A) on the first lateral surface (54) and a second set of ridges (46B) on the second  
30 lateral surface (56), each of the first (54) and second (56) lateral surfaces being located between the first (50) and second (52) at least substantially planar surfaces.

7. The face seal (12) of Claim 5, wherein the integrated strap (14) includes a longitudinal axis (58), each of the plurality of ridges (46) including a surface (62) that extends from the longitudinal axis (58) in a direction that is at least substantially orthogonal to the longitudinal axis (58).

5

8. The face seal (12) of Claim 7, wherein the surface (62) of each of the plurality of ridges (46) is a first surface (62), each of the plurality of ridges (46) further including a second surface (64) that extends from the longitudinal axis (58) in a direction that is at an angle of less than approximately 90° to meet the first surface (62).

10

9. The face seal (12) of Claim 4, wherein the integrated strap (14) and the face seal (12) are each composed of the first material.

15

10. The face seal (12) of Claim 4, wherein the second material has a greater durometer than the first material.

11. The face seal (12) of Claim 1, wherein the integrated strap (14) has a maximum thickness ( $T_{\max}$ ) of no more than 0.2 inches.

20

12. A respirator mask (10) comprising:  
a body (18); and  
a face seal (12) coupled to the body (18), the face (12) seal including:  
at least one integrated strap (14); and  
at least one buckle (16), the at least one integrated strap (14) being overmolded onto at least a portion of a corresponding one of the at least one buckle (16).

25

13. The respirator mask (10) of Claim 12, wherein the at least one buckle (16) includes a body portion (38) and a head portion (36), the at least one integrated strap (14) being overmolded onto the body portion (38) of the corresponding one of the at least one buckle (16).

30

14. The respirator mask (10) of Claim 13, wherein the body portion (38) includes at least one aperture (44).

5 15. The respirator mask (10) of Claim 13, wherein the body portion (38) includes:

a first at least substantially planar surface (50) and a second at least substantially planar surface (52) opposite the first at least substantially planar surface (50); and

10 a first lateral surface (54) and a second lateral surface (56) opposite the first lateral surface (54), the first (54) and second (56) lateral surfaces being between the first (50) and second (52) at least substantially planar surfaces.

15 16. The respirator mask (10) of Claim 15, wherein the body portion (38) further includes:

a plurality of apertures (44) extending between the first (50) and second (52) at least substantially planar surfaces; and

a first set of ridges (46A) on the first lateral surface (54) and a second set of ridges (46B) on the second lateral surface (56).

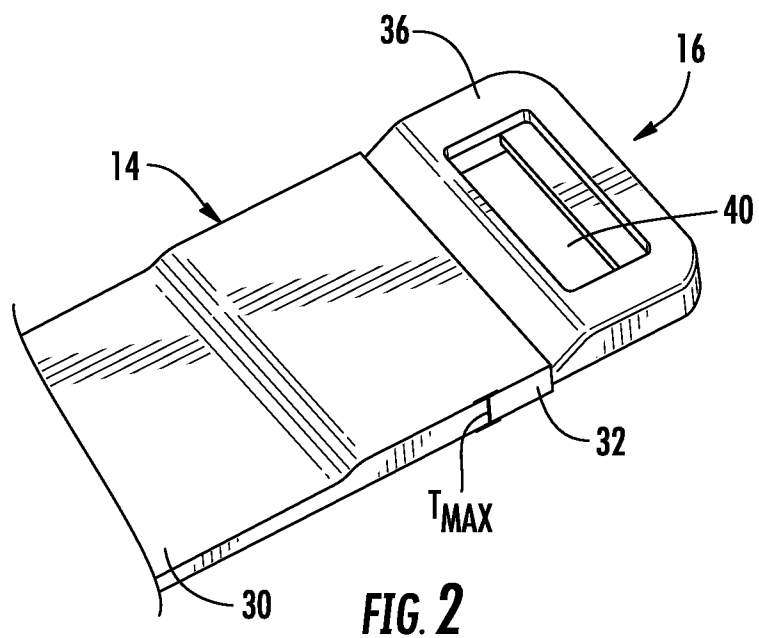
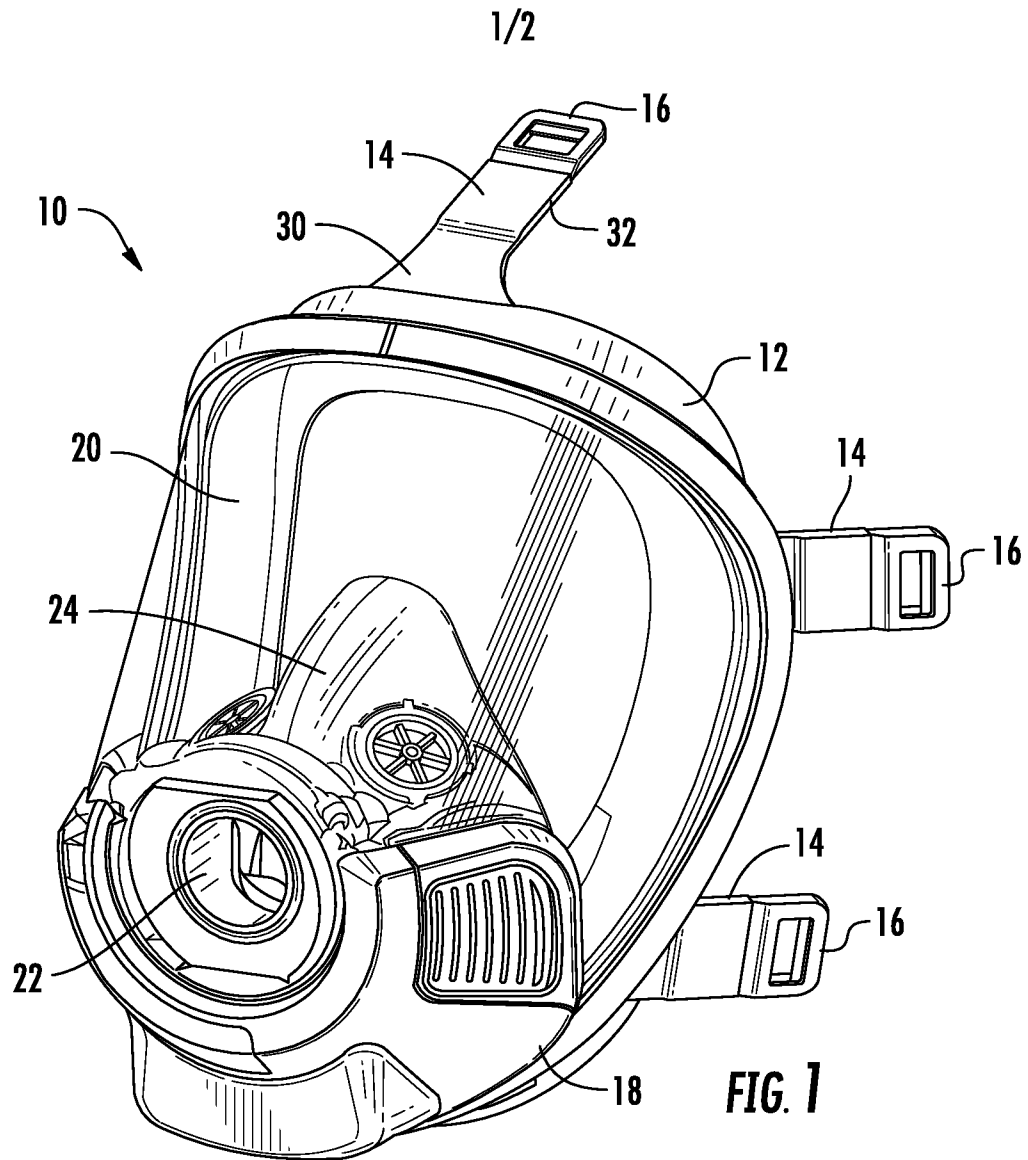
20 17. The respirator mask (10) of Claim 16, wherein the integrated strap (14) includes a longitudinal axis (58), each of the first (46A) and second (46B) sets of ridges including a surface (62) that extends from the longitudinal axis (58) in a direction that is at least substantially orthogonal to the longitudinal axis (58).

25 18. The respirator mask (10) of Claim 17, wherein the surface (62) of each of the first (46A) and second (46B) sets of ridges is a first surface (62), each of the first (46A) and second (46B) sets of ridges further including a second surface (64) that extends from the longitudinal axis (58) in a direction that is at an angle of less than  
30 approximately 90° to meet the first surface (62).



19. The respirator mask (10) of Claim 12, wherein the integrated strap (14) has a maximum thickness ( $T_{\max}$ ) of no more than 0.2 inches.

20. A method of manufacturing a face seal (12) for a respirator mask (10),  
5 the face seal (12) having at least one integrated strap (14), the method comprising:  
positioning a buckle (16) within a mold for the face seal (12) such that the  
buckle (16) is located at a distal end (32) of the at least one integrated strap (14), the  
buckle (16) being composed of a first material, the buckle (16) having a head portion  
(36) and a body portion (38), the body portion (38) having at least one aperture (44)  
10 and a plurality of structural features (46); and  
overmolding a second material onto the buckle body portion (38) such that the  
buckle head portion (36) is exposed from the distal end (32) of the at least one  
integrated strap (14) and the second material flows through the at least one aperture  
(44) and around the plurality of structural features (46), the plurality of structural  
15 features (46) being configured to retain the buckle body portion (38) within the at  
least one integrated strap (14).



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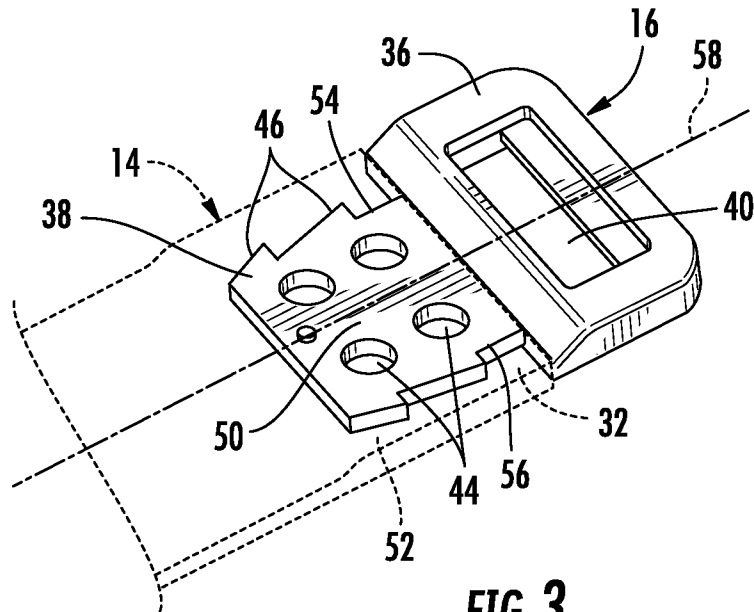


FIG. 3

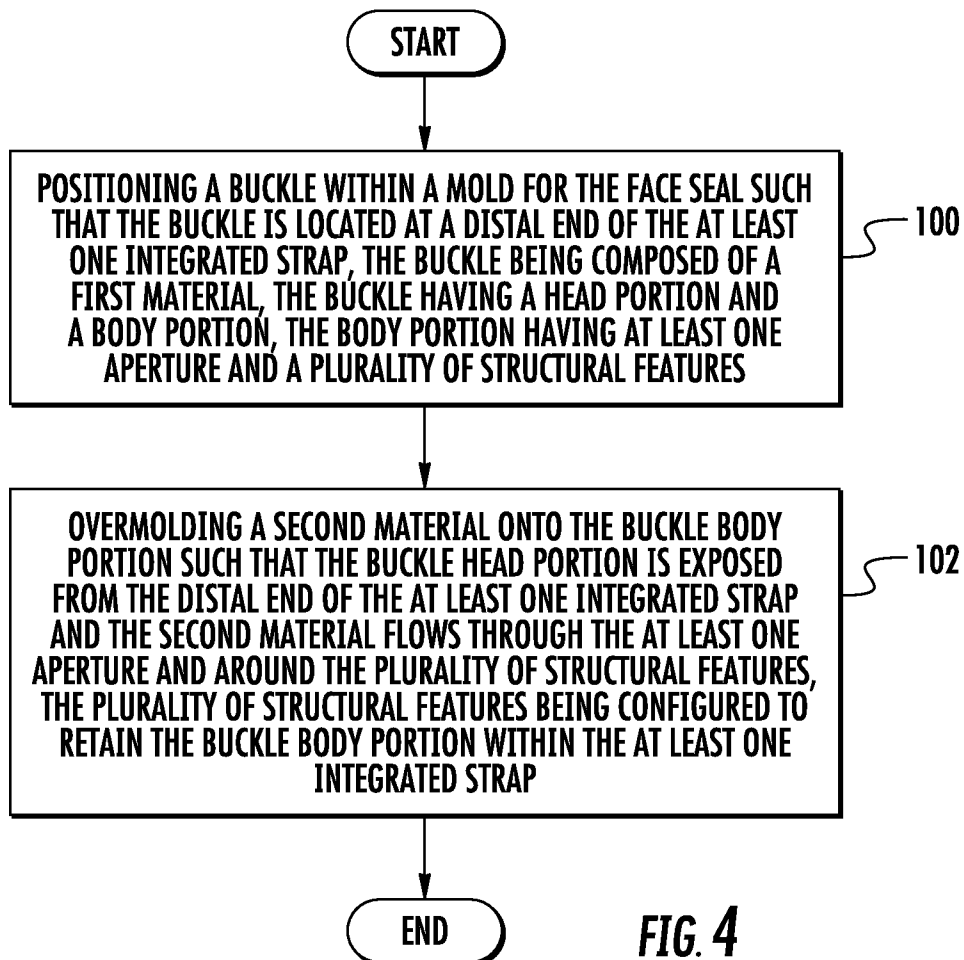


FIG. 4

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2017/027534

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>INV. A62B18/02 A62B18/08 F16G11/00 A44B11/00<br>ADD.  |   |  |
|---|---|--|
| According to International Patent Classification (IPC) or to both national classification and IPC   |   |  |
| <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br>A62B F16G A44B  |   |  |
| 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 practicable, search terms used)<br>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 2012/125341 A1 (GEBREWOLD YONAS [US] ET AL) 24 May 2012 (2012-05-24) paragraph [0055] figures 1,2  | 1-20   |
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| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.   |   |  |
| * Special categories of cited documents :<br>"A" document defining the general state of the art which is not considered to be of particular relevance<br>"E" earlier application or patent but published on or after the international filing date<br>"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)<br>"O" document referring to an oral disclosure, use, exhibition or other means<br>"P" document published prior to the international filing date but later than the priority date claimed<br>"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<br>"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<br>"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<br>"&" document member of the same patent family |   |  |
| Date of the actual completion of the international search   |   | Date of mailing of the international search report |
| 15 June 2017  |   | 29/06/2017   |
| Name and mailing address of the ISA/<br>European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016  |   | Authorized officer<br>Nehrdich, Martin             |

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International application No

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