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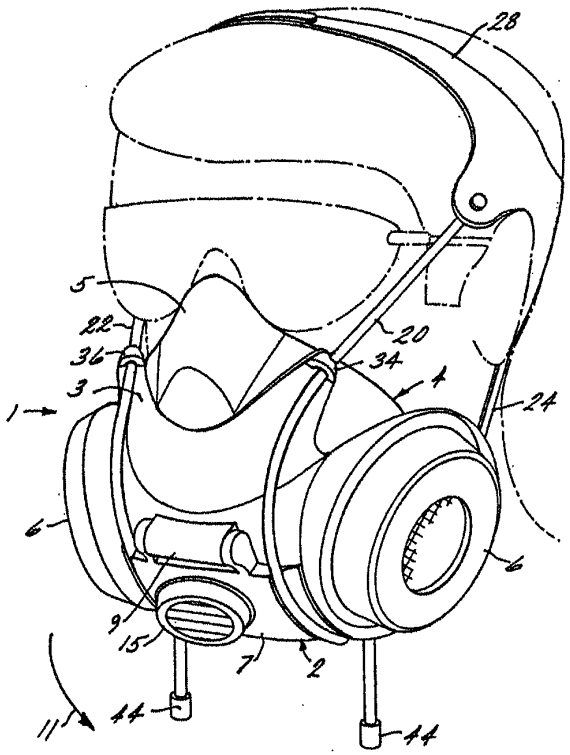
(54) Title: RESPIRATOR HEADPIECE AND RELEASE MECHANISM

(57) Abstract

A quick release mechanism and headpiece for use with a respirator. The quick release mechanism uses an over center latch pivotly attached to a yoke to control the tension in a pair of upper tension cords. In the latched position the upper tension cords traverse the yoke and together with a pair of lower tension cords support and seal the respirator mask agaisnt the face of the wearer. In the unlatched position the upper tension cords loosely support the mask below the chin of the wearer in a parked position. The upper and lower tension cords are attached to a circular shaped headpiece having a crown piece fitting to the top of the head of the wearer and a base portion fitting to the back of the head of the wearer. The headpiece is advantageously comprised of multiple layers wherein the outer layer is comprised of a rigid material and the inner layer is comprised of a compliant material. The rigid layer provides necessary structure to headpiece and the inner layer provides compliance and comfort to the head of the wearer.



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RESPIRATOR HEADPIECE AND RELEASE MECHANISM

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates generally to respirators and in particular to a novel headpiece and mask release mechanism.

Prior Art

Respirators are worn by persons subjected to unpleasant or noxious environments. A common type of respirator is the half mask respirator comprised of a cup type mask supported by a yoke attached to two sets of elastic straps. One set of straps, the upper set, is designed to rest on the crown of the head of a wearer. The second, lower, set is designed to wrap around the back of the neck of the wearer. The upper set is generally attached to a broadened flexible strap, commonly known as a cradle, that fits over, or cradles, the crown of the head. The upper strap is generally adjustably attached between the mask portion and cradle by a buckle having an adjusting mechanism such as a D-ring for tightening the strap against the head. A D-ring, as is well known in the industry, generally requires that a wearer use two hands to manipulate the D-ring to adjust the length of the strap during donning or doffing often proving to be challenging to the wearer. The lower strap generally includes a fastening element including a hook and slot arrangement and further includes an adjustment mechanism such as a D-ring.

A wearer typically puts on (dons) the respirator by clipping the lower straps

behind the neck and then lifting the cradle up onto the top of the crown while simultaneously guiding the mask and yoke portion, or facepiece, into position on the face. The straps are then manipulated through the D-rings and adjusted until a good fit is achieved and a successful face seal check is performed. Removal, or doffing, of the respirator is performed opposite the donning operation wherein the lower straps are unbuckled and the cradle is removed from the head while the facepiece is withdrawn from the face of the wearer.

In the course of an average day a worker required to wear a respirator may don and doff the respirator up to 20 times. The donning procedures of current art respirators, including adjustment and face seal check, are viewed by many wearers as being complex and cumbersome. In some cases wearers forego the donning procedure when it is perceived that the task they are to perform would take less time than the donning procedure. The donning procedure is further complicated by other protective equipment such as goggles, glasses, earmuffs, hats and hard hats that need to be removed in order to don or doff the respirator.

The doffing of current respirators is viewed by many wearers as an equally cumbersome task. In order to remove the respirator, even for short periods, the lower strap must be unbuckled and the cradle lifted off the head as described herein above. A temporary removal, or parking, of the respirator is performed by slipping the cradle off the back of the head and allowing the facepiece to drop in front of the wearer wherein the respirator is supported by the lower strap around the neck of the wearer. Both the complete doffing and the parking of the respirator are further hampered by the inclusion of safety equipment as set forth herein above. While the respirator is in the parked position the buckle typically rubs along the neck of the wearer causing irritation and discomfort. In some prior art respirators, the buckle rubs the neck of the wearer in the donned position because the facepiece, upper straps cradle and lower straps all move with the wearer's head while the neck remains stationary. This rubbing causes similar discomfort to the wearer especially when the wearer's job requires frequent side to side or up and down head motion. Attempts have been made in the prior art to combine the crown strap and the neck strap to eliminate the rubbing problem. In most of the attempts the neck straps and crown straps lack sufficient structure to preclude the combination from collapsing over the ear of the wearer. Another problem with prior art

attempts at combining the straps is the ability to position the straps on top of the head of the wearer far enough to preclude it from falling off while simultaneously avoiding interference with the wearer's peripheral vision.

Yet another problem with prior art respirators is that the straps, usually rectangular in cross section, twist and make it difficult to adjust using the D-rings. Another problem with prior art respirators is that the strap attachments, as well as tightening and release mechanisms, cause point loads in the facepiece making them uncomfortable to the wearer.

SUMMARY OF THE INVENTION

The above-discussed and other drawbacks and deficiencies of the prior art are overcome or alleviated by the respirator headpiece and quick release mechanism of the present invention. The quick release mechanism uses an over center latch pivotly attached to a yoke to control the tension in a pair of upper tension cords. In the latched position the upper tension cords traverse the yoke and together with a pair of lower tension cords support and seal the respirator mask against the face of the wearer. In the unlatched position the upper tension cords loosely support the mask below the chin of the wearer in a parked position. The upper and lower tension cords are attached to a circular shaped headpiece having a crown piece fitting to the top of the head of the wearer and a base portion fitting to the back of the head of the wearer. The headpiece is advantageously comprised of multiple layers wherein the outer layer is comprised of a rigid material and the inner layer is comprised of a compliant material. The rigid layer provides necessary structure to headpiece and the inner layer provides compliance and comfort to the head of the wearer.

The above-discussed and other features and advantages of the present invention will be appreciated and understood by those skilled in the art from the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings wherein like elements are numbered alike in the several FIGURES:

FIGURE 1 is a front perspective view of a respirator in accordance with the present invention showing the latched position;

FIGURE 2 is a perspective illustration of a quick release mechanism;

FIGURE 3 is a perspective illustration of a wearer donning a respirator of the present invention;

FIGURE 4 is a left side view of a respirator of the present invention showing the latch movement;

FIGURE 5 is a perspective illustration of a respirator showing the actuation of the quick release mechanism;

FIGURE 6 is a perspective illustration of a respirator of the present invention in a parked position;

FIGURE 7 is a rear perspective view of a respirator in accordance with the present invention showing a headpiece;

FIGURE 8 is a plan view of the inside surface of a headpiece;

FIGURE 9 is a plan view of the outside surface of the headpiece of FIGURE 8;

FIGURE 10 is a cross sectional view of the headpiece of FIGURE 8 along lines 10-10;

FIGURE 11 is a perspective illustration of alternative embodiment headpiece; and

FIGURE 12 is a perspective view of the headpiece of FIGURE 11 in a preassembled state.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGURE 1 a respirator 1 incorporates a quick release mechanism 2 into a facepiece support system, or yoke, 3. Facepiece 4 is supported by yoke 3 to fit mask portion 5 against the face of a wearer and includes filters 6 positioned on opposite sides. Yoke 3 attaches to facepiece 4 in a removable snap fit fashion against a button type stud (not shown) similar to that of prior art respirators. With filters 6 disposed within cartridge openings 12. Referring to FIGURE 2, quick release mechanism 2 consists of an over center cam latch 7 pivotly attached to yoke 3 via hinge pins 8 disposed within hinge 9 and further includes relief cut 13 to accommodate exhale valve 15 while in the latched position. Hinge 9 serves as the pivot point of latch 7 whereby

the latch is allowed to rotate outward in the direction indicated by arrow 10 to unlatch the respirator and inward in the direction indicated by arrow 11 to latch the respirator as will be more fully explained hereinbelow. The arrangement of hinge pins 8 and hinge 9 described herein is assembled in snap fit fashion allowing for quick and easy manufacture and assembly of the facepiece 4 of the present invention.

As best shown in FIGURE 3 respirator 1 is donned with latch 7 of quick release mechanism in the up and unlatched position by a wearer grasping base portion 30 of headpiece 28 with one hand and facepiece 4 with the other hand. Headpiece 28 is guided over the top of the head wherein base portion 30 is positioned around the back of the head and crown portion 32 is positioned near the top of the head. Simultaneously mask portion 5 of facepiece 4 is guided against the mouth and nose area of the wearer.

As best shown in FIGURE 1 latch 7 of quick release mechanism is rotated in the direction indicated by arrow 11 into the latched position tensioning upper cords 20, 22 and biasing facepiece 4 against the face of the wearer. Upper cords 20, 22 attach to headpiece 28 and run through guide holes 34, 36 in yoke 3 and further pass through lock holes 38, 40 (FIGURE 5) in latch 7. Tightening of respirator 1 is accomplished by pulling on ends 42, 44 of upper cords 20, 22 while latch 7 is in the latched position. Upper cords 22, 24 bind with guide holes 34, 36 and lock holes 38, 40 while in the latched position maintaining tension in the upper cords and biasing the facepiece against the face of the wearer.

The over-center latching feature of quick release mechanism 2 is best shown in FIGURE 4 where, as described herein above, respirator 1 is supported and biased against the face of the wearer by upper tension cords 20, 22 and lower tension cords 24, 26 attached to headpiece 28 fitted over the top and back of the head of the wearer. Hinge 9 allows latch 7 to rotate outward in the direction of arrow 10 from the face and in a downward opposite direction indicated by arrow 11 pulling the ends 42, 44 of the upper cords 20, 22 and increasing the tension in the cords. In the donning operation, latch 7 is moved in the direction of arrow 11 and upper cords 20, 22 are moved therewith from the position designated "A" (unlatched) to the latched position shown in the figure through intermediate positions designated as "B" and "C". As latch 7 is rotated in the direction of arrow 11, upper cords 20, 22 slide through guide holes 34, 36

and cross a line running through the center of the axis of the hinge 10 from guide holes 34, 36 shown as position "C". After latch 7 passes further in the direction of arrow 11 the quick release mechanism cams over to the latched position via the tension in cords 20, 22 wherein the tension in the cords bias latch 7 upwards under the chin area of the facepiece 4. The cords 20, 22 run through guides 34, 36 which are integral with yoke 3 as described herein above. When the latch 7 is in the latched position under the chin of the wearer, cords 20, 22 support facepiece 4 and bias it towards the face of the wearer.

Doffing of respirator 1 is best shown with reference to FIGURE 5 wherein it is shown that latch 7 is unlatched by a user rotating the latch about hinge 9 in the direction indicated by arrow 10. As latch 7 is rotated by a wearer from the latched position to the position indicated as "C" in FIGURE 4 upper cords 20, 22 pass through a line extending from hinge 9 and quick release mechanism 2 cams over into the unlatched position partially by tension in the cords and partially by the weight of the respirator. As described and shown herein, quick release mechanism 2 is actuated simply by applying thumb pressure against latch 7 and rotating the latch in the direction of arrow 10. In addition, respirator 1 in accordance with the present invention can be doffed without the removal of other safety head gear such as, for example, safety glasses 46.

Respirator 1 of the present invention provides for a convenient and comfortable parked position as best shown in FIGURE 6. Once respirator 1 is doffed as described herein before, ends 42, 44 of upper cords 20, 22 move closer to the wearer's face and the effective length of the upper cords is increased and facepiece 4 drops away from the face of the wearer in the direction indicated by arrow 48. In one embodiment, the length of cords 20, 22 between guide holes 34, 36 and their attachment to headpiece 28 increases by 4 inches from the latched to the unlatched position. Respirator 1 is effectively parked without removal of headpiece 28 from the neck or from the top of the head. Donning the respirator 1 from the "parked" position requires that the facepiece 4 be lifted with into position on the face while the cam latch 7 is flipped downward in direction arrow 1 preferable with the use of just one hand.

In a preferred embodiment, the upper cord 20, 22 is comprised of a resilient cord having a substantially circular cross section having the flexibility to trace out the path from headpiece 28 through yoke 3 to latch 7 in both the latched and unlatched

position. Elastic straps of the prior art, as described herein above, having a rectangular cross section are limited to following a geodesic path and are not well suited for this application. In addition, elastic straps, although usable with the present invention, tend to twist and would not bind properly within guide holes 34, 36 and locking holes 38, 40. Lower tension cords 24, 26 are preferably comprised of flat elastic straps as will be more fully described herein below. As best shown in FIGURE 1, upper cords 20, 22 support and seal facepiece 4 against the face of the wearer by spreading the tension load in the cords across the yoke 3 and mask portion 5. Spreading the loads as described creates a tight, yet comfortable, fit and seal of mask portion 5 against the face of the wearer. In addition, it is preferable that mask portion 5 be comprised of a resilient material, such as liquid silicone, rubber, or a thermoplastic elastomer, and that yoke 3 and latch 7 be comprised of a somewhat structural material such as polypropylene.

A preferred method of attaching lower straps 24, 26 to yoke 3 is shown with reference to FIGURES 4 and 7. In the embodiment shown yoke 3 includes a pair of slots 23, 25 forming a cinching mechanism 27 through which lower straps 24, 26 pass. The length of lower straps 24, 26 do not require frequent adjustment but may be adjusted by cinching mechanism 27. Straps 24, 26 are first passed through slot 23 positioned on either side of yoke 3 and then passed through slot 35 as shown. When end 29 is pulled by the wearer face piece 4 is pulled tighter to the wearer's face. Straps 24, 26 are loosened by pulling down on yoke 3 near slot 25. In another embodiment straps 24, 26 are positioned within a common D-ring (not shown) which is attached directly to yoke 3.

The performance of headpiece 28 is best described with reference to FIGURE 7 wherein it is shown that base portion 30 is positioned above the neck of the wearer and crown portion 32 is positioned on the top of the head of the wearer. With crown portion 32 and base portion 30 integrally connected with side portions 50, 52 headpiece 28 forms a continuous ring which rests on top of the head and wraps around the back of the head towards, but preferably not contacting the neck. As will be more fully explained herein below, the embodiment of headpiece 28 shown in FIGURE 7 is comprised of a one piece strap that is adjustably fastened together on crown portion 32 to form the continuous ring described. Because the entire head piece 28 moves with the wearer's head, and the respirator 1, there is no irritation to the back of the neck or to the

back of the head as with prior art respirators. In accordance with the present invention, the attachment of upper cords 20, 22 and lower cords 24, 26 to headpiece 28 may be accomplished in a variety of ways and is shown by way of example in FIGURE 7 as plastic rivets 54 swaged over by a known process such as ultrasonic welding.

The details of an embodiment of headpiece 28 are best shown with reference to FIGURES 8 and 9 wherein it is shown that the headpiece comprises a single strap 60. Base portion 30 is positioned between lower cord attachment loops 62, 64 and side portions 50, 52. Side portions 50, 52 are scalloped between upper cord attachment holes 66, 68 and lower cord attachment loops 62, 64 to allow relief around the ears of a wearer for use with other safety equipment such as protective muffs. As described herein above lower straps 24, 26 may be attached through loops 62, 64 by any suitable method such as sewn, glued, riveted, or looped through a conventional D-ring (not shown) attached to the loops 62, 64. The inside portion of headpiece 28, the side intended to contact the head of a wearer, is shown in FIGURE 8 and includes a hooked fabric fastener patch 70 which releasably fastens to looped fabric fastener patch 72 on the outside surface of the headpiece as shown in FIGURE 9. The position of patches 70, 72 may be reversed as is known without departing from the present invention. In a preferred embodiment, hooked fabric fastener patch 70 and looped fabric fastener patch 72 are comprised of Velcro® material and allow for headpiece 28 to be releasably adjustable to a wearer's head to accommodate a wide range of sizes. Patches 70, 72 are bonded, sewn, or otherwise attached to headpiece strap 60 by methods known in the art. Still referring to FIGURE 8 headpiece 28 includes relief channels 74, 76 which run from the periphery of strap 60 to upper cord attachment loops 66, 68. The channels 74, 76 preclude upper cords 20, 22 (FIGURE 7) from being pressed against the face of the wearer by strap 60.

Strap 60 is shown in one embodiment in FIGURE 10 as constructed from two materials preferably comprising a rigid plastic outer layer 78 and a compressible foam inner layer 80. In a specific embodiment outer layer 78 is comprised of a rigid plastic, such as polyethylene or polypropylene, and inner layer 80 is comprised of an elastomeric foam having a density of about 4 - 8 pounds per cubic foot. The two layers 78, 80 are joined together by a compression molding process, either with or without the use of a bonding agent or adhesive. Outer layer 78 provides headpiece 28 with

sufficient rigidity to preclude collapse of ear portions 50, 52 and inner layer 80 provides compliance and comfort against the head of the wearer. As best shown in FIGURES 8 and 10 the inside portion of strap 60 includes pillows comprised of raised sections 82. The raised sections 82 are preferable molded into inner layer 80 of strap 60 during the compression molding process and represent areas of less compression force. The raised portions 82 provide a softer and thereby a more comfortable contact area against the head of a wearer. The raised portions further provide strap 60 with the directional flexibility necessary to form the strap into ring shaped headpiece 28 as shown in FIGURE 7. In a particular embodiment pillows 82 are .040 inches in height and each layer is .040 in height prior to compression. It is within the scope of the present invention that outer layer 78 of strap 60 includes integrally molded design features such as patterns 84 and logo type indicia 86.

Referring now to Figures 11 and 12 an alternative embodiment headpiece 28 is shown therein including cutouts 88 in both the inner layer 80 and the outer layer 78 of strap 60. The cut outs 88 in each layer align with one another and form passages through strap 60 and serve to provide ventilation and flexibility to the strap. Size adjustment is incorporated into the headpiece 28 by locking tab 90 disposed on inner layer 80 and interlocking with cut outs 88 on the adjustment end 92 of strap 60. Locking tab 90 releasably hooks inside of the plurality of cooperating slots formed by cutouts 88 which when combined with locking tab 24 allow for the aforementioned adjustability for size.

While preferred embodiments have been shown and described, various modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustration and not limitation.

What is claimed is:

CLAIM 1. A quick release mechanism for use with a respirator having a face mask, said quick release mechanism comprising:

a yoke attached to the face mask of the respirator; and

a latch attached to the yoke.

CLAIM 2. A quick release mechanism as set forth in claim 1 wherein the latch is pivotly attached to the yoke at a first end of the latch.

CLAIM 3. A quick release mechanism as set forth in claim 1 wherein the yoke includes at least one opening and wherein the face mask includes at least one filter disposed within the opening.

CLAIM 4. A quick release mechanism as set forth in claim 1 wherein the respirator includes a headpiece, the quick release mechanism further comprising:

a pair of guide holes positioned in the yoke;

a pair of lock holes positioned in the latch at a second end thereof; and

a pair of cords attached to the headpiece, the cords disposed within the guide holes and the lock holes.

CLAIM 5. A quick release mechanism as set forth in claim 4 wherein the cords are comprised of a resilient material having a substantially round cross section.

CLAIM 6. A quick release mechanism as set forth in claim 4 wherein the latch is pivoted from an unlatched position to a latched position, and wherein a tension force is produced in the cords in the latched position biasing the mask against a face of a wearer.

CLAIM 7. A quick release mechanism as set forth in claim 4 wherein the respirator includes a headpiece, the quick release mechanism further comprising:

a pair of attachment points positioned in the yoke; and

a pair of straps attached to the headpiece, the straps disposed at the attachment points.

CLAIM 8. A quick release mechanism as set forth in claim 7 wherein the attachment points each comprise a cinching mechanism comprising a pair of slots.

CLAIM 9. A quick release mechanism as set forth in claim 8 wherein the cinching mechanisms comprise a D-ring attached to the yoke.

CLAIM 10. A quick release mechanism as set forth in claim 1 wherein the yoke is comprised of a rigid plastic material.

CLAIM 11. A quick release mechanism as set forth in claim 1 wherein the latch is comprised of a rigid plastic material.

CLAIM 12. A headpiece for use with a respirator to be worn on a head of a wearer, said headpiece comprising a strap forming a continuous substantially ring shape having a crown portion fitting over a top portion of the head and a base portion fitting over a back portion of the head.

CLAIM 13. A headpiece as set forth in claim 12 wherein the strap comprises a length having a first end and a second end and wherein the first end and second end are releasably attachable to one another to vary the length of the strap forming the continuous ring shape.

CLAIM 14. A headpiece as set forth in claim 13 wherein the strap includes an inside surface and an outside surface and a hooked fastener patch is disposed on either the first end or second end and further on either the inside surface or the outside surface and a looped fastener patch is disposed on the end and on the surface opposite the hooked fastener patch and cooperates with the hooked fastener patch to releasably attach the ends in an overlap fashion.

CLAIM 15. A headpiece as set forth in claim 13 wherein the strap includes a plurality of slots and wherein a hook is attached to either the first end or the second end and the hook cooperates with at least one of the slots to releasably attach the ends in an overlap fashion.

CLAIM 16. A headpiece as set forth in claim 12 wherein the strap comprises at least an inner layer and an outer layer, wherein the inner layer is comprised of a resilient material and the outer layer is comprised of a rigid material.

CLAIM 17. A headpiece as set forth in claim 16 wherein the resilient material is comprised of an elastomeric foam having a density from about 4 pounds per cubic foot to about 8 pounds per cubic foot.

CLAIM 18. A headpiece as set forth in claim 16 wherein the rigid material is comprised of a plastic.

CLAIM 19. A headpiece as set forth in claim 16 wherein the resilient layer includes a plurality of raised portions distributed along the length of the strap.

CLAIM 20. A headpiece as set forth in claim 19 wherein the inner layer and the outer layer are joined in a compression molding process and wherein the raised portions are compression molded thereby.

CLAIM 21. A headpiece as set forth in claim 16 wherein the inner layer and the outer layer are bonded together by a third layer positioned therebetween.

CLAIM 22. A headpiece as set forth in claim 12 further comprising a side portion positioned on opposite sides of the ring between the crown portion and the base portion, each side portion fitting around an ear on the head.

CLAIM 23. A headpiece as set forth in claim 22 wherein the headpiece further comprises an upper cord attachment hole positioned between each of the side portions and the crown portion.

CLAIM 24. A headpiece as set forth in claim 23 wherein the headpiece further comprises a relief channel disposed within the strap from each of the upper cord attachment holes to a periphery of the strap.

CLAIM 25. A headpiece as set forth in claim 22 wherein the headpiece further comprises a lower strap attachment loop positioned between each of the side portions and the base portion.

CLAIM 26. A respirator to be worn on the head of a wearer, the respirator having a face mask portion to seal against the face of the wearer and cartridge type filers mounted on opposing sides of the mask, the respirator comprising:

a yoke attached to the face mask, the yoke having a pair of openings fitting over the filters, a hinge disposed on a front portion of the yoke, and a pair of guide holes positioned in the yoke;

a latch pivotally attached to the hinge, the latch pivoting between an unlatched and latched position and having a pair of lock holes positioned at an end opposite the attachment;

a headpiece forming a continuous substantially ring shape having a crown portion fitting over a top portion of the head, a base portion fitting over a back portion of the head, a side portion positioned on opposite sides of the ring between the crown portion and the base portion, an upper cord attachment hole positioned between each of the side portions and the crown portion, and a lower strap attachment loop positioned between each of the side portions and the base portion;

a pair of upper cords attached to the headpiece at the upper attachment holes and passing through the guide holes and the lock holes; and

a pair of lower straps disposed between the lower strap attachment loops and a pair of attachment points positioned at a bottom portion of the yoke.

CLAIM 27. A respirator as set forth in claim 26 wherein the cords are comprised of a resilient material having a substantially round cross section.

CLAIM 28. A respirator as set forth in claim 26 wherein a tension force is produced in the cords in the latched position biasing the face mask against a face of a wearer and sealing the face mask to the face thereby.

CLAIM 29. A respirator as set forth in claim 26 wherein the attachment points each comprise a cinching mechanism comprising a pair of slots.

CLAIM 30. A respirator as set forth in claim 28 wherein the cinching mechanisms comprise a D-ring attached to the yoke.

CLAIM 31. A respirator as set forth in claim 26 wherein the yoke is comprised of a rigid plastic material.

CLAIM 32. A respirator as set forth in claim 26 wherein the latch is comprised of a rigid plastic material.

CLAIM 33. A respirator as set forth in claim 26 wherein the headpiece comprises a strap having a length, a first end and a second end and wherein the first end and second end are releasably attachable to one another to vary the length of the strap forming the continuous ring shape.

CLAIM 34. A respirator as set forth in claim 33 wherein the strap includes an inside surface and an outside surface and a hooked fastener patch is disposed on either the first end or second end and further on either the inside surface or the outside surface and a looped fastener patch is disposed on the end and on the surface opposite the hooked fastener patch and cooperates with the hooked fastener patch to releasably attach the ends in an overlap fashion.

CLAIM 35. A respirator as set forth in claim 34 wherein the strap includes a plurality of slots and wherein a hook is attached to either the first end or the second end and the hook cooperates with at least one of the slots to releasably attach the ends in an overlap fashion.

CLAIM 36. A respirator as set forth in claim 33 wherein the strap comprises at least an inner layer and an outer layer, wherein the inner layer is comprised of a resilient material and the outer layer is comprised of a rigid material.

CLAIM 37. A respirator as set forth in claim 36 wherein the resilient material is comprised of an elastomeric foam having a density from about 4 pounds per cubic foot to about 8 pounds per cubic foot.

CLAIM 38. A respirator as set forth in claim 36 wherein the rigid material is comprised of a plastic.

CLAIM 39. A respirator as set forth in claim 36 wherein the resilient layer includes a plurality of raised portions distributed along the length of the strap.

CLAIM 40. A respirator as set forth in claim 39 wherein the inner layer and the outer layer are joined in a compression molding process and wherein the raised portions are compression molded thereby.

CLAIM 41. A respirator as set forth in claim 36 wherein the inner layer and the outer layer are bonded together by a third layer positioned therebetween.

CLAIM 42. A respirator as set forth in claim 36 wherein the headpiece further comprises a relief channel disposed within the inner layer from each of the upper cord attachment holes to a periphery of the strap.

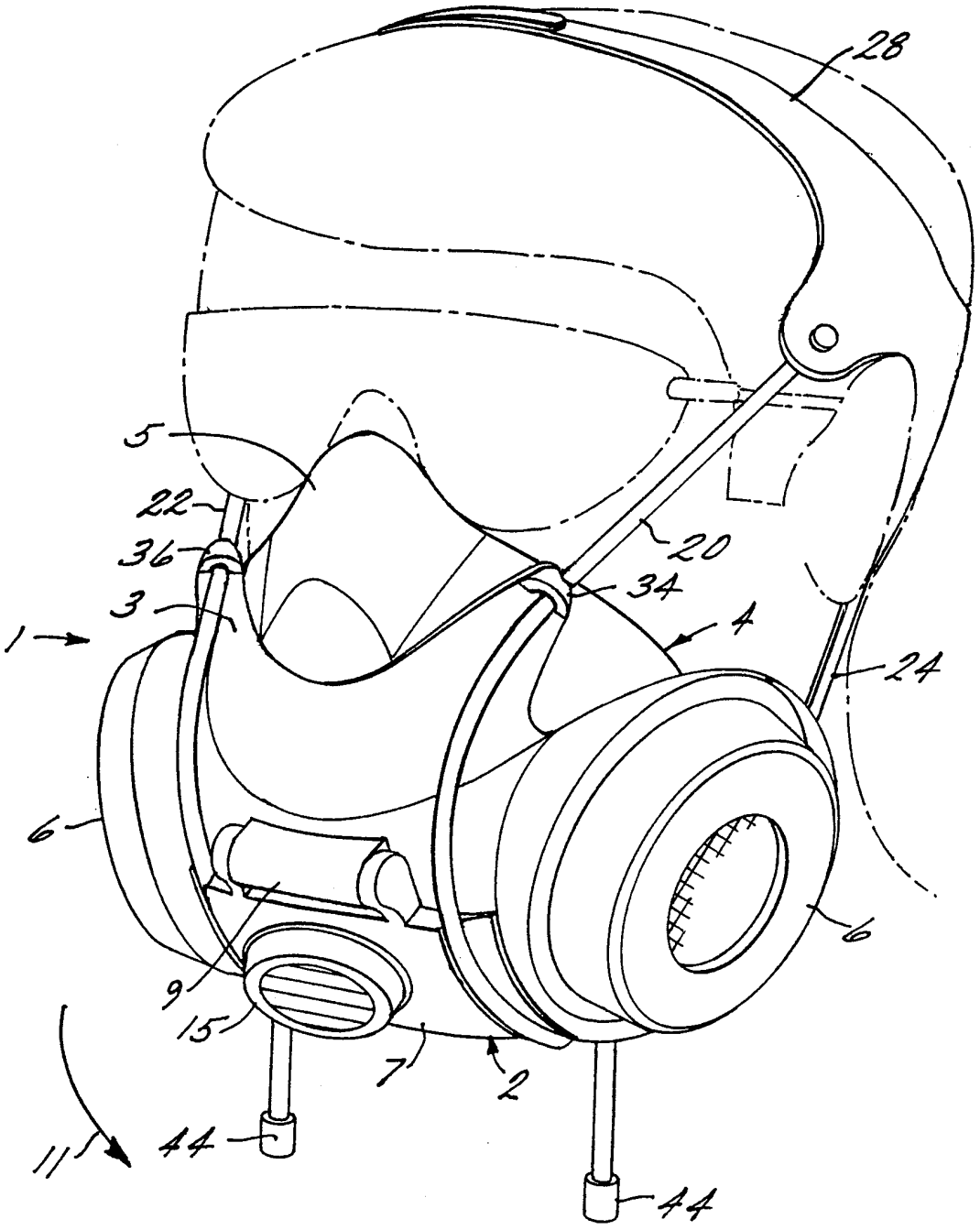


FIG. 1

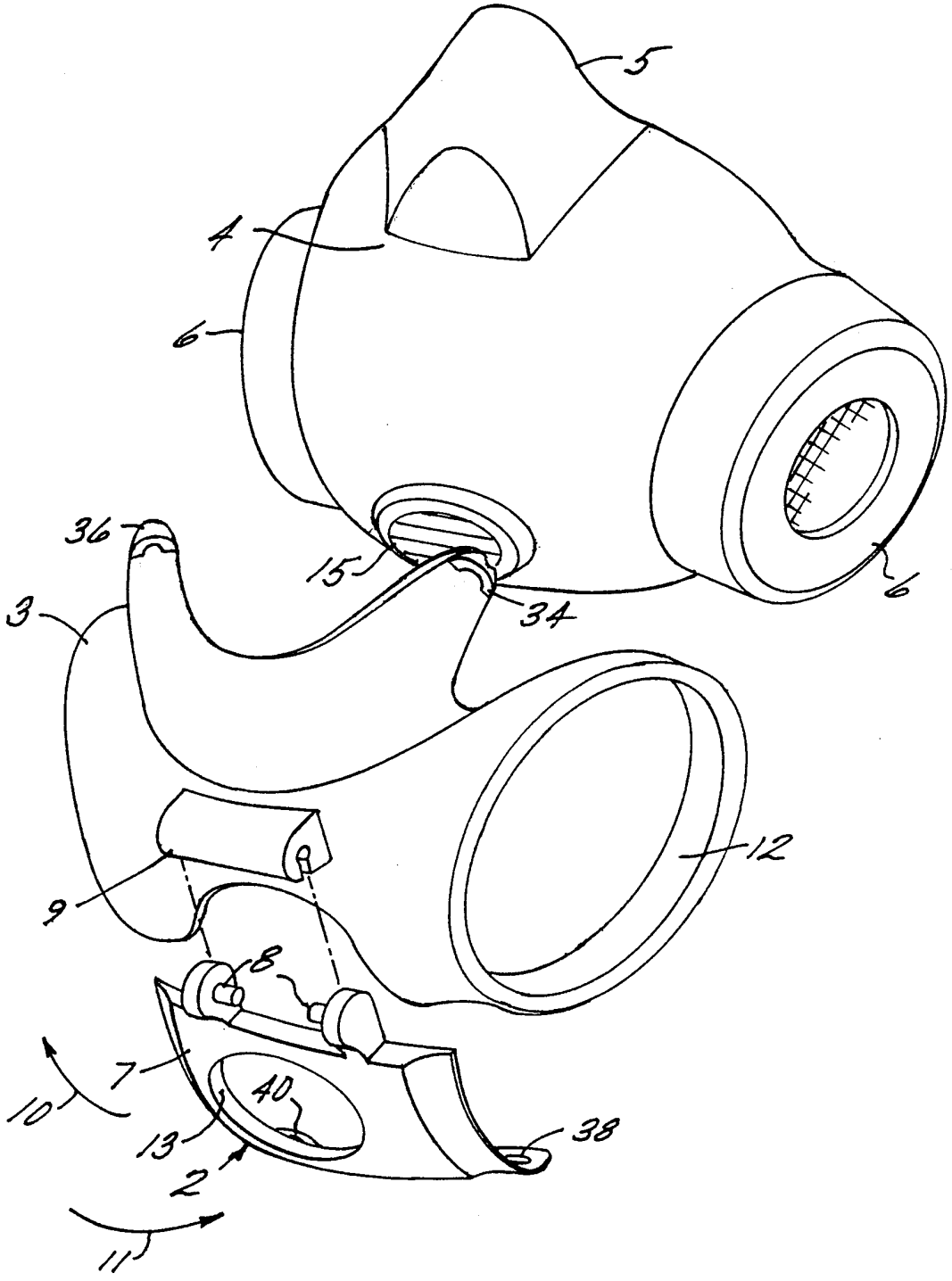


FIG. 2

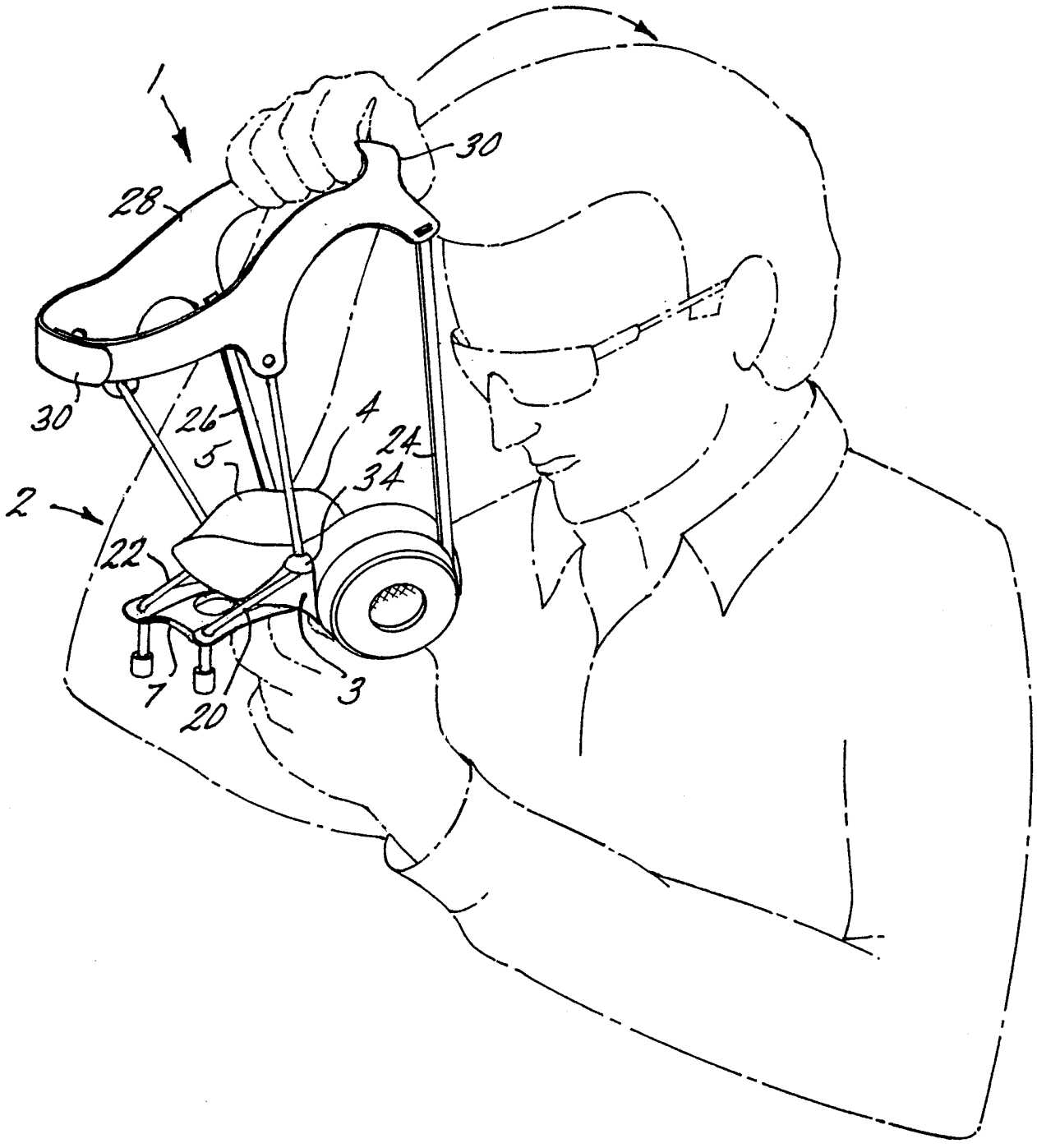
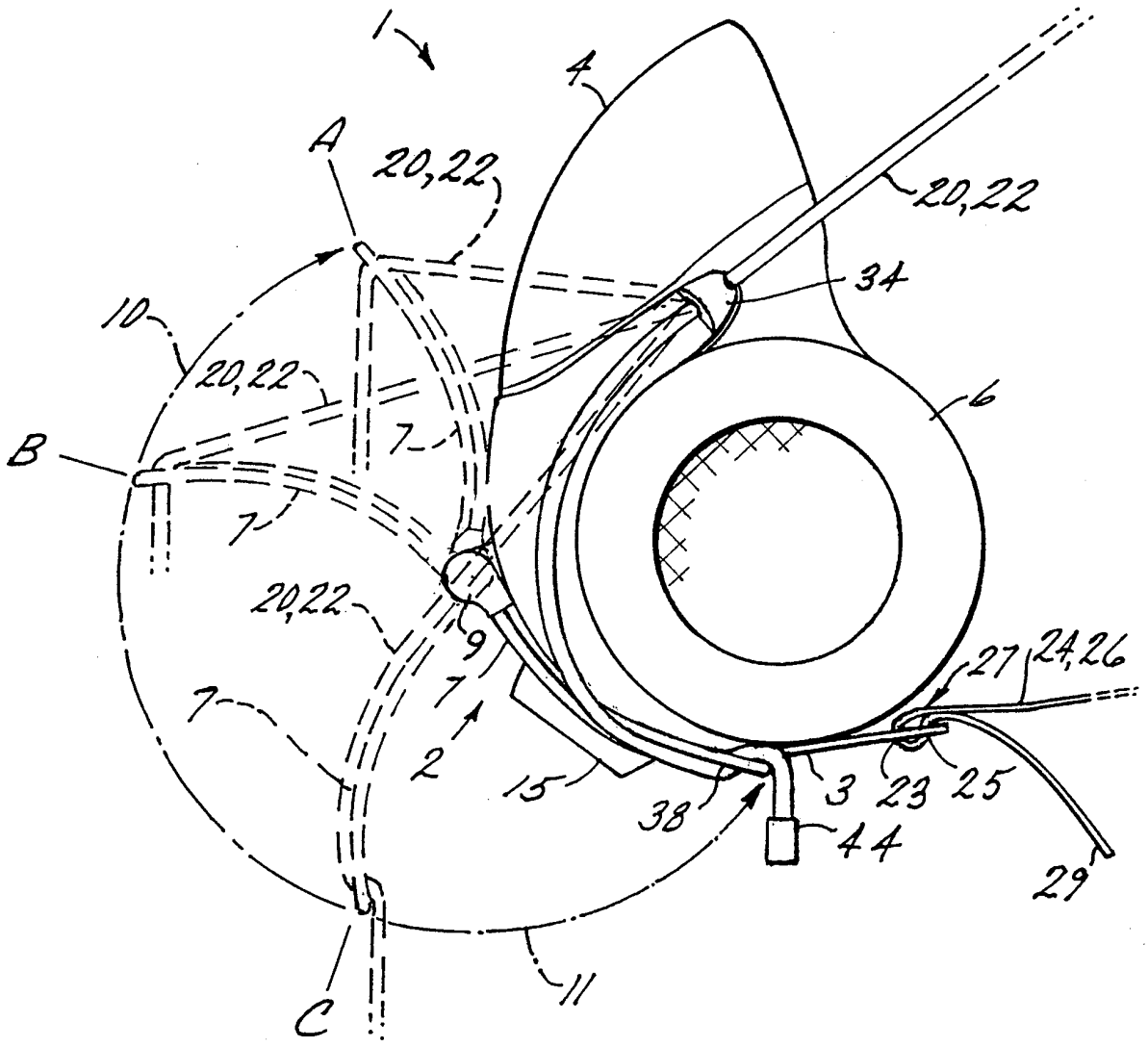


FIG. 3


1
4
A
20,22
20,22
34
10
20,22
6
B
7
7
20,22
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38
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23
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24,26
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C
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FIG. 4

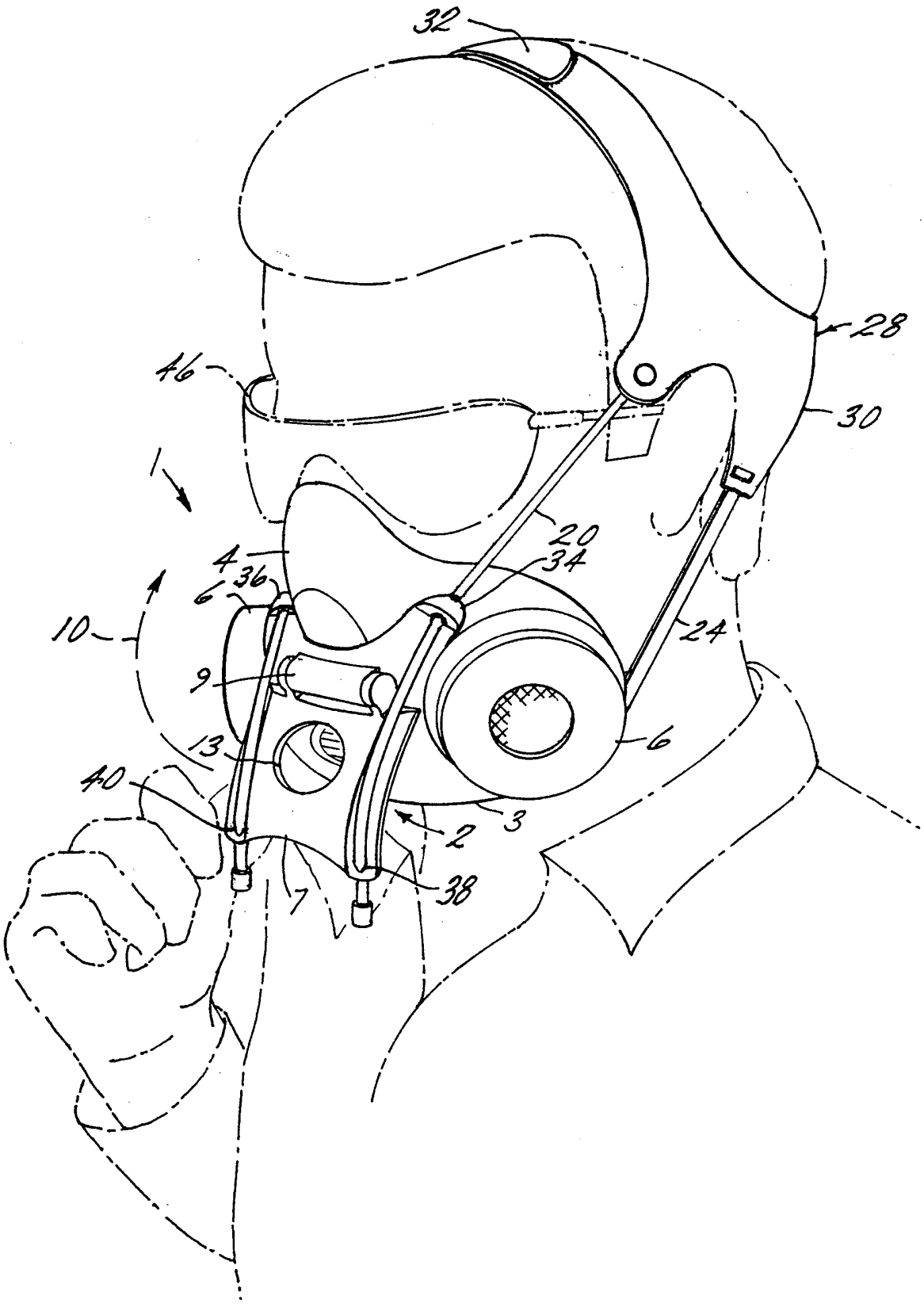

FIG. 5

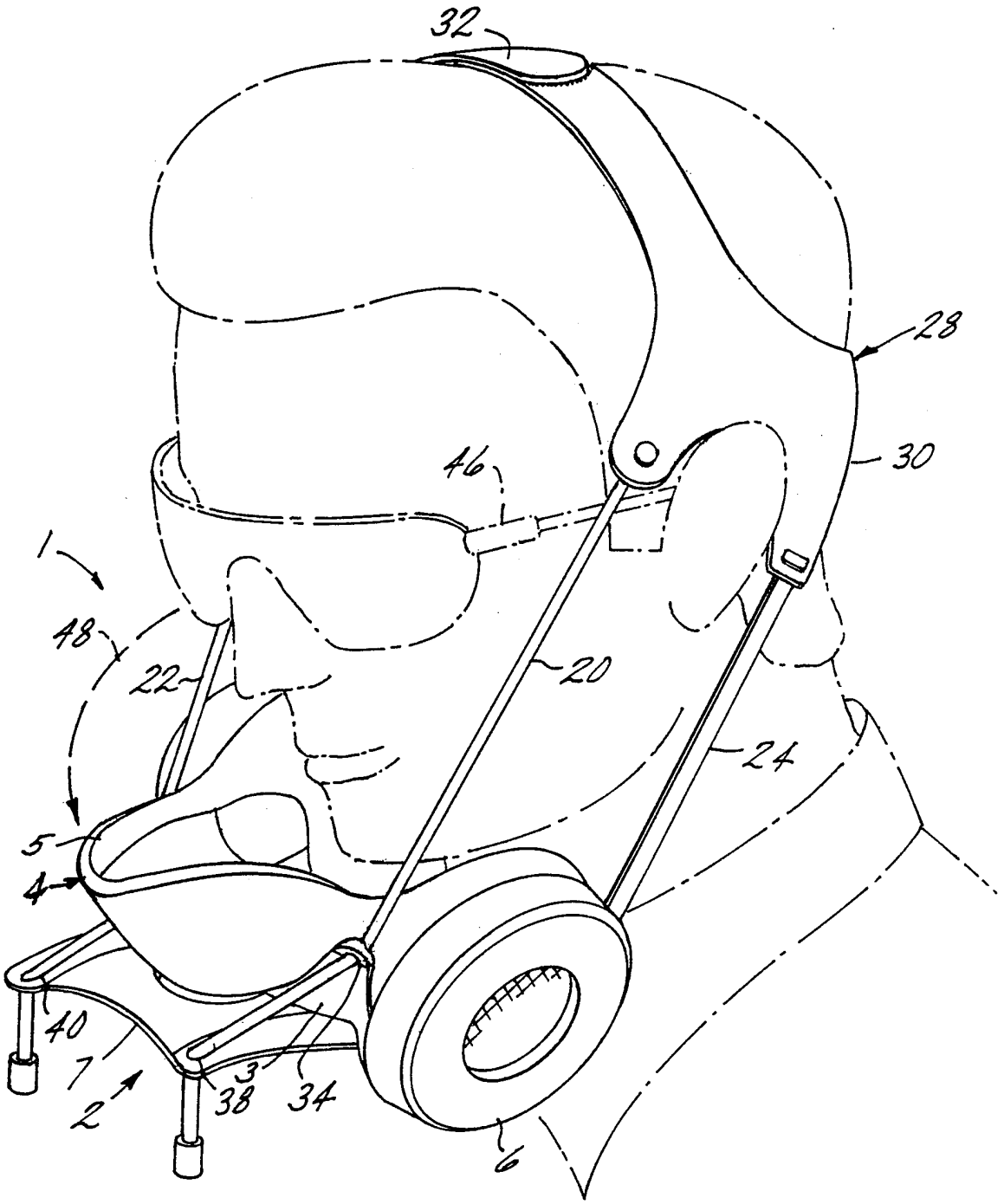

FIG. 6

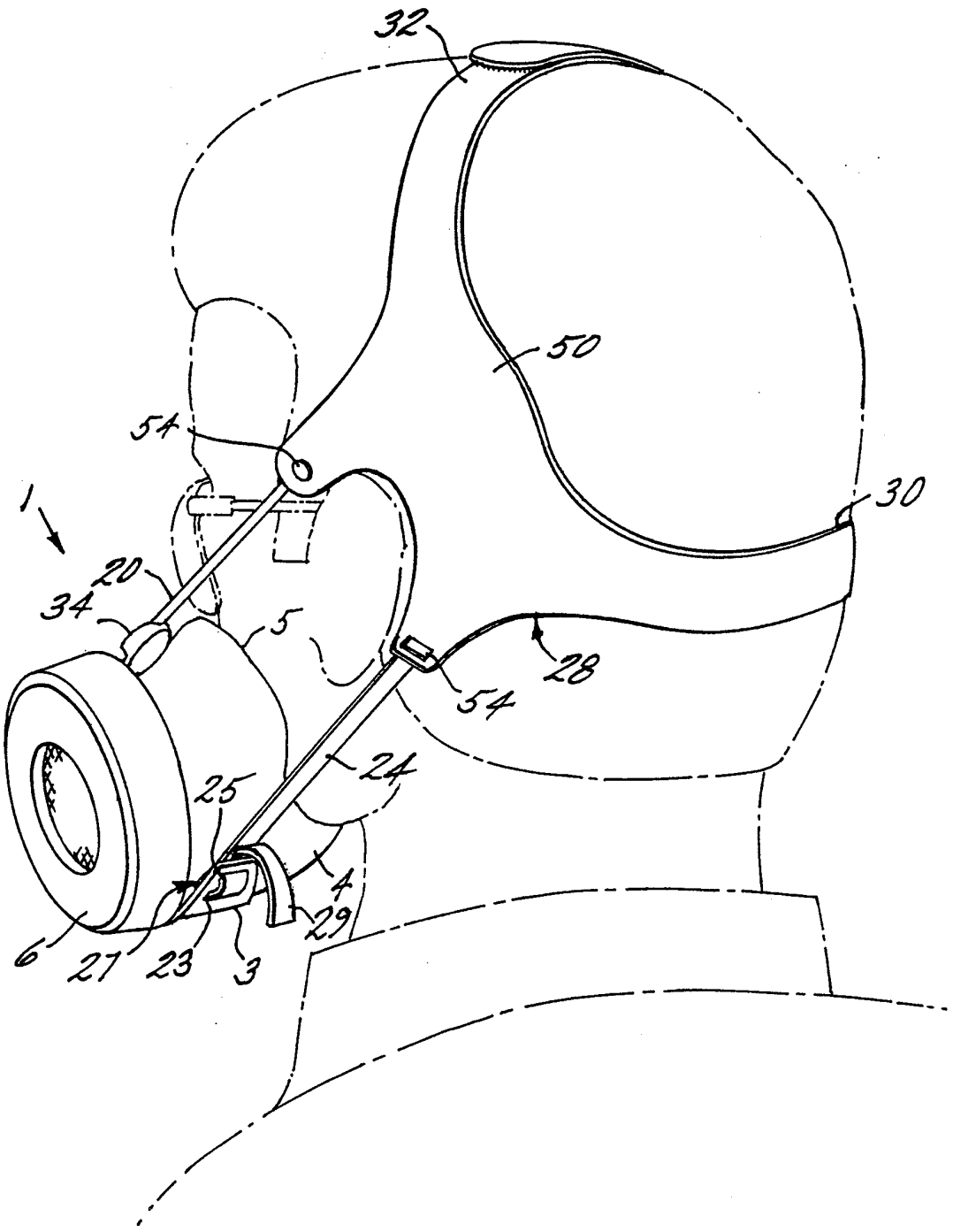

FIG. 7

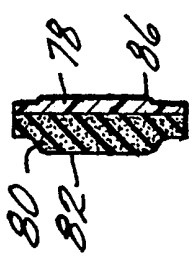

FIG. 10

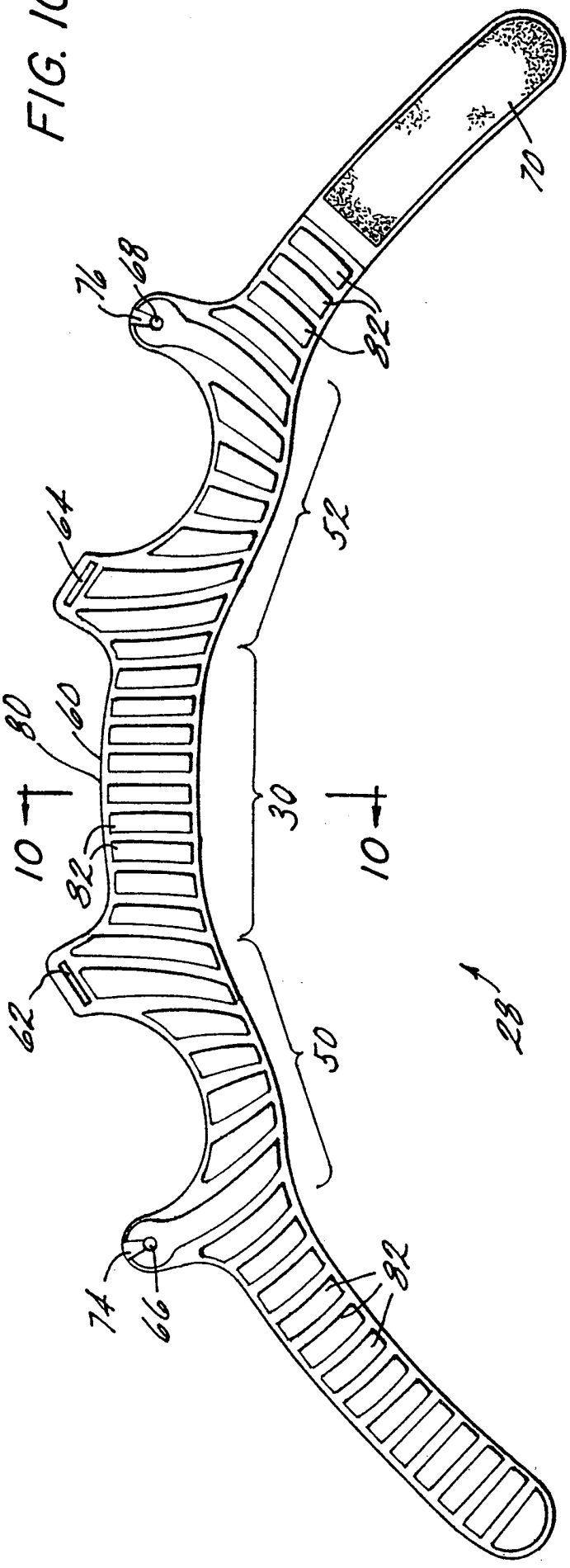

FIG. 8

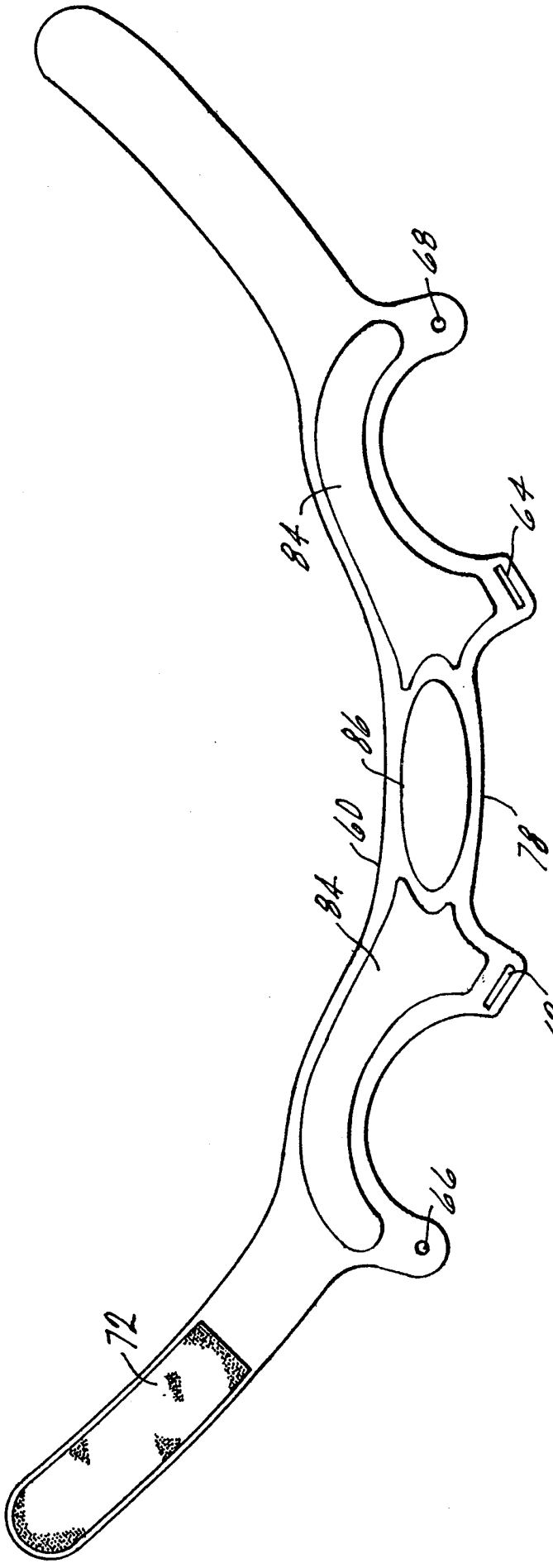

FIG. 9

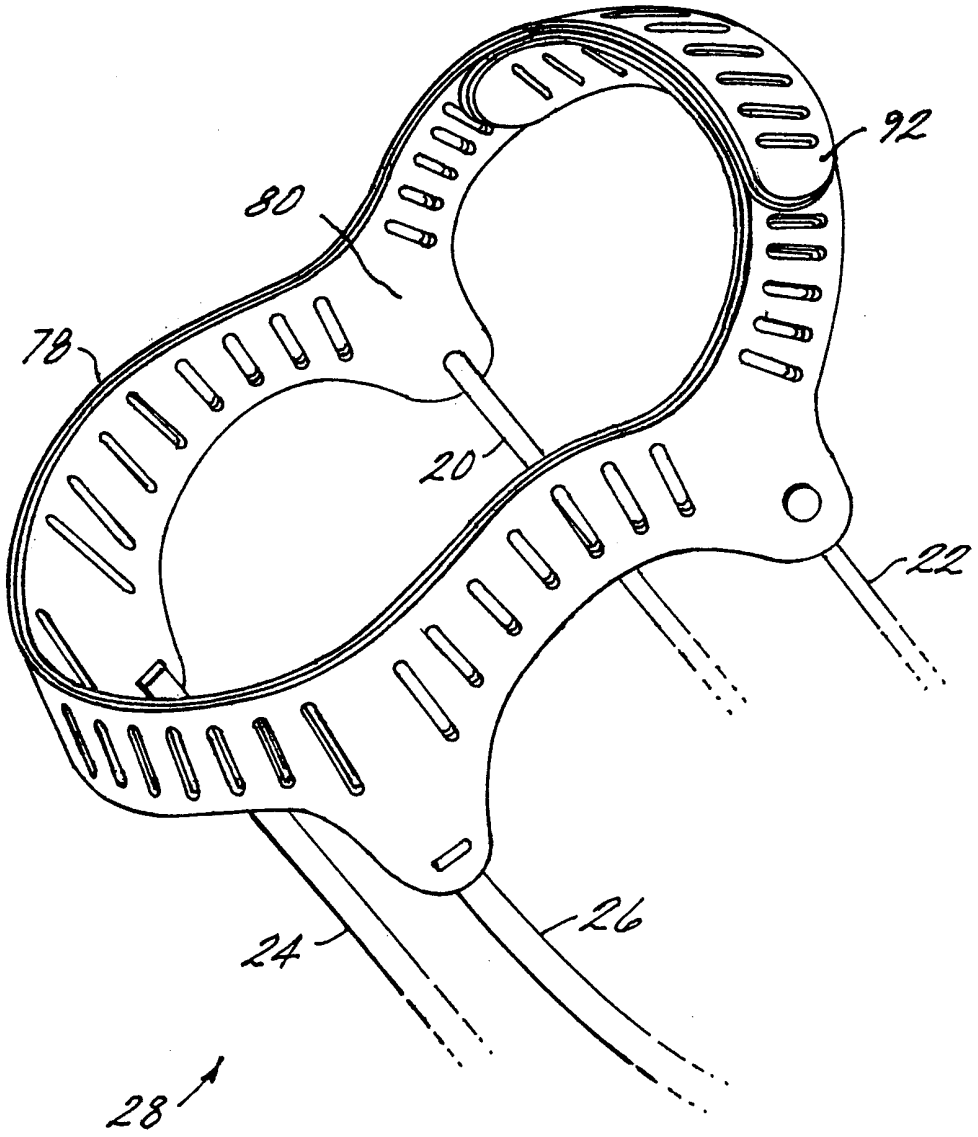

FIG. 11

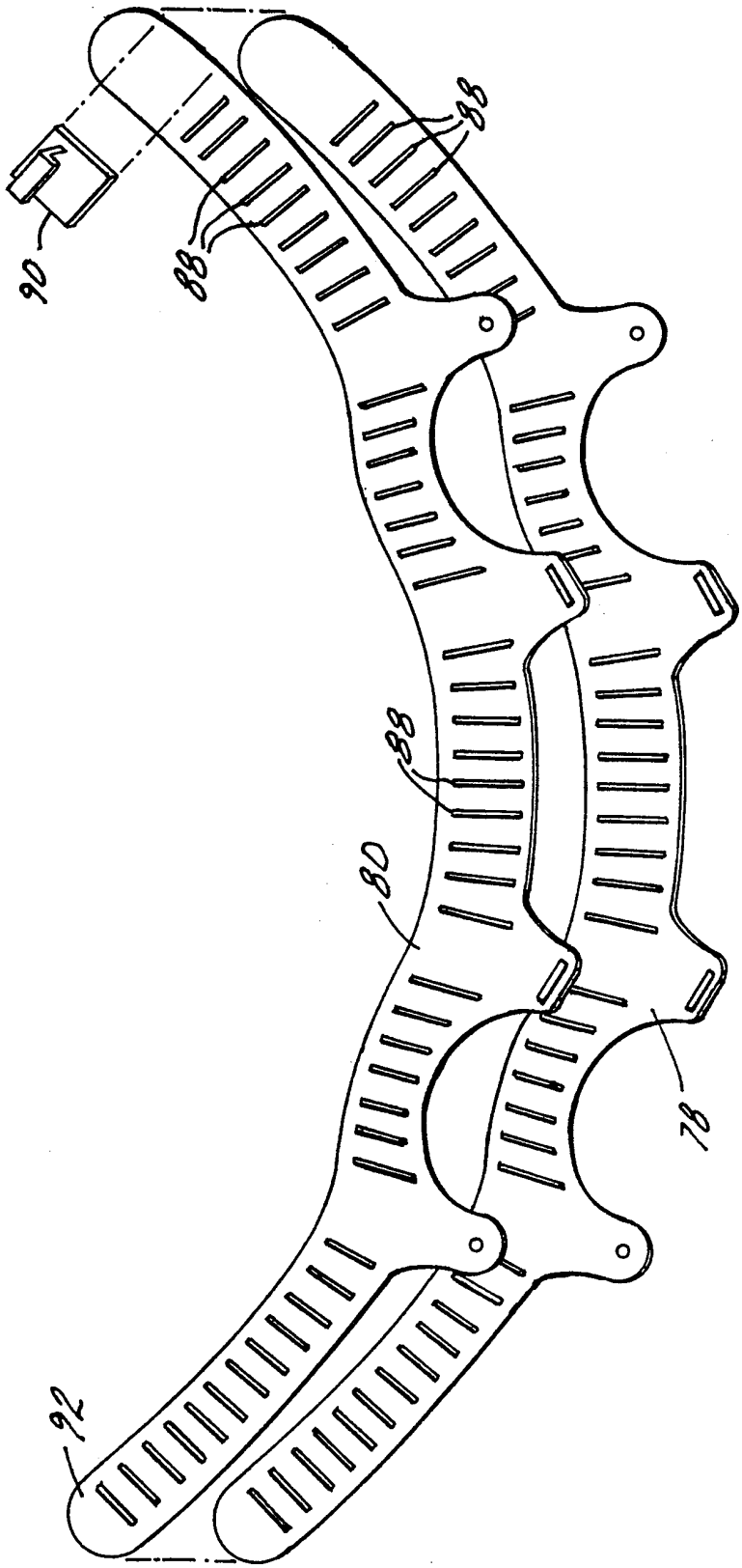

FIG. 12

INTERNATIONAL SEARCH REPORT

Inter ›nal Application No
PCT/US 00/03158

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A62B18/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A62B A61M A41D

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 880 942 A (SIERRA ENGINEERING CO) 25 October 1961 (1961-10-25) abstract; figures	1-42
A	US 3 040 741 A (CAROLAN R J) 26 June 1962 (1962-06-26) abstract; figures	1-42
A	US 4 960 121 A (NELSON JAMES E ET AL) 2 October 1990 (1990-10-02) abstract; figures	1-42
A	US 3 599 635 A (ANSITE WILLIAM KENNETH) 17 August 1971 (1971-08-17) abstract; figures	1-42

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° 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	Date of mailing of the international search report
10 May 2000	19/05/2000

Name and mailing address of the ISA	Authorized officer
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	Ottesen, R

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Form PCT/ISA/210 (second sheet) (July 1992)

Inter nal Application No
PCT/US 00/03158

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 062 421 A (BURNS JAMES A ET AL) 5 November 1991 (1991-11-05) abstract; figures	1-42
A	US 5 592 937 A (FREUND PAUL X) 14 January 1997 (1997-01-14) abstract; figures	1-42
A	US 4 934 361 A (KLINE JAMES P ET AL) 19 June 1990 (1990-06-19) abstract; figures	1-42

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 00/03158

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims : 1-11, 26-42

A quick release mechanism for use with a respirator.

2. Claims : 12-25

A headpiece for use with a respirator.

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter nal Application No
PCT/US 00/03158

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 880942 A		NONE	
US 3040741 A	26-06-1962	NONE	
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US 3599635 A	17-08-1971	NONE	
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US 5592937 A	14-01-1997	AU 5738196 A CN 1184434 A EP 0830180 A JP 11506621 T WO 9640370 A	30-12-1996 10-06-1998 25-03-1998 15-06-1999 19-12-1996
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