



(51) International Patent Classification:

A62B 9/04 (2006.01) A45F 3/10 (2006.01)
A45F 3/08 (2006.01)

(21) International Application Number:

PCT/CN2011/000572

(22) International Filing Date:

1 April 2011 (01.04.2011)

(25) Filing Language:

English

(26) Publication Language:

English

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(81) Designated States (unless otherwise indicated, for every

kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every

kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: IMPROVED ROTATIONAL WAIST PAD FOR SELF CONTAINED BREATHING APPARATUS HARNESSES

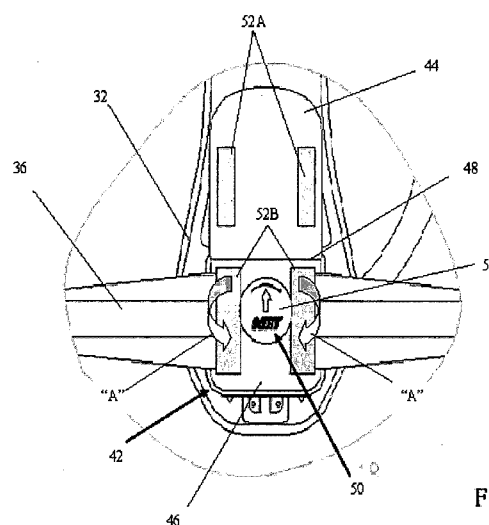


Fig. 4

(57) Abstract: A rotational waist pad assembly is disclosed for use in self contained breathing apparatus harnesses. The waist pad assembly includes a plurality of plate members that enable a discrete pad member to rotate with respect to the harness during use. This rotation enables the waist pad to remain stationary with respect to the user's lower back, while still enabling the harness to rotate as necessary according to the user's movements. The plurality of plate members are configured to engage each other so that a discrete and selectable amount rotation is enabled between the waist pad assembly and the harness. In one embodiment, the waist pad assembly can rotate about 60-degrees with respect to the harness. The plurality of plate members is enclosed in a pad to ensure user comfort.

WO 2012/129737 A1

IMPROVED ROTATIONAL WAIST PAD FOR SELF CONTAINED BREATHING APPARATUS HARNESSSES

5 Field of the Disclosure

[0001] The disclosure is generally related to the field of self contained breathing apparatuses, and more particularly to a rotational waist pad assembly for use in self-contained breathing apparatus harnesses.

10 Background of the Disclosure

[0002] Self-contained breathing apparatuses (“SCBA’s”) are commonly worn by individuals when carrying out activities in hazardous environments, such as when fighting fires and in other smoke- or gas-filled environments, in order to provide the wearer with breathable air. Conventional SCBA’s generally include a face piece, a pressurized gas cylinder, and a hose. The face piece, which covers the wearer’s nose, mouth and eyes and includes a lens for external viewing, is supplied with air from the cylinder via the hose. The cylinder is secured to the wearer's body by a harness.

20 [0003] Typical SCBA harnesses include a belt and shoulder straps, which allow the cylinder and associated hoses, regulators, etc. to be worn in a backpack style. Some pressurized gas cylinders can weigh thirty or more pounds (with associated equipment such as regulators, hoses, etc. adding even more weight). Such weight can render typical SCBA harnesses
25 uncomfortable for long term use. Furthermore, such harnesses cannot rotate or otherwise adjust to accommodate normal body movements of the wearer. This can lead to further discomfort.

[0004] In addition, typical SCBA harnesses cannot regulate weight

forces applied against the wearer's waist region. Such unregulated forces can cause premature fatigue for the wearer.

[0005] It would, therefore, be desirable to provide a SCBA harness design that facilitates automatic rotary movement of the lower portion of the harness to match the wearer's normal lower body movement during use. Such a design should regulate weight forces applied to the wearer, should protect the wearer's waist region, and should improve working efficiency. Such a design should also be simple so that the harness can be used comfortably and conveniently.

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Summary of the Disclosure

[0006] A rotational waist pad assembly is disclosed for use in self contained breathing apparatus harnesses. In some embodiments, the waist pad assembly includes a belt portion to secure the associated SCBA to the user's waist. The waist pad assembly includes a plurality of inter-engaged elements that enable the waist pad assembly to rotate with respect to the harness during use. This rotation enables the waist pad assembly to remain stationary with respect to the user's waist and lower back while enabling the harness to rotate as necessary according to the user's movements. The plurality of inter-engaged elements are configured to allow a predetermined range of rotation between the waist pad assembly and the harness. In one embodiment, the waist pad assembly can rotate about 60-degrees with respect to the harness. The plurality of inter-engaged elements can be enclosed in padding for user comfort. Other embodiments are described and claimed.

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[0007] A self-contained breathing apparatus harness is disclosed, comprising a back plate, and a waist pad portion comprising a pad portion, a rotational plate, and an outer fixing cover. The pad portion may be fixed to the rotational plate. The rotational plate may be disposed between the back

plate and the outer fixing cover. The outer fixing cover may have a protrusion engaged with an opening in the back plate to axially fix the outer fixing cover, the rotational plate, and the pad portion to the back plate while allowing the rotational plate and the pad portion to rotate with respect to the
5 back plate.

[0008] A self-contained breathing apparatus harness is disclosed, comprising a back plate for engaging a gas cylinder, a pair of shoulder straps connected to the back plate, a belt portion connected to the back plate, and a waist pad portion connected to the belt portion. The waist pad portion may
10 comprise a pad portion fixed to a rotational plate, and an outer fixing cover. The rotational plate may be disposed between the back plate and the outer fixing cover. The outer fixing cover may include a protrusion disposed within an opening in the back plate. The protrusion may axially fix the outer fixing cover, the rotational plate, and the pad portion to the back plate while
15 enabling the rotational plate and the pad portion to rotate with respect to the back plate.

[0009] A waist pad assembly is disclosed for use with a self-contained breathing apparatus harness. The waist pad assembly comprises a waist pad portion including a pad portion, a rotational plate and an outer fixing cover.
20 The rotational plate may be fixed to the pad portion. The rotational plate may be disposed between a back plate of a self-contained breathing apparatus harness and the outer fixing cover. The outer fixing cover may include a protrusion disposed within an opening in the back plate. The protrusion may axially fix the outer fixing cover, the rotational plate, and the pad portion to
25 the back plate while enabling the rotational plate and the pad portion to rotate with respect to the back plate.

Brief Description of the Drawings

[0010] By way of example, a specific embodiment of the disclosed

device will now be described, with reference to the accompanying drawings:

[0011] FIG. 1 is a block diagram of a self-contained breathing apparatus;

[0012] FIG. 2 is a view of the self-contained breathing apparatus of
5 FIG. 1 mounted on the disclosed harness;

[0013] FIG. 3 is a view illustrating the wearer side of the disclosed harness, including an exemplary rotational mechanism;

[0014] FIG. 4 shows an isolated view of the disclosed rotational pad assembly with the cover open showing the rotation assembly;

10 [0015] FIG. 5 is an exploded isometric view of the disclosed rotational pad assembly and the harness structure;

[0016] FIG. 6 is a reverse exploded isometric view of the disclosed rotational pad assembly and the harness structure shown in FIG. 5;

[0017] FIG. 7 shows a plan view of a back plate portion of the
15 disclosed harness;

[0018] FIGS. 8A-8F show a variety of views of an outer fixing cover of the disclosed rotational pad assembly;

[0019] FIGS. 9A and 9B show the stages of inter-engagement between an outer fixing cover and the back plate.

20 [0020] FIG. 10 shows a plan view of a rotational plate of the disclosed rotational pad assembly;

[0021] FIG. 11 is a view showing the rotational interaction between the rotational plate and the harness back plate; and

[0022] FIGS. 12A-12D show a variety of views of an inner cover of
25 the disclosed rotational pad assembly.

Detailed Description

[0023] The disclosed harness design is a rotary feature incorporated into a SCBA harness that carries the entire SCBA assembly and also provides

self-adjusting rotation of the assembly to follow the normal body movements of the wearer.

[0024] FIG. 1 is a schematic diagram of a self-contained breathing apparatus ("SCBA") 10 carried by firefighters, other emergency services workers, and the like. The SCBA 10 includes an air cylinder 20, one or more pressure reducers or regulators 22, 24, a face piece 26, and a hose assembly 30. The air cylinder 20 is a pressurized cylinder or tank that provides a supply of breathing air to the wearer. In one embodiment the tank 20 may be of a type that initially holds air at a pressure of about 316.4 kilograms/square centimeter (4,500 PSIG). The air cylinder 20 may include a conventional outlet valve 21 and pressure gauge (not shown). The air cylinder 20, outlet valve 21, pressure reducers or regulators 22, 24 and other equipment can be loaded on a user's back using a harness 32 (FIG. 2), and the face piece 26 can be placed over the user's face such that it covers the user's mouth, nose or both, in conventional fashion. The hose assembly 30 is arranged to extend comfortably between the pressure reducer 22 and the face piece 26, without interfering with the user's natural movements.

[0025] FIG. 2 shows the SCBA of FIG. 1 mounted on an exemplary harness 32. The harness 32 may include a back plate 34 (see FIG. 3), a belt portion 36 and a pair of shoulder straps 38. One end of the cylinder 20 may be connected to a lower end of the back plate 34 adjacent to the outlet valve 21. A body portion of the cylinder 20 may be connected to an upper end of the back plate 34 via a strap 40. The strap 40 may be loosened (i.e., to mount the cylinder on the harness), and tightened (i.e., to fix the cylinder to the harness during use), via a clamp mechanism (not shown). In this way, the cylinder 20 can be worn by a user in a manner similar to a backpack.

[0026] Referring now to FIGS. 3-11, the disclosed rotational waist pad feature will be described in greater detail. As noted, this feature enables the

waist pad 42 and belt portion 36 of the harness 32 to rotate with respect to the back plate 34. Such rotational freedom allows the waist pad 42 and belt portion 36 to remain substantially stationary with respect to the wearer's waist, while the back plate 34 and the remainder of the harness 32 rotate along with
5 the wearer's upper body.

[0027] FIG. 3 shows a wearer-side view of the harness 32, including back plate 34, belt portion 36, waist pad portion 42, shoulder straps 38, face piece 26 and hose assembly 30. The cylinder 20 is not shown in this view.

[0028] FIG. 4 shows a detail view of the back plate 34, waist pad
10 portion 42 and belt portion 36 in a partially disassembled condition. As can be seen, the waist pad portion 42 may include a pad portion 44 and a mechanism engaging portion 46 connected together by a hinge 48. The hinge 48 enables the pad portion 44 to be flipped up to expose the rotation mechanism 50. During use, the pad portion 44 is folded down to cover the
15 rotation mechanism 50. The pad portion 44 can be secured in the closed or covered position using any of a variety of fastening techniques such as hook and loop fasteners (i.e., Velcro), snaps, buttons and the like. In the illustrated embodiment, the pad portion 44 is secured using corresponding
20 pairs of Velcro strips 52A, B.

[0029] Since the pad portion 44 will be in contact with the wearer's lower back during use, it can include padding as desired to enhance comfort. In one embodiment, the pad portion is made of scale-board, cloth and sponge, sewn together.

[0030] Arrows "A" show the rotational freedom that the mechanism 50
25 provides the waist pad portion 42 with respect to the back plate 34. As will be described in greater detail later, rotation between the waist pad portion 42 and the back plate 34 may be provided within a limited range so that the back plate 34 (and attached cylinder 20) will not over-rotate with respect to the

waist pad portion 42.

[0031] FIGS. 5 and 6 show the arrangement of elements that facilitate the disclosed rotational waist pad feature. As can be seen, the back plate 34 is sandwiched between an inner cover 54, a rotation plate 56, and an outer fixing cover 58. For clarity, the pad portion 44 is not shown in these figures. It will be appreciated, however, that when assembled for use the rotation plate 56 is fixed to the mechanism engaging portion 46 (*see* FIG. 4) of the waist pad portion 42. In some embodiments, the rotation plate 56 is sewn into the mechanism engaging portion 46, though other fixing techniques can also be used, such as laminating and the like.

[0032] As will be described in greater detail later, the outer fixing cover 58 includes a protrusion 60 that extends through an opening 62 in the rotation plate 56 and engages the back plate 34 to axially fix the cover 58 and rotation plate 56 to the back plate 34. This connection, while fixing the parts in axial relation to each other, allows the rotation plate 56 to rotate with respect to the back plate 34 in the directions indicated by arrows "A" in FIG. 4.

[0033] Inner cover 54 includes one or more connectors 63 that enable the inner cover to snap into engagement with the outer fixing cover 58. The inner cover 54 provides a smooth finished surface to the cylinder-engaging side of the back plate 34.

[0034] FIG. 7 is a detail view of a lower portion of the back plate 34 shown in FIGS. 5 and 6. A variety of the functional aspects of the back plate 34 can be seen, including central opening 64, first and second rotation keys 66A, B and locking key 68.

[0035] The central opening 64 in the back plate 34 is circular, with first and second flat side portions 70A, B. The flat side portions 70A, B are sized to allow the protrusion 60 of the outer fixing cover 58 to pass through the

opening 64, and then to lock against the flat side portions 70A, B when the fixing cover 58 is rotated.

[0036] As can be seen in FIGS. 8A – 8F, the protrusion 60 of the outer fixing cover 58 has first and second flat sides 72A, 72B which correspond to the flat portions 70A, B of the central opening 64 in the back plate 34. The protrusion 60 also has a pair of lips 74A, B defined by the rounded portions 76A, B of the protrusion 60. During assembly, the protrusion 60 of the outer fixing cover 58 can be aligned with the central opening 64 in the back plate 34 so that the corresponding flat sides 72A, B of the cover 58 align with the flat side portions 70A, B of the central opening. So aligned, the protrusion 60 can be pressed through the central opening 64 until the lips 74A, B pass through the opening. This position is shown in FIG. 9A.

[0037] The outer fixing cover 58 can then be rotated so that the lips 74A, B lock behind the flat side portions 70A, B of the central opening 64. The inter-engagement of the lips 74A, B and the flat side portions 70A, B thereby locks the outer fixing cover 58 to the back plate 34. This locked position is shown in FIG. 9B.

[0038] In order to maintain the lips 74A, B locked to the flat portions 70A, B of the central opening 64, the locking key 68 of the back plate 34 may be received within a locking recess 78 formed in one of the rounded portions 76A, B of the protrusion 60. In the illustrated embodiment the locking recess 78 is formed in the second rounded portion 76B of the protrusion 60. As will be appreciated, this locking recess 78 prevents over-rotation of the outer fixing cover 58 with respect to the back plate 34, ensuring that the outer fixing cover 58 remains locked to the back plate 34.

[0039] Referring again to FIG. 7, the rotation enabling/limiting feature of the waist pad portion 42 will be described in greater detail. As previously noted, the back plate 34 can include first and second rotation keys 66A, B

disposed on a side of the back plate facing the rotation plate 56 (*see* FIGS. 5 and 6) when assembled. The rotation keys 66A, B comprise discrete protrusions configured to be received within recesses 80A, B (*see* FIG. 10) of the rotation plate 56 during operation. As shown in FIGS. 10 and 11, the recesses 80A, B in the rotation plate 56 enable the rotation plate (and the waist pad portion 42) to rotate by a predetermined amount with respect to the back plate 34. As noted, limiting the relative rotation between pieces may be important because, although it is desirable to enable the waist pad portion 42 to rotate with respect to the back plate 34, it is equally desirable that the back plate 34 (and attached cylinder 20) not be permitted to over-rotate with respect to the waist pad portion 42. Thus, in the illustrated embodiment, recesses 80A, B each form a pair of stop surfaces 82A, 82B which abut the first and second rotation keys 66A, B when the rotation plate 56 is rotated with respect to the back plate 34 (or vice versa) by a maximum desired amount. In the illustrated embodiment, this maximum rotation is about 60-degrees (as shown by angle α (FIG. 11)). Thus, the illustrated arrangement allows the waist pad portion 42 and belt portion 36 to rotate about 60-degrees in either direction with respect to the back plate 34 and remainder of the harness 32. It will be appreciated that the device is not limited in this regard, and thus, rotational ranges greater or less than 60-degrees can also be used.

[0040] In the illustrated embodiment the first and second rotation keys 66A, B are diametrically opposed. It will be appreciated however, that these keys could be located in any of a variety of positions with respect to each other. In addition, greater or fewer rotation keys could also be provided. In addition, different ranges of rotational motion can be provided simply by changing the geometry of the recesses 80A, B formed in the rotation plate 56. As noted, any of a variety of rotation ranges can be provided in this manner.

[0041] FIG. 12 shows the inner cover 54 in greater detail. As previously noted, the inner cover provides a smooth finished surface to the cylinder-engaging side of the back plate 34. Inner cover 54 may include one or more connectors 63 to enable the cover to snap into engagement with the protrusion 60 of the outer fixing cover 58. In the illustrated embodiment, these connectors 63 are snap-connectors which have barbs that engage an underside surface of the flat regions 72A, B of the outer fixing cover protrusion 60. It will be appreciated that the connectors can be any fixing means desired, including screws or other fasteners. Alternatively, the inner cover 54 could be glued in place with a suitable adhesive.

[0042] The inner cover 54 may be provided with one or more centering protrusions 84 which are positioned to ensure proper alignment of the connectors 63 (on the inner cover) with the flat regions 72A, B (on the outer fixing cover 58). In the illustrated embodiment, these protrusions 84 are positioned on the inner cover 54 so that they align with opposite ends of the locking recess 78 of the outer fixing cover 58.

[0043] The inner cover 54 may further be provided with a weakened zone 86 to enable the cover to be broken in order to disassemble the device for repair and/or replacement of one or more pieces. As illustrated, this weakened zone 86 is a reduced-thickness section disposed across the diameter of the cover on the inside surface of the cover.

[0044] Thus arranged, the disclose design enables the waist pad portion 42 and the connected belt portion 36 to rotate with respect to the back plate 34 of the harness 32 to provide a more comfortable range of motion to the wearer. This means that the wearer can twist or bend his/her upper body without changing the position of the waist pad portion 42 or the belt portion 36 on their waist. This can enable the device to more closely match the wearer's normal body movement during use. The design thus regulates weight forces

applied to the wearer's lower body, protecting the wearer's waist region, and resulting in improved work efficiency.

[0045] Based on the foregoing information, it will be readily understood by those persons skilled in the art that the present invention is susceptible of broad utility and application. Many embodiments and adaptations of the present invention other than those specifically described herein, as well as many variations, modifications, and equivalent arrangements, will be apparent from or reasonably suggested by the present invention and the foregoing descriptions thereof, without departing from the substance or scope of the present invention. Accordingly, while the present invention has been described herein in detail in relation to its preferred embodiment, it is to be understood that this disclosure is only illustrative and exemplary of the present invention and is made merely for the purpose of providing a full and enabling disclosure of the invention. The foregoing disclosure is not intended to be construed to limit the present invention or otherwise exclude any such other embodiments, adaptations, variations, modifications or equivalent arrangements; the present invention being limited only by the claims appended hereto and the equivalents thereof. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for the purpose of limitation.

CLAIMS

1. A self-contained breathing apparatus harness, comprising:
a back plate, and

5 a waist pad portion comprising a pad portion, a rotational plate, and an outer fixing cover, the pad portion fixed to the rotational plate, the rotational plate disposed between the back plate and the outer fixing cover, the outer fixing cover having a protrusion engaged with an opening in the back plate to axially fix the outer fixing cover, the rotational plate, and the pad portion to
10 the back plate while allowing the rotational plate and the pad portion to rotate with respect to the back plate.

2. The self-contained breathing apparatus harness of claim 1, comprising
15 an inner cover for engaging a side of the back plate opposite the rotational plate and outer fixing cover, the inner cover configured to cover the opening in the back plate, the inner cover having a connector for engaging the protrusion of the outer fixing cover to fix the inner cover to the outer fixing cover..

20 3. The self-contained breathing apparatus harness of claim 1, the back plate having first and second keys, the rotational plate having an opening with rotational stop surfaces, the first and second keys for engaging the rotational stop surfaces when the waist pad portion is rotated with respect to the back plate by a predetermined amount.

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4. The self-contained breathing apparatus harness of claim 1, wherein the predetermined amount is about 60-degrees.

5. The self-contained breathing apparatus harness of claim 1, the back plate further having a locking key extending into the opening, the locking key configured to engage a surface of the protrusion of the outer fixing cover to axially fix the back plate to the outer fixing cover.

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6. The self-contained breathing apparatus harness of claim 1, the opening having first and second flat side surfaces, the protrusion having first and second flat side surfaces to enable the protrusion to be received within the opening in a predetermined orientation.

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7. The self-contained breathing apparatus harness of claim 6, the protrusion having a lip portion, the outer fixing cover having a first orientation in which the first and second flat side surfaces of the protrusion are aligned with the first and second flat side surfaces of the opening, the outer fixing cover having a second orientation in which the first and second flat side surfaces are not aligned with the first and second flat side surfaces of the opening and the lip portion engages the back plate to axially fix the outer fixing cover to the back plate.

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8. A self-contained breathing apparatus harness, comprising:

a back plate for engaging a gas cylinder;

a pair of shoulder straps connected to the back plate;

a belt portion connected to the back plate; and

a waist pad portion connected to the belt portion, the waist pad portion

25

comprising a pad portion fixed to a rotational plate, and an outer fixing cover, the rotational plate disposed between the back plate and the outer fixing cover, the outer fixing cover including a protrusion disposed within an opening in the back plate, the protrusion axially fixing the outer fixing cover, the

rotational plate, and the pad portion to the back plate while enabling the rotational plate and the pad portion to rotate with respect to the back plate.

5 9. The self-contained breathing apparatus harness of claim 8, comprising an inner cover for engaging a side of the back plate opposite the rotational plate and outer fixing cover, the inner cover for covering the opening in the back plate.

10 10. The self-contained breathing apparatus harness of claim 8, the back plate having a key, the rotational plate having an opening with a rotational stop surface, the key for engaging the rotational stop surfaces when the waist pad portion is rotated with respect to the back plate by a predetermined amount.

15 11. The self-contained breathing apparatus harness of claim 10, wherein the predetermined amount is about 60-degrees.

20 12. The self-contained breathing apparatus harness of claim 8, the back plate having a locking key for engaging the protrusion of the outer fixing cover to axially fix the back plate to the outer fixing cover.

25 13. The self-contained breathing apparatus harness of claim 8, the opening of the back plate having first and second flat side surfaces, the protrusion having first and second flat side surfaces to enable the protrusion to be received within the opening in a predetermined orientation.

14. The self-contained breathing apparatus harness of claim 13, the protrusion having a lip portion, the outer fixing cover having a first

orientation in which the first and second flat side surfaces of the protrusion are aligned with the first and second flat side surfaces of the opening, the outer fixing cover having a second orientation in which the first and second flat side surfaces are not aligned with the first and second flat side surfaces of the opening and the lip portion engages the back plate to axially fix the outer fixing cover to the back plate.

15. A waist pad assembly for use with a self-contained breathing apparatus harness, comprising:

10 a waist pad portion comprising a pad portion, a rotational plate and an outer fixing cover, the rotational plate fixed to the pad portion, the rotational plate disposed between a back plate of a self-contained breathing apparatus harness and the outer fixing cover, the outer fixing cover including a protrusion disposed within an opening in the back plate, the protrusion axially fixing the outer fixing cover, the rotational plate, and the pad portion to the back plate while enabling the rotational plate and the pad portion to rotate with respect to the back plate.

16. The waist pad assembly of claim 15, comprising an inner cover for engaging a side of the back plate opposite the rotational plate and outer fixing cover, the inner cover for covering the opening in the back plate.

17. The waist pad assembly of claim 15, the rotational plate having an opening with a rotational stop surface for engaging a key of the back plate when the waist pad portion is rotated with respect to the back plate by a predetermined amount.

18. The waist pad assembly of claim 17, wherein the predetermined

amount is about 60-degrees.

19. A waist pad assembly as represented in figures 3-12.

5 20. A waist pad assembly as disclosed herein.

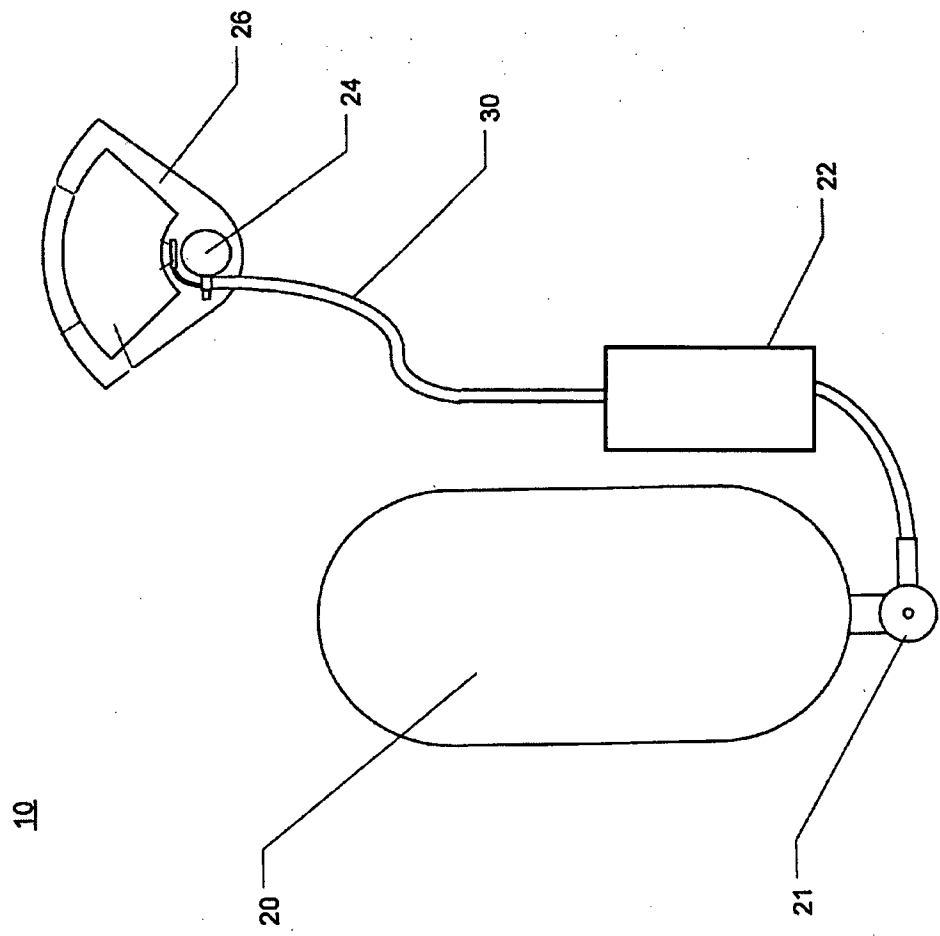
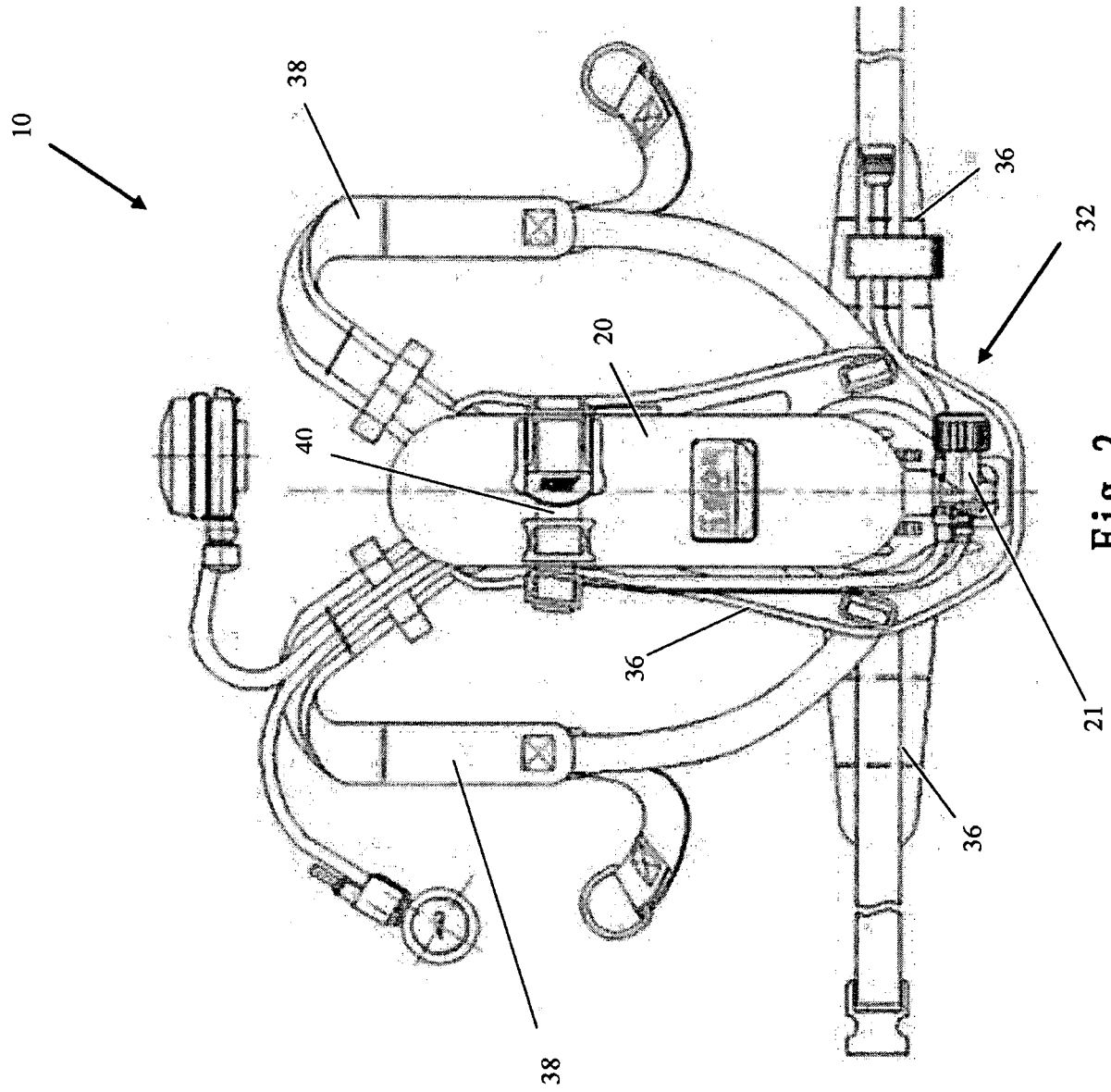


Fig. 1



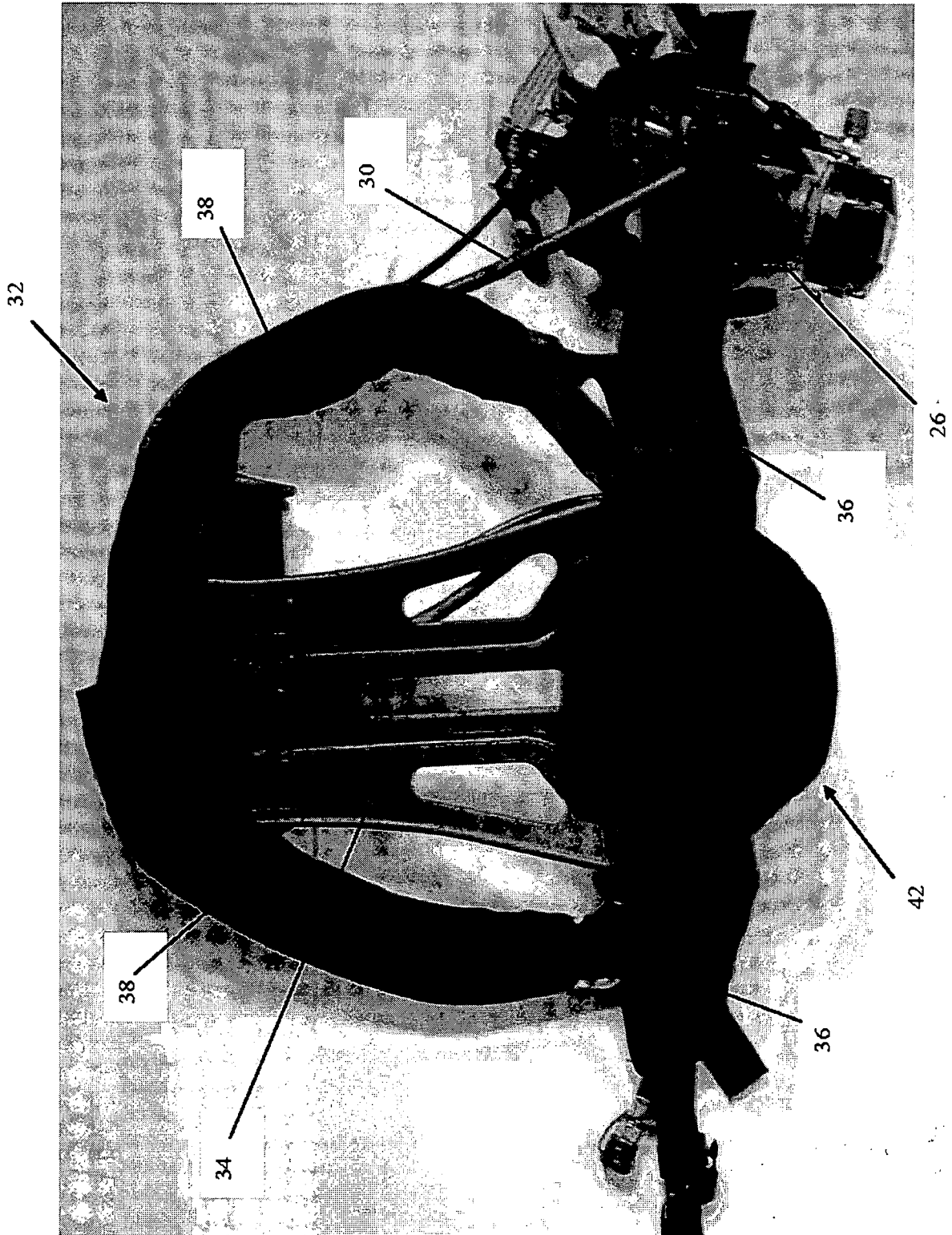


Fig. 3

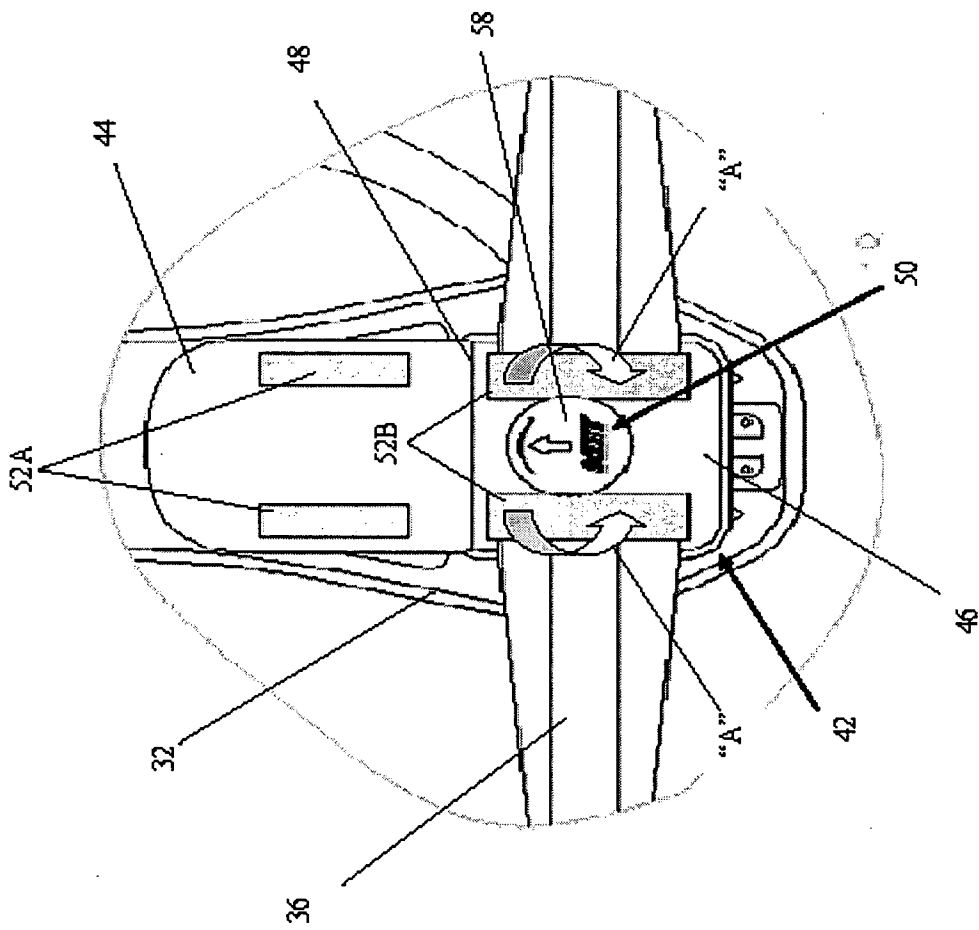


Fig. 4

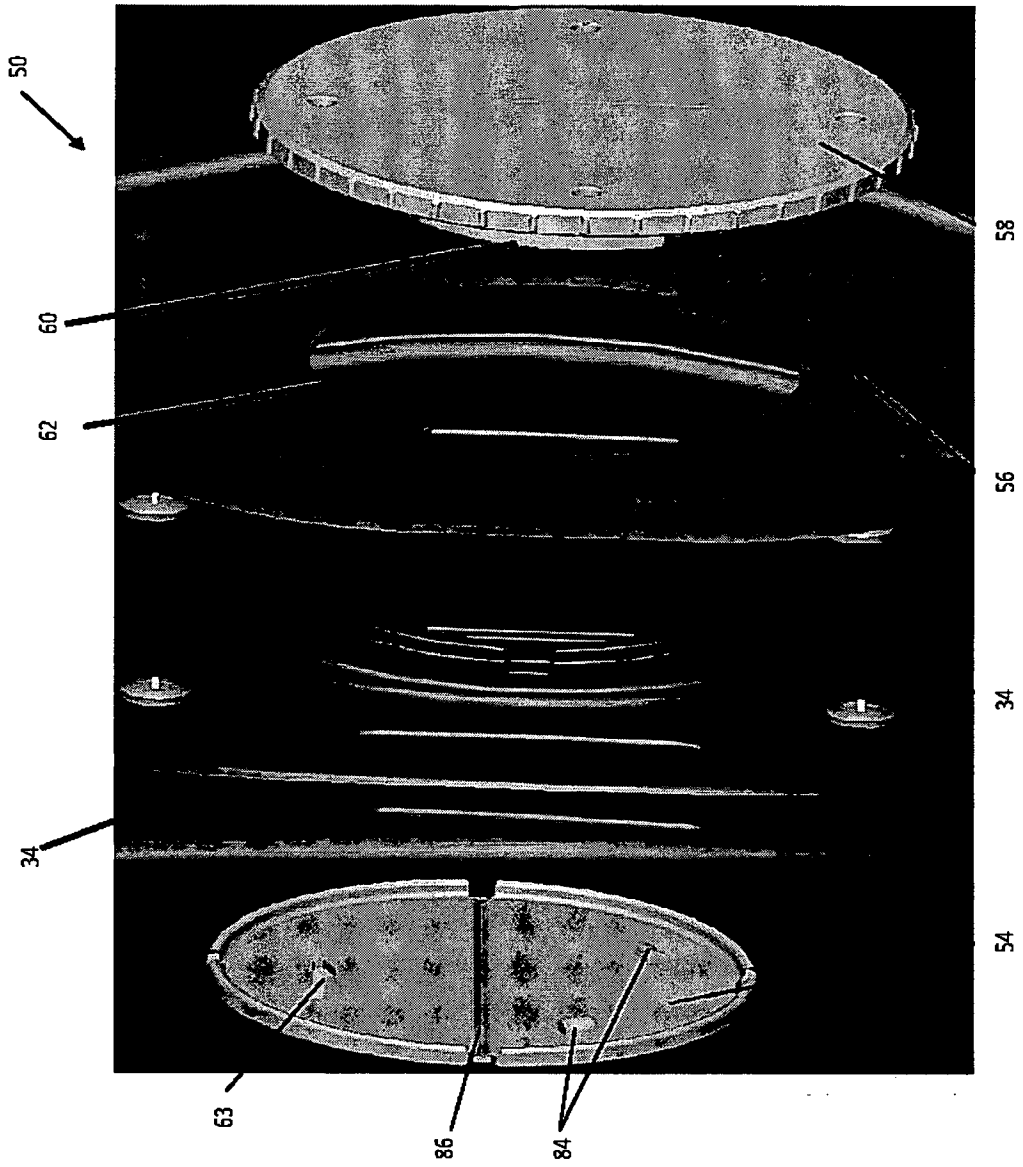


Fig. 5

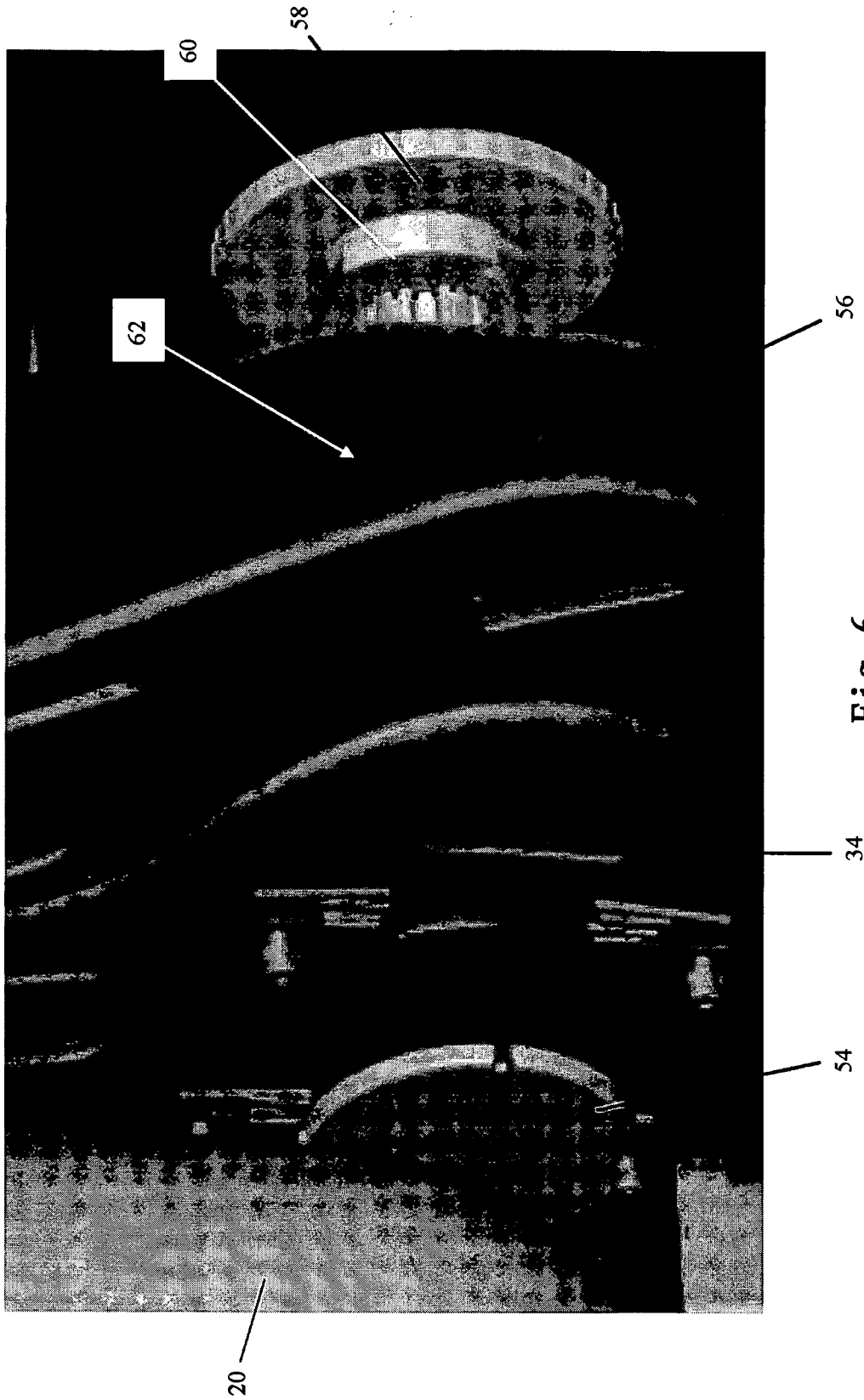


Fig. 6

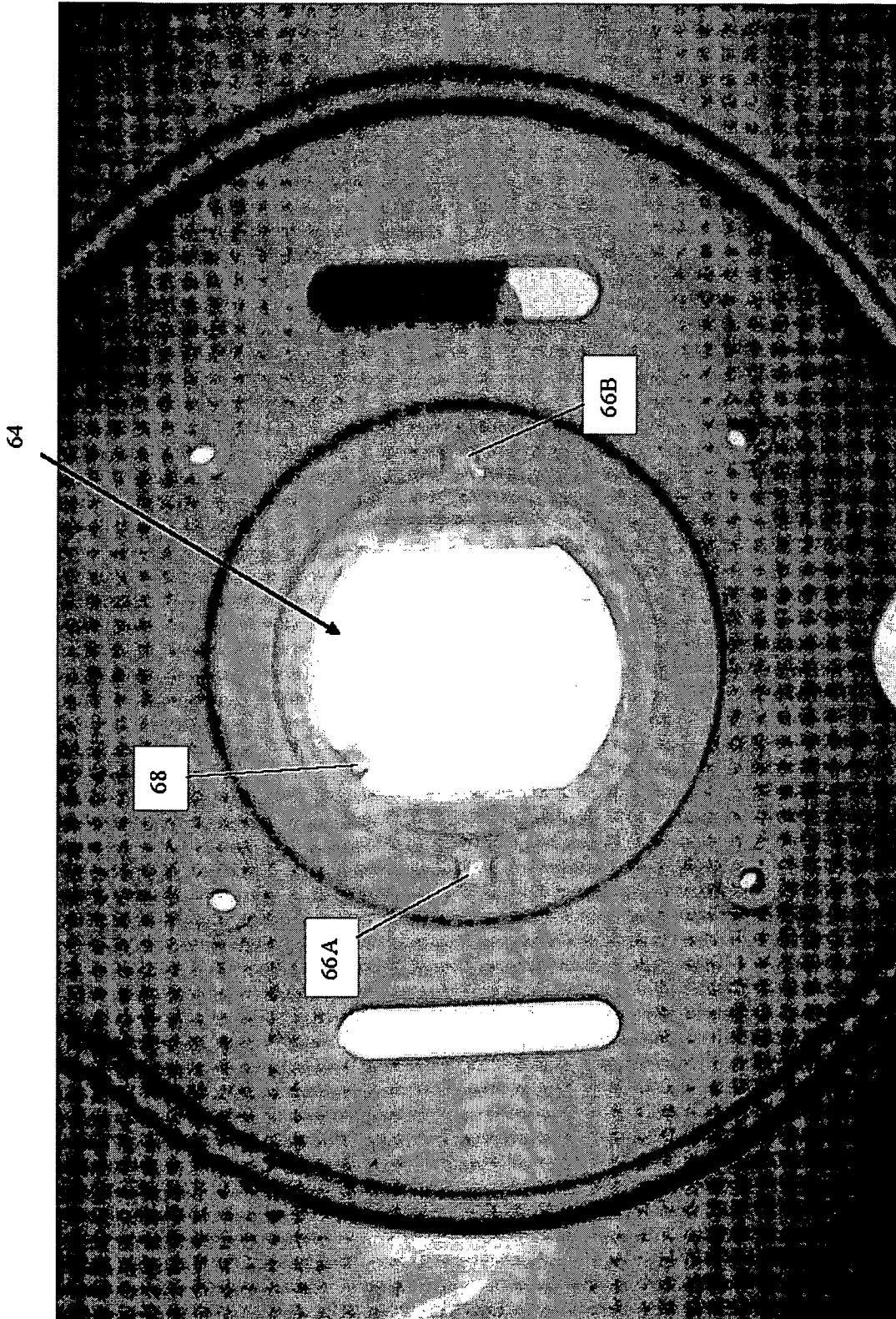
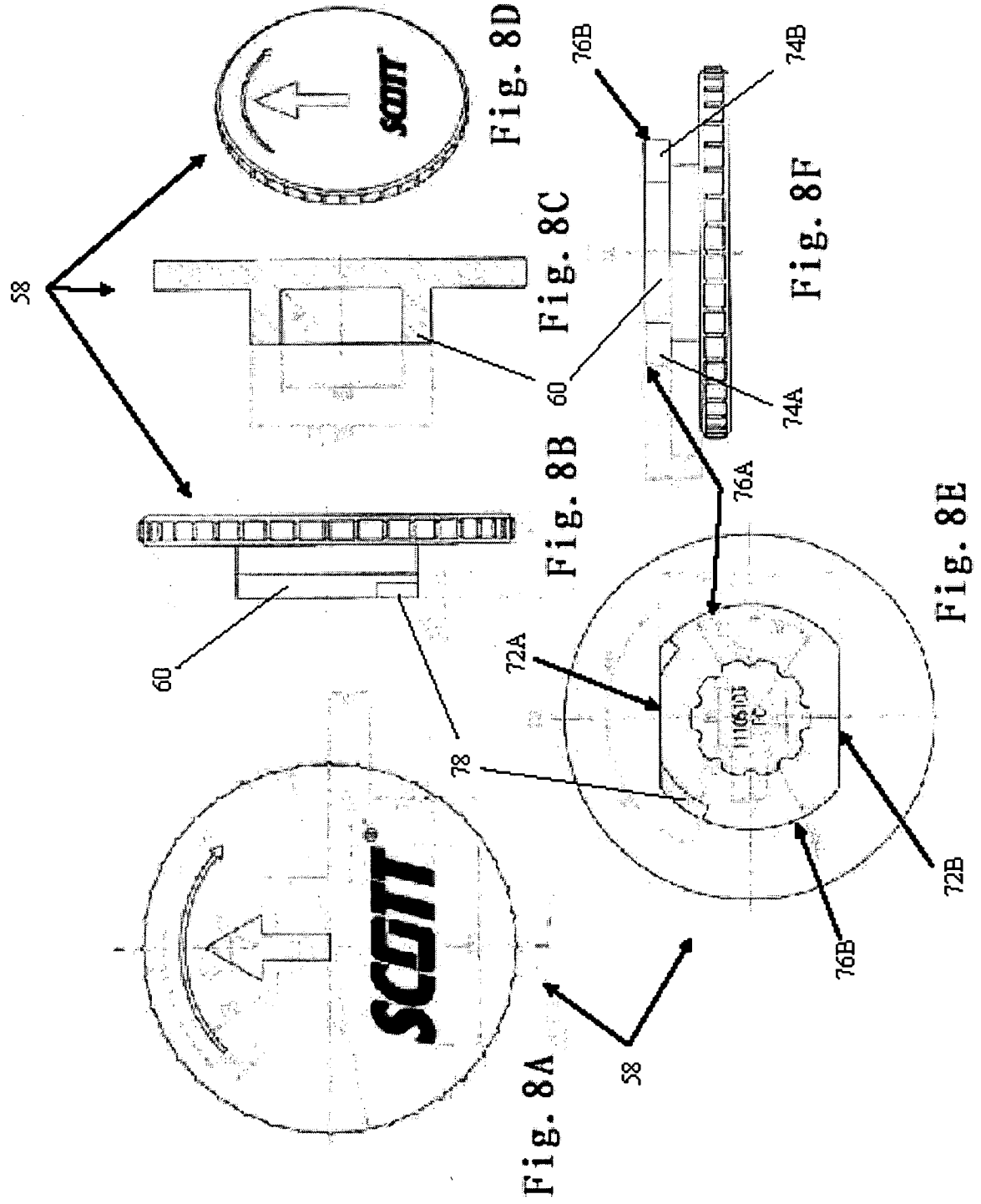


Fig. 7



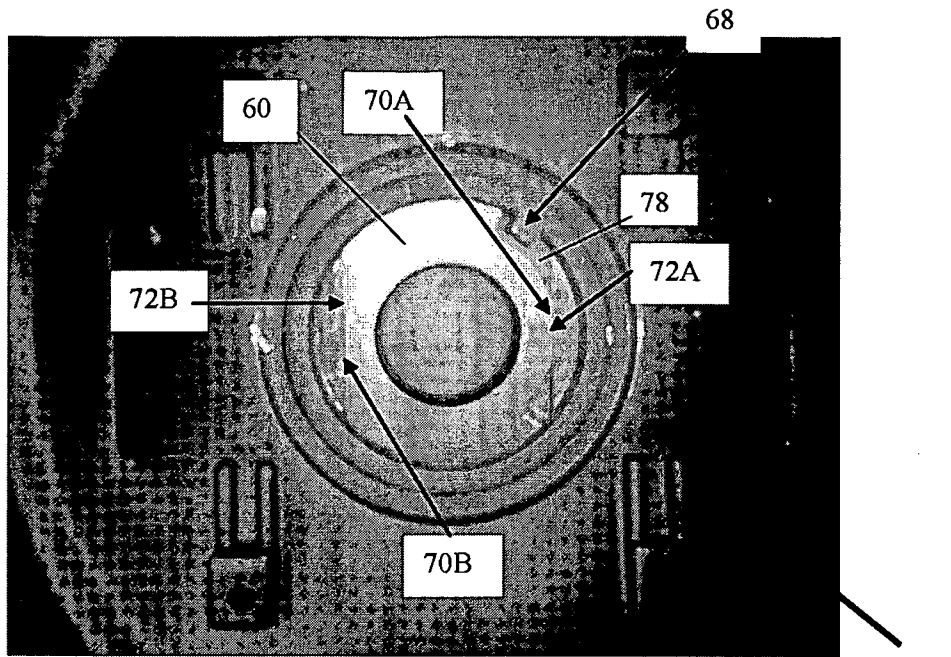


Fig. 9A

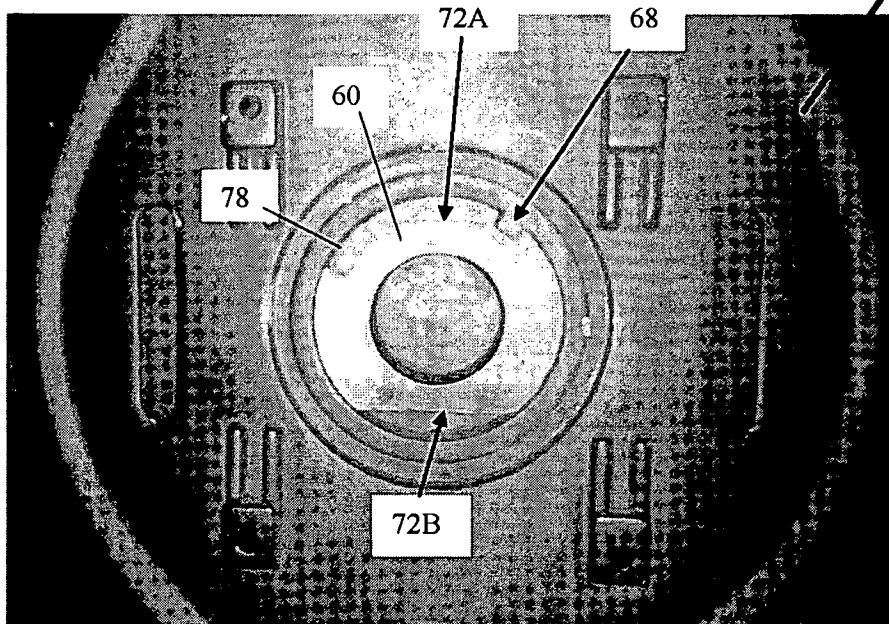


Fig. 9B

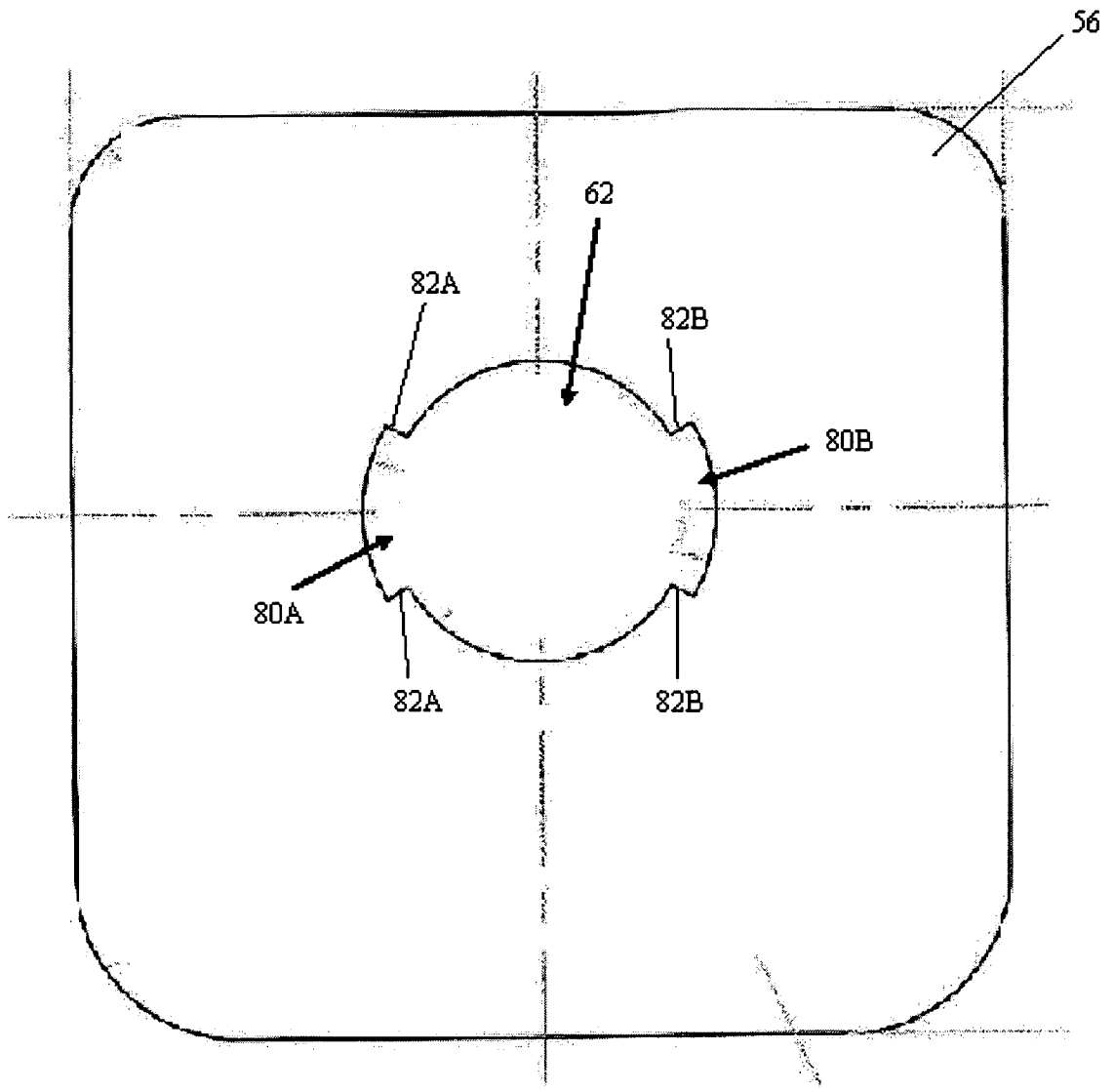


Fig. 10

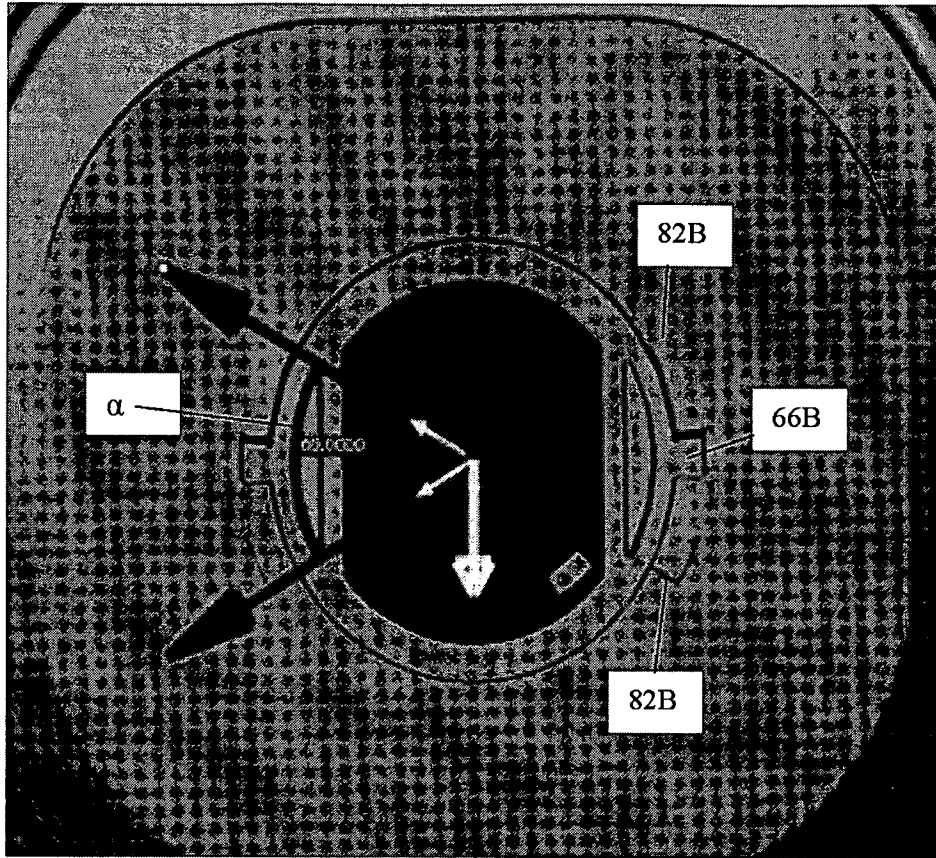


Fig. 11

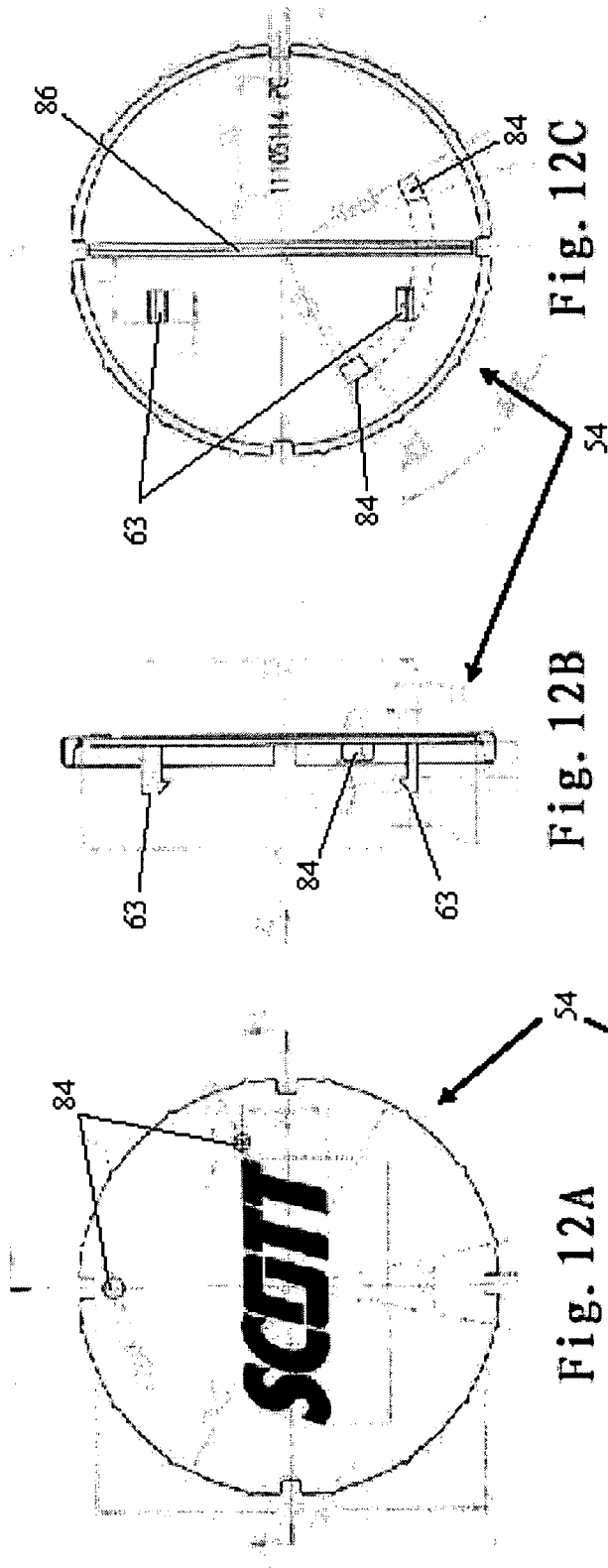


Fig. 12C

Fig. 12B

Fig. 12A

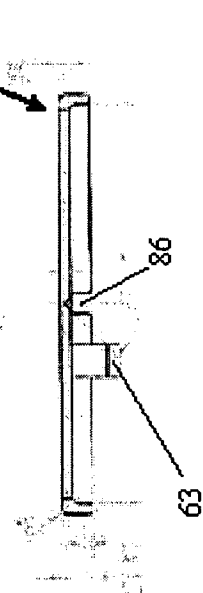


Fig. 12D

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2011/000572

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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: A62B 9/-; A45F 3/-; A41B 1/-

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)

CNPAT, WPLEPODOC, CNKI: SCBA, rotat+, back, waist, fix, cover, axial+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 1697617 A (SAN CHEONG CO. LTD.) 16 Nov. 2005 (16.11.2005) claim 6, page 9 line 17 – page 10 line 30 in the description, figures 3-8	1-4,6,8-11,13,15-18
A	CN 101686749 A (SPERIAN RESPIRATORY PROTECTION LLC.) 31 Mar. 2010 (31.03.2010) the whole document	1-18
A	US 2003/0140392 A1 (KLING, Peter et al.) 31 Jul. 2003 (31.07.2003) the whole document	1-18

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:	“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
“A” document defining the general state of the art which is not considered to be of particular relevance	“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
“E” earlier application or patent but published on or after the international filing date	“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
“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)	“&” document member of the same patent family
“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	

Date of the actual completion of the international search 23 Nov. 2011 (23.11.2011)	Date of mailing of the international search report 19 Jan. 2012 (19.01.2012)
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Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer MA, Wei Telephone No. (86-10)82245018
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2011/000572

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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.: 19-20
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:

Claim 19 is merely defined by figures, and claim 20 is merely defined by a general description "disclosed herein". The subject-matter of claims 19 and 20 is so unclear that no meaningful international search can be carried out.

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 No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

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

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 fees, this Authority did not invite payment of 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 and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2011/000572

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 1697617 A	16.11.2005	WO 2005/048769 A1	02.06.2005
		KR 20050049300 A	25.05.2005
		KR 20050107993 A	16.11.2005
		KR 100553346 B1	22.02.2006
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		DE 602004031665 E	14.04.2011
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		DE 10029838 A1	03.01.2002
		DE 10029838 B4	02.09.2004
		DE 50106509 G	21.07.2005
		AU 6203301 A	02.01.2002
		AU 2001262033 B2	19.02.2004
		EP 1207942 A1	29.05.2002
		EP 1207942 B1	15.06.2005
		US 6848120 B2	01.02.2005
		ES 2243498 T3	01.12.2005
		AT 297788 T	15.07.2005

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2011/000572

Continuation of: **A. CLASSIFICATION OF SUBJECT MATTER** in second sheet

A62B 9/04 (2006.01) i

A45F 3/08 (2006.01) i

A45F 3/10 (2006.01) i