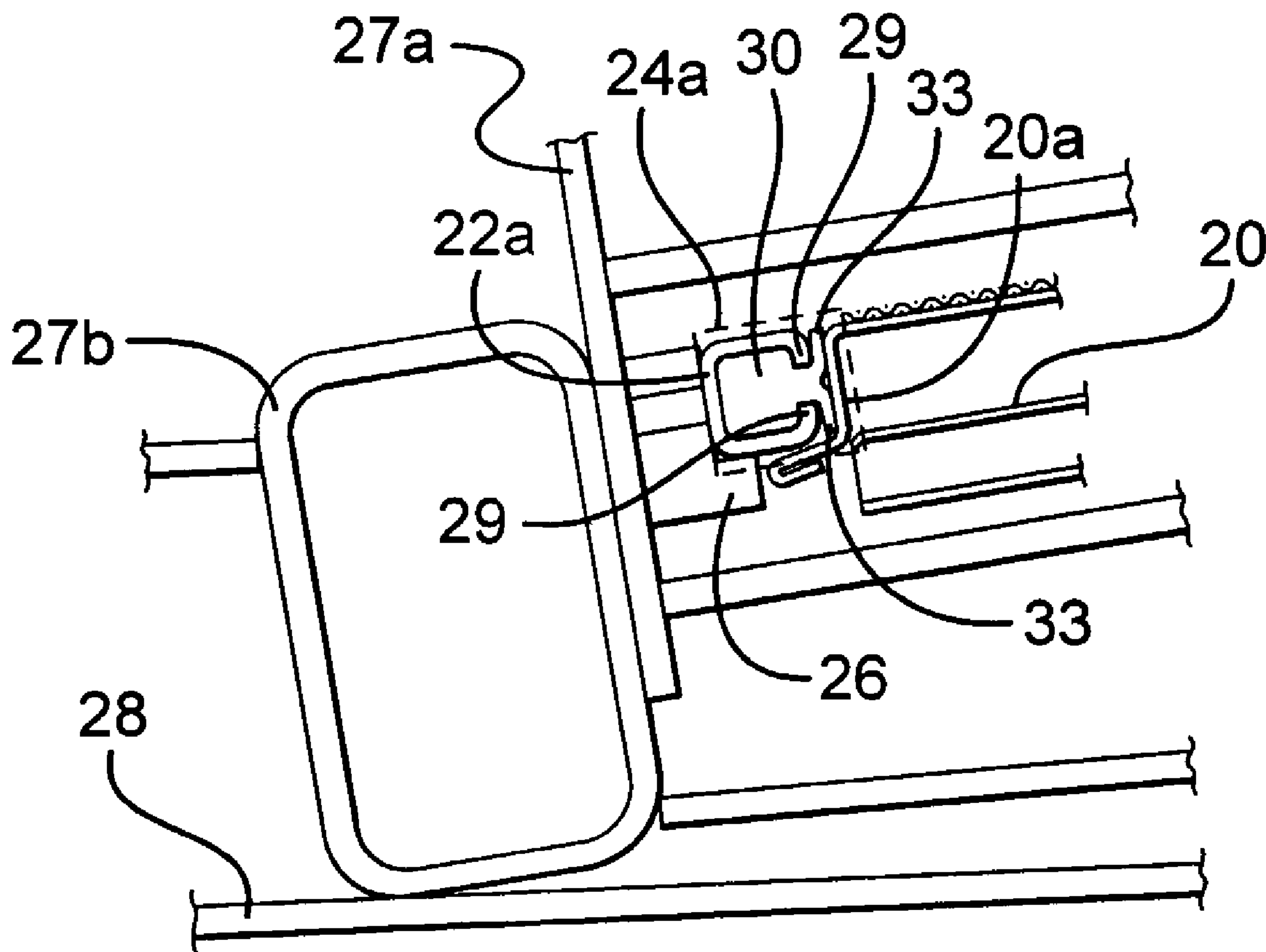




(86) Date de dépôt PCT/PCT Filing Date: 2003/08/05  
 (87) Date publication PCT/PCT Publication Date: 2004/04/29  
 (45) Date de délivrance/Issue Date: 2009/04/28  
 (85) Entrée phase nationale/National Entry: 2005/03/11  
 (86) N° demande PCT/PCT Application No.: GB 2003/003404  
 (87) N° publication PCT/PCT Publication No.: 2004/035232  
 (30) Priorités/Priorities: 2002/10/17 (GB0224155.2);  
 2003/05/02 (US10/429,290)

(51) Cl.Int./Int.Cl. *B07B 1/46* (2006.01),  
*B07B 1/48* (2006.01)  
 (72) Inventeurs/Inventors:  
 SEYFFERT, KENNETH WAYNE, US;  
 MCCLUNG, GUY LAMONT III, US;  
 BURNETT, GEORGE ALEXANDER, GB  
 (73) Propriétaire/Owner:  
 VARCO I/P, INC., US  
 (74) Agent: MCFADDEN, FINCHAM

(54) Titre : CRIBLE VIBRANT ET ENSEMBLE TAMIS  
 (54) Title: VIBRATORY SEPARATOR AND SCREEN ASSEMBLY



(57) Abrégé/Abstract:

An apparatus comprising a vibratory separator and a screen assembly (20), the apparatus comprising a seal (30) for sealing between said vibratory separator and said screen assembly characterised in that said apparatus further comprises a holder (22a) for removably holding said seal (30).

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

(19) World Intellectual Property  
Organization  
International Bureau



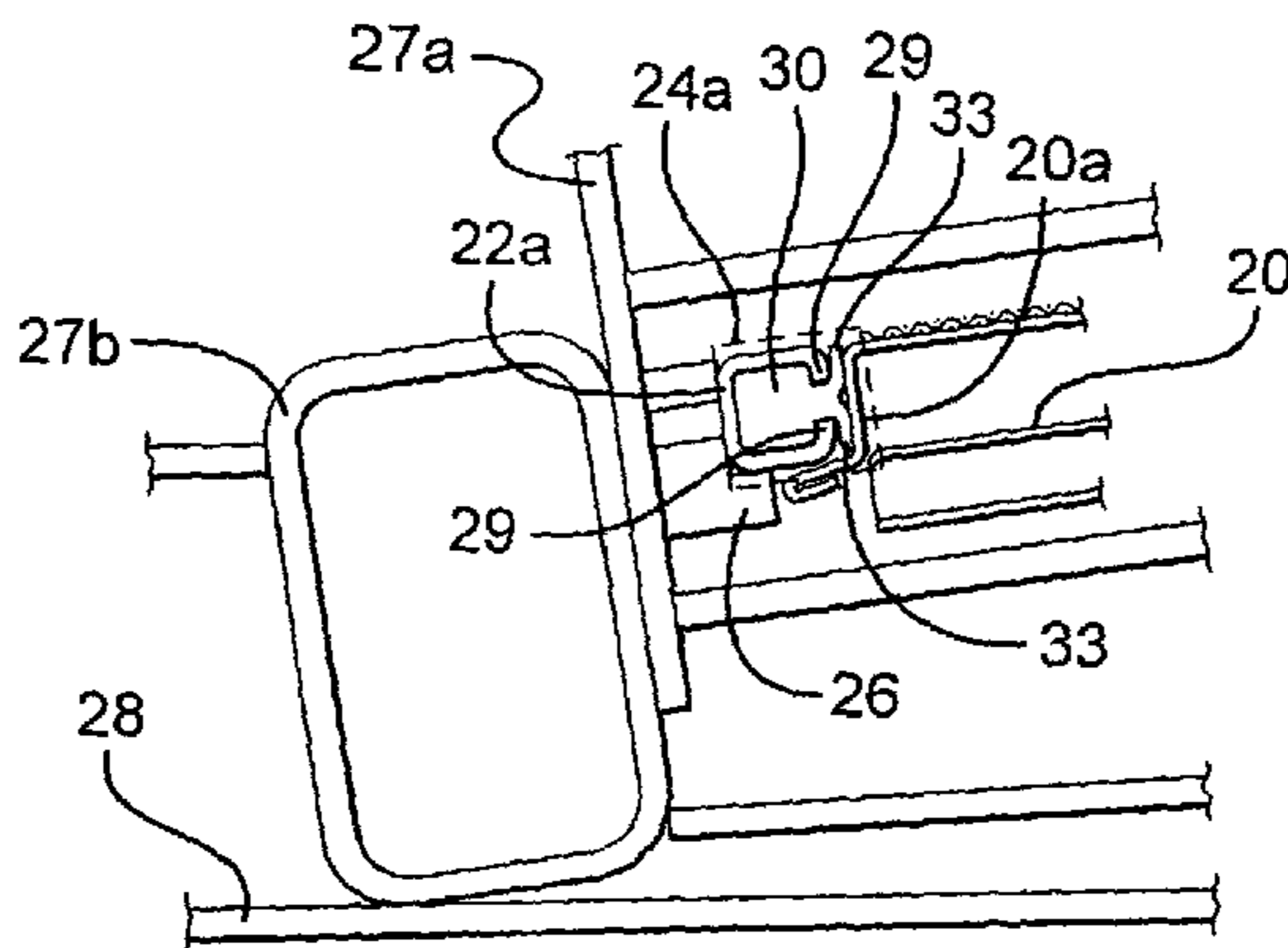
(43) International Publication Date  
29 April 2004 (29.04.2004)

PCT

(10) International Publication Number  
**WO 2004/035232 A1**

- (51) International Patent Classification<sup>7</sup>: **B07B 1/46**, Ruthriestone Road, Aberdeen, Aberdeenshire AB10 7JR (GB).  
B01D 33/03
- (21) International Application Number: PCT/GB2003/003404 (74) Agent: **LUCAS, Brian, Ronald**; Lucas & Co., 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB).
- (22) International Filing Date: 5 August 2003 (05.08.2003) (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
0224155.2 17 October 2002 (17.10.2002) GB  
10/429,290 2 May 2003 (02.05.2003) US
- (71) Applicants (*for all designated States except US*): **VARCO I/P, INC.** [US/US]; One Briar Lake Plaza, 2000 West Sam Houston Parkway South, Suite 1700, Houston, TX 77042 (US). **LUCAS, Brian, Ronald** [GB/GB]; 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB).
- (72) Inventors; and
- (75) Inventors/Applicants (*for US only*): **SEYFFERT, Kenneth, Wayne** [US/US]; 1019 LaMonte Lane, Houston, TX 77018 (US). **MCCLUNG, Guy, Lamont, III** [US/US]; 8002 Hertfordshire Circle, Spring, TX 77379 (US). **BURNETT, George, Alexander** [GB/GB]; Heath Cottage,
- Published:**  
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: VIBRATORY SEPARATOR AND SCREEN ASSEMBLY



(57) Abstract: An apparatus comprising a vibratory separator and a screen assembly (20), the apparatus comprising a seal (30) for sealing between said vibratory separator and said screen assembly characterised in that said apparatus further comprises a holder (22a) for removably holding said seal (30).

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## VIBRATORY SEPARATOR AND SCREEN ASSEMBLY

The present invention relates to an apparatus comprising a vibratory separator and a screen assembly. The invention also relates to a vibratory separator and a screen assembly for the apparatus. The invention also relates to a method for removing a seal arranged in a holder attached to or forming part of a screen for screening solids laden drilling mud and to a method for removing a seal arranged against a screen in a vibratory separator for screening solids from a solids laden drilling mud.

In the drilling of a borehole in the construction of an oil or gas well, a drill bit is arranged on the end of a drill string and is rotated to bore the borehole. A drilling fluid known as "drilling mud" is pumped through the drill string to the drill bit to lubricate the drill bit. The drilling mud is also used to carry the cuttings produced by the drill bit and other solids to the surface through an annulus formed between the drill string and the borehole. The drilling mud contains expensive synthetic oil-based lubricants and it is normal therefore to recover and re-use the used drilling mud, but this requires the solids to be removed from the drilling mud. This is achieved by processing the drilling fluid. The first part of the process is to separate the solids from the solids laden drilling mud. This is at least partly achieved with a vibratory separator, such as those shale shakers disclosed in US 5,265,730, WO 96/33792 and WO 98/16328.

Shale shakers generally comprise an open bottomed basket having one open discharge end and a solid walled feed end. A number of rectangular screens are arranged in the basket, which are held in C-channel rails located on the basket walls, such as those disclosed in GB-A-2,176,424. The basket is arranged on springs above a

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receptor for receiving recovered drilling mud. A skip or ditch is provided beneath the open discharge end of the basket. A motor is fixed to the basket, which has a drive rotor provided with an offset clump weight. In use, the motor rotates the rotor and the offset clump weight, which causes the basket and the screens fixed thereto to shake. Solids laden mud is introduced at the feed end of the basket on to the screens. The shaking motion induces the solids to move along the screens towards the open discharge end. Drilling mud passes through the screens. The recovered drilling mud is received in the receptor for further processing and the solids pass over the discharge end of the basket into the ditch or skip.

The screens are generally of one of two types: hook-strip; and pre-tensioned.

The hook-strip type of screen comprises several rectangular layers of mesh in a sandwich, usually comprising one or two layers of fine grade mesh and a supporting mesh having larger mesh holes and heavier gauge wire. The layers of mesh are joined at each side edge by a strip which is in the form of an elongate hook. In use, the elongate hook is hooked on to a tensioning device arranged along each side of a shale shaker. The shale shaker further comprises a crowned set of supporting members, which run along the length of the basket of the shaker, over which the layers of mesh are tensioned. An example of this type of screen is disclosed in GB-A-1,526,663. The supporting mesh may be provided with or replaced by a panel having apertures therein.

The pre-tensioned type of screen comprises several rectangular layers of mesh, usually comprising one or two layers of fine grade mesh and a supporting mesh having larger mesh holes and heavier gauge wire. The layers of mesh are pre-tensioned on a rigid support comprising a rectangular angle iron frame and adhered thereto. The

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screen is then inserted into C-channel rails arranged in a basket of a shale shaker. An example of this type of screen is disclosed in GB-A-1,578,948.

5 A further example of a known rigid support is disclosed in PCT Publication No. WO 01/76719, which discloses, amongst other things, a flat panel like portion having apertures therein and wing portions which are folded to form a support structure, which may be made from a single sheet of material. This rigid support has  
10 been assigned the Trade Mark "UNIBODY" by the applicants.

The layers of mesh in the screens wears out frequently and therefore needs to be easily replaceable. Shale shakers are generally in the order of 5ft wide and 10ft long. A screen of dimensions 4ft wide by 10ft long  
15 is difficult to handle, replace and transport. It is known to use two, three, four or more screens in a single shale shaker. A standard size of screen currently used is of the order of 4ft by 3ft.

It has been found that, in use, solids pass between  
20 adjacent screens and around the ends of screens. This is unsatisfactory, as contamination of the recovered drilling mud could cause damage to other processing equipment and damage to the oil or gas well and well tools and equipment.

25 An attempt at solving this problem is disclosed in GB-A-2,206,501, which discloses a tongue and groove interface between adjacent frames of screens.

PCT Publication Number WO 01/97947 discloses in  
30 Figures 1 to 5H improvements in a tongue and groove interface by the addition of a sealing member and in two embodiments, by the addition of two sealing members.

PCT Publication Number WO 01/97947 also discloses a "UNIBODY" rigid support structure disclosed in WO 01/76719, having a lip on one end and a lap on the other,

such that, in use, the lap of a first rigid support structure fits under the lip of a second rigid support structure. Either of the lip or lap or both may be provided with a seal member.

5           In certain circumstances, such as when drilling through porous rock formations, it is desirable to turn porous rock formations surrounding the borehole non-porous. This is achieved by circulating Lost Circulation Material through the drill pipe and back through the  
10           annulus formed by the drill string and the borehole. Lost Circulation Material generally comprises a fibrous material. When recovering used drilling mud, it is desirable to separate the fibrous Lost Circulation Material from the drilling mud.

15           The present invention attempts to provide a seal which will prevent solids from passing between adjacent screens and passing between the end of a screen and a fitting in the shale shaker into which it cooperates in use.

20           The present invention also attempts to provide a seal, which inhibits solids falling into the receiver where drilling mud is recovered during replacement of the screen.

          The present invention also attempts to retain  
25           rigidity in the screen at its interface with another screen or the end fitting arranged in the basket of the shale shaker.

          The present invention also provides a seal which is replaceable to reduce down time of the shale shaker, if  
30           the seal fails during use. Further, a seal which is easily replaceable during reconditioning of the screen or shale shaker. In many prior art apparatuses these seals are accessed by removing the screen assemblies. This can be a relatively long and expensive procedure and can  
35           require unnecessary handling of a screen assembly that

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can result in damage to an otherwise acceptable screen assembly which has some useful life remaining. Such a procedure also requires that the apparatus be shut down while the screen assemblies are removed. The seal is  
5 changed, and the screen assemblies reinstalled.

Another problem is accessing the seal to inspect a seal in a relatively short time.

According to the present invention, there is provided an apparatus comprising a vibratory separator  
10 and a screen assembly, the apparatus further comprising a seal arranged in a holder, the seal for sealing between the vibratory separator and the screen assembly characterised in that said seal comprises a pull apparatus for facilitating removal of said seal from said  
15 holder.

For example, the pull apparatus may comprise a ring connected to one or both ends of the seal suitable for a operator to pull or slide the seal out of the holder.

Preferably, the seal is slidably removable from the  
20 holder. Advantageously, the holder comprises a channel in which the seal is located. Preferably, the seal holder is generally C-shaped in cross-section. Advantageously, the holder has a projection and the seal has a recess therein for receiving the projection. Preferably, the holder  
25 extends substantially the entire width of the screen assembly. Advantageously, the seal extends substantially the entire width of the screen assembly. Preferably, the seal and the holder are substantially the same length. Advantageously, the vibratory separator comprises a hatch  
30 through which the seal can be accessed. A movable, for example a bolted, hinged, removable or openable door or cover selectively closes off the access opening. By opening the door, removing the door, or moving the door

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access is provided to the seal and to the seal holding structure permitting the seal to be removed and inspected and, if needed, replaced. For multi-tiered separators and shakers with screen assemblies at different levels, multiple access openings are provided for accessing multiple seals. Preferably, a spacer member within the seal holder between an inner surface of the seal holder and an outer surface of the seal member, wherein the spacer member is made of cushion material.

10

Advantageously, the seal comprises a base and at least one lip. The lip is preferably flexible for flexing upon contact with another member to facilitate sealing of an interface between the screen assembly and the another member. Preferably, the seal comprises a further lip and most preferably, spaced apart and connected to the main body of the seal. Advantageously, the seal has a void or hollow therein.

Preferably, the holder has an outer surface and the seal has a portion for sealingly contacting the outer surface.

Advantageously, the holder is formed from a single piece of material, folded, extruded or cast into a shape.

Preferably, the holder is arranged on or forms part of the vibratory separator.

Advantageously, the holder is arranged on or form part of the screen assembly.

The present invention also provides, in or for use in the apparatus of the invention, a screen assembly characterised in that the screen assembly further comprises a seal for sealing between said screen assembly

and an adjacent screen assembly, and a holder for removably holding said seal characterised in that said seal comprises a pull apparatus for facilitating removal of said seal from said holder.

5 Preferably, the holder is integral with the screen assembly. Advantageously, the screen assembly is formed from folded sheet material and the holder is formed from folded sheet material. Preferably, the holder comprises a channel in which the seal is located. Advantageously, the  
10 holder has a projection projecting into a cavity in which a seal is held. Preferably, the holder extends substantially the entire width of the screen assembly. Advantageously, the holder is formed from a single piece of material, folded, extruded or cast into a shape.  
15 Preferably, the screen assembly further comprises a seal for sealing between the screen assembly and an adjacent screen assembly. Advantageously, the seal is slidably removable from the holder. Preferably, the seal extends substantially the entire width of the screen assembly.  
20 Preferably, the seal comprises a base and at least one lip. Advantageously, the seal comprises a further lip. Preferably, the seal has a void or hollow therein. Advantageously, the holder has an outer surface and the seal has a portion for sealingly contacting the outer  
25 surface.

The present invention also provides In or for use in the apparatus of the present invention, a seal comprising a base and at least one lip. Preferably, this part of the seal member is flexible to enhance the sealing effect.

30 The seals in accordance with the present invention are removably installable in holders.

Preferably, the seal further comprises a further

lip. Advantageously, the seal further comprises a pull apparatus for facilitating removal of the seal from the holder. Preferably, the seal has a void or hollow therein. Advantageously, the seal comprises a recess or indentations for receiving a projecting part of a holder. Preferably, the seal is made of material able to withstand the drilling fluid material.

The present invention also relates to a method for removing a seal arranged in a holder attached to or forming part of a screen for screening solids laden drilling mud, the method comprising the steps of pulling on pull apparatus attached to the seal to remove the seal from the holder.

The present invention also relates to a method for removing a seal arranged against a screen in a vibratory separator for screening solids from a solids laden drilling mud, the method comprising steps of opening a hatch in said vibratory separator to access a pulling apparatus and pulling on the pulling apparatus to remove the seal.

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The present invention also provides a shale shaker or vibratory separator with access hatches for accessing and inspecting seals at the interface between the vibratory separator and the screen assembly and between  
5 adjacent or abutting screen assemblies.

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For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:

5 Figure 1 is a side view of a basket for a vibratory separator or shale shaker in accordance with the present invention, with hidden parts shown in dashed line;

Figure 2 is an enlargement of a seal and seal holding structure of the vibratory separator or shale shaker shown in Figure 1, with a screen assembly therein;

10 Figure 3 is a top view of the screen assembly, the seal and the seal holder of the vibratory separator or shaker as shown in Figure 1;

Figure 4A is a perspective view, Figure 4B is an end view (of both ends), Figure 4C is a top view, Figure 4D a  
15 bottom view, Figure 4E a front view, and Figure 4F an rear view of the seal in accordance with the present invention shown in Figure 2;

Figures 4G and 4H are side cross-section views of other seals in accordance with the present invention in  
20 seal holders in accordance with the present invention;

Figure 4I is a bottom view of a seal in accordance with the present invention;

Figures 5 to 8 are side cross-section views of seals and seal holders in accordance with the present  
25 invention;

Figure 9 is a perspective view of a shale shaker in accordance with the present invention.

Figure 10A is a top view of a screen assembly in accordance with the present invention; Figure 10B is a  
30 front view and Figure 10C is a rear view of the screen assembly of Figure 10A; Figure 10D is a side cross-section view of two screen assemblies as in Figure 10A in

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a shale shaker; Figure 10E is a cross-section view of a seal and seal holder of the screen assembly of Figure 10A;

5 Figure 11A is a side view in cross-section of screen assemblies in accordance with the present invention; Figure 11B is a side cross-section view of the screen assemblies of Figure 11A.

10 Figures 1 to 3 show a vibratory separator or shale shaker 10 (henceforth referred to as shaker 10) which has a basket 12 for holding a plurality of screen assemblies 20, 21, and 22. The basket 12 has spring mounts 14 and side walls 16 (one shown) with ends 17 and 18 interconnecting the two spaced-apart side walls. The screen assemblies 20 and 21 each have an ends 20a and 15 21a, respectively, which abuts a seal member mounted within the basket 12. As shown in detail in Figure 2 the end 20a of the screen assembly 20 sealingly contacts a seal member 30 in accordance with the present invention which is removably held within a seal holder 22a in 20 accordance with the present invention.

25 Adjacent each seal holder is a removable cover 24 which is secured (e.g. with bolts, not shown) over corresponding openings 24a through the side wall 16 of the basket 12. A dotted line 24b indicates the location of this opening in Figure 2. Upon removal of the cover 24, the seal member 30 can be grasped and removed from the seal holder 22a. If necessary, a new seal member 30 can be installed in the seal holder 30 and the cover 24 replaced. It is within the scope of this invention to 30 use doors hingedly connected over the openings 24. Seals or gasket may be used on the covers or doors to seal their interface with the basket wall. Alternatively the

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cover 24 is movably secured over the opening 24b (e.g. with a bolt or rod on which it can rotate) and is moved aside to access a seal member.

5 The seal holder 22a is secured to a support 26 which is connected to a structural member 27a within the shaker 10. The structural member 27a is itself connected to another structural member 27b which rests on a base 28 of the shaker 10.

10 The seal member 30 as shown in Figures 4A to 4F has at least one recess 32 (two shown in Figure 4A) into which projects a projecting part 29 of the seal holder 22a. The seal holder 22a has at least one (two shown in Figure 2) projecting part 29. The seal member 30 has a body 35 from which projects a part 34. Two lips or arms  
15 33 project from the part 34. Initially an obtuse angle is defined between the lips 33. The lips 33 are flexible so that upon contacting an end of a screen assembly they are movable resulting in an increased amount of the surface of the lips 33 contacting the end of the screen  
20 assembly, e.g. to move to a position as shown in Figure 2. This flexibility enhances the sealing contact of the lips 33 against the end of the screen assembly. The seal member 30 (as is the case for any seal or seal member of Figures 5 to 9 and any disclosed herein) may be made of  
25 any suitable known seal material, including, but not limited to neoprene, nitrile rubber, plastic, fiberglass, metal, wood, or composite material. In one particular aspect the seal member 30 is made of urethane, is about 2.5cm (1 inch) in height, about 4cm (1.5 inches) in  
30 width, about 75cm (29.5 inches) long and has a hardness of 95 durometer. In certain aspects such a seal has a hardness of 70 durometer. Such a seal member is suitable

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for use in a shale shaker which is used to treat drilling fluid material from an earth wellbore. In one aspect, the lips 33 are deleted. As shown, the recesses 32 extend along the entire length of the seal member 30.

5 This permits the seal member 30 to be installed from the side in a seal holder. In one aspect, e.g. as shown in Figure 2, the body 35 of the seal member 30 fills substantially all of the interior space of the seal holder 22a (as may be the case with any seal in accordance with

10 the present invention). As shown in Figure 4I the seal member 30 may, optionally, (as may any seal or seal member in accordance with the present invention) have a pulling apparatus 36 on one or both ends to facilitate removal from a seal holder. Although the pulling

15 apparatus 36 is shown as a ring with an open center, the open center may be deleted or any suitable structure such as, but not limited to a tab or cylinder, may be used to facilitate movement of a seal or seal member.

Figure 4G shows a seal holder 40 in accordance with

20 the present invention which has a lower part 41a, an upright part 41b, and a top part 41c projecting downwardly. A seal 42 has a body 43 releasably and removably disposed in an interior space of the seal holder 40. Optionally, the body 43 is hollow as shown

25 (or it may be solid). A lip 44 is connected to or formed integrally of a projecting part 45. The projecting part 46 is connected to or formed integrally of the body 43. The seal holder 40 can be used in a vibratory separator or shale shaker as the seal holder 22a, Figure 2, is

30 used. Preferably the shape of the interior space of the seal holder 40 and of the body 43 of the seal 42 are substantially the same. The lip 44 is optional.

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Preferably the seal 42 is flexible to enhance its sealing effect against the end of a screen assembly. The top part 41c of the seal holder 40 projects into a recess 46 formed between the lip 44 and the body 43 of the seal 42.

5 This assists in maintaining the seal 42 in a desired position with respect to the end of a screen assembly.

Figure 4H shows a seal holder 47 in accordance with the present invention which has a lower part 47a, an upright part 47b, and an inclined part 47c projecting

10 upwardly. A seal 48 has a body 48a releasably and removably disposed in an interior area of the seal holder 47. Optionally, the body 48a is hollow as shown (or it may be solid). A lip 49 is connected to or formed integrally of a projecting part 48b. The projecting part

15 48b is connected to or formed integrally of the body 48a. The seal holder 47 can be used in a vibratory separator or shale shaker as the seal holder 22a, Figure 2, is used. Preferably the shape of the interior space of the seal holder 47 and of the major portion of the body 48a

20 of the seal 47 are substantially the same. The lip 49 is optional. Preferably the seal 82 is flexible to enhance its sealing effect against the end of a screen assembly. The inclined part 47c of the seal holder 47 projects into a recess 48c formed between a lower part 48d of the lip

25 49 and the body 48a of the seal 48. This assists in maintaining the seal 48 in a desired position with respect to the end of a screen assembly. In one aspect the lip 49 is flexible with respect to the projecting part 48b and can move backwardly (to the left in Figure

30 4H) to accommodate a screen assembly end and/or to enhance sealing contact therewith.

The screen assembly 20 as shown has a tongue-end 21,

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a frame 23, and screening material 25. It is within the scope of this invention for the screen assembly 20 (as is the case for the screen assemblies in Figures 5 to 9 and any screen assembly disclosed herein) to be any known  
5 screen assembly that abuts an end, side, or surface of a vibratory separator or shaker; and for the screening material to be any known screening material of one or more layers, with or without support, with or without layers connected together, which are generally flat or  
10 undulating.

Figure 5 shows a seal 50 removably mounted in a seal holder 51 with a screen assembly 52 (shown schematically) having an end 53 sealingly contacting the seal 50. The seal 50 has a lip 54 that abuts an exterior surface 55 of  
15 the seal holder 51. The seal holder 51 is positioned, e.g., as is the seal holder 22a, Figure 2. The screen assembly 52 has screening material 56. The seal 50 is of a length substantially equal to or slightly larger than a length of the end 53. The seal holder 51 is secured to,  
20 connected to, or formed integrally of a side wall 57 of a basket or other screen supporting structure of a separator or shaker.

Figure 6 shows a seal 60 removably mounted to a seal holder 61 with a screen assembly 62 (shown schematically)  
25 having an end 63 sealingly contacting the seal 60. The seal 60 has a recesses 64 that receive portions 65 of the seal holder 61. The seal holder 61 is positioned, e.g., as is the seal holder 22a, Figure 2. The screen assembly 62 has screening material 66. The seal 60 is of a length  
30 substantially equal to or slightly larger than a length of the end 63. The seal holder 61 is secured to, connected to, or formed integrally of a side wall 67 of a

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basket or other screen supporting structure of a separator or shaker. Optionally, the seal 60 has a void space 68 which enhances seal/screen assembly contact and, also optionally, a corrugated surface 60a for contacting the screen end 63. Optionally a member 69 may be permanently or removably positioned within the seal holder 61 to serve as a space maintainer, shock absorber, cushion, and/or seal and may be made of any suitable plastic, metal, composite, fiberglass, alloy or seal material.

Figure 7 shows a seal 70 removably mounted in a seal holder 71 with a screen assembly 72 (shown schematically) having an end 73 sealingly contacting the seal 70. The seal 70 has a lip 74 that abuts a surface 75 of a seal holder 79. The seal holder 79 is removably or permanently positioned within a seal holder 71 which is positioned, e.g., as is the seal holder 22a, Figure 2. The screen assembly 72 has screening material 76. The seal 70 is of a length substantially equal to or slightly larger than a length of the end 73. The seal holder 71 is secured to, connected to, or formed integrally of a side wall 77 of a basket or other screen supporting structure of a separator or shaker. The seal holder 79 may be made of any material mentioned above for the member 69. Optionally the seal holder 79 may have a corrugated outer surface 79a to facilitate its movement within the seal holder 71. A recess 79b receives a lip 74 of the seal 70. A wall 75 connects the lip 74 to an outer part 78 of the seal 70. Optionally, the seal 70 has an inner void space 70a.

Figure 8 shows a seal 80 removably mounted in a seal holder 81 with a screen assembly 82 (shown schematically)

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having an end 83 sealingly contacting the seal 80. The seal 80 has a lip 84 that abuts an exterior surface 85 of the seal holder 81. The seal holder 81 is positioned, e.g., as is the seal holder 22a, Figure 2. The screen assembly 82 has screening material 86. The seal 80 is of a length substantially equal to or slightly larger than a length of the end 83. The seal holder 81 is secured to, connected to, or formed integrally of a side wall 87 of a basket or other screen supporting structure of a separator or shaker. A recess 81b receives a lip 88 of the seal 80. A wall 89 connects the lip 81b to an outer part 81c of the seal 80. A rigid member 80d extends throughout the length of the seal 80 to provide strength and rigidity. Any seal or seal member in accordance with the present invention may have a rigid member like the rigid member 80d of a cross-sectional shape similar to or different than that of the rigid member 80d (e.g., oval, circular, square).

The seal holders of Figures 5 to 8 have a length corresponding to the length of the seals mounted therein or thereto (e.g. slightly shorter, slightly larger or similar to that of the seal holder 22a)

Figure 9 shows a shale shaker 90 in accordance with the present invention with screens B (with screen or screening cloth or mesh as desired) mounted on the vibratable screen mounting apparatus or basket C. The screens B may be any screen disclosed or referred to herein or have any combination of any feature or features of any screen or screen part disclosed herein. The basket C is mounted on springs I (only two shown; two as shown are on the opposite side) which are supported from a frame D. The basket C is vibrated by a motor E and

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interconnected vibrating apparatus F which is mounted on the basket C for vibrating the basket and the screens. Elevator apparatus G provides for raising and lowering of  
5 the basked end.

An access cover V is removably secured with bolts T over an opening through a wall W of the basket C for providing access to seal structure (not shown, like any discussed above) which seals a screen/basket interface  
10 within the basket C.

Figures 10A to 10C show a screen assembly 100 in accordance with the present invention which has a support 102 for screen material. The support 102 has a plurality of different openings 105a, 105b, 105c therethrough, but  
15 it is to be understood that the support 102 may be any known support or frame or part thereof used to support screen material in a screen assembly. The pattern and size of the openings in the support 102 are disclosed in U.S. Patent No. 6,601,709. The support 102 has an end  
20 shoulder 102a.

A seal holder 104 removably holds a seal 110. The seal holder 104 is formed of or connected to an end 106 of the screen assembly 100. An end 108, spaced-apart from the end 106, has a shoulder 109. The seal holder 104 has  
25 a part 107 that projects into a recess 112 of the seal 110.

The seal 110 has a body 114 with an optional hollow center that extends along the entire length of the seal 110. The seal 110 is, in certain aspects, substantially  
30 as long as the end 106 of the screen assembly 100 and, in one particular aspect is as long as the seal member 30,

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Figure 4A, and may be made of any of the materials used for the seal member 30 and of a similar hardness.

The seal member 110 has two lips 116 and 118. Part of the exterior of the body 114 and a lower surface of the lip 118 define the recess 112. In certain aspects the seal 110 is made of flexible seal material so that the body 114 is flexible to facilitate insertion of the body 114 into a recess 109 of the seal holder 104 and so that the lip 116 can flex to a position shown by the dotted line in Figure 10E when the seal 110 abuts part of a shaker or separator, or an end or shoulder of an adjacent screen assembly (like the shoulders 108 shown in Figure 10D) to facilitate sealing of the interface between two adjacent screen assemblies.

Figure 10D shows two screen assemblies 100a, 100b (like the screen assembly 100) in abutting relationship to a shale shaker basket 101. A seal 110a of the screen assembly 100a seals a basket/screen-assembly interface where the screen assembly 100a has an end adjacent a shoulder 101a of the shale shaker basket 101. A seal 110b of the screen assembly 100b seals a screen-assembly-100a/screen-assembly-100b interface. The screen assembly 100a has a shoulder 109a and the screen assembly 100b has a shoulder 109b, both like the shoulder 102a of the screen assembly 100.

Figures 11A and 11B show screen assemblies 120, 121. It is to be understood that screen assembly 121, shown partially, has an end (not shown) like the end that is shown of the screen assembly 120; and the screen assembly 120 has an end (not shown) like the end that is shown of the screen assembly 121. A seal holder 122 formed of or connected to a body 123 of the screen assembly 120

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releasably holds a seal 124 in a recess 125 of the seal holder 122. Optionally the seal 124 has a hollow center. The seal 124 may have dimensions like the seal 110 or the seal member 30 described above and may be made of the material used for them.

The seal 124 has a flexible projection 126 which can flex as shown in Figure 11B when contacted by an end 127 of the screen assembly 121, thus sealing the interface between the two screen assemblies.

Any of the seals in Figures 10E and 11A may have a pull apparatus like that of the seal member 30.

The present invention, therefore, provides, in at least certain embodiments, a support apparatus for supporting at least one screen assembly of a vibratory separator, the vibratory separator having seal apparatus for sealing an interface between a portion of the at least one screen assembly and an interior surface of the support apparatus, the seal apparatus including a seal member removably held by a seal holder within the vibratory separator, the support apparatus having container apparatus (e.g., but not limited to, a basket of a shale shaker) having a side wall, the side wall having an opening therethrough adjacent an end of the seal apparatus, and a cover movably connected to the side wall on an exterior surface thereof, the cover movable to provide access to the seal apparatus.

The present invention, therefore, provides, in at least certain embodiments, a seal (seal structure or seal member) for sealing an interface between a screen assembly and a vibratory separator in which the screen assembly is mounted, the seal having a body, at least one recess in the body, and the at least one recess sized,

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configured and positioned for releasable receipt therein  
of part of a seal holder of the vibratory separator. Such  
a seal may have one or some, in any possible combination,  
of the following: a projecting portion of the seal  
5 projecting from the body and adjacent the at least one  
recess, the projecting portion for sealingly contacting  
the screen assembly; and/or wherein the projecting  
portion includes a main arm projecting from the body, and  
one lip or two spaced-apart lips projecting from the main  
10 arm; wherein the two spaced-apart lips are at a right  
angle or at an obtuse angle to each other.

An advantage with the apparatus of the present  
invention is that the seal access systems permit the  
efficient inspection of seals and, if needed,  
15 replacement; and the screen assemblies need not be  
removed and then reinstalled to inspect and/or replace  
such seals.

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**CLAIMS:**

1. An apparatus comprising a vibratory separator and a screen assembly, the apparatus further comprising a seal arranged in a holder, the seal for sealing between said vibratory separator and said screen assembly characterized in that said seal comprises a pull apparatus for facilitating removal of said seal from said holder, said seal being slidably removable from said holder.

2. The apparatus as claimed in claim 1, wherein said holder comprises a channel in which said seal is located.

3. The apparatus as claimed in claim 1 or 2, wherein said holder has a projection and said seal has a recess therein for receiving said projection.

4. The apparatus as claimed in any one of claims 1 to 3, wherein said holder extends substantially the entire width of said screen assembly.

5. The apparatus as claimed in any one of claims 1 to 4, wherein said seal extends substantially the entire width of said screen assembly.

6. The apparatus as claimed in any one of claims 1 to 5, wherein said seal comprises a base and at least one lip.

7. The apparatus as claimed in claim 6, wherein said seal comprises a further lip.

8. The apparatus as claimed in any one of claims 1

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to 7, wherein said seal has a void therein.

9. The apparatus as claimed in any one of claims 1 to 8, wherein said holder has an outer surface and said seal has a portion for sealingly contacting said outer surface.

10. The apparatus as claimed in any one of claims 1 to 9, wherein said holder is formed from a single piece of material which is shaped by one method selected from the folding, extruding and casting material.

11. The apparatus as claimed in any one of claims 1 to 10, wherein the holder is arranged on the vibratory separator.

12. The apparatus as claimed in any one of claims 1 to 10, wherein the holder forms part of the vibratory separator.

13. The apparatus as claimed in any one of claims 1 to 10, wherein the holder is arranged on the screen assembly.

14. The apparatus as claimed in any one of claims 1 to 10, wherein the holder forms part of the screen assembly.

15. A screen assembly comprising a seal for sealing between said screen assembly and an adjacent screen assembly, and a holder for removably holding said seal characterized in that said seal comprises a pull apparatus for facilitating removal of said seal from said holder,

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said seal slidably removable from said holder.

16. The screen assembly as claimed in claim 15, wherein said holder is integral with said screen assembly.

17. The screen assembly as claimed in claim 15 or 16, wherein the screen assembly is formed from folded sheet material and said holder is formed from folded sheet material.

18. The screen assembly as claimed in any one of claims 15 to 17, wherein said holder comprises a channel in which said seal is located.

19. The screen assembly as claimed in any one of claims 15 to 18, wherein said holder has a projection projecting into a cavity in which said seal is held.

20. The screen assembly as claimed in any one of claims 15 to 19, wherein said holder extends substantially the entire width of said screen assembly.

21. The screen assembly as claimed in any one of claims 15 to 20, wherein said holder is formed from a single piece of material which is shaped by one method selected from folding, extruding and casting.

22. The screen assembly as claimed in any one of claims 15 to 21, wherein said seal extends substantially the entire width of said screen assembly.

23. The screen assembly as claimed in any one of claims 15 to 22, wherein said seal comprises a base and at

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least one lip.

24. The screen assembly as claimed in any one of claims 15 to 23, wherein said seal comprises a further lip.

25. The screen assembly as claimed in any one of claims 15 to 24, wherein said seal has a void therein.

26. The screen assembly as claimed in any one of claims 15 to 25, wherein said holder has an outer surface and said seal has a portion for sealingly contacting said outer surface.

27. In a seal for use in sealing between a vibratory separator and a screen assembly, the improvement wherein a holder is provided for holding the seal and said seal comprises a pull apparatus for facilitating removal of said seal from said holder, said seal slidably removable from said holder.

28. The seal as claimed in claim 27, further comprising a solid base and at least one lip.

29. The seal as claimed in claim 28, said seal comprising a further lip.

30. The seal as claimed in claim 27, 28 or 29, wherein said seal has a void therein.

31. The seal as claimed in any one of claims 27 to 30, wherein said seal comprises a recess for receiving a

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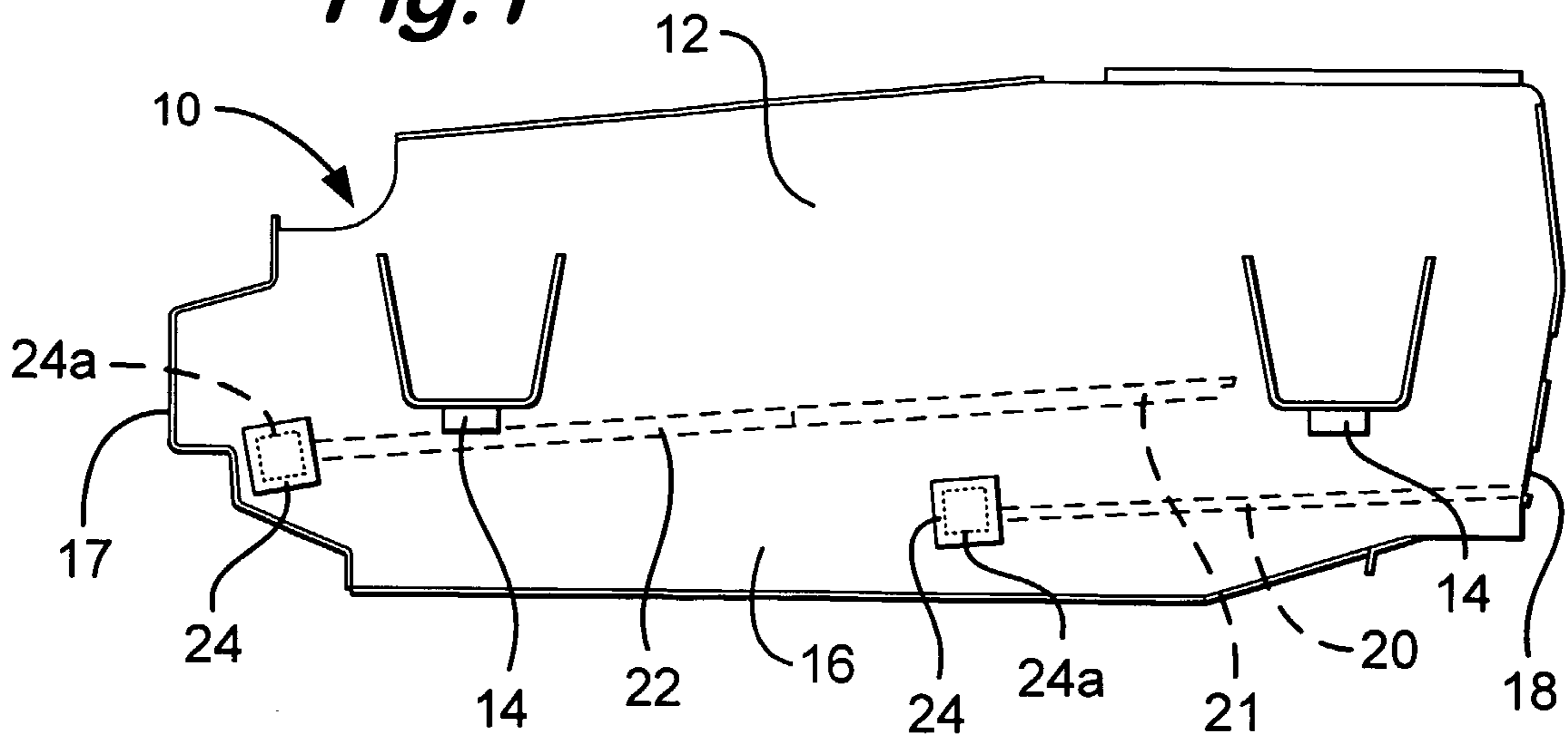
projecting part of the holder.

32. The seal as claimed in any one of claims 27 to 31, wherein said seal is made of material able to withstand drilling fluid material.

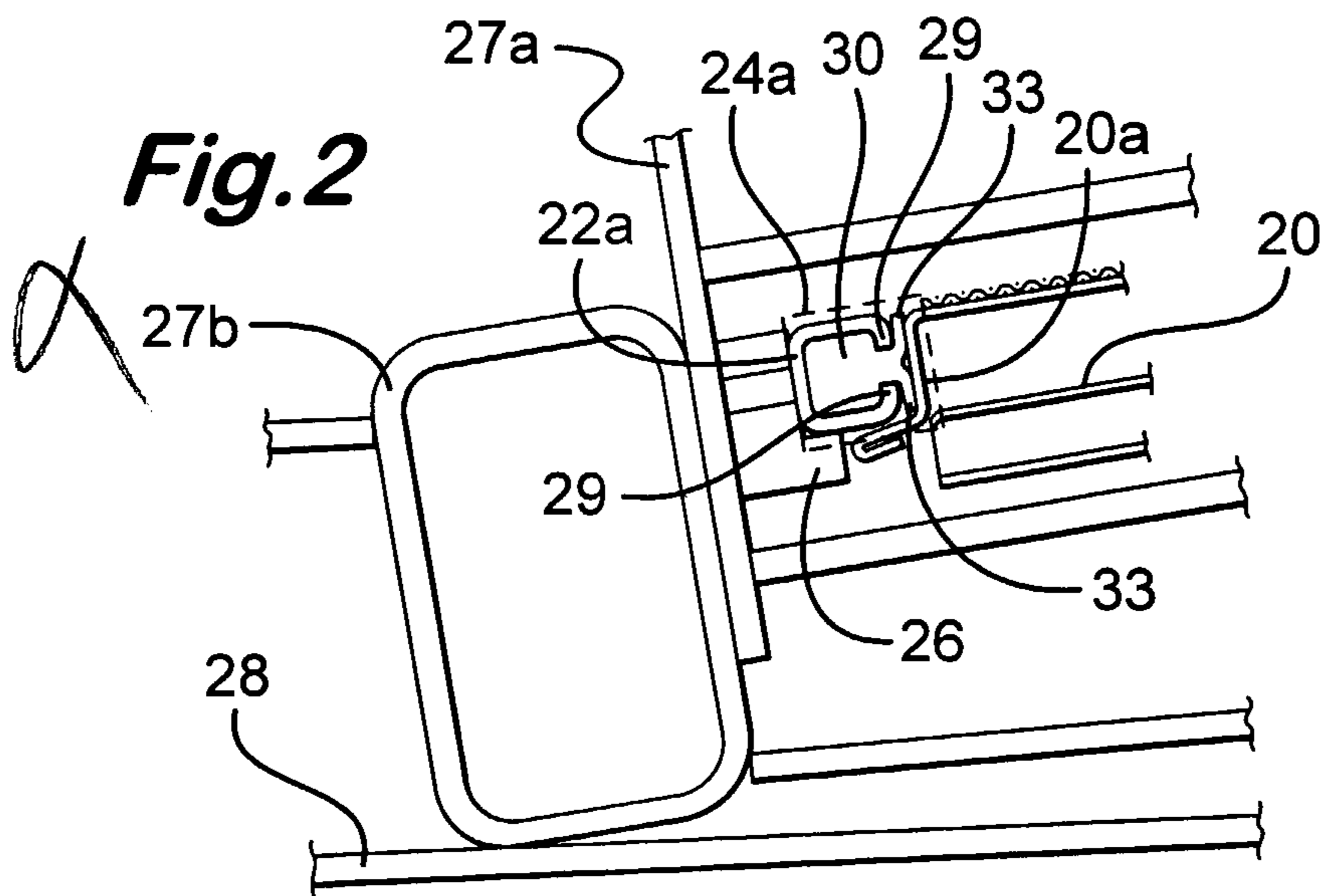
33. A method for removing a seal arranged in a holder attached to a screen for screening solids laden drilling mud, the method comprising the step of pulling on a pull apparatus attached to the seal to slidably remove the seal from the holder.

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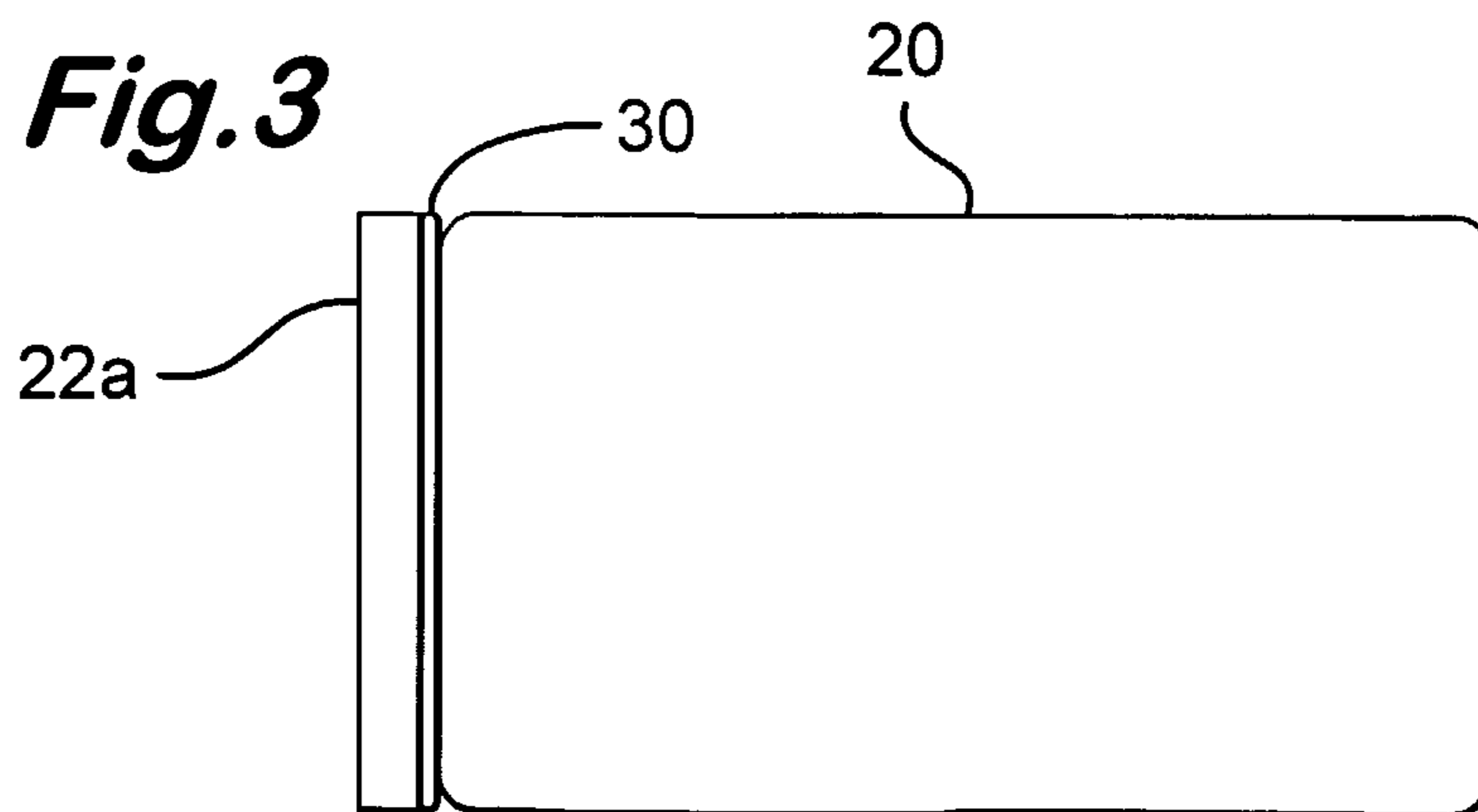
**Fig. 1**

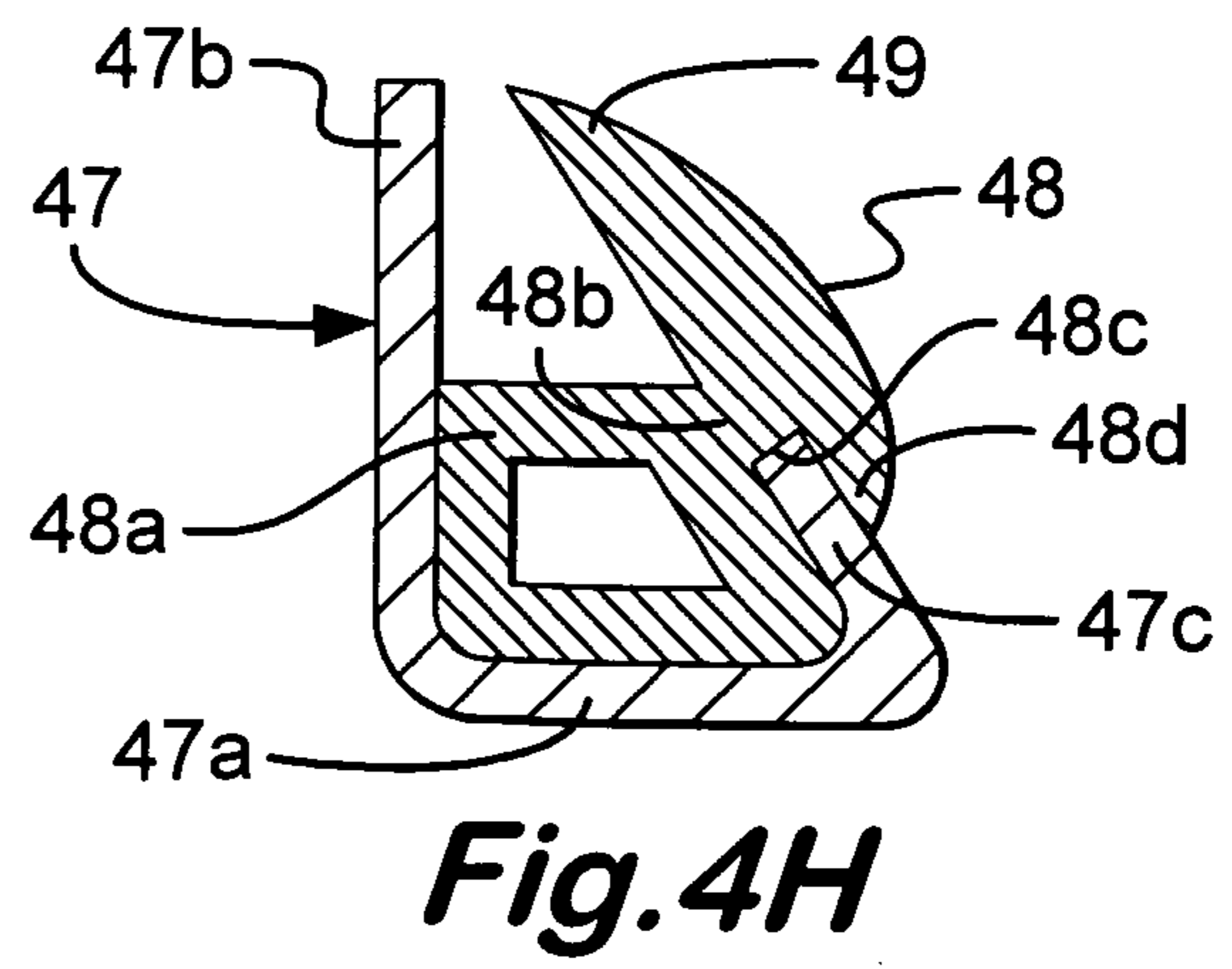
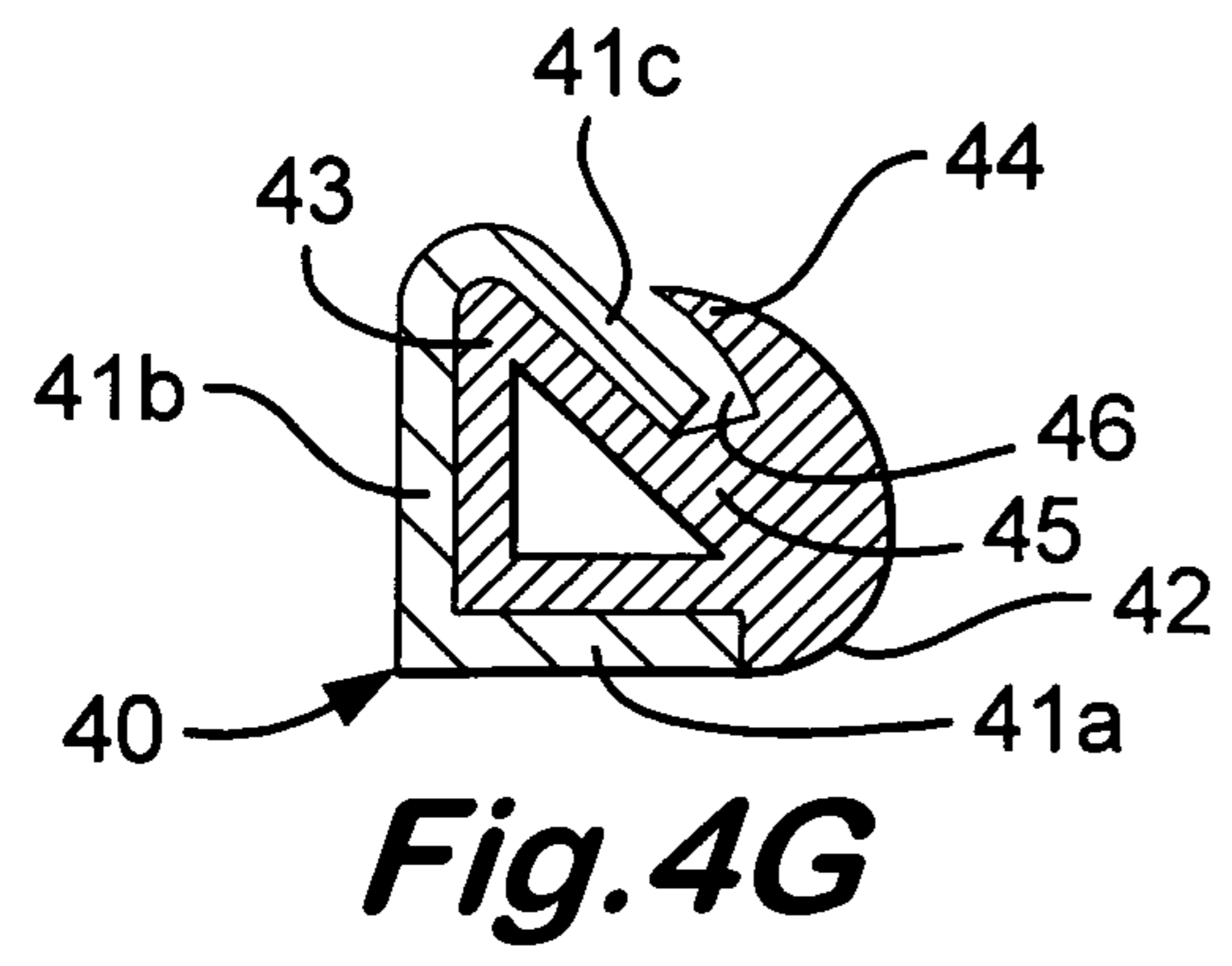
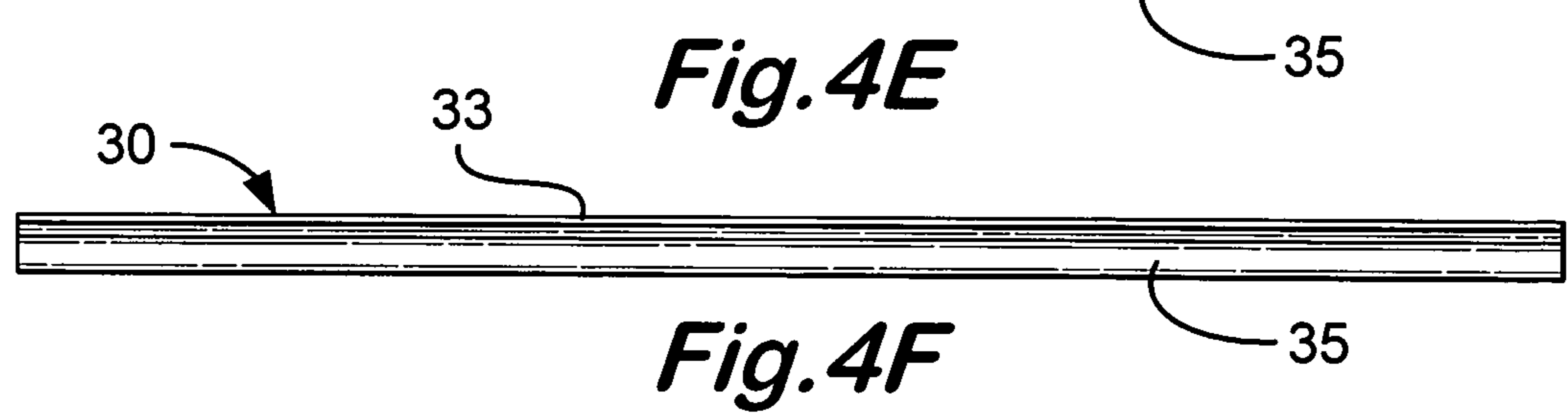
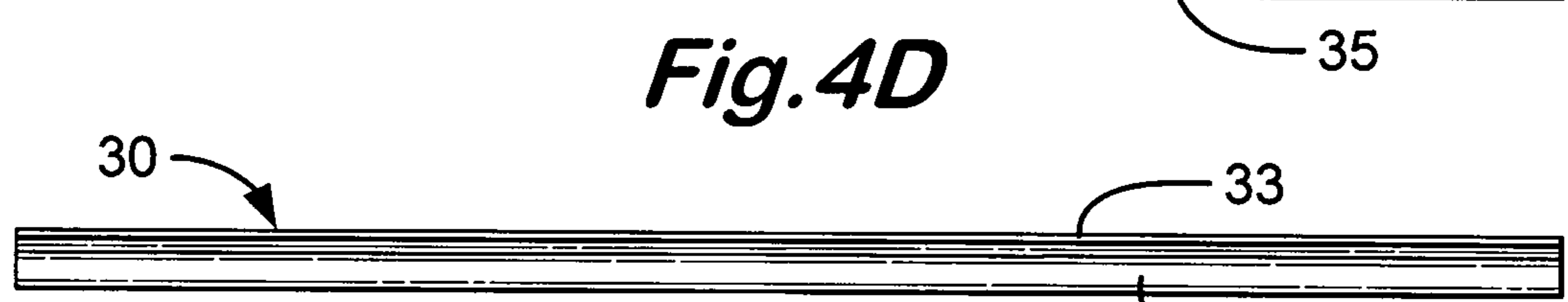
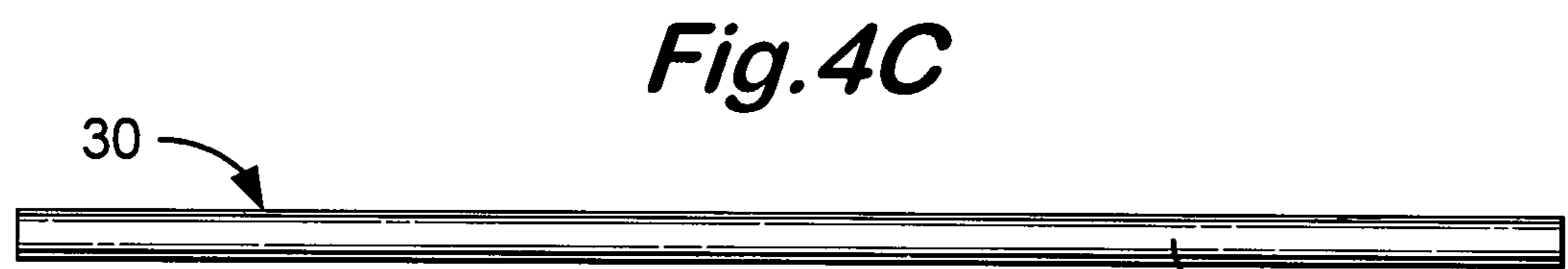
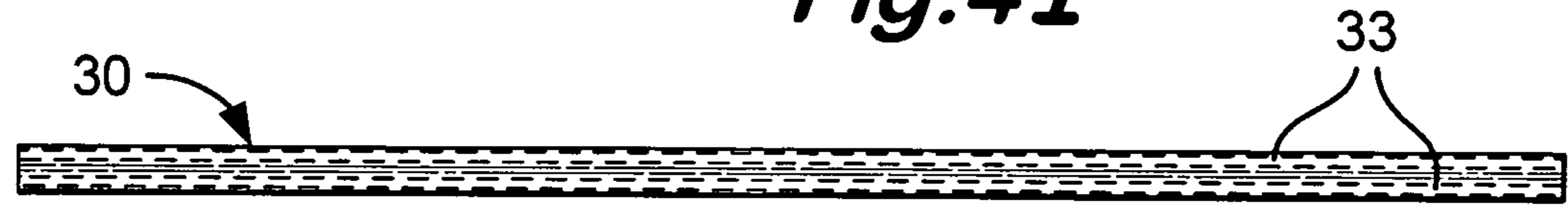
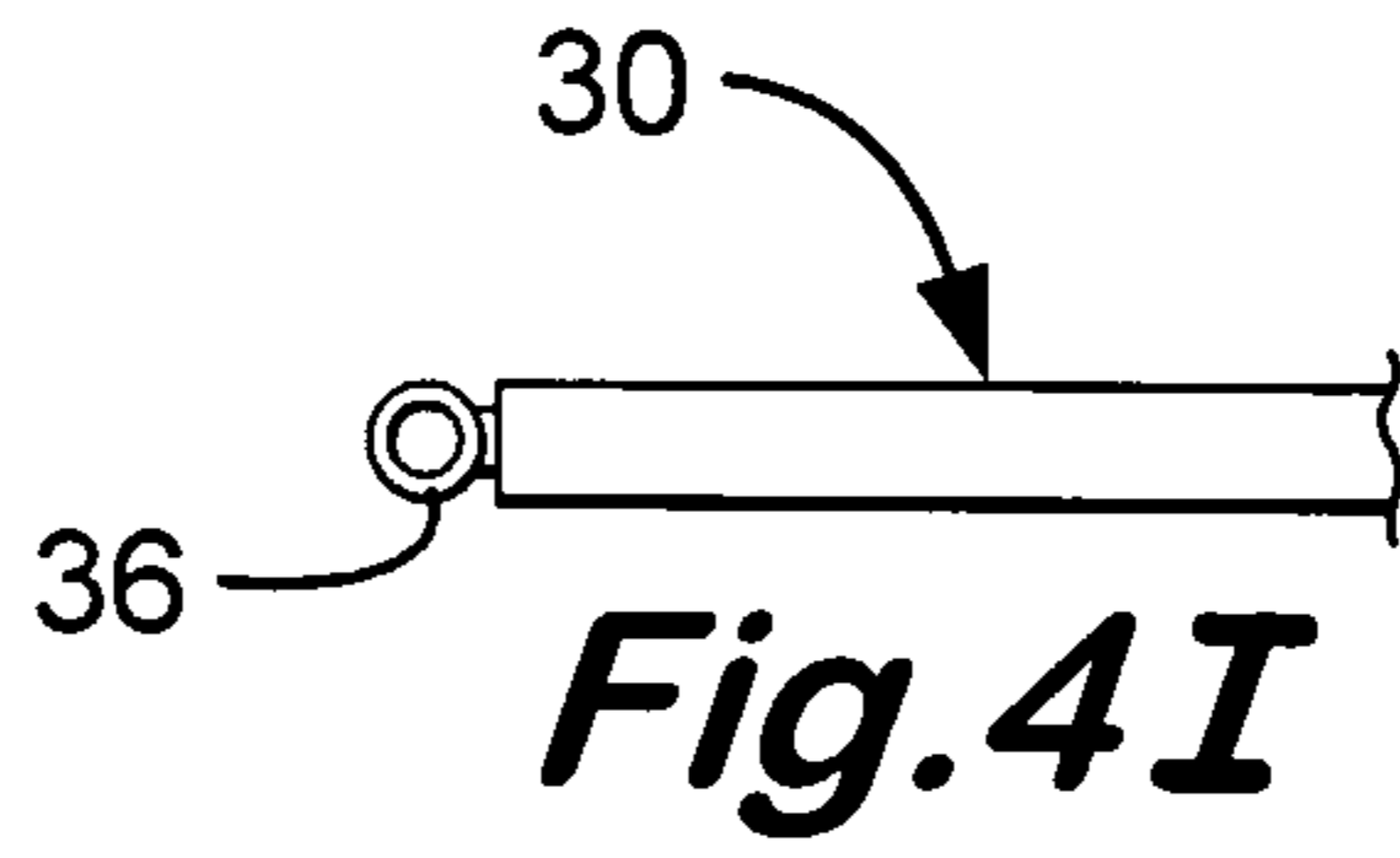
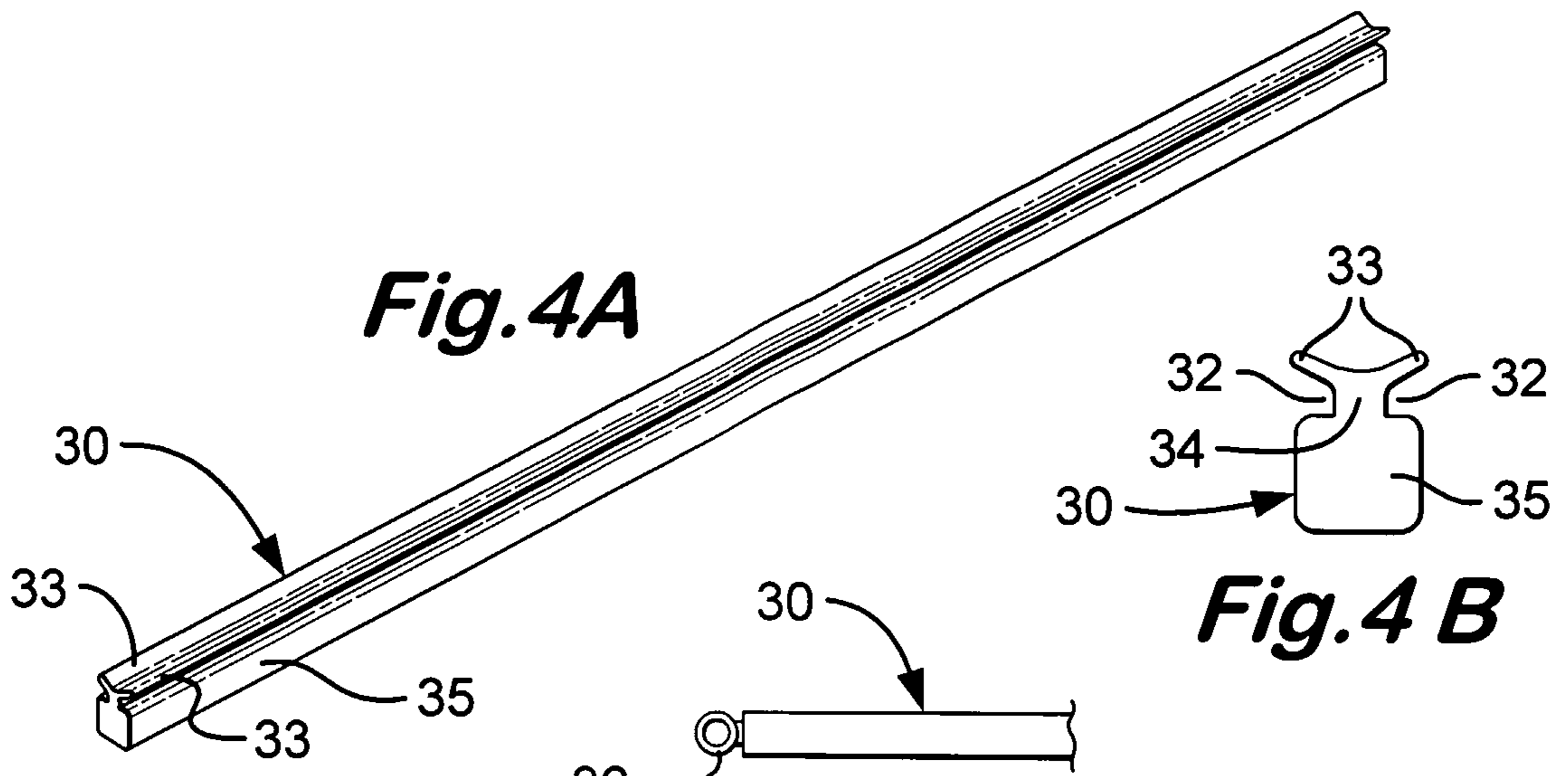


**Fig. 2**

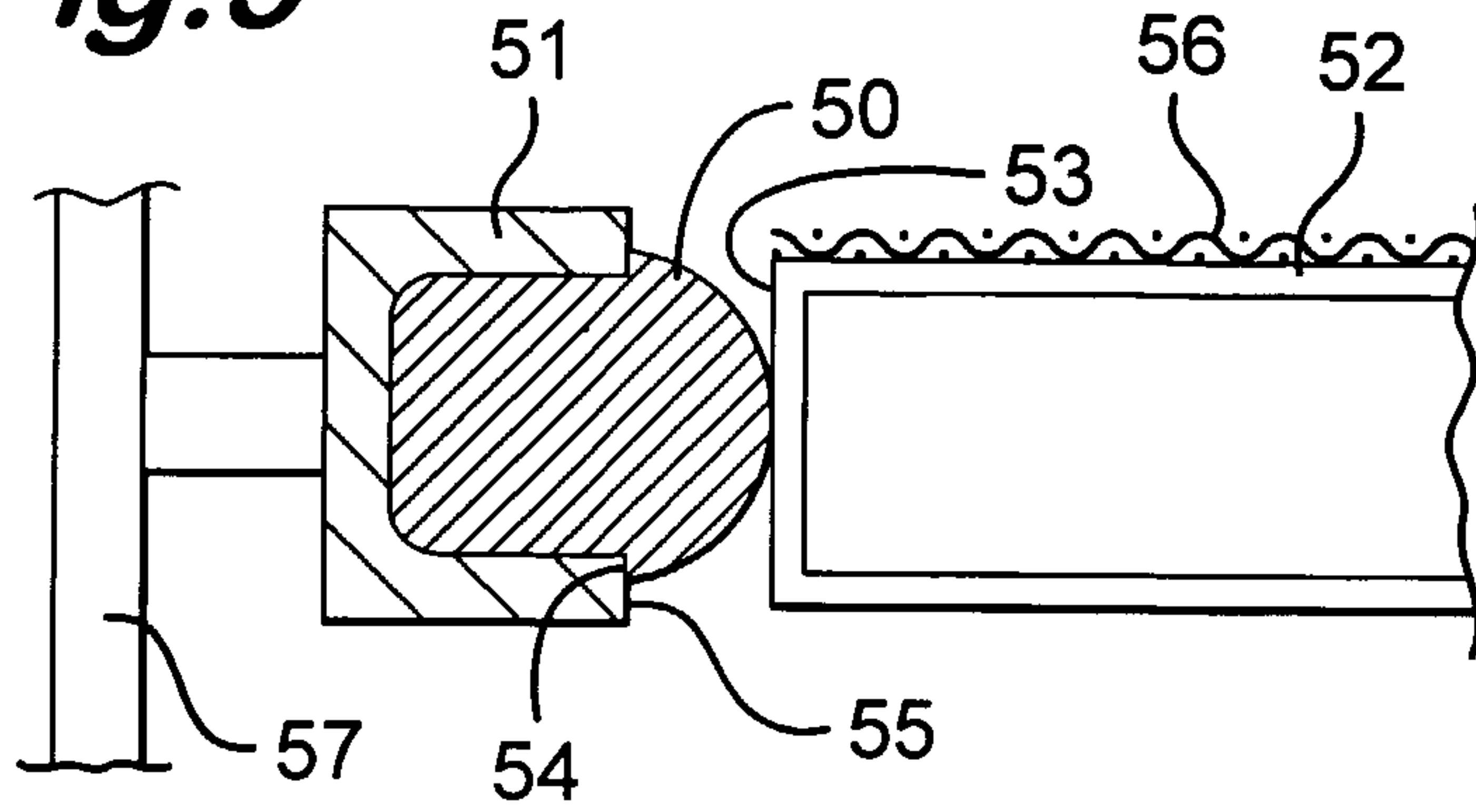


**Fig. 3**

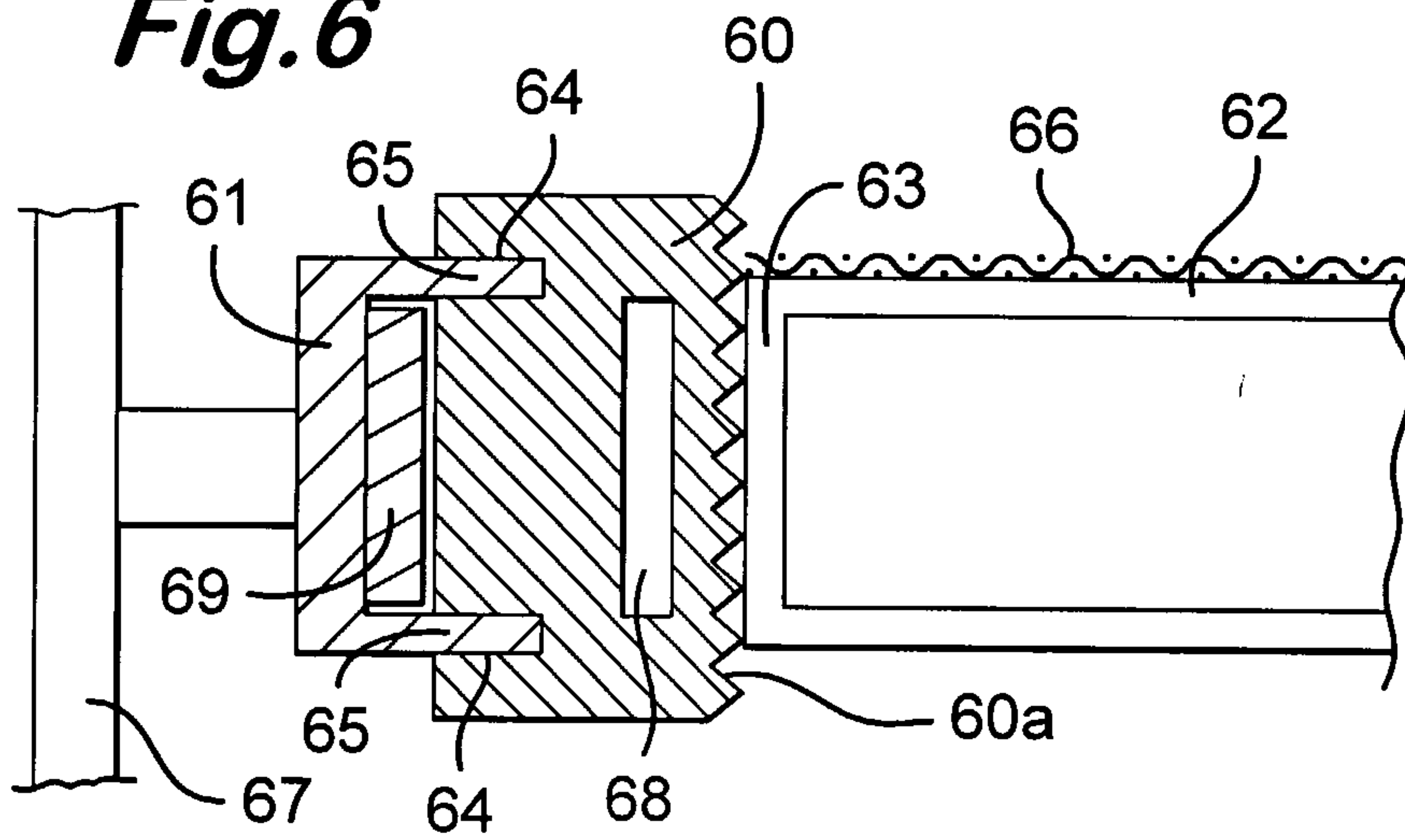




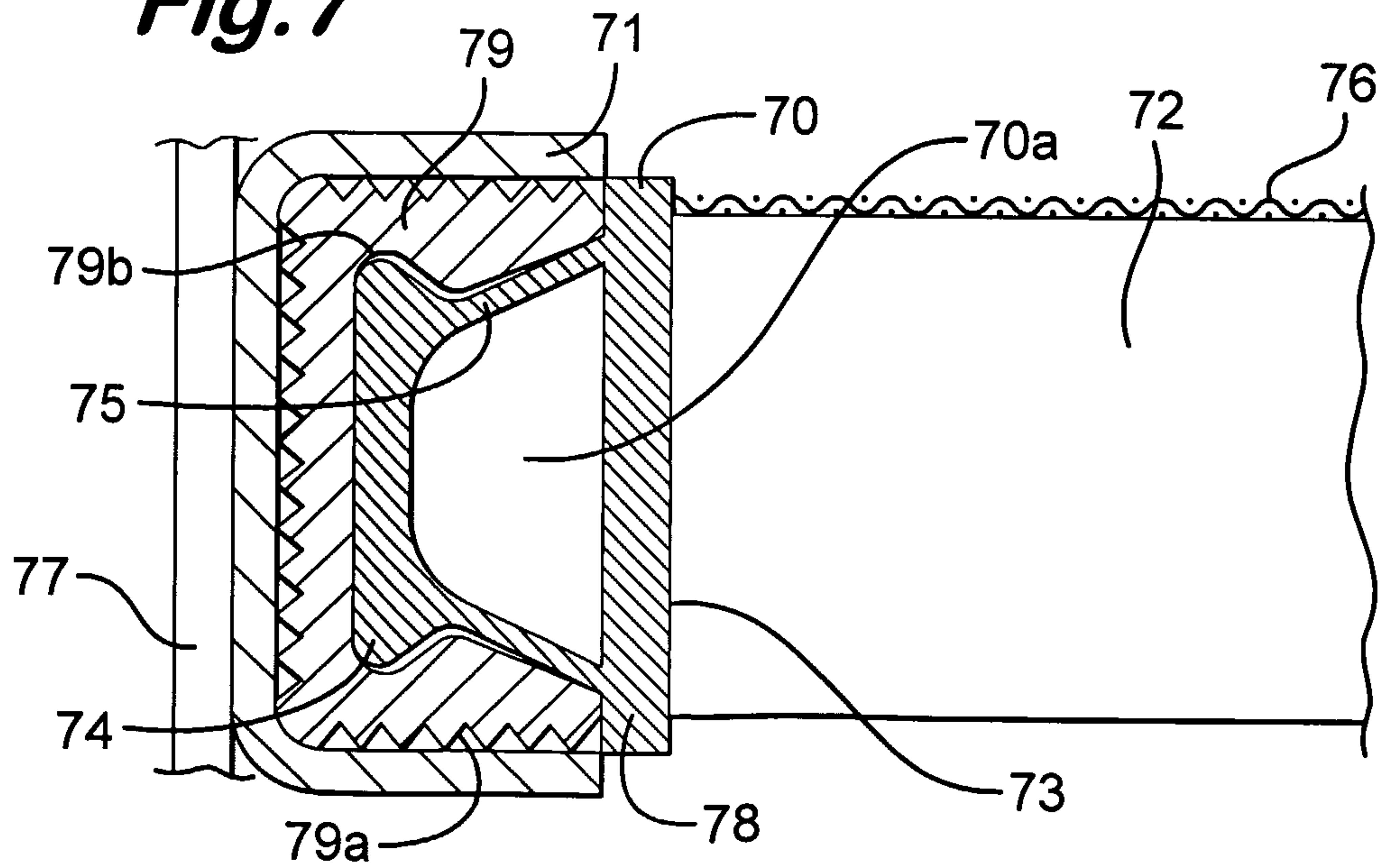
**Fig. 5**



**Fig. 6**

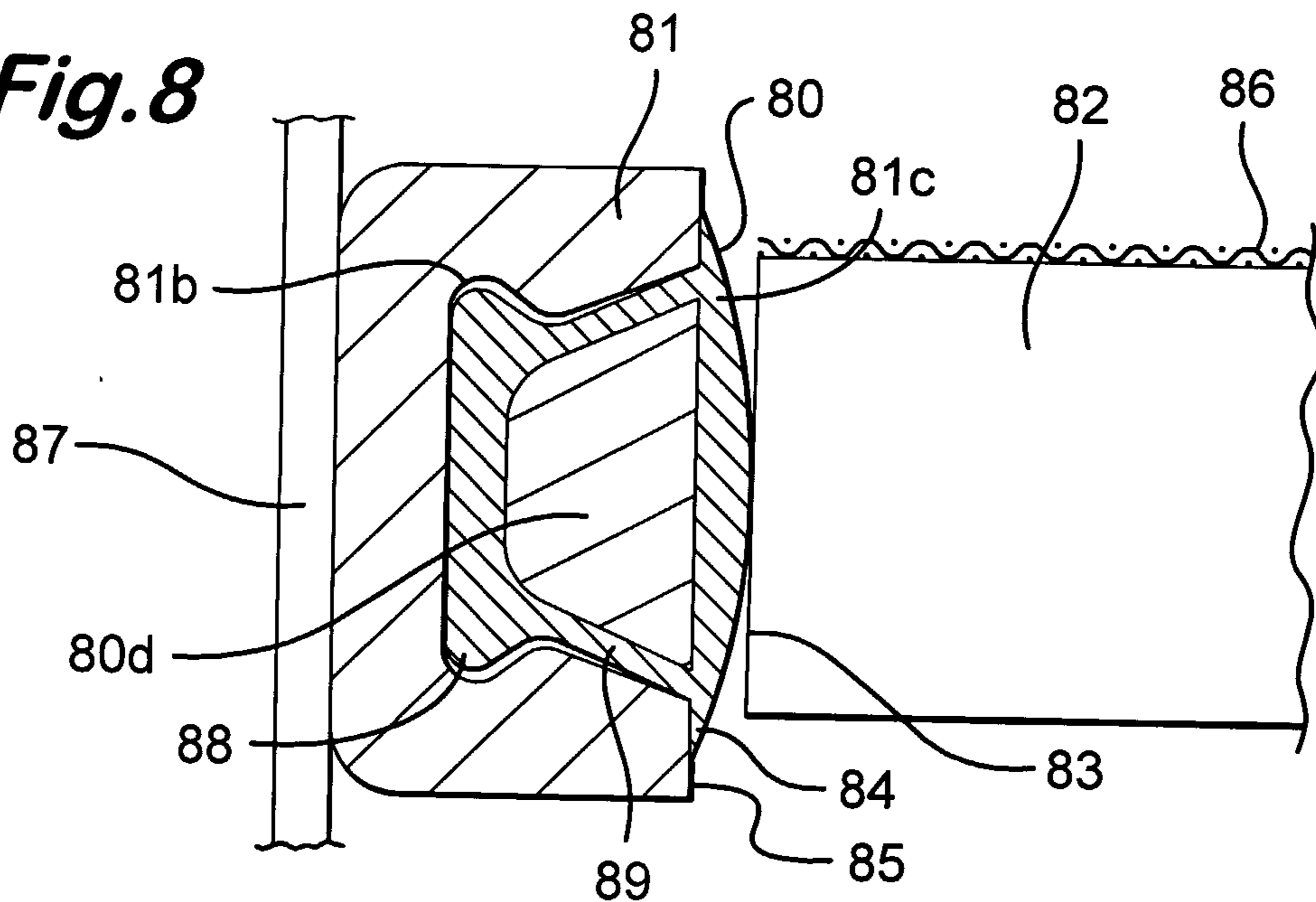


**Fig. 7**



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**Fig. 8**



**Fig. 9**

