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EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
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SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
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(54) Title: ENDOBRONCHIAL TUBE ASSEMBLIES AND SELECTORS

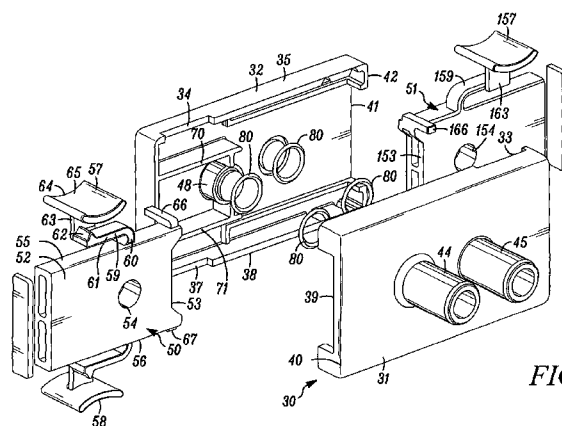


FIG. 4

(57) Abstract: An endobronchial tube assembly has a selector (2) at its machine end (20) by which passageways (3 and 4) along the tube shaft (10) to the right or left lung can be selectively blocked. The selector (2) has a housing (30) with two identical slider plates (50 and 51) movable laterally along the housing by squeezing together finger grips (57 and 58), (157 and 158) on the slider plates. An aperture (54, 154) through each plate (50 and 51) aligns with ports (44, 46) and (45, 47) on front and rear panels (31 and 32) of the housing (30) to permit gas flow when the plate is in an inner position. When the plate (50, 51) is displaced outwards its aperture (54, 154) moves out of alignment with the ports to block gas flow. Tabs (66, 166) on the two plates (50 and 51) engage one another to prevent both plates being moved to outer blocking positions at the same time.

WO 2011/148120 A1

ENDOBRONCHIAL TUBE ASSEMBLIES AND SELECTORS

This invention relates to endobronchial tube assemblies of the kind including a shaft having two passageways opening towards the patient end of the assembly and sealing means located towards the patient end of the assembly for sealing the shaft with portions of the respiratory tract such that one passageway opens into one lung and the other passageway opens into the other lung.

The invention is more particularly concerned with endobronchial tube assemblies of the kind by which the left or right lung can be selectively ventilated.

Various tube assemblies have been proposed for selective ventilation or anaesthesia of an individual lung. Gale and Waters proposed in 1931 a tube with a single cuff inserted into the right bronchus, the cuff being inflated just above the carina so that it blocks the right bronchus. This had the disadvantage that the cuff could also block the left bronchus and thereby prevent the left lung from collapsing. If the tube were inserted further into the bronchus there would be the danger that the cuff would occlude the upper lobe of the right bronchus. In 1936 Magill proposed a tube assembly with a separate blocker, the tube being positioned so that it opens above the carina and being sealed from the trachea by a cuff. The blocker is in the form of a narrow tube with an inflatable cuff inserted through the main tube into the left bronchus. When inflated, the blocker cuff seals the left bronchus from the right bronchus whereas the bore through the narrow tube enables the left lung to be separately ventilated. Green and Gordon (*Anaesthesia* Vol 12, No 1, January 1957) described an assembly of a tube with two cuffs. The patient end of the tube is located just below the upper lobe in the right bronchus, with one cuff being inflated to form a seal with the trachea above the carina and the other cuff forming a seal with the right bronchus in the region of the upper lobe, so as to seal the right bronchus from the left bronchus. Conventional endobronchial tubes sold today follow this general configuration. Examples of such tube assemblies are described in GB2168256 and in US5309906, which describes an endobronchial tube sold by Smiths Medical under the Portex Blue Line trade mark (Portex and Blue Line are registered trade marks of Smiths Medical).

Where only one lung is to be ventilated using a conventional endobronchial tube, it is usual practice to close the passage leading to the other lung by means of a clamp, such as forceps, that squeezes together opposite sides of a tube forming a part of that passage at the machine end of the assembly. This has obvious disadvantages. The clamped tube may not open fully without manipulation when the clamp is released. The wrong tube or both tubes could be clamped inadvertently. The seal provided by the clamp may not be completely effective. Also, it is a disadvantage to have to locate an additional component in order to close off one lung. WO2007/141487 proposes a rotatable switch device that can be manually displaced to open a selected one of the passageways. US5392772 describes another rotatable device for selecting between lumens in an endotracheal tube. US4489721 describes a double lumen adaptor with two rotatable valve plugs. WO99/19013 describes a double lumen adaptor that is rotatable. WO2010/061166 describes a lockable, rotatable endobronchial tube selector.

It is an object of the present invention to provide an alternative endobronchial tube assembly and selector.

According to one aspect of the present invention there is provided an endobronchial tube assembly of the above-specified kind, characterised in that the assembly includes towards its machine end a manually-displaceable selector that can be set in a first state in which the passageway opening into the left lung is open and the passageway opening into the right lung is closed or a second state in which the passageway into the right lung is open and the passageway into the left lung is closed, that the selector includes two planar sliders that are slidable longitudinally with respect to one another, and that the sliders are arranged to engage one another such as to prevent both passageways being closed at the same time.

The two sliders are preferably arranged to open or close a respective one of the passageways and preferably take the form of a plate having an aperture therethrough that can be displaced between a position in which gas can flow through the aperture and through the respective passageway to a position in which gas is prevented from flowing through the aperture. The sliders are preferably arranged in a face-to-face relationship. The selector preferably includes an outer housing along which the sliders can be slid. The sliders and

housing may be arranged such that a passageway is blocked when a respective slider is in an extended position projecting from the housing. The sliders preferably each have a finger grip a part of which projects from the housing for manual access, the finger grip having a spring member that urges a part of the finger grip to engage the inside of the housing and resist displacement of the slider. Each slider preferably has two finger grips located on opposite sides of the housing such that the grips can be squeezed together between finger and thumb to release the slider for displacement. The selector may have a third state in which the passageways into both lungs are open. The two sliders are preferably identical with one another.

According to another aspect of the present invention there is provided a manually-displaceable selector for an endobronchial tube assembly according to the above one aspect of the present invention.

An endobronchial tube assembly and selector according to the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

- | | |
|-----------------|--|
| Figure 1 | is a perspective view of the assembly; |
| Figure 2 | is a front view of the selector; |
| Figure 3 | is a plan view of the selector; |
| Figure 4 | is an exploded view of the selector; |
| Figures 5 and 6 | are cut-away perspective views of the selector with both passageways open; and |
| Figures 7 and 8 | are cut-away perspective views of the selector with the right-hand passageway blocked and the left-hand passageway open. |

The endobronchial assembly comprises an endobronchial tube 1 and a switch or selector 2 at its machine end by which ventilation connection can be made to the tube.

The tube 1 is conventional in having a curved shaft 10 with two gas passageways or lumens 3 and 4 extending side-by-side along its length. One passageway 3 opens at the patient end tip 11 of the tube 1, the other passageway opening through a side opening 12 displaced a short distance to the rear of the tip. A first inflatable sealing cuff 13 encompasses the tube 1 between the patient end tip 11 and the side opening 12, the cuff being inflatable via an inflation line 14 and a combined connector and pilot balloon 15. A second sealing cuff 16 is located immediately to the rear of the side opening 12 and is inflated via a second inflation line 17 and a combined connector and pilot balloon 18. When correctly inserted, the patient end tip 11 locates in the right lung and the side opening 12 opens just above the carina so that the left lung can be ventilated. The lower sealing cuff 13 serves to isolate the two lungs from one another while the upper cuff 16 seals the outside of the tube 1 with the lower end of the trachea in the usual way.

The upper, machine end 20 of the shaft 10 connects with a coupling assembly 21 including two branched tubes 22 and 23 connected with respective ones of the passageways 3 and 4 extending along the shaft. The tubes 22 and 23 extend generally longitudinally, side-by-side and are closed at their machine ends by respective tethered caps 24 and 25. Each tube 22 and 23 has a short, laterally-extending side arm 26 and 27 projecting at right angles towards the outside of the curve of the shaft 10. The two side arms 26 and 27 connect, at their outer end with the rear of the selector 2. The arrangement of the selector 2 of the present invention is such that, instead of being coupled to the side arms 26 and 27, it could be connected to the ends of the tubes 22 and 23 directly, with the side arms being capped.

The selector 2 has a rectangular outer housing 30 provided by a front and rear moulded plastics panel 31 and 32 (Figs 3 and 4). The two panels 31 and 32 are identical to keep down manufacturing costs and to simplify assembly. Typically, the housing is about 56mm long by 34mm wide and 12mm deep or thick. When fastened together, the two panels 31 and 32 define between them two short slots 33 and 34 towards opposite ends of the upper

edge 35, and two identical slots 37 (only one visible) along the lower edge 38. The front panel 31 has a rectangular cut-out 39 (Fig 4) extending along the major part of the length of its left-hand edge 40. Similarly, the rear panel 32 has a cut-out 41 extending along its right-hand edge 42. The front and rear panels 31 and 32 both have two tubular spigots 44 and 45, and 46 and 47 about 15mm long projecting orthogonally outwardly and spaced from one another longitudinally of the selector 2 either side of its midpoint. As can be seen in Figure 4, the left-hand spigot 46 on the rear panel 32 continues inside the housing 30 as a short tubular extension 48, whereas the right-hand spigot 47 terminates flush with the inside surface of the rear panel. Similarly, the right-hand spigot 45 on the front panel continues interiorly to form a short extension (not visible) and the left-hand spigot 44 terminates flush with the interior surface.

The selector 2 also includes two sliders 50 and 51 trapped between the front and rear panels 31 and 32 and slidable longitudinally to a limited extent relative to the housing 30 and to each other. The two sliders 50 and 51 are identical plastics mouldings but are mounted within the housing 30 in an inverted relationship to one another. Again, the fact that the two sliders 50 and 51 are identical keeps costs down and simplifies assembly. The left-hand slider 50 comprises a main rectangular plate 52, which has a trapezoidal recess 53 in its right-hand edge. A circular aperture or port 54 extends through the thickness of the plate 52 about two thirds the way along its length and midway up its height. The diameter of the port 54 matches the diameter of the bore through the spigots 44 and 46. Upper and lower finger grips 57 and 58 extend from the upper and lower edges 55 and 56 of the plate 52 respectively. The finger grips 57 and 58 each have a cantilevered, spring arm 59 with a short, vertically-projecting stem 60 attached at its lower end integrally of the plate 52, in line with the port 54. The stem 60 curves to the left at its upper end to continue as a horizontal limb 61 about one third the length of the plate 52. The free end of the limb 61 is resiliently deflectable towards the edge 55 or 56 of the plate 52. The width of the spring arm 59 is equal to that of the edge 55 or 56; the upper surface of the limb 61 is formed at its free end with a lateral projection 62 of triangular section. At the rear edge of the free end of the limb 61 a short rib 63 projects upwardly, the width of the rib extending longitudinally of the slider 50. The rib 63 supports the underside of a finger plate 64 having a concave upper surface 65.

The slider 50 is completed by two elongate tabs 66 and 67 projecting laterally rearwardly from the upper and lower edges 55 and 56 of the plate 52 at its right-hand, inner end.

The right-hand slider 51 is identical with the left-hand slider 50 and corresponding features have been given the same reference numeral with the addition of 100.

The left-hand slider 50 is supported in the housing 30 by contact of the rear face of the plate 52 with two parallel, longitudinally-extending guides 70 and 71 moulded with the rear panel 32 at its left-hand end. The ribs 63 on the upper and lower finger grip 57 and 58 project through the slots 34 and 37 on the upper and lower side of the housing 30. The dimensions of the finger grips 57 and 58 are such that the projections 62 are urged resiliently against the inside surface of the housing 30 on either side of the slots 34 and 37, the width of the projections exceeding that of the slots. It will be appreciated that the finger plates 64 are exposed externally of the housing for contact by the user.

The left-hand end of the plate 52 projects through the cut-out 39 on the left side of the housing 30. The distance by which the plate 52 projects depends on the setting of the slider 50. In the ON or open position shown in Figures 2 to 6, where both passages through the selector are open, the slider 50 is at its extreme right-hand position and the port 54 in the plate 52 is aligned with the left-hand spigots 44 and 46 and the internal extension 48 so that gas can flow freely between the two spigots. In this position, only a short length of the plate 52 projects outwardly through the cut-out 39. When, however, the slider 50 is slid fully to the left, it will be appreciated that a greater length of the plate 52 will project from the left-hand end of the housing 30. This is the OFF or closed position where the port 54 is displaced to the left, out of alignment with the spigots 44 and 46 and a solid or imperforate region of the plate 52 extends between the two spigots to block gas flow between them. Figure 4 shows optional O-ring seals 80 that could be mounted on the housing 30 around the openings of the spigots 44 to 47 to enhance the seal with the plate 52 or 152 in both the open or closed states.

The right-hand slider 51 is located rearwardly of the left-hand slider 50 and its forward surface bears on guides on the inside of the front panel 31 (not shown) corresponding to the guides 70 and 71 on the rear panel. The right-hand end of the left-hand slider 50 overlaps the left-hand end of the right-hand slider 51 with the two sliders being arranged in a face-to-face relationship. In the ON position shown in Figures 2 to 6, the right-hand slider 51 is located with the ribs 163 of the upper and lower finger grips 157 and 158 at the extreme left-hand end of the slots 33 and 36, that is, with the slider in the extreme left-hand position. It can be seen from Figure 5 that, in this position, there is a maximum overlap between the plates of the two sliders and that the tabs 66 and 67, and 166 and 167 are spaced from one another. In this position, the port 154 on the right-hand slider 51 aligns with the right-hand spigots 45 and 47 so that gas can flow freely between the two spigots so that gas can flow freely to both lungs.

In order to isolate one lung, the corresponding slider is simply displaced outwardly to its OFF position so that gas cannot flow through that passage in the selector 2. Figures 7 and 8 show a situation where the selector 2 is set to block flow to the right lung and in which passage between the right-hand spigots 45 and 47 is blocked. This is achieved simply by sliding the right-hand slider 51 outwardly, to the right, to its maximum extent. This displaces the port 154 in the plate 152 to the right of the passage through the spigots 45 and 47 and instead positions a solid or imperforate region of the plate 152 in line with the spigots to block flow therebetween. Figure 7 shows that, in this position, the tabs 66 and 67, and 166 and 167 on the two sliders 50 and 51 contact one another. It can be seen that, if any attempt were made to move the left-hand slider 50 also to a blocking OFF position, the engagement of the tabs 66 and 67, and 166 and 167 would cause the right-hand slider 51 to be pulled to the left to an ON or open position. This is a safety feature of the present arrangement in that it prevents the selector 2 being set in a state where both the left and right passages through the selector are blocked and hence both lungs are blocked.

It can also be seen that, in the OFF position, the slider plate 52 or 152 projects outwardly of the housing 30. Thus, if the projecting portion were inadvertently pushed in, it would cause the passage associated with that slider to open. Again, this helps ensure that a passage cannot be inadvertently blocked.

In the arrangement described, the sliders 50 and 51 are held in their set positions by friction between the sliders and the inside of the housing, and especially by frictional engagement of the projections 62 and 162 on the four finger grips 57, 58, 157 and 158 with the inside of the upper and lower edges of the housing. To move either slider, the user squeezes the upper and lower finger grips 57 and 58 or 157 and 158 inwardly together between finger and thumb so that the limbs 61 flex inwardly and displace the projections 62 or 162 away out of contact with the housing. A more positive action could easily be provided by means of a latch formation on the housing so that the projection snapped over the latch when fully in the ON or OFF position. Similarly, the slider and housing could be arranged such that the sliders could not be retained at an intermediate position but, when released, would move to a fully ON or a fully OFF position.

It will be appreciated that the housing would be marked appropriately to indicate which lung was associated with which spigot and also to indicate the open (ON) and closed (OFF) positions of the sliders.

The arrangement of the present invention can be made at low cost, it can be very compact and of low weight to reduce loading on the patient. The selector enables either or both lungs to be ventilated and prevents passage to both lungs being blocked at the same time. By appropriate marking it can be readily apparent which lung is being ventilated and which lung is blocked.

CLAIMS

1. An endobronchial tube assembly including a shaft (10) having two passageways (3 and 4) opening towards the patient end of the assembly and sealing means located towards the patient end (11) of the assembly for sealing the shaft with portions of the respiratory tract such that one passageway opens into one lung and the other passageway opens into the other lung, characterised in that the assembly includes towards its machine end (20) a manually-displaceable selector (2) that can be set in a first state in which the passageway (4) opening into the left lung is open and the passageway (3) opening into the right lung is closed or a second state in which the passageway (3) into the right lung is open and the passageway (4) into the left lung is closed, that the selector includes two planar sliders (50 and 51) that are slidable longitudinally with respect to one another, and that the sliders are arranged to engage one another such as to prevent both passageways being closed at the same time.
2. An endobronchial tube assembly according to Claim 1, characterised in that the two sliders (50 and 51) are arranged to open or close a respective one of the passageways.
3. An endobronchial tube assembly according to Claim 2, characterised in that the sliders are each in the form of a plate (50 and 51) having an aperture (54, 154) therethrough that can be displaced to a position in which gas can flow through the aperture and through a respective passageway to a position in which gas is prevented from flowing through the aperture.
4. An endobronchial tube assembly according to any one of the preceding claims, characterised in that the sliders (50 and 51) are arranged in a face-to-face relationship.
5. An endobronchial tube assembly according to any one of the preceding claims, characterised in that the selector (2) includes an outer housing (30) along which the sliders (50 and 51) can be slid.

6. An endobronchial tube assembly according to Claim 5, characterised in that the sliders (50 and 51) and housing (30) are arranged such that a passageway is blocked when a respective slider (50 or 51) is in an extended position projecting from the housing (30).
7. An endobronchial tube assembly according to Claim 5 or 6, characterised in that the sliders (50 and 51) each have a finger grip (57, 58 and 157, 158) a part of which projects from the housing (30) for manual access, that the finger grip (57, 58 and 157, 158) has a spring member (59, 159) that urges a part (62) of the finger grip to engage the inside of the housing and resist displacement of the slider.
8. An endobronchial tube assembly according to Claim 7, characterised in that each slider (50 and 51) has two finger grips (57 and 58, 157 and 158) located on opposite sides of the housing (30) such that the grips can be squeezed together between finger and thumb to release the slider for displacement.
9. An endobronchial tube assembly according to any one of the preceding claims, characterised in that the selector (2) has a third state in which the passageways into both lungs are open.
10. An endobronchial tube assembly according to any one of the preceding claims, characterised in that the two sliders (50 and 51) are identical with one another.
11. A manually-displaceable selector (2) for an endobronchial tube assembly according to any one of the preceding claims.

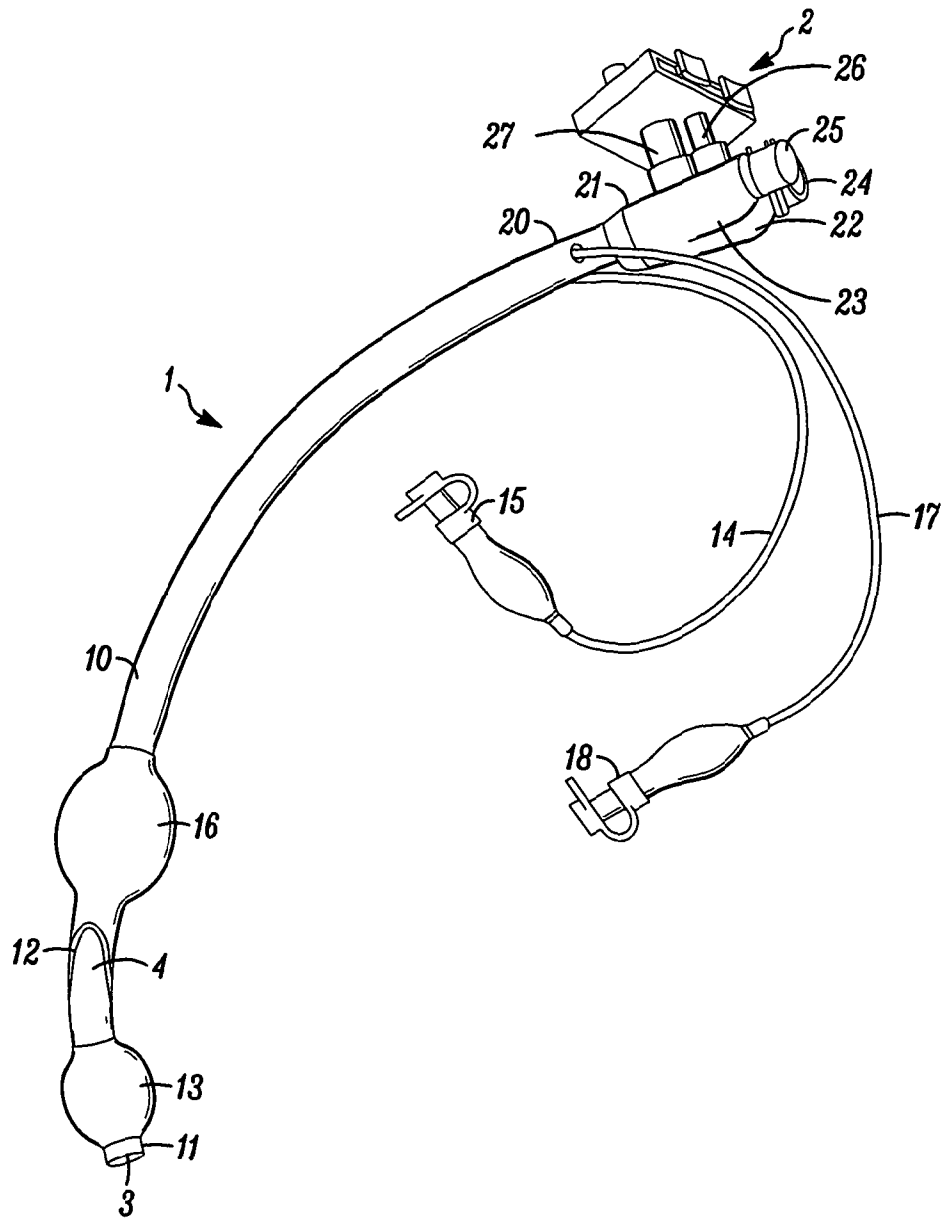


FIG. 1

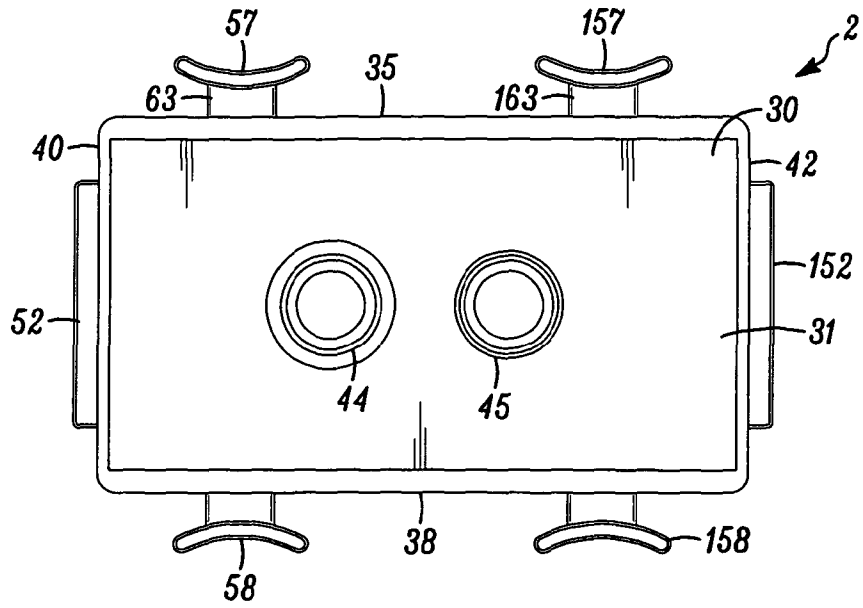


FIG. 2

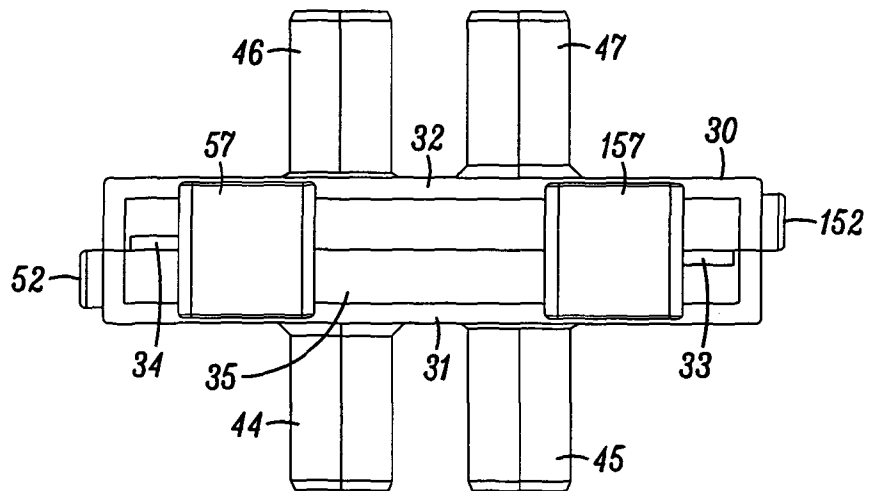


FIG. 3

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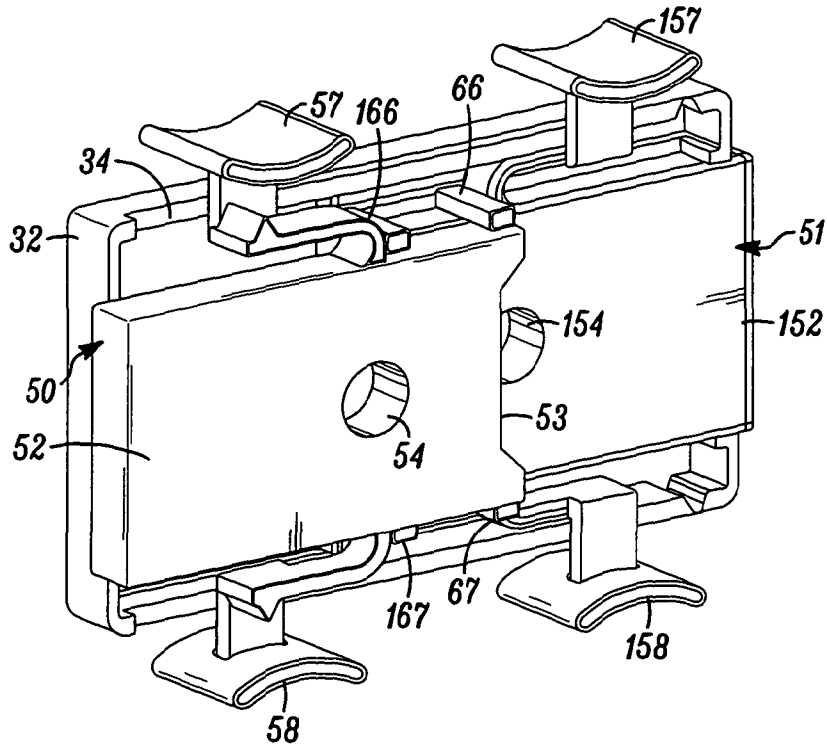


FIG. 5

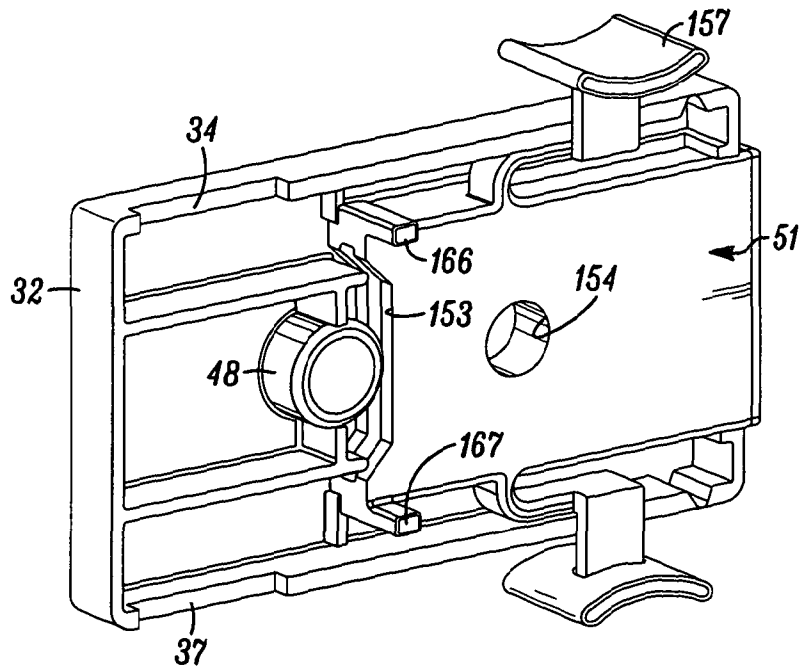


FIG. 6

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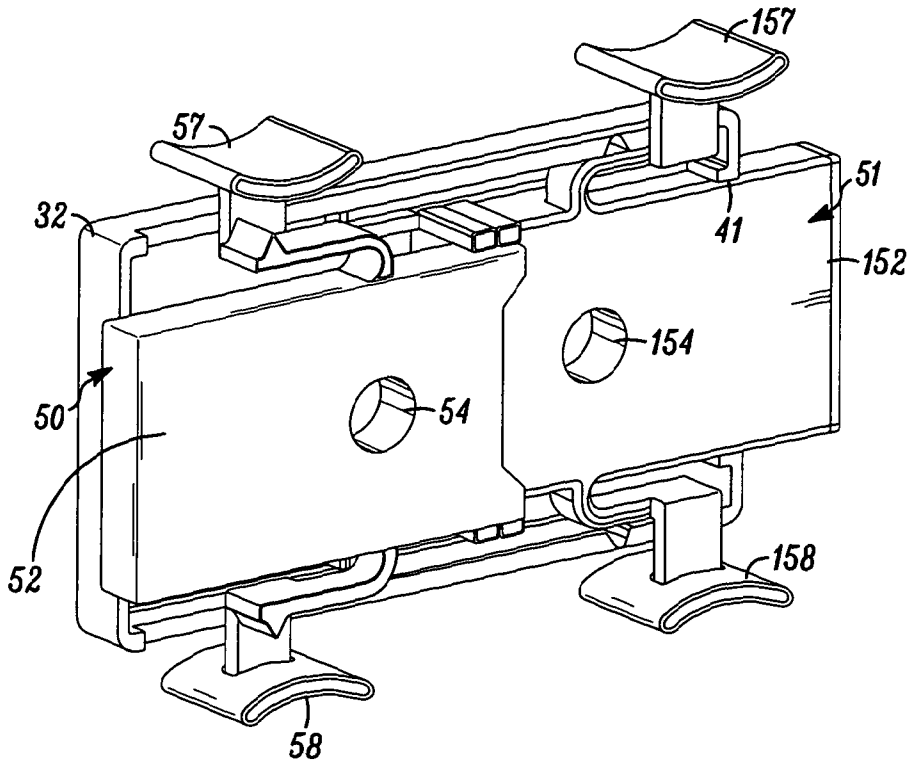


FIG. 7

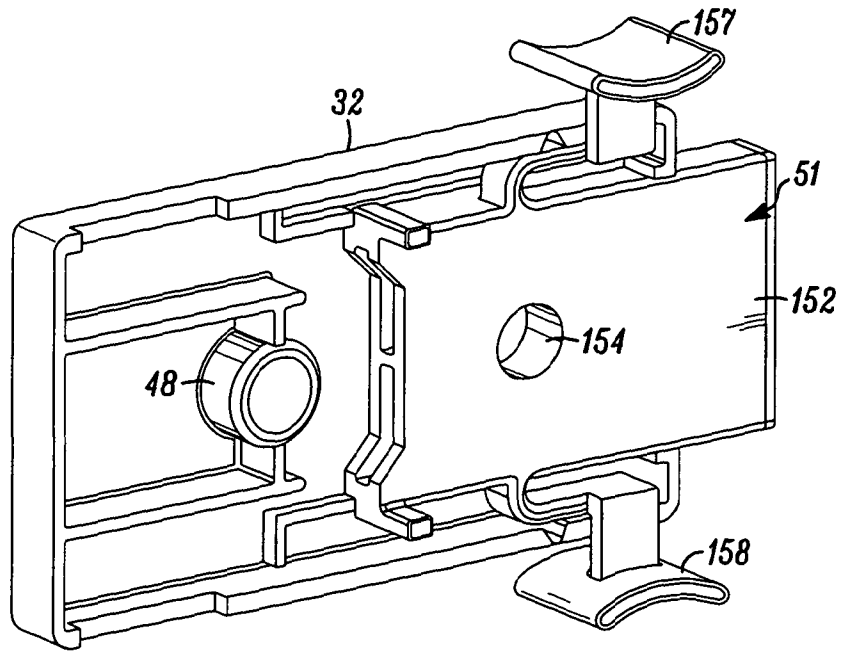


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2011/000681

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61M16/04
ADD. A61M39/22 A61M39/02

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)
A61M F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007/141487 A1 (SMITHS GROUP PLC [GB]; NOBLE ANDREW [GB]) 13 December 2007 (2007-12-13) cited in the application	11
A	the whole document	1-10
X	US 4 489 721 A (OZAKI GEORGE T [US] ET AL) 25 December 1984 (1984-12-25) cited in the application	11
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A	the whole document	1-10
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2011/000681

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 5 309 906 A (LABOMBARD DENIS [US]) 10 May 1994 (1994-05-10) cited in the application the whole document -----	1-11
X	US 5 813 402 A (JINOTTI WALTER J [US]) 29 September 1998 (1998-09-29)	11
A	the whole document -----	1-10
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A	the whole document -----	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2011/000681

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