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(54) **Apparatus for skiing using wind propulsion.**

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Description

The invention relates to apparatus for skiing using wind propulsion.

Skiing on grass or snow covered inclines is well known, as is water skiing, where the skier is towed by a motor boat and sailboarding has relatively recently become very popular.

In water skiing, either one or two skis can be used, the skis being buoyant in that they will float on the surface of the water but not being sufficiently buoyant to support the weight of a skier when the skier is stationary. It has been proposed to provide a pair of buoyant floats in or on which a person can stand on water, propulsion being obtained by using a paddle.

In sail-boarding a board is used which is normally sufficiently buoyant to support the user when stationary and a sail secured on a mast and stretched by a wishbone boom is used, the mast being pivoted to the board by a universal joint and the sail-boarder moving around the front of the mast to reach the other side of the board as the sail-board goes about when changing direction with respect to the wind, or the sail-boarder moving across the board to the other side around the rear of the mast with the sail being gybed.

Patent specification DE—A—3 017 759 shows an arrangement comprising a mast, a sail of rectangular form and a pair of support members extending out from a middle portion of the mast to the outer corners of the sail. The support members are provided on both sides of the sail and are coupled to a handle provided forward of the middle portion of the mast. The sail arrangement is to be used in a manner conventional for sail arrangements of sail boards and is particularly easy to assemble and disassemble.

From US—A—4 269 133 an apparatus for skating is described using a sail arrangement of the type described in the first part of claim 1. However, in this known apparatus the sail is hand-held by the user.

According to the invention there is provided apparatus for skiing utilizing wind propulsion comprising at least one ski and a sail arrangement, the sail arrangement comprising a mast, a sail and a boom and being substantially symmetrical about a line passing through substantially the mid point in its height with the boom provided on only one side of the sail, characterised in that the mast projects from the sail at each end thereof and means are provided on said at least one ski to receive an end of the mast, the sail arrangement being invertible in that it can be held by the user with either one end of the mast or the other end of the mast downwardly and engageable with said means whereby said side of the sail faces towards the wind at all times during propulsion by the wind.

Such a single sided sail can have considerable advantages over a double sided sail, particularly much lower drag.

When a skier wishes to go about, that is to say to change-over from a mode of sailing in which

the wind is coming from his right-hand side to a mode of sailing in which the wind is coming from his left-hand side, or vice-versa, the sail is inverted so that the end which was previously uppermost becomes the lowermost end.

The means on said at least one ski to receive an end of the mast may comprise a socket and/or track.

Advantageously said means to receive an end of the mast comprises a bowl to be secured to the ski and having upper flanges defining a converging slot therebetween.

Preferably the bowl is adjustable in position of the ski and the mast used in connection therewith has a flexible portion, a stem below the flexible portion and to engage in the converging slot of the bowl and a lower enlarged foot.

Preferably the boom has upper and lower members lying on opposite respective sides of the line about which the sail is symmetrical and joined together not only adjacent the position or positions at which the boom is engaged with the mast but also at a position spaced outwardly along the sail from the mast.

Where a plurality of skis are used, means may be provided to bridge between the skis and make a connection therebetween, such means preferably being torsionally flexible.

If desired the means bridging between the skis may be adjustable in position longitudinally of the skis or may be retained in engagement with the skis by engagement of the user's feet therewith.

The invention is diagrammatically illustrated by way of example in the accompanying drawings in which:-

Figure 1 is an elevation of one embodiment of a sail arrangement of apparatus for skiing utilizing wind propulsion according to the invention;

Figure 2 is an elevation of a second embodiment of a sail arrangement of apparatus according to the invention;

Figure 3 is a diagram showing how a skier using apparatus for skiing utilizing wind propulsion according to the invention can "go about";

Figures 4a and 4b show respectively a plan view and a side elevation of a pair of water skis of apparatus for skiing utilizing wind propulsion according to the invention;

Figures 5a, 5b and 5c show further plan views of other embodiments of skis of apparatus according to the invention;

Figures 6a and 6b are respectively a plan view and a side elevation of another embodiment of a pair of water skis of apparatus according to the invention;

Figures 7a and 7b are respectively a plan view and a side elevation of yet another embodiment of a pair of water skis of apparatus according to the invention;

Figures 8a and 8b are respectively a plan view and a side elevation of an adjustable mast foot fitting for a pair of skis of apparatus according to the invention;

Figure 9 is a perspective view of another mast foot fitting for a pair of skis according to the invention;

Figure 10 shows an embodiment of mast foot of apparatus according to the invention;

Figure 11 is a plan view of part of a mast and sail arrangement of apparatus according to the invention; and

Figure 12 and Figure 12 show elevations of boom fittings of apparatus according to the invention.

Referring to the drawings and firstly to Figure 1, a sail arrangement comprises a mast 1 having opposite ends 2 and 3, a sail 4 having battens 5 therein and a boom 6 comprising a generally U-shaped member 7 and a bar 8 which joins the limbs of the U-shaped member 7. A transparent window may be provided as indicated at 4a.

As shown the sail 4 has a sleeve 9 in which the mast 3 is received although it should be appreciated that a curved track on the mast, in which an edge of the sail was engaged would be an equivalent arrangement. An aperture 10 is provided at the mid-point of the sail so that a base portion 11 of the U-shaped member 7 of the boom 6 can be secured to the mast by yokes 12. Cords secured to the rear edge of the sail are passed through cleats provided adjacent the free ends of the limbs of the U-shaped member 7 of the boom 6 so that the free edge of the sail 4 can be pulled outwardly away from the mast thereby to cause the mast to curve to the shape shown in Figure 1. Preferably the mast tapers so that it is of greater diameter or at least greater stiffness in its mid-section compared with its ends 2, 3. The entire sail arrangement of Figure 1 is symmetrical about an axis I-I.

The sail 4 may for example have a total area of between 4 and 5 square metres and the overall length of the mast 1 may be in the region of $3\frac{1}{2}$ to 5 metres according to the height and weight of the skier, rubber grip members 13, 14 may be provided at the ends of the mast 1.

The embodiment shown in Figure 2 is very similar to Figure 1, the significant differences being that the boom 16 does not have a cross member 8 as in Figure 1 but rather the free ends of a U-shaped member 17 are bent in towards one another and then extend together outwardly as a double member 18 and out haul cords 19 attached to the sail adjacent the ends of a vertical batten 20 are passed round the outer end of the double member 18 and then cleated. Alternatively the sail could carry a triangular stiffening member instead of the vertical batten, only one cord 19 would then be required. The boom 16 may be secured to the mast by screws or bolts 12a.

Although the sail arrangements of Figures 1 and 2 can be used, at least for short periods, held free in the hands of the user, it is envisaged that they will normally be used with one or other end of the mast at least resting and preferably located on one or other of the skis on which the feet of the user are supported.

The skis may be snow or grass skis but are preferably water skis, the two skis advantageously having a combined buoyancy sufficient to support the weight of the user such that with

the user's weight fairly evenly divided between two skis he can stand upright substantially on the surface of water.

Figures 1 and 2 show the sail arrangements in an orientation which would be adopted when the skier had wind coming in from his left side that is to say the end 2 of the mast is lowermost and would preferably be supported by engaging the rubber member 13 on a forward portion of the right-hand ski. The sail arrangement would be held by the user with the right-hand grasping the lower limb of the U-shaped member 7 or 17 approximately midway between the mast and the rear edge of the sail, or the vertical bar 8, and the left-hand grasping the mast 1 at its approximate mid position or grasping the lower limb of the U-shaped member 7 or 17 adjacent the mast.

When sailing with the wind coming in from his right-hand side, the user would have the end 3 of the mast lowermost and the rubber member 14 preferably supported at a forward position on the left-hand ski. Figure 3 shows a sequence of diagrams showing how a skier initially moving in a direction indicated by arrow A and with a wind indicated by arrows B can "go about", moving sequentially from an arrangement shown at C to an arrangement shown at J.

Thus in arrangement C the skier has the end 3 of the mast lowermost and engaged on the left-hand ski, the mast 1 being generally upright and the boom 6 or 16, making an angle of approximately 30° with the left-hand ski as viewed in plan view. In arrangement D the angle of the boom to the ski has been reduced and in arrangement E it will be seen that the angle is negative, that is to say the rear end of the boom is inside the rear end of the left-hand ski. The skier then uses his knees and feet to cause the skis to change direction in the water to achieve the arrangement F and subsequently G. By arrangement G the skier has removed the end 3 of the mast 1 from the left-hand ski and has re-orientated the mast so that it is horizontal and above his head with the sail 4 streaming rearwardly in the wind generally horizontally from the mast 1. The turning of the skis with respect to the water continues to arrangement H and the skier lowers the end 2 of the mast to bring the mast into an upright orientation and engage the end 2 with the right-hand ski, this is the position shown at arrangement I. Finally the rear end of the sail is then pulled inwardly towards the skier at arrangement J so that the boom 6, 16 is approximately at an angle of 30° to the right-hand ski, that is to say a reverse position to that indicated in arrangement C.

If desired the mast may have a stiffening member therein, possibly a curved stiffening member, of lesser height than the height of the mast, the stiffening member falling from the upper end of the mast to the lower end of the mast as the mast is inverted and thereby strengthening the lower portions of the mast to stiffen it against bending and leaving the upper portion of the mast more flexible. Alternatively

the middle portion of the mast can be reinforced, for example by an outer sleeve, so that it is substantially rigid.

Figures 4a and 4b show a pair of skis each of which has a socket member 21 to receive a foot of the mast and a flexible bridge member 22, for example of marine plywood, secured at its ends to the skis 23, 24, the member 22 being torsionally flexible as indicated in Figure 4b so that the tip of one ski can move upwardly without the other one having to make a similar upward movement. The dotted line outlines indicated at 24a and 24b show that the shapes and profiles of the skis can be varied for various uses. Keels may be provided on the skis or the skis may be profiled in other ways.

Figure 5a shows that twin mast steps 25, 26 may be provided on a pair of skis 27, rubber shoe-type clamps 28 being provided to receive the feet of the user. Alternatively straps may be provided beneath which the feet of the skier can be engaged, particularly for high speed skiing.

Figure 5b shows that the mast steps 26 can be joined by a flexible member 29 with a track 30 therein so that the transverse position at which the lower end of the mast is supported can be adjusted.

Figure 5c shows that the members 29 and 22 can be extended and combined and that the resultant member 31 can be provided not only with a transverse track 30 but with at least one longitudinally extending track 32 so that the forward/rearward position at which the mast is supported can be adjusted.

In the embodiments shown in Figure 6 and 6a, each of a pair of skis 34 has three tracks 35, 36, 37 in its upper surface to provide for adjustment. Thus a platform 38 can be secured by rear screws 39 and forward screws 40 to the tracks 35 and 36 respectively on each side, the length of the tracks 35 and 36 allowing the platform 38 to be moved forwardly or rearwardly with respect to the skis 34 and allowing the skis 34 to be offset longitudinally as shown so that the right ski is advanced with respect to the left ski or vice versa. The tracks 37 provide for mounting of mast foot fittings 41, shown only in Figure 6b, and again provide for longitudinal adjustment. Each ski 34 has a keel 42, a skeg 43 and a stabilizing fin 44 projecting laterally from the outside edge adjacent the rear of the ski. The fins 44 assist stabilization, particularly when a user is learning, and also enable the skis to plane more readily. The keel 42 and skeg 43 may be removable and adjustable in position longitudinally of the ski on which they are mounted. The longitudinally offset arrangement shown in Figure 6a would normally be reversed each time the user "went about", i.e. changed direction so that the wind was blowing on a different side, and is intended for high speed runs. The skis of Figures 6a and 6b may for example be of length 2.45 metres, width 17 cm, depth 25 cm and weight, per pair including the platform 38, 16 Kg.

Each of the pair of skis 45 shown in Figures 7a and 7b has a keel 46 with a lead weight 47 at its

lower end and a skeg 48. Each ski also mounts two mast foot fittings 49 and 50 and the two skis are coupled by a platform 51 which has integral projections 52 on its underside, which projections 52 engage in recesses 53 in the skis, which recesses can, in an alternative mode of use, receive the feet of the user. In such alternative mode of use the platform 51 is not used and flexible coupling means indicated at 54 and 55 can be provided for coupling the two skis together to prevent undue separation. If desired, rigid coupling means similar to the means 54, 55 may be provided to couple the skis together at a set spacing and to prevent relative longitudinal movement during an initial stage of use, that is to say until the skier is balanced and beginning to move. The skis of Figures 7a and 7b while of much the same length as those of Figures 6a and 6b are wider but shallower, for example 25 cm width and 15 cm depth, they may be lighter to at 14 Kg and be more manoeuvrable.

Referring to Figures 8a and 8b, a mast foot fitting of the kind shown at 49 in Figure 7a may comprise a generally bowl shaped member 56 which is substantially pear shaped in plan view and has upper flange portions 57 at the narrower forward portion, the flange portions 57 defining a converging slot 58 which can receive a stem 59 of a mast. The bowl 56 may be secured by a rear screw 60 and a forward screw 61, each of which engages a respective member 62 in a track 63 whereby the bowl member 56 is adjustable forwardly and rearwardly. Generally the mast will need to be moved forwardly as the strength of the wind increases. The screw 60 may extend through a slot 64 so that the bowl 56 may be pivoted about the front screw 61 so as to be angled. Figure 8b particularly shows that a mast with a section 65 which passes through a sail (not shown) may extend into a flexible member 66 from which projects the stem 59 which engages in the slot 58, the mast having a lower enlarged foot 67. It will be seen that by engaging the foot 67 in the bowl 56 and allowing the mast to be moved in a forward direction by the pressure of the wind on the sail, the stem 59 of the mast foot can be engaged in the slot 58 defined by the flanges 57 of the bowl and thereby secure the mast in position without risk of it slipping.

In a more simple construction the mast foot mounting may, as shown in Figure 9, comprise a bowl 68 which is secured by a screw 69 passing through its base into a member 70 in a track to permit either longitudinal or lateral adjustment with respect to the ski. If desired the screw 69 may merely engage a fixed nut secured in a ski.

Figure 10 shows that an extreme end mast fitting 76, below a cleat 77 whereby a cord tensioning a sail can be tied off, may have its outer end of greater diameter than an inner end portion, such a mast foot is particularly suitable for a bowl of the shape of the bowl 68 shown in Figure 9. The portion 76 is preferably formed of or covered by plastics or rubber material.

Instead of a bowl provided above the surface of

the ski, the receiving means for the foot of the mast may be a recess as in the case of the recess 50 of Figure 7a, Figure 7b showing that such a recess has no projection above the upper surface of the ski.

Although emphasis has been placed in the above description on the use of buoyant skis for use on water, the invention is also applicable to skiing on land whether covered by snow or not. Thus the sail arrangements of Figures 1 and 2 and other arrangements within the scope of the invention could be used with ordinary snow skis modified by the addition of a mast foot fitting. The said arrangements could also be used on skis designed to run on surfaces which are not slippery, for example grass or sand, wheels or tracks in that event normally being provided on the ski or skis.

Figure 11 shows that a sail 78 having a sleeve 79 which receives a mast 80, may have a batten 81 which is permanently curved to the required aerofoil shape and is partially wrapped around the mast 80, such an arrangement being permissible since the sail is single sided, that is to say wind will always blow on to it in use in the direction indicated by the arrow 82 since upon the user "going about" the sail is inverted so that its other end is downwards.

Figure 12 shows that a bracket 83 on a forward member 84 of a boom may have a sleeve 85 through which the mast passes, the bracket 83 engaging in an aperture provided at the forward edge of the sail, for example the aperture 10 of Figure 1, such that when the mast is threaded into the sleeve 9 of the sail it is passed firstly through one half of the sleeve 9, then through the sleeve 85 before passing through the other part of the sleeve 9.

In the embodiment shown in Figure 13 a bracket 86 similar to the bracket 83 is provided in two parts securable together by fixing means 87 such that the mast can be first threaded through the sleeve 9 in the sail, the boom 88 laid thereon and the two parts of the bracket 86 brought into engagement within the aperture 10 so that a sleeve 89 surrounds the mast and a sleeve 90 surrounds the boom before the fixing means 87 are secured.

Claims

1. Apparatus for skiing utilizing wind propulsion comprising at least one ski (23, 24, 27, 34, 45) and a sail arrangement, the sail arrangement comprising a mast (1), a sail (4) and a boom (6, 16) and being substantially symmetrical about a line (I-I) passing through substantially the mid point in its height with the boom (6, 16) provided on only one side of the sail (4), characterised in that the mast (1) projects from the sail at each end (2, 3) thereof and means (25, 26, 41, 49, 50, 68) are provided on said at least one ski to receive an end (2 or 3) of the mast (1), the sail arrangement being invertible in that it can be held by the user with either one end (2) of the mast (1) or the other end (3) of the

mast (1) downwardly and engageable with said means (25, 26, 41, 49, 50, 68) whereby said side of the sail (4) faces towards the wind at all times during propulsion by the wind.

2. Apparatus according to claim 1, in which said means (50) to receive an end of the mast comprises a bowl (56) to be secured to the ski and having upper flanges defining a converging slot (58) therebetween.

3. Apparatus according to claim 2, in which the bowl (56) is adjustable in position on the ski and the mast has a flexible portion (66), a stem (59) below the flexible portion and to engage in the converging slot (58) of the bowl (56) and a lower enlarged foot (67).

4. Apparatus according to any one of claims 1 to 3, incorporating a track (37) whereby said means on said at least one ski to receive an end of the mast are adjustable in position on the ski.

5. Apparatus according to any one of claims 1 to 4, in which the boom (6, 16) has upper and lower members (7, 17) lying on opposite respective sides of the line (I-I) about which the sail is symmetrical and joined together not only adjacent the position or positions at which the boom (6, 16) is engaged with the mast (1) but also at a position (8, 18) spaced outwardly along the sail from the mast.

6. Apparatus according to claim 5, in which the boom includes a fitting having a sleeve (85, 89) to surround the mast within an aperture (10) in the sail (4).

7. Apparatus according to any one of claims 1 to 6, including a further means (22, 38, 51) provided to bridge between the skis and make a connection therebetween and said means (22, 38, 51) are torsionally flexible.

8. Apparatus according to claim 7, in which the means (38) to bridge between the skis are adjustable in position longitudinally of the skis.

Patentansprüche

1. Vorrichtung zum Skilaufen unter Verwendung des Windantriebes, mit mindestens einem Ski (23, 24, 27, 34, 45) und einer Segelanordnung, die einen Mast (1), ein Segel (4) und einen Baum (6, 16) aufweist und im wesentlichen symmetrisch um eine Linie (I-I) liegt, welche durch im wesentlichen den Mittelpunkt ihrer Höhe verläuft, wobei der Baum (6, 16) auf nur einer Seite des Segels (4) vorgesehen ist, dadurch gekennzeichnet, daß der Mast (1) aus dem Segel an jedem Ende (2, 3) desselben hervorragt und Mittel (25, 26, 41, 49, 50, 68) auf dem mindestens einen Ski vorgesehen sind, um ein Ende (2 oder 3) des Mastes (1) aufzunehmen, wobei die Segelanordnung umkehrbar insofern ist, als sie von dem Benutzer entweder mit einem Ende (2) des Mastes (1) oder dem anderen Ende (3) des Mastes (1) nach unten gehalten werden kann und mit den Mitteln (25, 26, 41, 49, 50, 68) in Eingriff bringbar ist, wodurch die Seite des Segels (4) jederzeit während des Antriebes durch den Wind zum Wind hin gewandt ist.

2. Vorrichtung nach Anspruch 1, bei welcher

das Mittel (50) zum Aufnehmen eines Endes des Mastes eine Schale (56) aufweist, die am Ski anbringbar ist und obere Flansche hat, welche einen konvergierenden Schlitz (58) dazwischen bilden.

3. Vorrichtung nach Anspruch 2, bei welcher die Schale (56) in der Stellung auf dem Ski einstellbar ist und der Mast einen flexiblen Teil (66), einen Steg (59) unterdem flexiblen Teil und für den Eingriff in den konvergierenden Schlitz (58) der Schale (56) und einen unteren vergrößerten Fuß (67) aufweist.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, mit einer Schiene (37), wodurch die Mittel auf dem mindestens einen Ski zur Aufnahme eines Endes des Mastes auf dem Ski in Position einstellbar sind.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, bei welcher der Baum (6, 16) obere und untere Teile (7, 17) hat, die auf jeweils gegenüberliegenden Seiten der Linie (I-I) liegen, um welche das Segel symmetrisch ist, und zusammen aneinandergefügt sind nicht nur neben der Position oder den Positionen, bei welchen der Baum (6, 16) mit dem Mast (1) in Eingriff ist, sondern auch bei einer Position (8, 18), die längs des Segels vom Mast nach außen im Abstand liegt.

6. Vorrichtung nach Anspruch 5, bei welcher der Baum ein Anschlußstück aufweist mit einer Hülse (85, 89), um den Mast innerhalb einer Öffnung (10) in dem Segel (4) zu umgreifen.

7. Vorrichtung nach einem der Ansprüche 1 bis 6, mit einem weiteren Mittel (22, 38, 51), welches dazu vorgesehen ist, eine Brücke zwischen den Skiern zu bilden und eine Verbindung dazwischen vorzusehen, und die Mittel (22, 38, 51) drehflexibel sind.

8. Vorrichtung nach Anspruch 7, bei welcher die Mittel (38) zum Überbrücken der Skier in Position längs der Skier einstellbar sind.

Revendications

1. Appareil pour la pratique du ski avec propulsion par le vent comprenant au moins un ski (23, 24, 27, 34, 45) et un agencement de voile, l'agencement de voile comprenant un mât (1), une voile (4) et un bout-dehors (6, 16) et étant sensiblement symétrique par rapport à une droite (I-I) passant sensiblement par le milieu de sa hauteur, le bout-dehors (6, 16) étant prévu d'un côté seulement de la voile (4), caractérisé en ce que le mât (1) dépasse de la voile à chacune de ses extrémités

(2, 3) et des moyens (25, 26, 41, 49, 50, 68) sont prévus sur ledit ou chaque susdit ski pour recevoir une extrémité (2 ou 3) du mât (1), l'agencement de voile étant réversible en ce que l'utilisateur peut le tenir en dirigeant soit une extrémité (2) du mât (1) soit l'autre extrémité (3) du mât (1) vers le bas et en pouvant l'engager dans lesdits moyens (25, 26, 41, 49, 50, 68) de façon que ledit côté de la voile (4) fasse face au vent à tous moments pendant la propulsion par le vent.

2. Appareil selon la revendication 1, dans lequel le dit moyen (50) de réception d'une extrémité du mât est une douille (56) à fixer au ski et dont les bords supérieurs définissent entre eux une fente convergente (58).

3. Appareil selon la revendication 2, dans lequel l'emplacement de la douille (56) sur le ski est réglable et le mât comporte un tronçon flexible (66), une tige (59) située sous le tronçon flexible et destinée à s'engager dans la fente convergente (58) de la douille (56) et une semelle inférieure élargie (67).

4. Appareil selon l'une quelconque des revendications 1 à 3, comportant un chemin (37) grâce auquel lesdits moyens prévus sur ledit ou chaque susdit ski pour recevoir une extrémité du mât sont réglables quant à leur emplacement sur le ski.

5. Appareil selon l'une quelconque des revendications 1 à 4, dans lequel le bout-dehors (6, 16) comporte des éléments supérieur et inférieur (7, 17) situés sur des côtés respectifs opposés de la droite (I-I) par rapport à laquelle la voile est symétrique et réunis l'un à l'autre non seulement près de l'emplacement ou des emplacements auxquels le bout-dehors (6, 16) est accouplé avec le mât (1) mais aussi en un emplacement (8, 18) espacé du mât vers l'extérieur le long de la voile.

6. Appareil selon la revendication 5, dans lequel le bout-dehors comporte un raccord présentant un manchon (85, 89) destiné à entourer le mât à l'intérieur d'une ouverture (10) ménagée dans la voile (4).

7. Appareil selon l'une quelconque des revendications 1 à 6, comportant un moyen supplémentaire (22, 38, 51) prévu pour s'étendre en pont entre les skis et établir une liaison entre eux, lesdits moyens (22, 38, 51) étant flexibles à la torsion.

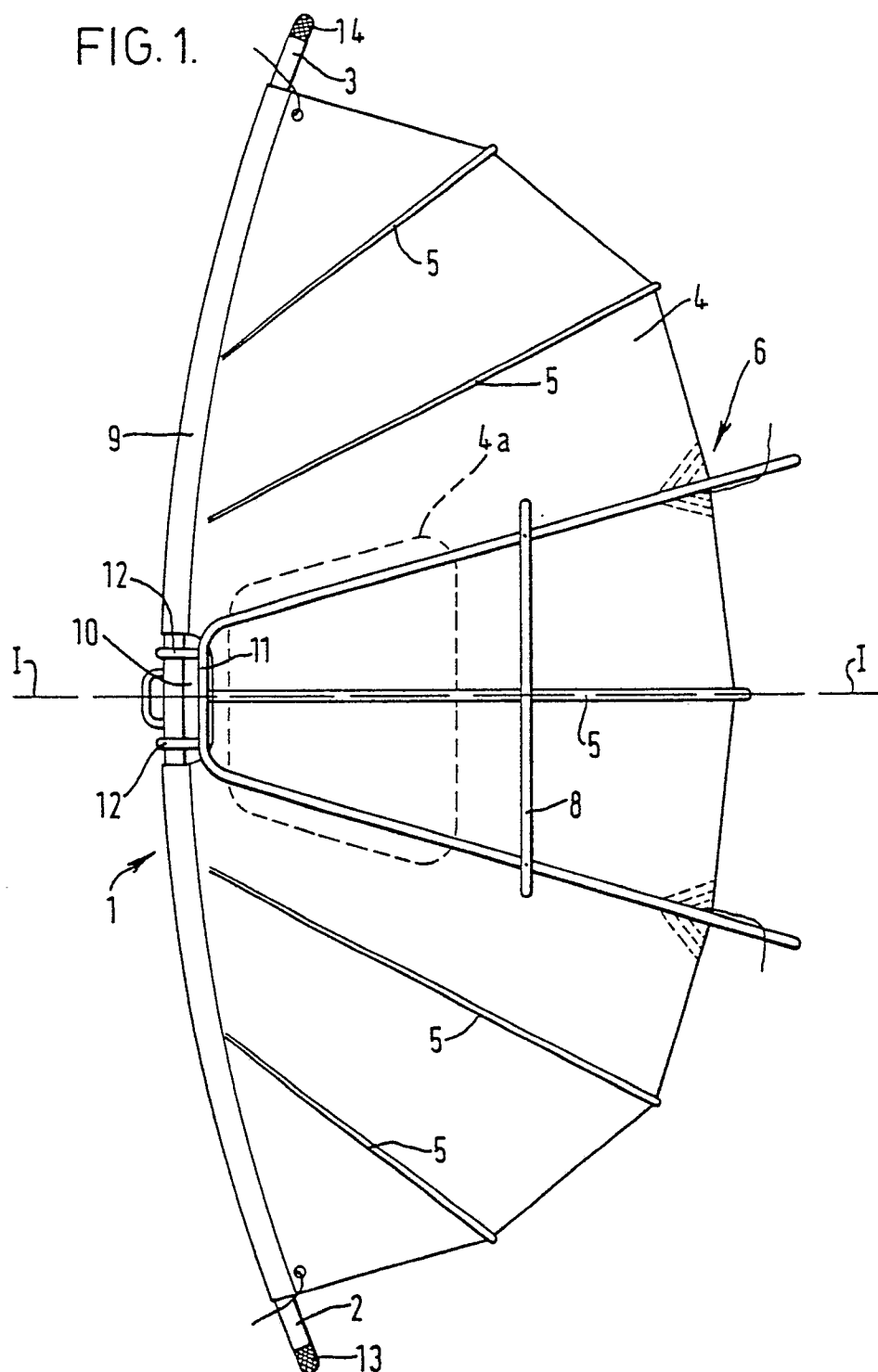
8. Appareil selon la revendication 7, dans lequel les moyens (38) de pontage entre les skis sont réglables quant à leur emplacement suivant la longueur des skis.

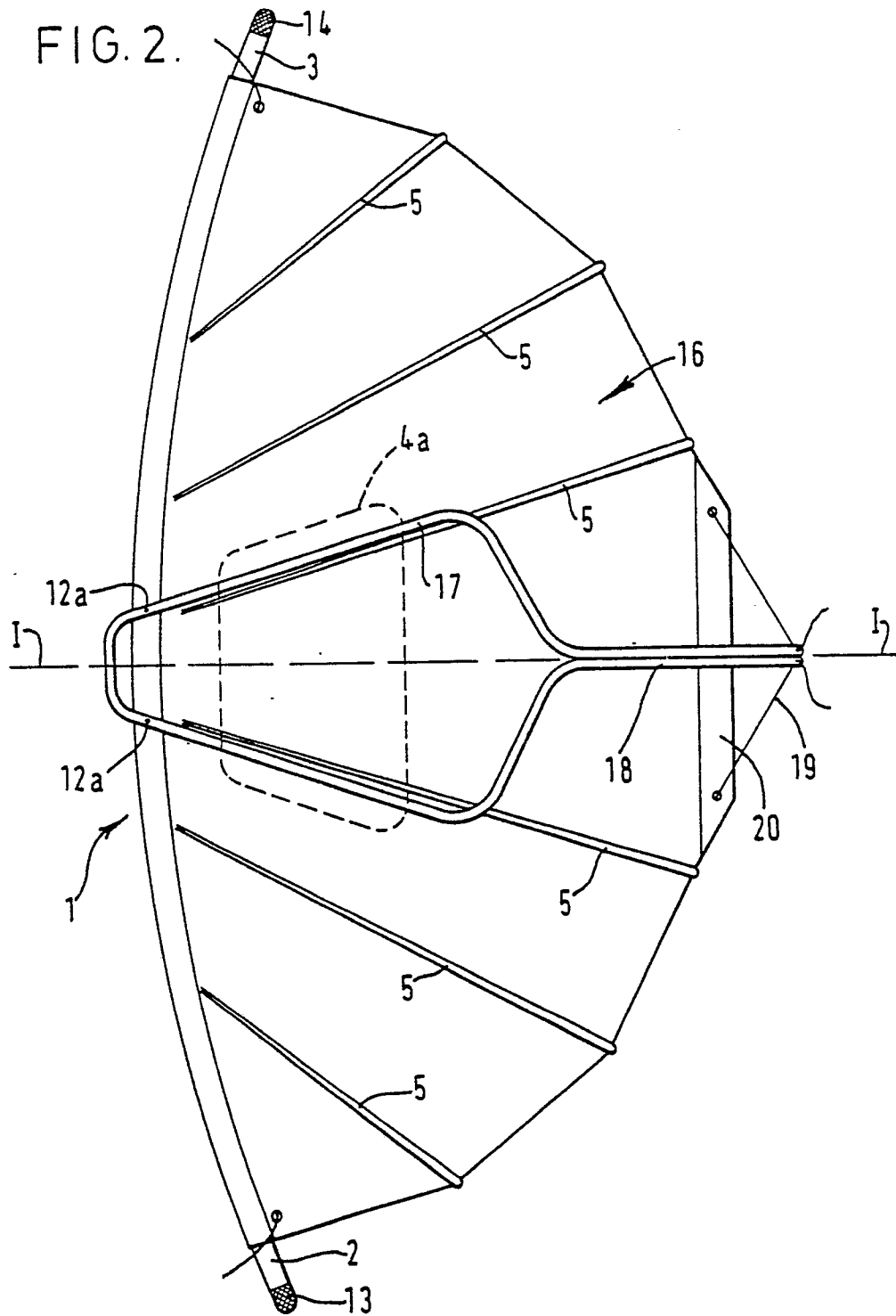
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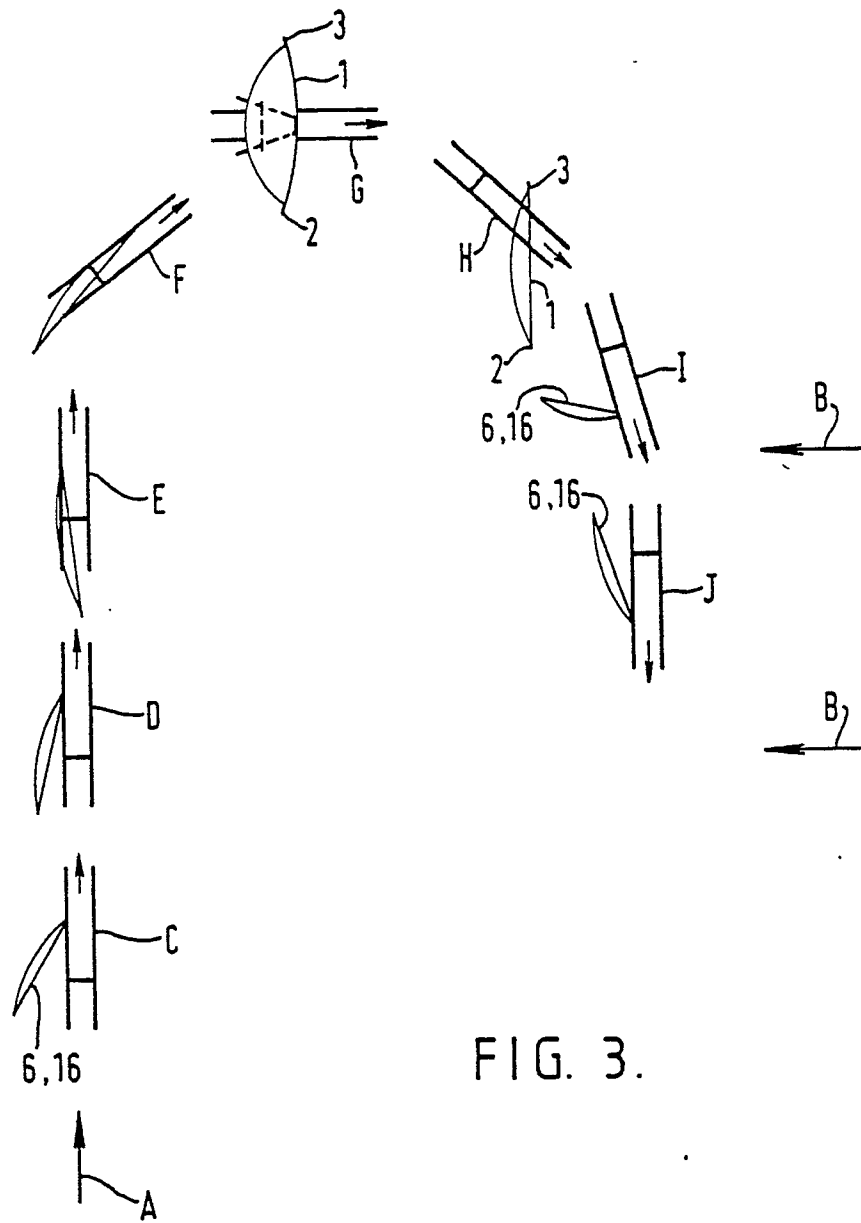


FIG. 4a.

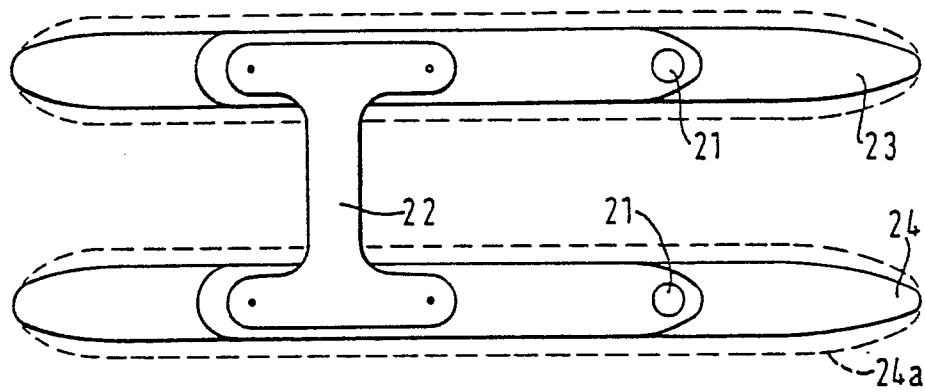


FIG. 4b.

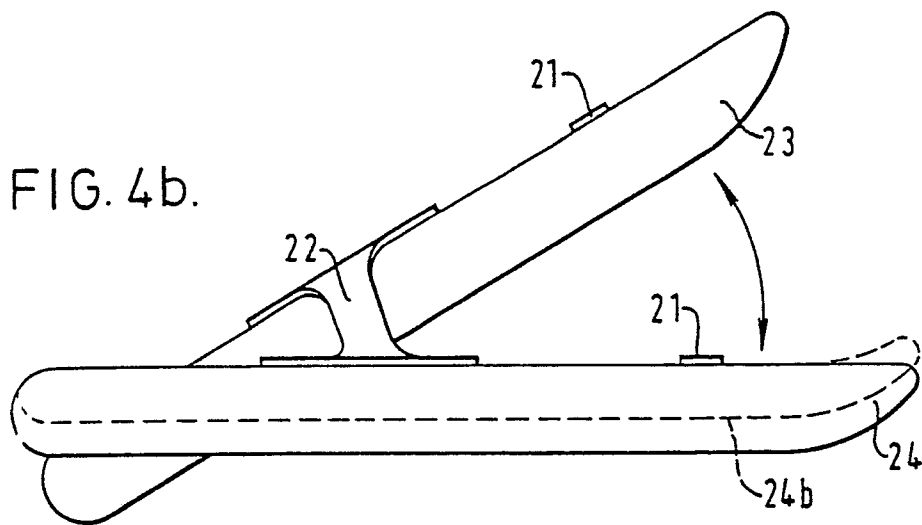


FIG. 5a.

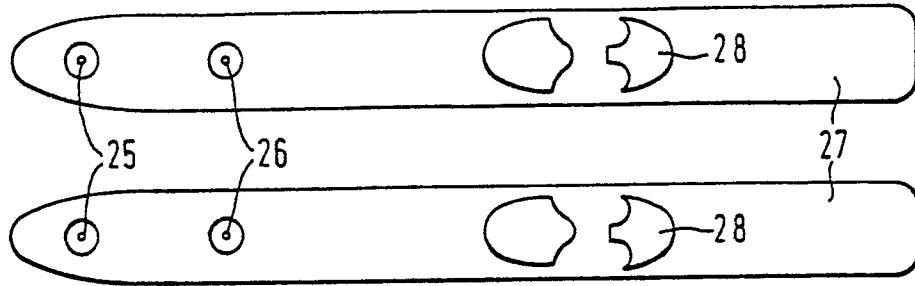


FIG. 5b.

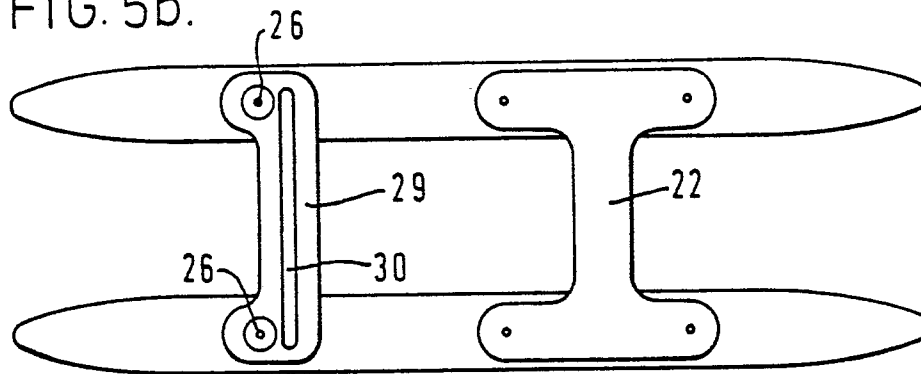
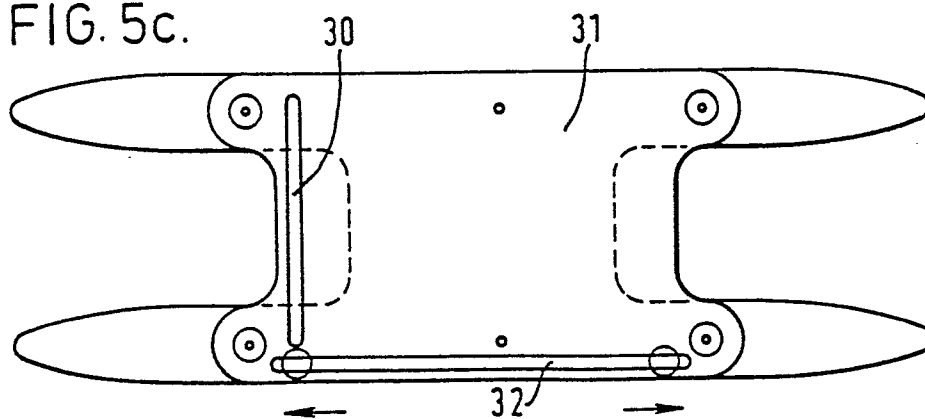
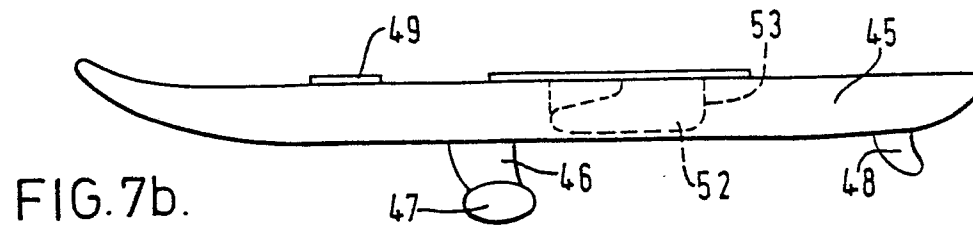
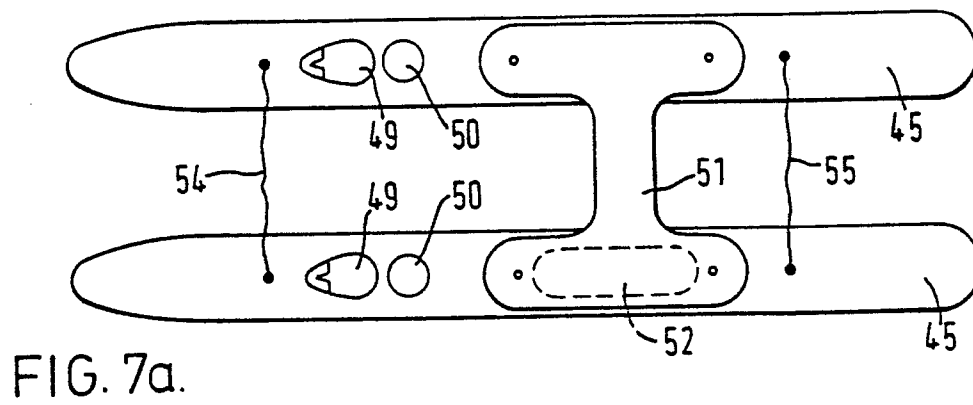
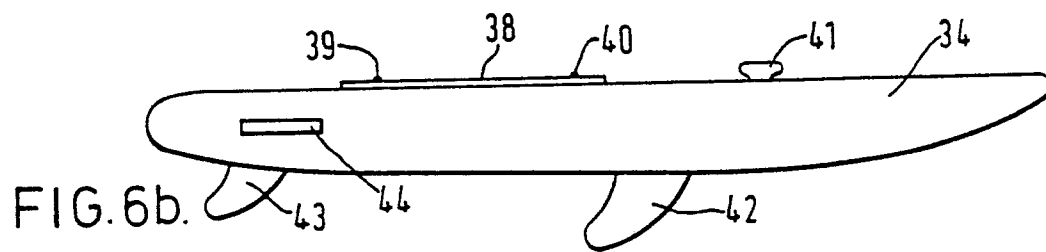
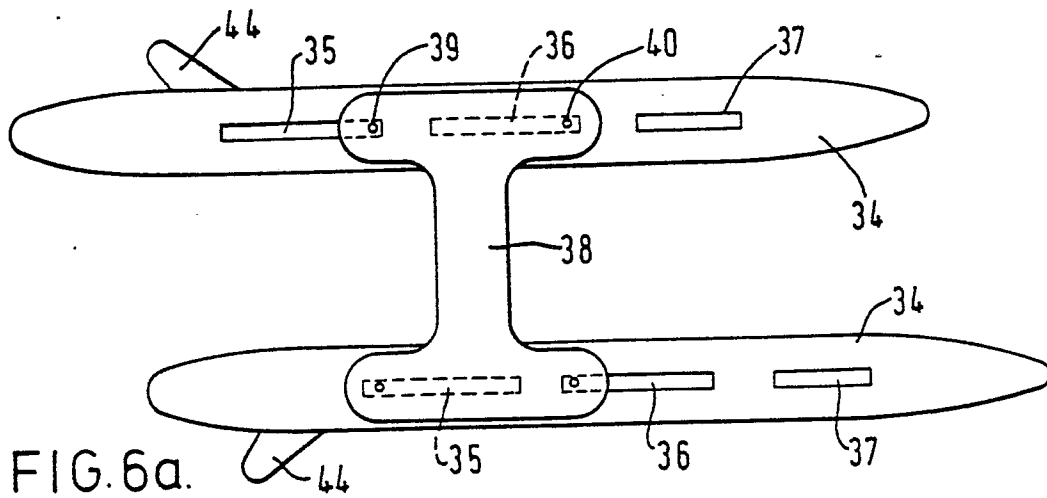


FIG. 5c.





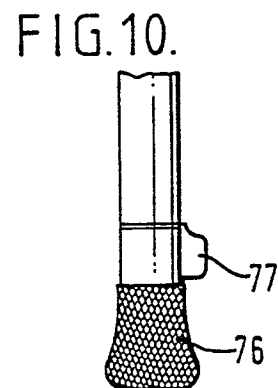
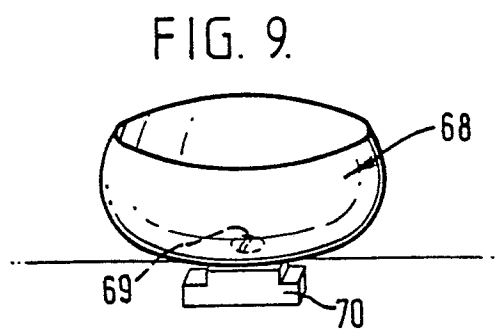
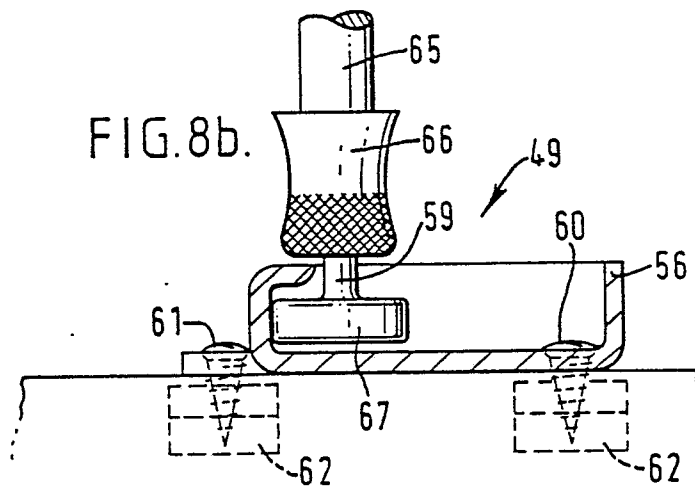
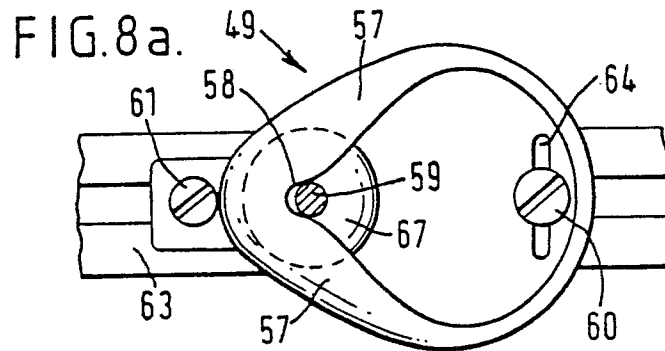


FIG. 11.

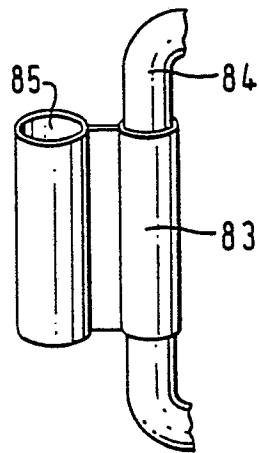
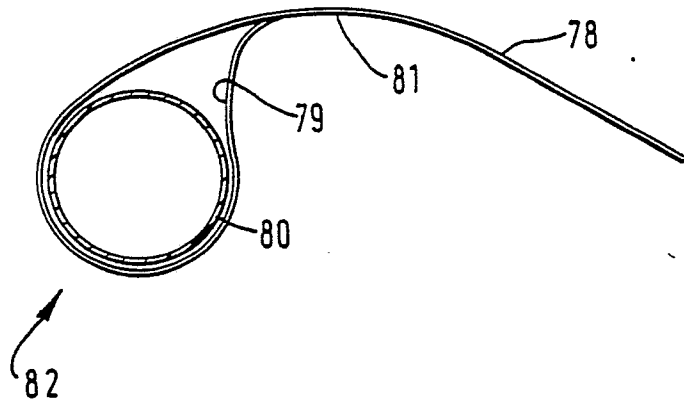


FIG. 12.

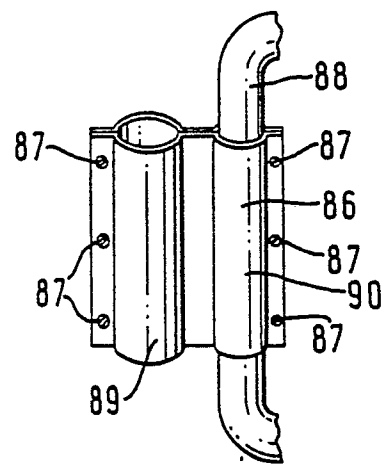


FIG. 13.