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(54) **Title**: A SUPPORT ELEMENT, TRANSFER DEVICE, LOADING METHOD AND UNLOADING METHOD

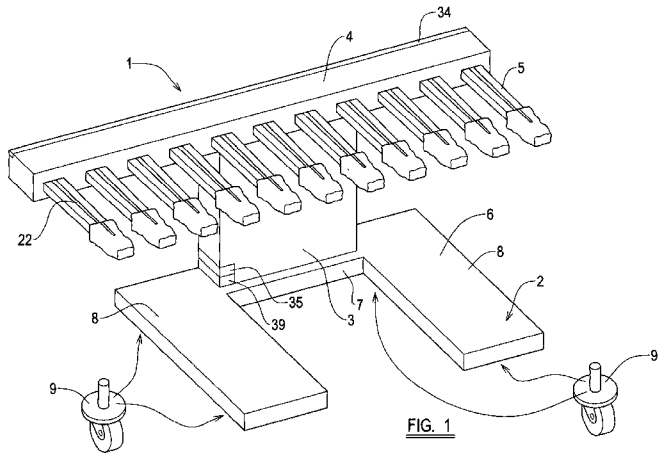

FIG. 1

(57) **Abstract**: A support element for use with a transfer trolley (1), the element comprising: an elongate tine (5); an inflatable sheath (17) connected to the tine (5) and covering an extreme distal end (11) of the tine (5); and a tether (22) coupled to the sheath (17), wherein the sheath (17) is moveable to scroll around the extreme distal end (11) of the tine (5), the tether being configured such that when the sheath (17) is inflated the tether restricts movement of the sheath (17) with respect to the tine (5) to maintain a substantially predetermined distance beyond the extreme distal end (11) of the tine (5) between the sheath (17) and the tine (5) as the sheath (17) is scrolled around the extreme distal end (11) of the tine (5) between a loading and an unloading configuration.

Title: A support element, transfer device, loading method and unloading method

The present invention relates to a transfer device (such as a transfer trolley), parts thereof (including a support element), and methods of operating such transfer devices and parts thereof. More particularly, aspects of the invention relate to a transfer device and parts thereof which can be used to lift a load and transfer it to a new location. A transfer device according to embodiments of the present invention can be used to lift medical patients from a bed or table for transfer to another location.

Specific embodiments of the present invention will be described with reference to the movement or lifting of a medical patient from a bed; however, it will be appreciated that embodiments of the present invention can be used for other purposes. For example, embodiments of the present invention could be used to lift other delicate objects (such as porcelain, ceramics, explosives, aerospace components, vehicles, or radioactive materials).

Transfer trolleys which use inflatable sheaths configured to inflate, evert, and insinuate under a patient are known. Transfer trolleys of this type are particularly useful for lifting overweight or obese patients, or patients with delicate wounds such a burns.

Documents which disclose such known transfer trolleys include WO2008/071940 and W091/07158.

W091/07158 discloses a transfer trolley which comprises an arm from which a number of rigid tines extend to form a bed-like surface which is suitable to support a patient. The tines are hollow tube-like structures with a hole

located at the free (distal) end of each tine (i.e. the end not connected to the arm). Each of the tines is covered in a resilient sheath and contains a plunger within the hollow cavity thereof.

The sheath is longer than the tine which it surrounds and the excess material is inserted into the hollow cavity of the tine (where there is a connection between the sheath and the plunger). A concertina section of the sheath is provided on the outside of the tine and is coupled to the arm.

A wedge shaped block separates the concertina section on a top surface of the tine from the rest of the sheath.

The transfer trolley of WO2008/071940 is similar in construction to that of WO91/07158 with several significant innovative improvements. For example, the transfer trolley of this document uses a sheath which partially (rather than completely covers) each tine; by using fixed or sliding seals to couple each sheath to its respective tine the need to provide a concertina section of the sheath, which can be prone to failure or malfunction, is eliminated.

Both known transfer trolleys of this type (as described above), however, may suffer from certain disadvantages. For example, the need to provide a plunger and plunger retraction mechanism or a retractable cable within each tine may necessitate the use of a gasket at the end of each tine in order to provide an airtight or substantially airtight access point for the cable or plunger retraction mechanism. The provision of a reliable gasket is difficult. Sliding seals are also difficult to manufacture and are prone to failure.

The retractable cables and associated retraction mechanism of known transfer trolleys must be very strong as they are required to control deployment of the sheaths – often against the forces applied by the fluid

which inflates the sheaths.

In operation of the above described known transfer trolleys, the inflatable sheaths must inflate under the patient. The position of a sheath which is sufficiently flexible to permit inflation, unfurling, and insinuation beneath a patient may be difficult to control as the sheath extends beyond the tine. For example, the sheaths of the above described prior art documents are intended to inflate in a direction which is substantially parallel to and aligned with the tine to which the sheath is coupled. However, as a sheath inflates, there is uneven resistance to the inflation of the sheath imposed by, for example, the weight distribution and anatomical features of the patient being lifted – which may impose uneven compressive forces on the sheath. This uneven resistance may cause a sheath to deviate from its intended inflation path. A sheath which deviates from its own intended path significantly may abut against and impede the operation of the other sheaths. Moreover, the insertion of the tine into an inflated sheath (as required during a lifting operation) which has deviated from its intended path is hindered by this deviation. Indeed, the deviation could cause the sheath to be torn or stretched by the tine as the tine is inserted into the sheath during operation of the transfer trolley.

As the sheaths inflate, in the above prior transfer trolleys, the end of each sheath may form a substantially bulbous end. It can, in practice, be difficult to insert this bulbous end under a patient, between the patient and (for example) a bed.

Moreover, the nature of the sheaths of the above described prior transfer trolleys can make them difficult to clean (hygiene being particularly important for medical applications of the transfer trolley).

The present invention seeks to ameliorate some of the problems associated with the prior art.

Accordingly an aspect to the present invention provides a support element for use with a transfer trolley, the element comprising: an elongate tine; an inflatable sheath connected to the tine and covering an extreme distal end of the tine; and a tether coupled to the sheath, wherein the sheath is moveable to scroll around the extreme distal end of the tine, the tether being configured such that when the sheath is inflated the tether restricts movement of the sheath with respect to the tine to maintain a substantially predetermined distance beyond the extreme distal end of the tine between the sheath and the tine as the sheath is scrolled around the extreme distal end of the tine between a loading and an unloading configuration.

Preferably, the sheath is connected to the tine at a first end of the sheath.

Advantageously, the support element further comprises an inner tube which defines a passage within the tine which is in fluid communication with a volume defined at least in part by the sheath such that inflation fluid supplied through the inner tube inflates the sheath.

Preferably, the passage is defined between the inner tube and an outer wall of the tine.

Conveniently, the inner tube is rigid.

Alternatively, the inner tube is flexible.

Preferably, the sheath is connected to the inner tube at a second end of the sheath.

Conveniently, the support element further comprises a gasket through which the tether may travel and through which the passage of inflation fluid is substantially prevented.

Advantageously, the support element further comprises a reel arrangement configured to drive movement of the tether with respect to the tine.

Advantageously, the support element further comprises an adjustment arrangement configured to adjust the substantially predetermined distance.

Preferably, the tether comprises a pair of tethers.

Conveniently, the tether comprises an outer sheath which covers substantially the entire of the inflatable sheath.

Another aspect of the present invention provides a transfer device including a support element, the device comprising: an elongate tine; a sheath material supply unit; and an inflatable sheath, wherein a first section of the sheath is connected to the tine at a first location and at least partially covers the tine and a second section of the sheath is stored in the sheath material supply unit such that the second section of the sheath can be connected to the tine at the first location to replace at least part of the first section of the sheath

Preferably, the device is a transfer trolley.

Another aspect of the present invention provides a support element comprising: an elongate tine; a slider located substantially adjacent to the tine; and an inflatable sheath connected to the tine and at least partially covering the tine and slider, such that the slider can be moved with respect to

the tine to guide the path of the sheath beyond an extreme distal end of the tine during an inflation operation.

Another aspect of the present invention provides a transfer trolley including a support element.

Another aspect of the present invention provides a method of loading an object comprising: providing a support element; inflating the inflatable sheath; moving the sheath with respect to the tine such that at least part of the sheath scrolls onto an outer surface of the tine; and restricting movement of the sheath using the tether to maintain the substantially predetermined distance beyond the extreme distal end of the tine between the sheath and the extreme distal end of the tine as the sheath is scrolled around the extreme distal end of the tine.

Preferably, the step of moving the sheath further comprises moving at least part of the sheath from an internal cavity of the tine.

Another aspect of the present invention provides a method of unloading an object comprising: providing a support element; inflating the inflatable sheath; moving the sheath with respect to the tine such that at least part of the sheath scrolls from an outer surface of the tine; and restricting movement of the sheath using the tether to maintain the substantially predetermined distance beyond the extreme distal end of the tine between the sheath and the extreme distal end of the tine as the sheath is scrolled around the extreme distal end of the tine.

Preferably, the step of moving the sheath further comprises moving at least part of the sheath into an internal cavity of the tine.

In order that the present invention may be more readily understood, and so that further features thereof may be appreciated, embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 shows a transfer trolley in accordance with an embodiment;

Figure 2 shows a side view of a transfer trolley in accordance with an embodiment;

Figure 3 shows an embodiment of a support element;

Figure 4 shows an embodiment of a support element;

Figure 5 shows an embodiment of a support element;

Figure 6 shows an embodiment of a support element;

Figure 7 shows two reel arrangements of part of an embodiment of a support element;

Figure 8 shows flow chart representing a method according to an embodiment;

Figure 9 shows flow chart representing a method according to an embodiment;

Figure 10 shows an embodiment of a support element;

Figure 11 shows an embodiment of a support element;

Figure 12 shows an embodiment of a support element;

Figure 13 shows an embodiment of a support element;

Figure 14 shows an embodiment of a support element;

Figure 15 shows an embodiment of a support element; and

Figure 16 shows an embodiment of a support element.

Figure 1 shows an embodiment in the form transfer trolley 1. The transfer trolley 1 may generally comprise a base unit 2, a support pillar 3, an arm 4, and one or more tines 5.

In an embodiment, the base unit 2 comprises a generally U-shaped section 6 in a base plane – in use the base plane may be substantially parallel to a floor or support surface (not shown). The U-shaped section 6 comprises a central member 7 and two side members 8. The two side members 8 are separated from each other across a length of the central member 7 and have respective longitudinal axes which are approximately parallel to each other and generally perpendicular to a longitudinal axis of the central member 7 – thus forming a U-shape.

In an embodiment, the support pillar 3 extends from the central member 7 of the U-shaped section 6 of the base unit 2 (in a direction which is substantially perpendicular to the base plane thereof). In an embodiment, the support pillar 3 extends upwards from the base unit 2.

In an embodiment, the arm 4 is coupled to an end of the support pillar 3

which is remote from the base unit 2 such that a longitudinal axis of the arm 4 is preferably substantially parallel with the longitudinal axis of the central member 7 of the base unit 2.

The one or more tines 5 are preferably elongate members and preferably comprise a plurality of tines 5. In an embodiment, the or each tine 5 projects from the arm 4 such that the or each tine 5 has a longitudinal axis which is generally parallel to the base plane and the or each tine 5 is generally separated from the side members 8 of the base unit 2 by a height of the support pillar 3. In an embodiment, each tine 5 has a width of between approximately 5cm and 10cm.

Thus, the transfer trolley 1 of embodiments of the present invention has a generally C-shaped appearance when viewed from a side (as shown in figure 2) with the base unit 2 forming a lower part of the C-shaped structure, and the tines 5 and arm 4 forming a comb-like arrangement which is separated from the base unit 2 by the support pillar 3.

In an embodiment, the one or more tines 5 comprise a plurality of tines 5 which project from the arm 4 such that at least one tine 5 projects from the arm 4 in a direction which opposes the direction in which another of said tines 5 projects from the arm 4. In other words, embodiments of the present invention include an arrangement (such as a transfer trolley 1) in which at least two tines 5 extend from the arm 4 in opposing directions.

In an embodiment of the present invention, the direction in which a tine 5 projects from the arm 4 differs from the direction in which another tine 5 projects from the arm 4 by 90° or 45° or less about the longitudinal axis of the arm 4. In an embodiment, the direction which a tine 5 projects from the arm 4 differs from the direction in which another tine 5 projects from the arm 4 (or

from a horizontal plane – in an embodiment) by less than 10° and, preferably, more than 5°. In an embodiment, the direction of projection of one tine 5 may form an acute angle with the direction of projection of another tine 5. However, preferably, a plurality of tines 5 are provided and all of the tines 5 have longitudinal axes which are substantially parallel with each other.

A mechanism (not shown) may be provided to allow one tine 5 to be moved with respect to another tine 5 (both tines 5 projecting from the arm 4) so that the angles of projection about the longitudinal axis of the arm 4 of the two tines 5 differ. The mechanism may permit each of a plurality of tines 5 to be moved with respect to each other about a longitudinal axis of the arm 4. A mechanism may be provided (not shown) to cause synchronous movement of all of the plurality tines 5 about the arm 4. Thus, it will be appreciated that the angle of attack for one or more of the tines 5 with respect to an object to be lifted can be varied. This may be useful, for example, to lift a heavy patient from a soft mattress.

The or each tine 5 is secured to the arm 4 by a suitable attachment arrangement (not shown). The attachment arrangement may comprise a nut and bolt, adhesive, or a press-fitting arrangement. Alternatively, the or each tine 5 may be integrally formed with the arm 4. A tine 5 may be secured to the arm 4 in a different manner to the manner in which another tine 5 is secured to the arm 4. The or each tine 5 may be removable from the arm 4 to permit maintenance or re-configuration of the transfer trolley 1 or a part thereof – for example. The or each tine 5 may be removable from the arm 4 to provide a particular configuration of tines 5 projecting from the arm 4 – this may, for example, allow the tines 5 to be configured to lift a delicate object or a patient with an injury which should not be contacted by a tine 5.

The arm 4, in an embodiment, comprises multiple sections. Each section is

connected to at least one other adjacent section of the arm 4 by a hinge arrangement. One section of the arm 4 can be moved about a hinge arrangement with respect to an adjacent section of the arm 4. Thus, an arm 4 comprising three sections can be formed into a chair-like shape – with a middle section of the arm 4 forming the seat of the chair, an end section of the arm 4 forming a leg support and an opposing end section of he arm 4 forming a back support. This movement may be driven (by a drive unit – not shown) or may be manual. A locking mechanism may be provided to allow a section of the arm 4 to be locked in a fixed relationship with an adjacent section of the arm 4. In an embodiment, sections of the arm 4 can move with respect to each other while all sections of the arm 4 remain in the same plane – which may, for example, be a horizontal or vertical plane. In an embodiment, sections of the arm 4 are connected to each other by a ball-and-socket (or similar arrangement) such that one section of the arm 4 can be moved with respect to an adjacent section in substantially any direction about the ball-and-socket arrangement.

The base unit 2 may be provided with a plurality of castors 9 such that the base unit 2 (and hence the rest of the transfer trolley 1) can be moved with respect to a floor or other support surface (not shown) on which the base unit 2 rests when in use. Movement of the base unit 2 with respect to the floor or support surface may be manual or may be driven (by a drive unit – not shown).

In some embodiments, the support pillar 3 is mounted on a track system (not shown) which may form part of the base unit 2. The track system may be configured to permit movement of the support pillar 3 (and everything supported by the support pillar 3, including for example the arm 4 and one or more tines 5) with respect to the base unit 2. This movement may be manual or driven (by a drive unit – not shown).

The support pillar 3 may include a rotatable joint (not shown) which is configured to permit rotation of part of the support pillar 3 (and everything supported by the support pillar 3, including for example the arm 4 and one or more tines 5) with respect to another part of the support pillar 3 and the base unit 2. Operation of the rotatable joint may be manual or driven (by a drive unit – not shown).

In an embodiment, the support pillar 3 further comprises a level adjustment mechanism which is configured to adjust the height of the arm 4 with respect to the base unit 2. This level adjustment mechanism may, for example, comprise two or more telescopically coupled sections of the support pillar 3 which are adapted to move with respect to each other along a longitudinal axis of the support pillar 3. The level adjustment mechanism may be a driven mechanism (by a drive unit – not shown) or may be a manual mechanism. The level adjustment mechanism may include a plurality of lifting rams.

In an embodiment, the two side members 8 of the U-shaped section 6 of the base unit 2 are retractable. This may be achieved by providing retractable side members 8 which telescopically extend from the central member 7. Alternatively, the side members 8 may be moveable with respect to the central member 7 between a position in which they extend from the central member 7 in a first direction and a position in which they extend away from the central member 7 in a second direction (the second direction may oppose the first direction). Movement or retraction of the side members 8 may be manual or driven by a drive unit (not shown). The two side members 8 may be independently moveable or may be configured to move synchronously.

A limiter (not shown) may be provided to limit movement of the two side members 8 of the U-shaped section 6 to locations in which the transfer trolley

1 is stable.

Thus, it will be appreciated that in such embodiments further including a level adjustment mechanism, movement of the arm 4 towards the surface on which the base unit 3 is resting is less restricted by the U-shaped section 6 of the base unit 3 and the arm 4 may be lowered closer to the surface on which the base unit 3 is resting. As will become apparent, this may permit the transfer trolley 1 to pickup objects which are far lower (i.e. closer to the support surface on which the base unit 3 rests) than would otherwise be the case; embodiments even permit an object to be lifted from the surface on which the base unit 3 is resting (e.g. the floor).

An embodiment of a tine 5 which is suitable for use with a transfer trolley 1 of the above described type is shown in more detail in figures 3-6. Figures 3 and 6 are generally identical; however, in figure 6 some reference numerals have been omitted and certain features have been drawn differently in order to reduce the complexity of the figure and ease understanding of the embodiment. The tine 5 comprises a tube-like structure with a proximal 10 and a distal 11 end. Figure 5 shows a more detailed view of this embodiment at the distal end 11 of the tine 5.

One or more additional retractable support members (not shown) may be provided which extend from the trolley 1 to a surface on which the base unit 3 is resting (e.g. the floor) in the event of the two side members 8 being retracts – to improve stability of the trolley 1.

It will be appreciated that the side members 8 improve the stability of the trolley 1.

With reference to figure 3, the proximal end 10 of the tine 5 is configured to

be attached to a support structure such as the arm 4 of the above described transfer trolley 1. The distal end 9 of the tine 5 is a free end of the tine 5. With reference to figure 4 (which shows a external view of a support element), the tube-like tine 5 has a generally rectangular or oval cross-section with a large support surface 12, an opposing large surface 13, and two smaller side surfaces 14 – it will be appreciated that in the case of a tine 5 with a generally oval cross-section (for example) the surfaces 12,13,14, of the tine 5 form a single substantially continuous surface without intervening edges. The surfaces 12,13,14 are all surfaces of an outer wall 15 (see figure 5 in particular) of the tine 5. It will be understood that tines 5 with other cross-sectional shapes (such as square or circular) can also be used in accordance with embodiments.

The outer wall 15 of the tine 5 defines an internal cavity 16 (as shown in figures 3, 5, and 6) which extends along substantially an entire length of the tine 5 between the proximal 10 and distal 11 ends thereof. The outer wall 15 must be sufficiently rigid to support a specified mass (the mass may be 80kg or 120kg or some other mass). The outer wall 15 may be constructed out of metal – for example steel, stainless steel, aluminium or the like. It will be appreciated that a different depth of material forming the outer wall 15 will be required depending on the material and the mass which the tine 5 is intended to support. In an embodiment, the tine 5 is constructed out of fibre-glass; in an embodiment, the tine 5 is constructed out of carbon-fibre.

In an embodiment, the tine 5 includes an inner tube 18 (see figures 3, 5, and 6). The inner tube 18 is sized and shaped (i.e. configured) to be fitted inside the internal cavity 16 of the tine 5. The inner tube 18 may be fitted inside the internal cavity 16 of the tine 5 such that a central longitudinal axis of the inner tube 18 is parallel to and aligned with the longitudinal axis of the tine 5 (i.e. the inner tube 18 may be coaxial with the tine 5).

The inner tube 18 has a length which is less than (or substantially equal to) a length of the internal cavity 16 of the tine 5 – such that the inner tube 18 is generally contained within the confines of the internal cavity 16 of the tine 5.

A passage 19 (see figures 3 and 5) is defined between an inner surface (or inner surfaces) of the outer wall 15 of the tine 5 and an outer surface of the inner tube 18. The passage 19 is a part of the internal cavity 16 of the tine 5. A distance between the inner surface of the outer wall 15 of the tine 5 and the outer surface of the inner tube 18 may be generally constant around a perimeter of the inner tube 18. In some embodiments, the distance between the inner surface of the outer wall 15 of the tine 5 and the outer surface of the inner tube 18 may not be constant around a perimeter of the inner tube 18; instead, the distance may vary around the perimeter of the inner tube 18 – in such embodiments, the inner surface of the outer wall 15 of the tine 5 may touch the outer surface of the inner tube 18 in one or more locations around the perimeter of the inner tube 18.

An inflatable sheath 17 is coupled to the tine 5. The sheath 17 is flexible and has an internal cross-section which has a greater area than an external cross-section of the outer wall 15 of the tine 5. The sheath 17 can, therefore, fit over at least part of the tine 5 in a sock-like configuration.

The inflatable sheath 17 is, in an embodiment, a tube of material and is coupled to an inner surface of the inner tube 18 at a first end 20 thereof and to an outer surface of the outer wall 15 of the tine 5 at a second end 21 thereof. The ends 20,21 of the sheath 17 are coupled to the tine 5 and inner tube 18 such that an outer surface of the sheath 17 is adjacent the outer surface of the outer wall 15 of the tine 5 and the inner surface of the inner tube 18 at the respective ends 20,21 of the sheath 17. In order to achieve

this arrangement the ends 20,21 of the sheath 17 are curled towards the respective surface of the outer wall 15 of the tine 5 and inner tube 18 (see figures 3, 5, and 6).

The ends 20,21 of the sheath 17 are coupled to the tine 5 (and the inner tube 18 of the tine 5) in a substantially fluid tight manner. In an embodiment, a degree of fluid leakage is permitted through the sheath 17 itself and/or through the ends of the sheath 17.

The sheath 17 has a length which is generally greater than the path between the location at which the sheath 17 is coupled to the outer surface of the outer wall 15 tine 5 and the location at which the sheath 17 is coupled to the inner surface of the inner tube 18 around the distal end 11 of the tine 5. Thus, there is excess sheath material.

The excess sheath material is typically stored, in an embodiment, along the length of the outer surface of the outer wall 15 of the tine 5 and along the inner surface of the inner tube 18 of the tine 5 which are towards the proximal end 10 of the tine 5 from the locations of the coupling of the sheath 17 to the tine 5 (on the outer surface of the outer wall 15 of the tine 5 and on the inner surface of the inner tube 18 of the tine 5). Thus, the sheath 17 may abut against an extreme distal end 11 of the tine 5 (when not inflated).

The passage 19 between the inner tube 18 and the outer wall 15 of the tine 5 is, in this embodiment, in fluid communication with a volume defined between an inner surface of the sheath 17 and the outer wall 15 of the tine 5 and between an inner surface of the sheath 17 and the inner tube 18. This volume and the internal cavity 16 of the tine 5 not forming part of the passage 19 are generally in fluid isolation from each other – although some fluid leakage may be permitted. Thus, inflation of the inflatable sheath 17 can be achieved by

supplying fluid (under pressure) to the passage 19. Inflation of the inflatable sheath 17 in this manner results in an inflated tube which would extend beyond the distal end 11 of the tine 5 by a distance determined by the length of the excess sheath material – if permitted to inflate freely.

Fluid (under pressure) can be provided to the passage 19 through a port 36 in the distal end 11 of the tine 5. The port 36 is in fluid communication with the passage 19 such that fluid which is provided under pressure to the tine 5 through the port 36 enters the passage 19 and inflates the sheath 17 (at least partially).

A pressurised fluid source 39 (schematically represented in figures 1 and 2) is in fluid communication with the port 36. One or more valves (not shown) may be provided between the pressurised fluid source 39 and the port 36 to control the delivery of pressurised fluid to the port 36. The port 36 may be provided in an end or base plate (not shown) of the tine 5.

The pressurised fluid source 39 may take the form of a compressor. The pressurised fluid source 39 could form part of the transfer trolley 1 or could be remote therefrom (and coupled to the transfer trolley by a pressurised fluid delivery conduit (not shown)).

A first tether 22 is coupled at a first end thereof to a first tether first anchor point 23 and at a second end thereof to a first tether second anchor point 24. Both first tether anchor points 23,24 are on the outer surface of the sheath 17. The first tether first anchor point 23 is on the outer surface of a part of the sheath 17 which is normally positioned outside of the internal cavity 16 of the tine 5. The first tether second anchor point 24 is on the outer surface of a part of the sheath 17 which is normally positioned inside the internal cavity 16 of the tine 5.

The first tether 22 passes from the first tether first anchor point 23 along at least part of a length of the tine 5 (over the large support surface 12 of the tine 5) towards the proximal end 10 of the tine 5. At the proximal end 10 of the tine a first reel arrangement 25 is provided (see figure 3). The first reel arrangement 25 may be secured to the tine 5 and may form part of the tine 5 or may be a separate arrangement which is secured to part of the transfer trolley 1 to which the tine 5 is intended to be attached (for example the arm 4 – as described herein).

The first reel arrangement 25 is configured to pass the first tether 22 through approximately 180° such that the first tether 22 passes into the internal cavity 16 of the tine 5 towards the distal end 11 of the tine 5 and to permit movement of the first tether 22 along this path relative to the tine 5. To this end, the first reel arrangement 25 may comprise a single rotatable reel; however, preferably, the first reel arrangement 25 comprises first 26 and second 27 rotatable reels – as depicted in figure 7. The first tether 22 preferably passes around part of the first reel 26 and part of the second reel 27. Each reel 26,27 passes the first tether 22 through a portion of the approximately 180° bend (in this embodiment the first 26 and second 27 reels each bend the first tether 22 through approximately 90°).

The first 26 and second 27 reels may be free to rotate and thus permit movement of the first tether 22 with respect to the tine 5.

A second tether 28 is also preferably provided. The second tether 28 has a generally similar location and arrangement to the first tether 22; however, the second tether 28 is, preferably, located on an opposing side of the tine 5. The second tether 28 accordingly has a second tether first anchor point 29, a second tether second anchor point 30, and an associated second reel

arrangement 31 (which preferably comprises a first reel 32 and a second reel 33). The configuration of the elements 28,29,30,31(32,33) is generally identical to that of the first tether 22 and corresponding elements 23,24,25(26,27) with the exception that the second tether 28 is located on an opposing part of the sheath 17 and tine 5 across a width thereof.

The second reels 27,33 of the first 25 and second 31 reel arrangements are preferably sufficiently close to each other that the first and second tethers 22,28 are sandwiched between the reels 27,33 so that the tethers 22,28 are gripped by the reels 27,33. Cooperative rotation of the reels 27,33 therefore causes movement of the tethers 22,28 with respect to the tine 5 in the same direction (e.g. away from or towards the distal end 11 of the tine 5). In an embodiment, the second reels 27,33 are resiliently biased towards each other.

Other configurations of the first and second tethers 22,28 are possible – as will be appreciated – indeed, it may be that some embodiments only have a single tether 22,28 or some embodiments may have a combined first and second 22,28 tether which uses a single continuous length of tether material which passes through loops of material secured to the sheath 17 inside the internal cavity 16 of the tine 5 to achieve the same effect as the second anchor points 24, 30. In an embodiment, the first and second tethers 22,28 may each comprise a respective pair of tethers (not shown) one of which passes into the internal cavity 16 of the tine 5 and the other of which passes along an outer surface of the outer wall 15 of the tine 5; in this embodiment, each pair of tethers is operated synchronously to achieve the same effect as described above.

The first and second reel arrangements 25,31 are preferably coupled to a transmission system 34 (schematically represented in figures 1 and 2). The

transmission system 34 is configured to provide rotational movement to at least part of the first and second reel arrangements 25,31 and preferably to the first 26,32 and/or second 27,33 reels thereof. The transmission system 34 may be coupled to the tine 5 or may be a separate element – for example, the transmission system 34 may be secured to part of the transfer trolley 1 to which the tine 5 is attached (such as the arm 4 – as described above).

In an embodiment the transmission system 34 comprises one or more transmission shafts which are each coupled to one or more reel arrangements 25,31.

The transmission system 34 is configured to transmit mechanical movement from a drive unit 35 (schematically represented in figures 1 and 2). The drive unit 35 is preferably not part of the tine 5 and is preferably not directly attached to the tine 5; however, in embodiments, it is envisaged that the drive unit 35 could be directly attached to the tine 5 and/or form part of the tine 5.

Rotation of an element of the first and second reel arrangements 25,31 causes the respective first 22 and second 28 tethers to move with respect to the tine 5 in an axis which is generally parallel with the longitudinal axis of the tine 5 (as will be described below in more detail).

Thus, in operation of the above described embodiment, a fluid (under pressure) is provided to the port 36 of the tine 5. This fluid inflates the sheath 17; however, the degree of movement of the sheath 17 with respect to the tine 5 is limited by the first and second tethers 22,28.

Inflation of the sheath 17 in this manner results in a gap (filled with inflation fluid) between the sheath 17 and the large support surface 12 of the tine 5 throughout most of the length of the sheath 17 (clearly the ends of the sheath

17 are still coupled to the tine 5 and inner tube 18). Importantly, there is an gap between the sheath 17 and the extreme distal end 11 of the tine 15. An adjustment arrangement (not shown) may be provided and configured to allow the size of this gap to be varied; this adjustment arrangement may be the first and second reel arrangements 25,31. The variation may be achieved during operation of the tine 5 or may be set before a load or unload operation of the tine. A transfer trolley 1 including a plurality of tines 5 may be configured such that the gap for one tine can be set independently of the gap for another of the tines 5. The gap associated with a particular tine 5 and sheath 17 is therefore a substantially controlled gap defining a substantially controlled distance beyond the end of the tine 5 between the extreme distal end 11 of the tine 5 and the sheath 17.

In particular, the first tether 22 in combination with a length of the sheath 17 between the first tether first and second anchor points 23,24 constitutes a loop of substantially fixed length. Similarly, the second tether 28 in combination with a length of the sheath 17 between the second tether first and second anchor points 29,30 constitutes a loop of substantially fixed length. As these two loops are of substantially fixed length, it will be appreciated that the distance between the extreme distal end 11 of the tine 5 and the sheath 17 will remain substantially constant even if the tethers 22,28 move with respect to the tine 5.

Activation of the drive unit 35 causes mechanical movement to be transmitted through the transmission system 34 to the first and second reel arrangements 25,31. Movement of the first 22 and second 18 tethers as a result of the driven movement of the first and second reel arrangements 25,31 and the pressure of the inflation fluid on the sheath 17 causes the sheath 17 to move with respect to the tine 5.

More specifically, if the first and second reel arrangements 25,31 are driven in such a manner that the first and second tethers 22,28 are fed from the outside of the tine 5 into the internal cavity 16 of the tine 5, then the first and second tether first anchor points 23,29 will move with respect to the tine 5 towards the proximal end 10 thereof. Correspondingly, the first and second tether second anchor points 24,30 (the anchor points inside the internal cavity 16 of the tine 5) will move with respect to the tine 5 towards the distal end 11 thereof.

The tethers 22,28 maintain a substantially fixed or predetermined distance (or gap) between the extreme distal end 11 of the tine 5 and the sheath 17 and excess sheath material will, as part of the above operation, collect along the outer wall 15 of the tine 5 towards the proximal end 10 thereof.

Conversely, if the first and second reel arrangements 25,31 are driven in such a manner that the first and second tethers 22,28 are fed from the internal cavity 16 of the tine 5 onto the outer wall 15 of the tine 5, then the first and second tether first anchor points 23,29 will move with respect to the tine 5 towards the distal end 11 thereof. Correspondingly, the first and second tether second anchor points 24,30 (the anchor points inside the internal cavity 16 of the tine 5) will move with respect to the tine 5 towards the proximal end 10 thereof.

Accordingly, the tethers 22,28 maintain a substantially fixed distance between the extreme distal end 11 of the tine 5 and the sheath 17 and excess sheath material will, as part of the above operation, collect along the inner surface of the inner tube 18 of the tine 5 towards the proximal end 10 thereof. The substantially fixed gap between the extreme distal end 11 of the tine 5 and the sheath 17 is filled with inflation fluid.

It will be appreciated that the sheath 17 scrolls around the extreme distal end 11 of the tine 5.

A tine 5 as described above may form part of a transfer trolley 1 as described above and as depicted in figures 1 and 2. Indeed, a tine 5 as described above may form part of a transfer trolley substantially as described in WO2007/050016 or W091/07158 with modifications that will be appreciated by the person skilled in the art with respect to, for example, the arrangements of the port 36, the transmission system 34, drive unit 35 and the like.

The transfer trolley 5 preferably includes a plurality of tines 5 as described above.

The operation of a transfer trolley 1 including a plurality of the above described tines 5 will now be described with reference to the lifting of a patient 37 from a bed 38. Reference is made to the flow charts of figures 8 and 9 which represent example loading and unloading operations for the transfer trolley 1 and tine 5 and to figures 10 and 11 (like the other figures, these figures are not to scale) which show parts of a support element including a tine 5 at different stages of a loading/unloading operation.

The transfer trolley 1 is arranged for operation such that the majority of the excess sheath material of each sheath 17 is contained within the internal cavity 16 of the respective tine 5. The transfer trolley 1 is manoeuvred on its castors 9 so that the arm 4 is substantially parallel to a longitudinal axis of the patient 37 and at a corresponding height to the surface of the bed 38 on which the patient 37 is supported – the tines 5 project towards the patient 37 from the arm 4 (see figure 10).

The pressurised fluid source 39 is used to provide fluid under pressure to the

ports 36 of the tines 5 and the sheaths 17 secured to the tines 5 are inflated. The transfer trolley 1 is moved towards the patient 37 generally maintaining the parallel relationship between the longitudinal axis of the patient 37 and the arm 4.

As the sheaths 17 contact the patient 37, the drive unit 35 and transmission system 34 are activated such that the first and second tethers 22,28 of each tine 5 are drawn by the reel arrangements 25,31 into the internal cavity 16 of the tine 5. In turn, the sheath 17 of each tine 5 moves with respect to the tine 5 from the internal cavity 16 of the tine 5 over and around the extreme distal end 11 of the tine 5 and along the outer wall 15 of the tine 5. The tines 5 are moved towards the patient 37 at a rate which corresponds to the rate of movement of the sheaths 17 with respect to the tines 5. Thus, each sheath unfurls, everting, beneath the patient 37; friction between the patient 37 and the sheaths 17 and the movement of the tines 5 with respect to the patient 37 will cause the patient 37 to move with respect to the tines 5 towards the proximal end of the tines 5 (i.e. towards the arm 4). The weight of the patient 37 becomes supported on the sheaths 17 and the tines 5 (see figure 11).

The sheaths 17 are inflated with a fluid under sufficient pressure to substantially prevent the sheaths 17 from contacting the extreme distal ends 11 of the tines 5 during this process. In an embodiment, a sheath 17 beneath the patient 37 may contact the tine 5 to which it is fitted in one or more locations to support, at least partially, the weight of the patient 37 without pressurised fluid between the sheath 17 and the outer wall 15 of the tine 5 at the or each such location. In an embodiment, the sheath 17 is in contact with the tine 5 substantially along an entire length of outer wall 15 which is covered by the sheath 17 or along an entire length of the sheath 17 which is beneath the object being lifted (such as a patient 37).

Once the transfer trolley 1 supports substantially the entire weight of the patient 37 (e.g. with the tines 5 entirely separating the patient 37 from the bed 38), the transfer trolley 1 can be moved with respect to the bed 38 to move the patient 37 from the bed 38.

In order assist with movement of the transfer trolley 1 with respect to the bed 38, the transfer trolley 1 may include a mechanism (not shown) which permits the distance between the arm 4 (and hence the tines 4) and the base unit 2 to be increased – for example a level adjustment mechanism as discussed above. Thus, the tines 5 (which are sandwiched between the patient 37 and the bed 38) can be lifted a distance from a surface of the bed 38 to prevent friction between the tines 5 (or the sheaths 17 of the tines 5) from hindering movement of the transfer trolley with respect to the bed 38.

The supply of pressurised fluid to the ports 36 of the tines 5 may not be necessary when the patient 37 is fully supported by the transfer trolley 1 as the weight of the patient 37 may be comfortably supported by the tines 5 without the cushion of pressurised fluid in the sheaths 17. However, in some embodiments and in some situations it may be preferably to maintain the supply of pressurised fluid to the sheaths 17.

It will be appreciated that embodiments of the present invention seek to provide a transfer trolley and/or a support element which permit a patient 37 can be lifted from the bed 38 in a comparatively gentle manner.

In the above described embodiment, the sheaths 17 unfurl beneath the patient 37 and hence there is comparatively little or no dragging of the sheaths 17 along the patient's body (during which the forces required to overcome friction may injure the patient 37). Embodiments of the present invention seek, therefore, to be particularly advantageous for lifting patients

37 with skin conditions or burns (i.e. patients with delicate skin or wounds). In addition, embodiments of the present invention seek to be particularly advantageous for lifting patients with fractured bones or spinal injuries or other injuries which require the patient to be maintained in a substantially fixed posture during transfer.

The sheaths 17 may be constructed out of a material which is not entirely fluid tight and/or the locations at which the sheaths 17 are coupled or connected to other elements (such as the outer wall 15) may not be entirely fluid tight. Thus, a degree of leakage of pressurised fluid from the sheath may be permitted. The pressurised fluid may be pressurised air or oxygen or a gas mixture containing more than about 21% oxygen (by volume) – in other words, a higher level of oxygen than is normally present in Earth's atmosphere. The pressurised fluid may contain more than 50% oxygen (by volume). The supply of oxygen to certain types of wound (such as burns) has been found to be beneficial in some instances. As such, a transfer trolley 1 including a tine 5 according to an embodiment of the invention (which is especially advantageous for lifting patients with, for example, burns) can be used to assist in the treatment of the patient 37.

In an embodiment, the pressurised fluid is an inert gas (such as nitrogen).

A patient 37, once supported by the transfer trolley 1, can be transferred to another support surface – such as another bed 38.

In order to transfer the patient 37 from the transfer trolley 1 to another bed 38, the lifting process described above is, substantially, reversed.

If the supply of pressurised fluid (from the pressurised fluid source 39) had been stopped while the patient 37 was supported by the transfer trolley 1

then the supply is re-activated. The sheaths 17 will inflate with pressurised fluid as described above (with movement of the sheaths 17 with respect to the tines 5 being substantially restricted by the tethers 22,28).

The transfer trolley 1 is moved so that the tines 5 extend over the surface of the bed 38 on which the patient 37 is to be deposited. The longitudinal axis of the arm 4 is preferably generally parallel with a longitudinal axis of the bed 38. If a mechanism has been provided to adjust the distance of the arm 4 (and hence the tines 5) with respect to the base unit 2, then this may be utilised to lower the tines 5 so that they are relatively close to the bed 38 (and may be in contact therewith).

The arm 4 is moved away from the bed 38 generally maintaining a parallel relationship between the longitudinal axis of the bed 38 and the arm 4. During this movement the drive unit 35 and transmission system 34 are activated such that the first and second tethers 22,28 of each tine 5 are drawn by the reel arrangements 25,31 out of the internal cavity 16 of the tine 5. In turn, the sheath 17 of each tine 5 moves with respect to the tine 5 into the internal cavity 16 of the tine 5 over and around the extreme distal end 11 of the tine 5 and from the outer wall 15 of the tine 5. The arm 4 is moved away from the bed 38 at a rate which corresponds to the rate of movement of the sheaths 17 with respect to the tines 5. Thus, each sheath 17 is drawn into the internal cavity 16 of its tine 5 and friction between the patient 37 and the sheaths 17 will cause the patient 37 to move towards the distal end of the tines 5 (i.e. away from the arm 4). The weight of the patient 37 is transferred from the sheaths 17 and the tines 5 to the bed 38. The sheaths 17 are inflated with a fluid under sufficient pressure to substantially prevent the sheaths 17 from contacting the extreme distal ends 11 of the tines 5 during this process. The fluid pressure in the sheaths 17 may be sufficient to permit the patient to be entirely supported on the cushion of fluid contained within

each sheath 17; however, in an embodiment, a sheath 17 beneath the patient 37 may contact the tine 5 to which it is fitted in one or more locations to support, at least partially, the weight of the patient 37 without pressurised fluid between the sheath 17 and the outer wall 15 of the tine 5 at the or each location.

Once the patient 37 is fully supported by the bed 38, the transfer trolley 1 can be moved away from the bed 38 freely. As will be appreciated, typically, the majority of the excess sheath material will now be stored inside the internal cavity 16 of the tine 5. In most cases, the transfer trolley 1 will be in a configuration which is suitable to lift another load without further adjustment of the position of the sheaths 17 with respect to the tines 5. In some situations however, it will be necessary to reset the transfer trolley 1 in order to lift another load by driving the tethers 22,28 to cause more of the excess material of the sheaths 17 to be stored in the internal cavity 16 of the tines 5.

Preferably, a mechanism is provided to permit only a complete load operation to occur before an unload operation can occur, and/or only a complete unload operation to occur before a load operation can occur (the load and unload operations being exemplified above with reference to the transferring of a patient from one bed to another). This mechanism may help to ensure the safe use of the transfer trolley 1 – to ensure that the patient 37 is supported to the greatest possible extent by the tines 5 during a transfer and to support the weight of the patient 38 as close to the arm 4 as possible to improve the stability of the transfer trolley 1. The mechanism may also help to ensure that the transfer trolley 1 is always ready for a load operation once an unload operation has been completed (this may be important if an emergency or otherwise urgent transfer of a patient is required).

An embodiment of a tine 5 is shown in figure 12. The tine 5 as described

below may form part of a transfer trolley 1 as described above and as depicted in figures 1 and 2. Indeed, the tine 5 as described below may form part of a transfer trolley substantially as described in WO2007/050016 or W091/07158 with modifications that will be appreciated by the person skilled in the art.

This embodiment of the tine 5 is similar to the above described embodiment and the same reference numerals will be used for corresponding features of this embodiment.

In this embodiment, the inner tube 18 of the above embodiment is not provided. In this embodiment, the sheath 17 is secured to a connection block 40 in the internal cavity 16 of the tine 5.

The connection block 40 substantially seals the second end of the inflatable sheath 17 and is secured to the first and second tethers 22,28 such that the first and second tether second anchor points 24,30 are located on the connection block 40 or are attached thereto.

In this embodiment, a gasket 41 is provided at the proximal end 10 of the tine 5 in the internal cavity 16 thereof. The gasket 41 is suitable to receive the first and second tethers 22,28 therethrough and hinder the flow of inflation fluid therethrough. In this embodiment, the port 36 is in fluid communication with a volume which is defined by the sheath 17, the connection block 40 and the outer wall 15 of the tine 5. It will be appreciated that the gasket 41 is required in order to reduce the leakage of pressurised inflation fluid from this volume.

The operation of a support element and a transfer trolley 1 including one or more tines 5 as shown in figure 12 is generally identical to that of the above described embodiments with the exception that the connection block 40 (and

hence the second end 21 of the sheath 17) moves with respect to the tine 5 in this embodiment. Importantly, the gap between the sheath 17 and the extreme distal end 11 of the tine 5 is maintained as a substantially predetermined or constant distance when the sheath 17 is inflated (as in the above described embodiment).

A further embodiment of the tine 5 is shown in figure 13. This embodiment is similar to the above described embodiment of figure 12. As with the embodiment of figure 12, the same reference numerals will be used for corresponding features of this embodiment.

In this embodiment, no gasket 41 is provided. Instead, a flexible inner tube 18 is provided. The flexible inner tube 18 extends from the proximal end 10 of the internal cavity 16 of the tine 5 towards the distal end 11 thereof. One end of the flexible inner tube 18 is secured to a base plate 42 of the tine 5 and the other end is secured to the connection block 40. The passage 19 is defined between the flexible inner tube 18 and the outer wall 15 of the tine 5. The port 36 is in fluid communication with the passage 19. Thus, as will be appreciated, there is no need to provide a gasket 41. Instead, the volume which receives inflation fluid under pressure is defined by the passage 19, the outer wall 15 of the tine 5 and the sheath 17 – the volume defined by an inner surface of the inner tube 18 and the connection block 40 (which contains the tethers 22,28) does not receive pressurised inflation fluid and is at substantially atmospheric pressure.

The flexible inner tube 18 may be a concertina-type flexible hose or other telescopic-type flexible hose. The flexible inner tube 18 is flexible in a longitudinal direction but preferably relatively inflexible in a radial direction such that the flexible tube 18 is generally prevented from radial compression during operation.

An embodiment of a tine 5 is depicted in figure 14. This embodiment of the tine 5 is similar to the above described embodiment and the same reference numerals will be used for corresponding features of this embodiment.

The tine 5 of figure 14 comprises an outer wall 15 as described above. A sheath 17 is also provided. In this embodiment, the second end 21 of the sheath 17 is connected to the outer wall of the tine 5 (such that the outer surface of the sheath 17 is immediately adjacent the outer surface of the outer wall 15); the sheath 17 passes over the outer wall 15 of the tine 5 towards the distal end 11 of the tine 5. The sheath 17 passes over and around the extreme distal end 11 of the tine 5 and into the internal cavity 16 thereof. The sheath 17 extends through an entire length of the internal cavity 16. The first end 20 of the sheath 17 is attached to a sheath material supply unit 46. This unit 16 may comprise a reel of sheath material.

In the embodiment of figure 14, a gasket (not shown in figure 14) may be provided. The gasket (which may be similar to gasket 41) is configured to permit the sheath 17 to pass therethrough but to hinder the flow of inflation gas therethrough. A port 36 is in fluid communication with a volume defined by the outer wall 15 of the tine 5, the gasket and the sheath 17.

In this embodiment as depicted in figure 14 no tethers 22,28 are provided. Instead, this embodiment operates by inflating the sheath 17 beneath a load to be lifted (such as a patient 37) and then advancing the outer wall 15 of the tine 5 into the inflated sheath 17 – in a loading operation. During inflation of the sheath 17, sheath material 17 passes through the gasket towards the distal end 11 of the tine 5. When the outer wall 15 is advanced into the inflated sheath 17, the excess sheath material is collected along the outer surface of the outer wall of the tine 5 towards the proximal end of the tine 5

with respect to the location at which the second end 21 of the sheath 17 is connected to the outer wall 15 of the tine 5.

In an unloading operation, the sheath 17 is drawn through the internal cavity 16 of the tine 5 towards the proximal end 10 of the tine 5. The load supported by the tine 5 will move, in a corresponding manner, towards the distal end 11 of the tine 5.

After a predetermined number of uses – which may be one load and unload operation – the connection between the second end 21 of the sheath 17 and the outer wall 15 of the tine 5 may be broken. Sheath material may be drawn through the gasket from the sheath material supply unit 46. When, for example, sufficient sheath material has been supplied by the unit 46 such that the sheath material has not be used in the preceding load and unload operation, the sheath 17 may be cut to form a new second end 21 of the sheath 17. The new second end 21 of the sheath 17 is then connected to the outer wall 15 of the tine 5 as before. Thus, each section of the sheath material is only used a predetermined number of times.

The sheath material supply unit 46 may be a cartridge of sheath material. The sheath material may be a sterilised sheath material. The sheath material may be a biodegradable sheath material. The sheath material may be a paper based sheath material.

An embodiment of a tine 5 is shown in figures 15 and 16. This embodiment of the tine 5 is similar to the above described embodiment and the same reference numerals will be used for corresponding features of this embodiment.

The tine 5 depicted in figures 15 and 16 comprises an outer wall 15 and a

sheath 17. The sheath 17 may be connected to the outer wall 15 of the tine 5 at a second end 21 of the tine 5 in a similar manner as in the embodiment depicted in figure 14 and described above. In this embodiment, a sheath material supply unit 46 may (or may not) be provided and the first end 20 (which is not shown in figures 15 and 16) of the sheath 17 may be connected to the tine 5.

In this embodiment, no tethers 22,28 are provided; however a slider 47 is provided. The slider 47 preferably comprises a comparatively thin rod (when compared to tine 5). The slider 47 may be flexible but is sufficiently rigid to perform its function – as will be described below.

The slider 47 is normally stored in the internal cavity 16 of the tine 5 – as shown in figure 16. During a loading operation, the sheath 17 is partially inflated with a pressurised fluid – see figure 16. This pressurised fluid is at a pressure which is less than the fluid pressure for the other embodiments described above and is not sufficient to inflate the sheath 17 fully. Instead, the sheath 17 is sufficiently inflated such that the slider 47 may be inserted into the partially inflated sheath 17 as the sheath unfurls beneath a patient 37. In this manner, the slider 47 may be used to guide the inflation of the sheath 17 beneath the patient 37 and provides some support to the sheath 17 to help to prevent the sheath 17 from inflating in an undesired direction (for example).

During a loading operation, when the slider 47 and partially inflated sheath 17 support a sufficient part of the load being lifted (preferably in the case of a patient 37, the slider 47 and sheath 17 extend beneath the whole of a width of the patient 37), the fluid pressure in the sheath 17 is increased to inflate the sheath 17 fully. This ensures that there is sufficient room within the inflated sheath 17 for the outer wall 15 of the tine 5 to be inserted into the inflated

sheath 17 until it is underneath the load.

It will be appreciated that this embodiment seeks to ease the insertion of the sheath 17 beneath the load while helping to prevent the sheath 17 from inflating in an in desired manner (e.g. not in a straight line and/or not in a direction which is parallel to the outer wall 15 of the tine 5).

It will be understood that the methods represented in figures 8 and 9 may in whole or in part be relevant to the operation of embodiments of the invention which include one or more tethers or equivalent features.

A tine 5 may be more generally described as a support element or may form part of a support element. The sheath 17 and other components of embodiments as described above may form part of a tine 5 or may be form part of a support element of which the tine 5 is also a part. A transfer trolley 1 may include one or more such support elements.

The inflation fluid which may be used in accordance with embodiments described herein may be a liquid or gas – as described above – and/or may be a substance with fluid-like properties – for example, the inflation fluid may be a powder or gel.

In an embodiment, the inflation fluid is supplied to the sheath during construction of the transfer trolley/support element. The sheath, in this embodiment, is impermeable to that inflation fluid such that the inflation fluid will not leak (in substantial quantities) from the sheath. The or each sheath in this embodiment will be generally permanently inflated and the supply of inflation fluid during normal operation of the transfer element/trolley may not be required (although it may be that this forms part of a maintenance operation).

In some embodiments, a single tether may be used instead of a first 22 and second 28 tether.

It will be appreciated that excess sheath material may not be stored along an inner surface of the outer wall 15 or inner tube 18 of the tine 5; instead a separate excess sheath material store (not shown) may be provided.

When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

Claims:

1. A support element for use with a transfer trolley, the element comprising:

an elongate tine;

an inflatable sheath connected to the tine and covering an extreme distal end of the tine; and

a tether coupled to the sheath, wherein the sheath is moveable to scroll around the extreme distal end of the tine, the tether being configured such that when the sheath is inflated the tether restricts movement of the sheath with respect to the tine to maintain a substantially predetermined distance beyond the extreme distal end of the tine between the sheath and the tine as the sheath is scrolled around the extreme distal end of the tine between a loading and an unloading configuration.

2. A support element according to claim, wherein the sheath is connected to the tine at a first end of the sheath.

3. A support element according to claim 1 or 2, further comprising an inner tube which defines a passage within the tine which is in fluid communication with a volume defined at least in part by the sheath such that inflation fluid supplied through the inner tube inflates the sheath.

4. A support element according to claim 3, wherein the passage is defined between the inner tube and an outer wall of the tine.

5. A support element according to claim 3 or 4, wherein the inner tube is rigid.

6. A support element according to claim 3 or 4, wherein the inner tube is

flexible.

7. A support element according to any of claims 3, 4, 5, or 6, wherein the sheath is connected to the inner tube at a second end of the sheath.

8. A support element according to claim 1 or 2, further comprising a gasket through which the tether may travel and through which the passage of inflation fluid is substantially prevented.

9. A support element according to any preceding claim, further comprising a reel arrangement configured to drive movement of the tether with respect to the tine.

10. A support element according to any preceding claim, further comprising an adjustment arrangement configured to adjust the substantially predetermined distance.

11. A support element according to any preceding claim, wherein the tether comprises a pair of tethers.

12. A support element according to any of claims 1 to 10, wherein the tether comprises an outer sheath which covers substantially the entire of the inflatable sheath.

13. A transfer device including a support element, the device comprising:

an elongate tine;

a sheath material supply unit; and

an inflatable sheath, wherein a first section of the sheath is connected to the tine at a first location and at least partially covers the tine and a second section of the sheath is stored in the sheath material supply unit such that the

second section of the sheath can be connected to the tine at the first location to replace at least part of the first section of the sheath.

14. A transfer device according to claim 13, wherein the device is a transfer trolley.

15. A support element comprising:

an elongate tine;

a slider located substantially adjacent to the tine; and

an inflatable sheath connected to the tine and at least partially covering the tine and slider, such that the slider can be moved with respect to the tine to guide the path of the sheath beyond an extreme distal end of the tine during an inflation operation.

16. A transfer trolley including a support element according to any of claims 1 to 12 or 16.

17. A method of loading an object comprising:

providing a support element according to any of claims 1 to 12;

inflating the inflatable sheath;

moving the sheath with respect to the tine such that at least part of the sheath scrolls onto an outer surface of the tine; and

restricting movement of the sheath using the tether to maintain the substantially predetermined distance beyond the extreme distal end of the tine between the sheath and the extreme distal end of the tine as the sheath is scrolled around the extreme distal end of the tine.

18. A method according to claim 17, wherein the step of moving the sheath further comprises moving at least part of the sheath from an internal cavity of the tine.

19. A method of unloading an object comprising:

providing a support element according to any of claims 1 to 12;

inflating the inflatable sheath;

moving the sheath with respect to the tine such that at least part of the sheath scrolls from an outer surface of the tine; and

restricting movement of the sheath using the tether to maintain the substantially predetermined distance beyond the extreme distal end of the tine between the sheath and the extreme distal end of the tine as the sheath is scrolled around the extreme distal end of the tine.

20. A method according to claim 18, wherein the step of moving the sheath further comprises moving at least part of the sheath into an internal cavity of the tine.

21. A support element substantially as hereinbefore described with reference to the accompanying figures.

22. A transfer device substantially as hereinbefore described with reference to the accompanying figures.

23. A transfer trolley substantially as hereinbefore described with reference to the accompanying figures.

24. A method substantially as hereinbefore described with reference to the accompanying figures.

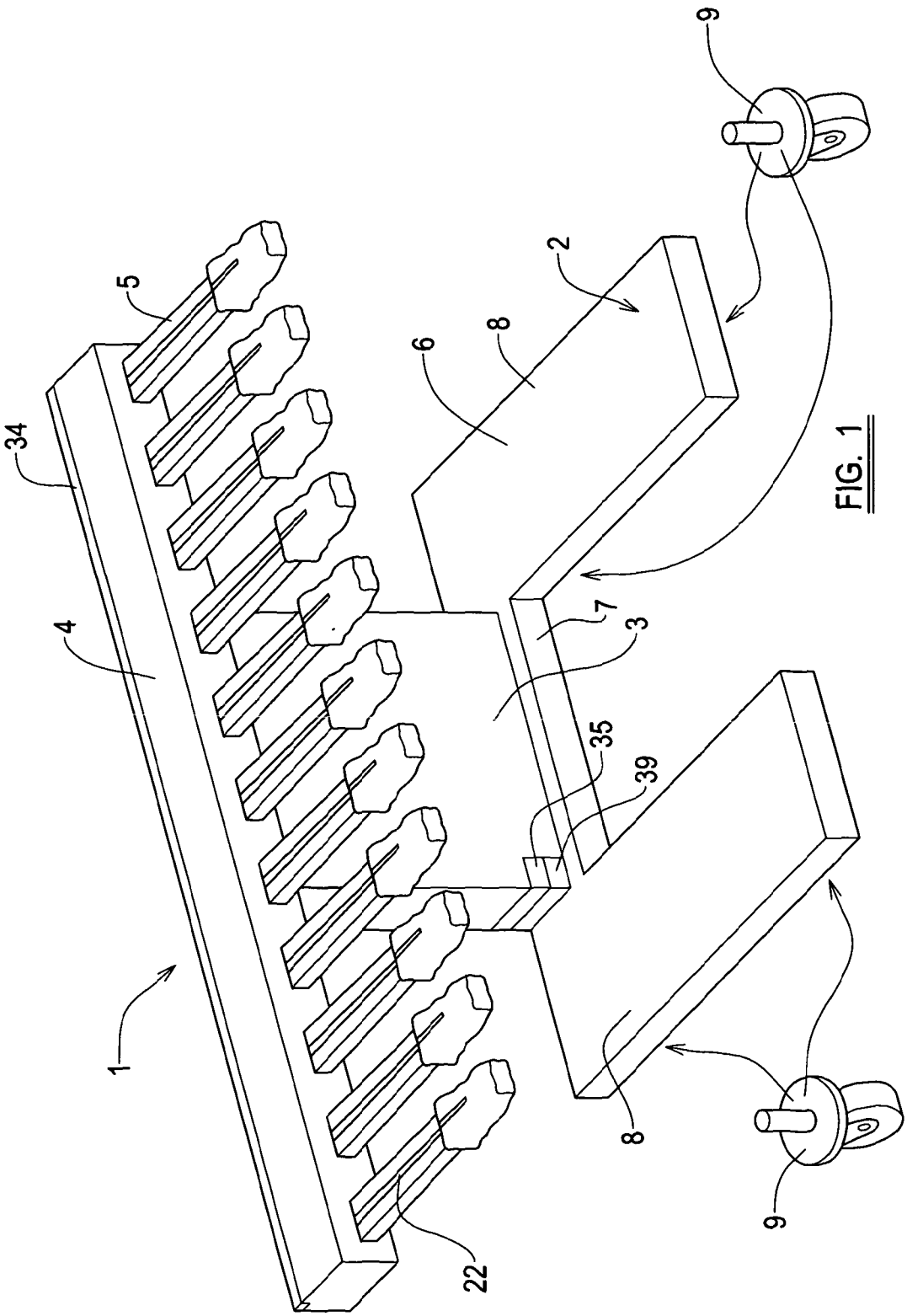

FIG. 1

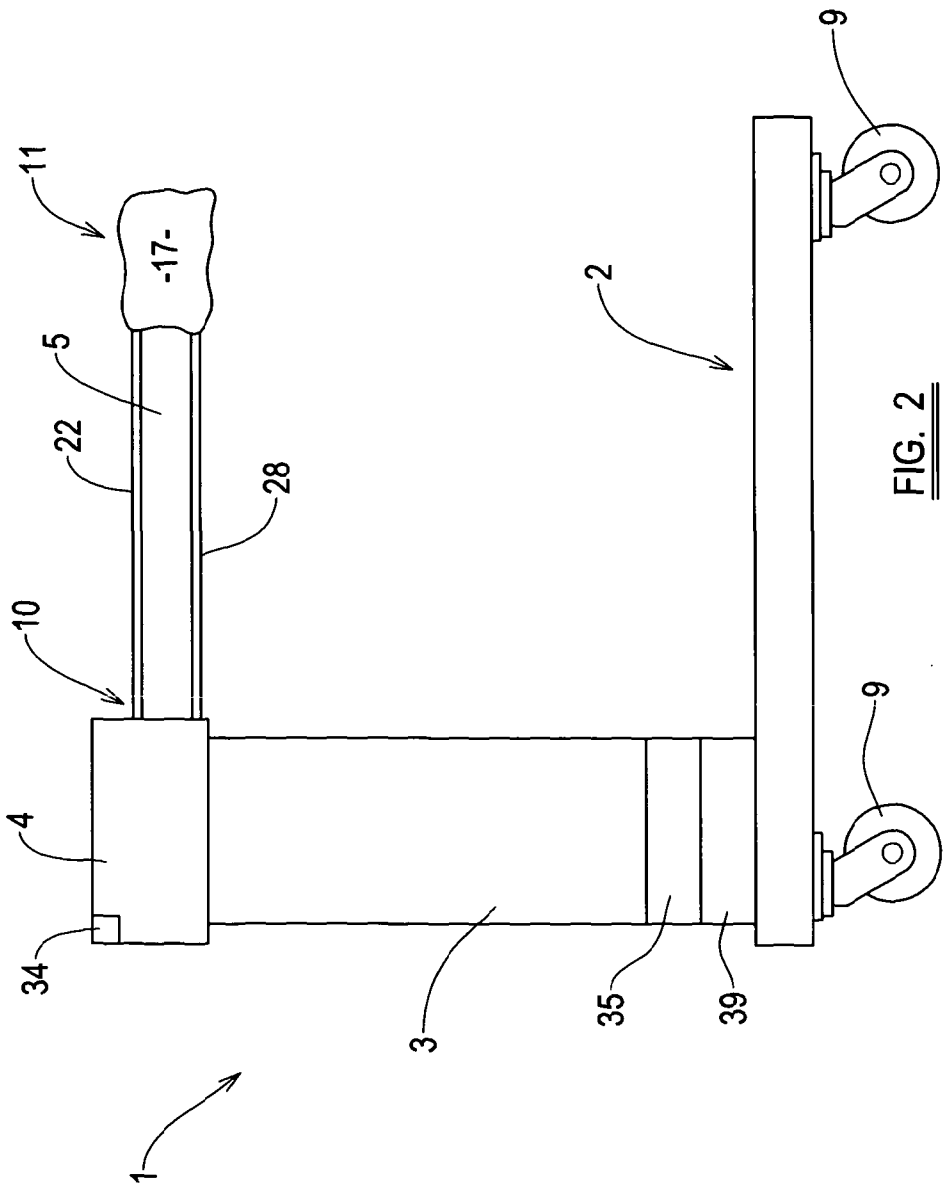

FIG. 2

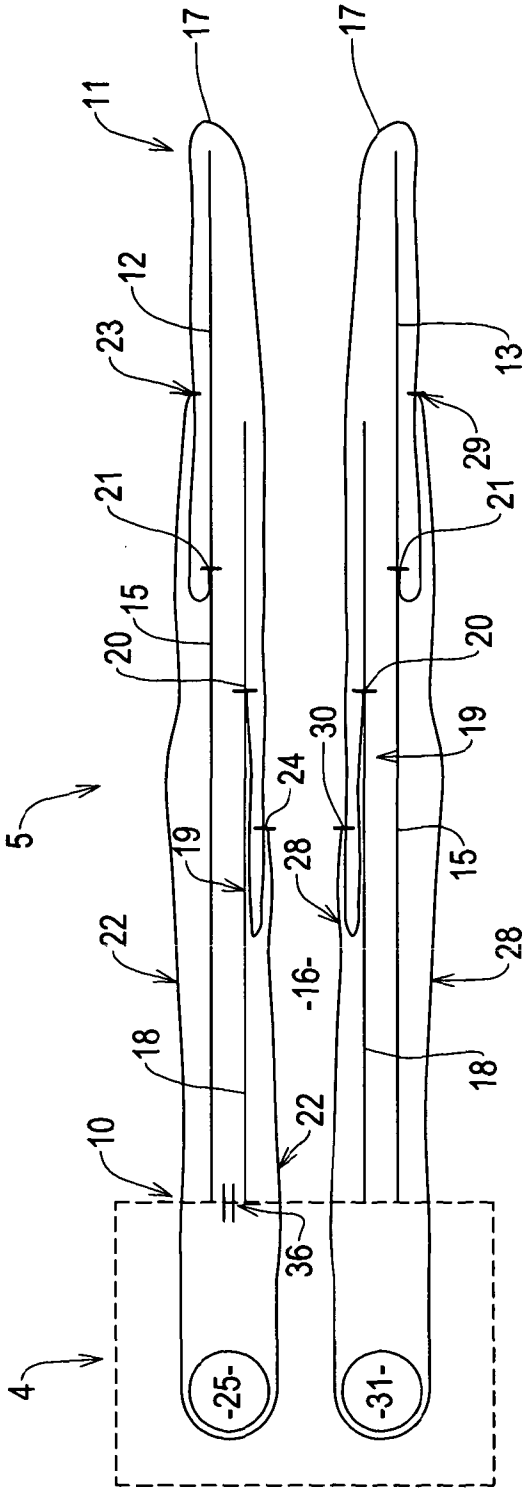
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FIG. 3

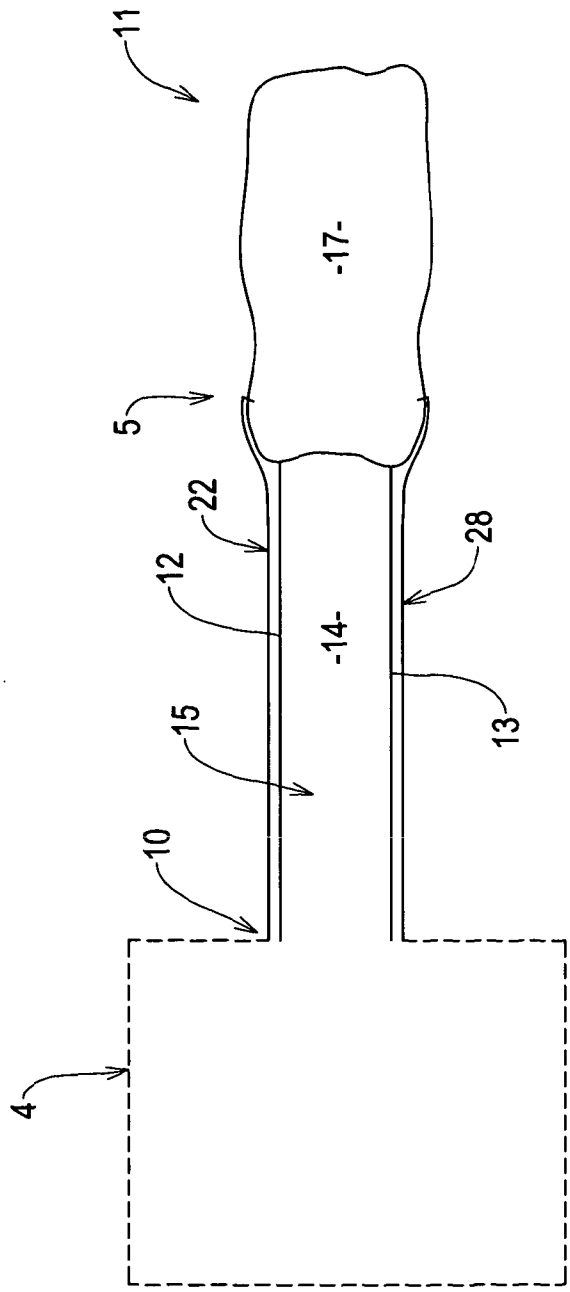


FIG. 4

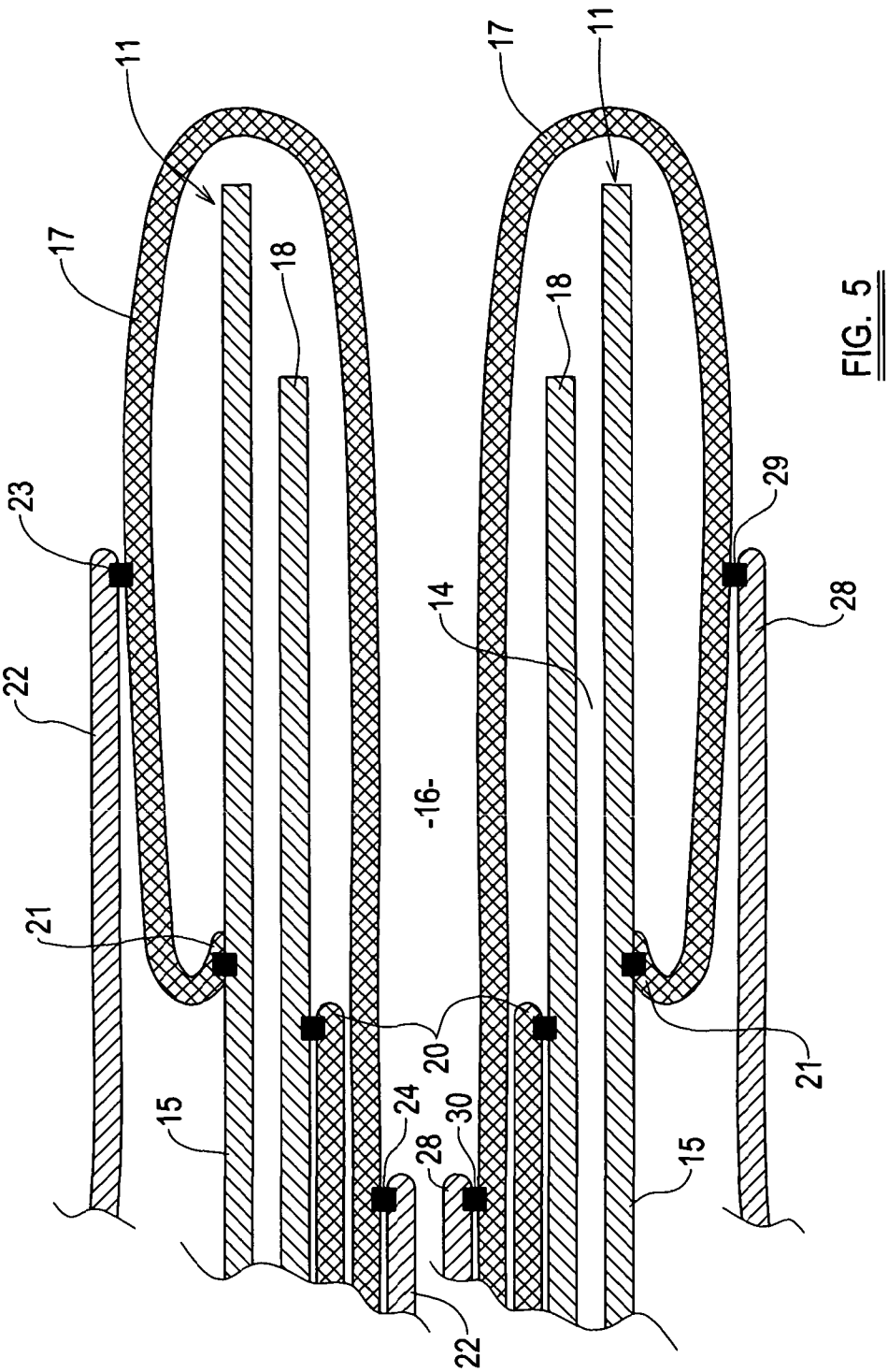


FIG. 5

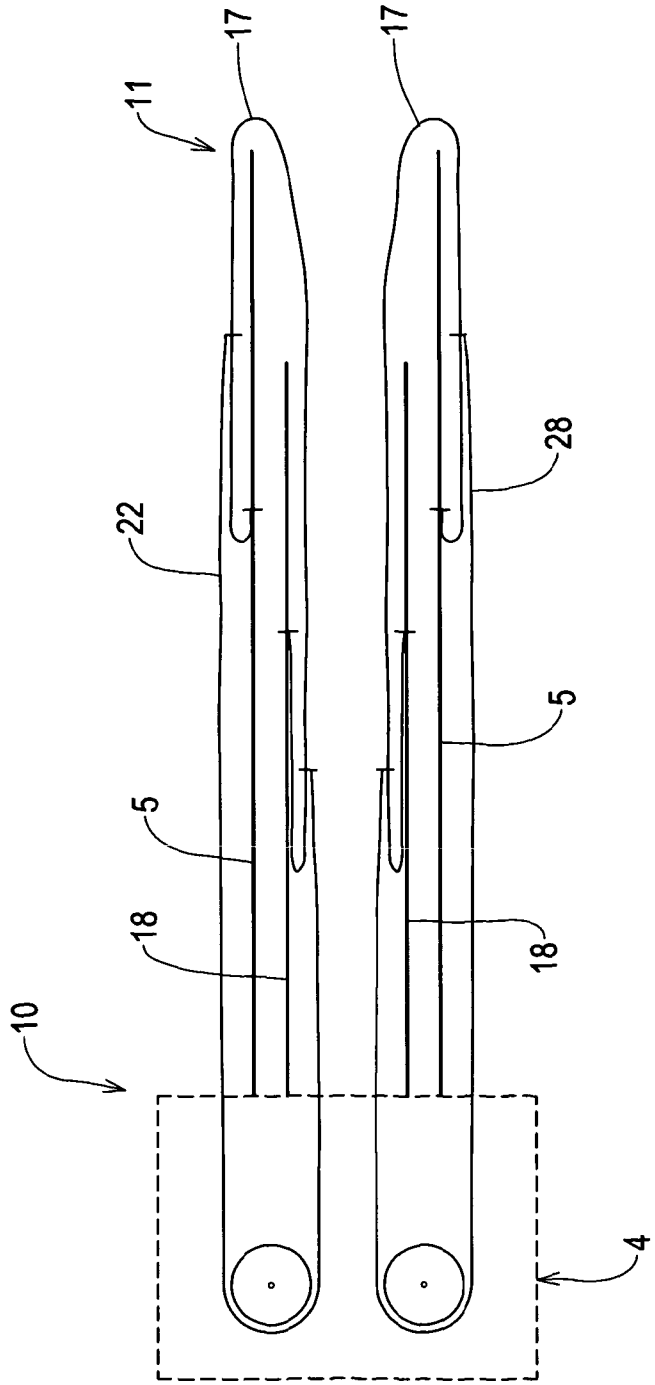
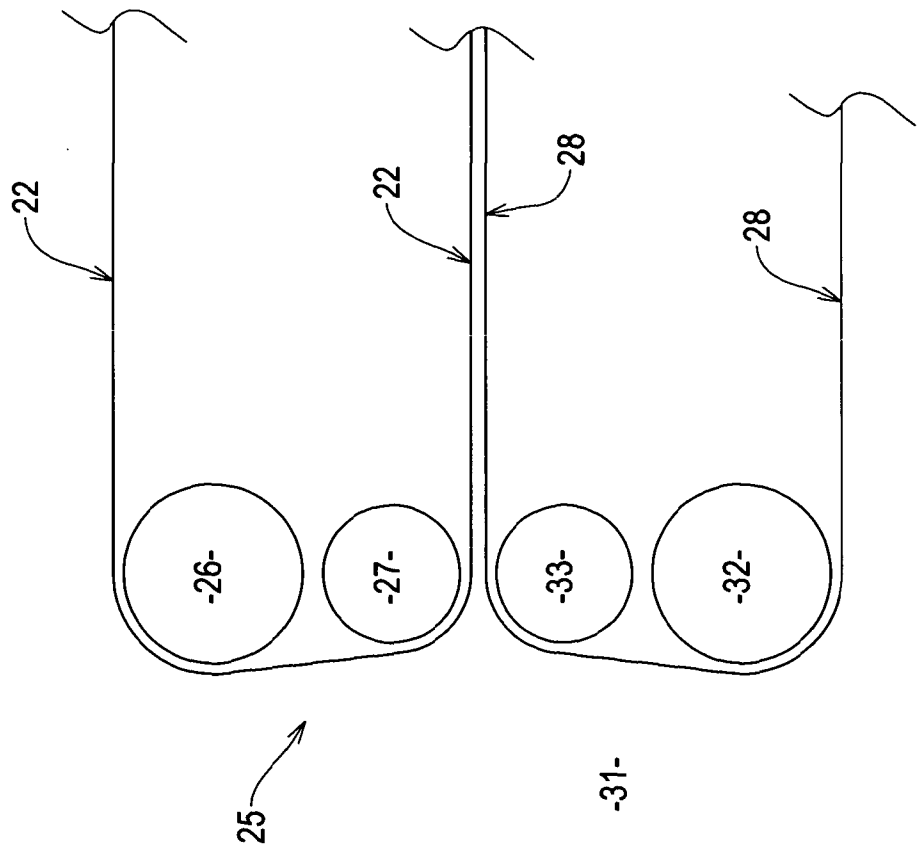


FIG. 6

FIG. 7



Loading Method

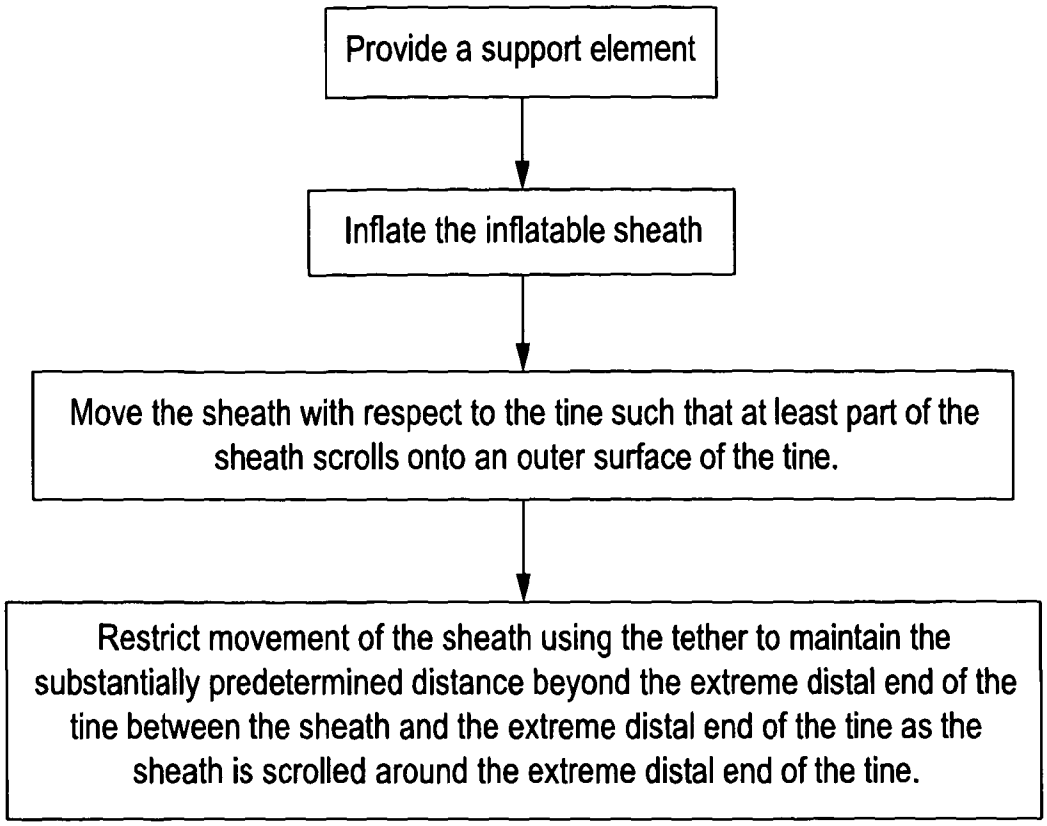


FIG. 8

Unloading Method

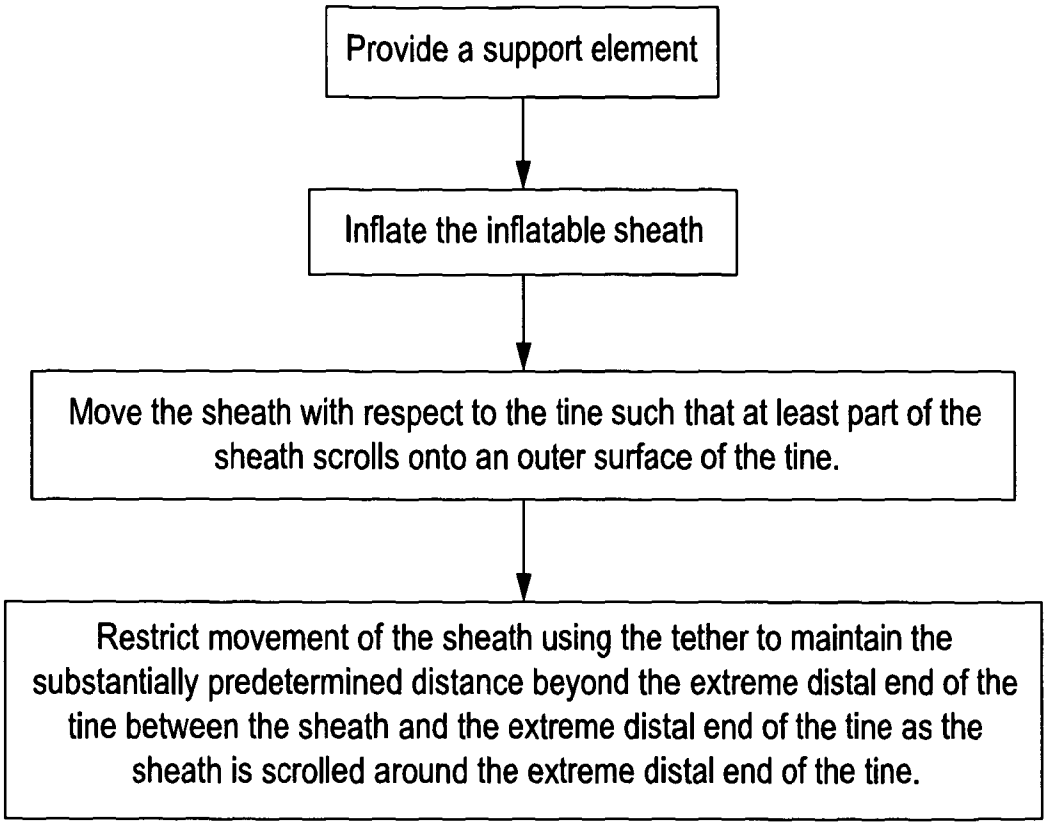


FIG. 9

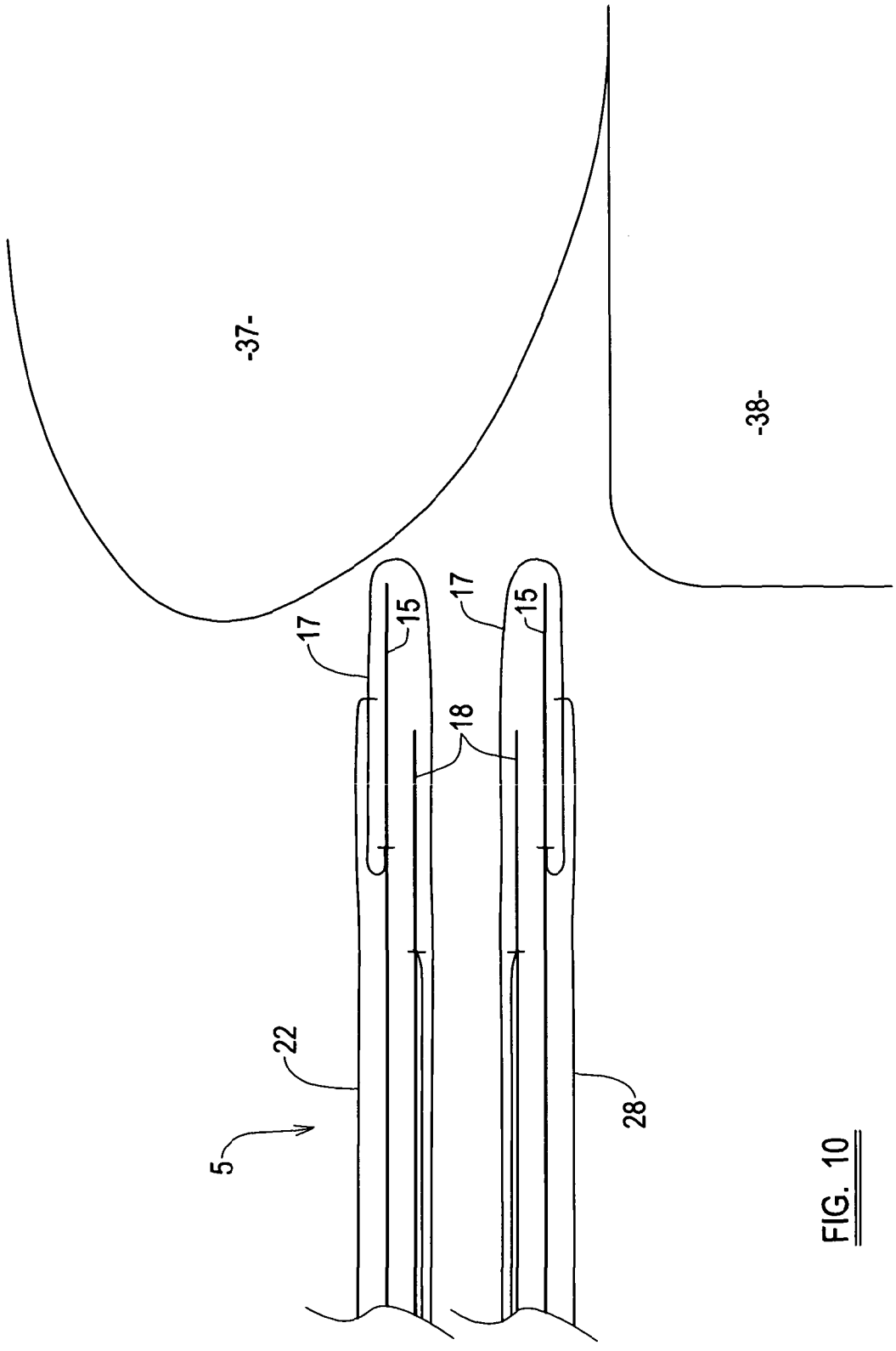


FIG. 10

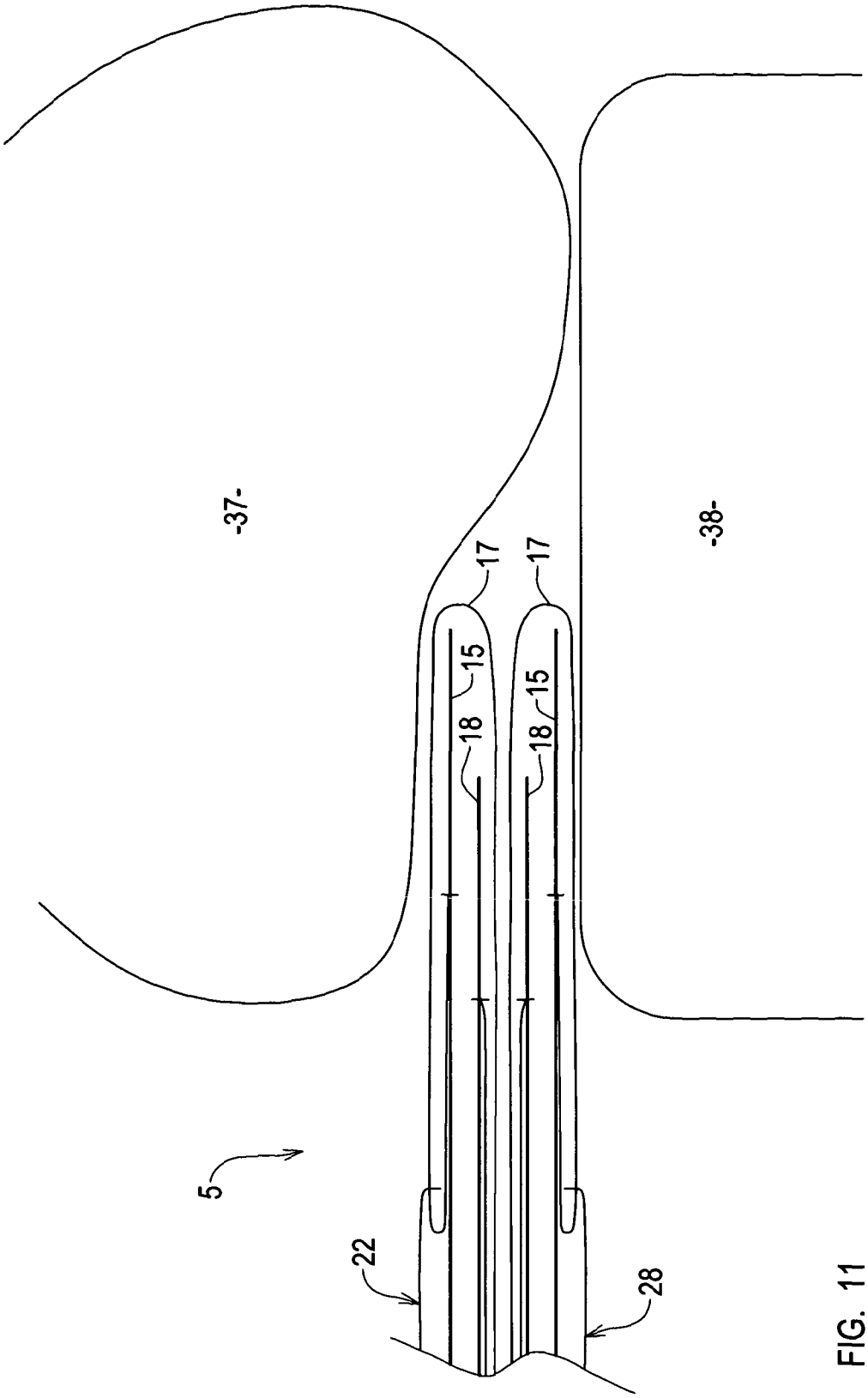


FIG. 11

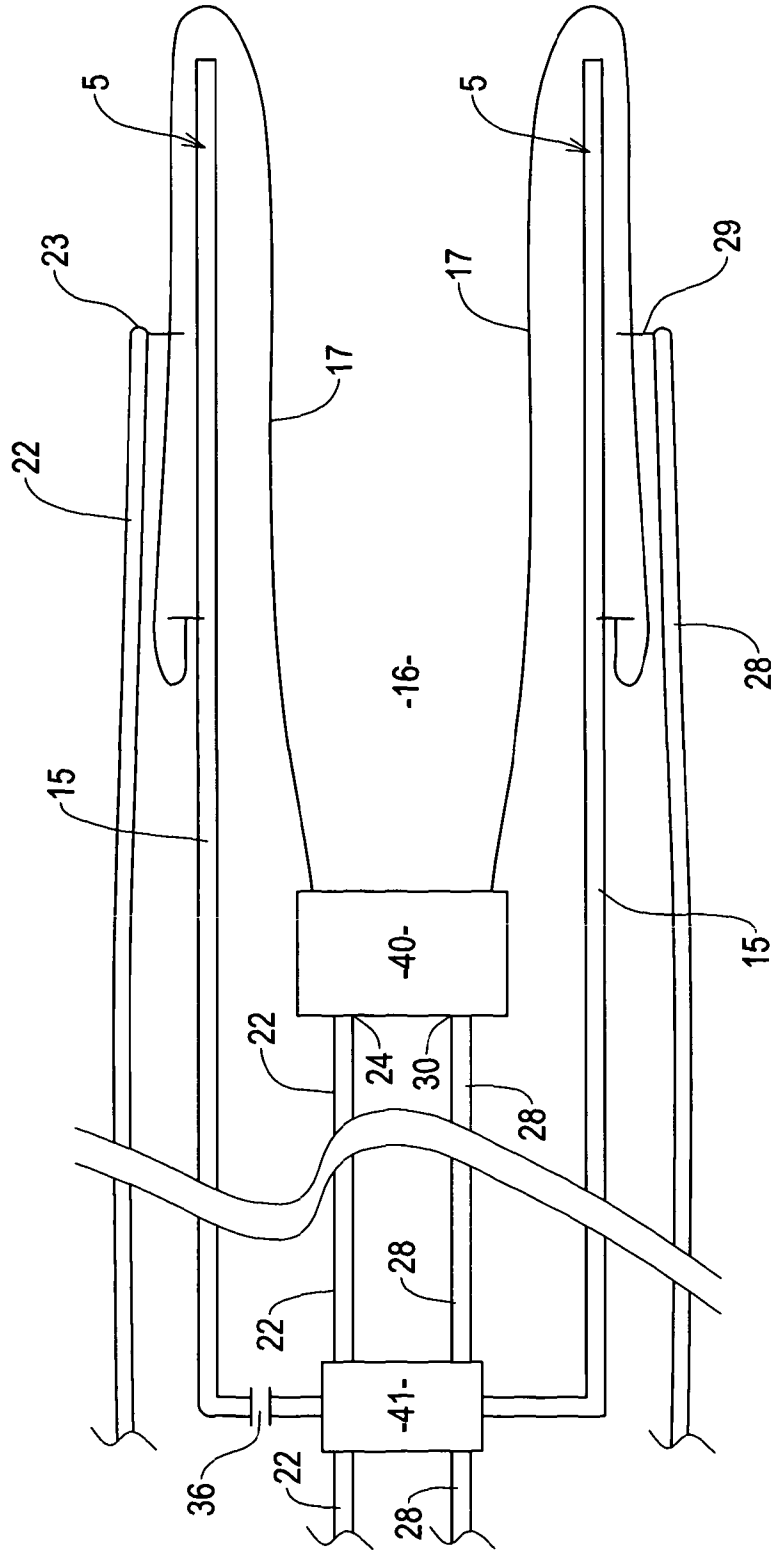


FIG. 12

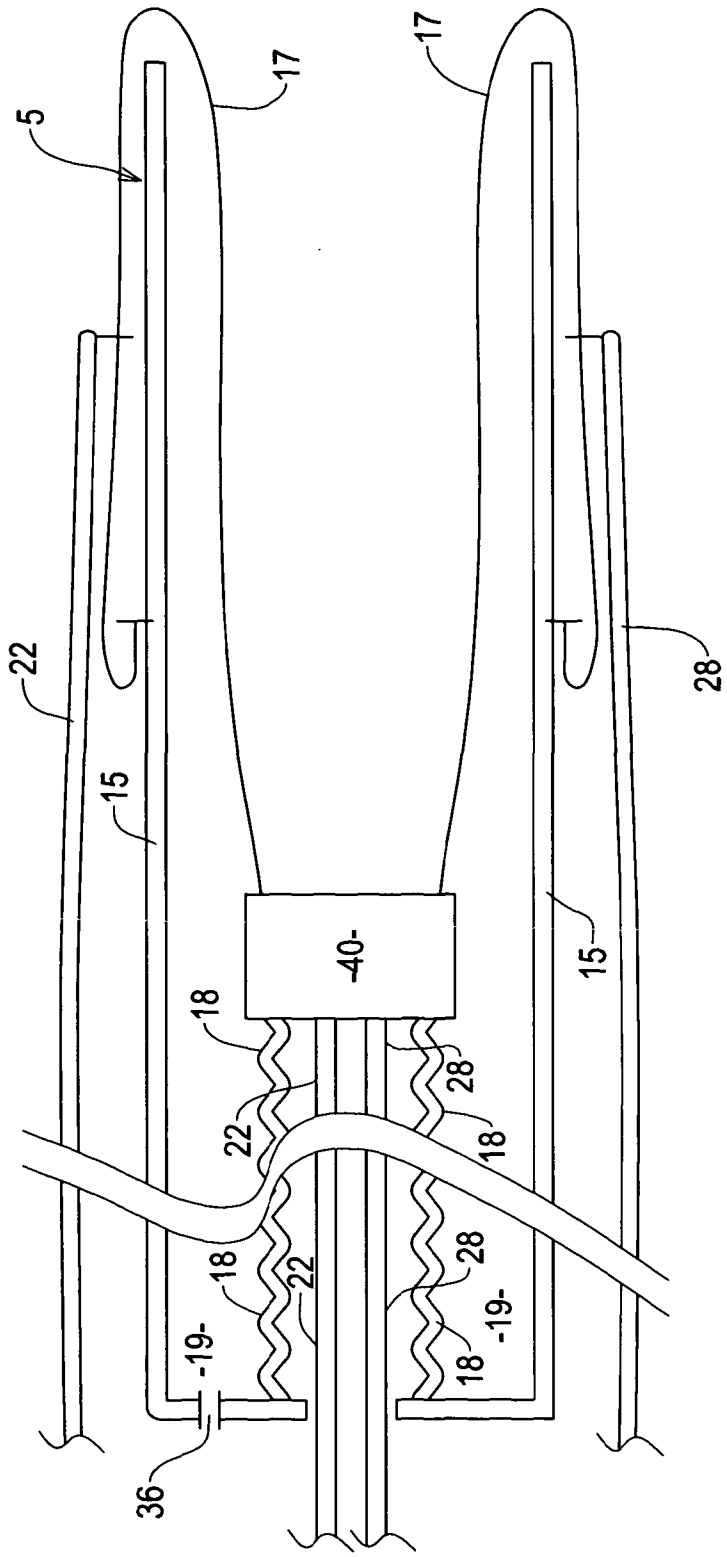


FIG. 13

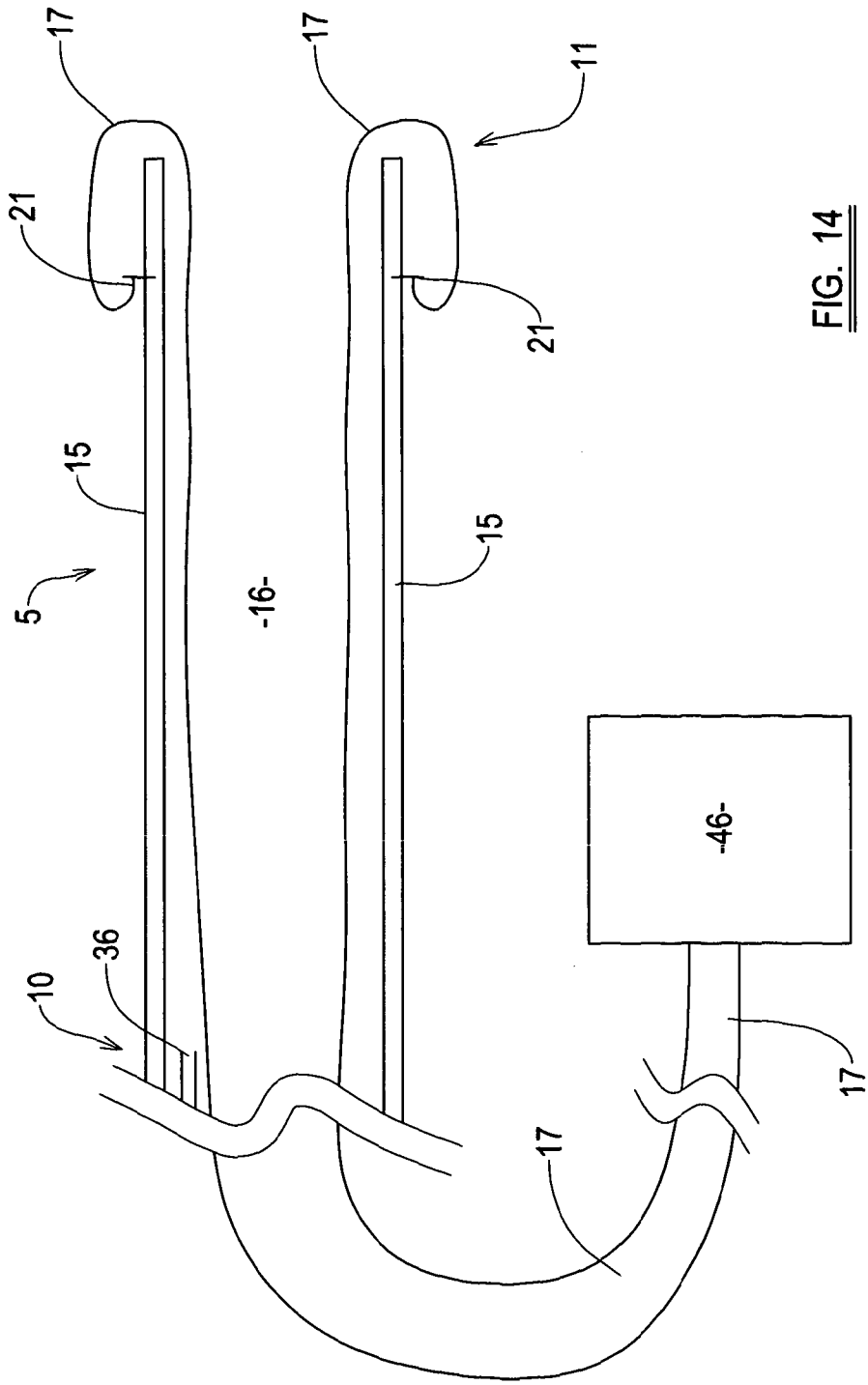


FIG. 14

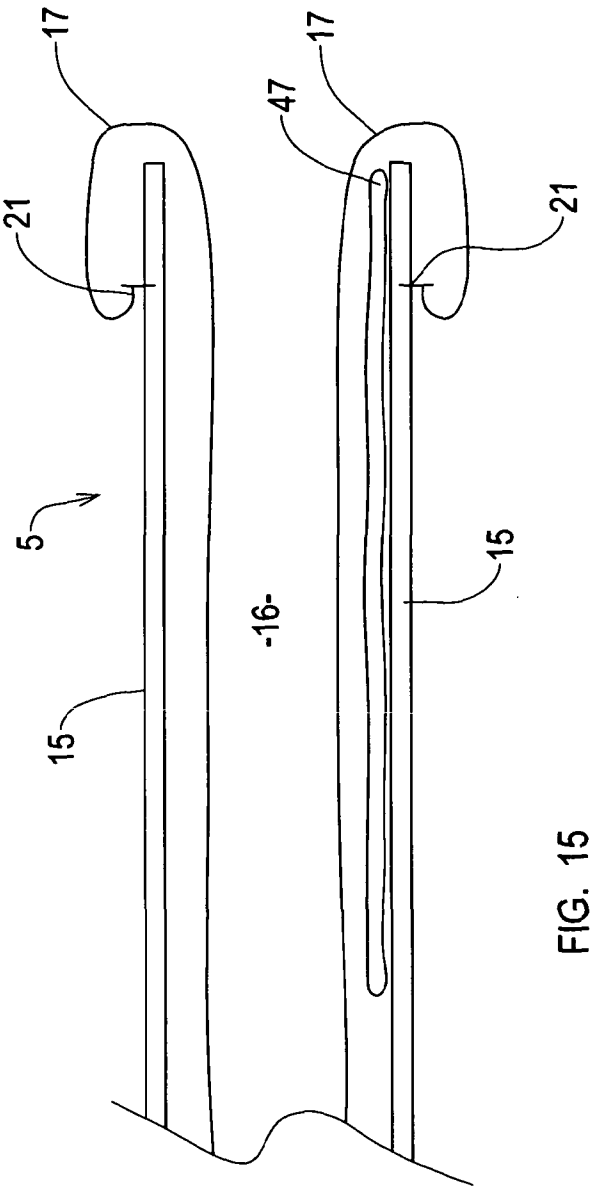


FIG. 15

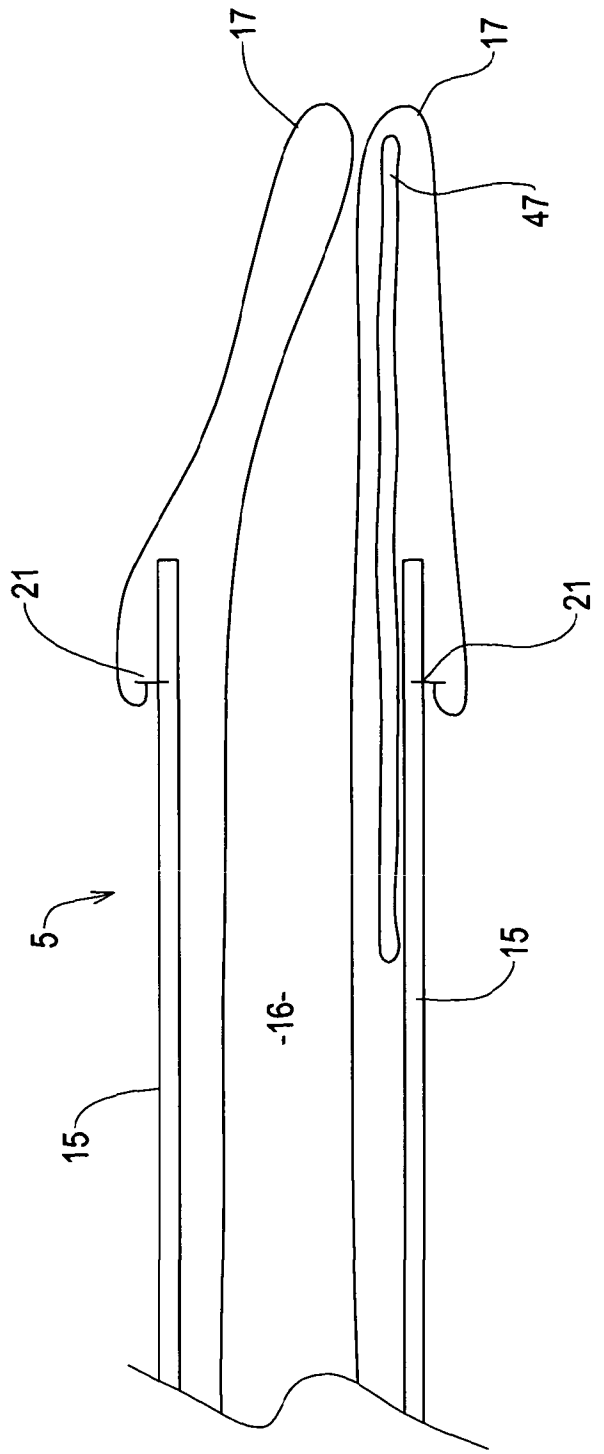


FIG. 16

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/051418

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61G7/10 B66F3/35
ADD.

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)
A61G B66F

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 2008/071940 A1 (SMS TECHNOLOGIES LTD [GB]; SANDLAND STEVEN [GB]; FINLAY PATRICK [GB]) 19 June 2008 (2008-06-19) cited in the application page 17 - page 20; claims 6,7; figures 5,7 page 11 - page 11	1-3,5,6, 9,10,16
Y	US 4 924 538 A (KUME MASAO [JP]) 15 May 1990 (1990-05-15) column 3 - column 4; figure 1	1,2,8-11
Y	US 3 178 732 A (STIBITZ GEORGE R) 20 April 1965 (1965-04-20) column 2 - column 4; figures	1,2,8-11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 December 2010	09/12/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Edlauer, Martin

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2010/051418

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

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

2. ☒ Claims Nos.: 21-24
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

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

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

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

see additional sheet

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

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

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

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

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 21-24

Claims shall not rely, in respect of the technical features of the invention on references to the drawings (Rule 6.2(a) PCT). This is the case for claims 21-24 and renders the subject-matter of said claims unclear.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-12, 17-20

A support element for use with a transfer trolley, the element comprising:
an elongate tine;
an inflatable sheath connected to the tine and covering an extreme distal end of the tine; and
a tether coupled to the sheath, wherein the sheath is moveable to scroll around the extreme distal end of the tine, the tether being configured such that when the sheath is inflated the tether restricts movement of the sheath with respect to the tine to maintain a substantially predetermined distance beyond the extreme distal end of the tine between the sheath and the tine as the sheath is scrolled around the extreme distal end of the tine between a loading and an unloading configuration.
The support element furhter comprising an inner tube which defines sage between the inner tube and an outher wall of the tine which is in fluid communication with a volume defined at least in part by the sheath such that inflation fluid supplied through the inner tube inflates the sheath.
A method of loading and unloading an object.

1.1. claims: 13, 14

A transfer device including a support element, the device comprising:
an elongate tine;
a sheath material supply unit; and
an inflatable sheath, wherein a first section of the sheath is connected to the tine at a first location and at least partially covers the tine and a second section of the sheath is stored in the sheath material supply unit such that the second section of the sheath can be connected to the tine at the first location to replace at least part of the first section of the sheath.

1.2. claims: 15, 16

A support element comprising:
an elongate tine;
a slider located substantially adjacent to the tine; and
an inflatable sheath connected to the tine and at least partially covering the tine and slider, such that the slider can be moved with respect to the tine to guide the path of the sheath beyond an extreme distal end of the tine during an inflation operation.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2010/051418

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008071940 A1	19-06-2008	AU 2007331329 A1	19-06-2008
		CA 2672060 A1	19-06-2008
		CN 101626748 A	13-01-2010
		EP 2101705 A1	23-09-2009
		US 2010138989 A1	10-06-2010
US 4924538 A	15-05-1990	JP 1274760 A	02-11-1989
		JP 1654046 C	13-04-1992
		JP 3054584 B	20-08-1991
US 3178732 A	20-04-1965	NONE	