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(54) **APPARATUS FOR AND A METHOD OF ADJUSTING THE LENGTH OF AN INFUSION TUBE**

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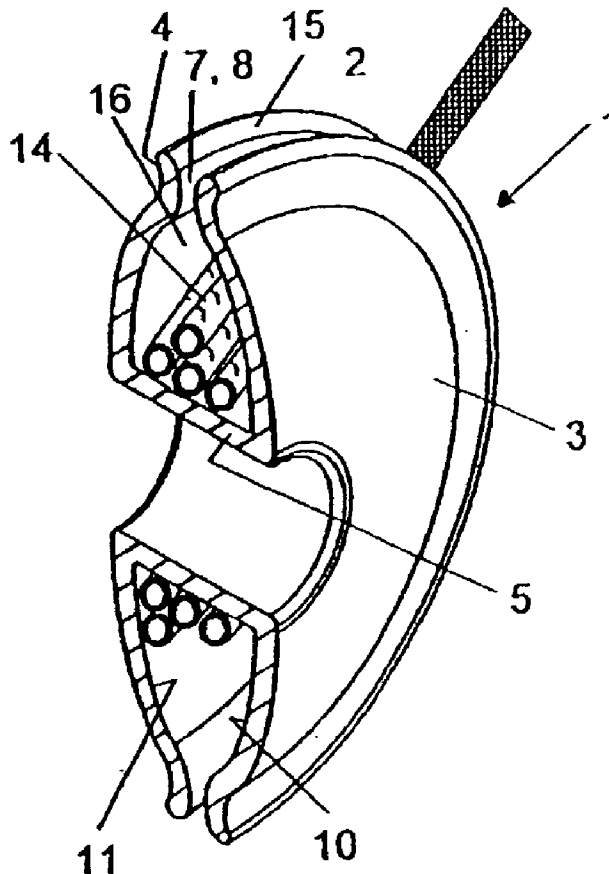
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(57) **ABSTRACT**

The invention relates to an apparatus (1) for adjusting the length of an infusion tube (2) comprising a first wall (3) and a second wall (4) and at least one connecting element (5) connecting the first wall (3) to the second wall (4), said connecting element (5) being situated at a distance to the peripheral circumference of the walls (6), and wherein the distance between the walls in radial distance to said connecting element provides an inlet opening extending around the connecting element having a width (M) measured between the walls (3, 4); and wherein the apparatus comprises at least one attachment device (8) for securing the infusion tube (2).

Hereby a winding of an infusion tube is enabled for adjusting the connection length between pump and the site of infusion anywhere on the infusion tube and on any kind of infusion unit. Thus, the apparatus enables reuse due to its independence of the pump. The system also enables the user to position the winding unit on any suitable place on his/her body with regard to physiology and to clothing.



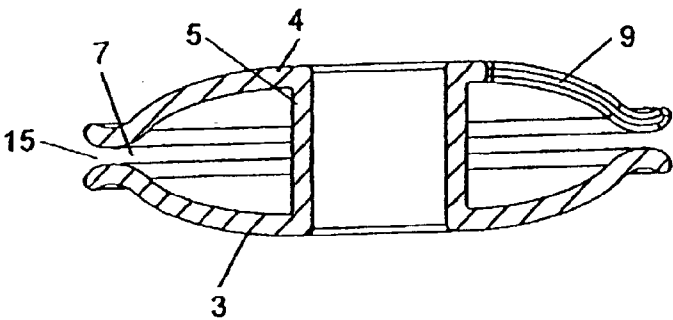


Fig. 5

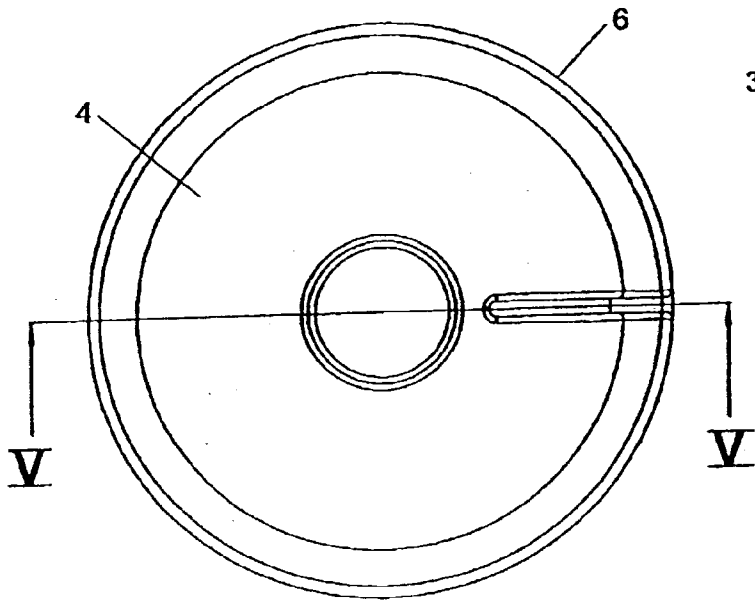


Fig. 3

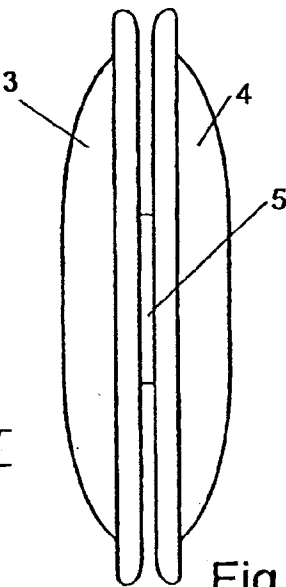


Fig. 4

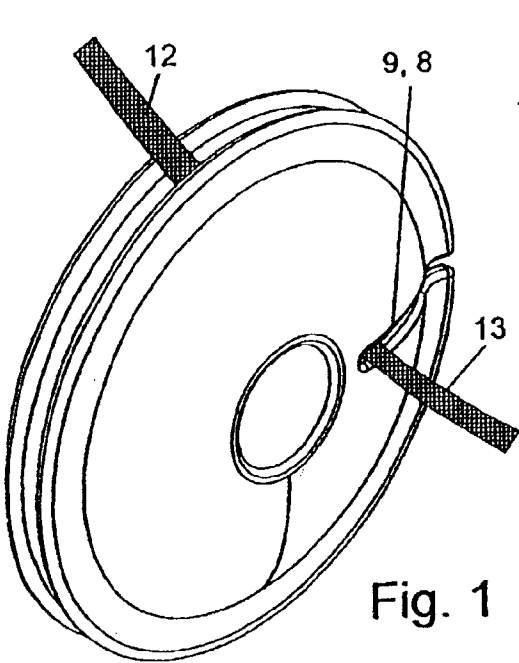


Fig. 1

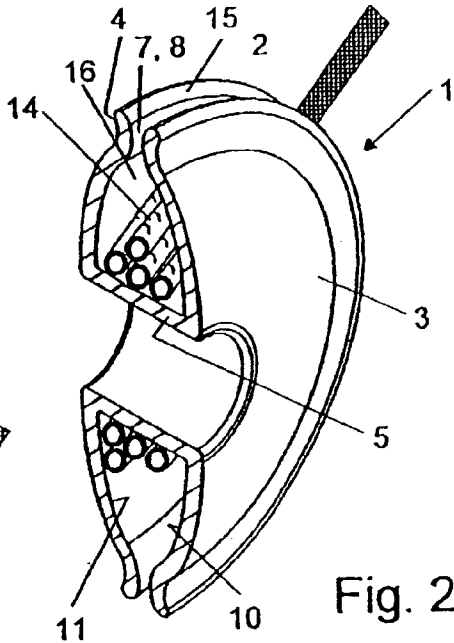


Fig. 2

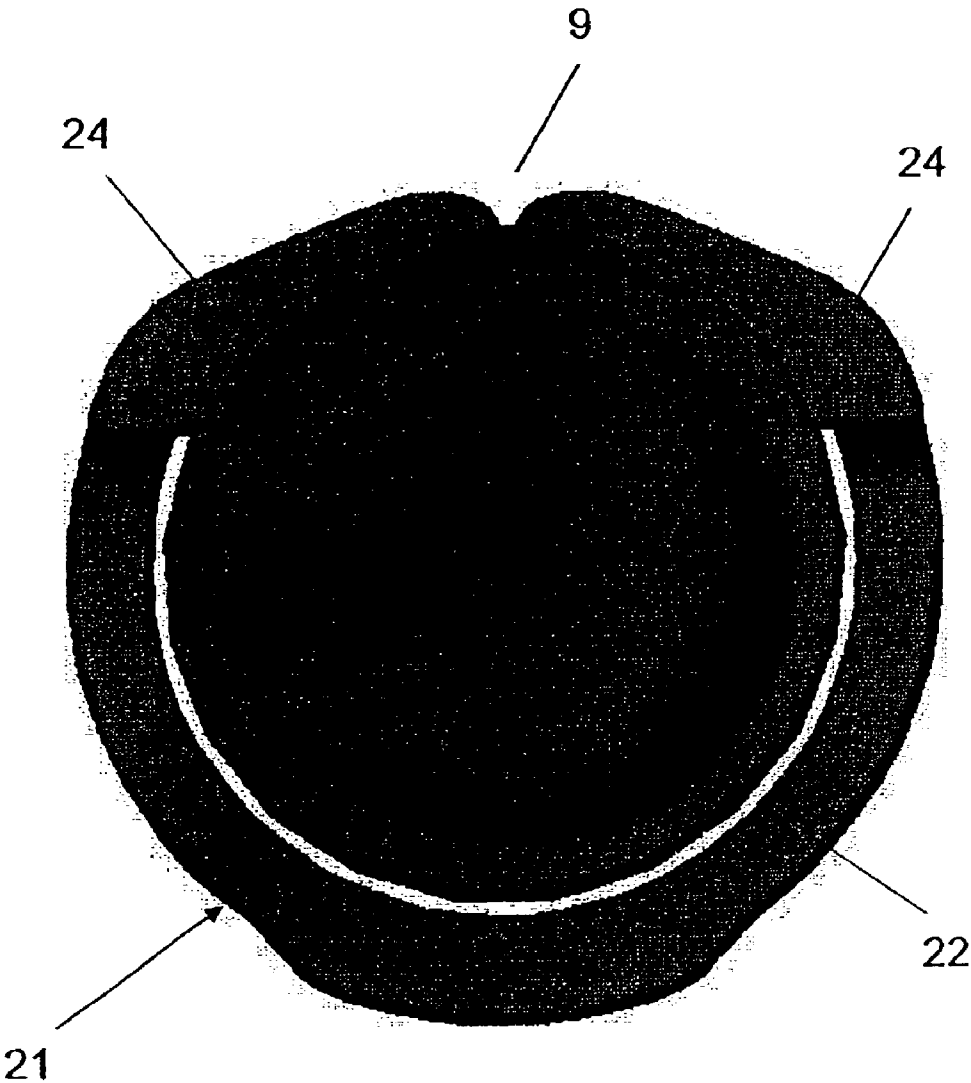


Fig. 6A

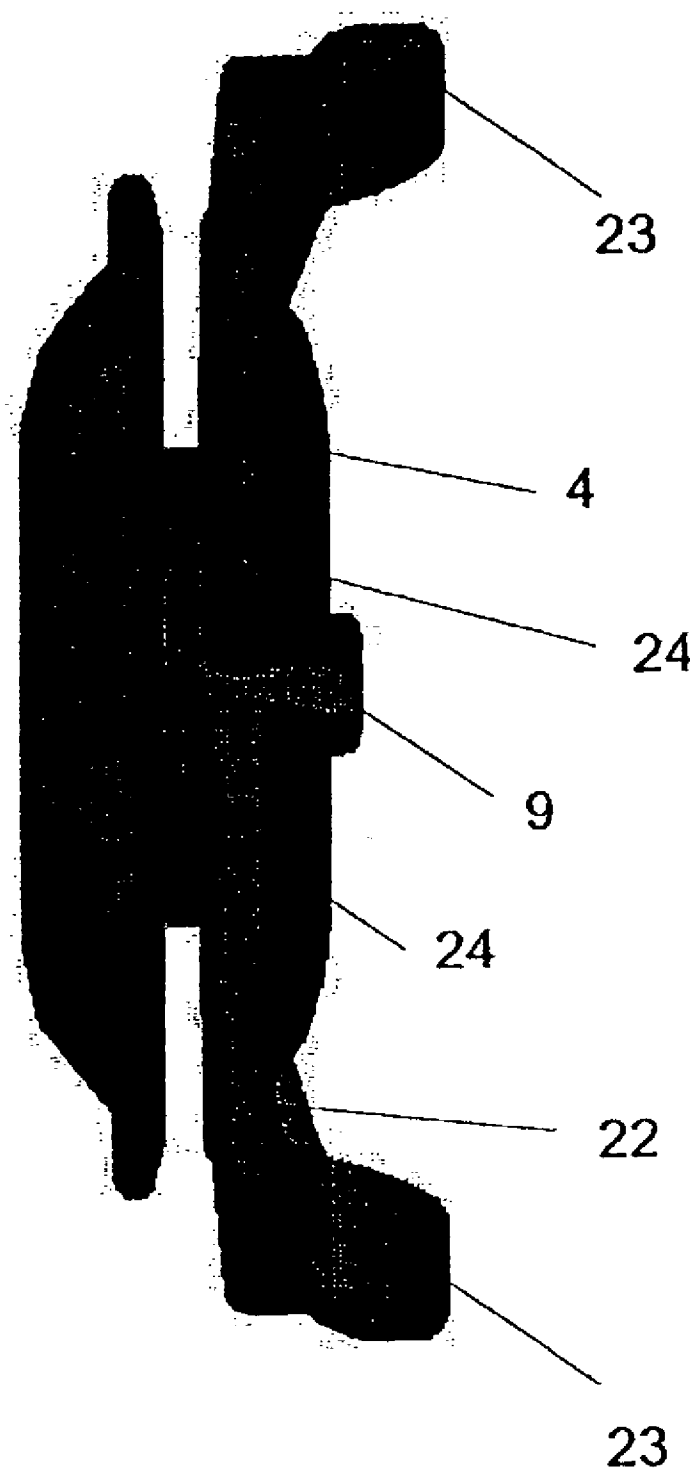


Fig. 6B

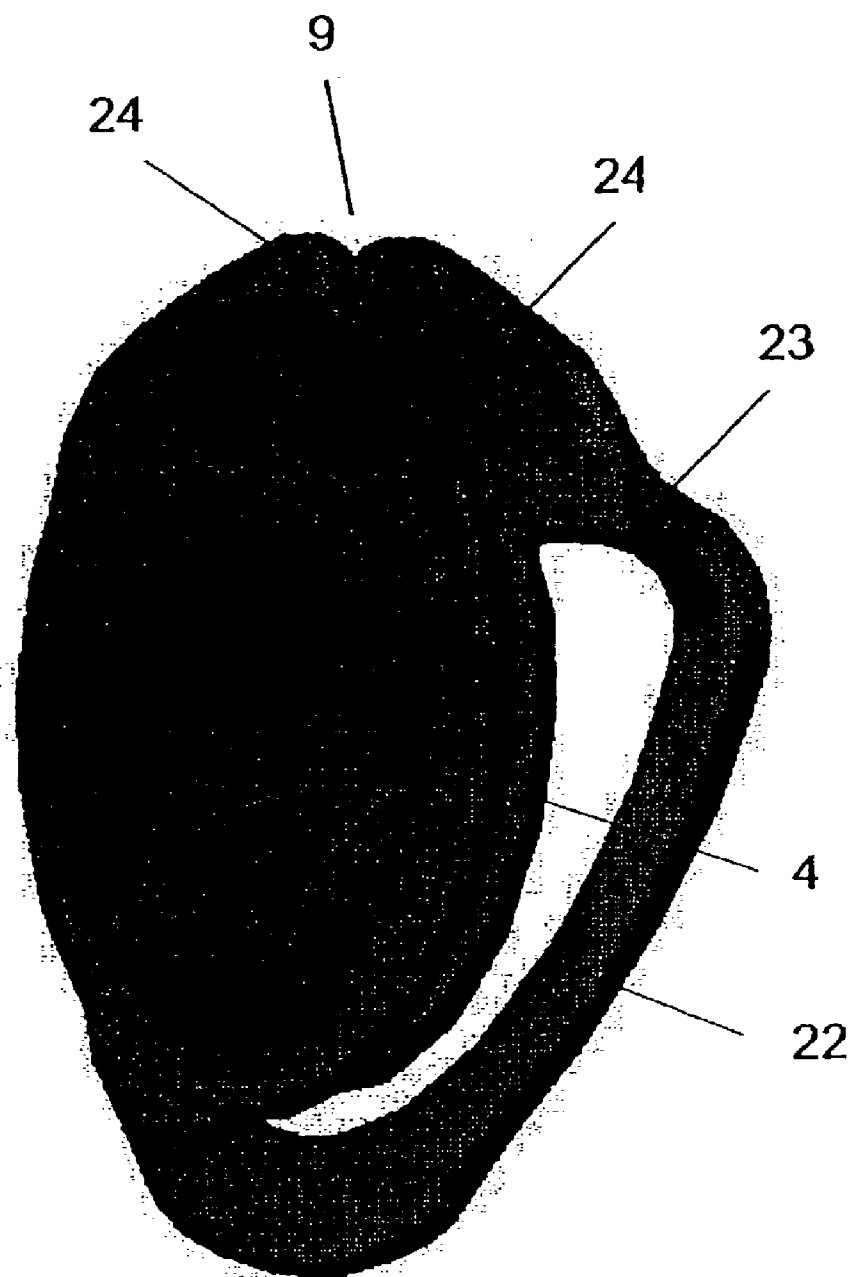


Fig. 6C

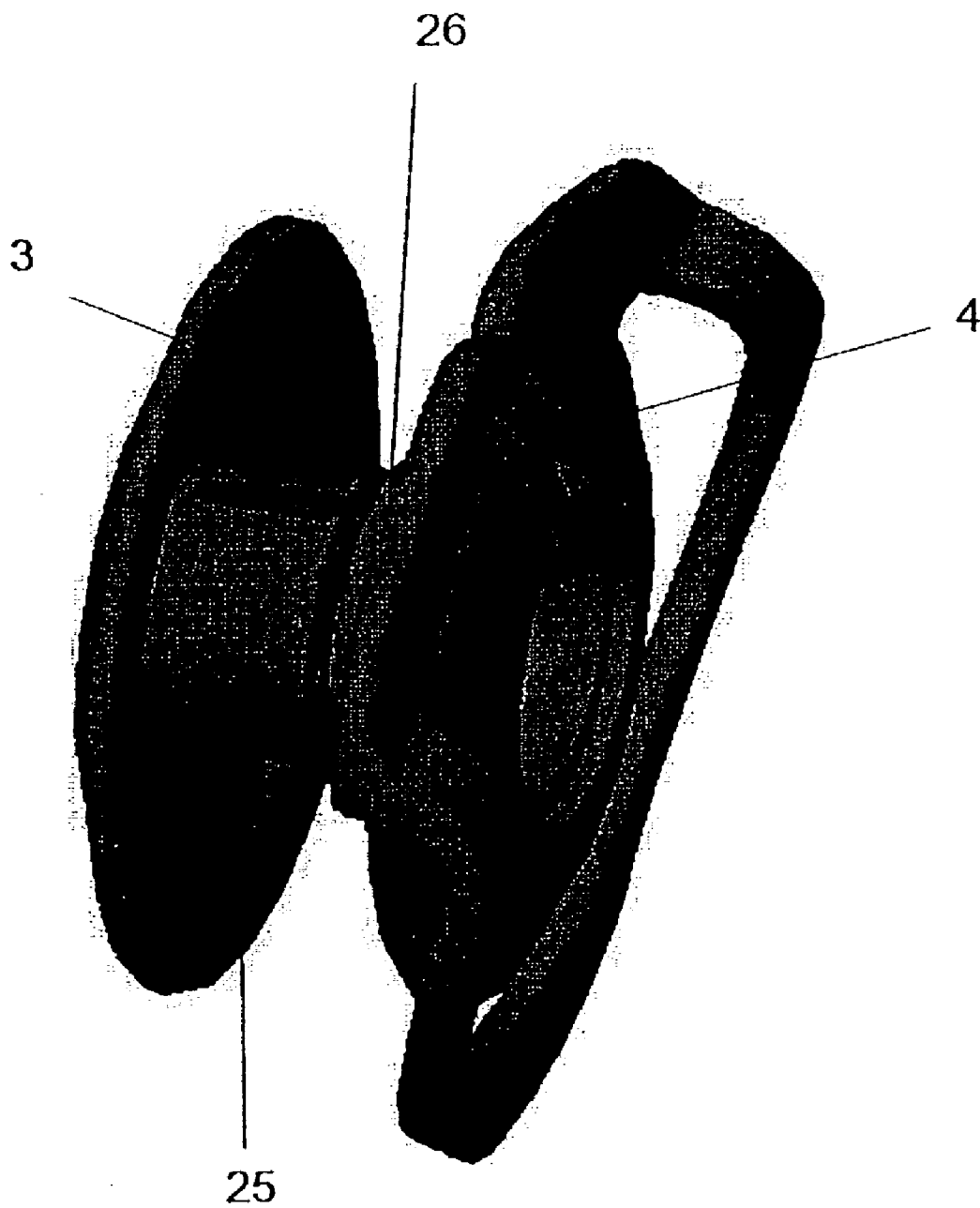


Fig. 7

APPARATUS FOR AND A METHOD OF ADJUSTING THE LENGTH OF AN INFUSION TUBE

[0001] The invention relates to an apparatus for adjusting the length of an infusion tube comprising a first wall and a second wall and at least one connecting element connecting the first wall to the second wall. The invention also relates to a method of adjusting the length of an infusion tube, said apparatus comprising an apparatus with a first wall and a second wall, between which walls parts of the infusion tube are situated, and further at least one connecting element connecting the first and the second walls to each other.

[0002] Use of an infusion kit in combination with an insulin pump necessitates use of a tubular member of a given length, since the distance between the insulin pump and the cannula housing will vary. This variation in the distance between pump and cannula occurs at night when the pump is sitting on the bedside table. Here the tube may have to be used in its full length. When, during the day, the pump is sitting in the belt of the diabetic, the requisite length of the tube will be smaller—but still variable as the cannula can be located in various places on the body.

[0003] Therefore the problem occurs of excessive tubing which may be difficult for the user to position/conceal. That is, when the cannula housing is located in immediate proximity of the pump and the user simultaneously uses a long tube of 110 cm, a worst case scenario will be one in which there will be about 90 cm that are not “in use”.

[0004] It is desired to develop a winding device that is able to compensate for the above-described problem.

[0005] The winding device is typically located in close proximity to the skin—underneath the clothes. Optionally by means of a clip to the trouser waistband.

[0006] The winding device must not in any way cause failure of the insulin supply, neither by damage/deformation of tube nor for any other reason.

[0007] WO 96/35472 teaches an apparatus of the kind described above, wherein a portable medical pump is described in which a winding unit for the infusion tube is integrally provided. It is the drawback of this system that, apart from the tube constituting an integral part of the pump device, the winding device is constituted of an essentially closed unit, and wherein the winding takes place by rotation of a rotatable sidewall. Such system is mechanically complex and restricts the winding to taking place in proximity of the infusion part and not anywhere on the tube and not on any kind of tube, as the winding system is designed exclusively for the pump it is an integral part of. Furthermore, there is a risk of damaging the tube during the winding due to the essentially closed housing. To the user, the system is not particularly flexible as it is not possible to locate the pump unit to itself and the winding unit to itself. Therefore the unit will be very visible to the user when he/she carries the pump unit.

[0008] It is thus the object of the present invention to provide an apparatus and a method that overcome the above drawbacks, and whereby it is possible to perform a winding of an infusion tube to adjust the connecting length between pump and infusion site essentially anywhere on the infusion tube and on any infusion tube, the apparatus being indepen-

dent of infusion cannula and pump. Thus, the apparatus enables reuse due to the independence of the pump. The system also enables the user to locate the winding unit anywhere on the body suitable to his/her physiology and clothing. It is thus possible to locate it underneath the blouse, in the trouser waistband, pocket or the like when the unit is provided with a clip device. It is also possible to locate the unit directly on the pump by means of attachment means. Finally it is possible to make unit and pump as an integral unit.

[0009] This object is obtained by an apparatus of the kind described above and wherein the connecting element is situated at a distance to the peripheral circumference of the walls, and wherein the distance between the walls in radial distance to said connecting element provides an inlet opening extending around the connecting element with a width measured between the walls, and wherein the apparatus comprises at least one attachment device for securing the infusion tube.

[0010] The object is further obtained by the method described above, and wherein, between the first and the second walls, an inlet opening is provided, between which the tube is pressed such that a first portion and a second portion of the tube is caused to be situated outside the apparatus, and a third portion is delimited by the walls; wherein the entire or portions of the second portion of the tube is wound around the connecting element, said connecting element being situated at a distance to the peripheral circumference of the walls; and wherein the first and second portions of the tubes are secured by attachment means.

[0011] The apparatus or tube winder, as it may be designated, thus operates in that an infusion tube is introduced between the outer periphery of the first and the second walls and between the lips thereof that provide an inlet opening throughout the entire periphery thereof. Preferably the walls will be cylindrical and this means that it is a kind of drum; and wherein the connecting element between the walls is constituted of a shaft around which the tube can be wound.

[0012] Owing to the attachment taking place of the tube when pressed into the attachment device, it is ensured that the tube does not unwind by itself. Now a winding around the connecting element takes place, which element is, as mentioned, comparable with a shaft, and it continues until the tube has reached the desired length.

[0013] The second tube portion which is now situated freely will be conveyed into the attachment device and secure that the second tube portion does not unwind. The attachment device is provided primarily by means of a slot in the one wall and extends from the periphery thereof and radially towards the centre. Both the first and the second tube portions can be secured in this slot. However, the apparatus may comprise several slots and located in both walls.

[0014] It is a further option that the inlet opening serves as attachment device, the first as well as the second tube portions, located freely outside the unit, being fastened in place by the inlet opening of the peripheral circumference, since it is provided to be so narrow that it squeezes around the tube. The width of the inlet opening is thus selected as a function of the infusion tube used, since this width is slightly smaller than the outer diameter of the infusion tube.

[0015] However, the dimensions of infusion tubes being standardised, use of only a few apparatuses will suffice. In this context, the width of the inlet opening is measured by taking the perpendicular distance between the adjoining walls and on the narrowest spot.

[0016] Finally, it is possible to combine slot and inlet opening as securing means for the tube ends.

[0017] By providing an apparatus according to the invention and as further featured in claim 2 a convenient manner of securing the tubing is obtained, such that they do not wind during the other winding of the tube; and also that the tubes do not unwind by themselves again.

[0018] By providing an apparatus according to the invention and as further featured in claim 3, convenient securing is obtained, since the portion of the tube which is not desired to be wound on the connecting element is secured in the slot as such, following which the winding takes place with the remaining part of the tube and subsequently a securing of the slot takes place in the slot of the second tube portion.

[0019] By providing an apparatus according to the invention and as further featured in claims 4 and 5, a convenient embodiment of the apparatus is obtained, which can be likened to a yoyo. The first and the second walls can be eg circular, elliptic or rectangular sheet elements

[0020] By providing an apparatus according to the invention and as further featured in claim 6, a cavity is obtained in which there is room for the wound-up infusion tube without an ensuing risk of damage.

[0021] By providing an apparatus according to the invention and as further featured in claim 7, it is obtained that the opening has an elastically squeezing function around the tube such that, although being secured, it is not exposed to damage.

[0022] By providing an apparatus according to the invention and as further featured in claim 8, it is possible to perform an injection moulding of the entire work piece and in a convenient material—an elastic material, eg a thermoplastic elastomer—exhibiting, as mentioned above, the flexible properties that are necessary for securing the tube.

[0023] However, the unit can also be manufactured in two pieces, such that the one wall with the drum part, a female part, being cast in one operation, and the second wall with a second drum part, a male part fitting by force fit into the first portion, being manufactured in a second moulding process. The two elements are assembled by a click device, the male part comprising an annular bead that is clicked into an annular recess extending on the female part. Furthermore, the apparatus may comprise a clip that can be cast integrally with one of the walls.

[0024] As mentioned previously, the invention relates to a method as featured in claim 10, while claims 11 and 13 feature further convenient steps of the method and claim 12 features that the periphery of the apparatus comprises an annular bead located on each wall periphery, said bead being configured from an elastic material able to squeeze around a free rod part, viz the first and/or the second tube portion(s).

[0025] Finally the invention relates to use of the apparatus for exercising the method and as featured in claim 14.

[0026] The invention will now be explained in further detail with reference to the drawing, wherein:

[0027] FIG. 1 is an exemplary embodiment of the invention, seen in a perspective view;

[0028] FIG. 2 is a sectional view of the exemplary embodiment shown in FIG. 1, illustrating an apparatus/a tube winder;

[0029] FIG. 3 shows the apparatus shown in FIG. 1, seen from the side;

[0030] FIG. 4 shows the apparatus shown in FIG. 1, seen from the front;

[0031] FIG. 5 is a sectional view along the line V-V in FIG. 3;

[0032] FIGS. 6A-C show an alternative exemplary embodiment of the invention, seen in a perspective view;

[0033] FIG. 7 shows the assembling of an apparatus as shown in FIGS. 6A-C.

[0034] With reference to FIGS. 1 and 2 the invention will now be explained in further detail, FIG. 1 showing a perspective view of an apparatus 1, and FIG. 2 showing a perspective view of the view of FIG. 1. The apparatus 1 comprises two walls, a first wall 3 and a second wall 4, said walls being provided to be plane parallel opposite each other; and in the example shown configured to be cylindrical for providing a kind of drum/yoyo; and wherein the two walls 3 and 4 are connected by means of a connecting element 5 configured as a shaft, the central axis of which coincides with the centre of the first and the second walls and extending perpendicular to the faces. At a distance to the connecting element 5, which is thus configured as a cylindrical shaft, the first and the second walls form an inlet opening 7; and wherein the distance between the wall for providing said inlet opening 7 corresponds to the outer diameter of an infusion tube 2 or something smaller as this inlet opening may serve the purpose of squeezing around the tube, such that an unwinding is avoided.

[0035] The walls 3 and 4 and the inner faces of the connecting element 5 provide a cavity in which the wound-up infusion tube is situated. The cavity 16 is, in cross section, configured as a funnel with the largest basis corresponding to that face of the connecting element 5 that faces towards the cavity and on the sides delimited by the inner faces of the first and the second wall 3 and 4 that converge towards the inlet opening.

[0036] Radially to the inlet opening an inlet area 15 is provided that is also funnel-shaped, but has diverging walls away from the inlet opening 7 and outwards, since it is the object of this funnel to assist in the catching of the tube during winding. The first and the second walls are cylindrical and in this case have the shape of curved shells.

[0037] The apparatus is conveniently manufactured in an injection moulding process, wherein a thermoplastic elastomer, TPE, or a copolymer, eg a PP copolymer, is preferred; since it is convenient that the inlet opening 7 has a resilient and elastic abutment on the tube, thereby optionally securing same without an ensuing risk, however, of exposing the tube to damage.

[0038] The one wall, optionally both walls **3, 4**, has/have a slot **9** extending radially from the peripheral circumference **6** of the wall and towards the centre, said slot serving the purpose of constituting a starting point on the tube prior to winding, as the tube is squeezed in place in said slot. The length of the slot is adapted such that its bottom is located at a smaller distance from the surface of the connecting element **5**. The slot also serves as securing means for the tube portion when it is wound. The delimiting side faces of the slot conveniently diverge towards the centre.

[0039] The winding process will be explained below

[0040] The slot **9** thus has a width corresponding essentially to the width of the inlet opening **7** and is approximately 1.4 mm; being, however, slightly less. Both the slot **9** and the inlet opening **7** serve as attachment devices **8**, as the winding takes place as follows:

[0041] The infusion tube **2** to be wound on the apparatus is pressed in through the inlet opening **7** via the inlet area **15** wherein, as mentioned, the funnel-shaped, reversed tunnel of the inlet area **15** ensures that the tube is readily caught.

[0042] The first portion of the tube **12** is secured in the slot, is subsidiarily secured with the inlet opening as such, while the second portion of the tube **13** is introduced into the slot **9**, such that a securing point is obtained when the winding is at an end. Between the first and the second portions, there is a third portion **14**, which is delimited by the walls **3, 4**. A winding of the tube takes place by the tube being seized and subsequently wound the number of times required for the infusion tube to acquire the desired length.

[0043] The securing means **8** having a securing/squeezing function around the tube, the latter will not be wound when the desired length is acquired.

[0044] FIG. 1 shows the case in which the securing takes place both in the inlet opening and in the slot. However, it is a very preferred embodiment in those cases where both the first tube portion (**12**) and the second tube portion (**13**) are both secured in the slot, and where the starting point will thus be that the first tube portion (**12**) is located in the slot; that a winding of the tube subsequently takes place on the drum; and that—when the desired tube length is thus desired, the second tube portion is pressed down into the slot. Of course, it is a consequence of this that, when the first tube portion (**12**) points in one direction, the second tube portion (**13**) will point in the opposite direction.

[0045] FIGS. 6A-C show an exemplary embodiment in which the product as such is essentially like that of the view shown in FIGS. 1-5, but wherein an attachment clip (**21**) is mounted. The clip (**21**) consists of a partially circular clamp (**22**) that is located offset perpendicular on the wall (**4**) on which it is secured and such that there is a space between the wall and the clamp. The clamp (**22**) is elastically connected to the wall by two bent plate parts (**22**) that are yet again connected to two constituent parts (**24**) that are integral with the wall (**4**). The damp (**22**) is attached to the wall (**4**) in which the slot (**9**) is situated and such that the two plate parts (**24**) are arranged symmetrically around said slot, and likewise the elastic clamp is arranged symmetrically around the slot. Preferably the clamp part and the wall to which it is attached will have a converging course towards each other as far as that part of the clamp is concerned that is located opposite the two plate parts

[0046] FIG. 7 shows an example of how the product can be manufactured in two parts such that a first wall (**3**) and a second wall (**4**) are provided; and wherein each of these walls has a cylindrical element mounted thereon, the centre axis of which coincides with the centre axis of the wall and such that the cylinder (**25**) of the one wall constitutes a female part, while the cylinder portion (**26**) of the second wall constitutes a male part. In the delimiting edge of the male part an annular bead is provided which will, when male and female parts are pressed completely against each other, have an engagement in a corresponding annular recess on the inner face of the female part.

[0047] The apparatus is used in particular for shortening the length of infusion tubes, wherein the one end of the infusion tube is connected to a pump for infusion of a medicament; and the free end is connected to eg a cannula or the like for infusion of a given medicament into a patient. Thus, the pump can be located anywhere on the body, where it may be convenient, and likewise the apparatus can be located anywhere on the body and independently of the position of the infusion pump. The apparatus can be attached to the belt, to the infusion pump as such, on the patient's body or on pieces of clothes if so desired by the user. The apparatus is very flexible and user-friendly and provides the user with ample opportunities for performing the requisite adjustment of the tube length. Usually the tubes have a length of 60-110 cm, as it is essential to the patient to be able to have eg a long connection to the pump while asleep, while it is essential to have a short connection to the pump when the patient moves around, the pump being in that case typically positioned on the body.

[0048] Thus, the invention enables adjustment of the length, such that the patient can adapt the length as a function of the physical framework. Typically, this is necessary in those cases where insulin pumps are concerned, since such pump is located at all times on the patient. By means of eg double-adhesive tape, however, the apparatus/tube winder can be located directly on the insulin pump. Alternatively the winder can be located in clothes rims, belts, etc. by means of a clip device on the winder.

1. An apparatus (**1**) for adjustment of the length of an infusion tube (**2**) comprising a first wall (**3**) and a second wall (**4**) and at least one connecting element (**5**) connecting the first wall (**3**) to the second wall (**4**), characterised in that the connecting element (**5**) is secured at a distance to the peripheral circumference (**6**) of the walls; and that the distance between the walls in radial distance to said connecting element provides an inlet opening (**7**) extending around the connecting element with a width measured between the walls (**3, 4**); and that the apparatus comprises at least one attachment device (**8**) for securing the infusion tube (**2**).

2. An apparatus according to claim 1, characterised in that the attachment device(s) (**8**) comprise(s) the inlet opening (**7**), the width (**M**) of which is smaller than the distance measured anywhere between the walls (**3, 4**) in the area from the connecting element (**5**) to the inlet opening (**7**).

3. An apparatus according to claim 1, characterised in that the attachment device(s) (**8**) comprise(s) at least one slot (**9**) in at least the one wall and extending from the periphery (**6**) thereof radially towards the internal area of the wall.

4. An apparatus according to claim 1, characterised in that the first and the second walls (3,4) are identically configured bodies arranged to be plane parallel opposite each other.

5. An apparatus according to claim 1, characterised in that the connecting element (5) comprises a cylindrical unit, the longitudinal axis of which is located perpendicular to the inner faces (10, 11) of the first and the second walls.

6. An apparatus according to claim 1, characterised in that the inner faces (10, 11) of the first and the second walls converge from the connecting element (5) out towards the inlet opening (7).

7. An apparatus according to claim 2, characterised in that the walls are, at least in the area delimiting the inlet opening (7), manufactured from an elastic material, eg a thermoplastic elastomer.

8. An apparatus according to claim 1, characterised in that the entire apparatus is manufactured from an elastic material, eg a thermoplastic elastomer.

9. An apparatus according to claim 1, characterised in comprising a clip device for mounting of the apparatus on a carrier face.

10. A method of adjusting the length of an infusion tube (2), comprising an apparatus (1) with a first wall (3) and a second wall (4), between which walls portions (14) of the infusion tube are situated, and at least one connecting element (5), connecting the first (3) and the second (4) walls to each other, characterised in that, between the first and the

second walls, an inlet opening (7) is provided between which the tube (2) is pressed through, such that a first portion (12) and a second portion (13) of the tube is caused to be situated outside the apparatus (1) and a third portion (14) is delimited by the walls; that the entire or parts of the second portion (13) of the tube is wound around the connecting element (5), said connecting element being situated at a distance to the peripheral circumference (6) of the walls; and that the first and the second portions of the tubes are secured by attachment means (8).

11. A method according to claim 10, characterised in that the first portion (12) of the tube is secured in an attachment device comprising a slot extending from the peripheral circumference (6) of the one wall and towards the internal area of the wall.

12. A method according to claim 10, characterised in that a free tube portion is secured at the delimitation of the inlet opening provided at the walls, said delimitation comprising a thermoplastic elastomer.

13. A method according to claim 11, characterised in that the second tube portion is secured in the slot (9) extending from the one peripheral circumference of the one wall and towards the internal area of the of the wall.

14. Use of apparatuses according to claims 1-9 for exercising the method according to claims 9-13.

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