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(19) **United States**(12) **Patent Application Publication****Michels et al.**(10) **Pub. No.: US 2008/0085200 A1**(43) **Pub. Date: Apr. 10, 2008**(54) **PERISTALTIC PUMP**(30) **Foreign Application Priority Data**(75) Inventors: **Stephan Michels**, Dinhard (CH);
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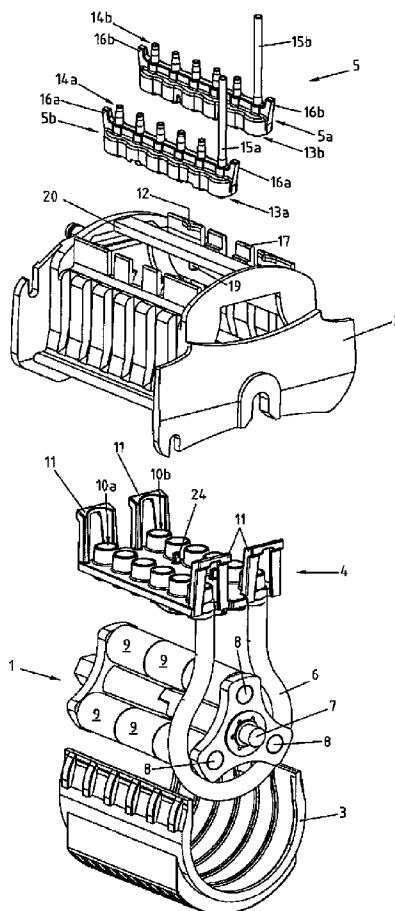
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F04B 43/12 (2006.01)(52) **U.S. Cl.** **417/477.1**(57) **ABSTRACT**

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Glattbrugg (CH)(21) Appl. No.: **11/574,646**(22) PCT Filed: **Sep. 2, 2005**(86) PCT No.: **PCT/CH05/00522**§ 371 (c)(1),
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The peristaltic pump is provided with a two-piece housing (2, 3), in which a conveying member (1) as well as a pump tubing section (6) squeezable by the conveying member is received. For fixing the pump tubing section (6) in the housing (2, 3), a tubing holder (4) is provided. Further provided is a connecting element (5) provided with duct shaped connecting sockets (14a, 14b) for connecting tubing sections (15a, 15b). For connecting the pump tubing section (6) to the tubing holder (4), the two ends of the particular pump tubing section (6) are fixed in receptacles (10a, 10b) of the tubing holder (4), which positively enclose the outside of the pump tubing section (6). The connecting element (5) is fixed to the tubing holder (4) by means of a snap-on connection. Thereby, the connecting sockets (14a, 14b) thereof are sealingly connected to the particular pump tubing section (6).



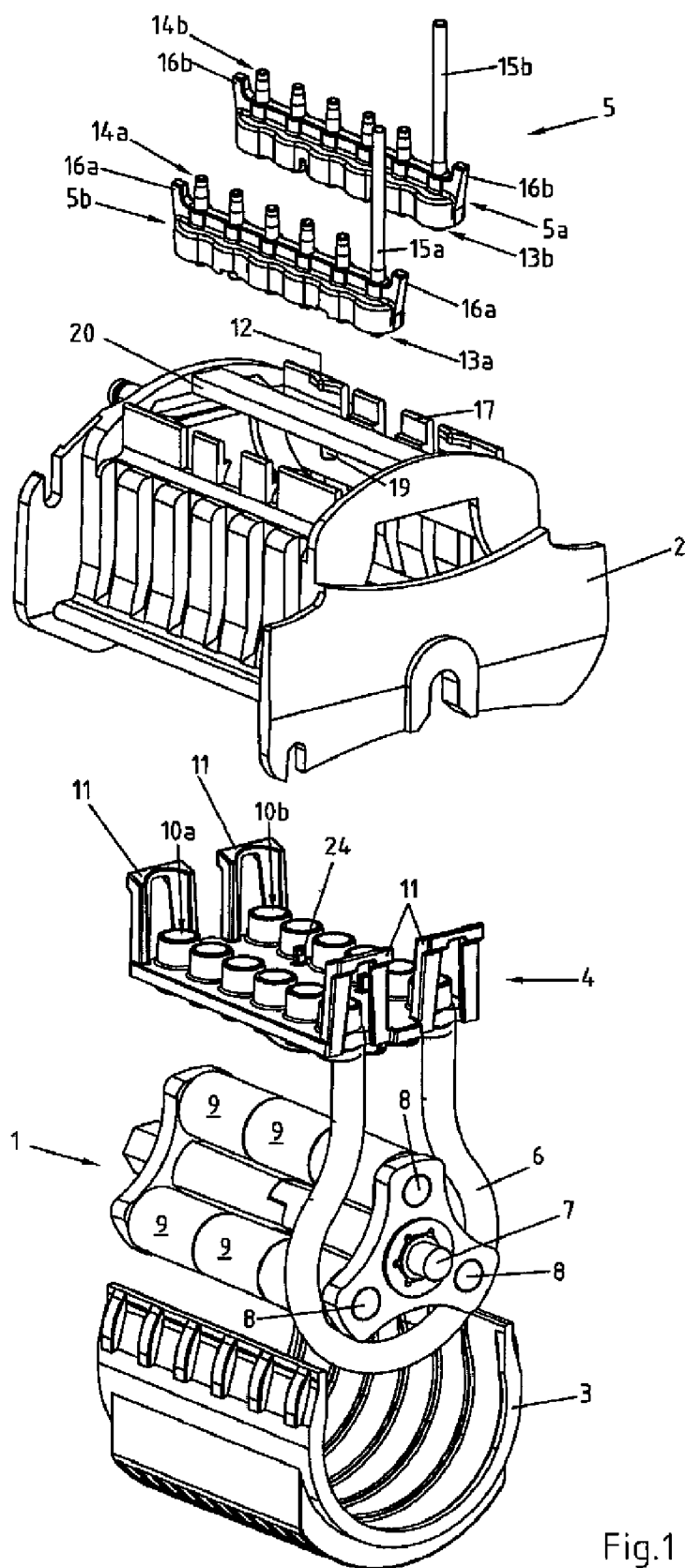


Fig.1

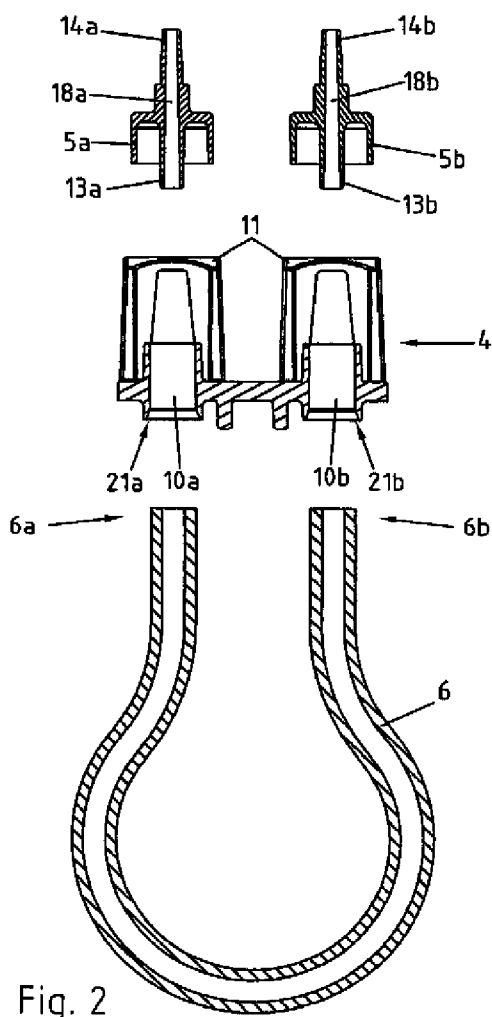


Fig. 2

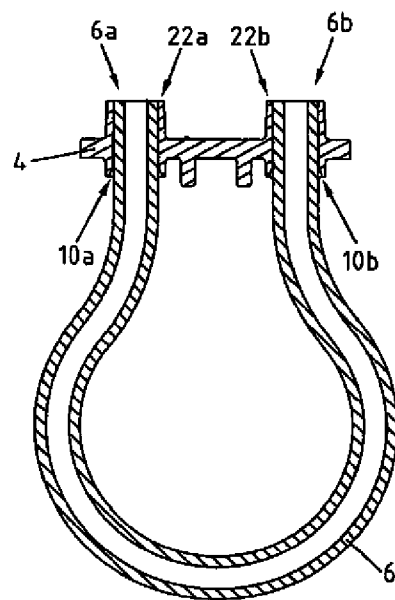


Fig. 3

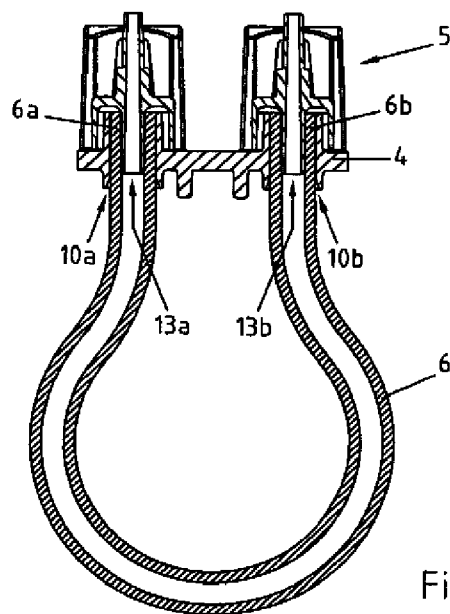


Fig. 4

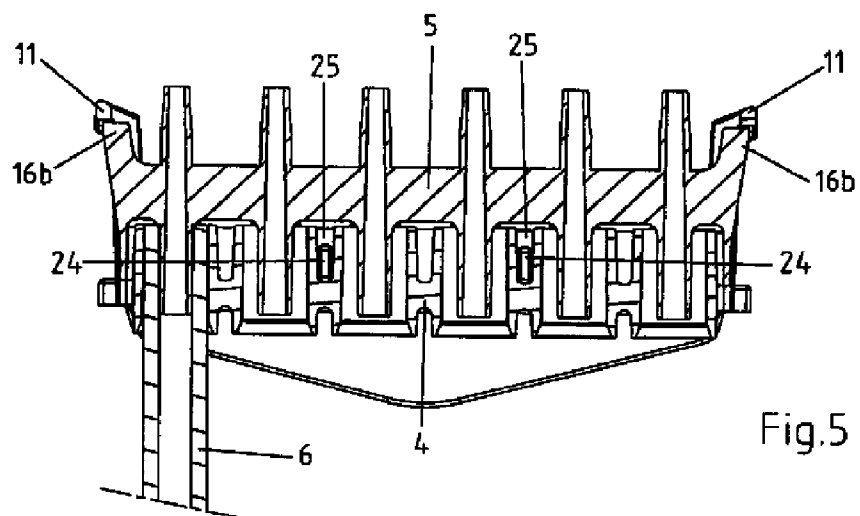


Fig.5

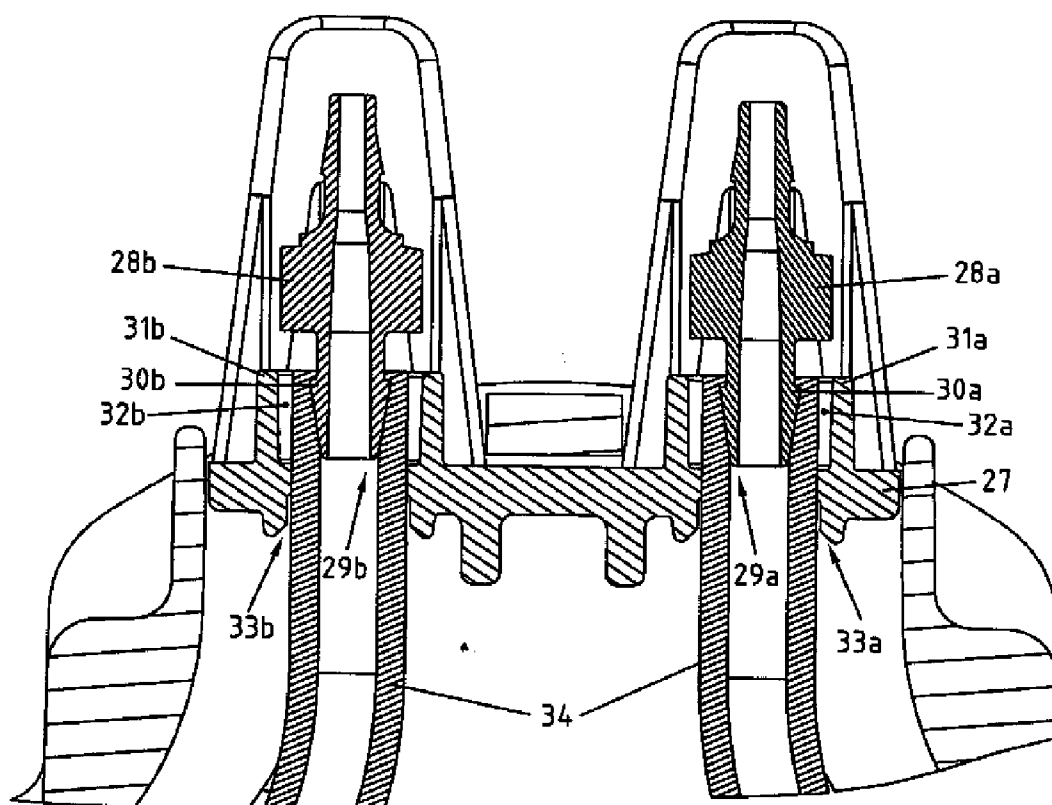


Fig.6

PERISTALTIC PUMP

BACKGROUND

[0001] The present invention relates to peristaltic pumps. Peristaltic pumps of the kind referred to herein are basically known. They are used for conveying different liquid and gaseous media.

[0002] The document DE 198 14 943 A1 discloses a flexible tube pump of the kind referred to herein. The pump is provided with a pump housing in which is arranged the pump tubing as well as a rotor provided with two strangling means in the shape of rollers. In order to connect the two ends of the pump tubing to the connecting pipes and connecting ports, respectively, flange members are provided that are fixed by means of threaded bolts.

[0003] One object of the present invention is to improve the design of a peristaltic pump in such a way that it can be manufactured at lower cost and in a simpler manner, and that the pump tubing can be replaced quickly and easily, if required.

[0004] Due to the fact that the pump is provided with a tubing holder adapted to be fixed to the housing, to which the end of the pump tubing is fixed and comprising at least one connecting element having connecting sockets for fixing connecting tubes, whereby the connecting sockets are sealingly connected to the particular pump tubing upon fixing the connecting element to the tubing holder, the pump tubing can be connected to the tubing holder prior to assembling the pump. Thus, the tubing holder can be inserted, together with the pump tubing, into the tubing receptacle of the pump. In order to connect the pump tubing to the connecting tubes, thereafter, only the connecting element has to be fixed to the tubing holder. This is accomplished preferably by means of a snap-on connection.

DESCRIPTION OF THE FIGURES

[0005] In the following, a preferred embodiment of the invention is further explained by means of drawings. In these drawings,

[0006] FIG. 1 shows an exploded view of the peristaltic pump;

[0007] FIG. 2 shows a cross sectional view of a tubing holder, a connecting element as well as a pump tube section;

[0008] FIG. 3 shows a cross sectional view of a tubing holder including the pump tube section connected thereto;

[0009] FIG. 4 shows a cross sectional view of the tubing holder, the connecting element and the pump tube section in an assembled state;

[0010] FIG. 5 shows a longitudinal sectional view of the elements of FIG. 4; and

[0011] FIG. 6 shows a cross sectional view of an alternative embodiment of a tubing holder as well as two connecting elements in an enlarged illustration.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0012] FIG. 1 shows a six channel peristaltic pump in an exploded view. Since peristaltic pumps of the kind referred to herein are basically known, in the following, the basic elements of the pump will be not addressed in detail, but only some of the components important in connection with the present invention. Essentially, the pump consists of a conveying member 1, an upper housing portion 2, a lower

housing portion 3, a tubing holder 4 as well as of a connecting element, generally designated by reference numeral 5 and comprising a first connecting element 5a and a second connecting element 5b. Moreover, the pump comprises, in total, six pump tube sections, whereby only one pump tube section 6 is shown for the sake of clarity.

[0013] The upper housing portion 2 is designed as a support frame member on which is supported, amongst others, the rotating conveying member 1. The top side of the upper housing portion 2 is provided with a support bar member 20. The lower housing portion 3 is connected to the upper housing portion by means of a snap-on connection and serves for receiving and positively supporting the pump tubing. The conveying member 1 comprises a shaft 7 driven by an electric motor (not shown) and is provided with three axles 8 on which are rotatably received, in each case, several conveying rollers.

[0014] As one important element of the invention, a tubing holder 4 is provided to fix the ends of six pump tube sections. To this end, the tubing holder 4 is provided with twelve receptacles 10a, 10b, preferably provided in two opposing rows. The inner sides of the receptacles are of hollow cylindrical shape, but may be preferably of conical shape. The two ends of a pump tube section can be fixed to each opposing pair of these receptacles 10a, 10b, the two ends of a pump tube section can be fixed. Moreover, the tubing holder 4 is provided with four elastically resilient brackets 11 to which the two connecting elements 5a, 5b can be fixed in the sense of a snap-on connection, as will be further explained herein after. The upper portion 2 thereof is provided with four latches 17 for fixing the tubing holder 4 to the housing. Moreover, evident from the drawing of FIG. 1 is a positioning element 19 asymmetrically arranged on the upper portion 2 of the housing, adapted to engage an opening (not shown) of the tubing holder 4 to ensure a positionally correct assembly of the tubing holder 4 and the upper portion 2 of the housing. The final position of the tubing holder 4 at the upper portion 2 of the housing is determined by the latches 17 as well as by stop members 12, the latter ones being provided on protrusions of the upper portion 2 of the housing.

[0015] The two connecting elements 5a, 5b are provided, at their bottom sides, in each case with six tube-shaped extension members 13a, 13b, while their top sides are provided, in each case, with six tube-shaped connecting sockets 14a, 14b. Each of the tube-shaped extension members 13a, 13b is connected to the corresponding tube-shaped connecting sockets 14a, 14b via a continuous channel 18a, 18b. The tube-shaped extension members 13a, 13b located at the bottom side have a slightly conical outside and constitute the male part of a plug-in connection for establishing a sealed connection to the particular pump tube section, without the need to provide additional sealing elements. The connecting tubes to the pump are fixed to the tube-shaped connecting sockets 14a, 14b located at the top side. Representative for the total of twelve connecting tubes, only two tube sections 15a, 15b are shown in FIG. 1. The two connecting elements 5a, 5b are provided at both end faces with catch members 16a, 16b by means of which they can be fixed to the brackets 11 of the connecting element 5. Instead of two separate connecting elements 5a, 5b, a common single connecting element could be provided, having two parallel rows of tube-shaped extension members 13a, 13b and connecting sockets 14a, 14b.

[0016] The advantage of two separate connecting elements **5a**, **5b**, on the one hand, is that it can be attached quickly and simply to the top portion **2** of the housing even if the support bar is present. Moreover, advantages in manufacturing and costs are evident if two substantially equal elements can be manufactured instead of a single complicated element. The two connecting elements **5a**, **5b** are of the same design, except for a possible coding that prevents confusion and/or wrong assembly. In order to code the connecting elements **5a**, **5b** such that they cannot be connected in a wrong way, the tubing holder **4** can be provided, for example, with protrusions **24** and the connecting elements **5a**, **5b** with corresponding recesses (not shown).

[0017] In the subsequent FIGS. **2** to **5**, only the tubing holder **4**, a single tube section **6** and, if appropriate, the connecting element **5** are shown. The illustration of further elements of the pump has been set aside. FIG. **2** shows, in a detailed illustration, the tubing holder **4**, the two connecting elements **5a**, **5b** and the pump tube section **6** in a cross sectional view. Besides the two brackets **11**, the hollow cylindrical receptacles **10a**, **10b** of the tubing holder **4** can be seen. The receptacles **10a**, **10b** are provided with a conical inserting portion **21a**, **21b**, facilitating the insertion of the particular ends **6a**, **6b** of the pump tube sections **6**. Although in the preferred embodiment the receptacles are defined as hollow cylindrical, the inside need not be absolutely cylindrical, but the inside diameter of the receptacles may preferably slightly decrease towards the top. In any case, the inner diameter of the particular receptacle **10a**, **10b** is matched to the outer diameter of the pump tube section in such a way that the particular end **6a**, **6b** of the pump tube section **6** is grasped in a positive fitting manner, i.e., without any substantial gap. In a conical design of the receptacle **10a**, **10b**, the particular end **6a**, **6b** of the pump tube section **6** is slightly compressed towards its front face. By means of the design, i.e., the shape, of the receptacles **10a**, **10b** of the tubing holder **4**, a positive or non-positive embracing of the pump tube section can be assured. Preferably, the two ends of the tubing **6a**, **6b** are cemented to the particular receptacle **10a**, **10b**.

[0018] FIG. **3** shows the pump tube section **6** fixed to the tubing holder **4**, whereby, for the sake of clarity, the illustration of the brackets has been omitted. It is evident from this illustration that the two ends **6a**, **6b** of the pump tube section **6** are flush with the front faces **22a**, **22b** of the particular receptacle **10a**, **10b**. The two ends **6a**, **6b** of the pump tube section **4** are cemented to the receptacles **10a**, **10b** of the tubing holder **4** and, thus positively fixed thereto.

[0019] FIG. **4** shows a cross sectional view of the tubing holder **4**, of the connecting element **5** and of the pump tube section **6** in an assembled state. Upon fixing the connecting element **5** to the tubing holder **4**, the tube shaped extension members **13a**, **13b** of the connecting element **5** penetrate the associated end **6a**, **6b** of the pump tube section **6** and establish a sealed connection between the particular extension member **13a**, **13b** and the pump tube section **6**. Contributing to the sealed connection are both the shape of the extension members **13a**, **13b** and the shape of the receptacles **10a**, **10b**, as well as the fact that the end of the pump tube section **6a**, **6b** is positively grasped by the particular receptacle **10a**, **10b**, such that the particular end of the pump tube section **6a**, **6b** cannot evade radially, but sealingly surrounds the particular extension member **13a**, **13b**. The pump tube

itself and the two pump tube section ends **6a**, **6b**, respectively, constitute the sealing element of the transition, with the result that additional sealing elements like, for example, O-rings, are not necessary. By abstaining from using additional sealing elements, the number of potentially leaking elements can be reduced to an absolute minimum. Due to the fact that the extension members **13a**, **13b** have a smooth outside, i.e., are not designed barb-like, the push-on connection between tubing holder **4** and connecting element **5** can be easily released manually and re-established in a sealing manner, whereby this operation can be repeated several times, if appropriate.

[0020] From FIG. **5**, showing a longitudinal sectional view of the elements of FIG. **4**, namely the tubing holder **4**, the connecting element **5** and the pump tube section **6**, it is particularly evident how the brackets **11** of the tubing holder **4** fix the connecting element **5** to the catch members **16a**, **16b**. Further visible from this illustration are protrusions **24** arranged on the connecting element **5**, engaging corresponding recesses **25** of the tubing holder **4** to correctly position the connecting element **5** with regard to the tubing holder **4** and, thereby, also with regard to the housing of the pump.

[0021] FIG. **6** shows a cross sectional view of an alternative embodiment of a tubing holder **27** as well as of two connecting elements **28a**, **28b** in a larger scale. One difference, as compared to the foregoing embodiment, is that the protrusion **29a**, **29b** of the connecting elements **28a**, **28b**, facing the pump tube section **34**, are provided with barb-like shoulders **30a**, **30b** at the outside. These barb-like shoulders **30a**, **30b** improve the reliability of the connection between the pump tube section **34** and the assigned protrusion **29a**, **29b**, which is particularly advantageous if a pulling force is exerted to the connection or if there is a high internal pressure. The receptacles **31a**, **31b** of the tubing holder **27** each are provided with a cylindrical recess **32a**, **32b**, enabling a radial enlargement of the ends of the pump tube sections when they are pushed, during assembling, over the barb-like shoulders. The inner diameter of the two receptacles **31a**, **31b** in the region of the particular cylindrical recess **32a**, **32b** is sufficiently tight that, on the one hand, the barb-like shoulders **30a**, **30b** can penetrate the assigned end of the pump tube section without great resistance. On the other hand, the inner diameter must be sufficient so that the receptacles **31a**, **31b** radially enclose the assigned end of the pump tube section if this end starts to enlarge in the region of the barb-like shoulders **30a**, **30b** under the influence of hydrostatic inner pressure. In other words, the radial gap between the receptacles **31a**, **31b** and the assigned end of the pump tube section is chosen such that the barb-like shoulders can relatively easily penetrate the end of the tube, while the other side the receptacles **31a**, **31b** counteract to a radial enlargement of the end of the tube in the case of higher internal pressure to reduce the risk of leakage.

[0022] The lower side of the particular receptacle **31a**, **31b** facing the interior of the pump is provided with a facet **33a**, **33b**, ending in a cylindrical or conical inserting portion. The facets **33a**, **33b** are meant to facilitate the introduction of the assigned end portion of the tube into the receptacle **31a**, **31b**, while the inserting portion additionally favors the penetration of adhesive material upon cementing the pump tube section and the end of the tube, respectively, to the assigned receptacle **31a**, **31b**.

[0023] The advantages of the pump described herein may be seen particularly in the fact that the pump tube sections

can be pre-assembled remote from the pump itself, i.e., connected to the tubing holder. Such assembly step can be performed extensively automatically and ensures advantages as far as assembly costs, precision and durability are concerned. Once the pump is assembled, only the two connecting elements provided with the pump tube sections have to be locked into place at the tubing holder in order to ensure that the pump is hydraulically ready for operation. Such a pump can be assembled, essentially without using any tools and with a few manual operations. If the outside of the receptacles **13a**, **13b** is essentially smooth and does not have barb-like shoulders, the pump tube sections, if needed, can be replaced very quickly and easily by replacing the connecting element **4** with the pump tube sections **6** cemented thereto as an unit. The aforementioned advantages are present both in one channel pumps and particularly in multi-channel pumps.

1-13. (canceled)

14. Peristaltic pump, having a conveying member (**1**) received in a housing (**2**, **3**), and having at least one flexible pump tube section (**6**) being squeezable by said conveying member (**1**) for peristaltically conveying a medium, said pump comprising a tubing holder (**4**) adapted to be attached to the housing (**2**) to which the pump tube section (**6**) is attached, said tubing holder (**4**) having at least one connecting element (**5**) for connecting tubing sections (**15a**, **15b**) for fluid communication with the pump tube section (**6**), said at least one connecting element (**5**) including connecting sockets (**14a**, **14b**) configured for sealing connection with the pump tube section (**6**) upon connecting the connecting element (**5**) to the pump tube section (**6**).

15. The peristaltic pump according to claim **14**, wherein said tubing holder (**4**) is provided with hollow cylindrical or conical receptacles (**10a**, **10b**), to which corresponding end portions (**6a**, **6b**) of the pump tubing section (**6**) are connected and positively and/or non-positively enclosed.

16. The peristaltic pump according to claim **15**, wherein said connecting element (**5**) is provided with duct shaped extension members (**13a**, **13b**) that are configured to penetrate said corresponding end portions (**6a**, **6b**) of the pump tubing section (**6**) and are further configured to radially load said end portions upon connecting the connecting element (**5**) to the tubing holder (**4**).

17. The peristaltic pump according to claim **16**, wherein said connecting element (**5**) is provided with connecting sockets (**14a**, **14b**) for connecting tubing sections (**15a**, **15b**) and with extension members (**13a**, **13b**) for sealingly connecting the pump tubing section (**6**), whereby each of said connecting sockets (**14a**, **14b**) communicates with a corresponding extension member (**13a**, **13b**) through a corresponding continuous channel (**18a**, **18b**).

18. The peristaltic pump according to claim **16**, wherein said duct-shaped extension members (**29a**, **29b**) are provided with a smooth outside surface.

19. The peristaltic pump according to claim **16**, wherein said duct-shaped extensions (**29a**, **29b**) are provided with barb-like shoulders (**30a**, **30b**).

20. The peristaltic pump according to claim **14**, wherein said tubing holder (**4**) is attachable to the housing (**2**) by means of a quick-release connection.

21. The peristaltic pump according to claim **20**, wherein said quick-release connection includes a latch or snap-on connection.

22. The peristaltic pump according to claim **14**, wherein said connecting element (**5**) is attachable to the tubing holder (**4**) by means of a quick release connection.

23. The peristaltic pump according to claim **22**, wherein said quick-release connection is a latch or snap-on connection.

24. The peristaltic pump according to claim **14**, wherein said end portion (**6a**, **6b**) of the particular pump tubing section (**6**) is cemented to the receptacle (**10a**, **10b**).

25. The peristaltic pump according to claim **14**, wherein positioning elements (**24**, **25**) are provided between said connecting element (**5**) and said tubing holder (**4**) for positioning said connecting element (**5**) relative to said tubing holder (**4**).

26. The peristaltic pump according to claim **14**, wherein the housing (**2**) is provided with at least one positioning element (**19**) to ensure a correct positional arrangement of the tubing holder (**4**) on the housing (**2**).

27. The peristaltic pump according to claim **14**, wherein said tubing holder (**4**) is provided with two parallel rows of receptacles (**10a**, **10b**) for fixing several two or more pump tube sections, and further wherein two connecting elements (**5a**, **5b**) are provided, a corresponding one of which is attachable to one of the parallel rows of receptacles (**10a**, **10b**).

28. The peristaltic pump according to claim **27**, wherein said two connecting elements (**5a**, **5b**) are of substantially identical configuration.

29. The peristaltic pump according to claim **27**, wherein said connecting elements (**5a**, **5b**) are of different construction, and further wherein positioning elements are provided between the housing and a corresponding one of said connecting elements (**5a**, **5b**), said positioning elements configured to ensure a correct positional arrangement of the particular connecting element (**5a**, **5b**) with regard to the housing (**2**).

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