(19) DANMARK

(10) **DK/EP 3444021 T3**

Patent- og
Varemærkestyrelsen

(12) Oversættelse af
europæisk patentskrift

(51) Int.Cl.: ***B 01 D 63/02 (2006.01)*** ***B 01 D 63/06 (2006.01)*** ***B 01 D 71/32 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2020-06-29**

(80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2020-04-15**

(86) Europæisk ansøgning nr.: **17186507.4**

(86) Europæisk indleveringsdag: **2017-08-16**

(87) Den europæiske ansøgnings publiceringsdag: **2019-02-20**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **Indretning til at bearbejde en fluid og fremstillingsfremgangsmåde af en sådan**

(56) Fremdragne publikationer:
DE-B- 1 213 384
JP-A- 2009 241 041
US-A1- 2013 075 321

DEVICE FOR PROCESSING A FLUID AND MANUFACTURING METHOD FOR SAME

Technical field

The invention relates to a device for processing a fluid and a method for producing such a device.

Prior art

Due to their special material properties, membranes made of polytetrafluoroethylene (PTFE) open up areas of application that previously could only be covered by ceramic membranes or were not accessible for membrane processes.

Flat membranes made of PTFE have been known for a long time and are used on a large scale, for example as a liquid barrier in clothing or for gas filtration. For various reasons, membranes having a tubular design are preferred for technical applications. These can be integrated more easily into fluid treatment systems, are easier to control in terms of flow technology and offer better access to the overall construction for cleaning and disinfection processes. In order to obtain technically useful units, it is generally necessary to combine several membrane tubes (capillaries) and to provide them with common connections so that the fluid on the outside of the membrane tubes can be collected or distributed in a jacket tube with one or more connections and the fluid on the inside of the membrane tubes can be supplied or discharged via at least one, normally two connections.

The inside and outside spaces of the membrane must be sealed off from one another in such a way that the usability in accordance with the task is ensured. Different solutions are used for ceramic membranes and polymer membranes.

The sealing of polymer membranes is usually carried out using so-called potting, i.e. the ends of individual membrane tubes are bundled vertically in one plane, e.g. via an outer metal ring, and the intermediate spaces are sealed with a casting compound (e.g. made of polyurethane or epoxy resin). After the casting compound has hardened, the outer ring, the casting compound and the membrane tubes embedded axially therein form a firmly connected head plate. This process is repeated at the other end of the membrane bundle, creating a module that consists of two head plates and the membrane bundle in between. If the two head plates are now sealed off from an outer jacket tube using customary methods, a tube module is created in which the inside and the outside of the membrane are completely sealed off from one another and the membrane is the only option for exchange between the two spaces of the module.

A further option that can be used with thermoplastics is the welding of membrane tubes and a perforated plate if both are made of a weldable plastic such as polyethylene (PE) or polypropylene (PP). The perforated plate is provided with a number of holes, each hole containing a membrane tube. The membrane tubes and the perforated plate are then connected to the head plate by welding the individual tubes to the surrounding material of the perforated plate.

Tubular membranes made of ceramic or other non-deformable materials are usually sealed in a prefabricated head plate made of metal or another non-plastic material which has defined, often slightly conical, openings for receiving one ceramic rod each. The ceramic rods usually have circularly ground ends, the sealing is then carried out radially by means of O-ring seals which are pressed by a further head plate in the cone area and lie sealingly against the ground end of the ceramic rod and at the opening of the head plate. Constructions with an additional press ring between the O-ring seal and head plate are also possible. Since ceramic membranes consist of a coarser support body and a finer membrane, it is also necessary to seal the end face. Generally, a suitable resin or polymer is used for this purpose, which penetrates into the sintered structure of the membrane support body and closes it in a liquid- tight and/or gas-tight manner. With this measure, it is only possible for fluid to pass through the membrane.

Membranes made of PTFE have the material properties of the PTFE. Its special chemical properties such as a practically inert surface prevent the use of conventional potting materials because the latter do not have sufficient adhesion and adhesive properties for the PTFE. The use of the O-ring seal as with a ceramic membrane element is not possible due to the easy deformability of the PTFE membranes.

A possible solution to the sealing problem - clamping and self-sealing via hollow connectors made of steel or plastic in a head plate made of non-plastic material such as, for example, PVDF - is described in US 2013/0075321 A1. This solution takes advantage of the sealing properties of the PTFE and the easy deformability by using the microporous membrane itself as a seal by pressing. A disadvantage is the smooth surface of the bores in the head plate; because of the good sliding properties of PTFE, axial fixing cannot be guaranteed in every case. A form-fitting design of the surface of the inside of the bore is difficult and expensive due to the type of processing of the head plate. Another disadvantage is that this solution requires a large number of individual parts in technical modules and, in connection therewith, a considerable amount of work for assembly. Technically disadvantageous is a narrowing of the flow channel, of the inner diameter of the membrane tube, which, for example in filtration processes, can lead to altered fluid properties and thus interferes with the parameters of the actual membrane process.

Presentation of the invention

It is an object of the invention to provide an improved device for processing fluids which reduces or eliminates the problems of the prior art.

This object is achieved with a device according to claim 1 and a manufacturing method according to claim 12.

Since the connecting segments of the connector for connecting the membrane channels have a hollow mandrel, the connection process is simplified and the connection quality is increased. Since devices for processing fluids with membrane channels often have a large number of membrane channels and very thin membrane channels, this leads to a significant simplification of the connection process.

The dependent claims relate to particularly advantageous exemplary embodiments of the above-described embodiments.

In one exemplary embodiment, the at least one connecting segment has a plurality of connecting segments and the at least one membrane channel has a plurality of membrane channels, each membrane channel being connected to one of the connecting segments.

In one exemplary embodiment, the at least one connecting segment has a fluid opening and a hollow mandrel in each case, wherein the fluid opening opens into the hollow mandrel. Since the hollow mandrel protrudes from the connecting element, it is particularly easy to place the corresponding membrane channel on the hollow mandrel. This also allows a particularly tight and stable connection to the membrane channel.

In one exemplary embodiment, the connecting element is manufactured using an additive manufacturing method. This allows particularly dense and/or stable and/or small connecting segments to be realised in the connecting element. In addition, it allows the arrangement, the number and dimensions of the connecting segments and the membrane channels to be varied easily for each application without significantly increasing the production effort.

In one embodiment, the connecting element is arranged such that at least a subgroup of the connecting segments is made from a common piece of material. This allows a particularly stable design of the connecting segments and an easier assembly of the connection.

In one embodiment, the outer circumference and/or outer diameter of the at least one hollow mandrel (13) changes in the axial direction of the hollow mandrel (13) in order to facilitate the insertion of the at least one hollow mandrel (13) into at least one membrane channel (2) and/or in order to better seal the at least one membrane channel (2) to the at least one hollow mandrel (13).

In one exemplary embodiment, the connector has a pressing means which presses the outside of the at least one membrane channel onto the associated hollow mandrel. This improves the axial retention of the membrane channel on the hollow mandrel and/or improves the tightness between the membrane channel and the hollow mandrel.

In one exemplary embodiment, the pressing means has a counter element which has a plurality of recesses which integrally surround the hollow mandrels with the membrane channels and are shaped in such a way that the counter element presses on the outside of the membrane channels. This counter element has the advantage that only one counter element or only a few partial counter elements of the counter element is or are required in order to press a large number of membrane channels radially onto the hollow mandrels. This significantly simplifies the assembly of the pressing means.

Brief description of the figures

The invention is explained in more detail with reference to the attached figures, in which:

Fig. 1 shows an exemplary embodiment of a device for processing fluids;

Fig. 2 shows a section along the line II-II from FIG. 3 through a connecting element of a connector;

Fig. 3 shows a section of the line III-III of FIG. 2 through the connecting element of the connector from FIG. 2;

Fig. 4 shows a first exemplary embodiment of a pressing means;

Fig. 5 shows a second exemplary embodiment of a pressing means;

Fig. 6 shows an exploded view of an exemplary embodiment of a device for processing fluids with a counter element as a pressing means;

Fig. 7 shows a first exemplary embodiment of the assembled device from Fig. 6;

Fig. 8 shows a first exemplary embodiment of the assembled device from Fig. 6;

Fig. 9 shows a first exemplary embodiment of the counter element with several partial counter elements;

Fig. 10 shows a second exemplary embodiment of the counter element with several partial counter elements; and

Fig. 11 shows a third exemplary embodiment of the counter element with several partial counter elements.

Fig. 12 shows an exemplary embodiment of a receiving element for receiving several connecting elements.

Ways of carrying out the invention

Fig. 1 shows a schematic exemplary embodiment of a device for processing fluids. The device preferably has at least one connector 1 and at least one membrane channel 2.

The at least one membrane channel 2 has a first end and a second end. The at least one membrane channel 2 is designed to channel a fluid from the first end to the second end or vice versa. The first end of a membrane channel 2 is connected to a first connector 1. The second end of the membrane channel 2 is preferably connected to a second connector 1. This allows a fluid to be processed to be channelled into a first connector 1, through the membrane channel 2 and back out of the second connector 1 (or vice versa). The processing of the fluid thus takes place in a flow arrangement in the at least one membrane channel 2 between the first and second connector 1. The second connector 1 is preferably designed like the first connector 1. The second connector 1 can, however, also be designed differently. It is also possible to reconnect the second end to the first connector 1 or to discharge the fluid from the second end in a different way. Fluids can be gases or liquids or liquid-gas mixtures or a mixture of a gas, a liquid or a liquid-gas mixture with solid particles.

The wall 21 of the membrane channel 2 is made of a membrane material that allows a substance to be transported through the wall 21 of the membrane channel 2. The substance transported through the wall 21 can be liquid, gaseous or present as solid particles. As a result, removal of a substance from and/or addition of a substance to the fluid introduced in the membrane channel 2 can be achieved as fluid processing. When a substance is removed, a fluid containing the substance is channelled through the membrane channel 2, the substance passing or being transported through the wall 21 of the membrane channel 2. The proportion of the substance in the fluid at the second end of the membrane channel 2 is thus reduced in comparison to its first end (also to 0% at the second end). When adding a substance, a substance is added to the fluid channelled through the membrane channel 2 due to the fact that the substance enters or is transported through the wall of the membrane channels 2 into the membrane channel 2. The proportion of the substance in the fluid at the second end of the membrane channel 2 thus increases in comparison to its first end (also from 0% at the first end). Thus, a first fluid is introduced into the membrane channel 2, a substance is transported through the wall 21 of the membrane channel 2, so that the first fluid is channelled from a first end to the second end and is processed by the substance transport through the wall 21 into a second fluid exiting from the second end. The substance is, for example, part of the first fluid and reduces its concentration in the first fluid by exiting from the membrane channel 2 through the wall 21, so that the first fluid is processed into the second fluid exiting at the second end. The substance can also be added through the wall 21 to the first fluid in the membrane channel 2, so that the first fluid mixes with the substance to form the second fluid. It is also possible for the wall to transport several substances through the wall. These substances can have different phases (solid, liquid, gaseous) and/or have different directions. As a result, liquid-liquid extraction or filtration can be achieved as fluid processing. This also enables liquids to be gassed or degassed. This method is very suitable, for example, for processing food fluids. The membrane material can be a microporous membrane or a dense membrane or another type of membrane. The membrane material is preferably a plastic or polymer, preferably a fluoropolymer, preferably a polytetrafluoroethylene (PTFE).

In one exemplary embodiment, the membrane channel 2 is compressible or elastic at least in the region of the first and/or the second end. In one exemplary embodiment, the membrane channel 2 is a hose or a hose-like tube. In one exemplary embodiment, the membrane channel 2 is elastic and/or flexible.

In one exemplary embodiment, the inner diameter of the membrane channel 2 is between 0.5 mm and 50 mm. In one exemplary embodiment, the wall thickness of the membrane channel 2 is between 0.005 mm and 5 mm.

In one exemplary embodiment, the device has a plurality of membrane channels 2 (with the properties described above). Depending on the application, the device can have more than two, ten, fifty, one hundred, five hundred or one thousand membrane channels 2. The membrane area can be regulated, for example, by the number of membrane channels 2.

The connector 1 is designed to connect at least the first ends of the at least one membrane channel 2 to the connector 1. The connector 1 has a connecting element 11. The connecting element 11 forms at least one connecting segment, preferably a plurality of connecting segments. The connecting segment is a region of the connecting element 11 with a fluid opening 12 and a hollow mandrel 13. The fluid opening 12 opens into the hollow mandrel 13, in particular into the opening of the hollow mandrel 13. The hollow mandrel 13 has an axial direction. The axial direction of the fluid opening 12 preferably corresponds to the axial direction of the hollow mandrel 13. The hollow mandrel 13 protrudes from the connecting element 11, so that the first end of the membrane channel 2 can be placed on the hollow mandrel 13 in the axial direction. The membrane channel 2 is placed, slid or fastened over or onto the outer circumference of the hollow mandrel 13, so that the membrane channel 2 encloses the hollow mandrel 13 in the interior of the membrane channel 2 in the assembled state. The distal (distant) end of the hollow mandrel 13, in which the fluid opening 12 opens, is thus surrounded by the assembled membrane channel 2, so that the fluid opening 12 opens into the interior of the membrane channel 2. The distal end of the hollow mandrel 2 is the end of the hollow mandrel 2 directed towards the membrane channel 2.

Preferably, a connecting segment 11 is arranged such that the fluid opening 12 and the hollow mandrel 13 are formed from one block of material, i.e. are formed in one piece. The connecting element 11 is preferably designed such that the fluid openings 12 and the hollow mandrels 13 of at least a plurality of connecting segments are formed from a common block of material, i.e. are formed in one piece. Figs. 2 and 3 show a section through the connecting element 11 with a plurality of connecting segments. Figs. 2 and 3 show a connecting element 11, in which all connecting segments (here seven) are formed from one block of material. Due to the one-piece design, a high level of stability of the hollow mandrels 13 in the connecting element 11 is achieved. All connecting segments of the connector are preferably formed in one piece in the same connecting element. However, it is also possible for the connecting element 11 to consist of partial connecting elements, which each have a plurality of connecting segments and are each formed in one piece.

Preferably, the connecting element 11 is manufactured with an additive manufacturing process, e.g. a 3D printing process. This has the advantage that even a large number of connecting segments and/or very small hollow mandrels 13 can be manufactured quickly, stably and precisely. Since the membrane channels 2 and the connecting elements 11 have to be specially made for each application, an additive manufacturing method allows a robust connecting element 11 to be manufactured quickly and precisely. Classic machining manufacturing processes are problematic and time-consuming with a large number of connecting elements and/or very small hollow mandrels 13. In addition, certain shapes of the hollow mandrels 13 are not possible with a machining manufacturing process. Injection moulding or other moulding processes are also problematic in this case, since the moulding material may not be able to fill the small cavities properly, and are also unsuitable for small quantities. However, for some exemplary embodiments it would alternatively also be possible to manufacture the connecting element 11 differently, e.g. with a cutting manufacturing process such as, for example, a milling and/or drilling machine, or with a casting process such as, for example, an injection moulding process.

The hollow mandrel 13 is preferably shaped such that the outer circumference and/or the outer diameter of the hollow mandrel 13 changes in the axial direction. This is particularly advantageous in combination with elastic, flexible and/or compressible first ends of the membrane channels 2.

The introduction of the hollow mandrels 13 into the membrane channels 2 can be facilitated if the outer circumference and/or the outer diameter of the hollow mandrel 13 at its distal end is smaller or the same as the inner circumference and/or inner diameter of the membrane channels 2. Preferably, the outer circumference and/or the outer diameter of the hollow mandrel 13 decreases in a first region along the axial direction towards the distal end from an outer circumference and/or the outer diameter of the hollow mandrel 13, which is larger than the inner circumference and/or inner diameter of the membrane channels 2 decreases towards an outer circumference and/or the outer diameter of the hollow mandrel 13, which is smaller than the inner circumference and/or inner diameter of the membrane channels 2. This reduction in the first region is preferably constant and/or continuous. This continuous reduction can also be achieved by a plurality of small steps in the circumference and/or diameter. Such a first region can be seen, for example, in the exemplary embodiments of Figs. 3, 4, 6, 7 and 8.

By changing the circumference and/or diameter via the axial direction of the hollow mandrel 13, the membrane channel 2 can also be sealed better to the hollow mandrel 13 and/or the retention of the membrane channel 2 in the axial direction can be improved. The first region described above also contributes to better sealing or a better retention. Alternatively or additionally, the hollow mandrel 13 preferably has a second region along the axial direction of the hollow mandrel 13, in which the outer circumference and/or the outer diameter of the hollow mandrel 13 increases toward the distal end. In combination with the first region, the outer circumference and/or the outer diameter of the hollow mandrel 13 would increase in the axial direction towards the distal end first in the second region and then decrease again in the first region. The increase in the outer diameter/circumference can be realised continuously (see exemplary embodiment in Fig. 4) or also in a single step (exemplary embodiment in Figs. 6 to 8).

In one exemplary embodiment, the hollow mandrel 13 has, alternatively or in addition to the first and/or second region, a third region along the axial direction of the hollow mandrel 13, in which the outer circumference and/or the outer diameter of the hollow mandrel 13 decreases towards the distal end. In combination with the first and second region, the outer circumference and/or the outer diameter of the hollow mandrel 13 would decrease in the axial direction towards the distal end first in the third region, then increase in the second region and then decrease again in the first region.

The outer circumference and/or the outer diameter of the hollow mandrel 13 can also remain constant in the axial direction, as is shown in Fig. 5.

The connecting element 11 is preferably designed as a connection plate 11. The hollow mandrels 13 protrude from the connection plate 11 such that the axial direction of the hollow mandrels 13 is arranged orthogonally to the plate plane of the connection plate 11. The fluid openings 12 preferably also extend at right angles to the plate plane of the connection plate 11. The hollow mandrels 13 are preferably arranged on a first side of the connecting element or the connection plate 11 and the fluid openings 12 are arranged on a second side of the connecting element 11 opposite the first side.

An outer shell 3 preferably encloses the membrane channels 2 such that a fluid space 4 is formed between the connector 1, the outer shell 3 and the outer sides of the membrane channels 2. The fluid space 4 is designed to contain a substance that is transported out of the membrane channels 2 and/or into the membrane channels 2 through the walls 21 thereof. The outer shell preferably extends between two connectors 1, so that the fluid space 4 is formed between the two connectors 1, the outer shell 3 and the outer sides of the membrane channels 2. The outer shell is preferably designed in the form of a pipe or hose line. The fluid space 4 can have one or more connectors in order to introduce and/or discharge the substance to be transported through the wall 21. The fluid space 4 preferably has a connector for introducing and a connection for discharging a substance.

In one exemplary embodiment, the first connector can be twisted relative to the second connector, so that the membrane channels 2 no longer runs parallel to the connecting line between the two connectors 1. This can be achieved, for example, by selecting the membrane channels 2 to be longer than the distance between the two connectors 1. As a result, the membrane area of the membrane channels 2 can be increased with the same space requirement. This twisting also allows the flow cross-section and thus the residence time of the fluid in the membrane channels 2 to be controlled.

The connector 1 preferably has pressing means which presses the outsides of the membrane channels 2 onto the hollow mandrels 13. The pressure is preferably exerted radially relative to the axial axis of the hollow mandrels 13. This improves the sealing between hollow mandrels 13 and membrane channels 2 and/or improves the retention of the membrane channels 2 on the hollow mandrels 13 in the axial direction of the hollow mandrels 13.

Fig. 4 shows a hose clamp 14.1 as a pressing means. The hose clamp closes around the circumference of the membrane channel 2 and presses it radially onto the hollow mandrel 13. In one exemplary embodiment, the pressing means has a plurality of hose clamps 14.1, which each press a membrane channel 2 onto a hollow mandrel 13 of a connecting segment. With a large number of membrane channels 2 and/or membrane channels 2 with small diameters, this fastening method is complex.

Fig. 5 shows a shrink tube 14.2 as a pressing means, which is arranged in the region of the hollow mandrel 13 and in the shrunk state presses radially onto the membrane channel 2. In one exemplary embodiment, the pressing means has a plurality of shrink tubes 14.2, which each press a membrane channel 2 onto a hollow mandrel 13 of a connecting segment. The shrink tubes 14.2 are slid onto the first ends of the membrane channels 2. Then the first ends of the membrane channels 2 are placed on the hollow mandrels 13 of the connecting segments. The shrink tube 14.2 may still have to be moved so that it is arranged in the region of the hollow mandrel 13. When heated, the diameter of the shrink tube 14.2 shrinks and the membrane channel 2 presses radially against the hollow mandrel 13. With a large number of membrane channels 2, this fastening method is still complex. However, the step of reducing the diameter of the shrink tube 14.2 can be achieved simply by a heat treatment carried out simultaneously, instead of by mechanical work steps carried out sequentially.

A further exemplary embodiment of a pressing means is a counter element 15 with corresponding recesses 16 for the hollow mandrels 13 of the connecting element 11. Figs. 6 to 8 show an exemplary embodiment of such a counter element 15. The counter element 15 has a first side and a second side opposite the first side. In the assembled state, the first side shows the connecting element 11 of the same connector 1. The recesses 16 are formed continuously from the first side to the second side, so that the membrane channels 2 and/or the hollow mandrels 13 can be guided through the recesses 16. The recesses 16 are arranged in the counter element 15 such that several or all of the hollow mandrels 13 of the connecting element 11 can be inserted simultaneously into the corresponding recesses 16 when the counter element 15 is placed on the connecting element 11. The recesses 16 are designed such that a membrane channel 2 can be arranged or clamped between each recess 16 and the corresponding hollow mandrel 13. The recesses 16 and/or the hollow mandrels 13 are designed such that the membrane channel 2 arranged between a recess 16 and a hollow mandrel 13 is pressed radially against the corresponding hollow mandrel 13. In one exemplary embodiment, the inner diameter of the recess 16 changes in a direction from the first to the second side of the counter element 15. This is particularly advantageous in combination with hollow mandrels 13 whose outer circumference and/or outer diameter change in the axial direction. Preferably, the recesses 16 basically correspond to the negative shape of the hollow mandrels 13. Here ‘basically’ means that the recesses 13 corresponds to the negative shape of the hollow mandrels 13 only in a partial region and/or that the recesses 13 is very similar to the negative shape of the hollow mandrels 13 and/or that the shape of the recesses 16 is slightly larger or smaller than that negative shape of the hollow mandrels 13. A slightly smaller shape of the recesses 16 compared to the hollow mandrels 13 could be justified, for example, by the elasticity of the material of the hollow mandrel 13 or the counter element 15. A slightly larger shape compared to the hollow mandrels 13 could be justified, for example, by the wall thickness of the membrane channels 2 or by a maximum diameter of the hollow mandrel 13. The counter element 15 can be formed from a hard and/or rigid material, e.g. metal or hard plastic. The counter element 15 can, however, also be formed from an elastic and/or compressible material. The counter element 15 is preferably manufactured by means of an additive manufacturing process, e.g. a 3D printing process. The counter element 15 is preferably designed as a counter plate 15. The first and second sides of the counter plate 15 are preferably parallel. The longitudinal axes of the recesses 16 preferably extend parallel to the orthonormal vector of the first or second side of the counter plate 15. The counter plate 15 is preferably arranged parallel to the connection plate 11.

To fasten the membrane channels 2 to the connector 1, the membrane channels 2 are threaded through the recesses 16 of the counter element 15. If the second connector 1 also has a counter element 16, as in the case of Fig. 6, the counter elements 16 can be placed one above the other in such a way that the recesses 16 overlap and/or that the two second sides adjoin one another. The membrane channels 2 can thus be threaded through the recesses 16 of the two counter elements 16. This has the advantage that the threading process has to be carried out only once per membrane channel 2 and additionally that the membrane channels 2 are always arranged in parallel between the two connectors 1 or do not cross each other. This situation is shown in Fig. 6. Then the membrane channels 2 are placed on the hollow mandrels 13. The membrane channel 2, which runs through a specific recess 16, is placed on the hollow mandrel 13, which lies opposite the specific recess 16 or which later receives the specific recess 16. For a connector 1, the first ends of the membrane channels 2 can of course also be placed on the hollow mandrels 13 and then the second ends of the membrane channels 2 (from the first side to the second side of the counter element 15) can be threaded through the recesses 16 of the counter element 15. Now the counter element 15 on the membrane channels 2 can be pushed towards the connecting element 11 until the recesses 16 are arranged on the hollow mandrels 13 and press the membrane channels 2 onto the hollow mandrels 13. The first side of the counter element or the counter plate 15 preferably lies on the side of the connecting element or the connection plate 11 with the hollow mandrels 13. In addition, the counter element 15 can be fastened on the connecting element 11 with fastening means 17, such as, for example, a clamp (see Fig. 7) or a screw (see Fig. 8). If there is a similar second connector 1, the same type of assembly procedure is carried out for the second connector 1. ‘The same type’ does not have to mean identical, but only that the second connector 1 has (at least a part of) the features of the first connector 1 described above. If there is an outer shell 3, this is fastened on the connector 1 and possibly the second connector 1, so that a bundle 23 of membrane channels 2 is enclosed in the outer shell 3.

The counter element 15 with recesses 16 in combination with the connecting element 11 with hollow mandrels 13 allows the membrane channels 2 to be fastened particularly easily and quickly, even if the number of membrane channels 2 is high.

Figs. 9 to 11 show exemplary embodiments of a counter element 15 with at least two partial counter elements 15.1. Each partial counter element 15.1 has a plurality of recesses 16. The division of the counter element 15 into several partial counter elements 15.1 allows, for example, quicker replacement of a counter element part 15.1, since not all membrane channels 2 have to be removed from the hollow mandrels 13 of the connecting element 11, but only those which are guided through the recesses 16 of the counter element part 15.1. In the second exemplary embodiment in Fig. 10, the partial counter elements 15.1 are arranged concentrically.

Fig. 12 shows an exemplary embodiment of a receiving element 18 of a connector 1 for receiving a plurality of connector elements 11. The receiving element 18 has a plurality of receiving stations 19, each of which can receive a connecting element 11. In one exemplary embodiment, the receiving element 18 contains seven receiving stations 19. This allows an optimal packing density. The receiving stations 19 are preferably of the same design, so that the same connecting elements 11 can be used to control the flow rate in a modular manner. Each receiving station 19 is connected to a fluid connection device of the connector 1 via a fluid connection. A connection to the piping system can also be established via a common connector for all receiving stations. Each receiving station 19 is designed such that a connecting element 11 is received in a sealing manner. As a result, the fluid can flow from the fluid connection device of the connector 1 to the fluid receiving device 19 through the connecting segments of the connecting element 11 to the membrane channels 2 or in the opposite direction in the reverse order. The receiving stations 19 which are not used can be closed, for example, by end elements. A possible outer shell 3 could be arranged on the receiving element 18 or between two receiving elements 18 of two connectors 1.

P A T E N T K R A V

1. Indretning til at bearbejde en fluid omfattende:

flere membranledninger (2);

en tilslutning (1) med et tilslutningselement (11), hvor tilslutningselementet (11) har flere tilslutningssegmenter, hvor hvert tilslutningssegment har en fluidåbning (12) og er forbundet med en første ende af én af membranledningerne (2),

hvor fluidåbningen (12) af hvert tilslutningselement hver munder ud i en huldorn (13) af tilslutningssegmentet, på hvilken membranledningen (2), der er forbundet med tilslutningselementet, er fastgjort,

k e n d e t e g n e t ved, at

tilslutningselementet (11) er dannet således, at i det mindste en undergruppe af tilslutningssegmenterne med flere tilslutningssegmenter er dannet i ét stykke.

2. Indretning ifølge krav 1, hvor yderomfanget og/eller yderdiameteren af huldornen (13) ændrer sig i en aksial retning af huldornen (13), for at lette indføringen af huldornen (13) i membranledningerne (2) og/eller for at tætne membranledningerne (2) bedre af over for huldornen (13).

3. Indretning ifølge krav 1 eller 2, hvor tilslutningen (1) har et pressemiddel, der trykker ydersider af membranledningen (2) mod huldornene (13).

4. Indretning ifølge krav 3, hvor pressemidlet har flere stykket krympeflex, som er anbragt på ydersiden af membranledningerne i området ved huldornene (13) og i krympet tilstand trykker membranledningen radialt på huldornene (13).

5. Indretning ifølge krav 3, hvor pressemidlet er et modelement (15), der har flere udsparinger (16), der omslutter omfanget af huldornene (13) med membranledningerne (2) og er dannet således, at modelementet (15) trykker på ydersiden af membranledningen (2).

6. Indretning ifølge krav 5, hvor udsparingerne (16) er anbragt således i modelementet (15), at flere eller alle huldorne (13) af tilslutningselementet (11) på samme tid kan puttes ind i de tilsvarende udsparinger (16), når modelementet (15) puttes på tilslutningselement (11).

7. Indretning ifølge en kombination af krav 2 og et af kravene 5 eller 6, hvor udsparingerne grundlæggende har den negative form af de tilsvarende huldorne (13).

8. Indretning ifølge et af kravene 1 til 7, hvor tilslutningselementet (11) er dannet som en plade, fra hvilken huldornene (13) rager frem i forlængelse af fluidåbningerne (12).

9. Indretning ifølge en kombination af krav 8 og et af kravene 5 til 7, hvor modelementet (15) er dannet som modplade (15), hvor modpladen er anbragt parallelt med tilslutningspladen (11).

10. Indretning ifølge et af kravene 1 til 9, der har en yderligere tilslutning (1) med et tilslutningselement (11), hvor tilslutningselementet (11) af den yderligere tilslutning (1)

har flere tilslutningssegmenter, hvor hvert tilslutningssegment af den yderligere tilslutning (1) har en fluidåbning (12) og er forbundet med en anden ende af én af membranledningerne (2), hvor fluidåbningen (12) af hvert tilslutningselement af den yderligere tilslutning (1) hver munder ud i en huldorn (13) af tilslutningssegmentet af den yderligere tilslutning (1), på hvilken membranledningen (2), som er forbundet med tilslutningselementet, er fastgjort.

11. Indretning ifølge et af kravene 1 til 10, hvor en yderkappe omslutter membranledningen (2), således at der dannes et fluidrum mellem tilslutningen (1) af yderkappen og ydersiderne af membranledningerne (2).

12. Fremstillingsfremgangsmåde omfattende:

at tilvejebringe et tilslutningselement (11), der har flere tilslutningssegmenter, hvor hvert tilslutningssegment har en fluidåbning (12) og en huldorn (13), hvor fluidåbningen (12) munder ud i huldornen (13);

at aksialt påskubbe en første ende af en membranledning (2) på hver huldorn (13) af tilslutningselementet (11), således at den første ende af membranledningen (2) omslutter huldornen (2) omfangsmæssigt,

k e n d e t e g n e t ved, at

i det mindste en undergruppe af tilslutningssegmenterne fremstilles med flere tilslutningselementer fra ét stykke materiale.

13. Fremstillingsfremgangsmåde ifølge krav 12, hvor at tilvejebringe af tilslutningselementet (11) omfatter at fremstille tilslutningselementet (11) med en additiv fremstillingsfremgangsmåde.

14. Fremstillingsfremgangsmåde ifølge krav 12 eller 13 ydermere omfattende:

at anbringe pressemidler ved ydersider af membranledningen i området af huldornene, således at membranledningerne trykkes på huldornen (13) til bedre tætning og/eller til bedre aksialt hold.

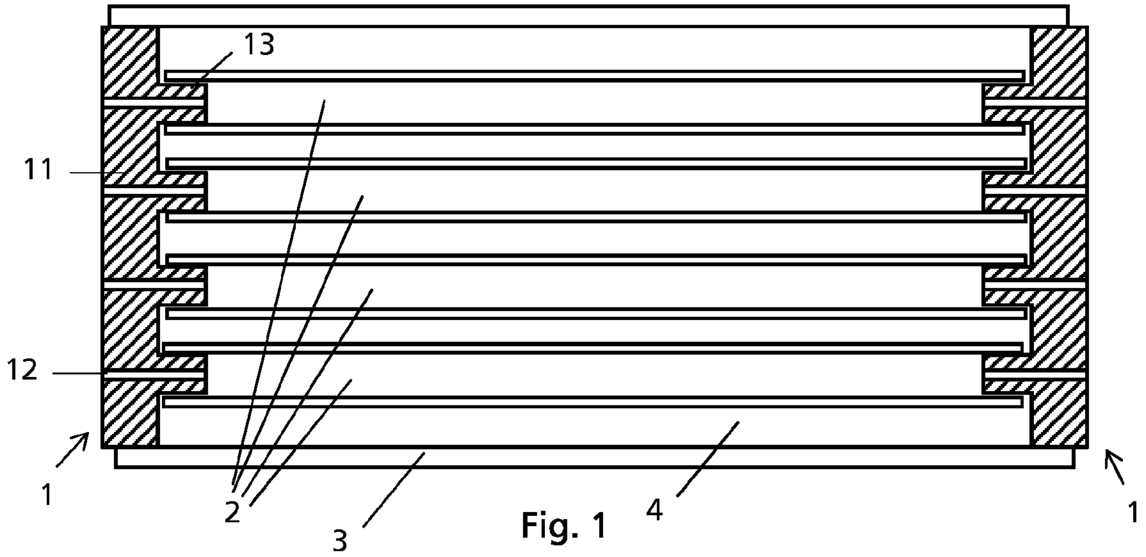

Fig. 1

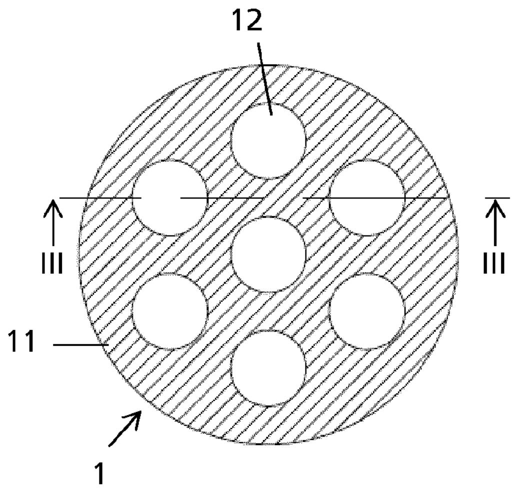

Fig. 2

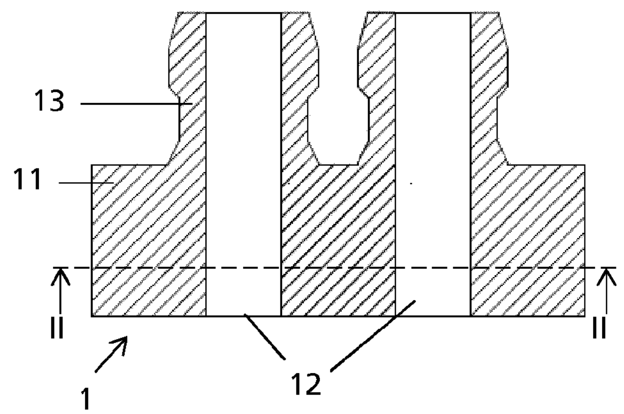

Fig. 3

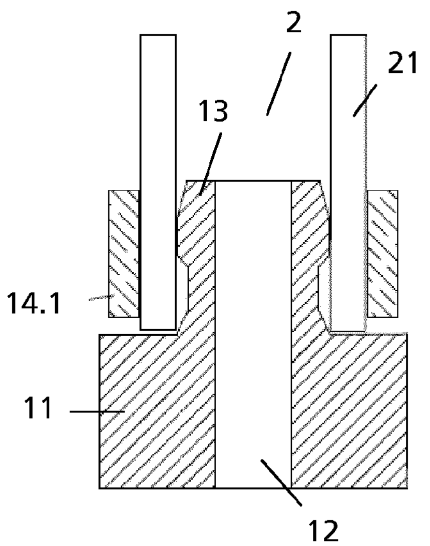

Fig. 4

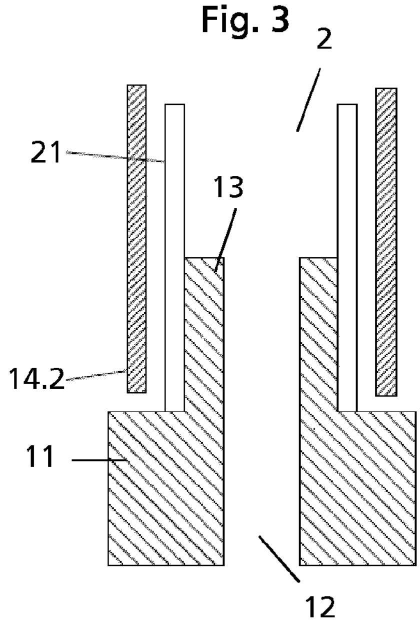

Fig. 5

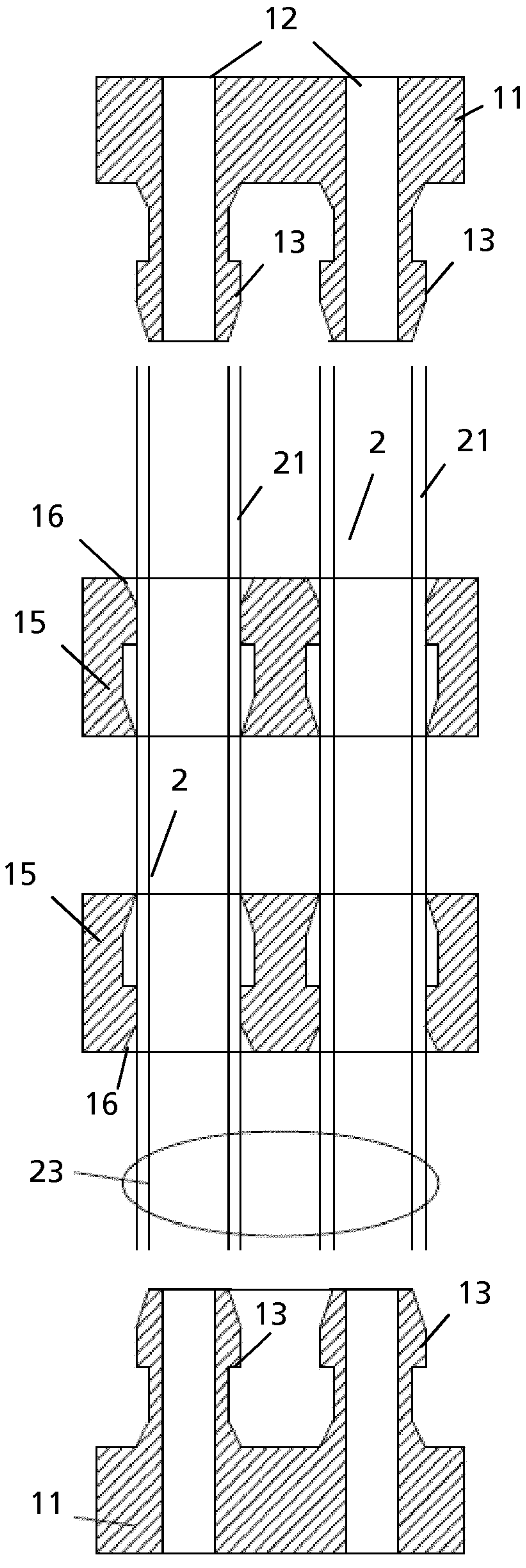

Fig. 6

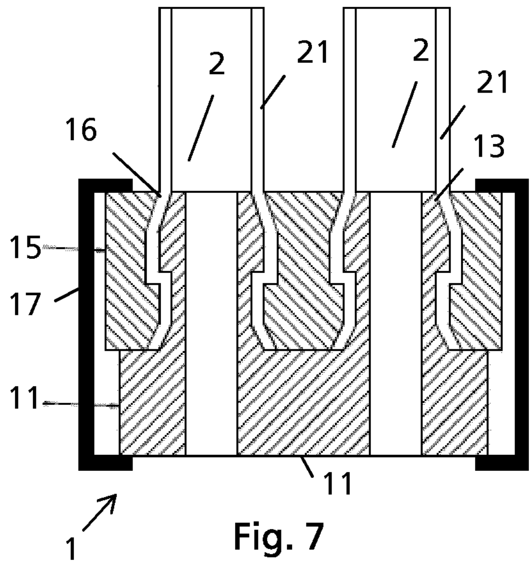

Fig. 7

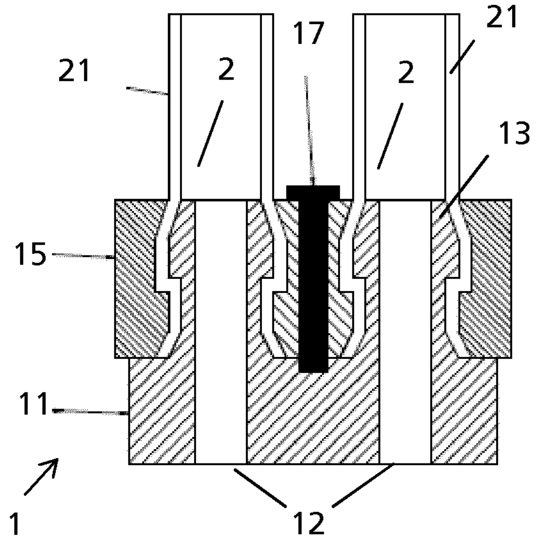

Fig. 8

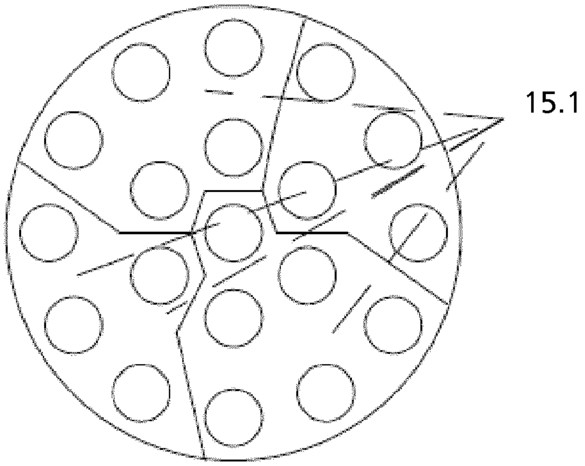

Fig. 9

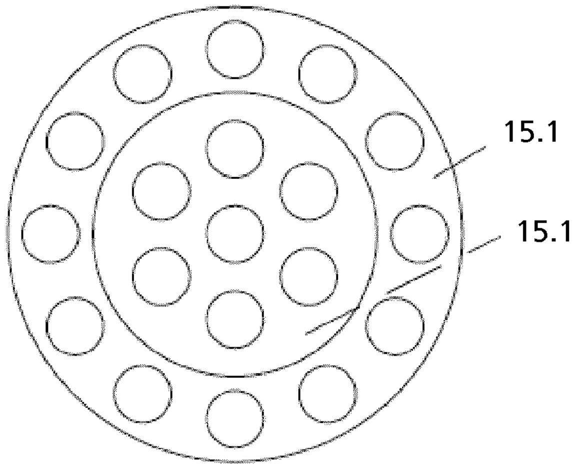

Fig. 10

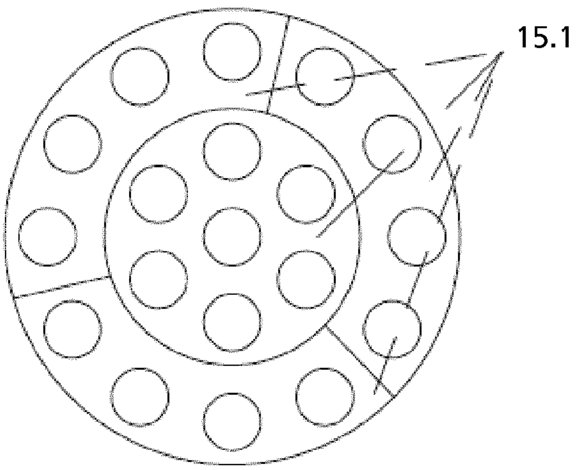

Fig. 11

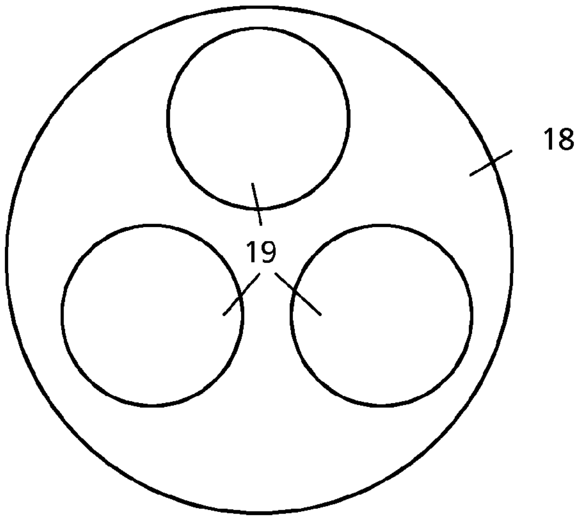

Fig. 12