

Cart and Device for Biological Liquid Treatment

Technical Field

5 The present invention relates to a device for treating a biological liquid, and while not limited to the following, particularly relates to a device for purifying a biopharmaceutical liquid in order to obtain products such as monoclonal antibodies, vaccines or recombinant proteins.

10 Background Art

 It is known that biopharmaceutical liquids are in general obtained by way of a culture solution in a bioreactor and that they must then be purified to achieve the required characteristics of purity, concentration, absence of viruses, etc.

15 Purification treatments are carried out by performing treatments such as clarification, to eliminate the residues from the bioreactor culture solution, and viral filtration in succession, which is sometimes followed by diafiltration and concentration by tangential flow filtration (TFF). Other operations exist concerning purification, such as chromatography and sterile filtration (to remove
20 bacteria).

 The purification treatments are essentially carried out by filtering operations in a circuit leading to a container for collecting the treated liquid.

 A number of types of container containing liquids can be connected to the inlet of the circuit, such as the source container that contains the product
25 to be treated, and containers containing a cleaning liquid such as sodium hydroxide (NaOH), a rinsing liquid such as pure water or a buffer liquid such as a saline solution. In addition to the container for collecting the treated liquid, various other containers for collecting cleaning, rinsing or buffer liquid, or for collecting residues, can be connected to the outlet of the circuit.

30 In a production situation, the liquid treatments can be carried out sequentially. The collecting container for the first treatment potentially becomes

the source container for the next treatment, which is repeated in this manner until the last treatment is carried out.

Summary of the Invention

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Problems to be Solved by the Invention

These treatments are conventionally carried out in dedicated circuits, with stainless steel pipes and other components such as tanks and filter housings, which necessitate operations before and after the actual treatment, which are relatively onerous, in particular, operations of cleaning after use are onerous.

An object of the invention is to provide a device for treating a biological liquid that is particularly simple, easy to use and effective.

15 Means for Solving the Problems

The present invention provides, according to a first aspect, a cart for a biological liquid treatment device characterized by comprising a first lateral face, a second lateral face, wherein said cart is adapted by the second lateral face so as to be juxtaposed against another cart, and a front face which meets the two said lateral faces;

said cart further comprising:

- a first pump;
- a second pump, disposed below said first pump and laterally offset, relative to said first pump, towards said first lateral face; and
- 25 - a tank disposed above said first pump and laterally offset, relative to said first pump, towards said first lateral face, said tank being adapted to receive a supply container provided so as to contain said biological liquid.

The supply container is provided so as to be linked, by flexible disposable pipes, to said pumps and to other elements of said device, at least one of said other elements (e.g. a filter) being provided to be disposed on said other cart.

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The device that the cart according to the invention enables to be obtained is provided so as to comprise disposable elements, the majority of which are flexible ("Flexware™ products"), such as the supply container for liquid to treat and a collecting container for treated liquid, circuit sections
5 including the disposable pipes as well as a filter or filter elements; and permanent or reusable elements ("hardware"), some of which are arranged on the cart according to the invention.

The assembly of such a device is performed simply by fitting the hardware, including the cart according to the invention, with the disposable
10 elements. The disposable elements include the components adapted to cooperate with the pumps (e.g. certain disposable pipes, if the pumps are of the peristaltic type and the like) and the supply container adapted to be received in the tank.

The arrangement of these permanent elements on the cart is also
15 predetermined to be particularly convenient and efficient. Accordingly, the second pump and the tank are each offset relative to a reference element constituted by the first pump.

The position of that first pump is determined by the positions of the main elements of the device (such as the single or multiple filters). The main
20 elements and the first pump cooperate, and the main elements are disposed on the other cart (or on any other support such as a table able to be juxtaposed against the cart according to the invention).

This arrangement ensures, firstly, fast mounting (and disassembly) of the device by facilitating connections, and by limiting pipe crossings.

25 This arrangement also enables marked reduction in the length of the disposable pipes linking the pumps and the supply container to mount in the tank, as well as the length of specific disposable pipes for linking the pumps and the supply container to the other elements of the device.

In particular, the relative positioning between the tank and the first
30 pump is performed in order for the flexible disposable pipe linking that pump to the supply container to be as short as possible, while maintaining a minimum radius of curvature in order to avoid risks of scissoring.

The reduction in the length of the disposable pipes enables the volume of biological liquid present in the pipes to be reduced. This makes it possible, for example, to achieve a smaller final volume in the case in which a treatment is carried out in which flow occurs in a loop to which the supply container belongs, and in a filter from which the filtrate is evacuated. This is because, at the end of treatment, the supply container is empty or nearly empty, and the liquid is essentially present in the pipes. This reduction in the final volume enables a higher concentration to be attained.

Lastly, the disposition of these re-usable elements on several superposed levels enables optimization of the floor area ("installation area") required for the device.

This possibility, given by the cart according to the invention, of optimizing the installation area is particularly advantageous when, as is generally the case in operations for treatment of biopharmaceutical liquids, the device is placed in an area of controlled atmosphere where space is limited and very costly.

According to features that are preferred due to reasons of the simplicity and facilitation of implementation:

- said second pump is offset depthwise relative to said first pump towards said front face;
- said tank is mounted so as to be movable between an upright service position for the operations of treating said biological liquid, and a lying-down installation position for the mounting or withdrawal of said supply container;
- said tank is adapted to pivot about an axis perpendicular to said front face of said cart;
- said cart comprises means for locking said tank in either of the service position and the installation position;
- said locking means comprise at least one pin;
- said tank is mounted on a U-shaped bracket of which the two ends are fixed to a balance frame that is adapted to cooperate with load cells in order to measure the mass of said tank;

- said pumps are peristaltic pumps;
- said cart comprises an electromagnetic drive device that raises and turns a stir bar contained in said supply container;
- said cart comprises a temperature probe that measures, through
5 said supply container, the temperature change of said biological liquid during said treatment; and/or
- said cart includes a control panel that controls said pumps.

According to a second aspect, the invention is also directed to providing a device for treating a biological liquid, comprising the cart set forth
10 above, which is designated as a first cart, a filter and a second cart that is juxtaposed against said first cart, the upper face of the second cart supporting said filter such that an outlet point of said first pump is positioned substantially facing an inlet/outlet aperture of said filter.

The fact that an outlet point of the first pump is positioned
15 substantially facing the aperture of the filter enables optimization of the length of the disposable pipe linking that outlet point to that aperture.

Moreover, the support for that filter by the second cart makes it possible to facilitate the mounting of the device according to the invention.

To describe this in concrete terms, by the operator just bringing the
20 two carts together, the main components of the device (pumps, tank and filter) will be optimally positioned relative to each other. Thereafter, all that has to be done is to connect those components by installing the disposable elements. The mounting of the device is thereby completed.

Lastly, in the same way as preparation of the device is facilitated by
25 the arrangement of its main components in the two carts, the operations to be carried out on the device, after the treatment operation that the cart has made possible to carry out, will be particularly simple. This is because these operations will be no more than discarding the disposable elements with which the carts are equipped, and it will be possible to perform the removal operations
30 just as simply as the mounting operations.

According to features that are preferred because they are favorable to the simplicity and convenience of use of the device of the invention:

- said filter is a tangential flow filter;
- said device comprises a container for collecting said filtered biological liquid, and said collecting container is disposed in a housing of said second cart;
- 5 - said housing is formed by the interior of a drawer;
- the facade of said drawer comprises a cut-out through which a flexible disposable pipe passes;
- said device comprises:
 - a source container for said biological liquid;
 - 10 - a supply container which is disposed in said tank of said cart;
 - a container that collects said filtered biological liquid;
 - a transfer section that connects said source container to a first aperture of a branching connector, the transfer section comprising a member adapted to cooperate with said second pump of said cart in order to generate a
 - 15 flow of said biological liquid;
 - a filling section that links a second aperture of said branching connector to an inlet/outlet aperture of said supply container;
 - a filtration section comprising said filter and connecting a third aperture of said branching connector to a first aperture of a second branching
 - 20 connector;
 - a supply section that links a second aperture of said second branching connector to an inlet/outlet aperture of said supply container, and comprising a member adapted to cooperate with said first pump of said cart in order to generate a flow of said biological liquid; and
 - 25 - a section that links a third aperture of said second branching connector to said collecting container and collects said filtered liquid;
 - each of said transfer section, filling section, filtration section, supply section and collecting section comprises at least one disposable pipe;
 - said device comprises at least one section that conveys the
 - 30 filtrate, which serves to link an outlet point of said filter to a waste container, and comprises at least one disposable pipe; and/or

- said device comprises two said conveying sections extending from the respective outlet point of said filter, and joining, via a branching connector, so as to form a single section.

Next, the disclosure of the invention will be continued with the detailed description of a mode of embodiment, given below as an illustrative but non-limiting working example, with reference to the accompanying drawings.

Brief Description of the Drawings

- 10 - Figure 1 this is a diagram of a circuit of a device for treatment by tangential flow filtration;
- Figure 2 this is a perspective view of a first and a second cart according to the invention, in separated configuration;
- Figure 3 this is a top view of the device according to the invention
- 15 comprising the two carts of Figure 2, in juxtaposed configuration;
- Figure 4 this is a cross-section view of that device on plane IV-IV of Figure 3;
- Figure 5 this is a cross-section view similar to the cross-section view of Figure 4, but the tank is in lying-down position, and its bottom is directed
- 20 towards the second cart;
- Figure 6 this is a cross-section view of that device on plane VI-VI of Figure 3;
- Figure 7 this is a perspective view from another viewing angle of the two carts of Figure 2, in juxtaposed configuration;
- 25 - Figure 8 this is a perspective view of a drawer of the second cart.

Modes for Carrying Out the Invention

First, a description will be given, using Figure 1, of a circuit for treating a biological liquid by tangential flow filtration, produced using disposable elements installed on the two carts referred to above (a more

30 detailed description of the device will be given later).

The liquid to be treated is initially in a source bag 20. The source bag 20 is filled with liquid from the culture bioreactor or from the previous treatment. This source bag 20 is connectable via a male coupling connector 21 to a transfer section 22. The transfer section 22 extends from a female coupling connector 28 to the first aperture 23a of a T-shaped branching connector 23.

The transfer section 22 comprises a disposable flexible pipe 24, a transfer pump 25 for generating a liquid flow (a peristaltic pump operating in the same way in both flow directions) and two isolation valves 26 and 27.

The term "pipe" must be understood, in the present document, as being a portion of piping connecting two elements of the circuit, it being equally possible for this portion to comprise a single tube or, on the contrary, several tubes. The several tubes can have different diameters, and are connected in series by a simple connector (not playing any other role here) or a complicated connector (for example a disposable connector for a pressure sensor (or for a sensor of another physico-chemical value) or a disposable connector for a disposable pump head).

The pipe 24 has a portion 24a passing through the pump 25 (from a first inlet/outlet point 25a to a second inlet/outlet point 25b), and this portion is made such that it may be compressed by said pump.

The valve 26 is implanted on the pipe 24 near the branching connector 23 in order to allow or prevent the flow of liquid in the pipe 24.

The valve 27 is implanted on the pipe 24 close to the female coupling connector 28.

The operator has the possibility of connecting other bags 30, 31 and 32 to the transfer section 22, via male coupling connectors 33, 34 and 35. The male coupling connectors 33, 34 and 35 can connect to the female coupling connector 28.

These bags 30, 31 and 32 respectively contain a buffer liquid (saline solution), a cleaning liquid (sodium hydroxide) and a rinsing liquid (water) to manage the degree of cleanliness of the circuit or to push the treated liquid towards the elements which perform the treatment, or towards the collecting container.

A filling section 40 and a filtration section 41 respectively extend from a second aperture 23b and from a third aperture 23c of the branching connector 23.

5 The filling section 40, which is linked to an inlet/outlet aperture 43a of a disposable flexible supply container 43, comprises a disposable flexible pipe 42 and a valve 44 implanted on the pipe 42 close to the branching connector 23 (which is also disposable).

10 An agitator 44, which is actuated by an electromagnetic drive 45, is disposed in the container 43, in order to make the liquid contained in the container 43 homogenous.

The filtration section 41, which is linked to a first aperture 60a of a T-shaped branching connector 60, comprises two disposable flexible pipes 50, 51, two connectors 52, 53 for pressure sensors, two isolation valves 54, 55 and the tangential flow filter 58.

15 The pipe 50 links the third aperture 23c of the branching connector 23 to a first inlet/outlet aperture 58a of the filter 58. The connector 52 is inserted in series in the pipe 50.

20 The pipe 51 links a second inlet/outlet aperture 58b of the filter 58 to the first aperture 60a of the branching connector 60. The pressure sensor connector 53 is inserted in series in the pipe 51.

The measurement made by the pressure sensor mounted on the connector 53, in conjunction with the measurement made by the pressure sensor mounted on the connector 52, enables the operational situation of the tangential flow filter 58 to be known.

25 The valve 54 is implanted on the pipe 50 close to the branching connector 23, and the valve 55 is implanted on the pipe 51 close to the branching connector 60.

30 A supply section 61 and a collecting section 62 respectively extend from a second aperture 60b and from a third aperture 60c of the branching connector 60.

The supply section 61 is linked to an outlet aperture 43b of the supply container 43. The supply section 61 comprises a disposable flexible pipe

63, a flow pump 64 that generates the liquid flow (here, a peristaltic pump operating in the same way in both flow directions), a valve 65 implanted on the pipe 63 close to the branching connector 60, and a pressure sensor connector 66 inserted in series in the pipe 63.

5 The pipe 63 has a portion 63a passing through the pump 64 (from an inlet point 64a to an outlet point 64b) and is made so that it can be compressed by said pump.

 The collecting section 62 is linked to a male coupling connector 70. The collection section 62 only comprises a flexible disposable pipe 68 and an
10 isolation valve 69 implanted on the pipe 68 close to the branching connector 60.

 Depending on the operations carried out, the male coupling connector 70 can be connected either to the female coupling connector 73 of a waste container 74, or to the female coupling connector 71 of a collecting connector.

15 The circuit for treatment by tangential flow filtration also comprises two sections 76a, 76b that convey the filtrate. These extend respectively from outlet points 58c and 58d of the filter 58 and merge the flows to form a single section 76. The single section 76 is linked to a male coupling connector 86, and this can be connected to the female coupling connector 73 of the waste
20 container 74.

 The section 76a communicates with a first aperture 80a of a T-shaped branching connector 80. The section 76a comprises a disposable flexible pipe 77 and an isolation valve 78, which is implanted on pipe 77 close to filter 58.

25 The section 76b communicates with a second aperture 80b of the branching connector 80. The section 76b comprises a disposable flexible pipe 81, an isolating valve 82 implanted on the pipe 81 close to filter 58, and a pressure sensor connector 83 inserted in series in pipe 81.

 The measurement made by the pressure sensor mounted on
30 connector 83, in conjunction with the measurements made by the pressure sensors mounted on the connectors 52 and 53, makes it possible to precisely check the operational state of the tangential flow filter 58. The section 76, which

extends from a third aperture 80c of the branching connector 80, comprises a disposable flexible pipe 84 and a flowmeter 85.

The pipe 84 has a portion 84a passing through the flowmeter 85 (from an inlet point 85a to an outlet point 85b) such that the amount of liquid and the flow rate of the filtrate retrieved at the outlet of the filter 58 can be
5 determined.

Next, the operation of this circuit will now be described.

After the operations of cleaning and rinsing explained below, the treatment by tangential flow filtration, can commence. The valves 54, 65 and 69
10 are closed, in order to prevent flow of liquid in the filtration section 41 and collecting section 62, the other valves being open.

The source bag 20 is linked to the section 22 by the connection of a male coupling connector 21 to the female coupling connector 28.

The liquid to treat is next sucked up from the source bag 20 by the transfer pump 25, and is conveyed to the supply container 43 via the transfer
15 section 22 and the filling section 40.

After the complete transfer of the liquid to treat into the circuit, the bag 30 containing the buffer liquid is connected, via the coupling connector 33, to the coupling connector 28. Next, this buffer liquid is introduced into the
20 transfer section 22 by the transfer pump 25, so that the liquid to be treated is pushed towards the section 40 such that all the liquid can be filtered and retrieved. Next, the transfer section 22 is isolated from the filling section 40 and filtration section 41 by closing the valve 26.

After the transfer has been carried out, the valves 54 and 65 are
25 opened, the liquid to be treated is made to flow, by the actuation of flow pump 64, in the sub-circuit formed by the supply section 61, filtration section 41 and filling section 40. After movement of the liquid into the tangential flow filter 58, the retentate returns to the supply container 43, and the filtrate is evacuated via the sections 76a, 76b and 76, and collected in the waste container 74.

30 The operation of making the liquid to be treated flow into filter 58 is continued until the liquid attains the desired concentration.

Next, the collection of the filtered liquid is carried out in two successive sub-steps.

The first sub-step comprises retrieving the filtered liquid contained in the filtration section 41 and in the filter 58.

5 For this purpose, the valve 44 is closed and the valve 26 is opened, so as to place the transfer 22 and filtration section 41 in a state of communication, and to isolate them from the filling section 40.

 At the same time, the valve 65 is closed and the valve 69 is opened so as to place the filtration section 41 and the collecting section 62 sections in a
10 state of communication, and to isolate them from the supply section 61.

 The male coupling connector 70 is connected to the female coupling connector 71 of the collecting container 72.

 Next, buffer liquid is conveyed in the section 22 by the transfer pump 25 so as to transfer the filtered liquid contained in the filtration section 41 and
15 the filter 58, via the collecting section 62, to the collecting container 72.

 The second sub-step comprises retrieving the filtered liquid contained in the filling section 40 and the supply section 61, and in the supply container 43.

 For this purpose, valve 54 is closed and valve 44 is opened, so as to
20 place the transfer section 22 and the filling section 40 in a state of communication, and to isolate them from the filtration section 41.

 At the same time, the valve 55 is closed and valve 65 is opened, so as to place the supply section 61 and the collecting section 62 in communication, and to isolate them from the filtration section 41.

25 Next, the buffer liquid is conveyed into section 22 by the transfer pump 25 so as to transfer the filtered liquid contained in the filling section 40 into the supply container 43.

 Next, the flow pump 64 allows liquid to be brought from container 43 to the collecting container 72, via the supply section 61 and the collecting
30 section 62.

Next, a description will be given of the cleaning and rinsing operations that are carried out by tangential flow filtration prior to the treatment, so as to avoid any contamination of the biological liquid to be treated.

In order to generate a flow of the cleaning liquid (sodium hydroxide) in the circuit, the bag 31 is placed in a state of communication with the transfer section 22 by connecting the male coupling connector 34 to the female coupling connector 28. An intermediate female coupling connector (not illustrated in Figure 1 for clarity) of section 22, which is positioned between the transfer pump 25 and the valve 26, is temporarily connected to an intermediate male coupling connector (not illustrated) of the section 61, which is positioned between the supply container 43 and the flow pump 64.

An intermediate male coupling connector of section 22 is normally connected to the intermediate female coupling connector (not illustrated) but is temporarily connected to a second female coupling connector (not illustrated) of the waste container 74, the connector 73 being connected to the male coupling connector 86.

The transfer pump 25 is set to the "open" position, such that all its rollers are separated from the portion 24a of the pipe 24. The valves 44 and 69 are closed, the other valves being open.

Next, the cleaning liquid is driven by the flow pump 64 in the circuit and is next retrieved in the waste container 74.

When the cleaning liquid is evacuated, rinsing of the circuit is performed by connecting the male coupling connector 35 of the bag 32 to the female coupling connector 28. Next, the rinsing liquid is driven by the flow pump within the circuit, and retrieved in the waste container 74 in the same way as described previously for the cleaning operations.

As a variant, an initial rinse of the circuit is carried out prior to the cleaning by passage of sodium hydroxide and/or the sodium hydroxide is flushed by the passage of air before the final rinsing.

Next, the device 1 that implements the circuit described above is described with reference to figures 2 to 8.

This device 1 comprises two carts 2 and 3, each having a parallelepiped general shape and being of identical depth.

It is also to be noted that the first cart 2 extends to a much greater height above the ground than the second cart 3.

5 In order to facilitate its movement in the treatment area, the first cart 2 is mounted on wheels 200, and has two arcuate handles 200a which project from a first lateral face 202. The first cart is hollow, in order to receive specific elements of the circuit, and partly open at its front face 201 and at its lateral faces 202 and 203 in order to simplify the connection operations.

10 Cart 2 comprises (Figure 2):

- an inner metal chassis 204 that is partly covered by flat panels 205;
- a supply tank 206 that receive the supply container 43;
- the electromagnetic drive 45;
- 15 - the transfer pump 25 and flow pump 64;
- an infrared temperature probe 211 (Figure 3)
- two horizontal trays 220 and 221 that respectively support the two pumps 25 and 64;
- a vertical panel 223 bearing the valves 26, 44 and 54 ;
- 20 - the flowmeter 85 (Figure 7) which is disposed in a recess of the lateral face 203 positioned above the pump 64; and
- a control panel 230 that controls, in particular, the pumps 25 and 64 and displays the values measured in the circuit (pressure, temperature, amount of flow, mass, flow rate, etc.), and is disposed on the front face 201
- 25 above pump 64.

The tank 206 comprises a cylindrical lateral wall 206a one of the ends of which is extended by a frustum shaped bottom wall 206b, which is provided with an oval opening 206c (Figure 3) for the passage of the apertures 43a and 43b of the disposable flexible supply container 43, and two other

30 circular openings 206d and 206e for cooperation with the electromagnetic drive 45 and the temperature probe 211.

The tank 206 is pivotally mounted on the lateral support posts 207a of a U-shaped bracket 207 (Figure 2), which are positioned in a plane parallel to the lateral faces 202 and 203 of the cart 2. The ends of the lateral support posts 207a are fixed to a weighing balance frame 208, resting on supports 209 linked
 5 to the chassis 204.

The load cells 210 (Figure 6), which are disposed between the frame 208 and its supports 209, enable the mass of the tank 206 to be precisely measured.

A handle 206f (Figure 3), which is fixed to the free end of the
 10 cylindrical lateral wall 206a of the tank 206 allows the tank to easily pivot about an axis 212 perpendicular to the front face 201, between an operating position (Figure 4) and an installation position (Figure 5). Two pins 213 (Figure 3), which are disposed on each of the support posts of the bracket 207 in the vicinity of the axis 212, are adapted to cooperate with two discs 214 fixed to the cylindrical
 15 lateral wall 206a of the tank 206, so as to lock the tank 206 in the desired position, or, on the contrary, to free the tank 206 to rotate.

The locking is achieved by the insertion of a metal rod positioned at the end of each pin 213 into a bore 214a of the corresponding disc 214. Conversely, in order to release the tank 206 and rotate it, it suffices to simply
 20 pull each of the pins 213 so that the rods come out of the discs 214.

In its operating position, the tank 206 is upright, and its frustum shaped bottom wall 206b is oriented towards the ground; the supply container 43 being disposed in the tank 206, and apertures 43a and 43b of the supply container 43 projecting from that bottom wall 206b towards the ground.

25 In the installation position illustrated in Figure 5, the tank 206 is sideways, and the free end of its cylindrical lateral wall 206a faces an opening 216 of the lateral face 202 of the cart 2. For the operator, this installation position facilitates the withdrawal of a supply container 43 after use and the installation new container.

30 The temperature probe 211 and the electromagnetic drive 45 serving for the actuation of the magnetic drive agitator 44 are fixed to a metal

framework 217 (Figures 4 and 5) pivotally mounted on the cross-member 207b (Figure 2) that forms the base of the bracket 207.

The infrared temperature probe 211 makes it possible to measure, through container 43, the temperature change of the biological liquid during treatment.

The electromagnetic drive 45 (Figure 2) comprises several spools, making it possible to raise and turn the agitator 44 contained in the supply container 43.

When the device 1 is caused to operate, and after the tank 206 has been disposed in its operating position, the framework 217 is brought, using a handle 217a, to its position illustrated in Figures 2 to 4. In this position, the respective ends of the electromagnetic drive 45 and of the temperature probe 211 (Figure 2) are positioned as closely as possible to container 43.

A pin 219 (Figure 2) that is fixed to the cross member 207b is adapted to cooperate with the framework 217 so as to lock the framework 217 in that position from the beginning to the end of the filtration process.

After the process has been terminated, the framework 217 is unlocked and freely pivots, and the framework 217 discovers its equilibrium position in which it rests on the chassis 204 of the cart 2.

Next the cart 3 will be described in more detail.

In the same manner as for the cart 2, in order to facilitate movement in the treatment area, cart 3 is also mounted on wheels 300, and has arcuate handles 300a which project from a first lateral face 305 (Figure 2).

The cart 3 comprises:

- an inner metal chassis 301 (Figure 4) that is partly covered by flat panels 302;
- supports for the connectors 52, 53, 66 and 83 for pressure sensors (although these connectors 52, 53, 66 and 83 are shown in Figures 3 and 7, they are disposable and are not permanently present on cart 3);
- supports for the valves 55, 65 and 69;

- two parallel arms 315, 316 fixed to the upper face 303 of that cart 3, which are arms 315, 316 on which the disposable filter 58 and the supports for the connectors 52, 53, 66 and 83 rest;
 - a horizontal panel 317 extending from the arm 316 on which the supports for valves 55, 65 and 69 are fixed; and
 - two storage drawers 304 (Figures 7 and 8) for storing the collecting container 72 and the waste container 74, as well as any sampling containers or drainage containers, which are not illustrated for reasons of simplification.
- 10 The upper face 303 is entirely or partly formed by a plate of transparent material, so as to allow observation over time of the progress of the filling of the collecting container 72.
- The tangential flow filter 58 is disposed close to the first lateral face 305 and to the front face 307, its four apertures 58a, 58b, 58c and 58d oriented
- 15 towards the second lateral face 308 of the cart 3.
- The four supports for the connectors 52, 53, 66 and 83 are positioned between the filter 58 and the second lateral face 308.
- The storage drawers 304 are slidably mounted in the internal part of the cart 3 and are accessible from its first lateral face 305 which is open. A cut-
- 20 out 306 is provided in the facade of each drawer 304 so as to allow the passage of the pipe 68 or 84 (Figure 8).
- When the device 1 is mounted, the lateral face 203 of the first cart 2 is juxtaposed against the lateral face 308 of the second cart 3, as illustrated in Figures 3 to 7.
- 25 At the time of their juxtaposition, the carts 2 and 3 lock to each other, here, by engagement of an lug (not visible in the drawings) in an accommodation 330 (Figures 2 and 4) of the cart 3.
- The lug of cart 2 is positioned at the end of a plate 230 (Figure 4) which is fixed to the lower face of the cart 2.
- 30 This lug projects from the face 203 and at its center has an opening where one or multiple retaining teeth are positioned. The retaining teeth are positioned at one of the ends of a lever 331 (Figure 4) that is connected by a

hinged on a pivot 332 that is carried by the lower face of cart 3. The other end of lever 331 is located at lateral face 305 and comprises a pedal 333 (Figure 7) whereby the lever 331 can be inclined to release the retaining teeth from the opening of the lug projecting from the cart 2, whereby the two carts can be released.

After the carts 2 and 3 have been juxtaposed, the disposable elements (pipes, containers, certain valves, connectors, filter, and the like) are installed on the re-usable elements that are disposed on the carts 2 and 3.

Next, the mounting of the device is finished and the device is in accordance with Figures 3 to 6.

Figure 4 represents a sectional view of the complete device with the pipes installed, is such as to allow understanding of how the disposition of the two pumps 25 and 64 and of the tank 206 on cart 2 is optimized.

Accordingly, the plate 221 which supports the flow pump 64 is disposed in the vicinity of lateral face 203 of the cart 2 at a predetermined height and depth (relative to the front face 201) such that the outlet point 64b of the flow pump 64 is positioned substantially facing the inlet/outlet aperture 58b of the tangential flow filter 58 (Figure 4). This positioning makes it possible to limit the length of the pipes 63 and 51 between the flow pump 64 and the filter 58, and thus the length of the sub-circuit in which the flow of the liquid occurs.

Similarly, the positioning of the tank 206 relative to the flow pump 64 makes it possible to limit the length of pipe 63 between the supply container 43 and the pump 64, while taking into consideration the fact that this portion of pipe 63 has an elbow-shaped profile (since the outlet aperture 43b of the container 43 is vertically oriented towards the ground, and the inlet point 64a of the flow pump 64 is horizontally oriented towards the tank 206).

To describe this in more concrete terms, in order to avoid the risk of scissoring the pipe 63, the radius of curvature of the elbow must be equal to or greater than a minimum value R_{min} , which depends on the characteristics inherent to that pipe.

In other words, the outlet aperture 43b of the container 43 must be offset in terms of height and width, relative to the inlet point 64a of the flow pump 64, by at least the value R_{min} .

Consequently, in order to meet this double offset constraint, the tank
 5 206 (receiving container 43) is positioned above and is laterally displaced (in the direction of the lateral face 202) relative to pump 64.

Still further, and still with the object of limiting the length of pipe 50 between the filter 58 and the branching connector 23, and thus the length of the sub-circuit in which the liquid is re-passed, when the circuit is mounted, this
 10 connector 23 must be disposed in the vicinity of the lateral face 203 of the cart 2, at a predetermined height and depth such that its aperture 23c is positioned substantially facing the inlet/outlet aperture 58a of the tangential flow filter 58 (Figure 6).

By looking at the filter 58 in Figure 2, it will be understood that the
 15 aperture 58a is positioned slightly higher and further forward than the aperture 58b. The aperture 23c of the branching connector 23 (Figure 6) must be positioned slightly higher and further forward than the aperture 64b of the pump 64.

Consequently, in order to meet this double offset constraint, the
 20 vertical panel 223 (on which is fixed branching connector 23) is positioned forward of pump 64 and at its upper portion (Figures 2, 6 and 7).

This constraint has an influence on the positioning of the transfer pump 25; the inlet point 25b of the transfer pump 25 must be disposed in the same plane as the aperture 23a, 23c of the branching connector 23 and the
 25 aperture 58a of the tangential flow filter 58 (Figures 3 and 6).

Accordingly, the pump 25 is offset towards the front relative to the flow pump 64, such that it is disposed in the vicinity of the front face 201 of the cart (Figures 2 and 3).

The position of the transfer pump 25 must also take into
 30 consideration the fact that the portion of pipe 24 between the transfer pump 25 and the branching connector 23 has an elbow-shaped profile, since the aperture

23a of the connector 23 is vertically oriented towards the ground, and the inlet/outlet point 25b of transfer pump 25 is horizontally oriented (Figure 5).

In order to avoid the risk of scissoring the pipe 24, the radius of curvature of that elbow must be equal to or greater than a minimum value R'_{min} which depends on the characteristics inherent to that pipe.

In other words, the inlet/outlet point 25b of the transfer pump 25 must be offset vertically and in width, relative to the aperture 23a of the branching connector 23, by at least the value R'_{min} .

Consequently, in order to meet this double offset constraint, the transfer pump 25 is positioned below branching connector 23 (and thus below pump 64) and it is laterally displaced towards lateral face 202. This has the advantage of not increasing the width of the cart 2, and thus the cart 2 is still compact.

It will be understood that the advantage of minimizing the length of the filtration loop formed by sections 40, 41 and 61 is that, at the end of treatment (feed container 43 empty or nearly empty), the amount of biological liquid remaining in that loop is also minimized, and the concentration attained is maximized.

In variants that are not illustrated here:

- rather than being horizontal, the plate 221 is inclined such that it drops towards the face 203. This is advantageous when the section 63a of the pipe 63 is curved within the pump 64 such that the concavity of the pipe 63 is oriented downwards (the rotor of the pump 64 turns about a horizontal axis). This enables the pump 64 to be inclined, so as to avoid there being a low point in the pipe 63 at the inlet/outlet point 64a;

- section 22 is replaced by a similar section that further comprises a pressure sensor connector that is disposed between the second inlet/outlet point 25b of the pump 25 and the valve 26 so that proper operation of that pump 25 is ensured;

- the bags 30, 31 and 32 are permanently connected to the transfer section 22, a set of valves positioned between those bags and the section 22 make it possible to select the liquid that it is desired to pass in the circuit;

- the valve 65 is eliminated, the blocking function is produced simply by the flow pump 64 when stopped;
- the peristaltic pumps 25 and 64 are replaced by pumps of another type, for example a pump adapted to receive a pumping head forming part of the disposable elements;
- when the volume of the source bag 20 is greater than the volume of the supply container 43, the operations for transfer of the liquid contained in that bag are carried out by the "fed batch" technique. This technique comprises transferring only a part of the liquid from the source bag 20 into the supply container 43, and next, transferring and concentrating that liquid in the sub-circuit formed by sections 40, 41 and 61, while progressively transferring (valve 26 remaining open) the rest of the liquid still contained in bag 20, so that this replaces the filtrate evacuated into the waste container 74;
- the connector 53 is eliminated, and next the pressure sensor connected onto the connector 66 is used so as to provide similar information;
- the connectors 21, 33, 34, 35, 70, 86, 28, 71 and 73 are replaced by fast connectors and/or non-male/female differentiated connectors;
- the flowmeter 85 is replaced by a weighing instrument on which the collecting container 72 is placed, so as to determine the mass and the flow rate of the filtrate retrieved at the outlet of the filter 58;
- other measuring and verification instruments are installed, for example, an electrical conductivity measuring cell or a pH measuring cell, or a cell that measures the absorbency of the liquid by ultraviolet;
- the drawers 304 are replaced by simple shelves. These shelves can be adjusted in height, and roller mats and boxes are disposed on the shelves so as to facilitate the positioning and withdrawal of the containers 72 and 74;
- when the collecting container 72 and the waste container 74 have too great a volume to be introduced inside the cart 3, they are placed directly on the floor in the vicinity of that cart 3;
- the male coupling connectors 70 and 86 are linked to a drain pipe;

- the metal framework 217 is replaced by a framework mounted so as to move vertically in translation relative to the cross-member 207b;
 - the filter 58, the connectors 52, 53, 66 and 83, and the valves 55, 65 and 69 are disposed on a simple table; and/or
- 5 - a final filter is disposed between the valve 69 and the collecting container 72.

In other variants not illustrated here, the carts 2 and 3 can serve for carrying out different tangential flow filtration treatments.

Numerous other variants are possible according to circumstances. In
10 this connection, it should be noted that the present invention is not limited to the exemplary modes of embodiment described and shown here.

CLAIMS

1. A cart for a biological liquid treatment device (1), the cart being characterized by comprising a first lateral face (202), a second lateral face (203), wherein said cart is adapted by the second lateral face so as to be juxtaposed against another cart (3), and a front face (201) which meets the two said lateral faces (202, 203);

further comprising:

- a first pump (64);
- a second pump (25) disposed below said first pump (64) and laterally offset, relative to said first pump (64), towards said first lateral face (202); and
- a tank (206) disposed above said first pump (64) and offset laterally, relative to said first pump (64), towards said first lateral face (202), the tank (206) being adapted to receive a supply container (43) provided so as to contain said biological liquid.

2. The cart recited in claim 1, characterized in that said second pump (25) is offset depthwise, relative to said first pump (64), towards said front face (201).

3. The cart recited in claims 1 or 2, characterized in that said tank (206) is mounted so as to be movable between an upright service position for the operations of treating said biological liquid, and a lying-down installation position for the mounting or withdrawal of said supply container (43).

4. The cart recited in claim 3, characterized in that said tank (206) is adapted to pivot about an axis (212) perpendicular to said front face (201) of said cart.

5. The cart recited in claims 3 or 4, characterized by comprising means (213, 214) for locking said tank (206) in either of the service position and the installation position.

6. The cart recited in claim 5, characterized in that said locking means (213, 214) comprise at least one pin (213).

7. The cart recited in any one of claims 1 to 6, characterized in that said tank (206) is mounted on a U-shaped bracket (207) of which the two ends are fixed to a balance frame (208) that is adapted to cooperate with load cells (210) in order to measure the mass of said tank (206).

8. The cart recited in any one of claims 1 to 7, characterized in that said pumps (64, 25) are peristaltic pumps.

9. The cart recited in any one of claims 1 to 8, characterized by comprising an electromagnetic drive (45) to raise and turn an agitator (44) contained in said supply container (43).

10. The cart recited in any one of claims 1 to 9, characterized by comprising a temperature probe (211) for measuring, through said supply container (43), the temperature change of said biological liquid during said treatment.

11. The cart recited in any one of claims 1 to 10, characterized by including a control panel (230) that control said pumps (64, 25).

12. A device for treating a biological liquid, the device being characterized comprising:

- the cart (2) recited in any one of claims 1 to 11, which is designated as a first cart;
- a filter (58); and
- a second cart (3) that is juxtaposed against said first cart (2), wherein an upper face (303) of the second cart supports said filter (58) such that an outlet point (64b) of said first pump (64) is positioned substantially facing an inlet/outlet aperture (58b) of said filter (58).

13. The device recited in claim 12, characterized in that said filter is a tangential flow filter (58).

14. The device recited in claim 13, characterized by further comprising a collecting container (72) that collects said filtered biological liquid, and which is disposed in a housing of said second cart (3).

15. The device recited in claim 14, characterized in that said housing is formed by the interior of a drawer (304).

16. The device recited in claim 15, characterized in that the facade of said drawer (304) comprises a cut-out (306) through which a disposable flexible pipe (68) passes.

17. The device recited in any one of claims 12 to 16, characterized in that the device comprises:

- a source container (20) for said biological liquid;
 - a supply container (43) which is disposed in said tank (206) of said cart;
 - a container (72) that collects said filtered biological liquid;
 - a transfer section (22) that connects said source container (20) to a first aperture (23a) of a branching connector (23), the transfer section (22) comprising a member (24a) adapted to cooperate with said second pump (25) of said cart (2) in order to generate a flow of said biological liquid;
 - a filling section (40) that links a second aperture (23b) of said branching connector (23) to an inlet/outlet aperture (43a) of said supply container (43);
 - a filtration section (41) comprising said filter (58) and connecting a third aperture (23c) of said branching connector (23) to a first aperture (60a) of a second branching connector (60);
 - a supply section (61) that links a second aperture (60b) of said second branching connector (60) to an inlet/outlet aperture (43b) of said supply container (43), and comprising a member (63a) adapted to cooperate with said first pump (64) of said cart (2) to generate a flow of said biological liquid; and
 - a section (62) that links a third aperture of said second branching connector (60) to said collecting container (72) and collects said filtered liquid;
- each of said transfer section (22), filling section (40), filtration section (41), supply section (61) and collecting section (62) comprising at least one disposable pipe (24, 42, 50, 51, 63, 68).

18. The device recited in claim 17, characterized by comprising at least one section (76a, 76b, 76) that conveys the filtrate, which serves to link an outlet point (58c, 58d) of said filter (58) to a waste container (74), and comprises at least one disposable pipe (77, 81, 84).

19. The device recited in claim 18, characterized by comprising two said conveying sections (76a, 76b) extending from a respective said outlet point (58c, 58d) of said filter (58) and joining via a branching connector, so as to form a single section (76).