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(71) Applicant: **Metso Fiber Karlstad AB**
651 15 Karlstad (SE)

(72) Inventor: **Snekkenes, Vidar**
NO-0682, OSLO (NO)

(54) A method for producing cellulose pulp in a continuous digester in an energy-efficient manner

(57) The invention describes a method for producing cellulose pulp in a continuous digestion system in an energy-efficient manner. Cellulose chips are fed continuously with a transfer liquid in a transfer line (11) to a top separator (20) arranged at the top of a digester (30), for the separation of free liquid from the cellulose chips. The top separator has a withdrawal space (21) in which free liquid collects. At least a fraction of the free liquid that has separated, with a temperature T_{ut}, is led in a return line (32) from the withdrawal space of the top separator to a position to be used as transfer liquid. At least one pressurised withdrawal of black liquor is carried out in the digester (30) essentially at the cooking temperature of at least 135 °C. The invention is characterised in that an additive liquid with a temperature T_{in} is added at the withdrawal space (21) of the top separator, where $T_{in}>T_{ut}$.

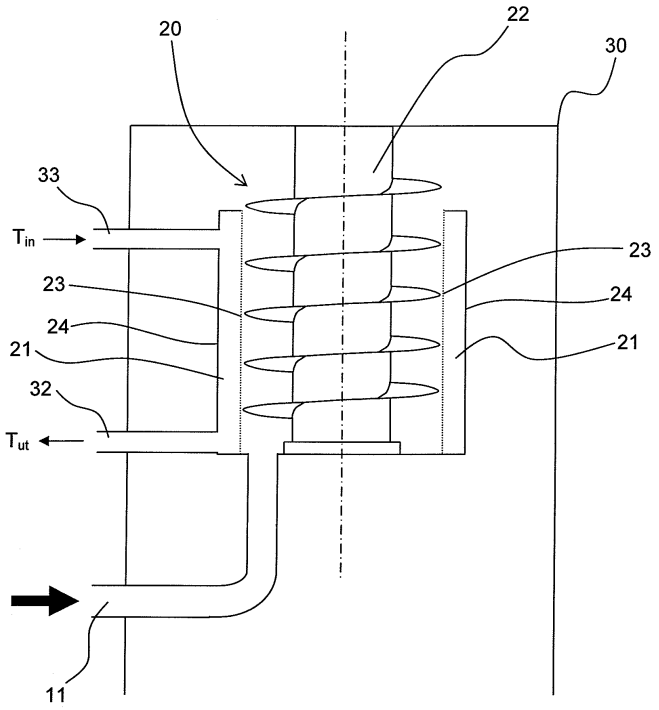

Fig. 4

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Description

Technical Area

[0001] The present invention concerns a method for producing cellulose pulp in a continuous digester in an energy-efficient manner, as described in the preamble of patent claim 1.

The Prior Art

[0002] In conventional continuous digesters, chips are impregnated with impregnation liquid in an impregnation vessel. The impregnated chips are subsequently cooked in a digester, whereby the impregnation vessel and the digester are coupled to each other by means of a transfer circulation. The transfer circulation consists not only of a transfer line that feeds the chips from the outlet end of the impregnation vessel to the top of the digester for the separation of free liquid in a top separator, but also of a return line that feeds separated liquid from the top of the digester to the outlet end of the impregnation vessel in order to be used as transfer liquid for the impregnated chips.

[0003] In a steam phase digester steam is added at the top of the vessel, in order to heat the chips before the cooking is begun. This steam requires a great deal of energy and several inventions for this reason have been directed towards reducing the requirement for steam that is added to the digester.

[0004] SE 518 957 reveals an invention in which one of the aims is to reduce the requirement for the supply of steam to the top of the digester. According to this patent, a fraction of the black liquor (14) withdrawn from the digester (2) is added at the beginning of the transfer flow at what is essentially the withdrawal temperature Tav, which the liquor has retained, with the aim of raising the temperature of the chips mixture in the transfer circulation. A fraction of the withdrawn liquid from the top separator of the digester is returned to the impregnation vessel such that it there can act as impregnation liquid. A heating of the chips is obtained with this invention, which ensures that the consumption of steam at the top of the digester can be reduced, and the steam can therefore be used for another purpose. One limitation of this method is that the temperature of the black liquor that is added should not be too high, since this would then introduce the risk of steam implosion.

[0005] SE 511 850 reveals a way of simplifying the digestion plant with respect to the withdrawal of liquid from the digestion system before the initial phase of the cooking, such that the design of the impregnation vessel can be simplified. In one preferred embodiment of the invention, cooking liquid is added to the top separator after the separation of liquid in order to be mixed with the fibre material that has a low liquid content under the influence of a screw in the top separator that feeds material in an upward direction.

In accordance with Figure 2, the top separator of the invention has a rotating screw 29 that is arranged vertically. The top separator has also a lower sieve section 31 that is surrounded by a wall 34 in order to form an intermediate liquid chamber 35 for the collection of liquid, which liquid is pressed out through the sieve section 31 under the influence of the screw. A ring-shaped supply pipe 36 is arranged around the screw 29. Holes 37 are arranged in the ring-shaped supply pipe for the supply of white liquor and possibly also other liquid to the chips. The return line 26 is connected to the liquid chamber 35. Steam at intermediate pressure is added through line 39 to the upper steam space of the digester at the top of the digester 4 in connection with the top separator 28 in order to heat the chips that are fed in by the screw 29 and that fall down over the edge 33. There is no connection between the withdrawal space 35 and the ring-shaped supply line.

[0006] One risk with this solution is that the liquid that is added in the supply line can give rise to blockage at the top of the digester since the added liquid can risk flushing the chips in a backwards direction.

The aim of the invention

[0007] A first aim of the invention is to reduce the requirement of heating with steam at the top of the digester.

[0008] A second aim of the invention is to be able to heat the chips before the cooking process using a temperature of the hot liquid that is higher than that which is possible when the heating is carried out at the transfer flow.

[0009] A third aim of the invention is to avoid clogging at the top separator in a steam phase digester.

Brief description of the invention

[0010] The concept of the invention is to achieve a method for producing cellulose pulp in a continuous digester system that is efficient in its use of energy. In a conventional continuous digester, chips are fed continuously in a transfer liquid to a top separator arranged at the top of a digester.

[0011] Separation of free liquid from the cellulose chips into a withdrawal space where the liquid is collected takes place in the top separator. A fraction of the free liquid is drawn from the withdrawal space in a return line, to a position at which it can act as transfer liquid.

[0012] The invention is characterised in that a hot additive liquid is added to the withdrawal space of the top separator. The temperature of the hot additive liquid that is added to the withdrawal space is greater than the temperature of the withdrawn liquid in the free liquid in the return line. The following advantages are achieved in that the hot liquid is added to the withdrawal space

+ Any heating that takes place in the transfer circulation can be reduced or totally eliminated, which ensures that the heating of the chips can be carried out

by a liquid at a higher temperature than that which is possible in, for example, the invention described in SE 518 957.

+ The amount of steam that is added at the top can be reduced.

+ The hot additive liquid that is added at the withdrawal position does not flush the chips against the direction of motion, and this means that the risk of blockage at the top of the digester is reduced. In comparison with SE 511 850.

+ This method ensures that the withdrawal space is filled with liquid all the time, which prevents blockage of the top separator.

Description of drawings

[0013]

Figure 1 shows a first preferred embodiment of the invention for which a patent is sought.

Figure 2 shows a second preferred embodiment of a digester system according to the invention for which a patent is sought.

Figure 3 shows a third preferred embodiment of the invention for which a patent is sought.

Figure 4 shows a top separator arranged at the top of a digester according to the method for which a patent is sought.

Detailed description of the invention

[0014] Figures 1 and 4 show a first preferred embodiment of a method for producing cellulose pulp in a continuous digester system in an energy-efficient manner. Cellulose chips are fed continuously to an impregnation vessel **10** in order to be impregnated in an impregnation liquid in the impregnation vessel **10**.

[0015] Once the impregnation is finished, the impregnated chips are fed with a transfer liquid in a transfer line **11** to a top separator **20** arranged at the top of a digester **30**, for the separation of free liquid from the cellulose chips, where the digester **30** is a steam phase digester.

[0016] The transfer line **11** is connected to the bottom of the top separator **20** and the chips are thus fed upwards through the top separator.

[0017] In accordance with Figure 4, the top separator **20** has a rotating upwardly feeding screw **22** that is arranged vertically. The top separator **20** has also a screening surface **23**, which is surrounded by an impenetrable wall **24** for the formation of an intermediate withdrawal space **21**, for the collection of free liquid that is pressed out through the screening surface **23** under the influence of the screw **22**. The withdrawal space **21** extends over at least 50%, preferably at least 75%, of the threaded height of the screw **22**.

[0018] At least a fraction of the free liquid that has separated is led in a return line **32** from the withdrawal space of the top separator to the outlet end of the impregnation vessel in order to be used as transfer liquid. The return line **22** is connected to the lower part of the withdrawal space **21** and the temperature of the withdrawn liquid in the return line **32** is $\mathbf{T_{ut}}$. A means **35** of creating pressure, preferably in the form of a pump, is arranged in the return line **22**.

[0019] At least one pressurised withdrawal of black liquor is carried out in the digester **30** essentially at the cooking temperature of at least 135 °C. A fraction of this pressurised withdrawal of black liquor can be led to the bottom of the impregnation vessel along a black liquor line **34**.

[0020] An additive liquid with a temperature $\mathbf{T_{in}}$ is added through an addition line **33** connected to the upper part of the withdrawal space, where this additive liquid consists of at least part of the black liquor withdrawal. The additive liquid is mixed with the chips under the influence of the screw **22** that feeds material upwards. The relationship between the temperature of the black liquor withdrawal that is added to the withdrawal space and the temperature of the free liquid withdrawn from the withdrawal space is such that $\mathbf{T_{in} > T_{ut}}$. The additive liquid that is led in the addition line **33** is added to the withdrawal space **21** downstream of the return line **32**, when seen in the direction of motion of the chips.

[0021] The liquid/wood ratio in the transfer line **11** is ≥7, the remaining liquid in the chips after they have passed the top separator lies at a liquid/wood ratio of ≥3 and the amount of additive liquid in the addition line **33** that is added to the withdrawal space **21** lies at a liquid/wood ratio ≥1.

[0022] The level of COD (Chemical Oxygen Demand) in the additive liquid that is added at the top separator **20** may be either lower or higher than that of the free liquid that is withdrawn at the top separator **20** in the return line **32**.

[0023] Figure 2 shows a second preferred embodiment according to the method according to the invention. Instead of using the pressurised black liquor withdrawal as additive liquid, at least a part of the free liquid that is withdrawn at the withdrawal space **21** is here used. This withdrawal is heated in a heat exchanger **40**, before it is led in the addition line **33** to the withdrawal space **21** as additive liquid, where the temperature of the additive liquid $\mathbf{T_{in}}$ is higher than $\mathbf{T_{ut}}$. The heating agent with which the additive liquid exchanges liquid in the heat exchanger **40** may be constituted of the pressurised black liquor withdrawal. Other types of heating are possible instead of that of exchanging heat with liquids, such as, for example, heating by steam. This embodiment otherwise is identical with the first preferred embodiment.

[0024] Figure 3 shows a third preferred embodiment according to the method according to the invention. The additive liquid in this embodiment is constituted by two liquids: partly the pressurised black liquor withdrawal according to the first preferred embodiment, and partly the heated free liquid that is withdrawn at the withdrawal space according to the second preferred embodiment.

This embodiment otherwise is identical with the first preferred embodiment.

[0025] The following positive advantage are achieved with the invention:

+ Any heating that takes place in the transfer circulation can be reduced or totally eliminated, which ensures that the heating of the chips can be carried out by a liquid at a higher temperature than that which is possible in, for example, the invention described in SE 518 957.
+ The amount of steam that is added at the top can be considerably reduced.
+ The hot additive liquid that is added at the withdrawal position does not flush the chips against the direction of motion, and this means that the risk of blockage at the top of the digester is reduced. In comparison with SE 511 850.
+ This method ensures that the withdrawal space is filled with liquid all the time, which prevents blockage of the top separator.
+ The hot additive liquid does not noticeably affect the temperature in the transfer flow.

[0026] Several embodiments than those described above are possible within the framework of the attached patent claims. It is not necessary, for example, that the chips be impregnated in an impregnation vessel before they are fed in the transfer liquid up to the top separator. The chips instead can be subject to steam pre-treatment in a steam pre-treatment vessel, or they may be treated by some other method.

[0027] It is thus fully without significance for the innovative concept of the invention how the chips have been treated before they are fed into the top separator. The important point is that a liquid is added to the withdrawal space, which liquid has a temperature that is higher than the temperature that is withdrawn in the return line from the withdrawal space.

[0028] The additive liquid can, as in the third preferred embodiment, be constituted by two liquids, and it can also be constituted by more than two liquids. The only point that is important for the innovative concept of the invention is that the temperature of the additive liquid is higher than the temperature of the withdrawal that is drawn in the return line.

Claims

1. A method for producing cellulose pulp in a continuous digestion system in an energy-efficient manner, where the method comprises the following steps:

   a) cellulose chips are fed continuously with a transfer liquid in a transfer circulation (11) to a top separator (20) arranged at the top of a digester (30), for the separation of free liquid from the cellulose chips, the top separator has a withdrawal space (21) in which free liquid collects;
   b) at least a fraction of the free liquid that has separated, with a temperature T_{ut}, is led in a return line (32) from the withdrawal space of the top separator to a position to be used as transfer liquid;
   c) at least one pressurised withdrawal of black liquor is carried out in the digester (30) essentially at the cooking temperature of at least 135 °C;

   characterised in that additive liquid with a temperature T_{in} is added at the withdrawal space (21) of the top separator, where $T_{in}>T_{ut}$.

2. The method according to claim 1, **characterised in that** the chips have been impregnated with impregnation liquid in an impregnation vessel (10), before the cellulose chips are fed in the transfer liquid to the top separator (20).

3. The method according to claim 2, **characterised in that** the free liquid that has separated is led in a return line (32) from the withdrawal space of the top separator to the outlet end of the impregnation vessel in order there to be used as transfer liquid.

4. The method according to any one of claims 1-3, **characterised in that** the additive liquid is added at the withdrawal space downstream of the return line, seen in the direction of motion of the chips.

5. The method according to any one of claims 1-4, **characterised in that** the additive liquid is mixed with the chips under the influence of a screw that feeds material upwards at the top separator, and where the digester is a steam phase digester.

6. The method according to any one of claims 1-5, **characterised in that** the additive liquid is constituted by a liquid that has been heated.

7. The method according to claim 6, **characterised in that** the liquid that has been heated is constituted at least partially by the liquid withdrawn from the top separator.

8. The method according to any one of claims 1-5, **characterised in that** the additive liquid is constituted at least a part of the pressurised black liquor withdrawal.

9. The method according to any one of claims 1-5, **characterised in that** the additive liquid is constituted by at least a part of the pressurised black liquor withdrawal and at least a part of the withdrawal from the top separator that has been heated.

10. The method according to any one of claims 1-9, **characterised in that** the liquid/wood ratio in the transfer line is ≥7, and **in that** the residual liquid in the chips after the top separator lies at a liquid/wood ratio ≥3, where the amount of additive liquid that is added lies at a liquid/wood ratio ≥1.

11. The method according to any one of claims 1-10, **characterised in that** the withdrawal space (21) extends over at least 50%, preferably at least 75% of the threaded height of the screw.

12. The method according to any one of claims 1-11, **characterised in that** the additive liquid that is added to the top separator has a lower COD level than the liquid that is withdrawn from the top separator.

13. The method according to any one of claims 1-11, **characterised in that** the additive liquid that is added to the top separator has a higher COD level than the liquid that is withdrawn from the top separator.

14. The method according to any one of the preceding claims, **characterised in that** the additive liquid is added to the upper part of the withdrawal space through an addition line (33), and **in that** the return line (22) is connected to the lower part of the withdrawal space (21).

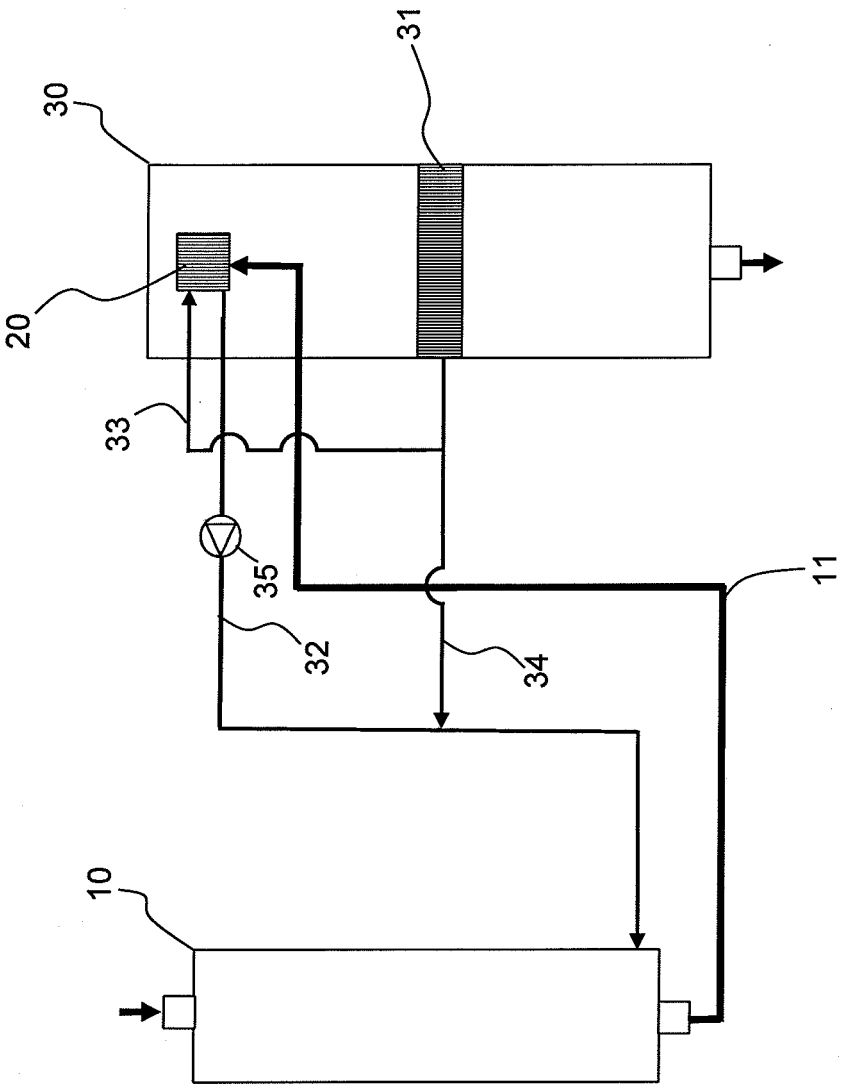

Fig. 1

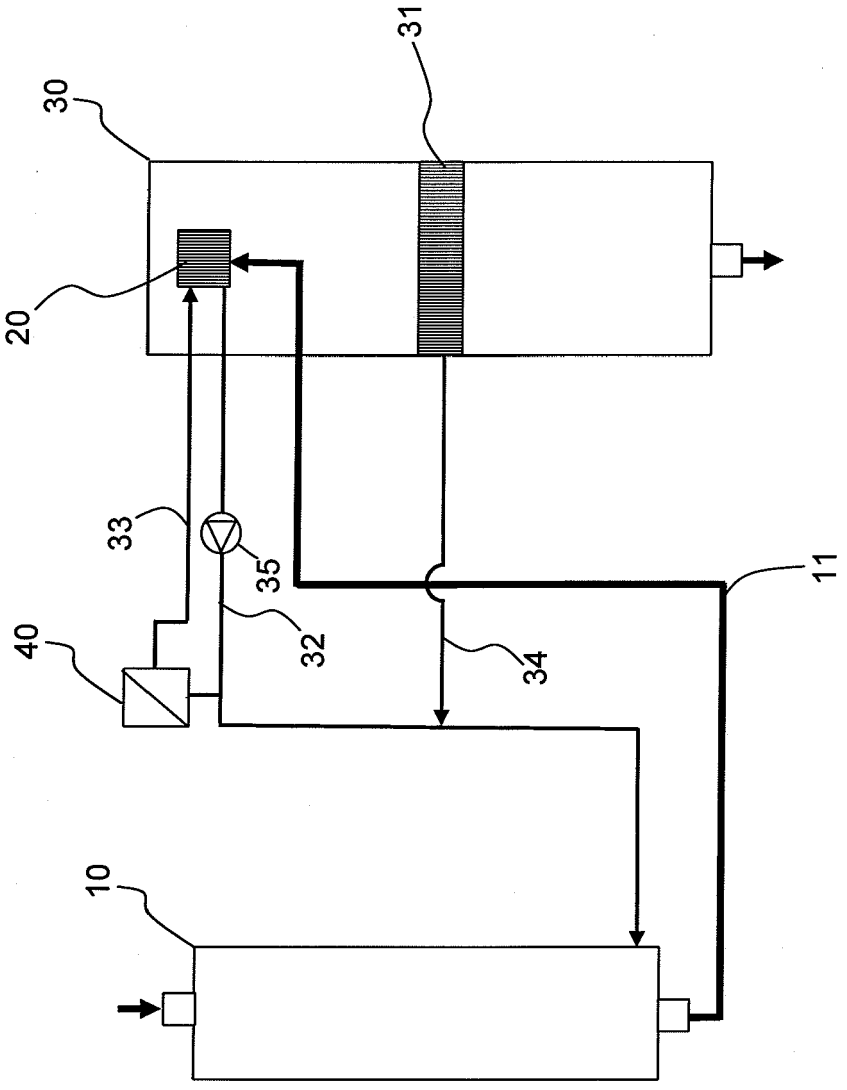

Fig. 2

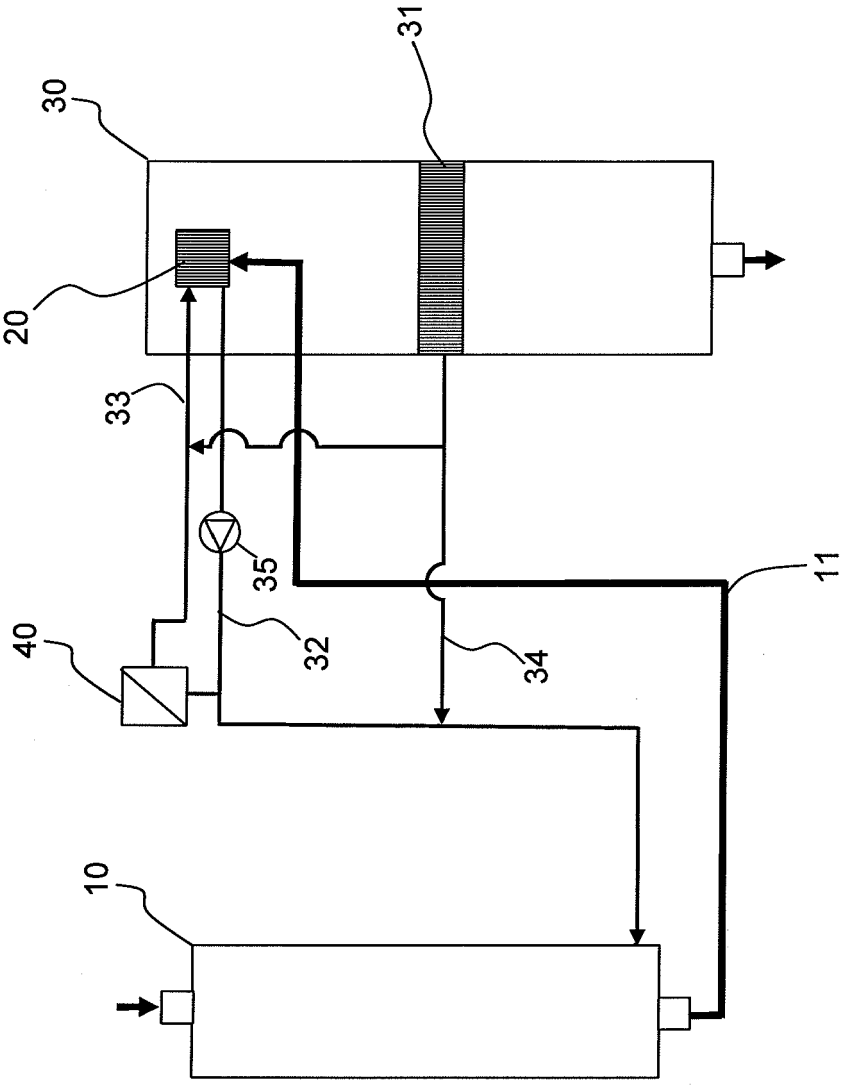

Fig. 3

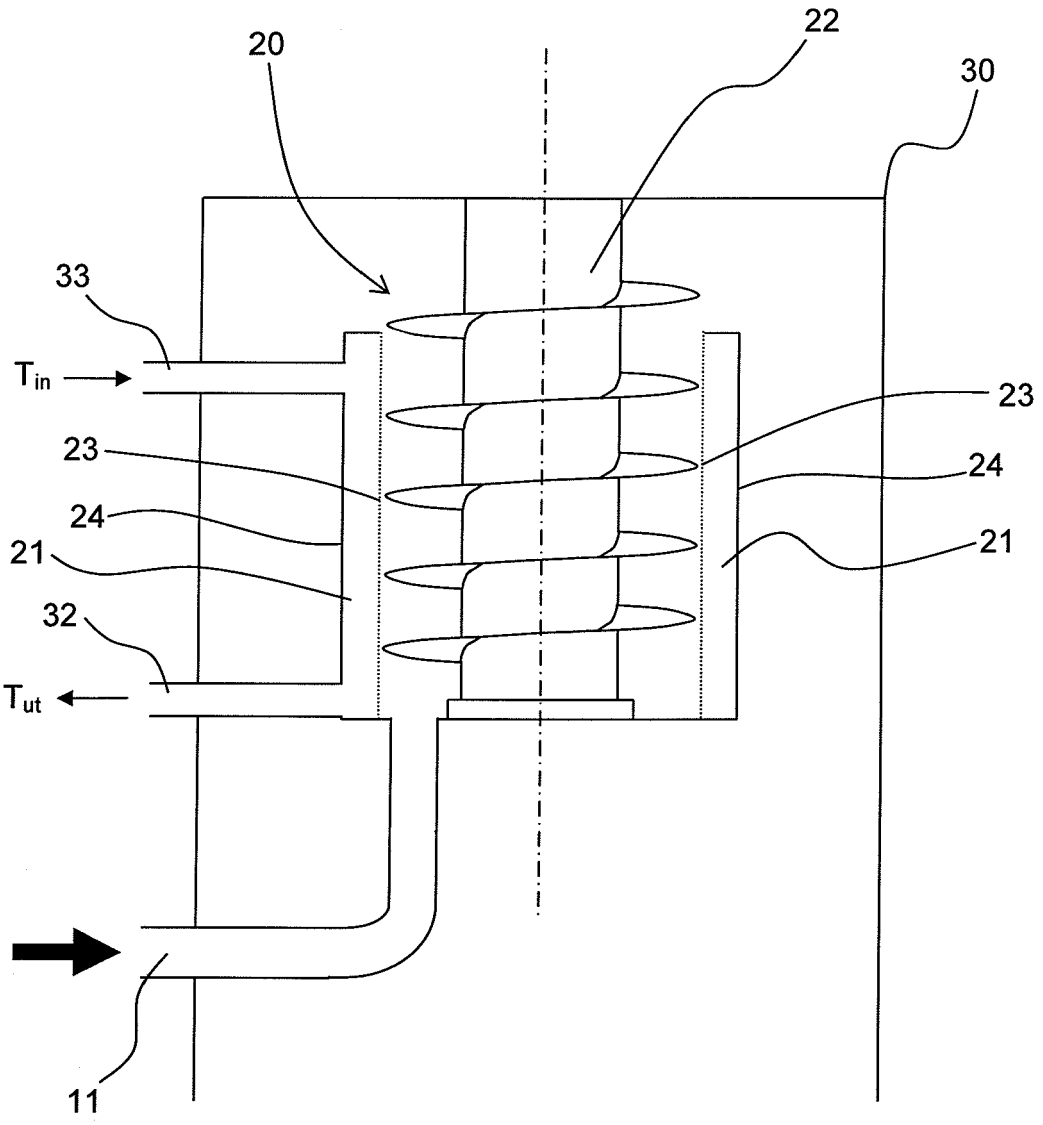

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- SE 518957 **[0004] [0012] [0025]**
- SE 511850 **[0005] [0012] [0025]**