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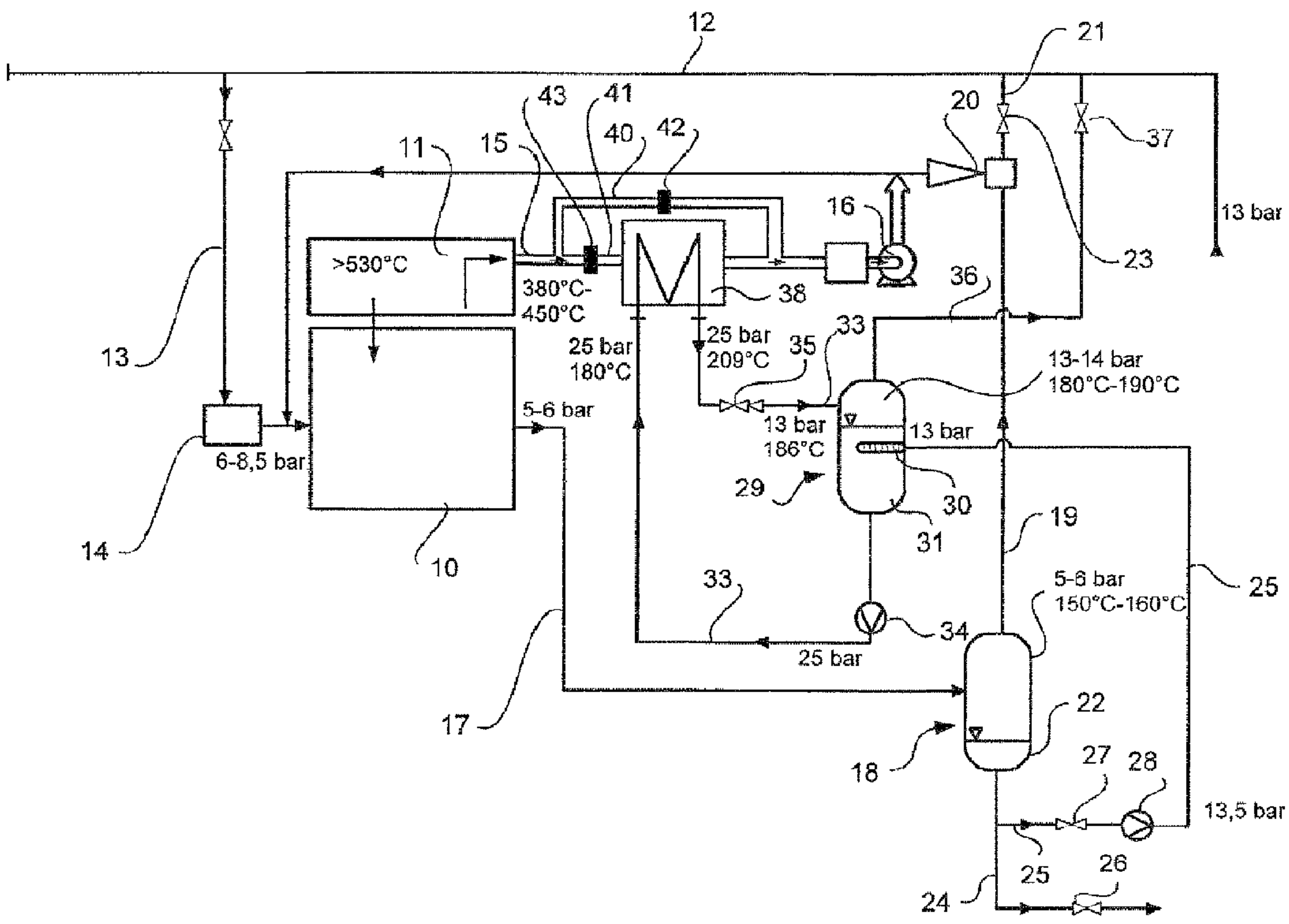
(54) Titre : DISPOSITIF ET PROCEDE DE SECHAGE D'UNE BANDE CONTINUE DE PAPIER TISSU PAR RECUPERATION DE VAPEUR
(54) Title: DEVICE AND METHOD FOR DRYING A TISSUE PAPER WEB USING STEAM RECOVERY



(57) **Abrégé/Abstract**:
The invention relates to a method for recapturing steam when drying a tissue paper web having a cylinder (10) fed from a fresh steam network (1) and a hot air hood (11) blowing hot air onto the tissue paper web, comprising the steps of: removing condensate from the cylinder; compressing the condensate to a first pressure level substantially corresponding to that of the fresh steam network; heating the condensate by heat exchange with the exhaust air from the hot air hood; vaporizing the condensate; and feeding the generated steam into the fresh steam network.

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(54) Title: DEVICE AND METHOD FOR DRYING A TISSUE PAPER WEB USING STEAM RECAPTURE

(54) Bezeichnung : VORRICHTUNG UND VERFAHREN ZUM TROCKNEN EINER TISSUEPAPIERBAHN MIT DAMPFRÜCKGEWINNUNG

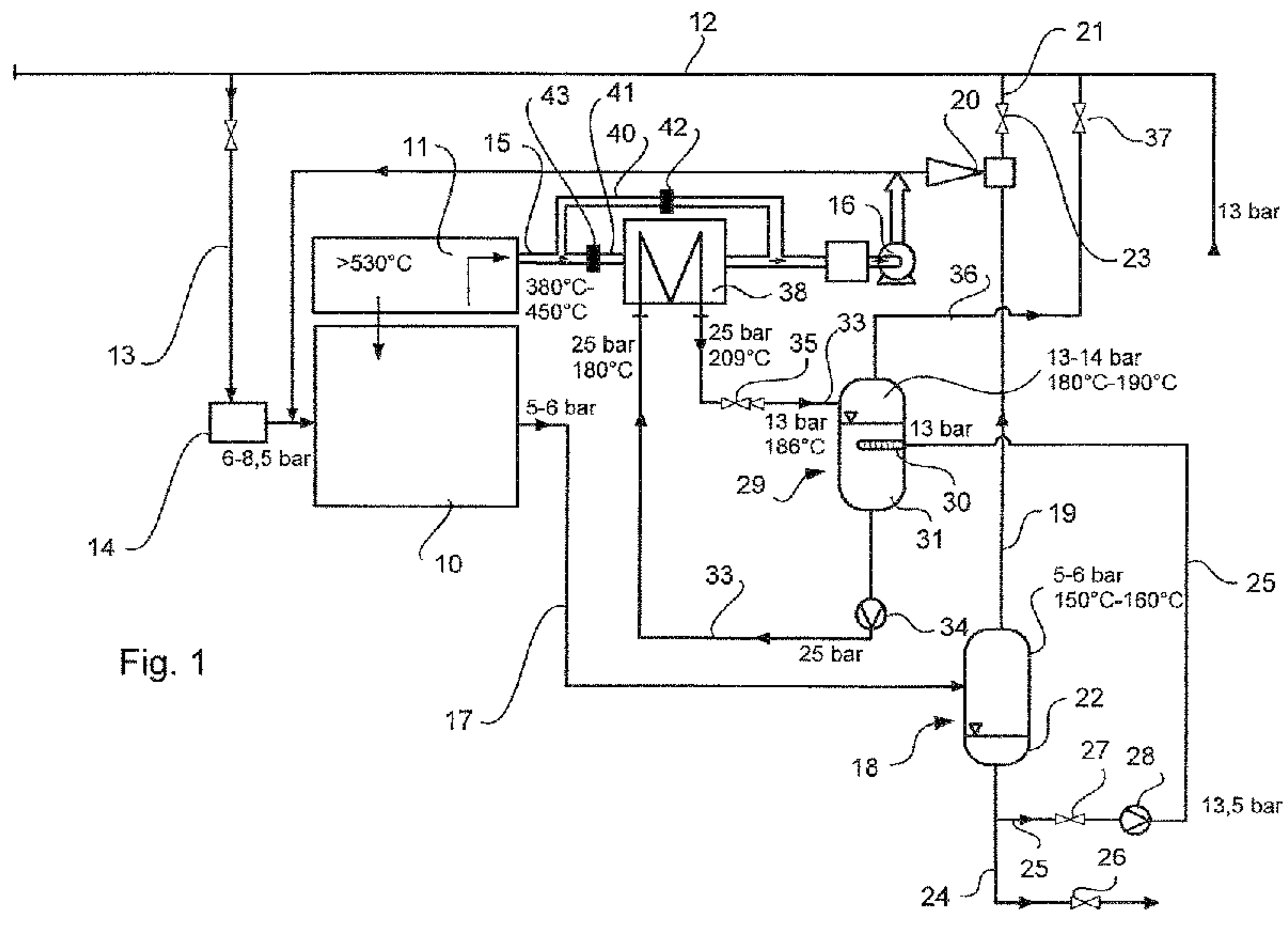

Fig. 1

(57) Abstract: The invention relates to a method for recapturing steam when drying a tissue paper web having a cylinder (10) fed from a fresh steam network (1) and a hot air hood (11) blowing hot air onto the tissue paper web, comprising the steps of: removing condensate from the cylinder; compressing the condensate to a first pressure level substantially corresponding to that of the fresh steam network; heating the condensate by heat exchange with the exhaust air from the hot air hood; vaporizing the condensate; and feeding the generated steam into the fresh steam network.

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Verfahren zur Dampfrückgewinnung beim Trocknen einer Tissuepapierbahn mit einem aus einem Frischdampfnetz (1) gespeisten Zylinder (10) und einer Heißlufthaube (11), die Heißluft auf die Tissuepapierbahn strömt, umfassend die Schritte: Entnehmen von Kondensat aus dem Zylinder; Verdichten des Kondensats auf ein erstes Druckniveau im Wesentlichen entsprechend dem des Frischdampfnetzes; Erwärmen des Kondensats durch Wärmetausch mit der Abluft aus der Heißlufthaube; Verdampfen des Kondensats; und Einspeisen des erzeugten Dampfes in das Frischdampfnetz.

DEVICE AND METHOD FOR DRYING A TISSUE PAPER WEB USING STEAM RECOVERY

The present invention relates to the manufacture of tissue paper, and in particular, to a device for drying a tissue paper web using a heatable cylinder known as a Yankee cylinder or creping cylinder, which is heated by steam supplied from a live steam network, and a hot air hood arranged around the periphery of the cylinder for blowing hot air onto the tissue paper web and extracting air from the web, whereby the tissue paper web is dried by the hot outer surface of the cylinder as well as by the hot air. The water vapor produced is removed through the air extraction vent of the hot air hood. The present invention further relates to a method of recovering steam when drying a tissue paper web using such a device.

Tissue paper shall refer to a soft, absorbent paper having a low paper density. In general, the weight per unit area is selected to be between 8 and 40 g/m^2, and in particular, between 10 and 25 g/m^2 per layer. The overall basis weight of a multi-ply tissue product is preferably at most 120 g/m^2, and particularly preferably, at most 60 g/m^2. The density of such a product is typically below 0.6 g/cm^3, preferably below 0.30 g/cm^3, and more preferably between 0.08 and 0.20 g/cm^3.

The production of tissue paper differs from the production of paper in that the weight per unit area is extremely low, and the tensile index is much higher (see DIN EN 12625-4 and DIN EN 12625-5). In general, paper and tissue paper also differ in terms of their modulus of elasticity, which is a material parameter that characterizes the stress-strain properties of these planar products.

The high tensile index is due to the external or internal creping of the tissue. External creping is achieved by compression of the paper web on a dry cylinder using a creping doctor blade, while internal creping is achieved by a speed difference between two screens. The compression and shearing causes the paper web, which is still damp and plastically deformable, to break open internally, thereby becoming more extensible under load than uncreped paper.

Damp tissue paper webs are usually dried using so-called Yankee drying, Through Air Drying (TAD) or impulse drying processes.

The fibers contained in the tissue paper are chiefly cellulose fibers such as pulp fibers from chemical pulp (e.g. kraft sulfite and sulfite pulps), mechanical pulp (e.g. ground wood), thermo-mechanical pulp, chemimechanical pulp and/or chemithermomechanical pulp (CTMP). It is possible to use pulps formed from hardwoods, softwoods or annual plants. The fibers may also be recycled fibers, or incorporate recycled fibers. The fibers may be treated with additives such as fillers, plasticizers (e.g. quaternary ammonium compounds) and binders (e.g. conventional dry-strength agents or wet-strength agents) which are used to facilitate the original formation of paper and to adjust its properties. The tissue paper may also contain other types of fibers, such as regenerated cellulose fibers or synthetic fibers, which increase the strength, absorbency, smoothness or softness of the tissue paper.

The use of a steam-heated cylinder and a hot-air hood to blow hot air onto the tissue web passing around the heated cylinder is known in the prior art, as disclosed for example in DE 10 2007 006 960 A1, EP 294 982 B1 or EP 1 027 495 B1.

Due to increasing energy costs, which are also reflected in the cost for drawing steam from the live steam network, efforts are being made to reduce the quantity of steam required, so as to reduce the energy costs associated with paper making.

It is therefore the object of the present invention to provide a device for drying a tissue paper web, and a method for recovering steam when drying a tissue paper web, which enable a reduction in the quantity of steam required from a live steam network to dry the tissue paper web using a stable control loop, and, in particular, reduce the costs associated with drying processes during the manufacture of paper.

The invention is based on the concept of utilizing the air extracted from the hot air hood that had been used to dry the tissue paper web (and still contains a large amount of residual energy) to re-vaporize condensate from the heatable cylinder, and feeding the produced steam at a raised pressure back to the live steam network. The effect of this is that less steam needs to be drawn from the live steam network, thereby reducing energy costs and also the cost of manufacturing the tissue paper web. In addition, the live steam network acts as a large buffer, permitting the establishment of a stable control loop with associated stable drying and stable paper quality.

Accordingly, the device for drying a tissue paper web comprises a heatable cylinder, known as a Yankee cylinder or creping cylinder. In order for the cylinder to be steam heated, it is connected to a supply line which supplies steam and which is connectable to a live steam network. In the context of the present invention, a live steam network refers to any network that provides live steam at a first pressure to at least two consumers. One of these consumers is the heatable cylinder of a tissue paper machine. The other consumer could be, for example, another heatable cylinder belonging to a different tissue paper machine. However, other consumers are conceivable. The condensate generated in the cylinder during the drying process is removed from the cylinder through a condensate line. The device further comprises a hot air hood arranged around the periphery of the cylinder for blowing hot air in the direction of the periphery and therefore, in operation, for blowing hot air onto the tissue paper web passing around the heatable cylinder. Thus, while the tissue paper web is dried by the hot outer periphery of the heatable cylinder, it is also dried by the hot air blown onto it from the hot air hood. Once the hot air from the hot air hood has been used to dry the tissue paper, it is removed from the hot air hood, along with the evaporated water, via an exhaust line. The device of the invention further comprises a first pressure stage which is configured to compress the condensate removed from the cylinder to the first pressure of the Yankee cylinder. The pressure achieved in the first pressure stage may deviate from the first pressure by ±2-7 bar. Furthermore, the device of the present invention includes a vaporizing means for at least partially vaporizing the condensate using an energy transfer means. The energy transfer means is configured to transfer energy from the exhaust air in the exhaust line into the condensate. The transfer of energy can be adversely affected by the presence of vapor bubbles in the condensate; for this reason, in accordance with the present invention, the energy transfer takes place downstream of the first pressure stage. The increase in pressure raises the boiling point of the condensate (water), thereby avoiding the occurrence of vapor bubbles in the heat exchanger. Finally, the device of the present invention comprises a feedback line connectable to the live steam network, for supplying the steam produced from the condensate back into the live steam network. The inventive configuration enables the utilization of the air extracted from the hot air hood, or in particular its energy, to generate steam from the condensate that is removed from the cylinder, so as to reduce the amount of live steam required from the live steam network, and thereby reduce the energy costs and the costs for producing live steam. Furthermore, the live steam network constitutes a buffer of sufficient size to allow the establishment of a stable control loop, which is necessary to keep the temperature of the heatable cylinder constant, and thereby achieve a constant quality of drying and a constant paper quality.

In order to further improve the transfer of heat between the air extracted from the hood and the condensate (water), and further reduce the occurrence of vapor bubbles in the condensate, it is preferable to provide a second pressure stage which is configured to compress the condensate from substantially the first pressure, to a second, higher pressure. This further raises the boiling point, causing any vapor bubbles in the condensate to condense, thereby substantially eliminating the occurrence of vapor bubbles. The energy transfer means is therefore provided downstream of the second pressure stage, and is preferably formed by a heat exchanger, in particular a tubular heat exchanger, arranged in the exhaust air. The heat exchanger heats the condensate that was compressed to the second pressure.

Finally, it is still more preferable to provide a third pressure stage, which is configured to instantaneously flash-vaporize the heated condensate by expanding the condensate from the second pressure to the first pressure, i.e. this vaporization is chiefly the result of reducing the pressure of the previously heated condensate so that its boiling point suddenly drops and becomes exceeded, causing a phase transition from liquid to gas. This expansion is also intended to bring the pressure of the generated vapor to the pressure level of the live steam network so that it can be returned to the network via the feedback line.

In order to obtain an optimal separation between vapor and condensate, and to allow the establishment of a control loop, it is also preferable that the device of the present invention further comprises a first condensate separator connected to the condensate line, and a first return line connected to the first condensate separator. In this arrangement, the first pressure stage is formed by a first pump in the first return line. A second condensate separator is also provided, and is connected to the first return line. As will become evident from the description below, the temperature in the second condensate separator is significantly higher than the temperature in the first condensate separator, and as such is higher than the temperature of the condensate that is introduced into the second condensate separator via the first return line. To compensate for this difference in temperature, the condensate is preferably introduced into the second condensate separator via a diffusor. In addition, a second return line is connected to the second condensate separator. In this arrangement, the second pressure stage is formed by a second pump in the second return line, and the heat exchanger is integrated in the second return line, downstream of the second pump. In this embodiment, the third pressure stage is preferably formed by an expansion means in the form of an expansion valve or capillary tube / throttle arranged in the second return line, downstream of the heat exchanger. Furthermore, the second return line is connected to the second condensate separator, downstream of the expansion means. The generated steam is fed back from the second condensate separator by means of the feedback line connected to it.

Depending on the initial temperature of the condensate and the temperature of the exhaust air passing through the heat exchanger, the second pressure is preferably in the range 23-27 bar, preferably in the range 24-26 bar, and most preferably 25 bar. This pressure range is selected so that the boiling point is not exceeded in relation to the heat transferred to the condensate, and therefore no vapor is produced during the passage through the heat exchanger. In this preferred embodiment, vapor will not be produced until the condensate undergoes expansion in the third pressure stage.

Depending on the pressure of the live steam network, the first pressure is in the range 10-15 bar, preferably 13-14 bar, and most preferably 13 bar.

As an alternative to configuring the energy transfer means as a heat exchanger that is integrated in the second return line, it is also conceivable that the energy transfer means could include a condensate separator through which the exhaust line passes, preferably with a large surface area, so that heat is transferred from the exhaust air to the condensate in the condensate separator, causing the condensate in the condensate separator to vaporize. In this embodiment, the steam generated in the condensate separator is likewise fed back to the live steam network via the feedback line. However, with this arrangement, the condensate separator needs to be arranged at a high position, i.e. above the paper machine, although its dimensions and weight are large. This may present structural and design problems. However, the advantage of this configuration is that pumps and valves are not required.

To achieve a sufficiently large transfer of heat for vaporization and thereby attain an efficient system, it is particularly preferable to use high temperature hoods for the hot air hoods, as described in EP 0 905 311 A2, for example. Such hot air hoods are designed to blow hot air onto the tissue paper web at a temperature in excess of 530°C. Currently, the maximum temperature achieved is approximately 650°C. Depending on the application, the exhaust air from this type of high temperature hood has a temperature some 150°C less than the hot air temperature and the maximum temperature of the exhaust air is therefore 500°C.

In addition to the device of the present invention, a method is also proposed for recovering steam when drying a tissue paper web using a cylinder fed from a live steam network, and a hot air hood which blows hot air onto the tissue paper web. The method of the present invention comprises the steps of removing condensate from the cylinder, compressing the condensate to a first pressure corresponding to that of the live steam network, heating the condensate by exchange of heat with the exhaust air from the hot air hood, vaporizing the condensate, and supplying the generated steam to the live steam network.

As is the case in relation to the device, after the condensate has been compressed to the [first] pressure and before it is heated by the exhaust air from the hot air hood, it is preferable to compress it to a second, higher pressure, thereby raising the boiling point of the condensate (water) and reducing the occurrence of vapor bubbles. This provides for a better thermal transfer. It is also preferable that the condensate is not vaporized during the transfer of heat from the exhaust air to the condensate. Thus, a sufficiently high pressure should be chosen, and the vaporization (by expansion to the first pressure) should not occur until the condensate has been heated by the exhaust air from the hot air hood.

The second and first pressures are in the ranges given above, while the temperature of the exhaust air is preferably greater than 350°C.

The above-mentioned features of the invention may apply in contradiction to each other, individually and independent of each other, or in any combination. Further features, which may be combined with one or more of the above-mentioned features, will be apparent from the following description of a preferred embodiment. The description makes reference to the following accompanying drawings:

Fig. 1 is a schematic diagram of a first embodiment of the device of the present invention, and

Fig. 2 is a schematic diagram of a second embodiment of the device of the present invention.

In Fig. 1, the only parts of the tissue paper machine shown are the steam-heated Yankee cylinder 10 and the associated high-temperature hot air hood 11. The hot air hood 11 may be a hood in accordance with EP 0 905 311 A2, for example. Also shown is a live steam network line 12, which represents the live steam network from which the Yankee cylinder 10 is supplied with steam. The live steam network 12 provides live steam at a pressure of approximately 13 bar. The live steam network 12 and the Yankee cylinder 10 are connected together via a supply line 13. The pressure in the supply line 13 is reduced by an expansion means 14. The steam supplied to the Yankee cylinder 10 at a pressure of 6-8 bar heats the Yankee cylinder 10 so that the tissue paper web (not shown) passing around the outer surface (or part of the outer surface) of the Yankee cylinder 10 is dried by means of heat conduction.

Furthermore, a so-called high-temperature hot air hood 11 is arranged along a portion of the outer surface of the Yankee cylinder 10, and, in the illustrated embodiment, blows hot air at a temperature in a range currently not exceeding 650°C onto the side of the tissue paper web opposite the outer surface of the Yankee cylinder 10, thereby drying the web by means of convection. After impinging on the tissue paper web, the hot air is removed via exhaust channels (not shown) in the hot air hood 11. For this purpose, a fan 16 is arranged at the end of an exhaust line 15. The exhaust air is removed by means of the fan 16 via an exhaust line 15 through a bypass 40 with a valve 42 for opening or closing the bypass, and via the fan 16, and made available for hot water generation, for heating the machine shop in which the paper machine is located, for pre-heating fresh air, or for further heat recovery processes. Alternatively, and according to the present invention, the exhaust air can flow via the exhaust line 15 when the valve 43 is open via the line 41 through a heat exchanger 38 integrated in the exhaust line 15, before it is supplied via the fan 16 to the aforementioned heat-recovery processes. The heat exchanger 38 may be a conventional tubular heat exchanger.

On heating the Yankee cylinder 10, the steam condenses, and the condensate, which is at the temperature of saturated steam, is removed from the Yankee cylinder 10 at a pressure of about 5-6 bar. A condensate line 17 is provided for this purpose. The condensate line 17 leads to a first condensate separator 18 which separates condensate from steam. Further, the upper portion of the condensate separator 18 is connected via a line 19 to a thermo-compressor 20 (jet pump) which can be brought into fluid connection with the live steam network line 12 via a line 21 and a valve 23. Thus the steam in the first condensate separator 18, which is in a pressure range of 5-6 bar and at a temperature of approx. 150°C to 160°C, is drawn into the thermo-compressor 20 and supplied back to the Yankee cylinder 10 via the supply line 13. The condensate 22 (water vapor), i.e. water at a temperature substantially close to that of saturated steam, collects in the lower portion of the first condensate separator 18. The condensate is supplied to a collecting tank (not shown) via an expansion means 26. The lower portion of the first condensate separator 18 is also connected to a first return line 25 for removing the condensate 22. A valve 27 allows the condensate 22 in the first condensate separator 18 to flow into the first return line 25. A first pump 28 (first pressure stage) is arranged downstream of the valve 27. The pump 28 causes compression of the condensate 22 to a pressure of approximately 13.5 bar, and conveys the condensate to a second condensate separator 29. At the inlet to the second condensate separator 29, the condensate has an approximate pressure of 13 bar and a temperature between about 150°C and 160°C. However, the prevailing temperature in the second condensate separator 29 is approximately 180°C to 190°C (as described below). Because of the difference in temperature between the introduced condensate and the medium in the second condensate separator 29, the condensate from the return line 25 is introduced into the second condensate separator 29 via a diffusor 30. Condensate 31 substantially in liquid form collects in the lower portion of the second condensate separator 29. The lower portion of the second condensate 29 is connected to a second return line 33. A second pump 34 (second pressure stage) is arranged downstream of the condensate separator 29. The second pump 34 compresses the condensate 31 from the second condensate separator 29 to a pressure of approximately 25 bar.

The compressed condensate, which has a temperature of approximately 180°C to 190°C downstream of the pump 34, flows through the heat exchanger 38. Energy from the exhaust air in the exhaust line 15 is thereby transferred to the condensate in the return line 33, and the condensate is heated. The pressure of the condensate is chosen to be high enough to ensure that the condensate does not vaporize when heated, in particular so that no vapor bubbles are generated. Downstream of the heat exchanger 38, the condensate has a temperature of approximately 209°C at a pressure of 25 bar. An expansion valve 35 is also provided in the return line 33, downstream of the heat exchanger 38. At the expansion valve 35, part of the condensate expands from 25 bar to approximately 13.5 bar, causing flash vaporization of the condensate, and a reduction in temperature to that of saturated steam. Following the expansion valve 35 (expansion means), the second return line 33 leads to the second condensate separator 29, preferably at an upper portion thereof. Thus, the second condensate separator 29 contains steam produced from the condensate in a pressure range of 13-14 bar and at a temperature of approximately 180-190°C.

A feedback line is connected to the upper portion of the second condensate separator 36 [sic], and is connected to, or brought into fluid connection with the live steam network line 12 via a valve 37. When the valve 37 is open, steam produced from the second condensate separator 29 is fed back to the live steam network (or to the live steam network line) at a pressure that approximately corresponds to the pressure of the live steam network.

The operation of the device of the present invention, and hence the method of the present invention, is explained below.

The water vapor used to dry the tissue paper web (not shown) condenses in the Yankee cylinder 10 and is removed from the Yankee cylinder 10 via a condensate line 17 in the form of a condensate at a temperature around that of saturated steam and in a pressure range of 5-6 bar. The condensate is fed to a first condensate separator 18. This performs a first separation of vapor and liquid phases. The liquid water (condensate) 22 collects in the lower portion of the first condensate separator 18, and when the valve 27 is open, it is conveyed via the first return line 25 to the second condensate separator 29 by means of a first pump 28 (first pressure stage) which compresses it to approximately 13.5 bar. The condensate is then fed via a diffusor 30 into the second condensate separator 29, which performs a further separation of vapor and liquid phases. The liquid condensate 31 that collects in the lower portion of the second condensate separator 29 is fed at a temperature of approximately 180°C, via a valve 32, to a heat exchanger 38 by means of the second pump 34 in the second return line 33 which compresses the condensate from the pressure prevailing in the second condensate separator 29 (between 13 and 14 bar), to a pressure of 25 bar. The condensate still has a pressure of 25 bar at the outlet of the heat exchanger 38, but is at a significantly higher temperature, approximately 209°C. The exhaust air from the hot air hood flows through the heat exchanger 38 at a maximum temperature of 500°C, thereby heating the condensate from an initial temperature of 180°C to a temperature of approx. 209°C. An expansion means in the form of an expansion valve 35 abruptly reduces the pressure of the heated condensate from 25 bar to 13.5 bar, resulting in a drop in temperature to that of saturated steam. This reduction in pressure causes a flash vaporization of the condensate, and the condensate enters the vapor phase. This vapor is fed via the return line 33 into the second condensate separator 29, from where it can be fed back to the live steam network via the feedback line 36 when valve 37 is open. By means of the two pressure stages, in particular the second pressure stage which raises the pressure to 25 bar, the boiling point of the condensate is significantly raised, thereby avoiding any vapor bubbles which may otherwise be present in the condensate. As a result, the transfer of heat from the exhaust air to the condensate in the heat exchanger 38 is more efficient. This makes more efficient use of the energy content of the exhaust air.

For a paper machine that consumes between 7 and 9 tonnes of steam per hour, the inventive system makes it possible to feed 1-3 tonnes of steam per hour back into the live steam network 12. Thus, the actual live steam demand from the network is reduced by 1-3 tonnes, thereby enabling a significant reduction (up to 1/3) in the cost of live steam. In terms of the design of the control system, the feedback of steam to the live steam network is particularly advantageous because fluctuations in demand do not occur. The live steam network provides live steam in quantities of at least 20 tonnes, and forms a large buffer that is capable of buffering the 1-3 tonnes of fed-back steam without any control problems. Accordingly, steam cannot be oversupplied to the Yankee cylinder, which would cause excessive temperature rises or fluctuations. Problems arise if the outer surface of the Yankee cylinder is too hot: the moisture in the tissue paper web produces vapor bubbles, lifting the paper from the Yankee cylinder. Significant production problems are likely if the temperature profile of the Yankee cylinder varies by more than 10°C. This causes unwanted variations in the quality of the paper web as a result of unstable drying. The device and method of the present invention can prevent “overheating and temperature fluctuations” in the Yankee cylinder, thereby avoiding the problems described. The energy present is fed back into the network, and is thus removed from the control loop.

As a further advantage, the return of the condensate and production of steam also reduces the quantity of condensate that needs to be removed to the condensate collection tank via lines 24 and 26. This reduction is likewise 1-3 tonnes. A reduced quantity of cooling water also leads to a reduction in production costs.

Thus, the present system presents a significant advantage over the prior art.

As an alternative to the embodiment described with reference to Fig. 1, the device may conceivably be configured as shown in Fig. 2. The same or comparable parts are marked with the same reference numbers, and a repeat description will be omitted.

The configuration of Fig. 2 essentially differs from that of Fig. 1 in that the second pressure stage (including the second return line 33, the valve 32 and the pump 34), the expansion valve 35 and the heat exchanger 38 are omitted.

Instead, the condensate 22 in the first condensate separator 18 is compressed to 13 bar by the pump 28 and the first return line 25, and fed via the diffusor 30 into the second condensate separator 29. The liquid condensate collects in the lower portion of the second condensate separator 29. Preferably, the exhaust line 15 passes through this portion in the form of a tubular heat exchanger (air - water) 39, such that the heat from the exhaust air in the exhaust line 15 flowing via valve 43 and line 41 into the coil 39, is directly transferred to the condensate 31 contained in the second condensate separator 29, and the condensate vaporizes in the second condensate separator. The cooler exhaust air is subsequently fed via a fan 16 to the other heat recovery processes previously described. When valve 37 is open, the steam generated in the second condensate separator 29 is fed back to the live steam network line 12 via the feedback line 36, and thereby returns to the live steam network.

The advantage of this configuration is that the second pressure stage and associated components can be eliminated, so that investment costs may be reduced. The device is also structurally much simpler. However, this configuration has a disadvantage compared to that shown in Fig. 1, in that the second condensate separator 29 needs to be arranged uppermost, i.e. directly below, or on the roof of the machine shop in which the paper machine is located. However, because such a vessel has very large outer dimensions and a weight between around 30 and 50 tonnes, this may pose structural engineering problems.

Apart from this aspect, the second embodiment provides the same advantages as the embodiment described with reference to Fig. 1.

In addition to the embodiments described above, it is clear that other configurations and/or combinations of the embodiments are also conceivable. For example, it is possible for the exhaust air leaving the heat exchanger 38 in Fig. 1 to be subsequently fed through the second condensate separator 29 to preheat the contained condensate. Also, it is possible that other waste heat sources from the paper machine be used, for example, to preheat the condensate at one point or another (at the first or second condensate separator or a different location). Based on the foregoing descriptions, the person skilled in the art will appreciate that the scope of the claims is not limited by the specific embodiments set forth herein, but should be given the broadest interpretation consistent with the description as a whole.

What is claimed is:

1. A device for drying a tissue paper web, comprising
a heatable cylinder (10);
a supply line (13) connected to the cylinder to heat it with steam, and adapted to be connected to a live steam network (12);
a condensate line (17) for removing condensate from the cylinder;
a hot air hood (11) on the outer periphery of the cylinder for blowing hot air in the direction of the outer periphery;
an exhaust line (15) connected to the hot air hood for removing exhaust air from the hot air hood; and
a vaporizing means for at least partially vaporizing the condensate, comprising an energy transfer means (38 or 39) for transferring energy from the exhaust air in the exhaust line to the condensate, downstream of a first pressure stage;
wherein
the first pressure stage (28) is adapted to compress condensate from the cylinder to substantially a first pressure, wherein the live steam network supplies at least two consumers with live steam at the first pressure; and
a feedback line (36) adapted to be connected to the live steam network, for feeding the steam produced from the condensate back into the live steam network.

2. A device according to Claim 1, wherein the vaporizing means further comprises:
a second pressure stage (34) adapted to compress the condensate from the first pressure to a second pressure, wherein the
energy transfer means is formed by a heat exchanger (38) arranged in the exhaust line, downstream of the second pressure stage, for heating the condensate that was compressed to the second pressure; and
a third pressure stage (35) adapted to expand the heated condensate from the second pressure to substantially the first pressure and to vaporize it.

3. A device according to Claim 2, further comprising:
a first condensate separator (18), which is connected to the condensate line (17),
a first return line (25), which is connected to the first condensate separator, wherein the first pressure stage is formed by a first pump (28) in the first return line,
a second condensate separator (29), which is connected to the first return line and

which is heated by the hot extracted air via a tubular heat exchanger (39), wherein the steam generated in the condensate separator is discharged to the steam network (12) via a control valve (37).

4. A device according to Claim 3, wherein the second condensate separator (29), is connected to the first return line via a diffusor (30).

5. A device according to any one of Claims 2 to 4, further comprising:
a second return line (33) which is connected to the second condensate separator, wherein the second pressure stage is formed from a second pump (34) in the second return line, and the heat exchanger (38) is integrated in the second return line downstream of the second pump,
wherein the third pressure stage is formed by an expansion means (35) disposed in the second return line downstream of the heat exchanger, the second return line is connected to the second condensate separator downstream of the expansion means, and the feedback line is connected to the second condensate separator.

6. A device according to any one of Claims 2 to 5, wherein the second pressure is in the range 23-27 bar.

7. A device according to any one of Claims 1 to 6, wherein the first pressure is in the range 10-15 bar.

8. A device according to Claim 1 or 7, wherein the energy transfer means comprises a condensate separator (29) through which the exhaust line (39) passes.

9. A device according to any one of Claims 1 to 8, wherein the hot air hood is adapted to blow hot air in the direction of the outer periphery at a temperature in excess of 530°C.

10. A method for recovering steam when drying a tissue paper web using a cylinder (10) fed from a live steam network (12), and a hot air hood (11) which blows hot air onto the tissue paper web, comprising the steps of:
removing condensate from the cylinder;
heating the condensate by exchanging heat with the exhaust air from the hot air hood; and
vaporizing the condensate, characterized by

compressing the condensate to a first pressure, corresponding substantially to that of the live steam network; and
feeding the generated steam into the live steam network.

11. A method according to Claim 10, wherein, after being compressed to the first pressure, and before being heated by the exhaust air from the hot air hood, the condensate is compressed to a second pressure, and after being heated by the exhaust air from the hot air hood, the condensate is compressed to substantially the first pressure to cause vaporization.

12. A method according to Claim 11, wherein the second pressure is in the range 23-27 bar.

13. A method according to any one of Claims 10 to 12, wherein the first pressure is in the range 10-15 bar.

14. A method according to any one of Claims 9 to 13, wherein the exhaust air has a temperature in excess of 350°C.

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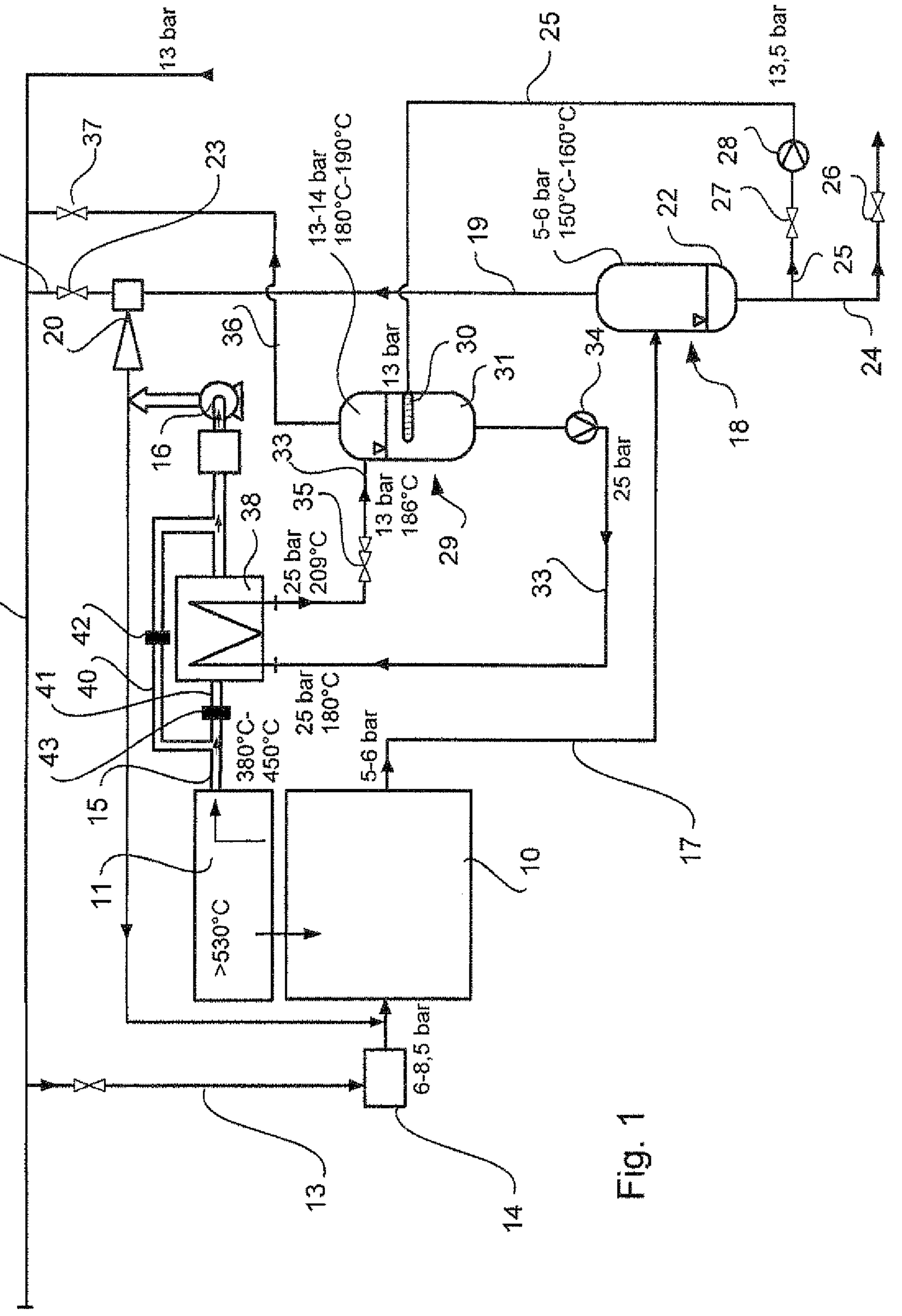
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Fig. 1

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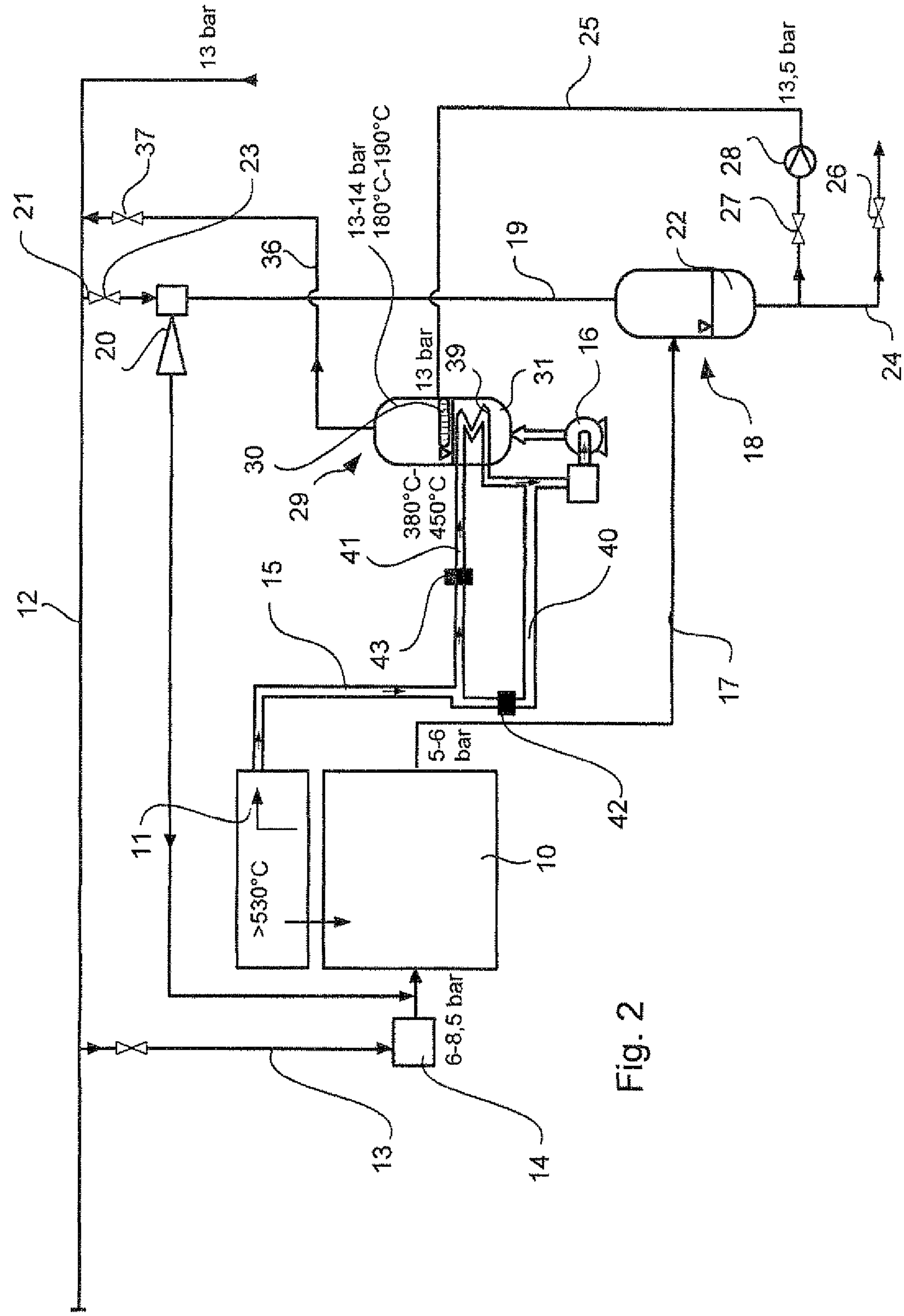
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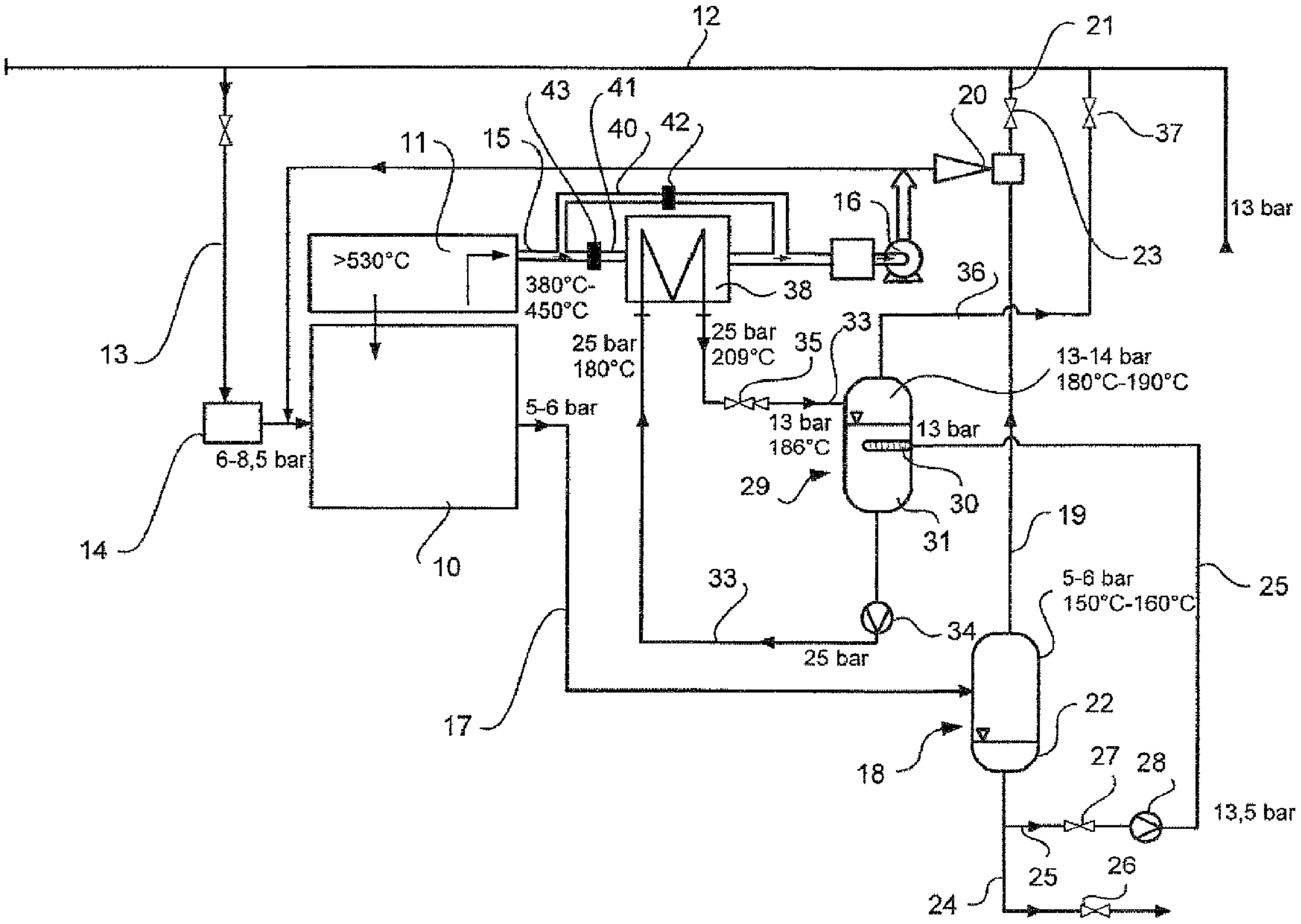
Fig. 2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