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(54) An arrangement for drying a tissue paper web and a method for recapturing steam during drying of a tissue paper web

(57) The invention relates to an arrangement (1) for drying a tissue paper web. The arrangement (1) comprises a fresh steam network (2) and Yankee cylinder (3) which is connected to the fresh steam network (2) in such a way that it is capable of receiving steam from the fresh steam network (2). A hot air hood (4) at the outer circumference (5) of the Yankee cylinder (3) is arranged to let hot air flow against the outer circumference (5) of the Yankee cylinder (3). A first condensate pipe (6) is arranged to remove condensate from the Yankee cylinder (3). A condensate separator (7) is connected to the first condensate pipe (6) such that the condensate separator (7) can receive condensate from the Yankee cylinder (3) and a steam generator (9) is arranged to receive condensate from the condensate separator (7). A pump (10) is arranged to convey condensate from the condensate separator (7) to the steam generator (9) and increase the pressure of the condensate to a level that exceeds the pressure in the Yankee cylinder (3). A waste air conduit (11) is connected to the air hood (4) for conducting waste air out of the air hood (4) and a heat exchanger (12) is arranged to transfer heat energy from the waste air conduit (11) to the steam generator (9) such that condensate in the steam generator (9) is heated and evaporates. A steam conduit (16) is connected to the steam generator (9) such that steam can be passed from the steam generator (9) and subsequently sent to the Yankee cylinder (3). The arrangement further comprises a steam collector tank (18) arranged to receive steam from the steam generator (9). A control system (20) is set to control the pressure in the steam collector tank (18) such that a selected property is kept within predetermined limits. The invention likewise relates to a method of recovering steam during drying of a tissue paper web.

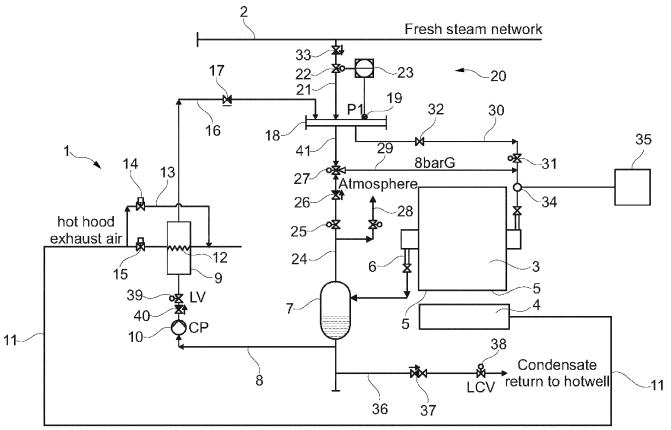

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an arrangement for drying a tissue paper web and to a method of recapturing steam during drying of a tissue paper web.

BACKGROUND OF THE INVENTION

[0002] In a tissue paper machine, it is a common practice to form a paper web in a forming section and pass the newly formed paper web to a Yankee drying cylinder which is heated from the inside by means of hot steam. On the Yankee drying cylinder, the tissue paper web is dried by heat when most of the water in the web is caused to evaporate when the tissue paper web contacts the hot outer surface of the Yankee drying cylinder such that heat energy is transferred from the surface of the Yankee drying cylinder to the tissue paper web. The ready-dried tissue paper web is typically creped from the surface of the Yankee drying cylinder and brought to a reel-up where it is wound to a paper roll. It is also known in the art that a hot air hood may be arranged at the outer circumference of the Yankee drying cylinder. During operation, the hot air hood blows hot air towards the surface of the Yankee drying cylinder. Examples of such arrangements with a hot air hood are disclosed in, for example, EP 1 027 495 B1 or US patent No. 8196314.

[0003] During the drying, large amounts of hot steam are used which correspondingly requires large amounts of energy. The cost of generating the steam may therefore be considerable.

[0004] In order to reduce the cost of generating the steam that is used by the Yankee drying cylinder, it has been suggested that waste heat from the hot air hood be used to heat condensate water from the Yankee drying cylinder such that the heated condensate water can be used as a source for steam that is recirculated back to the Yankee drying cylinder. Such a solution is disclosed in, for example, DE 35 01 584 A1. However, the solution suggested in that document is to simply send the recirculated steam back to the drying cylinder. The amount of steam in the recirculation loop does not necessarily correspond to the actual steam requirement of the Yankee drying cylinder at a given moment which may lead to such variations in cylinder temperature that the web risks becoming overheated.

[0005] It has also been suggested in WO 2010/091765 A1 that the condensate be pressurized to a level which substantially corresponds to the pressure level in the fresh steam network that supplies fresh steam, that the condensate be vaporized at that pressure by heat energy taken from waste hot air and subsequently fed back into the fresh steam network. The fresh steam network is then used as a buffer from which steam can be fed to the Yankee drying cylinder.

[0006] The solution suggested in WO 2010/091765 A1 allows that steam which has been regenerated from the condensate which is evacuated from the Yankee drying cylinder can be stored in a way which is not possible in the system disclosed in DE 35 01 584 A1. However, the pressure in the fresh steam network may vary due to boiler control problems. As a result, the flow of steam from the fresh steam network may be subject to variations. Such variations may also lead to variations in the surface temperature of the Yankee drying cylinder and thereby to variations in the amount of heat that is transferred to the wet paper web.

[0007] Therefore, it is an object of the present invention to provide an arrangement and a method that offers the possibility of heat recovery and also provides reliable control of the steam that is fed to the Yankee drying cylinder such that undesirable variations in temperature may be eliminated or at least reduced.

DISCLOSURE OF THE INVENTION

[0008] The inventive arrangement for drying a tissue paper web comprises a fresh steam network, a Yankee cylinder which is connected to the fresh steam network in such a way that it is capable of receiving steam from the fresh steam network and a hot air hood at the outer circumference of the Yankee cylinder. The hot air hood is arranged to let hot air flow against the outer circumference of the Yankee cylinder. The inventive arrangement further comprises a first condensate pipe for removing condensate from the Yankee cylinder and a condensate separator connected to the first condensate pipe such that the condensate separator can receive condensate from the Yankee cylinder. In the inventive arrangement, there is also a steam generator that is arranged to receive condensate from the condensate separator and a pump arranged to convey condensate from the condensate separator to the steam generator and increase the pressure of the condensate to a level exceeds the pressure level in the Yankee cylinder and at which higher pressure level the condensate water is evaporated. The arrangement further comprises a waste air conduit connected to the air hood for conducting waste air out of the air hood and a heat exchanger arranged to transfer heat energy from the waste air conduit to the steam generator such that condensate in the steam generator is heated (and such that it evaporates). Furthermore, a first steam conduit is connected to the steam generator such that steam can be passed from the steam generator and subsequently sent to the Yankee cylinder. The arrangement further comprises a steam collector tank that is arranged to receive steam from the steam generator via the first steam conduit and the steam collector tank is connected to the Yankee cylinder such that steam can be passed from the steam collector tank to the Yankee cylinder. In the inventive arrangement, at least one sensor is arranged to detect a selected property of the steam and water that is being circulated through the arrangement. The selected property is a property which is directly or

indirectly dependent on the pressure in the steam collector tank and the arrangement comprises a control system that is set to control the pressure in the steam collector tank such that the selected property is kept within predetermined limits. In all embodiments, the control system is also set such that the pressure in the steam collector tank is kept at a level that is lower than the level of the pressure in the fresh steam network.

[0009] The steam collector tank is preferably connected to the fresh steam network such that it can receive pressurized steam from the fresh steam network. The Yankee cylinder is then connected to the fresh steam network through (via) the steam collector tank.

[0010] For the purposes of this patent application, the term "property" should be understood as referring to such properties of gas and fluids as pressure, temperature, speed, mass flow, density or similar properties.

[0011] For the purposes of this patent application, the pressure in the steam collector tank is itself considered to be a property which is directly dependent on the pressure in the steam collector tank. Therefore, the expression "a property which is directly or indirectly dependent on the pressure in the steam collector tank" could mean simply "the pressure in the steam collector tank" and in one embodiment, this is the meaning.

[0012] In preferred embodiments, the control system that is set to control the pressure in the steam collector tank comprises a second steam conduit leading from the fresh steam network to the steam collector tank such that pressurized steam can be fed from the fresh steam network to the steam collector tank. In such embodiments, a control valve would be arranged in the second steam conduit and a logic control unit would be connected to the control valve in the second steam conduit. The logic control unit may then be set to control the control valve in the second steam conduit and thereby also the pressure in the steam collector tank.

[0013] In advantageous embodiments, a steam evacuation conduit leads from the condensate separator to a thermocompressor which is connected to the steam collector tank such that it can receive motive steam from the steam collector tank. In such embodiments, a first cylinder steam supply conduit leads from the thermocompressor to the Yankee cylinder.

[0014] Preferably, a second cylinder steam supply conduit leads from the steam collector tank to the Yankee cylinder, either directly or via the first cylinder steam supply conduit. In such embodiments, a control valve may optionally be arranged in the second cylinder steam supply conduit such that the flow of steam through the second cylinder steam supply conduit can be regulated or shut off.

[0015] In one embodiment of the invention, the selected property is the speed of the steam in either of the first cylinder steam supply conduit or the steam evacuation conduit or the speed of the motive steam that is fed from the steam collector tank to the thermocompressor.

[0016] In another embodiment, the selected property is a difference in pressure between the steam that is fed into the Yankee cylinder and the condensate that is removed from the Yankee cylinder.

[0017] It should be understood that, the at least one sensor must include a pressure sensor for detecting the pressure in the steam collector tank since, in all embodiments, the pressure in the collector tank must be controlled such that it remains lower than the pressure in the fresh steam network.

[0018] It should also be understood that, for the purposes of this patent application, the expression "at least one sensor" means "one or several sensors of which at least one is a pressure sensor arranged for detecting the pressure in the steam collector tank".

[0019] In a preferred embodiment of the invention, the selected property is the pressure in the steam collector tank. The at least one sensor is then a pressure sensor that detects the pressure in the steam collector tank. The logic control logic control unit is then set to keep the pressure in the steam collector tank at a level that is selected to be higher than the pressure in the Yankee cylinder but lower than the pressure in the fresh steam network. In this embodiment of the invention, the pressure in the Yankee cylinder is set to remain at a first pressure level and the logic control unit is set to control the pressure in the steam collector tank such that the pressure in the steam collector tank is kept at a second pressure level that is lower than the pressure in the fresh steam network but higher than the first pressure level. Preferably, the logic control unit is set to keep the pressure in the steam collector tank at a level that is 1.5 - 2 times higher than the pressure in the Yankee drying cylinder (i.e. the selected pressure in the Yankee drying cylinder).

[0020] In embodiments having a second steam conduit leading from fresh steam network to the steam collector tank, a one-way valve may advantageously be arranged in the second steam conduit such that steam cannot pass from the steam collector tank to the fresh steam network.

[0021] Optionally, a sensor may be arranged to detect the pressure in at least one of the first or the second cylinder steam supply conduit. This sensor may then advantageously be connected to a control unit that is arranged to control the thermocompressor.

[0022] The invention also relates to a method for recapturing steam during drying of a tissue paper web with a Yankee cylinder which is heated by steam and connected to a fresh steam network that operates at an elevated pressure level and wherein a hot air hood lets hot air flow against an outer circumference of the Yankee cylinder. The inventive method comprises removing condensate from the Yankee cylinder and passing the condensate to a condensate separator where condensate water is separated from steam. The method further comprises pressurizing the condensate water to a pressure level that exceeds the pressure level in the Yankee cylinder and passing the condensate water to a steam generator. In the steam generator, hot waste air that has been taken from the hot air hood is used to heat conden-

sate water in the steam generator such that the condensate water is caused to evaporate. The steam generated in the steam generator is then fed to the Yankee cylinder. According to the invention, the condensate water is pressurized to a pressure that is higher than the pressure in the Yankee cylinder but lower than the pressure in the fresh steam network such that the condensate water is evaporated in the steam generator at this pressure. The steam that has been generated in the steam generator is fed to a steam collector tank in which the pressure level is controlled such that it is lower than the pressure level in the fresh steam network. From the steam collector tank, steam is subsequently fed to the Yankee cylinder. Furthermore, a selected property of the condensate water and steam that is circulated is detected. The property that is detected is a property that is directly or indirectly dependent on the pressure in the steam collector tank and the pressure in the steam collector tank is controlled/regulated such that the selected property is kept within predetermined limits.

[0023] The pressure in the steam collector tank is controlled by supplying more or less steam from the fresh steam network to the steam collector tank to such an amount that the selected property is kept within the predetermined limits.

[0024] In an advantageous embodiment, the selected property is the pressure in the steam collector tank. In this embodiment, the pressure in the steam collector tank is detected (i.e. measured) and a flow of pressurized steam from the fresh steam network to the steam collector tank is increased or decreased in response to the detected pressure in the steam collector tank such that the pressure in the steam collector tank remains within predetermined limits. The pressure in the steam collector tank is preferably controlled such that it exceeds the pressure in the Yankee cylinder by a predetermined factor which predetermined factor is preferably in the range of 1.5 - 2.0. In this preferred embodiment of the invention, the pressure in the steam collector tank is thus controlled such that it is lower than the pressure in the fresh steam network but higher than the pressure in the Yankee drying cylinder.

[0025] Preferably, a steam evacuation conduit leads away steam from the condensate separator. The steam that is taken from the condensate separator can advantageously be fed to a thermocompressor which receives motive steam from the steam collector tank. The motive steam is mixed with the steam from the condensate separator and the resulting mixture is then sent to the Yankee cylinder.

[0026] Steam may optionally also be sent directly from the steam collector tank to the Yankee cylinder without passing any thermocompressor.

[0027] In one embodiment of the invention, the selected property is the speed of either the steam which is passing from the condensate separator to the thermocompressor, the speed of the motive steam reaching the thermocompressor or the speed of the mixture of motive steam and steam coming from the condensate separator. In another embodiment, the selected property may be a difference in pressure between the steam that is fed into the Yankee cylinder and the condensate that is removed from the Yankee cylinder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

Figure 1 is a schematic representation of the inventive arrangement for drying a tissue paper web.

Figure 2 is a diagram that illustrates the principle for control according to one embodiment of the invention.

Figure 3 is a diagram that illustrates how the inventive arrangement can be controlled according to other embodiments of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0029] Reference will now be made to Figure 1. It should be understood that Figure 1 is a purely schematic representation of the inventive arrangement.

[0030] With reference to Figure 1, the inventive arrangement 1 for drying a tissue paper web comprises a fresh steam network 2. It should be understood that the fresh steam network 2 is supplied with steam from a source of steam which may typically be a main boiler. The fresh steam network 2 typically includes one or several conduits which may be formed by pipes. The steam in the fresh steam network 2 is pressurized. Depending on the actual application, the pressure in the fresh steam network may have different values but in many cases, the pressure may realistically be 12 bar - 20 bar. A realistic value for the pressure in the fresh steam network may be, for example, 16 bar. The inventive arrangement also comprises a Yankee cylinder 3 which is connected to the fresh steam network 2 in such a way that it is capable of receiving steam from the fresh steam network 2. During operation, the Yankee drying cylinder 3 will be heated by hot steam and the heat will be transferred to a newly formed wet web of tissue paper such that water in the web is evaporated. Although not indicated in Figure 1, it should be understood that a doctor blade would typically be arranged to act against the outer surface of the Yankee drying cylinder to crepe the paper web from the surface of the Yankee drying cylinder. The outer surface, i.e. the outer circumference of the Yankee drying cylinder, is typically a smooth surface.

[0031] A hot air hood 4 is placed at the outer circumference 5 of the Yankee cylinder 3 and the hot air hood is arranged to let hot air flow against the outer circumference 5 of the Yankee cylinder 3. The hot air hood may be designed in, for example, substantially the same way as disclosed in US patent No. 5784804 but other designs

are of course also possible.

[0032] In Figure 1, the air hood 4 is showed below the Yankee drying cylinder. It should be understood that Figure 1 is a schematic representation. In real machines, the air hood 4 would (usually but not necessarily) be arranged above the Yankee drying cylinder 3.

[0033] A first condensate pipe 6 is connected to the Yankee drying cylinder for removing condensate from the Yankee cylinder 3 and a condensate separator 7 is connected to the first condensate pipe 6 such that the condensate separator 7 can receive condensate from the Yankee cylinder 3. A steam generator 9 is arranged to receive condensate from the condensate separator 7 and a pump 10 is arranged to convey condensate from the condensate separator 7 to the steam generator 9 and increase the pressure of the condensate to a level that exceeds the pressure in the Yankee cylinder 3. The pump 10 may be arranged in a pipe or conduit 8 that connects the condensate separator 7 and the steam generator 9. It is deemed suitable to use such a conduit 8 in which the pump 10 may be placed but, in principle, the pump 10 itself could directly connect the steam separator 7 to the steam generator 9. Embodiments are also conceivable in which the pump 10 is placed inside the steam separator 7 although such embodiments may entail disadvantages, for example difficulties with maintenance and repair.

[0034] Following the pump 10, a one-way valve 40 may optionally be arranged in the conduit 8 to prevent condensate from passing back from the steam generator 9 towards the pump 10. Optionally, a control valve 39 may also be placed in the conduit 8 at a point between the pump 10 and the steam generator 9.

[0035] A waste air conduit 11 is connected to the air hood 4 and the waste air conduit is arranged to conduct waste air out of the air hood 4. The waste air conduit 11 leads to the steam generator 9 and more specifically to a heat exchanger 12 that is arranged to transfer heat energy from the waste air conduit 11 to the steam generator 9 (i.e. to the condensate water in the steam generator) such that condensate in the steam generator 9 is heated. It should be understood that the heat exchanger 12 and the steam generator 9 will normally be integrated with each other and that the heat exchanger 12 (or a part of the heat exchanger 12) may advantageously be placed inside the steam generator 9. Thanks to the heat exchanger 12, heat can be transferred from the hot waste air to the condensate in the steam generator 9 such that the condensate is heated and evaporates into steam. As indicated in Figure 1, a first steam conduit 16 is connected to the steam generator 9 such that steam can be passed from the steam generator 9 and subsequently sent to the Yankee cylinder 3. As can be seen in Figure 1, the hot waste air may optionally bypass the steam generator 9 and the heat exchanger 12 through a by-pass conduit 13. A valve 14 may be placed in the by-pass conduit 13 such that the amount of waste air that passes through the by-pass conduit can be controlled (i.e. increased or decreased) or entirely shut off. A further valve 15 may also be placed in the part of the waste air conduit that leads to the heat exchanger 12. Waste air that has passed (or bypassed) the heat exchanger can be used for heating purposes or be sent into the atmosphere. The by-pass conduit 13 for the hot waste air and the valves 14, 15 offer a possibility to regulate/control the amount of heat that is transferred to the condensate water by means of the heat exchanger 12. The valves 14, 15 may be dampers that are arranged to move together such that, when one opens, the other closes and vice versa. When the damper 14 opens, the damper 15 closes and vice versa. However, the valves 14, 15 need not necessarily be dampers and they need not necessarily be arranged to move together even if that is advantageous. Any valves 14, 15 that can be used to control the flow of air (i.e. for increasing or decreasing the flow of air) can be used.

[0036] It should be understood that there may be more than one waste air conduit 11 and that the expression "a waste air conduit" should be understood as "at least one waste air conduit" although embodiments with only a single waste air conduit are possible. In embodiments with more than one waste air conduit 11, it may be so that all waste air conduits lead to the heat exchanger 12 in the steam generator 9 but it is also possible that one or several waste air conduits lead waste air to some other destination, for example for heating purposes. However, at least one waste air conduit 11 must lead to the heat exchanger 12 in the steam generator 9.

[0037] In the inventive arrangement, the pump 10 is set to pressurize the condensate water to a level that exceeds the pressure in the Yankee cylinder 3 such that the condensate water in the steam generator 9 is evaporated at this elevated pressure. Furthermore, the arrangement 1 also comprises a steam collector tank 18 arranged to receive steam from the steam generator 9 via the first steam conduit 16. The steam collector tank 18 is in turn connected to the Yankee cylinder 3 (directly or indirectly) such that steam can be passed from the steam collector tank 18 to the Yankee cylinder 3. As further indicated in Figure 1, the inventive arrangement comprises at least one sensor 19 that is arranged to detect a selected property of the steam and water that is being circulated through the arrangement 1. The property being detected is a property which is dependent directly or indirectly on the pressure in the steam collector tank 18. Furthermore, the arrangement 1 comprises a control system 20 that is set to control the pressure in the steam collector tank 18 such that the selected property is kept within predetermined limits. It should be understood that the at least one sensor 19 is arranged to give a signal to the control system 20 which signal corresponds to the value of the detected property such that the control system 20 will control the pressure in the collector tank 18 in response to this signal.

[0038] The pump 10 should raise the pressure of the condensate water to a level that exceeds the pressure

in the Yankee drying cylinder 3 and it should be able to raise the pressure to such a level that the steam that is generated in the steam generator 9 can reach the steam collector tank 18. It should be understood that it is the pressure in the steam collector tank 18 that determines the level of the pressure in the steam generator 9. From the steam generator 9 to the steam collector tank 18, there is an inevitable pressure loss in the first steam conduit 16. The pump 10 must be able to raise the pressure of the condensate to a level which is the sum of the pressure in the steam collector tank and the inevitable pressure loss (pressure drop). The actual flow of steam will depend on where the pump curve of the pump 10 meets the system curve of the conduits. Since the pressure in the steam collector tank 18 is kept at a level which is higher than the pressure in the Yankee drying cylinder but less than the pressure in the fresh steam network, the pump 10 must be able to raise the pressure of the condensate to this level and slightly higher to compensate for pressure loss. During operation, the pump 10 will pressurize the condensate water in the steam generator 9 to a level that exceeds the pressure in the Yankee drying cylinder but which is lower than the pressure in the fresh steam network 2. The pump 10 may of course be a pump which, in principle, is capable of pressurizing water even to levels above the pressure in the fresh steam network but, since the pump 10 feeds the steam generator 9 and since the steam generator 9 is connected to the steam collector tank 18, the pressure in the steam generator is determined by the pressure in the steam collector tank and the pressure at which condensate water is vaporized is thus determined by the pressure in the steam collector tank 18 which is kept lower than the pressure in the fresh steam network 2 by the control system 20. It can thus be appreciated that the pump 10 will only pressurize the condensate water to a level that corresponds to the sum of the pressure in the steam collector tank 18 and the pressure loss between the steam generator 9 and the steam collector tank 18. With other words, it can thus be stated that the pump 10 is arranged to pressurize the condensate water to a pressure level at which the condensate water is able to enter the steam generator 9.

[0039] Advantageously (but not necessarily), a one-way valve 17 may be placed in the first steam conduit 16 to prevent steam from passing from the steam collector tank 18 towards the steam generator 9.

[0040] In preferred embodiments, the Yankee cylinder 3 is connected to the fresh steam network 2 through the steam collector tank 18.

[0041] In the following, a preferred embodiment of the invention will be described. As can be seen in Figure 1, the control system 20 that is set to control the pressure in the steam collector tank 18 comprises a second steam conduit 21 leading from the fresh steam network 2 to the steam collector tank 18 such that the steam collector tank 18 is connected to the fresh steam network 2. In this way, pressurized steam can be fed from the fresh steam network 2 to the steam collector tank 18. The control system further comprises a control valve 22 that is arranged in the second steam conduit 21. By means of the control valve 22, the amount of steam passing from the fresh steam network 2 to the steam collector tank 18 can be increased, decreased or shut off. A logic control unit 23 is connected to the control valve 22 in the second steam conduit 21 and the logic control unit 23 is set to control the control valve 22 in the second steam conduit 21 and thereby the pressure in the steam collector tank 18.

[0042] In preferred embodiments of the inventive arrangement, a steam evacuation conduit 24 leads from the condensate separator 7 to a thermocompressor 27 which is connected to the steam collector tank 18 such that it can receive motive steam from the steam collector tank 18. A first cylinder steam supply 29 conduit leads from the thermocompressor 27 to the Yankee cylinder 3 such that a mixture of motive steam and steam from the condensate separator 7 can be supplied to the Yankee cylinder. A control valve 25 may optionally be placed in the steam evacuation conduit 24 to regulate the amount of steam passing that way. Optionally, a one-way valve 26 may also be placed in the steam evacuation conduit to ensure that steam does not pass back towards the condensate separator 7. Optionally, steam may be sent to the atmosphere through an exit conduit 28 which may have a control valve that can be more or less open or completely shut off such that no steam can exit that way.

[0043] Optionally, a part of the condensate water from the condensate separator 7 may be removed through an evacuation conduit 36 and used for other purposes than steam recovery. For example, it may be sent to the hotwell and then back to the main boiler. The evacuation conduit may have a control valve 38 and a one-way valve 37 that prevents condensate water to flow back towards the condensate separator.

[0044] Embodiments are conceivable in which all steam that passes from the steam collector tank 18 goes through the thermocompressor 27 as motive steam. However, it is preferable that there is also a second cylinder steam supply conduit 30 that leads from the steam collector tank 18 to the Yankee cylinder 3 without passing the thermocompressor. Such a second cylinder steam supply conduit can pass directly to the Yankee cylinder but it may be suitable to connect it to the first cylinder steam supply conduit 29 at some point downstream of the thermocompressor 27 such that the Yankee drying cylinder 3 only receives steam through one conduit. Preferably, a control valve 31 is arranged in the second cylinder steam supply conduit 30 such that the flow of steam through the second cylinder steam supply conduit 30 can be regulated or shut off.

[0045] A throttle valve 32 may be placed in the second cylinder steam supply conduit such that the pressure of the steam is reduced to the level required for the Yankee drying cylinder.

[0046] In the most preferred embodiment of the invention, the selected property which is detected by the at

least one sensor is the pressure in the steam collector tank 18. The at least one sensor 19 is then a pressure sensor that detects the pressure in the steam collector tank 18 and the logic control unit 23 is set to keep the pressure in the steam collector tank 18 at a level that is selected to be higher than the pressure in the Yankee cylinder 3 but lower than the pressure in the fresh steam network 2. In practice, this works in such a way that the pressure in the Yankee drying cylinder 3 is set to remain at a suitable first pressure level and the logic control unit 23 is then set to control the pressure in the steam collector tank 18 such that the pressure in the steam collector tank 18 is kept at a second pressure level that is lower than the pressure in the fresh steam network 2 but higher than the first pressure level. Preferably, the logic control unit 23 is set to keep the pressure in the steam collector tank at a level that is 1.5 - 2 times higher than the selected pressure for the Yankee drying cylinder. This control principle can be further explained with reference to Figure 2. In Figure 2, the horizontal axis represents the selected pressure in the Yankee drying cylinder while the vertical axis represents the pressure level that must be kept in the steam collector tank 18.

[0047] In all embodiments of the invention, the control system 20 is set to keep the pressure in the steam collector tank at a level that is lower than the pressure in the fresh steam network 2.

[0048] In practice, control of the pressure in the steam collector tank 18 based on the selected Yankee pressure may function in many different ways. One way is the following. A sensor 34 may be arranged to detect the pressure in one of the two cylinder steam supply conduits 29, 30 that supply steam to the Yankee. With reference to Figure 1, the sensor 34 is suitably placed downstream of the throttle valve 32 which is located in the second cylinder steam supply conduit 30 such that pressure is measured at a point where the pressure is lower than in the steam collector tank 18. With reference to Figure 1, a further valve 31 may also be placed in the second cylinder steam supply conduit 30. Downstream of the valve 31, the pressure may be even lower than after the throttle valve 32 and the pressure sensor 34 may be placed downstream of the valve 31. Preferably, the pressure sensor 34 is arranged at a point immediately before the steam enters the Yankee drying cylinder 3 itself. Alternatively, the pressure sensor 34 could be placed inside the Yankee drying cylinder. The pressure sensor 34 measures/detects the actual value of the pressure of the steam inside the Yankee drying cylinder 3 or at a point shortly before the steam enters the Yankee drying cylinder 3. The sensor 34 is connected to a control unit 35 that is arranged to control the thermocompressor 27. The control unit 35 is suitably programmed to maintain a set value for the pressure in the Yankee drying cylinder 3 and the control unit 35 can be set or programmed to maintain this value. The control unit 35 could be, for example, a computer and the set values for pressure in the Yankee drying cylinder 3 can be fed into the control unit 35 in a conventional way, for example by means of a keybord. It should be understood that the control unit 35 is able to communicate with the thermocompressor 27. If the control unit 35 receives a signal from the pressure sensor 34 that indicates that steam pressure in the Yankee drying cylinder 3 is too low (i.e. that the pressure in the Yankee drying cylinder is below the set value), the control unit 35 can cause the thermocompressor to supply more motive steam such that the pressure of the steam in the Yankee drying cylinder increases. If the signal from the pressure sensor 34 in the first cylinder steam supply conduit 29 (or inside the Yankee drying cylinder 3) indicates that the pressure of the steam in the Yankee drying cylinder 3 is too high (i.e. above the set value), the control unit 35 can cause the thermocompressor to reduce the amount of motive steam until the pressure detected by the pressure sensor 34 has reached the set value.

[0049] Instead of controlling the thermocompressor 27, the control unit 35 could be connected to a control valve 31 in the second cylinder steam supply conduit 30 and arranged to control the control valve 31 so that more or less steam comes through the second cylinder steam supply conduit 30. In this way, the pressure level in the Yankee drying cylinder 3 can be controlled and kept at a set value.

[0050] It should be understood that the control unit 35 could be arranged to control both the thermocompressor 27 and the control valve 31 that is arranged in the second cylinder steam supply conduit 30. If the signal from the pressure sensor 34 indicates that the pressure in the Yankee drying cylinder 3 is too low, first the thermocompressor 27 may be allowed to let through more motive steam. If that should be insufficient, the control unit 35 may cause the control valve 31 to also let more steam through from the steam collector tank 18.

[0051] With a set value for the steam pressure in the Yankee drying cylinder 3, the logic control unit 23 can be set to maintain pressure in the steam collector tank 18 at a level which is higher than the pressure which has been set for the Yankee drying cylinder but lower than the pressure in the fresh steam network 2. The control unit 35 could advantageously (but not necessarily) be in communication with the logic control unit 23 that controls the control valve 22 in the second steam conduit 21 that connects the fresh steam network 2 to the steam collector tank 18. When the desired Yankee pressure is set, this can then be automatically communicated to the logic control unit 23 such that the pressure in the steam collector tank 18 is directly determined as a function of the set pressure level in the Yankee drying cylinder 3. For example, if the control unit 35 is set to maintain the pressure in the Yankee drying cylinder 3 at a set value, this set value can be communicated by the control unit 35 to the logic control unit 23. The logic control unit 23 can then determine what the pressure in the steam collector tank 18 must be according to an algorithm programmed into the logic control unit 23, for example that pressure in the steam collector tank 18 should be determined as the set

value for the Yankee drying cylinder 3 multiplied with a constant.

[0052] In all embodiments of the invention, the control system 20 is set to keep the pressure in the steam collector tank 18 at a lower level than the pressure in the fresh steam network. In addition to this, the control system 20 is set to control the pressure in the steam collector tank 18 such that a selected property is kept within predetermined limits. In practice, this means that the control system 20 will ensure that pressure in the steam collector tank 18 is kept at a level that is higher than the pressure in the Yankee drying cylinder 3 but lower than the pressure in the fresh steam network 2, even in such embodiments where the selected property which is to be kept within predetermined limits is not directly based on the pressure in the Yankee drying cylinder 3. Since the control system 20 is set to keep the pressure in the steam collector tank 18 at a level that is lower than the level of the pressure in the fresh steam network, it follows that the at least one sensor must include a pressure sensor for detecting the pressure in the steam collector tank.

[0053] In the following, an embodiment will be explained in which the selected property is the pressure in the steam collector tank itself and wherein the pressure in the steam collector tank is controlled such that it is higher than the pressure in the Yankee drying cylinder 3 but lower than the pressure in the fresh steam network 2.

[0054] In Figure 2, the horizontal axis represents the pressure which is set for the Yankee drying cylinder 2 ("Yankee pressure") while the vertical axis represents the pressure in the steam collector tank 18 ("Collector pressure").

[0055] With reference to Figure 2, the desired pressure level in the steam collector tank 18 is preferably controlled to be a linear function of the set pressure level in the Yankee drying cylinder 3. In Figure 2, the pressure of the steam collector tank 18 has been set to be 2 times higher than the pressure in the Yankee drying cylinder. As can be seen in Figure 2, a highest limit for the pressure in the steam collector is set to be lower than the pressure in the fresh steam network. The pressure level in the steam collector tank increases linearly with the set pressure level in the Yankee drying cylinder but only up to a maximum level which is lower than the pressure level in the fresh steam network 2. Figure 2 illustrates a case where it is assumed that the pressure in the fresh steam network is 16 bar. The highest permissible pressure in the steam collector tank 18 should be lower than the pressure in the fresh steam network 2 and preferably at least 1 bar lower. In the case illustrated in Figure 2, the pressure in the steam collector tank increases as a function of the pressure which has been set for the Yankee drying cylinder 3. The pressure in the steam collector is determined as Yankee pressure multiplied with a constant and the constant may preferably be somewhere in the range 1.5 - 2. The constant may have values outside the range 1.5 - 2.0 but it must necessarily be higher than 1.0. The constant may have values up to 3.0 ore even above 3.0 but control is deemed to be easier if the constant lies in the range of 1.5 - 2.0. The pressure level in the steam collector tank does not have to vary linearly with the set Yankee pressure, it could also follow some other curve as long as the pressure in the steam collector tank is higher than the pressure in the Yankee drying cylinder but lower than the pressure in the fresh steam network.

[0056] Although it may be practical to feed the set value for the Yankee pressure directly to the logic control unit 23, embodiments are conceivable in which the desired pressure for the Yankee level is set and the level of the desired pressure in the steam collector tank 18 is then set manually by someone who is aware of the set value for the pressure in the Yankee drying cylinder. The control unit 35 may be in communication with the logic control unit 23. Embodiments are also conceivable in which one and the same unit performs the function of both the control unit 35 and the logic control unit 23.

[0057] With a set value for the pressure in the Yankee drying cylinder, the function is then as follows. The logic control unit 23 that is connected to the control valve 22 in the second steam conduit 21 is connected to the at least one sensor 19. The at least one sensor 19 is a pressure sensor that detects (i.e. measures) the value of the pressure in the steam collector tank 18. If the pressure detected in the steam collector tank is too low, this will be noticed by the logic control unit 23 since it receives signals from the at least one sensor 19 that indicate the actual pressure in the steam collector tank 18. If the pressure in the steam collector tank 18 is found to be below the correct value, the logic control unit 23 will cause the control valve 22 to open up more such that more steam at high pressure will flow from the fresh steam network to the steam collector tank 18 such that the pressure in the steam collector tank increases. If the at least one sensor 19 should instead give a signal that indicates that the pressure in the steam collector tank is too high, the logic control unit will instead cause the control valve 22 to reduce or shut off the flow of steam from the fresh steam network to the steam collector tank 18 such that the pressure in the steam collector tank 18 decreases until it reaches a correct value.

[0058] In an alternative embodiment, a different control principle could be used which is illustrated by Figure 3. Instead of basing the control of pressure in the steam collector tank 18 on the pressure that is actually detected in the steam collector tank 18 itself, the selected property on which control is based could be the speed of the steam passing through the first cylinder steam supply conduit 29. This could mean that a speed sensor is placed in the first cylinder steam supply conduit 29. The speed sensor communicates with the logic control unit 23. If the speed of the steam is too low, the logic control unit 23 acts to open the control valve 22 such that pressure in the steam collector tank 18 increases. The increased pressure in the steam collector tank 18 will increase the flow of motive steam through the thermocompressor 27 such that the speed of the steam increases. In the corresponding way,

pressure in the steam collector tank 18 can be decreased if the speed that is detected exceeds a set value. It is to be understood that, also in this embodiment, the pressure in the steam collector tank 18 is kept below the pressure in the fresh steam network 2 and pressure in the steam collector tank 18 is still being monitored by a sensor in contact with the logic control unit.

[0059] With reference to Figure 3, the horizontal axis may represent the speed (or mass flow) of blow-through steam, i.e. the steam passing through the steam evacuation conduit 24 while the vertical axis represents the pressure in the steam collector tank 18 (collector pressure). It can be seen that increasing pressure in the steam collector tank 18 results in an increased flow of steam in the steam evacuation conduit 24. If the speed of the steam in the steam evacuation conduit 24 is too low, the control system 20 may act to increase the pressure in the steam collector tank 18 but only up to a level which is less than the pressure level in the fresh steam network 2. Suitably, the pressure in the steam collector tank 18 should be kept at least 1 bar lower than the pressure in the fresh steam network 2.

[0060] It should be understood that, in such embodiments where the selected property that is to be kept within predetermined limits is something else than the pressure in the steam collector tank 18, pressure in the steam collector tank 18 must still be controlled in the sense that the pressure in the steam collector tank 18 is lower than the pressure in the fresh steam network 2.

[0061] Instead of placing the speed sensor in the first cylinder steam supply conduit 29, the speed sensor can be placed in the steam evacuation conduit 24 or it could be placed in a conduit 41 for motive steam which conduit connects the steam collector tank 18 with the thermocompressor 27 such that the thermocompressor can receive motive steam from the steam collector tank 18. If the motive pressure is increased and more motive steam is used, this will suck more steam through the steam evacuation conduit 24 such that the speed of the steam in the steam evacuation conduit 24 increases. The most advantageous place to measure the speed of the steam is actually considered by the inventor to be the steam evacuation conduit 24 since the speed of the steam in that conduit is a good indicator of the prevailing conditions in the system but speed or mass flow of the steam may optionally or alternatively also be measured in one or several of the other steam conduits 29, 30 41.

[0062] Reference will now again be made to Figure 3. In yet another embodiment, the selected property is a difference in pressure between the steam that is fed into the Yankee cylinder 3 and the condensate that is removed from the Yankee cylinder 3. In this embodiment, a pressure sensor may be placed in the steam supply conduit at a point immediately before the steam enters the Yankee drying cylinder and another pressure sensor may be placed in the first condensate pipe 6 that leads condensate away from the Yankee drying cylinder 3. Both pressure sensors may suitably be connected to the logic control unit 23 such that the logic control unit 23 can determine the difference in pressure before and after the Yankee drying cylinder 3. In this embodiment, the logic control unit is set to maintain a certain pressure difference (i.e. pressure drop over the Yankee drying cylinder). If the pressure difference is too high or too low, the pressure in the steam collector tank 18 is increased or decreased until the pressure difference over the Yankee drying cylinder reaches a correct value. In Figure 3, the horizontal axis represents differential pressure (DP), i.e. the difference in pressure before and after the Yankee drying cylinder. With a selected value for pressure difference, the control system 20 acts such that the pressure in the collector tank (collector pressure) is increased or decreased such that the desired pressure difference is reached but the pressure in the steam collector tank 18 is still not allowed to reach the same level as the pressure in the fresh steam network 2. Suitably, the pressure in the steam collector tank 18 should be kept at least 1 bar lower than the pressure in the fresh steam network 2.

[0063] At all times, steam should preferably be prevented from passing from the steam collector tank 18 to the fresh steam network 2. This can normally be prevented by control of the pressure levels but, as a precaution, a one-way valve 33 may optionally arranged in the second steam conduit 21 such that steam cannot be pass from the steam collector tank 18 to the fresh steam network 2.

[0064] The inventive method will be apparent from the above given description of the inventive arrangement. In the inventive method, steam is recaptured during drying of a tissue web with a Yankee cylinder 3 which is heated by steam and connected to a fresh steam network 2 that operates at an elevated pressure level. In the method, the hot air hood 4 lets hot air flow against the outer circumference 5 of the Yankee cylinder 3. Condensate is removed (together with steam) from the Yankee cylinder 3 through the first condensate pipe 6 and the condensate is passed to the condensate separator 7 where condensate water is separated from steam. The condensate water is pressurized to a pressure level that exceeds the pressure level in the Yankee cylinder 3 and passed to the steam generator 9. In practice, the Yankee pressure may be, for example, 6 bar and the pressure in the fresh steam network 2 may be 16 bar. In such a case, the condensate water may be pressurized to a pressure of 9 - 12 bar before it is sent to the steam generator 9. At higher pressure levels in the Yankee cylinder 3, the condensate water may correspondingly be pressurized to higher levels but it cannot be pressurized to a level substantially higher than the pressure in the steam collector tank 18 and the pressure in the steam collector tank 18 must be lower than in the fresh steam network 2. It is considered by the inventor that the condensate should be pressurized to a level that is at least 1 bar less than the pressure level in the fresh steam network 2. If the pressure in the fresh steam network 2 is 16 bar, the condensate water cannot be pressurized to substantially

more than 15 bar.

[0065] Hot waste air is taken from the hot air hood 4 and used to heat condensate water in the steam generator 9 such that the pressurized condensate water is caused to evaporate at the pressure level to which it has been brought. The steam generated in the steam generator 9 is then fed to the Yankee cylinder 3. The steam generated in the steam generator 9 is then fed to a steam collector tank 18 in which the pressure is lower than the pressure level in the fresh steam network 2 but higher than the pressure level in the Yankee cylinder 3. In practice, the pressure in the steam collector tank 18 will normally be substantially the same as the pressure level in the steam generator 9 (actually, the pressure in the steam collector tank 18 is slightly higher in order to compensate for pressure losses between the steam generator 9 and the steam collector tank 18). From the steam collector tank 18, steam is subsequently fed to the Yankee cylinder 3 through at least one cylinder steam supply conduit 29, 30. As explained above with reference to Figure 1 and Figure 2, a selected property of the condensate water and steam (for example pressure, speed or a difference in pressure) that is circulated is detected which property is directly or indirectly dependent on the pressure in the steam collector tank 18. The pressure in the steam collector tank 18 is then controlled in a way that has been explained above such that the selected property is kept within predetermined limits.

[0066] In preferred embodiments, the pressure in the steam collector tank 18 is controlled by simply supplying more or less steam from the fresh steam network 2 to the steam collector tank 18 to such an amount that the selected property is kept within the predetermined limits. However, embodiments are conceivable in which the pressure in the steam collector tank may be controlled by other means, for example by compression.

[0067] It should be understood that embodiments are possible the first steam conduit 16 may be very short or even so short that the steam collector tank 18 is practically directly connected to the steam generator 9. In such embodiments, the first steam conduit 16 may be, for example, an integrated part of the steam generator 9 that is adapted for connection to the steam collector tank 18.

[0068] It should be understood that the pressure levels indicated refer to overpressure, i.e. the pressure that exceeds the atmospheric pressure. For convenience, numerical values for pressure have been indicated in the unit "bar" but, if desired, the unit "bar" may of course be converted to the SI-unit Pa (Pascal) since 1 bar = 0.1 MPa.

[0069] Although the inventive arrangement has been termed an arrangement for drying a tissue paper web, it may equally well be termed an arrangement for recapturing steam during drying of a tissue paper web.

[0070] Although the invention has been described above in terms of an arrangement and a method, it should be understood that these categories only reflect different aspects of one and the same invention. The inventive method may thus include such method steps that would be the inevitable consequence of using the inventive arrangement, regardless of whether such steps have been explicitly mentioned or not.

[0071] The invention offers the advantage that a buffer of steam can be made available in the steam collector tank which can be used to supply the Yankee drying cylinder with steam according to the actual requirements of the Yankee. This buffer is not entirely independent of the fresh steam network but it is less sensitive to such variations in the pressure that may occur in the fresh steam network as a result of boiler problems. As a result, the risk of unwanted fluctuations in Yankee heating is reduced at the same time as heat energy can be recovered.

[0072] In comparison to a system where evaporated condensate water is returned to the fresh steam network, the present invention also offers yet another advantage, namely that more steam can be generated by the heat energy in the waste air from the hot air hood. The reason for this is that a greater part of the heat energy in the hot air becomes available. When hot air is used in a heat exchanger to evaporate condensate water, the air can in principle deliver heat energy until the air is cooled down to the saturation temperature of the condensate. In practical cases, this is not a realistic option since the heat exchanger would have to be very large and since there would be a risk of water droplets in the steam. As a rule of thumb, the hot air can only be cooled down to a temperature that is 15°C - 25°C above the saturation temperature of the condensate water. If the pressure in the fresh steam network is 16 bar and if evaporated steam is to be fed back into the fresh steam network, the steam must also have a pressure of at least 16 bar. The saturation temperature of water at 16 bar is 204°C. This means that, in practice, the air from the hot air hood 4 can only be cooled down to about 219°C or perhaps only down to 229°C. The heat energy delivered to by the waste air to the condensate water is determined by the equation $m*Cp*(T_{in} - T_{out})$ where m = mass flow of the air, Cp =specific heat of the air, T_{in} = the ingoing temperature of the waste air and T_{out} = the temperature of the outgoing air. The ingoing temperature of the waste air may vary but in many realistic cases, it may be in the range of 350°C - 500°C. If the condensate water is pressurized to a pressure level that is lower than 16 bar, for example if it is pressurized to a level of 8 bar, the saturation temperature of the condensate water will be 175°C and the waste air can be cooled in the heat exchanger to a temperature that may even be below 200°C, perhaps as low as 190°C. This means that a larger amount of heat energy is delivered to the condensate water compared to the case where the water is pressurized to a higher pressure level.

[0073] Therefore, the present invention provides both a buffer that is less sensitive to pressure fluctuations in the fresh steam network and also an effective way of using the heat energy in the waste air from the hot air hood.

Claims

1. An arrangement (1) for drying a tissue paper web, the arrangement (1) comprising: a fresh steam network (2); a Yankee cylinder (3) which is connected to the fresh steam network (2) in such a way that it is capable of receiving steam from the fresh steam network (2); a hot air hood (4) at the outer circumference (5) of the Yankee cylinder (3) arranged to let hot air flow against the outer circumference (5) of the Yankee cylinder (3); a first condensate pipe (6) for removing condensate from the Yankee cylinder (3); a condensate separator (7) connected to the first condensate pipe (6) such that the condensate separator (7) can receive condensate from the Yankee cylinder (3); a steam generator (9) arranged to receive condensate from the condensate separator (7); a pump (10) arranged to convey condensate from the condensate separator (7) to the steam generator (9) and increase the pressure of the condensate to a level that exceeds the pressure in the Yankee cylinder (3); a waste air conduit (11) connected to the air hood (4) for conducting waste air out of the air hood (4); a heat exchanger (12) arranged to transfer heat energy from the waste air conduit (11) to the steam generator (9) such that condensate in the steam generator (9) is heated and evaporated; a first steam conduit (16) connected to the steam generator (9) such that steam can be passed from the steam generator (9) and subsequently sent to the Yankee cylinder (3), ***characterised in that*** the arrangement (1) further comprises a steam collector tank (18) arranged to receive steam from the steam generator (9) via the first steam conduit (16), the steam collector tank (18) being connected to the Yankee cylinder (3) such that steam can be passed from the steam collector tank (18) to the Yankee cylinder (3), **in that** at least one sensor (19) is arranged to detect a selected property of the steam and water that is being circulated through the arrangement (1) which property is dependent directly or indirectly on the pressure in the steam collector tank (18) and wherein the at least one sensor (19) includes at least one pressure sensor for detecting the pressure in the steam collector tank and **in that** the arrangement (1) comprises a control system (20) that is set to control the pressure in the steam collector tank (18) such that the selected property is kept within predetermined limits and also such that the pressure in the steam collector tank (18) is kept at a level that is lower than the level of the pressure in the fresh steam network (2).

2. An arrangement according to claim 1, wherein the control system (20) that is set to control the pressure in the steam collector tank (18) comprises a second steam conduit (21) leading from the fresh steam network (2) to the steam collector tank (18) such that pressurized steam can be fed from the fresh steam network (2) to the steam collector tank (18), in that a control valve (22) is arranged in the second steam conduit (21), in that a logic control unit (23) is connected to the control valve (22) in the second steam conduit (21), and in that the logic control unit (23) is set to control the control valve (22) in the second steam conduit (21) and thereby the pressure in the steam collector tank (18).

3. An arrangement according to claim 1 or 2, wherein a steam evacuation conduit (24) leads from the condensate separator (7) to a thermocompressor (27) which is connected to the steam collector tank (18) such that it can receive motive steam from the steam collector tank (18) and wherein a first cylinder steam supply (29) conduit leads from the thermocompressor (27) to the Yankee cylinder (3).

4. An arrangement according to claim 3, wherein a second cylinder steam supply conduit (30) leads from the steam collector tank (18) to the Yankee cylinder (3), either directly or via the first cylinder steam supply conduit (29) and wherein a control valve (31) is arranged in the second cylinder steam supply conduit (30) such that the flow of steam through the second cylinder steam supply conduit (30) can be regulated or shut off.

5. An arrangement according to claim 3 or 4, wherein the selected property is the speed of the steam in either of the first cylinder steam supply conduit (29) or the steam evacuation conduit (24) or the speed of the motive steam that is fed from the steam collector tank (18) to the thermocompressor (27).

6. An arrangement according to claim 1, wherein the selected property is a difference in pressure between the steam that is fed into the Yankee cylinder (3) and the condensate that is removed from the Yankee cylinder (3).

7. An arrangement according to any of claims 1-4, wherein the selected property is the pressure in the steam collector tank (18), wherein the at least one sensor (19) is a pressure sensor that detects the pressure in the steam collector tank (18) and wherein a logic control unit (23) is set to keep the pressure in the steam collector tank (18) at a level that is selected to be higher than the pressure in the Yankee cylinder (3) but lower than the pressure in the fresh steam network (2), wherein the pressure in the Yankee cylinder (3) is set to remain at a first pressure level and wherein the logic control unit (23) is set to control the pressure in the steam collector tank (18) such that the pressure in the steam collector tank (18) is kept at a second pressure level that is lower than the pressure in the fresh steam network (2) but

higher than the first pressure level, preferably 1.5-2 times higher.

8. An arrangement according to any of claims 2-7, wherein a one-way valve (33) is arranged in the second steam conduit (21) such that steam cannot be fed from the steam collector tank (18) to the fresh steam network (2).

9. An arrangement according to claim 4, wherein a sensor (34) is arranged to detect the pressure in at least one of the first or the second cylinder steam supply conduit (29, 30), the sensor (34) being connected to a control unit (35) that is arranged to control the thermocompressor (27).

10. A method for recapturing steam during drying of a tissue paper web with a Yankee cylinder (3) which Yankee cylinder (3) is heated by steam and connected to a fresh steam network (2) that operates at an elevated pressure level and wherein a hot air hood (4) lets hot air flow against an outer circumference (5) of the Yankee cylinder (3), the method comprising: removing condensate from the Yankee cylinder (3) and passing the condensate to a condensate separator (7) where condensate water is separated from steam, pressurizing the condensate water to a pressure level that exceeds the pressure level in the Yankee cylinder (3) and passing the condensate water to an steam generator (9), using hot waste air taken from the hot air hood (4) to heat condensate water in the steam generator (9) such that the condensate water is caused to evaporate and feeding steam generated in the steam generator (9) to the Yankee cylinder *(3),* ***characterised in*** **that** the steam generated in the steam generator (9) is fed to a steam collector tank (18) from which steam collector tank (18) steam is subsequently fed to the Yankee cylinder (3), **in that** a selected property of the condensate water and steam that is circulated is detected which property is directly or indirectly dependent on the pressure in the steam collector tank (18) and **in that** the pressure in the steam collector tank (18) is controlled such that the selected property is kept within predetermined limits and also such that the pressure in the steam collector tank (18) is lower than the pressure in the fresh steam network (2).

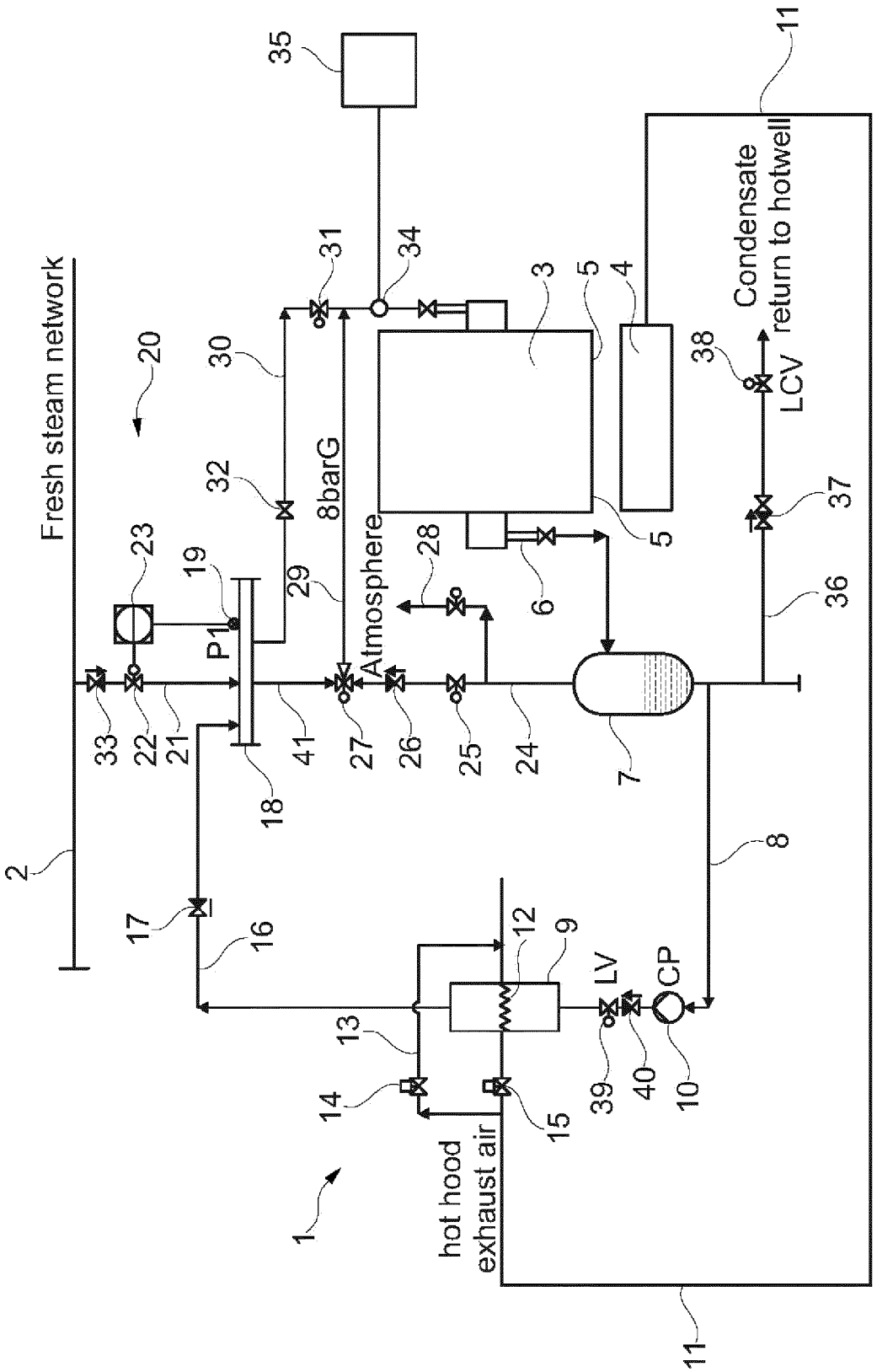
11. A method according to claim 10, wherein the pressure in the steam collector tank (18) is controlled by supplying more or less steam from the fresh steam network (2) to the steam collector tank (18) to such an amount that the selected property is kept within the predetermined limits.

12. A method according to claim 10, wherein the selected property is the pressure in the steam collector tank (18) and wherein the pressure in the steam collector tank (18) is detected and a flow of pressurized steam from the fresh steam network (2) to the steam collector tank (18) is increased or decreased in response to the detected pressure in the steam collector tank (18) such that the pressure in the steam collector tank (18) remains within predetermined limits, and wherein the pressure in the steam collector tank (18) is preferably controlled such that it exceeds the pressure in the Yankee cylinder (3) by a predetermined factor which predetermined factor is preferably in the range of 1.5 - 2.0.

13. A method according to claim 10, wherein the a steam evacuation conduit (24) leads away steam from the condensate separator (7) and where the steam from the condensate separator (7) is fed to a thermocompressor (27) which receives motive steam from the steam collector tank (18) which motive steam is mixed with the steam from the condensate separator and sent to the Yankee cylinder (3).

14. A method according to claim 11 or 12, wherein steam is sent from the steam collector tank (18) to the Yankee cylinder (3) without passing any thermocompressor (27).

15. A method according to claim 12, wherein the selected property is one of a) the speed of the steam which is passing from the condensate separator (7) to the thermocompressor (27), the speed of the motive steam reaching the thermocompressor (27) or the speed of the mixture of motive steam and steam coming from the condensate separator (7) or b) a difference in pressure between the steam that is fed into the Yankee cylinder (3) and the condensate that is removed from the Yankee cylinder (3).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Condensate return to hotwell
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8barG
Atmosphere
P1
LV
CP
hot hood exhaust air
1
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8
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10
11
12
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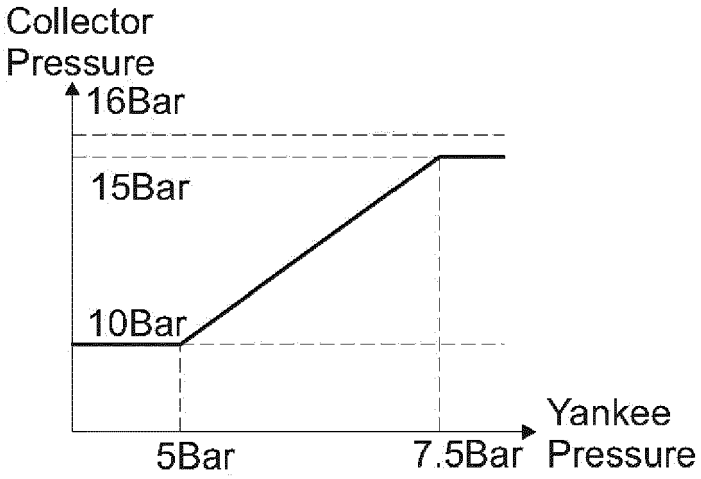
Fig. 1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Pressure
16Bar
15Bar
10Bar
5Bar
7.5Bar
Yankee
Pressure

Fig. 2

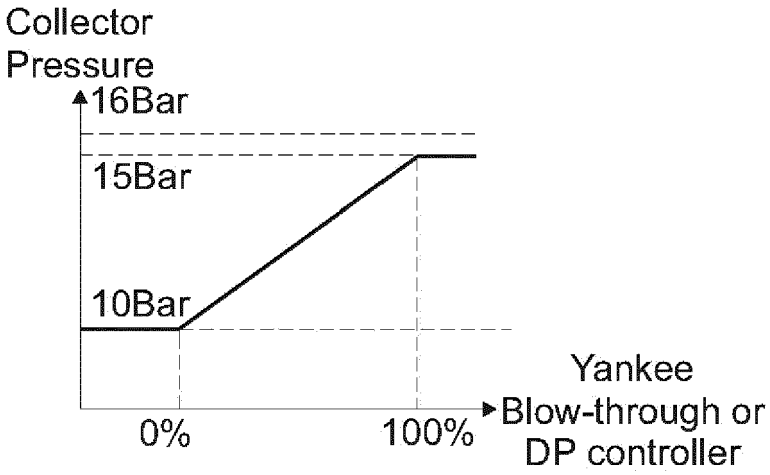
Collector
Pressure
16Bar
15Bar
10Bar
0%
100%
Yankee
Blow-through or
DP controller

Fig. 3

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 13 15 8017

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D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 June 2013	Sabatucci, Arianna

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 15 8017

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