



(43) International Publication Date  
27 August 2015 (27.08.2015)

- (51) International Patent Classification:  
*B01D 1/26* (2006.01)      *D21C 11/10* (2006.01)  
*B01D 1/28* (2006.01)
- (21) International Application Number: PCT/FI2014/050130
- (22) International Filing Date: 20 February 2014 (20.02.2014)
- (25) Filing Language: English
- (26) Publication Language: English
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

**Published:**

- with international search report (Art. 21(3))

(54) Title: EVAPORATOR

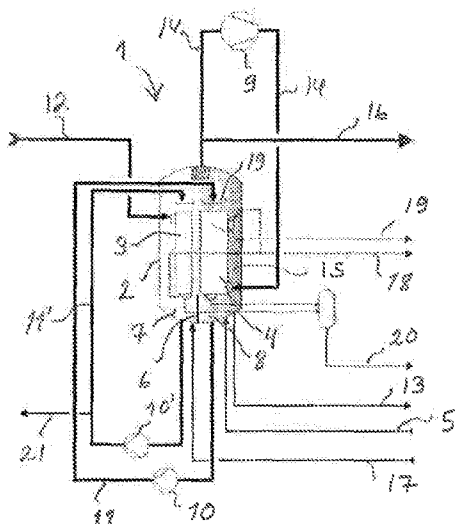


FIG. 1

(57) Abstract: The present invention relates to an evaporator of a multi-effect evaporation plant for black liquor at a pulp mill, the evaporator comprising: a housing, and in the housing a first and second evaporation section comprising heat exchanger units which have falling film heat transfer surfaces and inlets for heating vapor, feed inlet lines for introducing black liquor to be evaporated to the evaporation sections and onto the heat transfer surfaces of the heat transfer units, discharge lines connected to the housing for withdrawing evaporated black liquor, the vapor inlet of the heat exchanger unit of the first evaporation section is connected to a vapor outlet of an effect of the multi-effect evaporation plant, and a vapor outlet line for vapor generated in evaporation. The vapor line is connected to a vapor pressure increasing device for leading at least a portion of the vapor therein, and a discharge line from the pressure increasing device is connected to the vapor inlet of the heat exchanger unit of the second section. The housing is provided with a partition between the evaporation sections, so that the partition divides the lower part of the housing into two liquid compartments having a common vapor space, where the heat exchanger units are located, and the common vapor space is connected to the vapor outlet line.

WO 2015/124828 A1

## EVAPORATOR

- 5 The present invention relates to an evaporator for concentrating evaporating black liquor in a black liquor evaporation plant of a chemical pulp mill, where pre-evaporation of black liquor is effected in a novel way using vapor compression evaporation.
- 10 For combustion in a recovery boiler, black liquor is concentrated most usually in a multi-effect evaporation (MEE) plant. The numbering of the effects is based on the order defined by their vapor flow. Most usually an evaporation plant operates so that an evaporator under the highest pressure receives as a source of heat e.g. fresh steam, which boils liquid on the liquid-side of the evaporator, whereby vapor is generated having a lower pressure than the pressure of steam introduced to the steam-side of the evaporator. The generated vapor is used for heating an evaporator that is under the next lower pressure, as the liquor flows through the evaporation plant countercurrently in relation to the heating steam or vapor. Correspondingly, in a third effect, a fourth effect etc., the same process takes place, until the pressure and temperature of the vapor from the last effect in relation to the vapor flow are so low that it is not worth continuing both in technical sense and in view of the total economy. Vapor at the lowest pressure is usually condensed in a condenser with water or air. Typically an evaporation plant comprises 5–7 effects. One conventional evaporation unit type is a so-called falling film evaporator, where liquor is introduced to flow downwards on the surface of a heating element in form of a thin film in order to generate a high heating efficiency.

In black liquor concentration, for combustion, also vapor-compression evaporation has been used, which is also referred to as mechanical vapor recompression (MVR), where the pressure, and thus also the saturation temperature of the vapor evaporated from a solution is raised with steam by means of an ejector, or mechanically by means of a compressor or a fan so high that this vapor can be used as heating medium of the same effect. The compression is required in order to raise the saturation temperature of the vapor for generating an adequate temperature difference over the evaporation effect. The increase in the saturation temperature is to be greater than the boiling point rise. As the power demand of the compressor or fan is relative to the pressure increase, vapor compression evaporation has been used mostly when the

boiling point rise is low. A restricting factor for mechanical vapor compression in black liquor evaporation is the black liquor boiling point rise. As the dry solids content of the black liquor increases, the boiling point rise increases fast and reduces the available temperature difference. In practice, the use of fan evaporators in sulfate pulp industry is limited to pre-evaporators, where liquor is evaporated in approximately 20–25 % dry solids content. Pre-evaporation is typically followed by the above described multi-effect evaporation for increasing the dry solids content of the black liquor to a preferred dry solids content, typically 75–85 %, even 90 %, for combustion in the recovery boiler. Typically, falling film evaporators are suitable for use as compression evaporators, because they operate effectively also with small temperature differences.

The economical applicability of vapor compression evaporation is dependent on the fact that the price of electrical energy is low enough compared to the price of available heat energy. An advantage of this evaporation method is that no external steam source is required.

As the prices of additional fuel and green electricity - which term generally refers to electricity produced with other than fossil fuel - are continuously increasing, various plant solutions which decrease the steam consumption of the mill are becoming more and more cost-effective. As steam consumption is decreased, the mill balance either saves in additional fuel or more electricity will be available to the condensate part of a turbine for electricity production. Pulp mills are tending to sell out more electricity due to increased economic interest. In addition to chemical pulp mills, also other production plants, such as paper mills, aim at more efficient and more economical energy consumption.

The energy consumption of a mechanical vapor compression pre-evaporation plant, which can also be called a fan pre-evaporation plant, if a fan is used, compared to e.g. a 7-effect in-series connected evaporation plant, when calculated in terms of money, is often as much as 70 % lower. Earlier fan pre-evaporation plants have been used at sulfate pulp mills mainly for obtaining additional capacity for the evaporation plant. Only a portion of the required total evaporation can be carried out at the fan pre-evaporation plant, because excessively high dry solids content of the liquor to be evaporated increases the boiling point rise and requires a high pressure increase from the fan or compressor, which increases energy consumption.

WO 2009/053518 discloses an evaporator arrangement at a multi-effect evaporation plant, which can be used for black liquor evaporation. In the arrangement the black liquor evaporation using mechanical vapor recompression is integrated in one effect of the multi-effect evaporation plant. An evaporator of the evaporation plant can be provided with a vapor compression evaporation section and an evaporation section, which are arranged inside a common housing. When two different black liquors are evaporated, a space for secondary vapor is divided by means of an intermediate wall such that the intermediate wall has an opening or openings for equalizing the pressure between the sections formed by the intermediate wall inside the housing. Secondary vapors are discharged via separate discharge conduits so that one discharge conduit is connected in the steam flow direction to a next evaporation effect, where a portion of the vapors is taken directly as heating medium. One discharge conduit for secondary vapor is connected to a pressure increasing device, such as a fan, for increasing the vapor pressure and for returning a portion of the vapors after the pressure increase into the vapor compression section of the evaporator plant. By integrating the vapor compression evaporation with an evaporation effect of the multi-effect evaporation plant according to the WO publication the steam consumption may be decreased compared to a normal multi-effect evaporation plant. However, there is a need to further improve steam economy.

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An object of the present invention is to provide a method of coupling vapor compression evaporation to a multi-effect black liquor evaporation plant in a way that is more advantageous both in view of heat economy and in view of economical aspects.

25 In order to achieve these goals the present invention relates to an evaporator of a multi-effect evaporation plant for black liquor at a pulp mill, the evaporator comprising:

- a housing, and in the housing
- a first and second evaporation section comprising heat exchanger units which have falling film heat transfer surfaces and inlets for heating vapor,
- feed inlet lines for introducing black liquor to be evaporated to the evaporation sections and onto the heat transfer surfaces of the heat transfer units,
- discharge lines connected to the housing for withdrawing evaporated black liquor,
- the vapor inlet of the heat exchanger unit of the first evaporation section is connected to a vapor outlet of a previous effect of the multi-effect evaporation plant, and

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- a vapor outlet line for vapor generated in evaporation, which vapor line is connected to a vapor pressure increasing device for leading at least a portion of the vapor therein, and a discharge line from the pressure increasing device is connected to the vapor inlet of the heat exchanger unit of the second section.

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The evaporator according to the invention is characterized in that the housing is provided with a partition between the evaporation sections, so that the partition divides the lower part of the housing into two liquid compartments having a common vapor space, where the heat exchanger units are located. The common vapor space is  
10 connected to the vapor outlet line. Typically, the black liquors fed to the evaporation sections have a different dry solids content, such as weak black liquor and black liquor from an effect of the MEE plant.

The invention is implemented so that a heat exchanger unit of the vapor compression evaporation and a heat exchanger unit of the multi-effect evaporation plant are  
15 arranged in a same housing (vessel), i.e. in a common evaporation device. Thus, a single evaporator body has two heat exchanger units, of which one uses as heating medium vapor coming from the vapor pressure increasing device and the other uses vapor that is generated in a preceding effect of the multi-effect evaporation plant. As  
20 black liquor is evaporated on an outer surface of heat exchanger units, vapor generated in the evaporation enters the same space defined by the housing and is discharged typically via a conduit or conduits positioned in the housing, typically at the upper part thereof. A portion of this vapor is used in a following evaporation effect being at a lower pressure and the pressure of a portion of the vapor is increased and  
25 returned as heating steam into a unit of the vapor compression evaporation plant. An essential feature of the present invention is the common vapor space, and only the liquor compartments are separated from each other by a partition. This allows that vapor generated in one evaporation section can flow to the other evaporation section and heat the black liquor evaporating in the other evaporation section. For instance,  
30 if the temperature of the weak black liquor is low, vapor from the evaporation section connected to the MEE plant can pre-heat the weak black liquor to be evaporated. Thus no separate preheater is needed.

A preferred heat transfer surface of the heat exchanger units is a falling film evaporation  
35 device, where the evaporation surface is formed of a number of lamellas or tubes. Preferably the liquor to be evaporated flows on the outer surface of the lamellas or on the inner surface of the tubes, while the heating steam is led inside the la-

mellas or to the outer side of the tubes. For instance in plate-type falling film lamella evaporators almost all or all the vertical part of the evaporation surface is in contact with the surrounding vapor space, whereby free space is left between the heat transfer elements for releasing the vapor generated on their surface. In an evaporator operating on the freely falling film principle the vapor flows freely in a space defined by a housing-vessel, inside which vessel the heat transfer element units are located. The generated vapor flows essentially vertically upwards in the free space between the heat transfer element units and the wall of the housing vessel to the upper part of the housing vessel. Normally the vapor is collected into a drop separator and it is allowed to flow out from the upper part of the vessel. Each of the effects of a multi-effect in-series connected evaporation plant comprises one heat exchanger unit arranged inside the housing or several parallel connected heat exchange surface units each arranged inside a housing.

According to a preferred embodiment of the invention the second evaporation section functions as a black liquor pre-evaporator. The feed line of the second evaporation section is connected to a weak black liquor tank of the pulp mill. Thus according to the invention the MVR pre-evaporator is integrated with one of the MEE evaporator effects (typically with effects 2 through 7), and they are disposed in the same evaporator body. The effect is divided to liquor sections: one section for the weak liquor pre-evaporation and the other for the normal MEE liquor. The evaporation surface is also divided to sections: one section for the weak black liquor pre-evaporation and the other for the normal MEE liquor. The vapor amount evaporated in the pre-evaporation section is compressed in a vapor compressor and after the compressor used as heating steam in the pre-evaporator section. Vapor coming from the previous MEE effect is used as heating steam in the MEE section and the vapor amount evaporated in this section continues to the next MEE effect. In this case the common vapor space may be further connected to a conduit for leading a portion of the vapor in the steam flow direction into a next effect of the multi-effect evaporation plant.

Typically the heat exchanger units are located above the liquid compartments, and the partition is substantially vertical and extends to the level of the lower edges of the units.

Typically the vapor pressure increasing device is a fan or a compressor.

According to an embodiment the vapor inlet of the heat exchanger unit of the vapor compression evaporation section (second evaporation section) is also connected to a vapor outlet of an effect of the multi-effect evaporation plant through a line which is provided with a by-pass valve. This increases the flexibility of the evaporation system. When the MVR pre-evaporation section, and so the vapor compressor, is in operation, the by-pass valve is closed. However, if the vapor compressor is not used for some reason, the by-pass valve is open and the MVR section is heated by vapor from another effect of the MEE plant. Thus, depending on the energy situation of the mill the pre-evaporation can be switched from MVR evaporation to steam operation.

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10 The two-section evaporator can operate also regardless of the inoperability of the vapor compressor or any other disturbance at the evaporation plant.

Typically the discharge, i.e. venting of non-condensable gases generated in a heat exchange unit of the vapor compression evaporation is effected by means of the respective devices of the multi-effect evaporation plant.

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Typically the discharge and treatment of condensates generated in a heat exchange unit of the vapor compression evaporation are handled with dedicated devices of the multi-effect evaporation plant.

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The invention is described in more detail with reference to the accompanying figures, of which

Fig. 1 illustrates schematically in detail an evaporator according to a preferred embodiment of the present invention,

25 Fig. 2 illustrates schematically a coupling of an evaporator in multi-effect evaporation plant in accordance with the invention, and

Fig. 3 illustrated schematically another preferred arrangement accordance with the invention.

30 Fig. 1 illustrates an evaporator with a housing 2, inside which a heat exchanger unit 4 of a vapor compression evaporation section and a heat exchanger unit 3 of a multi-effect evaporation section are arranged, both operating on the falling film principle. In this embodiment the heat transfer surface units are formed of a number of lamellas, to the interior of which heating steam is fed, and the liquor to be evaporated flows on

35 the outer surface thereof. Thereby, liquor is thus heated by means of indirect contact with the vapour inside the heat exchanger units. Instead of lamellas, also tubes can be used, whereby the liquor can flow on the inner or outer surface thereof. The

lower part of the housing 2 is provided with a partition 6, which divides the bottom into two liquor compartments 7, 8.

Weak black liquor (feed liquor), which is to be evaporated, is fed via a conduit 5 into the liquor compartment 8, wherefrom the liquor is pumped by means of a pump 10 via a conduit 11 into a distribution device 19 located above the heat transfer unit 4. In the distribution device the liquor flows via openings or corresponding to the outer surface of the lamellas, where liquor is evaporated. The evaporated liquor is collected in the liquor compartment 8, wherefrom it is discharged into a following evaporation effect via line 13.

The heat transfer unit 3 of the multi-effect evaporation plant receives as heating medium typically vapor via conduit 12 from a preceding evaporation effect operating at a higher pressure. The heat transfer surface unit 4 of the vapor compression evaporation section receives as heating medium from a vapor pressure increasing device 9 via line 14.

Because the heat exchanger unit 4 of the vapor compression evaporation section and the heat exchanger unit 3 of the multi-effect evaporation plant are located in the same housing 2, vapors evaporated from black liquor on their outer surface flow into a common space 15, where the heat exchanger units are located. A conduit 10 is connected thereto. The conduit 14 is provided with a vapor pressure increasing device 9, which typically is a compressor or a fan. In the pressure increasing device 9, the vapor pressure is increased to a level at which the vapor can be returned as heating medium back to the same effect, into the vapor compression heat transfer surface unit 4. A branch conduit 16 is also connected to conduit 14, via which branch conduit a portion of the vapor discharged from the housing 2 is taken as heating medium into another evaporation effect.

Black liquor is introduced to the liquor compartment 7 of the multi-effect evaporation section from another evaporation effect via line 17. From the liquor compartment 7 the liquor is further led into the multi-effect evaporation plant's heat exchanger unit 3. The liquor is taken by means of a pump 10' via line 11' into the upper part of said unit and made to flow down-wards on its outer surface. The evaporated liquor is led to the next evaporation effect via line 21. Evaporated secondary vapor flows to the common vapour space in the housing 2, as described above. Condensates are discharged from the interior of the heat exchanger units via lines 19 and 20 into con-

densate treatment of the multi-effect evaporation plant. Non-condensable gases generated in said units are also discharged via a common line 18 to further treatment. An advantage of the invention is that the treatment of condensates and the treatment of non-condensable gases can be effected with the same devices, i.e. devices of the multi-effect evaporation plant, and the vapor compression evaporation does not need its own separate devices.

An advantage of the present invention is better possibility to utilize apparatuses, such as transfer pipings for liquor and steam, condensate system and vacuum system of a multi-effect evaporation plant, compared to known couplings.

Figure 2 illustrates a 7-effect multi-effect in-series connected black liquor evaporation plant. In this case the evaporation plant comprises sequential effects 1–7, which operate at pressures and temperatures that decrease sequentially in the flow direction of the steam. The final evaporation effect 1A, B of the liquor comprises steps IA and IB. The evaporators illustrated in Figure 2 are falling film lamella evaporators, but other evaporators suitable for black liquor evaporation can be used as well in this case. Figure 2 uses the same reference numerals as figure 1 where applicable.

For the evaporation, fresh steam of the mill is typically fed via channel 30 into steps IA and IB of evaporation effect I so that it warms the black liquor and simultaneously condenses. In evaporation effect I vapor separates from black liquor, which vapor is taken as heating medium into effect 2A via channel 31. In evaporation effect 2A, vapor separates that is at a lower temperature than in evaporation effect I, which vapor is further led into a following evaporation effect 3A via channel 32. Accordingly, in evaporation effects 3A, 4A, 5A and 6A the secondary vapor separated from black liquor is taken to a respective following evaporation effect 4A, 5A, 6A and 7A, for warming and evaporating black liquor.

The weak black liquor (feed liquor) is introduced via line 5 into the vapour compression evaporation section of effect 4A, from where it flows via line 13 into effect 7A. Liquor from effect 7A is introduced for evaporation into effect 6A via line 40 and further into effect 5A via line 41 for formation of intermediate liquor in line 42. The intermediate liquor is further led to effect 4A, wherefrom the liquor is taken via evaporation effects 3A and 2A to final evaporation 1A, B provided with two steps IA and IB connected in series at the liquor side. Liquor is first evaporated in step IB, from where it is led to step IA for evaporating the liquor to a high dry-solids content, i.e.

approximately 75–90%. The concentrated combustion liquor is discharged via line 43 to combustion.

5 In the last effect 7A the produced vapor is taken via line 33 to the vacuum system of the evaporation plant, where it is e.g. cooled by means of cooling water in a surface condenser (vacuum condenser) (not shown).

10 In accordance with the invention, a vapor compression evaporation section is integrated to the first evaporation effect, in relation to the black liquor flow direction, of a multi-effect evaporation plant. The integration is similar to that presented in more detail in Figure 1. Effect 4A is provided with a heat exchanger unit 4 of a vapor compression evaporation section and a heat exchanger unit 3 of a multi-effect evaporation section, which units operate on the falling film principle and are located inside a common housing. The bottom part of the housing is provided with a partition which  
15 divides the bottom into two liquor compartments. The weak black liquor (feed liquor) 5 is introduced into the bottom part of the evaporator housing, wherefrom the liquor is pumped via a distribution device to the outer surface of heat exchanger unit 3, whereby as the liquor flows downwards on the surface, vapor is evaporated therefrom. The vapour compression evaporation section functions as a black liquor pre-  
20 evaporator.

The heat exchanger unit 3 of a multi-effect evaporation section, which operates on the falling film principle, is located inside the common housing of effect 4A. Black liquor is introduced into the multi-effect evaporation plant's heat exchanger unit 3 located  
25 in housing 2 from the second evaporation effect via line 42. The liquor is taken by means of a pump into the upper part of said unit and made to flow downwards on its outer surface.

30 The secondary vapor formed in the evaporation in effect 4A is discharged from the upper part of the evaporator via conduit 14. A portion of the vapor is taken to the next evaporation effect 5A via line 16 in the steam flow direction. A portion of the vapor is again led into a vapor pressure increasing device 9 arranged in conduit 14, wherein the pressure of the vapor is increased so that this vapor can be returned as heating medium into heat transfer surface unit 4' of the vapor compression evaporation  
35 plant. The condensates 19 and 20 (Fig. 1) generated in the heat exchanger units can be treated in the condensate treatment system of the multi-effect evaporation plant.

Fig. 3 shows an embodiment in which the vapor inlet of the heat exchanger unit 4 of the vapor compression evaporation section (second evaporation section) is also connected to a vapor outlet of an effect of the multi-effect evaporation plant via a line 45, which is provided with a by-pass valve 46. This increases the flexibility of the evaporation system. When the MVR pre-evaporation section, and so the vapor compressor 9, is in operation, the by-pass valve 46 is closed and valves 47, 48 downstream and upstream of the compressor are open. The bypass valve is open, when the vapor compressor is shut off. Then the second evaporation section is heated by vapor from an effect of the multi-effect evaporation plant, which vapor is led via lines 45 and 14'.

By connecting the black liquor vapor compression pre-evaporator to the multi-effect evaporation plant in accordance with the invention, at least the following advantages can be gained:

- Pre-evaporator capacity can be chosen so that soft wood liquor sweetening can be done in the pre-evaporator
- No outside heat (like fresh steam) needed for liquor preheating
- In case of low weak liquor temperature, heat required for pre-heating transfers to the pre-evaporation section in vapor form from the normal evaporation section
- Depending on the energy situation of the mill the pre-evaporation can be switched from MVR evaporation to steam operation.
- Significant cost savings compared to stand-alone pre-evaporators:
  - only one evaporator body, common with the MEE body
  - common condensate collection tanks with MEE effect
  - no separate feed or discharge pumps are required
  - no separate vacuum system, common system with MEE is used
  - common instrumentation with the MEE effect

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While the invention has herein been illustrated and described in connection with what at present is considered to be the most practical and most preferred embodiment, it is obvious to persons skilled in the art that many modifications can be made within the scope of the invention, which scope is to be given the broadest possible interpretation in accordance with the appended claims in order to cover all corresponding systems and processes.

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## Claims:

1. An evaporator of a multi-effect evaporation plant for black liquor at a pulp mill,  
5 the evaporator comprising:
- a housing, and in the housing
  - a first and second evaporation section comprising heat exchanger units which have falling film heat transfer surfaces and inlets for heating vapor,
  - feed inlet lines for introducing black liquor to be evaporated to the evapora-  
10 tion sections and onto the heat transfer surfaces of the heat transfer units,
  - discharge lines connected to the housing for withdrawing evaporated black liquor,
  - the vapor inlet of the heat exchanger unit of the first evaporation section is connected to a vapor outlet of an effect of the multi-effect evaporation plant,  
15 and
  - a vapor outlet line for vapor generated in evaporation, which vapor line is connected to a vapor pressure increasing device for leading at least a portion of the vapor therein, and a discharge line from the pressure increasing device is connected to the vapor inlet of the heat exchanger unit of the second sec-  
20 tion,
- characterized in that the housing is provided with a partition between the evaporation sections, so that the partition divides the lower part of the hous-  
ing into two liquid compartments having a common vapor space, where the heat exchanger units are located, and the common vapor space is connect-  
25 ed to the vapor outlet line.
2. An evaporator according to claim 1, characterized in that the second evap-  
oration section functions as a black liquor pre-evaporator, wherein the feed  
line of said evaporation section is connected to a weak black liquor tank of  
30 the pulp mill.
3. An evaporator according to claim 1 or 2, characterized in that the common  
vapor space is further connected to a conduit for leading a portion of the va-  
por in the steam flow direction into a next effect of the multi-effect evapora-  
35 tion plant.

4. An evaporator according to claim 1, characterized in that the heat exchanger units are located above the liquid compartments, and the partition is substantially vertical and extends to the level of the lower edges of the heat exchanger units.

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5. An evaporator according to any one of the preceding claims, characterized in that the vapor pressure increasing device is a fan or a compressor.

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6. An evaporator according to claim 1, characterized in that the vapor inlet of the heat exchanger unit of the second evaporation section is further connected to a vapor outlet of an effect of the multi-effect evaporation plant through a line which is provided with a by-pass valve.

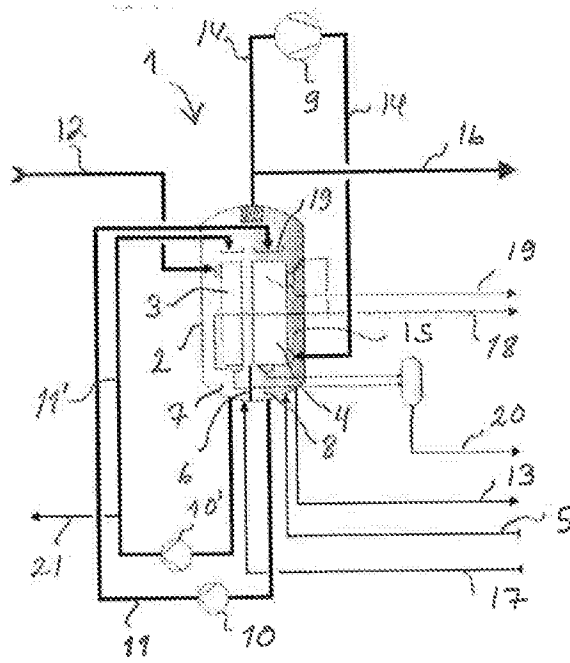


FIG. 1

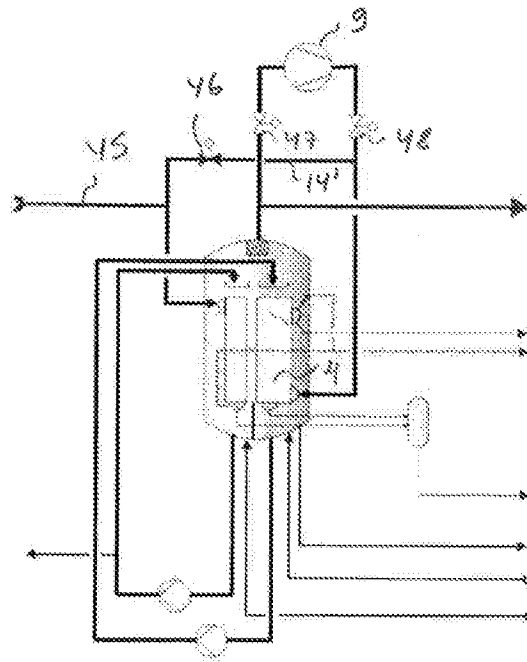


FIG. 3

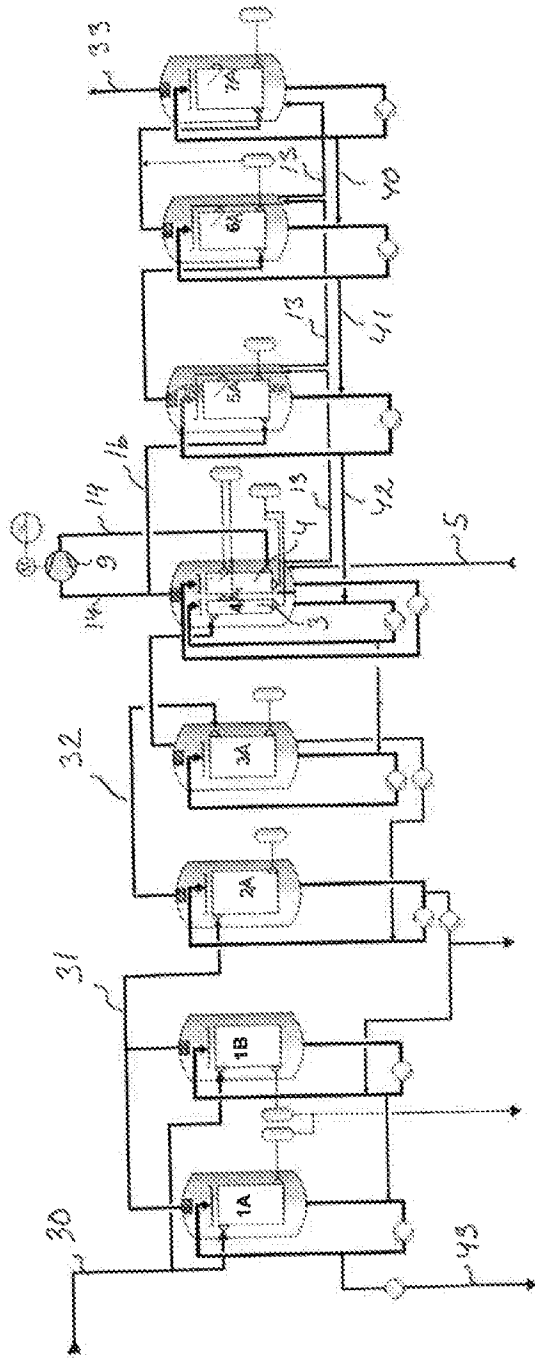


FIG. 2

# INTERNATIONAL SEARCH REPORT

International application No PCT/FI2014/050130
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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. B01D1/26      B01D1/28      D21C11/10 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) B01D D21C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/053518 A2 (ANDRITZ OY [FI]; KOISTINEN PETER [FI]; TIKKA PETRI [FI]) 30 April 2009 (2009-04-30) cited in the application page 10, lines 1-32; figures 2,3 -----	1-6
A	US 5 512 141 A (KOISTINEN PETER [FI] ET AL) 30 April 1996 (1996-04-30) abstract; figure 1 -----	1-6
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<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
Date of the actual completion of the international search	Date of mailing of the international search report	
25 November 2014	04/12/2014	
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

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