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(54) **CLEAN STEAM GENERATOR**

(57) The subject-matter of the invention is a clean steam generator, which is supplied with process/power steam and generates steam meeting the hygiene requirements, and thus is applicable in medical, pharmaceutical and food industries.

The clean steam generator in the form of a flow device equipped with a tube exchanger, whose shell is supplied by the pump with clean water from its external source, whereby inside of the shell of the exchanger there is a coil or a bundle of tubes for the heating medium supplied from the outside, is characterised by that it has a separate separation tank **(8)** of clean steam taken in from the stub pipe (**9**), which separation tank **(8)** of clean steam is connected in series and in a one-way manner with the stub pipe **(3)** of the exchanger **(5)** equipped on the inside with a bundle of tubes **(14)**, whereby the level of water in the shell of the exchanger **(5)** is regulated by the level sensor **(13)** of the water level regulator (**6**) installed on the shell space of the tube exchanger **(5)** controlling the operation of the feed pump **(7),** whereas the separation tank **(8)** is connected in a one-way manner with the stub pipe **(3)** of the tube exchanger (**5**), whereby the separation tank (**8**) possesses drainage **(11)** and blowdown **(10)** in the bottom part.

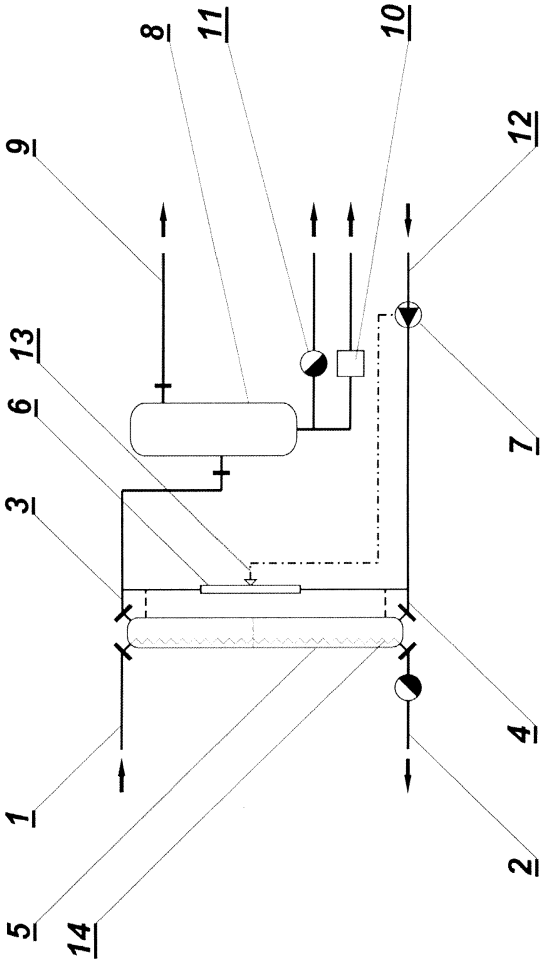

Fig. 1

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Description

[0001] The subject-matter of the invention is a clean steam generator which is supplied with process/power steam and generates steam meeting the hygiene requirements, and thus is applicable in medical, pharmaceutical and food industries.

[0002] Clean steam generators used so far are constructed in such a way that the main tube/plate exchanger in which steam is generated is connected through the inlet and the outlet with the tank which at the same time is the tank supplying the exchanger with water and the separation tank possessing a steam space and a water space, which is regulated with the water level regulator. In this system the water/steam circulation is possible, and water dosing occurs into the tank and the exchanger, because the exchanger and the tank constitute a system of connected vessels. In the tank, storage of the feed water and separation of steam occur, and dosing of water up to the assumed level is regulated by the sensor on the separation tank. Clean steam condensate can return to the exchanger installed in parallel.

[0003] The purpose of the invention is to develop a design of a small-size clean steam generator of high purity of steam, which does not require the application of a typical desalting process, and condensate and sludge from the reparation tank cannot return to the tube exchanger in which the water steam is generated, and are removed outside as waste, it results from the application of a series connection of the flow elements.

[0004] The clean steam generator in the form of a flow device equipped with the tube exchanger supplied by the pump with water of required purity from its external source and pumped to the exchanger shell, whereby inside of the exchanger shell there is a coil or a bundle of tubes heated with a heating medium in the form of steam or thermal oil supplied to it from the outside, according to the invention is characterised by that it possesses a separate separation tank of clean steam taken in from a stub pipe, which separation tank of clean steam is connected in series and in a one-way manner with the stub pipe of the exchanger equipped on the inside with a bundle of tubes, whereby the level of water in the exchanger shell is regulated by the level sensor of the water level regulator installed on the shell space of the tube exchanger which controls the feed pump operation, whereas the separation tank is connected in a one-way manner with the stub pipe of the tube exchanger, whereas the separation tank possesses drainage and blowdown in the bottom part. The exchanger is equipped over its entire height with a bundle of tubes for the heating medium, whereby the ratio of the volume V1 of the tube exchanger shell to the volume V2 of the bundle of tubes or the coil amounts to V1:V2 from 1.0 to 3.0.

[0005] The advantage of the flow clean steam generator is the absence of accumulation of pollutants and of the necessity of separate desalting of the water used, since in the exchanger system concentration of salt does not occur, which is the result of the flow character of steam generation in the tube exchanger and of the continuous removal of the excess condensate through the steam trap from the bottom part of the separation tank. Any possible pollutants carried by the feed water that can appear in the separation tank and the steam condensate are easily separated and removed from the whole system in such a way so as to obtain the highest degree of the purity of steam used for example for pharmaceutical manufacture purposes.

Moreover, it is possible to select the level of water in the separation tank - its presence or absence - thus, the humidity level may be controlled and an adverse phenomenon of temporary overheating of clean steam may be eliminated when used in medical sterilization processes according to EN 285.

[0006] The subject-matter of the invention is presented in the embodiment in the drawing, where in Fig. 1 a schematic diagram of the clean steam generator is presented, and in Fig. 2 a schematic diagram of the clean steam generator consisting of tube exchangers connected with each other in a parallel way is presented.

[0007] As it is presented in the drawing, the heating medium, for example steam of higher temperature, flows through the inlet **1** to the bundle of tubes (14) or the coil of the tube exchanger **5** and heats clean water accumulated in the shell of the tube exchanger **5**, which is supplied through the pipeline **12** to the pump **7,** from where it is pumped to the shell of the tube exchanger **5** equipped with a bundle of tubes **14**, where the energy is taken off from the heating medium through the walls and water is converted into steam, then the cooled heating medium leaves the tube exchanger **5** through the outlet **2**. The inside space of the bundle of tubes **14** or the coil does not possess a connection with the shell space and the heating medium does not mix with clean water and steam. Clean steam leaves the shell of the tube exchanger **5** through the outlet **3**. The level of clean feed water in the shell of the tube exchanger **5** is set by the water level regulator **6** which controls the pump **7** supplying clean water, ensuring appropriate level of water by dosing depending on the clean steam demand. The water level regulator **6** is installed on the shell space of the tube exchanger **5.** Steam generated in the shell of the tube exchanger **5** goes into the separation tank **8**. The separation tank **8** separates possible condensate and pollutants, and then the separated clean steam can be taken in by the clean steam pipeline **9**. The separation tank **8** is equipped with drainage **11** fulfilling at the same time the function of desalting - removal of light floating pollutants, and blowdown **10** located in the lowest point.

[0008] The tube exchanger **5** is equipped over its entire height with a bundle of tubes **14** for the heating medium, whereby the ratio of the volume V1 of the tube exchanger **5** to the volume V2 of the bundle of tubes **14** amounts to V1:V2 from 1.0 to 3.0.

Claims

1. Clean steam generator in the form of a flow device equipped with the tube exchanger, whose shell is supplied by the pump with clean water from its external source, whereby inside of the exchanger shell there is a coil or a bundle of tubes for the heating medium supplied from the outside, **characterised by** that it has a separate separation tank (8) of clean steam taken in from the stub pipe (9), which separation tank (8) of clean steam is connected in series and in a one-way manner with the stub pipe (3) of the exchanger (5) equipped on the inside with a bundle of tubes (14), whereby the level of water in the shell of the exchanger (5) is regulated by the level sensor (13) of the water level regulator (6) installed on the shell space of the tube exchanger (5) controlling the operation of the feed pump (7), whereas the separation tank (8) is connected in a one-way manner with the stub pipe (3) of the tube exchanger (5), whereby the separation tank (8) possesses drainage (11) and blowdown (10) in the bottom part.

2. The generator according to Claim 1, **characterised by** that the tube exchanger (5) is equipped over its entire height with a bundle of tubes (14) for the heating medium, whereby the ratio of the volume V1 of the tube exchanger (5) to the volume V2 of the bundle of tubes (14) or the coil amounts to V1:V2 from 1.0 to 3.0.

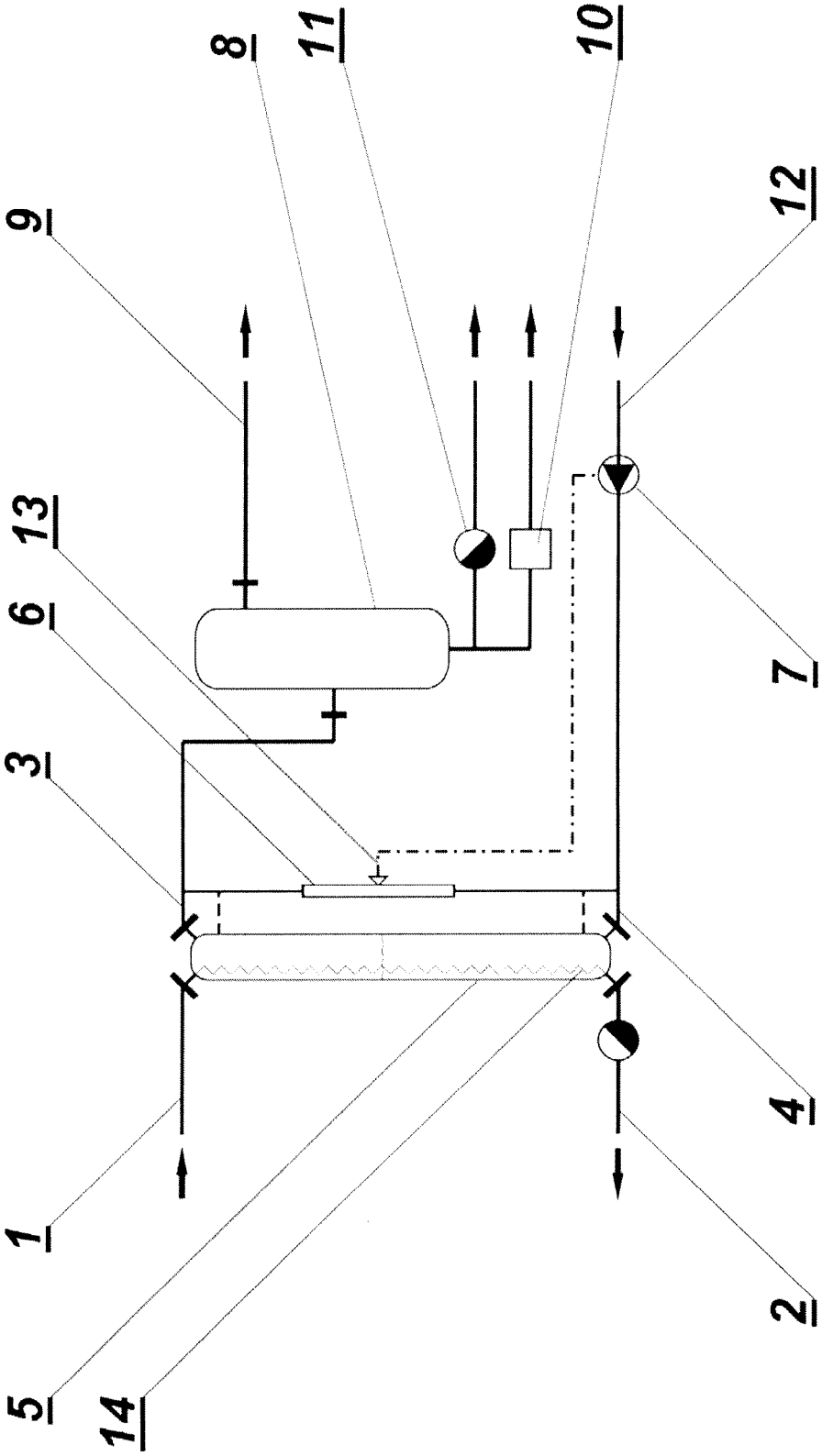

Fig. 1

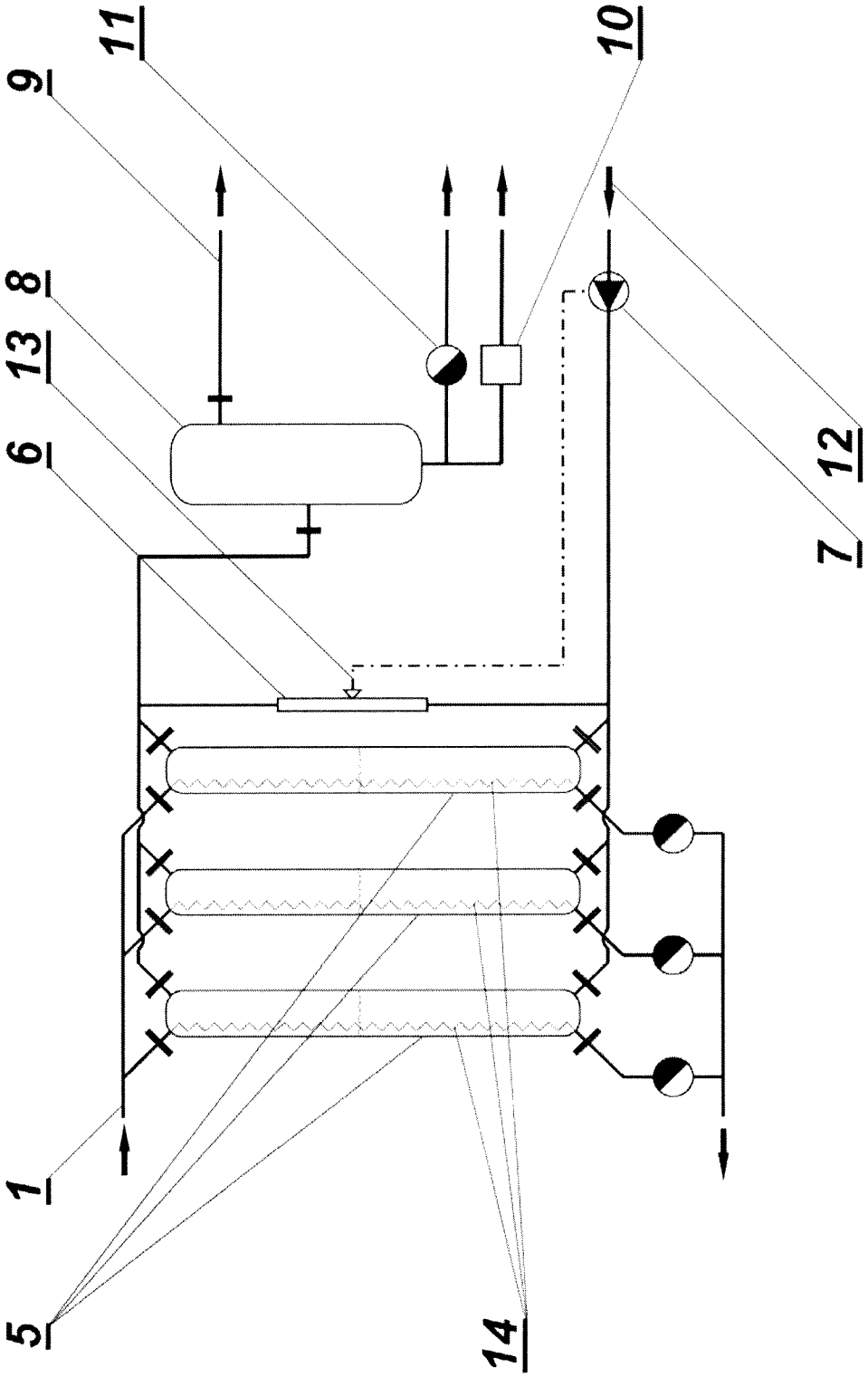

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 16 46 0038

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	DE 101 09 251 C1 (RATIONAL AG [DE]) 8 August 2002 (2002-08-08) * paragraph [0010] * * paragraph [0018] - paragraph [0021]; claims; figure * * abstract * -----	1 2	INV. F22B1/02 F22B37/26
A	FR 2 653 208 A1 (BONNET SA [FR]) 19 April 1991 (1991-04-19) * page 2, line 31 - page 5, line 20; claims; figures 1,2 * * abstract * -----	1,2	
A	US 2003/016952 A1 (ELPHEE DAVID ANDREW [US]) 23 January 2003 (2003-01-23) * paragraph [0023] - paragraph [0026]; claims; figures; table * * abstract * -----	1,2	
A	US 2008/006261 A1 (SAKSENA ATUL [US] ET AL) 10 January 2008 (2008-01-10) * paragraph [0019] - paragraph [0039]; claims; figures * * abstract * -----	1,2	

TECHNICAL FIELDS SEARCHED (IPC)

F22B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	27 February 2017	Zerf, Georges

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 46 0038

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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27-02-2017

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82