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(54) Apparatus and method for balances removal of gasses from electrolysis cells by suction

(57) The invention concerns an apparatus and a method for the removal of gasses from electrolysis cells (21) by suction, the apparatus comprising a branch duct (3) for each electrolysis cell, a main duct (4) connecting the branch ducts to a gas treatment centre (5) and a central suction fan (6) providing for at least part of the suction, wherein one or more of the branch ducts are provided with supplementary suction means (8) and wherein control means (9) to control the supplementary suction means and pressure monitor means are provided, wherein the control means are adapted to control the supplementary suction means in dependence from changes in the monitored pressure with respect to a reference pressure.

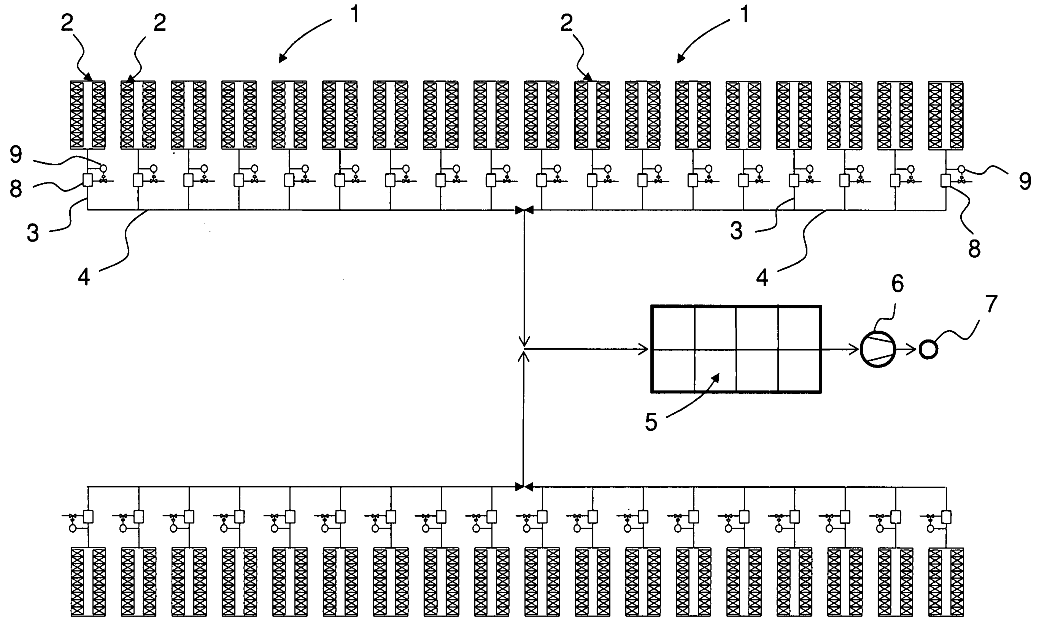

Fig. 1

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Description

[0001] The invention relates to an apparatus for the removal of gasses from electrolysis cells by suction comprising a branch duct for each electrolysis cell, a main duct connecting the branch ducts to a gas treatment centre and a central suction fan providing for at least part of the suction.

[0002] During the electrolysis process gasses are produced that can be harmful for the environment and that could provide unacceptable working conditions. Especially in the aluminium electrolysis process harmful gasses containing fluorides and fluoride particles are emitted. The last decades major improvements have been implemented to reduce the emission of both fluoride particles and gasses containing fluorides. Today in most plants the emission of the fluoride particles through the chimney stack of the plant is, because of an efficient adsorption system, at a level that no significant further improvement seem to be possible.

[0003] However, emission directly from the shielded electrolysis cells or pots into the potroom and subsequently from the potroom through the roof to the outside environment is an area wherein improvement is still possible. Proper shielding of the electrolysis cells and the suction of the gasses from the electrolysis cells adequately prevent that gasses enter the potroom. However, during the tapping of molten aluminium from the electrolysis cells, maintenance around the electrolysis cells or the change of anodes, for which the hoods of the electrolysis cells have to be lifted, still a considerable emission of gasses into the potroom occurs. Also defect covers of the hood will contribute to the emission in the potroom.

[0004] In order to reduce the emission of gasses during the change of anodes several systems are known that provide for boosted suction during the change of anodes to prevent these emissions. Although these systems seem to provide a good solution to the problem, the major disadvantage of these systems is that the systems all involve large investments due to the necessity of a secondary duct system required for the boosted suction. A secondary system is also difficult to install in older plants due to lack of space. A secondary duct system is connected to each branch duct of each pot and is activated by closing and opening valves during anode change only. Separate fans in the secondary system provide the boost capacity.

[0005] With the normal operation of an electrolysis cell is meant the electrolysis process in operation with all hoods of the electrolysis cells closed.

[0006] However, taking the covers of the hood off the electrolysis cells for tapping and changing of anodes and putting the covers back again will result after a period of use that not all electrolysis cells close off as well as originally designed to do. Most common damages to these covers are bends and holes through spilling of molten aluminium with a tapping operation. This will result in a larger open area between the covers and this will increase the ventilation of the potgas to the potroom, stimulating the emission.

[0007] It is an object of the present invention to provide an apparatus for the removal of gasses from a number of electrolysis cells by suction wherein the suction is adjusted to a level needed to minimize emissions from the electrolysis cells.

[0008] It is a further object of the invention to provide an apparatus for the removal of gasses from a number of electrolysis cells by suction wherein for all levels of suction only one duct system is used.

[0009] It is a further object of the present invention to provide an apparatus for the removal of gasses from a number of electrolysis cells by suction wherein the pressure in each of the electrolysis cells or in the branch duct downstream of the electrolysis cell is kept at a predetermined pressure.

[0010] It is a further object of the present invention to provide an apparatus for the removal of gasses from a number of electrolysis cells by suction wherein the temperature of the gasses provides additional information and or in combination with the pressure and calculated flow present the heat load leaving the pot.

[0011] It is a further object of the present invention to provide an apparatus for the removal of gasses from a number of electrolysis cells by suction that is easier to build, use and maintain than the existing apparatuses.

[0012] It is a further object of the present invention to provide an apparatus for the removal of gasses from a number of electrolysis cells that is cheaper to build than the existing apparatuses.

[0013] According to a first aspect of the invention one or more of these objects are realized by providing an apparatus for the removal of gasses from electrolysis cells by suction comprising a branch duct for each electrolysis cell, a main duct connecting the branch ducts to a gas treatment centre and a central suction fan providing for at least part of the suction, wherein control means to control the supplementary suction means and pressure monitor means are provided, wherein the control means are adapted to control the supplementary suction means in dependence from changes in the monitored pressure with respect to a reference pressure.

[0014] With the supplementary suction means and control means therefore the flow from each electrolysis cell may be adjusted to have the pressure in the electrolysis cell or in the branch duct correspond to a predetermined pressure, wherein the predetermined pressure is such that under all conditions the removal of gasses from an electrolysis cell is sufficient to minimize emission of the gasses from the electrolysis cell into the potroom. This will mean that with normal operation the flow of gasses from the electrolysis cells will be at a minimum but for each electrolysis cell adapted to the degree of leakage from that electrolysis cells to the potroom. The invention relates to an apparatus to control pot emission dedicated for each pot and independent of the operational status and shielding condition of the pot. A clear advantage is that for all electrolysis cells the emission is reduced to a minimum providing a working environment for the workers on the floor as safe as possible without the chance as with the know suction systems that one of the electrolysis cells unexpectedly has a far larger emission into the potroom than the other electrolysis cells.

[0015] Another advantage is that since there is no need to generate a large predetermined common gas flow that will be sufficient for all electrolysis cells the total flow of gasses with the apparatus according the invention will be lower than with the known apparatuses. This results in an important further advantage that more electrolysis cells can be connected to a single gas treatment centre which allows for further expansion of the plant without the need to have to provide for a further gas treatment centre, which will be far more capital-intensive.

[0016] The reference pressure with respect to which the supplementary suction means are controlled dependent on changes in a monitored pressure can be a predetermined pressure in the electrolysis cells or a pressure linked in a known manner to that predetermined pressure. For instance the pressure at the outlet of an electrolysis cell is monitored wherein a reference pressure at said outlet has a known ratio to said predetermined pressure in the electrolysis cell. In the same manner it is possible to monitor a pressure drop over a part of a branch duct between the electrolysis cell and the supplementary suction means for that cell and compare the pressure drop with a reference pressure drop which in its turn has a known ratio to the predetermined pressure in the electrolysis cells.

[0017] In an analogous manner it is possible to monitor the flow in a part of a branch duct between the electrolysis cell and the supplementary suction means for that cell, wherein the measured flow corresponds to a difference in pressure which in its turn has a known ratio to the predetermined pressure in the electrolysis cells.

[0018] The supplementary suction means operate in combination with the central suction fan and since part of the suction is realized by the supplementary suction means the central fan does not need to be as powerful as in the known suction systems.

[0019] Another advantage is that since the flow from the electrolysis cells is controlled with the supplementary suction means there is no need for valves or other flow restriction devices in the branch duct as with the known suction systems. Although this will mean a reduction in costs with new suction systems, the main advantage in both new and upgraded existing systems is that misbalance in the suction system by incorrect settings of these valves can be prevented since these valves or restriction devices are no longer needed.

[0020] In the known suction systems, despite the flow restriction devices, boosted suction of an electrolysis cell will influence the normal suction of electrolysis cells which connect to the main duct close to the branch duct of said electrolysis cell and misbalance of the system might occur. With the apparatus according the invention any misbalance is avoided since the pressure in the other electrolysis cells is kept at the predetermined pressure with the supplementary suction means and the control means therefore. The obvious advantage of avoiding any misbalance in the suction system is that the emission of gasses in the potroom is kept at a minimum at all times.

[0021] According to a further aspect of the invention the supplementary suction means comprise air injection means. To control the air injection means the control means control feed means with which pressurized air is fed to the air injection means.

[0022] According a first embodiment air is injected in a branch duct therewith increasing the flow of the gasses in the branch duct.

[0023] According to a second embodiment the air injection means comprise an air amplifier, also known as an air driven positive displacement pump. An air amplifier increases the gas pressure at point of use therewith increasing the flow through the device. With such an air amplifier less pressurized air is needed than with the direct injection of air in a branch duct to control the flow. By adjusting the amount of pressurized air fed to the air amplifier the pressure difference over the air amplifier and therewith the gas flow can be adjusted accurately over a wide range.

[0024] Another embodiment provides that the supplementary suction means comprise a suction fan, wherein the control means control the speed of the motor of the suction fan.

[0025] The invention also provides a method to control the removal of gasses from electrolysis cells by suction wherein the gasses are removed through branch ducts connected to the electrolysis cells and a main duct connecting the branch ducts to a gas treatment centre, a central suction fan providing for at least part of the suction, wherein for each of a number of electrolysis cells supplementary suction is provided for by means of supplementary suction means provided for in the branch ducts of each of said electrolysis cells in dependence of changes of a monitored pressure with respect to a reference pressure.

[0026] The suction of the gasses from the electrolysis cells is controlled by keeping the pressure at the outlet of the electrolysis cells or the pressure or drop in pressure in the branch ducts connecting the electrolysis cells to the main duct at a reference pressure by means of the supplementary suction means in the branch ducts.According to a further aspect the supplementary suction is realized by means of injection of a fluid medium in a branch duct. Preferably the fluid medium is pressurized air.

[0027] The pressurized air can be fed directly in the branch duct therewith entraining the gasses from the electrolysis cell. By controlling the amount of pressurized air fed to the branch duct the flow can be controlled. However, it is preferred to feed the pressurized air to an air amplifier in the branch duct since less pressurized air is needed while the flow of gasses can be controlled more accurately and over a wide range.

[0028] According to a further embodiment of the invention it is provided that the temperature of the gasses coming from each of the electrolysis cells is monitored. To this end temperature measurement means are provided in the electrolysis cell and/or in the part of the branch duct between the electrolysis cell and the supplementary suction means. By monitoring the temperature of the gasses important information of the process in each of the electrolysis cells is obtained on basis of which the process can further be controlled. For instance a rise in temperature can be controlled or temporarily controlled by increasing the suction for that particular electrolysis cell to get the temperature down.

[0029] The temperature measurement means can be connected directly or via a central control system to the control means of the supplementary suction means to be able to control the temperature of the gasses by increasing the suction in an electrolysis cell.

[0030] With the monitor and measurement means also connected to a central control and monitor system an easy overview of each of the electrolysis cells can be obtained, also facilitating separate action for a electrolysis cell for instance if the process temperature starts to rise.

[0031] The invention is further explained on hand of the embodiments given by way of example in the drawing, wherein

fig.1 shows schematically an arrangement of a row of electrolysis cells with a suction system according to the invention,
fig.2 shows schematically an embodiment of supplementary suction system using pressurized air, and
fig.3 shows schematically an embodiment of supplementary suction system with a suction fan.

[0032] In fig.1 rows 1 of electrolysis cells 2 are shown, wherein each electrolysis cell 2 connects by means of a branch duct 3 to a main duct 4. The main duct 4 is connected to a gas treatment centre 5 downstream of which a central suction fan 6 is provided. The central suction fan 6 in its turn connects to chimney 7. The number of electrolysis cells 2 in a row 1 may amount to well over a hundred and the number of rows 1 may be up to ten in a single plant. The central suction fan 6 may consist of a single fan or a number of separate suction fans.

[0033] In each of the branch ducts 3 supplementary suction means 8 are provided with control means 9 to control the supplementary suction means 8.

[0034] Fig.2 shows in more detail a number of electrolysis cells 2. Each of the electrolysis cells 2 are provided with hoods 10 to be able to locally open an electrolysis cell 2 for tapping molten aluminium, to change anodes and for maintenance of the cells. In branch ducts 3 supplementary suction means 8 are provided with control means 9. The control means 9 comprise pressure monitor means 11 such as a pressure sensor in branch duct 3 upstream of supplementary suction means 8, a microcontroller 12 connected to the pressure monitor means 11 and to a valve 13 in a supply pipeline 15 for pressurized air.

[0035] The supplementary suction means 8 preferably comprise an air amplifier because this is a simple device without any moving parts and with which the pressure drop over the air amplifier and therewith the gas flow can be controlled over a considerable range without having to use a lot of pressurized air. It is also possible to only use pressurized air as supplementary suction means 8 but this will require much more pressurized air than when using an air amplifier as supplementary suction means 8.

[0036] In the branch duct 3 of each electrolysis cells 2 temperature measurement means 14 are provided to monitor the electrolysis process in each of the cells 2.

[0037] The pressure in the main duct 4 will be less in downstream direction towards the gas treatment centre 5 resulting in that the pressure drop over the supplementary suction means 8 in each successive branch duct 3 connecting to main duct 4 further downstream will have to be less to get the desired suction and therewith the desired gas removal from the electrolysis cells 2. With the supplementary suction means 8 and control means 9 the suction and therewith the pressure in the electrolysis cell will be automatically controlled and kept within a narrow range around the predetermined pressure. This will also be the case if for one of the electrolysis cells 2 the normal suction for that electrolysis cell is changed to a level of boosted suction when one or more of the hoods 10 have to be lifted for tapping or to change anodes. The locally increased pressure in main duct 4 will automatically be compensated for with the supplementary suction means 8 and control means 9.

[0038] In fig.3 an embodiment is shown wherein a suction fan 16 is used as a supplementary suction means. In this configuration the control means 9 comprise pressure monitor means 11 such as a pressure sensor in branch duct 3 upstream of suction fan 16, a microcontroller 12 connected to the pressure monitor means 11 and to a variable speed drive 17 for motor 18 of suction fan 16.

[0039] The balancing of the pressure in each of the electrolysis cells and therewith the suction from each of the electrolysis cells is with this embodiment in principle the same as with the previous embodiment. The only difference is that the control is done by means of an electric circuit and that consequently no pressurized air system is needed.

Claims

1. Apparatus for the removal of gasses from electrolysis cells by suction comprising a branch duct for each electrolysis cell, a main duct connecting the branch ducts to a gas treatment centre and a central suction

fan providing for at least part of the suction, wherein one or more of the branch ducts are provided with supplementary suction means and wherein control means to control the supplementary suction means and pressure monitor means are provided, wherein the control means are adapted to control the supplementary suction means in dependence from changes in the monitored pressure with respect to a reference pressure.

2. Apparatus according to claim 1, wherein the pressure monitor means are provided in the electrolysis cell and/or in the part of the branch duct between the electrolysis cell and the supplementary suction means.

3. Apparatus according to one or more of claims 1-2, wherein the supplementary suction means comprise air injection means.

4. Apparatus according to claim 3, wherein the control means control feed means with which pressurized air is fed to the air injection means.

5. Apparatus according to claim 3, wherein the air injection means comprise an air amplifier.

6. Apparatus according to claim 1 or 2, wherein the supplementary suction means comprise a suction fan and wherein the control means control the motor of the suction fan.

7. Apparatus according to one or more of the claims 1-6, wherein temperature measurement means are provided in the electrolysis cell and/or in the part of the branch duct between the electrolysis cell and the supplementary suction means.

8. Apparatus according to claim 8, wherein the temperature measurement means are connected to the control means for the supplementary suction means

9. Apparatus according to one or more of the claims 1-8, wherein central control means are provided to which pressure monitor means, control means for the supplementary suction means and the temperature measurement means are connected.

10. Method to control the removal of gasses from electrolysis cells by suction wherein the gasses are removed through branch ducts connected to the electrolysis cells and a main duct connecting the branch ducts to a gas treatment centre, a central suction fan providing for at least part of the suction, wherein for each of a number of electrolysis cells supplementary suction is provided for by means of supplementary suction means provided for in the branch ducts of each of said electrolysis cells in dependence of changes of a monitored pressure with respect to a reference pressure.

11. Method according to claim 10, wherein the pressure is monitored in the electrolysis cell or in the part of the branch duct between the electrolysis cell and the supplementary suction means.

12. Method according to claim 10 or 11, wherein the supplementary suction is realized by means of injection of a fluid medium in a branch duct.

13. Method according to claim 12, wherein the fluid medium is pressurized air.

14. Method according to one or more of claims 10-13, wherein the temperature of the gasses is monitored in the electrolysis cell and/or in the part of the branch duct between the electrolysis cell and the supplementary suction means.

15. Method according to claim 14, wherein the temperature of the gasses is used in the control of the supplementary suction means.

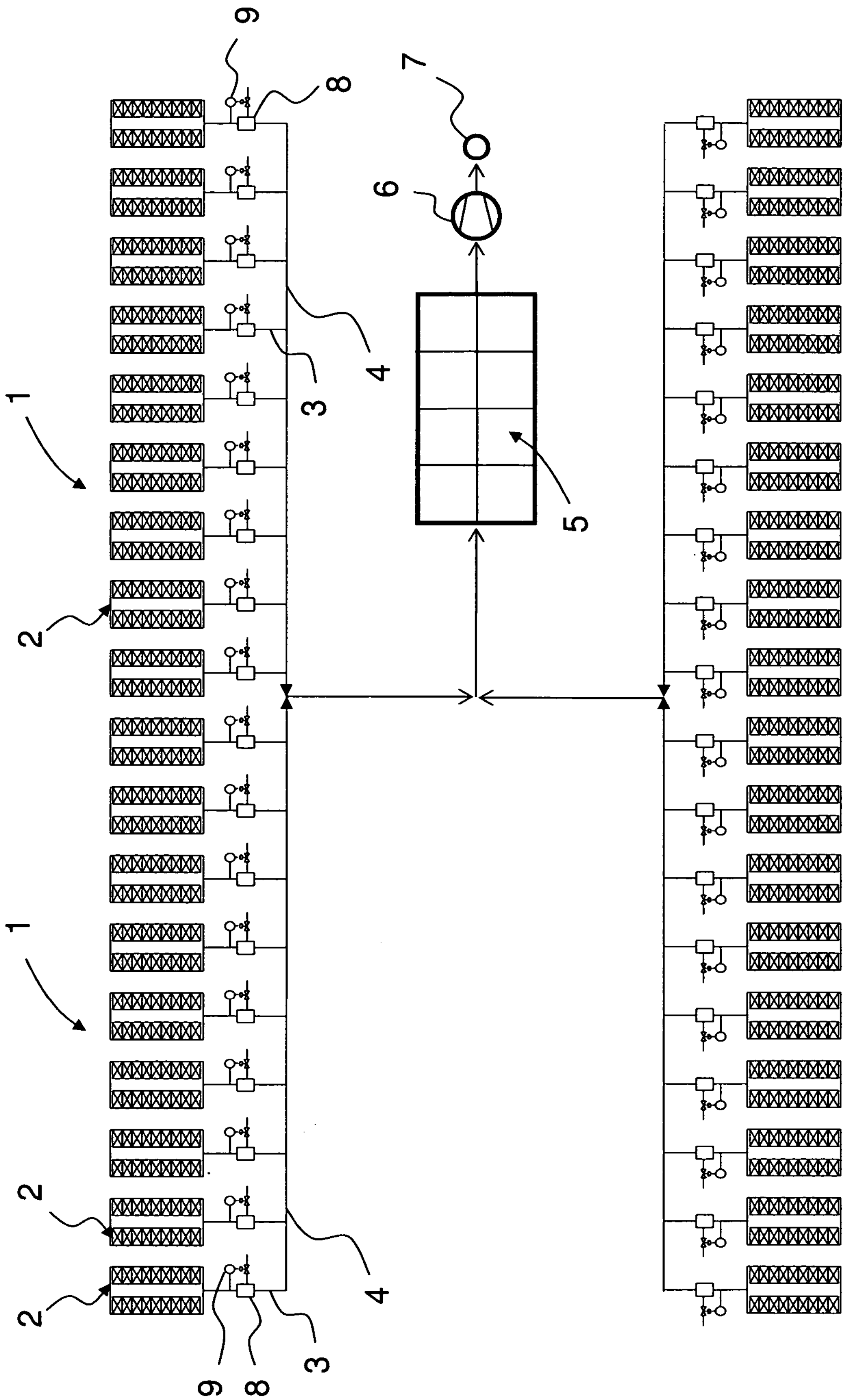


Fig. 1

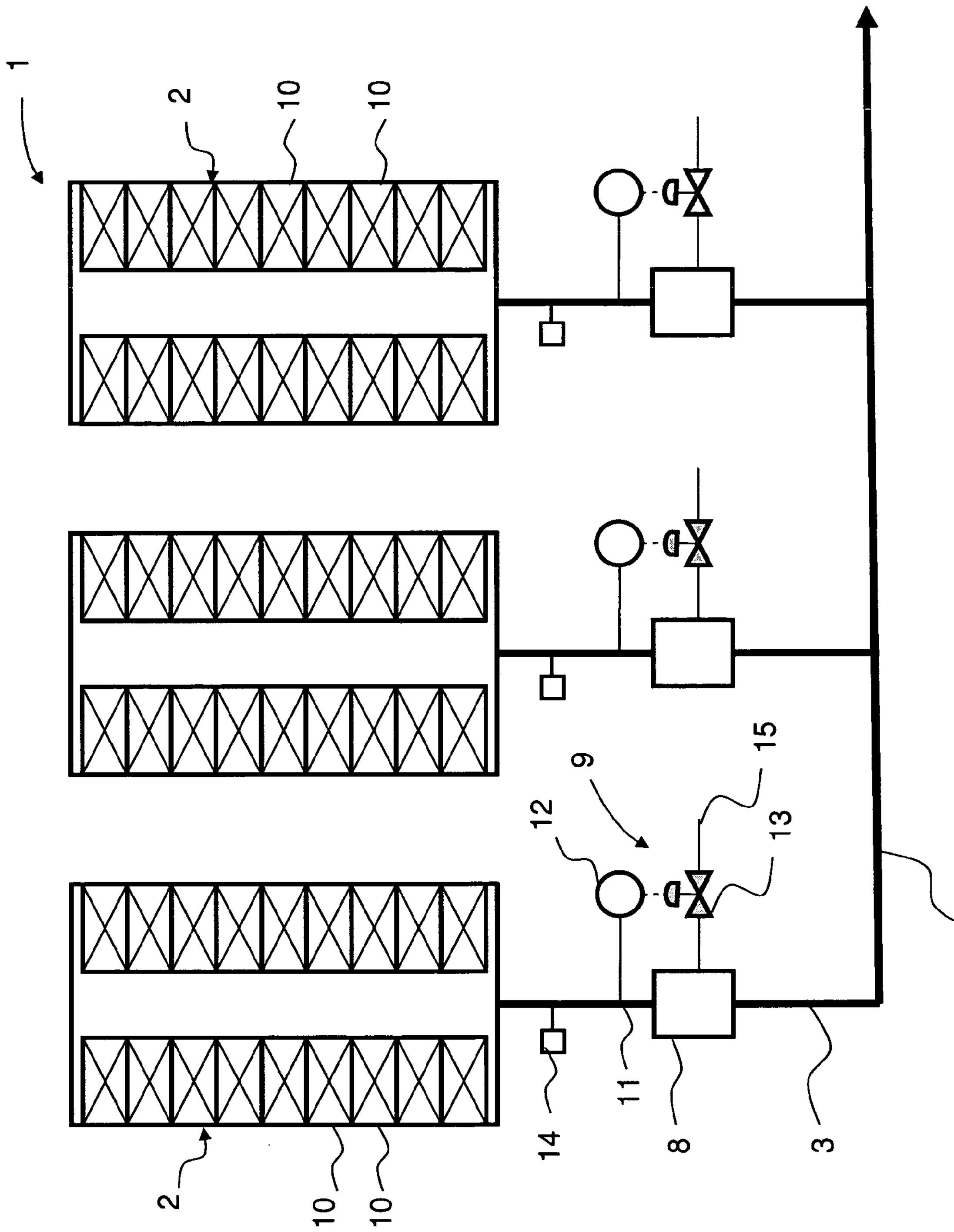
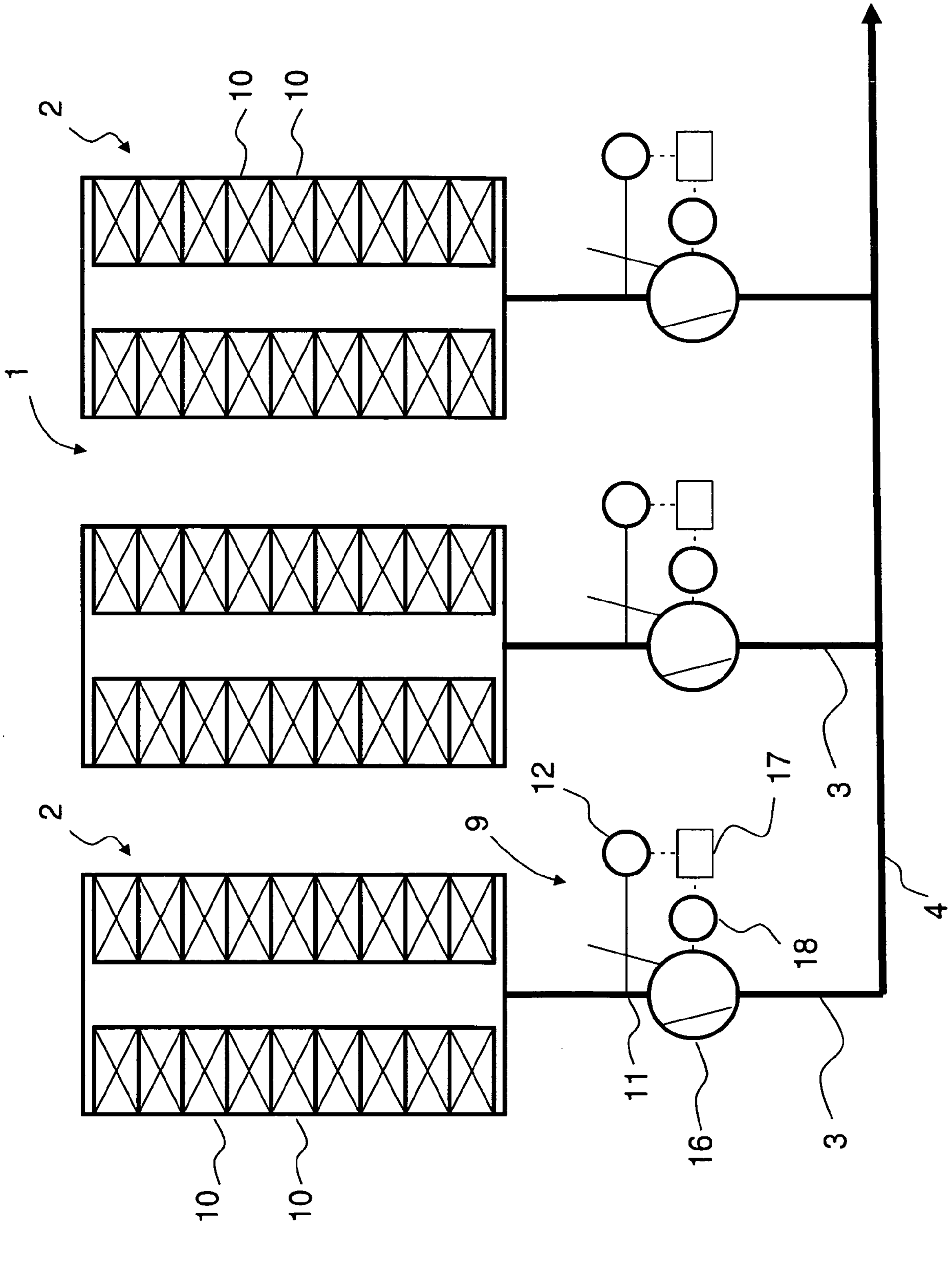


Fig. 2

Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 09 00 6172

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2008/074386 A2 (DANIELI CORUS TECHNICAL SERVIC [NL]; KLUT PIETER DIRK [NL]; VERBRAAK P) 26 June 2008 (2008-06-26) * abstract; figures * * page 6, line 32 - page 9, line 17 * -----	1-15	INV. B08B15/00 C25C3/22
A	US 2002/073503 A1 (WISSER DAVID A [US]) 20 June 2002 (2002-06-20) * abstract; figure * * paragraph [0017] - paragraph [0022] * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

B08B
C25C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 November 2009	Plontz, Nicolas

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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 09 00 6172

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