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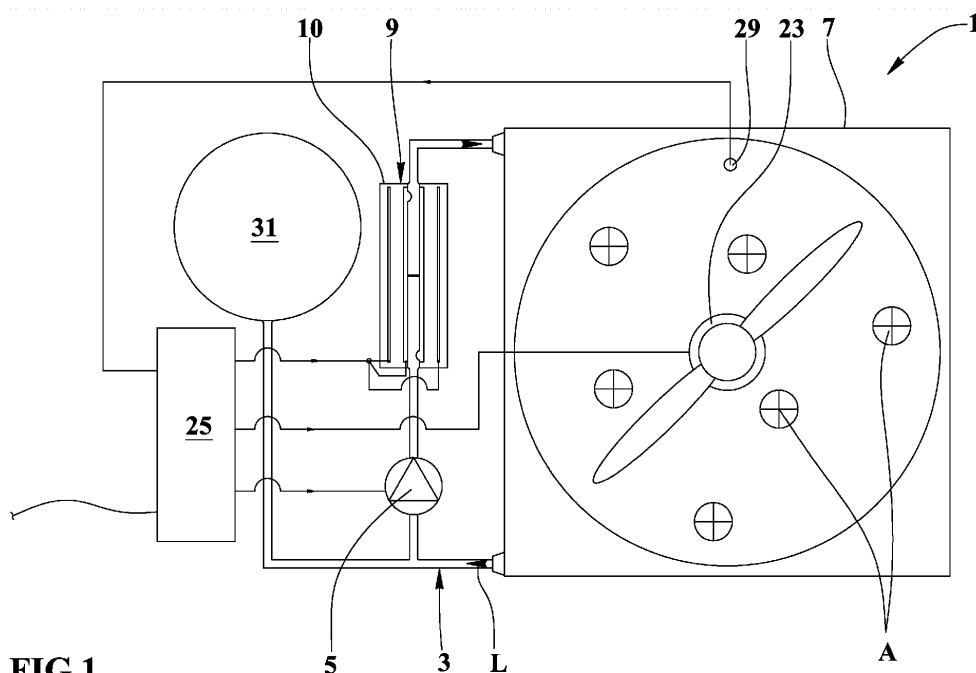
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(54) CELL HEATING DEVICE

(57) A cell heating device comprises a ring circuit (3) for a liquid, heating means and electric pump means (5) for the heating and circulation of a carrier liquid (L) assigned to transfer heat, by means of an exchanger means (7), to a fluid (A) to be heated.

The heating means comprises cell means (9) electrically powered with at least single-phase alternating current and a possible neutral and/or ground, where each phase and each possible neutral or ground constitute a pole.

Said cell means (9) comprises a container means (10) whose cavity is at least partially included in the circuit (3), and that is provided with an entrance (11) and an exit (12) for the liquid carrier (L) flow through the cavity, in which there is arranged, for each pole, at least an electrode means (15) made of an electrically conducting material, and electrically connected with the corresponding pole, lapped on by the carrier liquid (L) flow having a pH different from 7.

**FIG.1****EP 3 333 500 A1**

Description

[0001] The present invention refers to the field of the heating of rooms, locations and spaces in general, and it relates to an electrically powered cell heating device, particularly suitable for heating a fluid, for example air, passing through it.

[0002] There are known devices provided with heating means consisting of electrical resistances assigned to heat an air flow generated by an electric fan of the device itself.

[0003] Such known devices have the drawback that they are poorly efficient.

[0004] There are also known devices provided with exchangers assigned to transfer the heat obtained from hot water in a heating circuit having electric or combustion heating means, to an air flow generated by an electric fan of the device itself.

[0005] Both said known devices have the drawback that in case of interruption of the air or water flow, caused for example by a stoppage or malfunction of the fans or of the pumps supporting the flow through the respective heating means, they can keep on supplying the heating means, despite any flow or temperature control systems, thus causing unnecessary consumptions and damage to or the destruction of the heating means, with possible short-circuits or fuel leakages.

[0006] Another drawback of said former known devices is that as the electrical resistances turn off, they completely stop heating and turn out to be hardly usable when there is required an accurate thermostatic control of a room, even when there are used complex, expensive, independent control and supply systems having a number of electrical resistances.

[0007] The latter known devices are provided with decent thermal inertia, and keep on heating the air for a certain limited period of time even in case of interruption of the supply of hot water for heating. These latter known devices have the drawback of being complex and expensive, and of requiring connection both to the electricity network and to the plant generating hot water for heating, thus requiring expensive installation works and burdensome maintenance activities.

[0008] Another drawback is that the latter known devices have high heat losses and low efficiency.

[0009] A further drawback of these latter known devices, when they are installed in upper parts of rooms, is that the high number of junctions and connections of the hot water feeding pipes causes a not negligible risk of leakages and drippings even in the central portions of the respective rooms, thus preventing their use in areas intended for the storage and/or the processing of materials and products that may perish upon contact with water or with the aqueous mixture used in the plant.

[0010] An object of the present invention is to provide a cell heating device that is intrinsically safe since it can stop the electrical consumption for heating, and thus the heating, as the respective carrier liquid is drained or is

no longer present.

[0011] A further object is to provide a device having high efficiency that is higher than that of said known devices.

5 **[0012]** Another object is to provide a device having a specific power that is greater than that of said known devices.

[0013] A further object is to provide a device exclusively requiring power supply and not causing significant mismatches between voltage and current.

10 **[0014]** Another object is to provide a device that may be configured to be lightweight, simple and inexpensive as well as suitable for nearly any type of installation, even emergency installations or in situations of aid to population.

15 **[0015]** A further object is to provide a device that may be configured to have high thermal inertia, and that at the same time is efficient and nearly risk-free as regards liquid leakages.

20 **[0016]** The prior art patent applications no. WO2006/108198 A1 and no. US 2009/074389 A1 disclose heating devices having the features of the preamble of claim 1 of the present document.

25 **[0017]** The features of the invention are illustrated hereafter, with specific reference to the accompanying drawings, in which:

- Figure 1 shows a schematic view of the cell heating device subject-matter of the present invention;
- 30 - Figure 2 shows an enlarged, section view, taken from a longitudinal plane, of a cell means of Figure 1, run across by a carrier liquid flow;
- Figure 3 shows a cross-sectional view of the cell means of Figure 2.

35 **[0018]** Referring to Figures 1-3, the numeral 1 indicates the cell heating device subject-matter of the present invention.

[0019] Such device 1 comprises at least:

- 40 - a ring circuit 3 for a circulating liquid referred to as carrier liquid L;
- heating means for the carrier liquid L;
- electric pump means 5 for the circulation of the carrier liquid L;
- 45 - an exchanger means 7 assigned to transfer part of the heat of the carrier liquid L to a fluid to be heated A;
- control and actuation means 25 for the electrically-driven means of the device;
- 50 - an expansion vessel 31 shunted with the circuit 3 to allow the carrier liquid L to expand and contract without causing significant pressure variations.

55 **[0020]** The heating means comprise at least a cell means 9 electrically powered with at least single-phase alternating current and a possible neutral and/or ground, where each phase and each possible neutral or ground constitute a pole.

[0021] Said cell means 9 comprises a container means 10 whose cavity is at least partially included in the circuit 3 and run across by the carrier liquid L flow.

[0022] The cavity of the container means 10 of the cell means 9 is provided with an entrance 11 and an outlet 12 for the liquid carrier L flow through the cavity itself.

[0023] In such cavity of the container means 10 there is arranged, for each pole, at least an electrode means 15 made of an electrically conducting material, and electrically connected with the corresponding pole, lapped on by the carrier liquid L flow having a pH different from 7.

[0024] In case of triangle three-phase power supply, for example, the container means 10 may contain three electrodes, each being connected to a respective phase. Such electrodes may have an angular arrangement at 120°.

[0025] Preferably, the container means 10 and the respective cavity are elongated and cylindrical in shape. The container means 10 may be made of a synthetic material, e.g., plastics or resin, even reinforced with fibers.

[0026] The container means 10 comprises a tubular element 17, e.g., made of plastics or resin, even reinforced with fibrous fillers. Such tubular element 17 passes through the container means 10 and is axially positioned in said cavity. The ends of the tubular means 17 protrude from the ends of the container means 10, and are connected to the circuit 3. Said entrance 11 and exit 12 are obtained in correspondence of respective portions of the lateral wall of the tubular element 17, inside said cavity of the container means 10 and close to the ends of the container means 10 itself.

[0027] The portion of the tubular element 17 inside the cavity and comprised between the entrance 11 and the exit 12 has a partition means 19 which is fixed and assigned to stop the carrier liquid flow, or of a valve type, for example a throttle valve or a gate valve, that may be operated to stop or regulate the carrier liquid L flow along the tubular element 17.

[0028] Said entrance 11 and exit 12 comprise respective openings, with an orthogonal projection onto a circularly shaped plane, obtained in respective portions oriented in opposed directions of the lateral wall of the tubular element 17, so that the entire carrier liquid flow laps on the electrode. Alternatively, said entrance 11 and exit 12 may form respective plural openings, preferably having an annular arrangement, obtained in the lateral wall of the tubular element 17.

[0029] Alternatively, the invention provides that said entrance 11 and exit 12 are obtained directly in the ends of the container means.

[0030] Each electrode means 15 forms a plate-like or sheet-like elongated element which is straight and flat, or curved in the shape of a cylindrical longitudinal sector.

[0031] Preferably, each electrode means 15 is parallel to the longitudinal axis of the container means 10 and is spaced from the other electrode means 15 and from other conductive elements of the container means 10. Prefer-

ably, and also to increase its surface exposed to the liquid, each electrode means 15 is spaced from the inner wall of the container means 10 and from the tubular element 17.

[0032] As an alternative, each electrode means 15 may form an elongated sheet-like or thread-like element in the shape of a helicoid's segment, to extend the path of the carrier liquid flow, and to increase the contact surface between the latter liquid and the electrode.

[0033] The invention further provides that one among the tubular element 17 and the inner wall of the container means 10 or portions or inserts thereof, are made of an electrically conducting material, for example the same metal material as that of the electrodes; in this way, the tubular element 17 or the inner wall of the container means 10, or parts thereof, may serve as an electrode, for example, for the neutral or the ground. By way of example, and in case of star three-phase power supply, the neutral may be connected to the tubular element 17 or to the inner wall of the container means 10 or to conductive elements thereof, whereas the three phases will be connected to respective electrodes.

[0034] The heat exchanger means 7 has a first duct forming part of the circuit 3 and assigned to the carrier liquid flow, and has a second duct for the fluid to be heated, where preferably such fluid is air delivered through the second duct by an electrically driven fan means 23 of the exchanger means 7.

[0035] Alternatively, for example for the production of domestic water, the second duct will be a serpentine for the domestic water to be heated.

[0036] The control and actuation means 25 of the device are equipped with triacs and/or inverters, or similar power supply means, controlled by programmable microprocessors. The control and actuation means 25 are powered by said alternating current, and may be connected with a set of sensors 29 for the operation parameters of the device, e.g., for the temperature of the air exiting from the exchanger, for the current drawn by the cell means 9, for the temperature and the flow rate of the liquid through the cavity of the container means, etc., which provide the control and actuation means 25 with data relating to said parameters.

[0037] Said power supply means of the control and actuation means 25 are assigned to supply power to each electrode means 15, to the pump means 5 and to the fan means 23. The control and actuation means 25 control the actuation and operation of at least one among electrode means 15, pump means 5, fan means 23 and any possible partition means 19 of the valve type, by means of control algorithms of the control and actuation means 25 themselves, and possibly on the basis of the operation parameter values provided by the sensors 29.

[0038] The carrier liquid L is an electrolytic solution, preferably a solution of sodium hydroxide - NaOH, CAS number 1310-73-2 - in distilled water.

[0039] The amount of sodium hydroxide in the solution ranges between 100 and 500 ppm, preferably is of about

200 ppm.

[0040] Furthermore, the carrier liquid L may possibly comprise glycol.

[0041] The operation of the device provides that the carrier liquid heats up as it flows through the cell means 9 and that it transfers heat to the air A to be heated as it flows through the exchanger means.

Claims

1. A cell heating device comprising a ring circuit (3) for a liquid, heating means and electric pump means (5) for heating and circulation of a carrier liquid (L), such liquid assigned to transfer heat by means of an exchanger means (7) to a fluid (A) to be heated; the heating means comprises at least a cell means (9) electrically powered with at least one phase alternating current and a possible neutral and/or ground where each phase and each possible neutral or ground constitute a pole, said cell means (9) comprises a container means (10), whose cavity is at least partially included in the circuit (3) and that is provided with an entrance (11) and an exit (12) for the flow of the carrier liquid (L) through the cavity in which it is arranged, for each pole, at least one electrode means (15) made of electrical conducting material and electrically connected to the correspondent pole and lapped on by the flow of the carrier liquid (L) which has a pH different from 7; said device (1) being **characterized in that** the container means (10) and the respective cavity have an elongated cylindrical shape and the container means (10) comprises one tubular element (17) axially positioned in said cavity and whose ends protrude from the ends of the container means (10) and said ends are connected to the circuit (3); where said entrance (11) and exit (12) are obtained in correspondence of respective portions of the lateral wall of the tubular element (17) where said portions are inside said cavity of the container means (10) and they are close to the ends of the container means (10) and where the inner portion of the tubular element (17) comprised between the entrance (11) and the exit (12) has a partition means (19) which is fixed and assigned to stop the flow of the carrier liquid or which is of the valve type operated to stop or regulate the carrier liquid (L) flow along the tubular element (17).
2. Device according to claim 1 **characterized in that** said entrance (11) and exit (12) consist of respective circular openings obtained in respective portions oriented in opposed directions of the lateral wall of the tubular element (17) or said entrance (11) and exit (12) consist of respective plurality of openings preferably having an annular arrangement and obtained in the lateral wall of the tubular element (17).

3. Device according to claim 1 or 2 **characterized in that** each electrode means (15) consist of one elongated plate-like or sheet-like element flat or in the shape of a cylindrical longitudinal sector parallel to the longitudinal axis of the container means (10) and spaced from the other electrode means (15) and from other conductive elements of the container means (10).
4. Device according to any of the claims 1-3 **characterized in that** each electrode means (15) consist of an elongated sheet-like or thread-like element and in the shape of a helicoid's segment.
5. Device according to any of the claims 1-4 **characterized in that** at least one among the tubular element (17) and the inner wall of the container means (10) is made of electrically conducting material and serves as an electrode for the neutral or the ground.
6. Device according to any of the preceding claims **characterized in that** it comprises a heat exchanger means (7) having a first duct forming part of the circuit (3) and assigned to the carrier liquid flow and a second duct for the fluid to be heated where preferably such fluid consist of air delivered through the second channel by means of an electrically driven fan means (23) of the exchanger means (7).
7. Device according to the preceding claims **characterized in that** it comprises control and actuation means (25) powered by said alternating current, connected to a set of sensors (29) for the operation parameters of the device and said control and actuation means (25) comprises electrical power supply means at least for supplying power to each electrode means (15), pump means (5) and fan means (23) where the control and actuation means (25) control the actuation and operation of at least one among the electrode means (15), the pump means (5), the fan means (23) and eventual partition means (19) of the valve type, by means of control algorithms of the control and actuation means (25) and eventually on the base of the operation parameters values provided by the sensors (29).
8. Device according to claim 1 **characterized in that** the carrier liquid (L) is a solution of sodium hydroxide in distilled water.
9. Device according to claim 1 **characterized in that** the amount of sodium hydroxide in the solution ranges between 100 and 500 ppm, preferably is about 200 ppm and that the carrier liquid (L) may possibly comprise glycol.

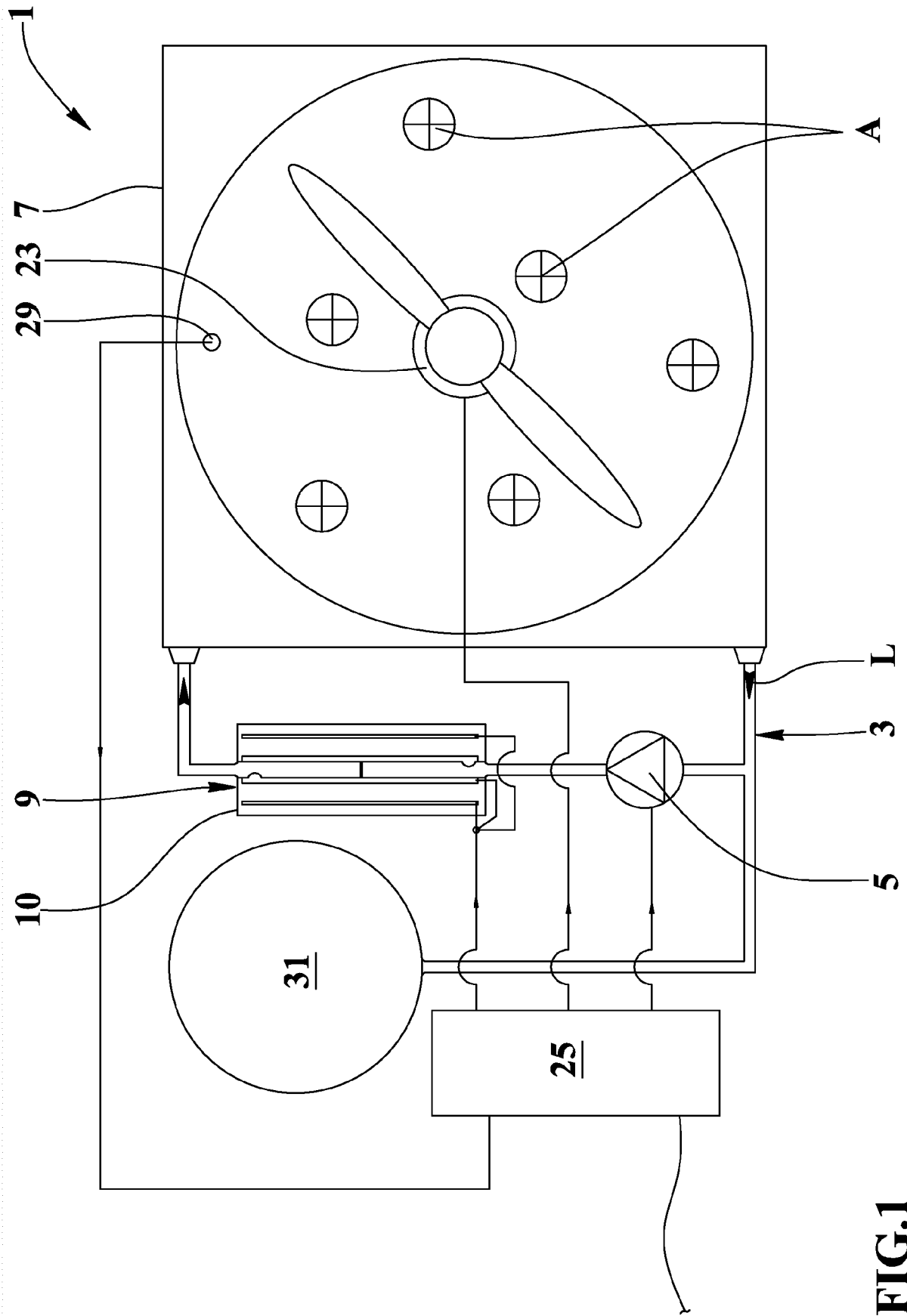


FIG.3

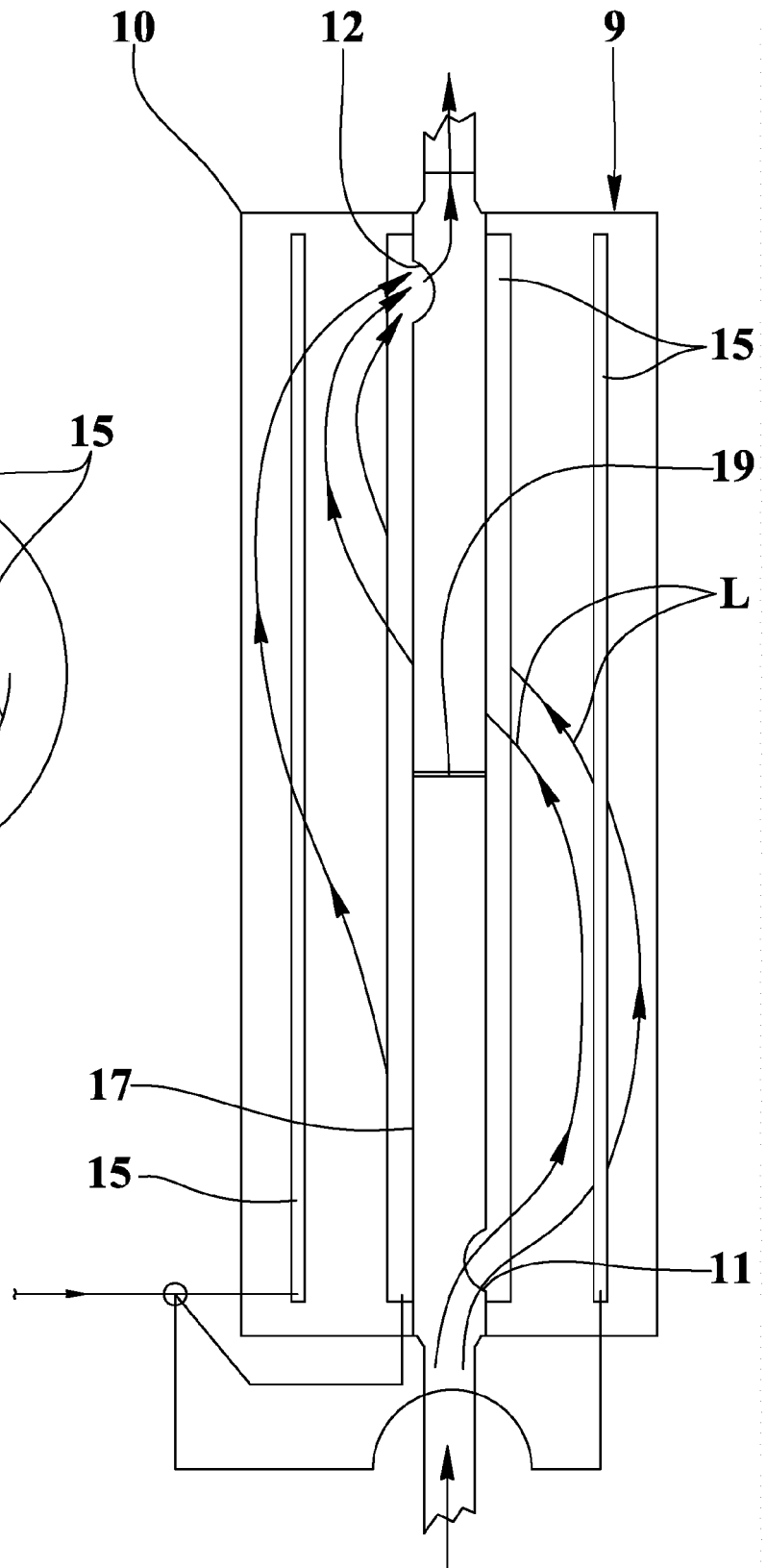
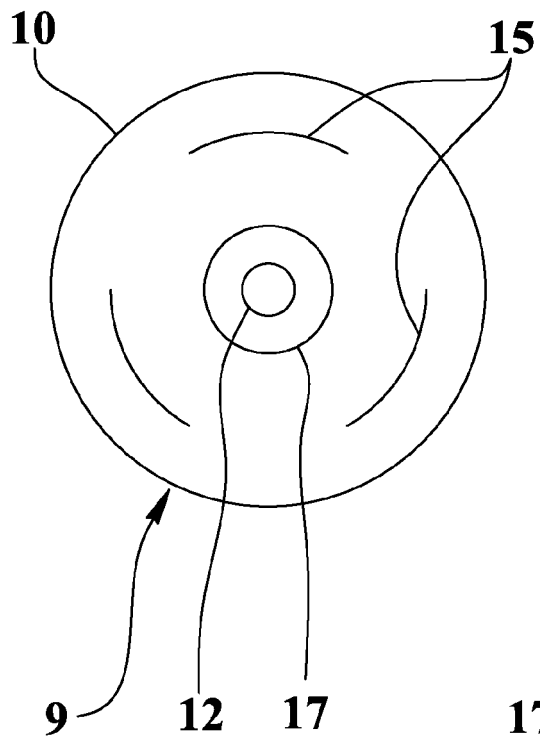


FIG.2



EUROPEAN SEARCH REPORT

Application Number
EP 17 20 4985

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 April 2018	Examiner Riesen, Jörg
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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