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(54) CELL HEATING DEVICE

ZELLENERWÄRMUNGSVORRICHTUNG

DISPOSITIF DE CHAUFFAGE DE CELLULE

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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.

[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.

[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.

[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.

[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.

[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;
- 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.

[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:

- 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;
- 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;
- an expansion vessel 31 shunted with the circuit 3 to allow the carrier liquid L to expand and contract without causing significant pressure variations.

[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. Preferably, 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 though 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 8 **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.

Patentansprüche

1. Zellheizvorrichtung mit einem Ringkreislauf (3) für eine Flüssigkeit, einer Heizeinrichtung und einer elektrischen Pumpeinrichtung (5) zur Erwärmung und Zirkulation einer Trägerflüssigkeit (L), wobei diese Flüssigkeit zur Übertragung von Wärme mittels einer Austauschereinrichtung (7) auf ein zu erwärmendes Fluid (A) bestimmt ist; das Heizmittel umfasst mindestens ein Zellelement (9), das elektrisch mit mindestens einem Phasenwechselstrom und einem möglichen Neutralleiter und/oder Erde gespeist wird, wobei jede Phase und jeder mögliche Neutralleiter oder jede mögliche Erde einen Pol bilden, das vorgenannte Zellelement (9) umfasst ein Behälterelement (10), dessen Hohlraum zumindest teilweise in den Kreislauf (3) einbezogen ist und das mit einem Eingang (11) und einem Ausgang (12) für den Fluss der Trägerflüssigkeit (L) durch den Hohlraum, in dem es angeordnet ist, versehen ist, für jeden Pol mindestens ein Elektrodenelement (15) aus elektrisch leitendem Material, das mit dem entsprechenden Pol elektrisch verbunden ist und von der Strömung der Trägerflüssigkeit (L), die einen von 7 verschiedenen pH-Wert hat, umspült wird; die Vorrichtung (1) **dadurch gekennzeichnet, dass** das Behälterelement (10) und der entsprechende Hohlraum eine längliche zylindrische Form haben und das Behälterelement (10) ein röhrenförmiges Element (17) umfasst, das axial in dem Hohlraum angeordnet ist und dessen Enden von den Enden des Behälterelements (10) hervorstehen und die Enden mit dem Kreislauf (3) verbunden sind; wobei der Eingang (11) und der Ausgang (12) entsprechend den jeweiligen Abschnitten der Seitenwand des rohrförmigen Elements (17) erhalten werden, wobei sich die Abschnitte innerhalb des Hohlraums des Behälterelements (10) befinden und sich nahe den Enden des Behälterelements (10) befinden, und wobei der innere Abschnitt des rohrförmigen Elements (17), der zwischen dem Eingang (11) und dem Ausgang (12) angeordnet ist, eine Trenneinrichtung (19) aufweist, die fest und dazu bestimmt ist, den Fluss der Trägerflüssigkeit zu stoppen, oder die vom Ventiltyp ist, der betätigt wird, um den Fluss der Trägerflüssigkeit (L) entlang des rohrförmigen Elements (17) zu stoppen oder zu regulieren.

2. Vorrichtung gemäß Anspruch 1, **dadurch gekennzeichnet, dass** der Eingang (11) und der Ausgang (12) aus jeweiligen kreisförmigen Öffnungen bestehen, die in jeweiligen Abschnitten ausgebildet sind, die in entgegengesetzten Richtungen der Seitenwand des rohrförmigen Elements (17) ausgerichtet sind, oder der Eingang (11) und der Ausgang (12) aus einer jeweiligen Vielzahl von Öffnungen bestehen, die vorzugsweise eine ringförmige Anordnung aufweisen und in der Seitenwand des rohrförmigen Elements (17) ausgebildet sind.

3. Vorrichtung gemäß Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** jedes Elektrodenelement (15) aus einem länglichen platten- oder scheibenartigen Element besteht, das flach oder in der Form eines zylindrischen Längssektors parallel zur Längsachse der Behältereinrichtung (10) ist und von der anderen Elektrodenelementen (15) und von anderen leitenden Elementen des Behälterelements (10) beabstandet ist.

4. Vorrichtung gemäß einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** jedes Elektrodenelement (15) aus einem langgestreckten platten- oder fadenförmigen Element und in Form eines Schraubenlinien-Segments besteht.

5. Vorrichtung gemäß einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** mindestens eines der rohrförmigen Elemente (17) und die Innenwand des Behälterelements (10) aus elektrisch leitendem Material besteht und als Elektrode für den Neutralleiter oder die Erde dient.

6. Vorrichtung nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** sie eine Wärmetauschereinrichtung (7) aufweist, die eine erste Leitung, die Teil des Kreislaufs (3) ist und dem Strom der Trägerflüssigkeit zugeordnet ist, und eine zweite Leitung für das zu erwärmende Fluid aufweist, wobei dieses Fluid vorzugsweise aus Luft besteht, die durch den zweiten Kanal mittels einer elektrisch angetriebenen Gebläseeinrichtung (23) der Wärmetauschereinrichtung (7) gefördert wird.

7. Vorrichtung gemäß den vorstehenden Ansprüchen, **dadurch gekennzeichnet, dass** sie Steuer- und Betätigungsmittel (25) umfasst, die mit dem genannten Wechselstrom gespeist werden und mit einem Satz von Sensoren (29) für die Betriebsparameter der Vorrichtung verbunden sind, und dass die genannten Steuer- und Betätigungsmittel (25) Mittel zur elektrischen Versorgung zumindest für die Versorgung jeder Elektrodenelement (15), Pumpenmittel (5) und Gebläseeinrichtung (23) umfassen, wobei die Steuer- und Betätigungsmittel (25) die Betätigung und den Betrieb von mindestens einem der Elektrodenelemente (15), der Pumpenelement (5) und der Gebläseeinrichtung (23) und gegebenenfalls der Trenneinrichtung (19) des Ventiltyps mit Hilfe von Steueralgorithmen der Steuer- und Betätigungsmittel (25) und gegebenenfalls auf der Grundlage der von den Sensoren (29) gelieferten Betriebsparameterwerte steuern.

8. Vorrichtung gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Trägerflüssigkeit (L) eine Lösung

von Natriumhydroxid in destilliertem Wasser ist.

9. Vorrichtung gemäß Anspruch 8, **dadurch gekennzeichnet, dass** die Menge an Natriumhydroxid in der Lösung zwischen 100 und 500 ppm liegt, vorzugsweise etwa 200 ppm beträgt und dass die Trägerflüssigkeit (L) gegebenenfalls Glykol enthalten kann.

Revendications

1. Dispositif de chauffage à cellule comprenant un circuit annulaire (3) pour un liquide, un moyen de chauffage et un moyen de pompe électrique (5) pour le chauffage et la circulation d'un liquide porteur (L), ledit liquide étant destiné à transférer de la chaleur, à l'aide d'un moyen d'échangeur (7), à un fluide (A) devant être chauffé ; le moyen de chauffage comprend au moins un moyen de cellule (9) alimenté électriquement avec au moins du courant alternatif monophasé et un éventuel neutre et/ou une masse, chaque phase et chaque éventuel neutre ou masse constituant un pôle, ledit moyen de cellule (9) comprend un moyen de contenant (10), dont une cavité est au moins partiellement comprise dans le circuit (3) et qui comporte une entrée (11) et une sortie (12) pour l'écoulement du liquide porteur (L) à travers la cavité dans laquelle il est disposé, pour chaque pôle, au moins un moyen d'électrode (15) fait de matériau électroconducteur et relié électriquement au pôle correspondant et léché par l'écoulement du liquide porteur (L) qui a un pH différent de 7 ; ledit dispositif (1) étant **caractérisé par le fait que** le moyen de contenant (10) et la cavité respective ont une forme cylindrique allongée et le moyen de contenant (10) comprend un élément tubulaire (17) positionné axialement dans ladite cavité et dont des extrémités font saillie à partir des extrémités du moyen de contenant (10) et lesdites extrémités sont reliées au circuit (3) ; ladite entrée (11) et ladite sortie (12) étant obtenues en correspondance de parties respectives de la paroi latérale de l'élément tubulaire (17), lesdites parties étant à l'intérieur de ladite cavité du moyen de contenant (10) et elles sont proches des extrémités du moyen de contenant (10), et la partie interne de l'élément tubulaire (17) comprise entre l'entrée (11) et la sortie (12) ayant un moyen de séparation (19) qui est fixe et destiné à arrêter l'écoulement du liquide porteur ou qui est du type valve actionné pour arrêter ou réguler l'écoulement de liquide porteur (L) le long de l'élément tubulaire (17).

2. Dispositif selon la revendication 1, **caractérisé par le fait que** ladite entrée (11) et ladite sortie (12) se composent d'ouvertures circulaires respectives obtenues dans des parties respectives orientées dans des directions opposées de la paroi latérale de l'élément tubulaire (17) ou ladite entrée (11) et ladite sortie (12) se composent d'une pluralité respective d'ouvertures ayant, de préférence, un agencement annulaire et obtenues dans la paroi latérale de l'élément tubulaire (17) .

3. Dispositif selon la revendication 1 ou 2, **caractérisé par le fait que** chaque moyen d'électrode (15) se compose d'un élément allongé de type plaque ou de type feuille, plat ou sous la forme d'un secteur longitudinal cylindrique parallèle à l'axe longitudinal du moyen de contenant (10), et espacé de l'autre moyen d'électrode (15) et d'autres éléments conducteurs du moyen de contenant (10) .

4. Dispositif selon l'une quelconque des revendications 1 à 3, **caractérisé par le fait que** chaque moyen d'électrode (15) se compose d'un élément allongé de type feuille ou de type fil et sous la forme d'un segment d'hélicoïde.

5. Dispositif selon l'une quelconque des revendications 1 à 4, **caractérisé par le fait qu'**au moins un parmi l'élément tubulaire (17) et la paroi interne du moyen de contenant (10) est fait de matériau électroconducteur et sert d'électrode pour le neutre ou la masse.

6. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**il comprend un moyen d'échangeur de chaleur (7) ayant un premier conduit faisant partie du circuit (3) et affecté à l'écoulement de liquide porteur et un second conduit pour le fluide devant être chauffé, ledit fluide se composant, de préférence, d'air délivré à travers le second canal à l'aide d'un moyen de ventilateur à entraînement électrique (23) du moyen d'échangeur (7).

7. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé par le fait qu'**il comprend un moyen de commande et d'actionnement (25) alimenté par ledit courant alternatif, relié à un ensemble de capteurs (29) pour les paramètres de fonctionnement du dispositif, et ledit moyen de commande et d'actionnement (25) comprend un moyen d'alimentation électrique au moins pour fournir une alimentation à chaque moyen d'électrode (15), moyen de pompe (5) et moyen de ventilateur (23), le moyen de commande et d'actionnement (25) commandant l'actionnement et le fonctionnement d'au moins un parmi le moyen d'électrode (15), le moyen de pompe (5), le moyen de ventilateur (23) et l'éventuel moyen de séparation (19) du type valve, à l'aide d'algorithmes de commande du moyen de commande et d'actionnement (25) et facultativement sur la base des valeurs de paramètres de fonctionnement fournies par les capteurs (29).

8. Dispositif selon la revendication 1, **caractérisé par le fait que** le liquide porteur (L) est une solution d'hydroxyde de sodium dans de l'eau distillée.

9. Dispositif selon la revendication 8, **caractérisé par le fait que** la quantité d'hydroxyde de sodium dans la solution est comprise entre 100 et 500 ppm, de préférence est d'environ 200 ppm, et **par le fait que** le liquide porteur (L) peut facultativement comporter du glycol.

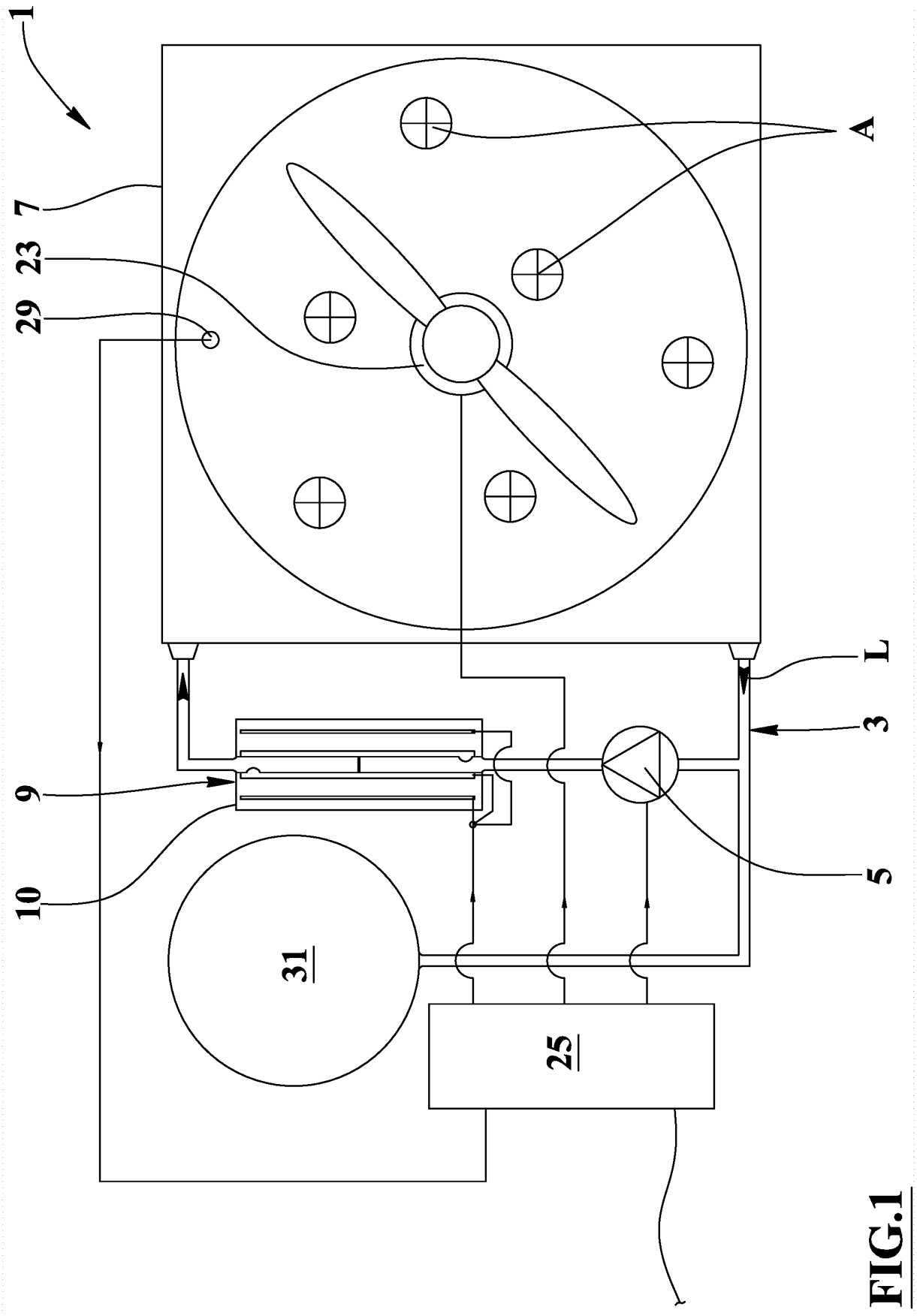
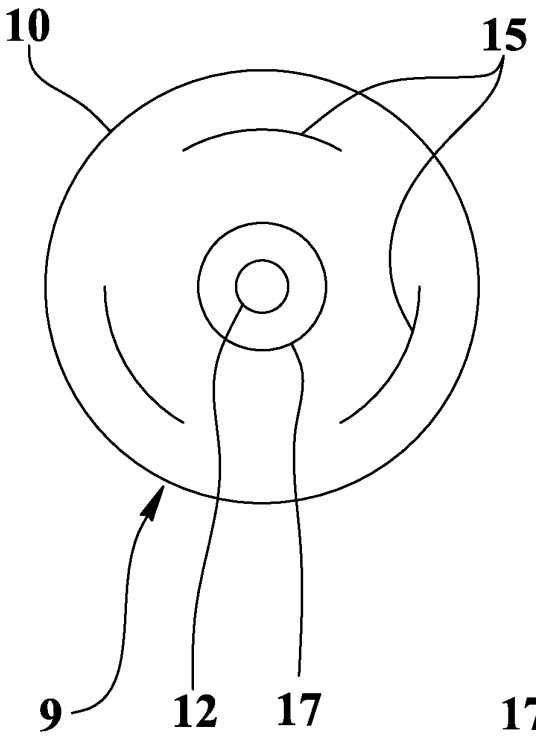


FIG.1

FIG.3



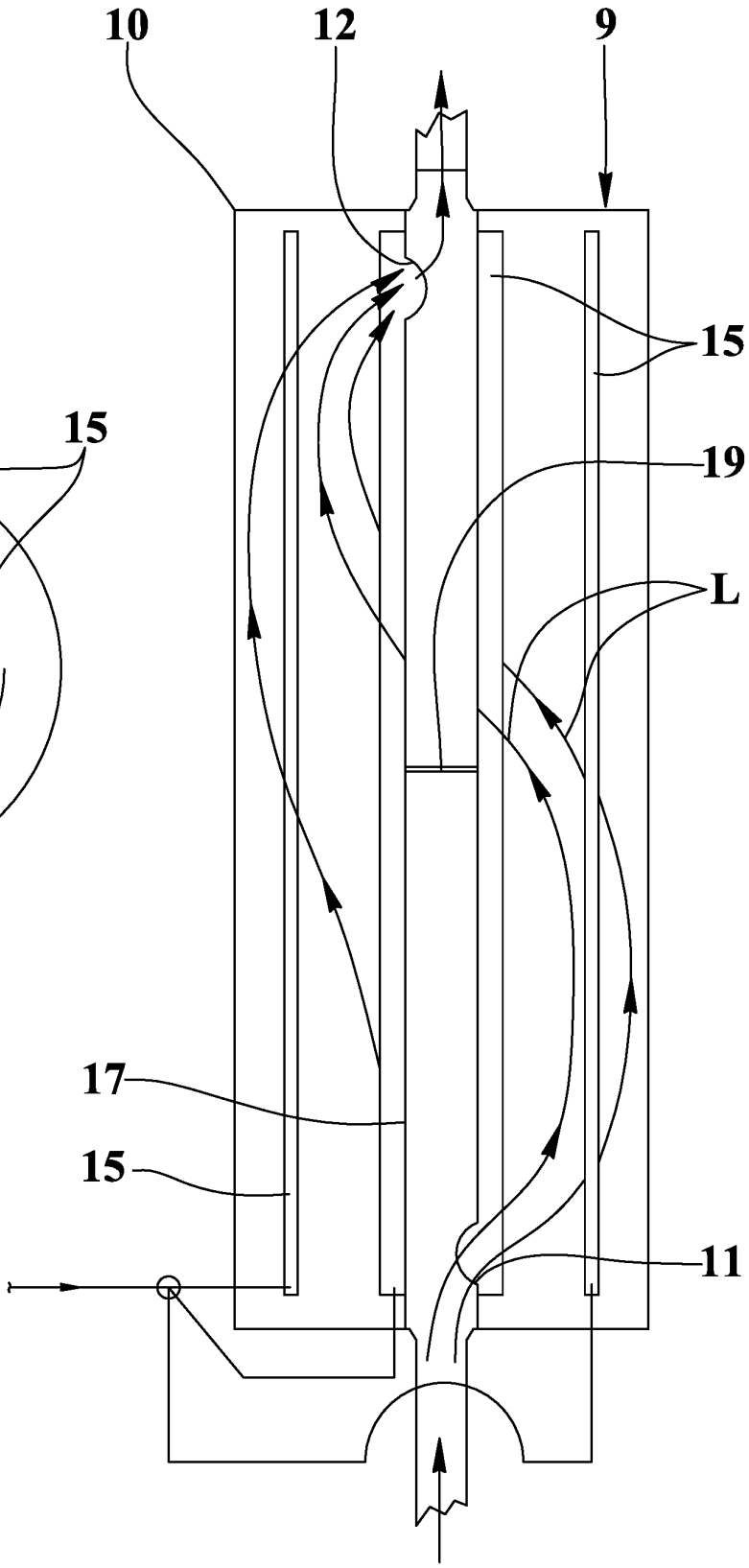


FIG.2

REFERENCES CITED IN THE DESCRIPTION

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