

Description

This invention relates to an apparatus for effecting direct contact between a gas and a liquid, and to a process in which direct contact is effected between a gas and a liquid.

There are many processes in which directly, or indirectly, contact is effected between a gas and a liquid. For example, a gas may be indirectly contacted with a cooling liquid in a heat-exchanger in order to cool the gas, and similarly a liquid may be cooled in such a heat-exchanger by effecting indirect contact with a cooling gas.

Direct contact may be effected between a liquid and a gas in order, for example, to dry the gas, or to absorb the gas in the liquid to form a solution therein, or to strip from the liquid a gas which is in admixture with the liquid, or to effect evaporation of the liquid. Such direct contact between a liquid and a gas may be effected in a number of different ways. For example, the gas may be bubbled through a pool of liquid, or streams of the gas and liquid may be contacted in a counter-current manner, for example by passing the liquid downwardly through a column and the gas upwardly through the column. The column may have plates therein, or it may be packed in order to effect intimate contact between the gas and the liquid.

Where such known processes for effecting direct or indirect contact between a gas and a liquid are carried out it is necessary to provide means for circulating the gas and/or the liquid, and means for transferring the gas and/or liquid to and from the apparatus in which contact between the gas and liquid is effected. Such means may be provided by a pump or a plurality of pumps.

The present invention relates to an apparatus suitable for effecting direct contact between a gas and a liquid which is of simple construction and which does not depend on the provision of pumps to circulate the gas and/or liquid, or to transfer the gas or liquid to or from the apparatus, or which at least reduces the number of such pumps which are necessary. Thus, maintenance of the apparatus in which such direct contact between a gas and liquid is effected is simplified as the number of moving parts such as pumps is reduced, or such moving parts are eliminated entirely.

GB-A-1 569 729 describes a vapourisation bubbler apparatus which comprises a vertical bubble tube which contains liquid into which bubbles of gas are introduced. The bubbles rise into the tube and vapour bearing bubbles are removed from the tube and liquid overflows from the tube.

US-A-4 325 923 describes an apparatus for effecting contact between a gas and a liquid which comprises bubble column reactors in which this contact is effected.

DE-A-275 941 describes an apparatus in which a liquid is heated by injecting steam into the liquid, the liquid being forced continuously or intermittently through inclined pipes.

According to the present invention there is

provided an apparatus suitable for effecting direct contact between a gas and liquid which apparatus comprises at least a pair of spaced apart plates which are parallel or substantially parallel to each other and which define at least one substantially vertical channel therebetween, and end walls separating the plates, means for introducing gas at a lower part of the channel, means for introducing liquid to the channel, and means for removing gas and liquid at an upper part of the channel, the height of the channel being substantially greater than the distance between the walls thereof defined by the parallel or substantially parallel plates such that gas at elevated pressure, when introduced into the channel, can cause liquid to move upwardly in the channel and to be removed from the channel.

There is also provided a process for effecting direct contact between a gas and a liquid in an apparatus which comprises at least a pair of spaced apart plates which are parallel or substantially parallel to each other and which define at least one substantially vertical channel therebetween, end walls separating the plates, means for introducing gas at a lower part of the channel, means for introducing liquid to the channel, and means for removing gas and liquid at an upper part of the channel, in the apparatus the height of the channel defined by the parallel or substantially parallel plates being substantially greater than the distance between the walls thereof, the process comprising introducing gas at elevated pressure and liquid to the channel, causing the liquid to move upwardly in the channel, and removing gas and liquid from the channel.

In the process the gas and liquid pass upwardly, concurrently, in the channel.

The liquid may be caused to pass upwardly by a gas lift effect, in which case the dimensions of the channel, and in particular the height of the channel in relation to the distance between the walls thereof, should be chosen in order to obtain the gas lift effect where this is the sole means of causing the liquid to move upwardly in the channel.

Where the liquid is caused to move upwardly in the channel by a gas lift effect the means for introducing liquid to the channel may suitably be at a lower part of the channel, for example, at or near the base of the channel.

Alternatively the liquid may be caused to move upwardly in the channel by means of a static head acting on the liquid in the channel. In this case also the means for introducing liquid to the channel may suitably be at a lower part of the channel, for example, at or near the base of the channel, although this is not necessarily so.

The liquid may be caused to move upwardly in the channel by means of a combination of a gas-lift effect and a static head acting on the liquid in the channel.

The channel in the apparatus should be substantially vertical, at least in the case where liquid is caused to move upwardly in the channel by

means of a gas lift effect. The channel need not be precisely vertical. However, where it is desired to operate the process by the gas lift effect the channel should not be displaced from a vertical position by such an amount that in use a gas lift effect cannot be obtained, or cannot be sustained.

The channel in the apparatus is formed from at least a pair of spaced apart plates and end walls separating the plates. The spaced apart plates are parallel, or substantially parallel to each other.

The means for introducing gas and liquid to the channel may be an aperture or apertures, for example, at or near the base of the channel. Separate apertures may be provided for introduction of gas and of liquid. The aperture or apertures may be in the base of the channel or in a wall which defines the channel at a position at or near the base of the channel, e.g. in one of the spaced apart plates. Similarly, the means for removing gas and liquid from the channel may be an aperture or apertures at the top of the channel or in a wall which defines the channel at a position at or near the top of the channel, e.g. in one of the spaced apart plates. Gas and liquid may be removed via separate apertures.

The dimensions of the channel must be chosen such that liquid introduced into the channel can be caused to move upwardly in the channel. These dimensions will depend at least in part on the means by which the liquid is caused to move upwardly in the channel. For example, where the liquid is caused to move upwardly in the channel at least in part by a gas lift effect these dimensions will depend at least in part on the pressure of the gas and the rate at which the gas is introduced into the channel, and on the density and viscosity of the liquid and on the rate at which the liquid is introduced into the channel. In general the height of the channel will be substantially greater than the distance between the walls which define the channels, that is the height of the plates, will be substantially greater than the distance between the plates. The dimensions of the channel may be chosen by means of experiment bearing in mind the factors referred to above.

The apparatus may comprise a plurality of channels which are adjacent to each other and which are interconnected at least some of the channels being provided with means for introducing gas and liquid thereto and with means for removing gas and liquid therefrom. Not all of the channels may be provided with the said means. For example, a first channel may be provided with means for introducing gas and liquid thereto and with means for removing gas and liquid therefrom and be interconnected to a second channel adjacent thereto. In the second channel the gas and liquid may be separated, the gas being removed therefrom or passed to another channel adjacent thereto, e.g. via an aperture at or near the top thereof, and the liquid passing to the bottom of the channel. This liquid may, for example, be recirculated to the first channel for re-use therein, or it may be passed to a third

channel adjacent thereto in which it may be contacted with a gas, which may be the same or different, and caused to move upwardly in the channel e.g. by the gas lift effect.

The flow of gas and liquid through such an apparatus comprising a plurality of interconnected channels may be in a co-current or counter-current manner.

The apparatus comprising a plurality of channels may be formed by three or more plates which are parallel or substantially parallel and which have end walls separating adjacent plates and which may have apertures in the faces thereof which provide means for introducing gas and liquid to the channels and means for removing gas and liquid from the channels.

The apparatus comprising a plurality of channels may be formed by at least two spaced apart plates which are parallel or substantially parallel to each other, and end walls separating adjacent plates, in which a spacer or plurality of spacers are positioned between adjacent plates and spaced apart from each other and which, together with the spaced apart plates, form the channels in the apparatus. The spacers may have apertures therein to provide the required interconnection between the adjacent channels. This embodiment the apparatus of the invention may comprise three or more spaced apart plates in which a plate or plates have apertures therein in order to provide interconnection between a channel positioned between one pair of parallel plates and a channel or channels positioned between another pair of parallel plates adjacent thereto.

The apparatus of the present invention which comprises a plurality of channels which are adjacent to each other and which are interconnected is a preferred embodiment of the present invention. In such a preferred apparatus a plurality of separate functions may be carried out. For example, in a first channel a gas may be contacted with a first liquid in order to remove impurities from the gas, in a second channel the gas may be separated from the first liquid, and in a third channel the gas may be contacted with a second liquid in order to dry the gas.

The apparatus of the present invention which comprises a plurality of channels which are adjacent to each other and which are interconnected is formed of a plurality of plates positioned substantially parallel to each other and having appropriately positioned apertures therein which provide the necessary interconnection between the adjacent channels. Such an apparatus is readily produced and is of simple construction. The plates may be fixed to each other by a variety of different techniques. For example, the plates may be bolted to each other, or they may be bonded to each other, e.g. by the use of a suitable adhesive or, in the case where they are formed of a metal or of an organic polymeric material, by welding to each other, e.g. by heat welding.

A variety of different processes may be effected in the apparatus of the present invention. Such

processes include, for example, drying of a gas by direct contact with a liquid, absorption of a gas in a liquid, directly contacting a first gas with a liquid in order to remove from the liquid a second gas admixed therewith, directly contacting a gas with a liquid in order to evaporate the liquid, cooling of a gas by contact with a liquid, purifying of a gas by contact with a liquid, and effecting chemical reaction between a gas and a liquid. A plurality of such processes may be effected in an apparatus of the invention, for example, by use of an apparatus comprising a plurality of channels and contacting a gas with different liquids in the separate channels of the apparatus.

The apparatus of the invention is particularly suitable for use in the treatment of gases which are produced in the electrolysis of an electrolyte, e.g. an aqueous electrolyte. An apparatus of the invention may be operatively connected to an electrolytic cell which cell comprises at least one anode and at least one cathode and which is provided with means for introducing to the apparatus a gas or gases produced in the electrolytic cell. The apparatus may be used in a facility which comprises a plurality of electrolytic cells and the gaseous products from an electrolytic cell may be treated in an apparatus associated with each electrolytic cell. Alternatively, the gaseous products from a plurality of electrolytic cells may be combined and treated in an apparatus of the invention. The electrolytic cell may comprise a separator positioned between each anode and adjacent cathode. The separator may be a cation-exchange membrane and the electrolytic cell may be of the filter press type.

The apparatus of the invention is particularly suitable for use in the treatment of chlorine and hydrogen in gaseous form which are produced in the electrolysis of aqueous alkali metal chloride solution. The apparatus is particularly suitable for use in the treatment of gases which are produced at elevated pressure, for example chlorine and hydrogen which may be produced under elevated pressure in an electrolytic cell as no additional pressurisation of the gases may be necessary before use in the apparatus, the pressure of the gases, such as the chlorine and hydrogen from the electrolytic cell, being sufficient, for example, to provide the required gas lift effect in the process of the invention.

Treatments of gaseous chlorine and hydrogen which may be effected include the following, cooling by direct contact of the gas with a liquid, e.g. with water, and drying of the gaseous chlorine, e.g. by direct contact of the chlorine with sulphuric acid.

In the apparatus it is not necessary that contact between, or separation of, a gas and liquid be effected in all the channels. One or more of the channels in the apparatus may comprise a further component. For example, when a gas, e.g. chlorine or hydrogen, has been cooled by contact with a liquid the liquid entrained in the gas may be removed by passing the gas through a fibrous filter contained in one of the channels. A channel

may contain a bed of material comprising a catalyst or on which absorption of a gas may be effected.

An embodiment of the invention will now be described with the aid of the following drawings in which

Figure 1 is an isometric view, partly in cross-section of a part of an apparatus of the invention,

Figure 2 is an isometric view, partly in cross-section, of that part of the apparatus of Figure 1 outlined at A, and

Figure 3 is a cross-sectional view in elevation of a part of an apparatus of the invention.

In Figure 1 to 3 there is illustrated an apparatus of the invention which comprises a plurality of plates 1, 2, 3, 4, 5, 6 which together define a plurality of channels 7, 8, 9, 10. For the sake of convenience and ease of illustration, in the apparatus of Figure 1 the end walls between adjacent plates which together with the plates define the channels have been omitted, as have top and bottom walls positioned between adjacent plates.

Referring to Figure 1 the plate 1 comprises an aperture 11, the plate 4 comprises an aperture 12, and the plate 6 comprises an aperture 13.

Referring to Figure 2, which illustrates in detail that part of the apparatus of Figure 1 outlined at A the plate 2 contains an aperture 14 leading from one side of the plate 2 to the other and providing a passageway between channels 7 and 8. Plate 2 also comprises an aperture 15 leading from one side of the plate to the other.

Plate 3 comprises a passageway 16 which is vertically positioned. Plates 3 and 4 comprise an aperture 17 which is formed by the plates 3 and 4 being shorter than the plate 2.

Referring to Figure 3 the apparatus comprises an outlet port 18 and spacers 19, 20, 21 which space apart adjacent plates and which serve to form part of the top, bottom and side walls of the apparatus.

In operation gas under pressure, for example from an electrolytic cell, enters the channel 7 via the aperture 11, passes downwardly in the channel 7 in the direction indicated by arrow B, and into channel 8 via aperture 14. Liquid, from a reservoir at the lower end of the space between the plates 4 and 6 passes through aperture 17 in the direction indicated by arrow C and then passes upwardly through passageway 16 into channel 8. The gas and liquid pass upwardly in channel 8 in the direction indicated by arrow D and through aperture 12 into channel 9. Upward passage of the liquid in channel 8 is assisted in part by a gas lift effect provided by the gas and in part by a head of liquid provided by the reservoir of liquid at the lower end of the space between the plates 4 and 6. Aperture 15 serves to provide a liquid balancing effect.

After passage through the aperture 12 the gas and liquid separate, and the gas passes upwardly in channel 10 in the direction of arrow E and thence through aperture 13 in plate 6. The liquid which has separated from the gas falls in passage

9 to form a reservoir of liquid at the lower end of the space between plates 4 and 6. The liquid is then recycled via aperture 17 to channel 8 and contacted with more gas entering channel 8 via aperture 14. An excessive head of liquid in the space between plates 4 and 6 is prevented as any excess liquid is removed from the apparatus via port 18.

If desired, the apparatus may comprise many more spaced apart plates having apertures therein such that the gas may be contacted with a plurality of different liquids.

The apparatus of the invention is suitable for use, for example, in the purification and drying of chlorine and/or hydrogen produced in an electrolytic cell in which aqueous alkali metal chloride solution is electrolysed. In this case, an apparatus may be connected to the chlorine outlet from the cell and an apparatus to the hydrogen outlet from the cell.

Claims

1. An apparatus suitable for effecting direct contact between a gas and a liquid which apparatus comprises at least a pair of spaced apart plates (1, 2, 3, 4, 5, 6) which are parallel or substantially parallel to each other and which define at least one substantially vertical channel (7, 8, 9, 10) therebetween, and end walls separating the plates, means 14 for introducing gas at a lower part of the channel, means (17) for introducing liquid to the channel, and means (12) for removing gas and liquid at an upper part of the channel, the height of the channel (7, 8, 9, 10) being substantially greater than the distance between the walls thereof defined by the parallel or substantially parallel plates (1, 2, 3, 4, 5, 6) such that gas at elevated pressure, when introduced into the channel, can cause liquid to move upwardly in the channel and to be removed from the channel.

2. An apparatus as claimed in claim 1 in which the means (14) for introducing gas is situated at or near the base of the channel.

3. An apparatus as claimed in claim 1 or claim 2 in which the means (12) for removing gas and liquid are situated at or near the top of the channel.

4. An apparatus as claimed in any one of claims 1 to 3 in which the means (14, 17) for introducing gas and liquid are provided by apertures in one of the spaced apart plates.

5. An apparatus as claimed in any one of claims 1 to 4 in which means (12) for removing gas and liquid is provided by apertures in one of the spaced apart plates.

6. An apparatus as claimed in any one of claims 1 to 5 which comprises a plurality of channels (7, 8, 9, 10) which are adjacent to each other and which are interconnected, at least some of the channels being provided with means (12) for removing gas and liquid therefrom.

7. An apparatus as claimed in claim 6 which comprises three or more parallel or substantially

parallel spaced apart plates (1, 2, 3, 4, 5, 6) which have end walls separating adjacent plates.

8. An apparatus as claimed in claim 6 which comprises at least two spaced apart plates which are parallel or substantially parallel to each other, and end walls separating adjacent plates, in which a spacer or a plurality of spacers are positioned between adjacent parallel or substantially parallel plates and spaced apart from each other and which, together with the parallel or substantially parallel plates, form the channels in the apparatus, the spacers having apertures therein which form the interconnection between the channels.

9. An apparatus as claimed in claim 8 which comprises three or more parallel or substantially parallel spaced apart plates and in which a plate or plates have apertures therein to provide an interconnection between a channel positioned between one pair of parallel or substantially parallel plates and a channel positioned between another pair of parallel or substantially parallel plates adjacent thereto.

10. An apparatus as claimed in any one of claims 1 to 9 which is operatively connected to an electrolytic cell which cell comprises at least one anode and at least one cathode and which is provided with means for introducing to the apparatus a gas or gases produced in the electrolytic cell.

11. An apparatus as claimed in claim 10 in which the electrolytic cell comprises a separator positioned between each anode and adjacent cathode.

12. An apparatus as claimed in claim 11 in which the separator is a cation-exchange membrane.

13. An apparatus as claimed in any one of claims 10 to 12 in which the electrolytic cell is a filter press type electrolytic cell.

14. A process for effecting direct contact between a gas and a liquid in an apparatus which comprises at least a pair of spaced apart plates (1, 2, 3, 4, 5, 6) which are parallel or substantially parallel to each other and which define at least one substantially vertical channel (7, 8, 9, 10) therebetween, and end walls separating the plates, means (14) for introducing gas at a lower part of the channel, means (17) for introducing liquid to the channel, and means (12) for removing gas and liquid at an upper part of the channel, in the apparatus the height of the channel (7, 8, 9, 10) defined by the parallel or substantially parallel plates (1, 2, 3, 4, 5, 6) being substantially greater than the distance between the walls thereof, the process comprising introducing gas at elevated pressure and liquid to the channel (8), causing the liquid to move upwardly in the channel, and removing gas and liquid from the channel (8).

15. A process as claimed in claim 14 in which the gas is introduced into the channel at or near the base of the channel.

16. A process as claimed in claim 14 or claim 15 in which the gas and liquid are removed from the channel at or near the top of the channel.

9 to form a reservoir of liquid at the lower end of the space between plates 4 and 6. The liquid is then recycled via aperture 17 to channel 8 and contacted with more gas entering channel 8 via aperture 14. An excessive head of liquid in the space between plates 4 and 6 is prevented as any excess liquid is removed from the apparatus via port 18.

If desired, the apparatus may comprise many more spaced apart plates having apertures therein such that the gas may be contacted with a plurality of different liquids.

The apparatus of the invention is suitable for use, for example, in the purification and drying of chlorine and/or hydrogen produced in an electrolytic cell in which aqueous alkali metal chloride solution is electrolysed. In this case, an apparatus may be connected to the chlorine outlet from the cell and an apparatus to the hydrogen outlet from the cell.

Claims

1. An apparatus suitable for effecting direct contact between a gas and a liquid which apparatus comprises at least a pair of spaced apart plates (1, 2, 3, 4, 5, 6) which are parallel or substantially parallel to each other and which define at least one substantially vertical channel (7, 8, 9, 10) therebetween, and end walls separating the plates, means (14) for introducing gas at a lower part of the channel, means (17) for introducing liquid to the channel, and means (12) for removing gas and liquid at an upper part of the channel, the height of the channel (7, 8, 9, 10) being substantially greater than the distance between the walls thereof defined by the parallel or substantially parallel plates (1, 2, 3, 4, 5, 6) such that gas at elevated pressure, when introduced into the channel, can cause liquid to move upwardly in the channel and to be removed from the channel.

2. An apparatus as claimed in claim 1 in which the means (14) for introducing gas is situated at or near the base of the channel.

3. An apparatus as claimed in claim 1 or claim 2 in which the means (12) for removing gas and liquid are situated at or near the top of the channel.

4. An apparatus as claimed in any one of claims 1 to 3 in which the means (14, 17) for introducing gas and liquid are provided by apertures in one of the spaced apart plates.

5. An apparatus as claimed in any one of claims 1 to 4 in which means (12) for removing gas and liquid is provided by apertures in one of the spaced apart plates.

6. An apparatus as claimed in any one of claims 1 to 5 which comprises a plurality of channels (7, 8, 9, 10) which are adjacent to each other and which are interconnected, at least some of the channels being provided with means (12) for removing gas and liquid therefrom.

7. An apparatus as claimed in claim 6 which comprises three or more parallel or substantially

parallel spaced apart plates (1, 2, 3, 4, 5, 6) which have end walls separating adjacent plates.

8. An apparatus as claimed in claim 6 which comprises at least two spaced apart plates which are parallel or substantially parallel to each other, and end walls separating adjacent plates, in which a spacer or a plurality of spacers are positioned between adjacent parallel or substantially parallel plates and spaced apart from each other and which, together with the parallel or substantially parallel plates, form the channels in the apparatus, the spacers having apertures therein which form the interconnection between the channels.

9. An apparatus as claimed in claim 8 which comprises three or more parallel or substantially parallel spaced apart plates and in which a plate or plates have apertures therein to provide an interconnection between a channel positioned between one pair of parallel or substantially parallel plates and a channel positioned between another pair of parallel or substantially parallel plates adjacent thereto.

10. An apparatus as claimed in any one of claims 1 to 9 which is operatively connected to an electrolytic cell which cell comprises at least one anode and at least one cathode and which is provided with means for introducing to the apparatus a gas or gases produced in the electrolytic cell.

11. An apparatus as claimed in claim 10 in which the electrolytic cell comprises a separator positioned between each anode and adjacent cathode.

12. An apparatus as claimed in claim 11 in which the separator is a cation-exchange membrane.

13. An apparatus as claimed in any one of claims 10 to 12 in which the electrolytic cell is a filter press type electrolytic cell.

14. A process for effecting direct contact between a gas and a liquid in an apparatus which comprises at least a pair of spaced apart plates (1, 2, 3, 4, 5, 6) which are parallel or substantially parallel to each other and which define at least one substantially vertical channel (7, 8, 9, 10) therebetween, and end walls separating the plates, means (14) for introducing gas at a lower part of the channel, means (17) for introducing liquid to the channel, and means (12) for removing gas and liquid at an upper part of the channel, in the apparatus the height of the channel (7, 8, 9, 10) defined by the parallel or substantially parallel plates (1, 2, 3, 4, 5, 6) being substantially greater than the distance between the walls thereof, the process comprising introducing gas at elevated pressure and liquid to the channel (8), causing the liquid to move upwardly in the channel, and removing gas and liquid from the channel (8).

15. A process as claimed in claim 14 in which the gas is introduced into the channel at or near the base of the channel.

16. A process as claimed in claim 14 or claim 15 in which the gas and liquid are removed from the channel at or near the top of the channel.



17. A process as claimed in any one of claims 16 to 18 in which the liquid is caused to pass upwardly in the channel by a gas lift effect.

18. A process as claimed in any one of claims 14 to 17 in which the liquid is caused to pass upwardly in the channel by means of a static head of liquid.

19. A process as claimed in any one of claims 14 to 18 in which the gas and liquid are introduced through apertures (14, 17) in one of the spaced apart plates.

20. A process as claimed in any one of claims 14 to 19 in which the gas and liquid are removed through apertures (12) in one of the spaced apart plates.

21. A process as claimed in any one of claims 14 to 20 in which the apparatus comprises a plurality of channels (7, 8, 9, 10).

22. A process as claimed in any one of claims 14 to 21 in which the gas is produced by the electrolysis of an electrolyte.

23. A process as claimed in claim 22 in which the electrolyte is an aqueous solution of an alkali metal chloride.

24. A process as claimed in claim 23 in which the gas is chlorine or hydrogen.

25. A process as claimed in any one of claims 14 to 24 in which the gas is dried in the apparatus by contacting the gas with a liquid.

26. A process as claimed in any one of claims 14 to 25 in which the gas is cooled in the apparatus by contacting the gas with a liquid.

27. A process as claimed in any one of claims 21 to 26 in which contact between a gas and a liquid is not effected in all of the channels of the apparatus.

28. A process as claimed in any one of claims 22 to 27 in which the gas which is produced in the electrolytic cell is produced at elevated pressure.

29. A process in which an electrolyte is electrolysed in an electrolytic cell comprising at least one anode and at least one cathode to produce a gas or gases, in which the gas or gases is or are contacted with a liquid in an apparatus as claimed in any one of claims 1 to 13.

Patentansprüche

1. Vorrichtung, die zum Herbeiführen eines direkten Kontakts zwischen einem Gas und einer Flüssigkeit geeignet ist, wobei diese Vorrichtung wenigstens ein Paar mit Abstand angeordnete Platten (1, 2, 3, 4, 5, 6), die parallel oder im wesentlichen parallel zueinander sind und die dazwischen wenigstens einen im wesentlichen senkrechten Kanal (7, 8, 9, 10) abgrenzen, und Stirnwände, die die Platten trennen, eine Einrichtung (14) zum Einführen von Gas bei einem unteren Teil des Kanals, eine Einrichtung (17) zum Einführen von Flüssigkeit in den Kanal und eine Einrichtung (12) zum Entfernen von Gas und Flüssigkeit bei einem oberen Teil des Kanals aufweist, wobei die Höhe des Kanals (7, 8, 9, 10) wesentlich größer ist als der Abstand zwischen seinen Wänden, die durch die parallelen oder im

wesentlichen parallelen Platten (1, 2, 3, 4, 5, 6) festgelegt werden, so daß Gas mit erhöhtem Druck, wenn es in den Kanal eingeführt wird, bewirken kann, daß sich die Flüssigkeit in dem Kanal nach oben bewegt und aus dem Kanal entfernt wird.

2. Vorrichtung nach Anspruch 1, bei der sich die Einrichtung (14) zum Einführen von Gas bei dem Boden des Kanals oder in der Nähe des Bodens befindet.

3. Vorrichtung nach Anspruch 1 oder Anspruch 2, bei der sich die Einrichtung (12) zum Entfernen von Gas und Flüssigkeit bei dem Oberteil des Kanals oder in der Nähe des Oberteils befindet.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, bei der die Einrichtungen (14, 17) zum Einführen von Gas und Flüssigkeit durch Öffnungen in einer der mit Abstand angeordneten Platten bereitgestellt werden.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, bei der die Einrichtung (12) zum Entfernen von Gas und Flüssigkeit durch Öffnungen in einer der mit Abstand angeordneten Platten bereitgestellt wird.

6. Vorrichtung nach einem der Ansprüche 1 bis 5, die wenigstens zwei Kanäle (7, 8, 9, 10) aufweist, die aneinander angrenzen und miteinander verbunden sind, wobei wenigstens einige der Kanäle mit einer Einrichtung (12) zum Entfernen von Gas und Flüssigkeit aus dem Kanal ausgestattet sind.

7. Vorrichtung nach Anspruch 6, die wenigstens drei parallele oder im wesentlichen parallele, mit Abstand angeordnete Platten (1, 2, 3, 4, 5, 6) aufweist, wobei die Platten Stirnwände haben, die benachbarte Platten trennen.

8. Vorrichtung nach Anspruch 6, die wenigstens zwei mit Abstand angeordnete Platten, die parallel oder im wesentlichen parallel zueinander sind, und Stirnwände, die benachbarte Platten trennen, aufweist, wobei zwischen benachbarten parallelen oder im wesentlichen parallelen Platten ein Abstandshalter oder wenigstens zwei Abstandshalter mit Abstand voneinander angeordnet sind, die zusammen mit den parallelen oder im wesentlichen parallelen Platten die Kanäle in der Vorrichtung bilden, wobei sich in den Abstandshaltern Öffnungen befinden, die die Verbindung zwischen den Kanälen bilden.

9. Vorrichtung nach Anspruch 8, die wenigstens drei parallele oder im wesentlichen parallele, mit Abstand angeordnete Platten aufweist, wobei sich in wenigstens einer Platte Öffnungen befinden, um zwischen einem Kanal, der zwischen einem Paar parallelen oder im wesentlichen parallelen Platten angeordnet ist, und einem daran angrenzenden Kanal, der zwischen einem anderen Paar parallelen oder im wesentlichen parallelen Platten angeordnet ist, eine Verbindung herzustellen.

10. Vorrichtung nach einem der Ansprüche 1 bis 9, die mit einer Elektrolysezelle betriebsfähig verbunden ist, wobei diese Zelle wenigstens eine Anode und wenigstens eine Kathode aufweist und mit einer Einrichtung zum Einführen wenig-



stens eines in der Elektrolysezelle erzeugten Gases in die Vorrichtung ausgestattet ist.

11. Vorrichtung nach Anspruch 10, bei der die Elektrolysezelle einen Separator aufweist, der zwischen jeder Anode und der benachbarten Kathode angeordnet ist.

12. Vorrichtung nach Anspruch 11, bei der der Separator eine Kationenaustauschermembran ist.

13. Vorrichtung nach einem der Ansprüche 10 bis 12, bei der die Elektrolysezelle eine Elektrolysezelle vom Filterpressentyp ist.

14. Verfahren zum Herbeiführen eines direkten Kontakts zwischen einem Gas und einer Flüssigkeit in einer Vorrichtung, die wenigstens ein Paar mit Abstand angeordnete Platten (1, 2, 3, 4, 5, 6), die parallel oder im wesentlichen parallel zueinander sind und die dazwischen wenigstens einen im wesentlichen senkrechten Kanal (7, 8, 9, 10) abgrenzen, und Stirnwände, die die Platten trennen, eine Einrichtung (14) zum Einführen von Gas bei einem unteren Teil des Kanals, eine Einrichtung (17) zum Einführen von Flüssigkeit in den Kanal und eine Einrichtung (12) zum Entfernen von Gas und Flüssigkeit bei einem oberen Teil des Kanals aufweist, wobei in der Vorrichtung die Höhe des Kanals (7, 8, 9, 10), der durch die parallelen oder im wesentlichen parallelen Platten (1, 2, 3, 4, 5, 6) abgegrenzt wird, wesentlich größer ist als der Abstand zwischen seinen Wänden, wobei das Verfahren darin besteht, daß in den Kanal (8) Gas mit erhöhtem Druck und Flüssigkeit eingeführt werden; bewirkt wird, daß sich die Flüssigkeit in dem Kanal nach oben bewegt; und Gas und Flüssigkeit aus dem Kanal (8) entfernt werden.

15. Verfahren nach Anspruch 14, bei dem das Gas bei dem Boden des Kanals oder in der Nähe des Bodens in den Kanal eingeführt wird.

16. Verfahren nach Anspruch 14 oder Anspruch 15, bei dem das Gas und die Flüssigkeit bei dem Oberteil des Kanals oder in der Nähe des Oberteils aus dem Kanal entfernt werden.

17. Verfahren nach einem der Ansprüche 16 bis 18, bei dem durch eine Gasliftwirkung bewirkt wird, daß die Flüssigkeit in dem Kanal nach oben strömt.

18. Verfahren nach einem der Ansprüche 14 bis 17, bei dem durch eine Druckhöhe (d.h., durch einen durch eine Flüssigkeitssäule ausgeübten statischen Druck) bewirkt wird, daß die Flüssigkeit in dem Kanal nach oben strömt.

19. Verfahren nach einem der Ansprüche 14 bis 18, bei dem das Gas und die Flüssigkeit durch Öffnungen (14, 17) in einer der mit Abstand angeordneten Platten eingeführt werden.

20. Verfahren nach einem der Ansprüche 14 bis 19, bei dem das Gas und die Flüssigkeit durch Öffnungen (12) in einer der mit Abstand angeordneten Platten entfernt werden.

21. Verfahren nach einem der Ansprüche 14 bis 20, bei dem die Vorrichtung wenigstens zwei Kanäle (7, 8, 9, 10) aufweist.

22. Verfahren nach einem der Ansprüche 14 bis 21, bei dem das Gas durch die Elektrolyse eines Elektrolyten erzeugt wird.

23. Verfahren nach Anspruch 22, bei dem der Elektrolyt eine wäßrige Lösung eines Alkalimetallchlorids ist.

24. Verfahren nach Anspruch 23, bei dem das Gas Chlor oder Wasserstoff ist.

25. Verfahren nach einem der Ansprüche 14 bis 24, bei dem das Gas in der Vorrichtung getrocknet wird, indem das Gas mit einer Flüssigkeit in Kontakt gebracht wird.

26. Verfahren nach einem der Ansprüche 14 bis 25, bei dem das Gas in der Vorrichtung gekühlt wird, indem das Gas mit einer Flüssigkeit in Kontakt gebracht wird.

27. Verfahren nach einem der Ansprüche 21 bis 26, bei dem nicht in allen Kanälen der Vorrichtung ein Kontakt zwischen einem Gas und einer Flüssigkeit herbeigeführt wird.

28. Verfahren nach einem der Ansprüche 22 bis 27, bei dem das in der Elektrolysezelle erzeugte Gas mit erhöhtem Druck erzeugt wird.

29. Verfahren, bei dem in einer Elektrolysezelle, die wenigstens eine Anode und wenigstens eine Kathode aufweist, ein Elektrolyt elektrolysiert wird, um ein Gas oder Gase zu erzeugen, wobei das Gas oder Gase in einer Vorrichtung nach einem der Ansprüche 1 bis 13 mit einer Flüssigkeit in Kontakt gebracht wird oder werden.

Revendications

1. Appareil convenant pour effectuer le contact direct entre un gaz et un liquide, lequel appareil comprend au moins une paire de plaques espacées (1, 2, 3, 4, 5, 6) qui sont parallèles ou sensiblement parallèles les unes aux autres et qui définissent au moins un canal sensiblement vertical (7, 8, 9, 10) entre elles, et des parois d'extrémité séparant les plaques, des moyens (14) pour introduire du gaz à une partie inférieure du canal, des moyens (17) pour introduire du liquide dans le canal, et des moyens (12) pour évacuer du gaz et du liquide à une partie supérieure du canal, la hauteur du canal (7, 8, 9, 10) étant sensiblement supérieure à la distance entre les parois de celui-ci définies par les plaques parallèles ou sensiblement parallèles (1, 2, 3, 4, 5, 6), de façon que ce gaz sous une pression élevée, lorsqu'il est introduit dans le canal, fasse que le liquide se déplace en sens ascendant dans le canal et soit évacué du canal.

2. Appareil suivant la revendication 1, dans lequel les moyens (14) pour introduire du gaz sont situés à ou près de la base du canal.

3. Appareil suivant la revendication 1 ou 2, dans lequel les moyens (12) pour évacuer du gaz et du liquide sont situés à ou près du sommet du canal.

4. Appareil suivant l'une quelconque des revendications 1 à 3, dans lequel les moyens (14, 17) pour introduire du gaz et du liquide sont constitués par des orifices dans l'une des plaques espacées.

5. Appareil suivant l'une quelconque des revendications 1 à 4, dans lequel les moyens (12) pour évacuer du gaz et du liquide sont constitués par des orifices dans l'une des plaques espacées.



6. Appareil suivant l'une quelconque des revendications 1 à 5, qui comprend une pluralité de canaux (7, 8, 9, 10) qui sont adjacents les uns aux autres et sont interconnectés, au moins certains des canaux étant munis de dispositifs (12) pour en évacuer du gaz et du liquide.

7. Appareil suivant la revendication 6, qui comprend trois ou plus de trois plaques espacées parallèles ou sensiblement parallèles (1, 2, 3, 4, 5, 6) qui comprennent des parois d'extrémité séparant les plaques adjacentes.

8. Appareil suivant la revendication 6, qui comprend au moins deux plaques espacées qui sont parallèles ou sensiblement parallèles entre elles et des parois d'extrémité séparant les plaques adjacentes, dans lequel une pièce d'espacement ou une pluralité de pièces d'espacement sont disposées entre les plaques adjacentes parallèles ou sensiblement parallèles et sont espacées les unes des autres et qui, conjointement avec les plaques parallèles ou sensiblement parallèles, forment les canaux dans l'appareil, les pièces d'espacement comportant des orifices qui forment l'interconnexion entre les canaux.

9. Appareil suivant la revendication 8, qui comprend trois ou plus de trois plaques espacées parallèles ou sensiblement parallèles et dans lequel une ou des plaques comportent des orifices pour établir une interconnexion entre un canal disposé entre deux plaques parallèles ou sensiblement parallèles et un canal disposé entre deux autres plaques parallèles ou sensiblement parallèles qui leur sont adjacentes.

10. Appareil suivant l'une quelconque des revendications 1 à 9 qui se trouve en connexion opérationnelle avec une cellule électrolytique, laquelle cellule comprend au moins une anode et au moins une cathode et est munie de moyens pour introduire dans l'appareil un ou des gaz produits dans la cellule électrolytique.

11. Appareil suivant la revendication 10, dans lequel la cellule électrolytique comprend un séparateur agencé entre chaque cathode et une anode adjacente.

12. Appareil suivant la revendication 11, dans lequel le séparateur est une membrane échangeuse de cations.

13. Appareil suivant l'une quelconque des revendications 10 à 12, dans lequel la cellule électrolytique est une cellule électrolytique du type filtre presse.

14. Procédé pour effectuer le contact direct* entre un gaz et un liquide, dans un appareil comprenant au moins une paire de plaques espacées (1, 2, 3, 4, 5, 6) qui sont parallèles ou sensiblement parallèles les unes aux autres et qui définissent au moins un canal sensiblement vertical (7, 8, 9, 10) entre elles, et des parois d'extrémité séparant les plaques, des moyens (14) pour introduire du gaz à une partie inférieure du canal, des moyens (17) pour introduire du liquide dans le canal, et des moyens (12) pour évacuer du gaz et du liquide à une partie supérieure du canal, la hauteur, dans l'appareil, du canal (7, 8, 9, 10)

défini par les plaques parallèles ou sensiblement parallèles (1, 2, 3, 4, 5, 6) étant sensiblement supérieure à la distance entre les parois de celui-ci, le procédé comprenant les actions d'introduire du gaz sous pression élevée et du liquide dans le canal, de faire se mouvoir le liquide en sens ascendant dans le canal et d'évacuer du gaz et du liquide du canal.

15. Procédé suivant la revendication 14, dans lequel le gaz est introduit dans le canal à ou près de la base du canal.

16. Procédé suivant la revendication 14 ou 15, dans lequel le gaz et le liquide sont évacués du canal à ou près du sommet du canal.

17. Procédé suivant l'une quelconque des revendications 14 à 16, dans lequel le liquide est amené à passer en sens ascendant dans le canal par un effet ascensionnel du gaz.

18. Procédé suivant l'une quelconque des revendications 14 à 17, dans lequel le liquide est amené à passer en sens ascendant dans le canal par une pression statique du liquide.

19. Procédé suivant l'une quelconque des revendications 14 à 18, dans lequel le gaz et le liquide sont introduits par des orifices (14, 17) dans l'une des plaques espacées.

20. Procédé suivant l'une quelconque des revendications 14 à 19, dans lequel le gaz et le liquide sont évacués par des orifices (12) dans l'une des plaques espacées.

21. Procédé suivant l'une quelconque des revendications 14 à 20, dans lequel l'appareil comprend une pluralité de canaux (7, 8, 9, 10).

22. Procédé suivant l'une quelconque des revendications 14 à 21, dans lequel le gaz est produit par électrolyse d'un électrolyte.

23. Procédé suivant la revendication 22, dans lequel l'électrolyte est une solution aqueuse d'un chlorure de métal alcalin.

24. Procédé suivant la revendication 23, dans lequel le gaz est le chlore ou l'hydrogène.

25. Procédé suivant l'une quelconque des revendications 14 à 24, dans lequel le gaz est séché dans l'appareil par mise en contact du gaz avec un liquide.

26. Procédé suivant l'une quelconque des revendications 14 à 25, dans lequel le gaz est refroidi dans l'appareil par mise en contact du gaz avec un liquide.

27. Procédé suivant l'une quelconque des revendications 21 à 26, dans lequel le contact entre un gaz et un liquide n'est pas effectué dans tous les canaux de l'appareil.

28. Procédé suivant l'une quelconque des revendications 22 à 27, dans lequel le gaz qui est produit dans la cellule électrolytique est produit sous pression élevée.

29. Procédé dans lequel un électrolyte est électrolysé dans une cellule électrolytique comprenant au moins une anode et au moins une cathode pour produire un ou des gaz, dans lequel le ou les gaz sont mis en contact avec un liquide dans un appareil suivant l'une quelconque des revendications 1 à 13.

