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54 **SYSTEM FOR GENERATING MICROBUBBLES IN A LIQUID MASS.**

57 The system is based on the utilization of porous diffusers (2) arranged in parallel and forming a lattice in the installation for homogenization of the liquid mass. Each porous diffuser (2) is comprised of a tubular part (4) of porous material wherein is tight-fitted a concentric tube (5) with calibrated orifices (6) at its lower portion which open into a linear and common chamber (7), before reaching said porous body (4), in order to equalize the pressures and to make the bubbles reach the liquid mass in correspondence with the upper half of each porous diffuser. The system may be applied to electrolytic processes, gas transfers, water purification systems, fish-breeding stations, etc.

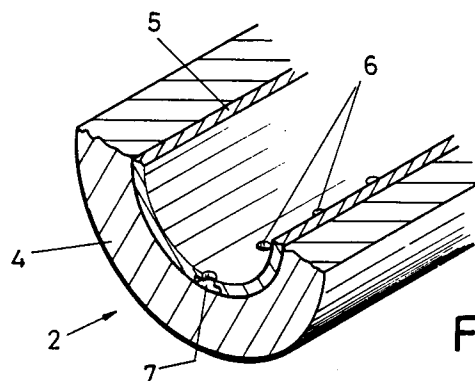


FIG.-2

OBJECT OF THE INVENTION

The invention relates to a system designed to homogenize a liquid mass by injecting air bubbles into the actual liquid mass, thereby to disturb the same and attain a uniform homogeneity thereof. The system can be applied to electrolytic processes, gas transfers, water purification, fish farms and so forth.

BACKGROUND OF THE INVENTION

In electrolytic processes, the parts are anodized in a horizontal arrangement because of the scarce height of the tanks (usually between 2 and 3 m). Thus, the upward travel of the bubbles injected into the electrolyte barely takes enough time for them to come together before reaching the surface, and therefore the methods used in injecting air bubbles can be deemed to be acceptable.

With the introduction in anodizing processes of tanks having a greater height (between 6 and 7 m), the anodizing process is carried out with the parts in a vertical arrangement, which means that the systems usually employed to inject air into the electrolyte are no longer valid, inasmuch as the bubbles produced gradually come together as they travel up the approximately 6 or 7 m and, becoming increasingly larger, and preventing not only homogenization of the electrolyte and correct anodizing, but correct uniformity of the conductivity of the actual electrolyte.

In short, the effect sought by injecting bubbles is for the latter to have as small a diameter as possible and the least possible kinetic energy, viz. the lowest possible speed, so that the bubbles remain unaltered as they travel up the tank, preventing as best as possible their coming together.

Habitually, the means used to produce bubbles comprised making manifold orifices along the piping, which orifices had a diameter ranging between 1 and 3 mm, thus being unduly large. An attempt was made at overcoming this disadvantage by using porous diffusers able to produce bubbles with a diameter of just a few microns. That is to say, slow-moving small bubbles favour the homogenization of the gas in a liquid.

To such end, Spanish patent of invention 9001093 claims a homogenization device using a porous diffuser, such device comprising a gas distributing element in which various injectors are inserted through which the high-speed gas moves, the porous elements or diffusers being precisely arranged to cover the injectors, all such that on injecting the gas into the said diffusers, the said gas may spread throughout the porous mass, and the speed lowered to suitable circulation values through the pores. On exiting through the diffusers,

the gas produces bubbles that are evenly spread throughout the surface of the diffusers and evenly transferred and homogenized in the liquid mass.

Now then, the difficulties of using porous diffusers lies in that when air or liquid ceases to be blown through the same, water enters through the said ceramic diffusers, filling the inside of the piping, such that within a short space of time the said porous parts will actually be clogged, thereby preventing bubble production.

Furthermore, in the installations used habitually, the branches making up the ducts where the porous diffusers are arranged are mounted in series and therefore the loss of head is important, prevents the last diffusers in each branch to evacuate the water passed through the same, this leading on the one hand to the placing of check valves preventing the entry of water into the ducting when blowing stops, and on the other, in order for blowing at the last diffusers on each branch to be appropriate, to a larger quantity of air being blown which causes the first diffusers in the branches to inject more air than should be.

Finally, another disadvantage of the facilities that are currently used, employing porous elements, could be said to be that the failure of one of these porous parts leads the whole process to be imbalanced, since all the installation's blowing air leaks through the same.

Reference should also be made to US patents numbers 4,118,447 and 4,048,072, the first of which claims an apparatus for aerating a liquid mass having a lower hollow tube provided with a ballast, which tube has orifices which lead on the one hand into an air inlet and on the other into a chamber defined between such tube and an external porous tube, in order for the bubbles to exit through the latter.

This patent of invention 4,118,447 is primarily conceived to oxygenate fish farm or reservoir waters, such that although the it is aimed at achieving bubbles of tiny calibre, clearly being designed to oxygenate fish farms or the like, whether the bubbles achieved are big or small is not all that important.

For its part, patent 4,048,072, that is designed for this same purpose, provides that the bubbles exit through an enveloping chamber lying between an external lattice and an internal concentric tube, such chamber being full of a grained product, such as pebbles.

In either patent, when air or gas is injected into the device or diffuser provided, the pressure at which this is effected must be the normal working pressure, in order for the air to move the water that shall have flooded the inside of the diffuser, which must naturally be immersed in a liquid medium, but will do so at the sector close to the air inlet up

to wherever the injected air pressure is equal to the internal water pressure, which means that bubbles will only exit through a sector close to the entrance to the diffuser rather than through the whole of the same. Now then, at an ingoing pressure in excess of the working pressure it will be possible to cause the liquid inside the diffuser to move, but it will never be possible to prevent the bubble leaving through the sector close to the air inlet from being oversized and carrying more kinetic energy, such kinetic energy causing the same to come together and hence to become even bigger. In short, these patents 4,118,447 and 4,048,072, cited as background, cannot afford microbubbles, with little kinetic energy, and it will therefore be impossible to prevent the said kinetic energy from being absorbed when they come together, whence the formation of oversize bubbles will not be prevented.

In short, both these US patents are able to homogenize a gas or air in the liquid or water, but are unable to provide high quality homogenization for want of sufficient dispersion that could be appropriate if they were applied to certain processes, namely electrolytic processes. These processes require the size of the bubbles to be as little as possible and equal at different depth levels, and at the same time a perfectly uniform distribution of the microbubbles throughout the mass. All of this is aimed at achieving a uniform distribution of the current, modifying the conductivity of the electrolyte as little as possible, and homogenizing the temperature thereof as much as possible. These characteristics are not attained with the devices or diffusers claimed in these patents 4,118,447 and 4,048,072, inasmuch as the diffusers claimed in the same do not yield microbubbles in the actual liquid, and furthermore upward travel is not slow, given the general configuration of the diffuser.

DESCRIPTION OF THE INVENTION

The system subject hereof has been designed to fully solve the above problems, affording in such respect a simple and efficient solution, relying in the first place on the fact that the installation will be structured with lattices rather than arranging the branches in series as in conventional installations, the said lattice arrangement being such that the porous diffusers are arranged in parallel thereby to avoid the problems posed by the above-mentioned series arrangement.

It has also been provided that the air will not exit directly through the porous diffusers, as is usually the case, and thus before reaching such porous diffusers, the air shall pass through a number of orifices provided in a concentric tube in the porous diffuser, which orifices lead into a common ducting, before reaching the actual porous diffuser,

to equalize the pressures. These concentric tubes naturally define a chamber that can never be filled with liquid, moreover ensuring a uniform air pressure.

On the other hand, the said concentric tube orifices linking the chamber defined in the tube with the common chamber provided before reaching the porous diffuser, are specifically arranged on the lower sector, thereby for the useful surface through which the bubbles exit to be located on the upper half of the porous diffuser, whereas approximately the lower half remains as a useless surface through which no bubbles will exit, this causing the said bubbles to rise through the liquid mass up to the latter's surface without coming together.

The section of the orifices on each main branch has also been provided to be greater than the sum of the surface of the above-mentioned calibrated or outlet orifices in order to cause overpressures in the conduits thereby to achieve a correct outlet of the air.

In consequence of the lattice arrangement of the various branches in the installation, the failure of a diffuser will not affect the rest of the network, inasmuch as these porous diffusers afford no resistance whatsoever to the passage of air, and therefore the slight head loss at the outlet would only be influenced by the calibrated lower orifices of the concentric tube provided in the porous diffusers, which tube will further comprise a plastic or like material and will not break.

It finally remains to be said that clogging of the said diffusers comes about when water enters through the diffuser up to the lower orifices, so that since the latter are very small and the through speed is very low, the clogged section will be the lower diffuser sector, viz. the useless sector in bubble production.

It shall have become clear hitherto in the description that the arrangement of the porous diffusers in parallel, forming lattices, resembles an electric layout where resistance is similar to charge loss, and therefore total charge loss will be equivalent to an element divided by the number of elements, and hence blowing pressure of the equipment compared with voltage for a same air passage, must be the lower blowing pressure.

DESCRIPTION OF THE DRAWINGS

In order to provide a fuller description and contribute to the complete understanding of the characteristics of this invention, a set of drawings is attached to the specification which, while purely illustrative and not fully comprehensive, shows the following:

Figure 1.- Is a diagrammatic view of the lattice arrangement of the porous diffusers provided in

a conventional plant for homogenization of a liquid mass.

Figure 2.- Is a cross-section perspective view of the lower half of a porous diffuser including the concentric tube provided with the calibrated orifices in the lower part thereof and leading into a common chamber.

Figure 3.- Is finally yet another cross-section in outline of what could be said to be the useful surface and useless surface of the porous diffuser for the outlet of bubbles.

PREFERRED EMBODIMENT OF THE INVENTION

These figures, and referring firstly to figure 1, show part of a general installation forming a lattice with branches (1) or fluid distribution conduits, with the porous diffusers (2) arranged in parallel, and the relevant communication orifices (3) provided on the main branches (1).

Figure 2 shows a cross-section of a porous diffuser (2), such comprising a tubular body (4), obviously made of porous material, inside which is concentrically arranged a tube (5) preferably made of plastic, such as PVC, the lower part of which is provided with a number of calibrated orifices (6) leading into a common and linear chamber (7) before reaching the actual body (4) of the general porous diffuser (2). The section of the orifices on each main branch must be greater than the sum of the surface of the outlet orifices (6) in order to cause overpressures in the conduits and for outlet of the air to be correct.

According to this structure, the air entering the chamber formed by the concentric tube (5) reaches the latter's orifices (6) and before arriving at the porous body or diffuser (4) enters a linear and common chamber (7) that, as aforesaid, joins all the orifices (6), thereby for the pressures to be equalized.

Since the air has little speed as it exits through the diffuser (4), distribution shall take place at the upper surface enclosed by the arch (8) in figure 3, whereas the lower surface enclosed by the arch (9) is a useless surface through which no bubbles shall exit, thereby to prevent the bubbles that could exit through the lower part from slipping over the lower contour of the actual diffuser and the said bubbles from coming together, which would obviously lead to a total lack of homogenization of the liquid mass.

Therefore, based upon the said diffuser, when immersed in a liquid, the latter shall pass into the tube (5) through the lower sector, this being where the orifices (7) are provided, until it reaches a certain height, which is when the pressures of the air or gas lying inside the actual tube (5) and of the water or liquid flooding the diffuser shall be balanced, and therefore the latter shall never be fully

flooded, as compared with the diffusers described in the US patents referred to as state of the art.

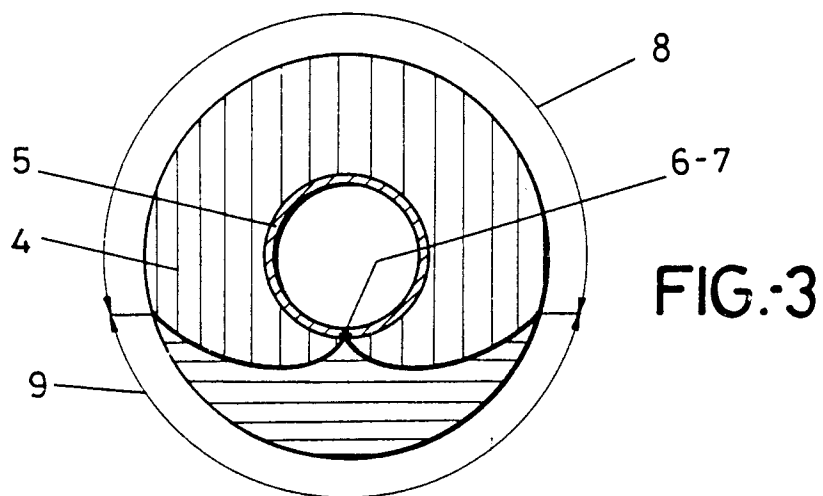
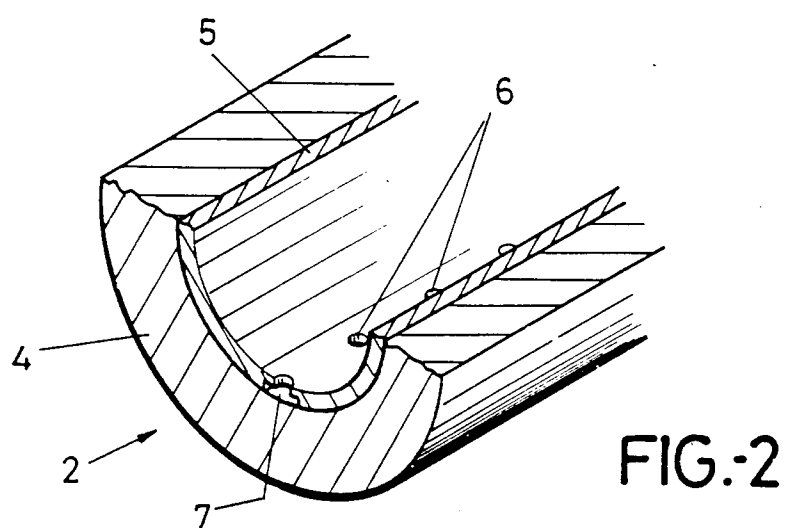
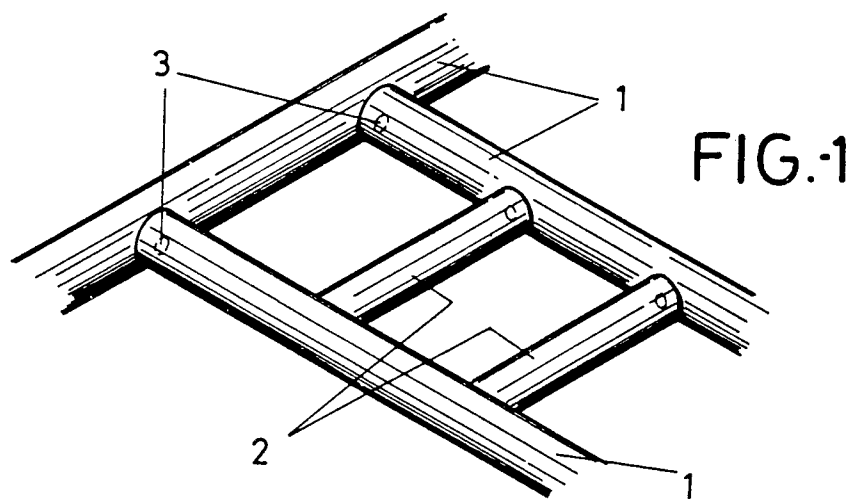
We feel that the device has now been sufficiently described for any expert in the art to have grasped the full scope of the invention and the advantages it offers.

The materials, shape, size and layout of the elements may be altered provided that this entails no modification of the essential features of the invention.

The terms used to describe the invention herein should be taken to have a broad rather than a restrictive meaning.

Claims

1. System for generating microbubbles in a liquid mass, based upon the use of porous diffusers (2) located on branches (1) in an installation that is to be used to homogenize a liquid mass by injecting air bubbles into the same, applicable primarily to electrolytic processes, gas transfers, water purification, fish farms and the like, essentially characterized in that the relevant porous diffusers (2) are arranged in parallel to form a lattice with the relevant branches (1) in the installation, each porous diffuser (2) comprising a porous tubular part (4) inside which is concentrically provided a plastic tube (5), the lower part of which is provided with calibrated orifices (6) that lead into a linear and common chamber (7) before reaching the actual porous diffuser body (4), the said concentric tube (5) having been provided to be fitted tightly inside the body (4) of porous material.
2. System for generating microbubbles in a liquid mass, as in claim 1, characterized in that the section of the orifices (3) on each main branch (1) in the installation is greater than the sum of the surface of the calibrated outlet orifices (6) provided in the concentric tube (5) in each porous diffuser (2).



INTERNATIONAL SEARCH REPORT

International Application No PCT/ES 92/00008

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁵ B 01 F 3/04		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁵	B 01 F	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT *		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
Y	US,A,3911068 (HAMILTON) 7 October 1975, see abstract; figures	1
Y	US,A,3279773 (SCHWARTZ) 18 October 1966, see figures	1
A	US,A,4960546 (THARP) 2 October 1990, see column 6, lines 29-38; figures	1
A	FR,A,1271718 (PELLEN) 7 August 1961, see column 1, last paragraph column 2, first paragraph; figures	2
A	DE,A,3744608 (SCHUBERT) 13 July 1989	
* Special categories of cited documents: ¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
21 April 1992 (21.04.92)	29 May 1992 (29.05.92)	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE		

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

ES 9200008
SA 55837

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 11/05/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3911068	07-10-75	None	
US-A- 3279773		None	
US-A- 4960546	02-10-90	None	
FR-A- 1271718		None	
DE-A- 3744608	13-07-89	None	