Aug. 7, 1934. W. GAVETT 1,969,644

AERATION OF FLUIDS

Filed April 16, 1932

Fig. 1.

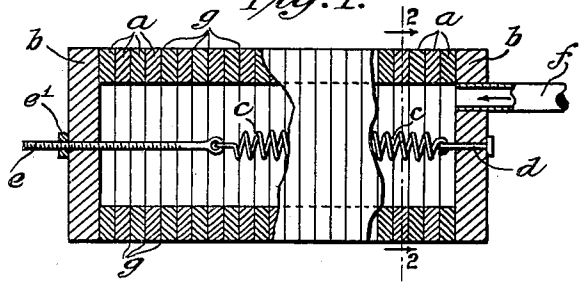


Fig. 2.

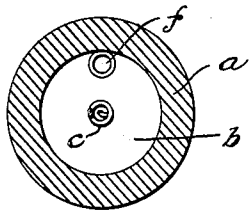


Fig. 3.

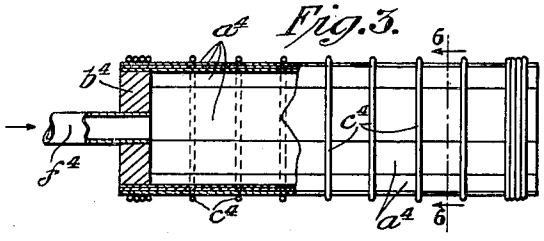


Fig. 4.

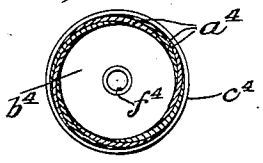
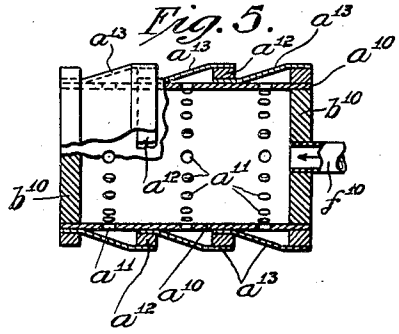


Fig. 5.



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AERATION OF FLUIDS

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2 Claims. (Cl. 261—124)

This invention is concerned with the introduction of air or gas into fluid for the purpose of effecting solution of the air or gas in the fluid into which it is introduced and otherwise for the purpose of effecting, for example, either a physical change or a chemical or biological reaction. While the invention has been developed with particular reference to the introduction of air into a liquid or semi-liquid mass, such as sewage, for example, and as a matter of convenience is described as an improvement in aeration, it will nevertheless be understood that the invention is capable of realization wherever it is desired to introduce either air or any other gaseous substance into a fluid, and more particularly into a liquid, in such manner that the air or gaseous substance shall be most completely and quickly taken up by the fluid and the desired result attained. It will be understood, therefore, that the entitling of the invention as an improvement in the aeration of fluids is adopted as a convenient expression and without admitting any restriction upon the scope of the invention other than that indicated in the accompanying claims and imposed by the prior art.

It is well understood, in the aeration of liquids, that the efficiency of the procedure is dependent largely upon the emission of the air or gas into the fluid in a state of subdivision as minute as practicable, due regard being had to the character of the fluid, the character of the gaseous body, the readiness with which the solution or reaction proceeds and the volume of fluid to be aerated. The subdivisions of the air, as will be understood, take the form of minute bubbles in the liquid and that solution proceeds generally in a measure determined by the minuteness of the bubbles. Experience has shown that it is difficult to form bubbles smaller than a certain minimum size, that the normal size of the bubbles, under given conditions, is determined by the surface tension, and that larger bubbles sometimes tend to subdivide while smaller bubbles sometimes tend to coalesce. It has been shown that under given conditions air emitted through an orifice one-thousandth of an inch in diameter produces bubbles one thirty-second of an inch in diameter and that in the aeration of water under given conditions the diameter of the bubbles lies somewhere between one-sixteenth of an inch and five thirty-seconds of an inch. Various efforts have been made to effect satisfactory aeration of liquids for various purposes. For example, in the separation of ore by flotation, the air is sometimes admitted through a fabric mat or bed of suitable fibres, which sometimes breaks through permitting the emission of air in large streams, sometimes becomes clogged, and sometimes deteriorates rapidly under the action of the substances held in suspension or in solution in the liquid. It has also been proposed to effect the aeration by the passage of the air through a perforated sheet or mat but such perforations sometimes become clogged, sometimes become unduly enlarged, and are not responsive to the conditions of pressure and flow. It has also been proposed to pass the air through a body of porous stone, either natural or artificial, but the pores sometimes become clogged more or less at different points with resultant inequality in aeration and such pores by reason of their tortuous character offer excessive resistance to the passage of the air or gas, requiring the same to be supplied under excessive pressure. It has also been proposed to form the bottom of the receptacle in which is placed the liquid to be aerated of a slab of wood cut across the grain, the air being forced through the natural pores of the wood, but this expedient is subject to the same difficulties in operation as are all of the devices in which the air is emitted through pores or small perforations separated one from another.

In the effort to overcome the objections to the expedients heretofore employed or proposed to be employed it has been found that the desired results, that is, the introduction of the air into the fluid in bubbles sufficiently minute to permit rapid absorption or solution or reaction and in volume sufficiently great to permit the operation to be carried on economically can be accomplished by permitting the passage of the air into the fluid through a relatively thin fissure which has substantial length but is of such a thinness as to be capillary in its action. The surfaces between which such capillary fissure, as it may be called, is formed are pressed together with a yielding pressure, whereby the fissure is responsive to the pressure under which the air is supplied so that regulation of the process of aeration can be accomplished either by regulation of the pressure under which the air is supplied or by regulation of the pressure with which the surfaces of the fissure are pressed toward each other, or by both. In accordance with the invention a vessel, adapted to be dipped into the liquid to be aerated, is provided with a fissure or fissures of substantial length but of such thinness as to be capillary in its action and is

further provided with means for introducing air under pressure into the chamber of the vessel. It will be obvious, particularly as this description proceeds that the vessel and its fissure or fissures may be formed in various ways and also that various means, in themselves yielding, may be provided for pressing together with a yielding pressure the surfaces between which each fissure is formed.

The invention will be more fully explained hereinafter with reference to the accompanying drawing in which it is illustrated, and in which:

Figure 1 is a view, partly in longitudinal section and partly in elevation, of one form of an aerator or diffusor in which the invention can be realized, the fissures being formed between laminæ which themselves form a chamber into which the air is introduced.

Figure 2 is a view in section on the plane indicated by the broken line 2—2 of Figure 1.

Figure 3 is a view similar to Figure 1, but showing a form of the device in which the fissures are formed by circumferentially overlapping laminæ.

Figure 4 is a view in section on the plane indicated by the broken line 3—3 of Figure 3.

Figure 5 is a view, partly in elevation and partly in longitudinal section, of a device in which several fissures are formed.

In the embodiment of the invention illustrated in Figures 1 and 2 the chamber of the vessel to which the air is supplied is formed by a plurality of annular laminæ a held between end plates b, b, the end plates being held together with a yielding pressure by a means in itself yielding, such as a spring c which may be anchored at one end to one of the plates b, as by a bolt d and at the other end may be connected to a threaded bolt e provided with a nut e^1 so that the yielding pressure of the laminæ against one another can be regulated. The air to be used in aeration may be supplied from any suitable source through a pipe f which communicates with the chamber formed within the laminæ. The laminæ are so formed as to their contacting surfaces that there are formed between successive laminæ fissures, indicated at g, through which the air supplied to the central chamber is permitted to pass into the liquid in which the device is, in the present instance, immersed. As the air passes through the thin, capillary fissures between the several laminæ it escapes into the surrounding liquid in such manner that it forms minute bubbles and it will be understood that with decrease of the yielding pressure with which the laminæ are pressed together or with increase of pressure under which air is supplied the fissures will open somewhat whereby it is possible to regulate the process of aeration, both as to the size of the individual bubbles and as to the aggregate volume of air which passes through the fissures in a given time. It will be understood that the means by which the laminæ are pressed together must be in itself yielding so that the fissures shall be at all times and instantly responsive to the varying conditions under which the apparatus is used.

In the embodiment of the invention shown in Figures 3 and 4 a cylindrical shell is formed of a series of circumferentially overlapping laminæ a^4 mounted on end plates b^4 and held together by rings c^4 which may be elastic. Air may be supplied through one of the end plates b^4 as by a pipe f^4. The fissures in this embodiment of the invention are formed between the circumferentially overlapping laminæ a^4 which by reason of their own formation are held together with yielding pressure so that the device responds to the regulated pressure of the air.

In the embodiment of the invention shown in Figure 5 a metal cylinder a^{10}, mounted on end plates b^{10}, is provided with several series of perforations a^{11}. Adjacent to each series of perforations, on the outside of the shell a^{10}, is secured a ring a^{12} and also secured to the shell a^{10} is a circumferential band or lamina a^{13} which forms a chamber between itself, the shell a^{10} and the ring a^{12} and forms between itself and the ring a^{12} a capillary, circumferential fissure through which the air supplied through the pipe f^{10} may escape. As the laminæ a^{13} are subjected to the pressure of air supplied to the chamber within the shell a^{10} the capillary fissures between the rings a^{12} and the laminæ a^{13} are responsive to the air pressure within the shell.

The operation of the several forms of the device will be readily understood without further explanation and it will be seen also that the invention may be embodied in various forms suited to the conditions of operation or the convenience of the maker.

I claim as my invention:

1. A vessel adapted to be dipped in liquid, means to introduce air under pressure into the vessel, the vessel having a capillary fissure to permit the passage of the air into the liquid in minute bubbles, and yielding means other than elasticity inherent in the walls of the vessel to press together the fissure forming surfaces with yielding pressure.

2. A vessel adapted to be dipped in liquid and having a series of laminæ which form capillary fissures between them, yielding means other than elasticity inherent in the walls of the vessel to hold the laminæ together with yielding pressure, and means to introduce air under pressure into the vessel.

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