Jan. 7, 1936. E. ÖMAN ET AL 2,027,115

METHOD AND APPARATUS FOR CONCENTRATING BRISKLY FOAMING SOLUTIONS

Filed Feb. 21, 1931

Fig. 1

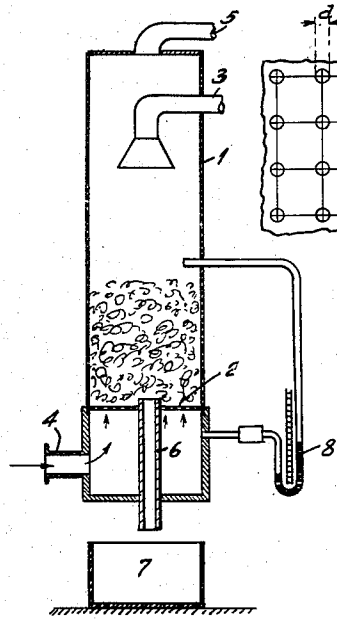


Fig. 2

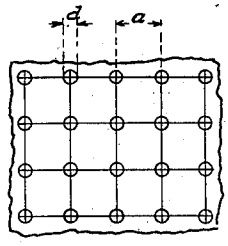


Fig. 3

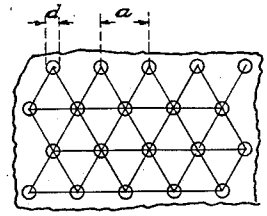


Fig. 4

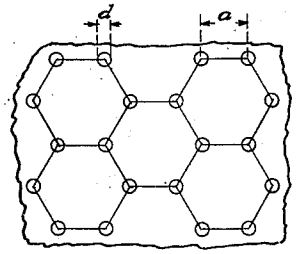


Fig. 8

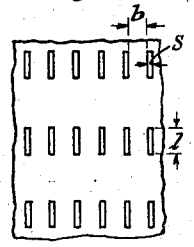


Fig. 9

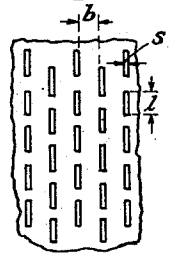


Fig. 10

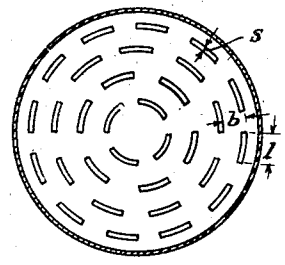


Fig. 5

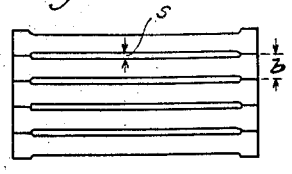


Fig. 6

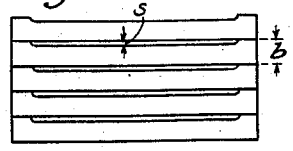
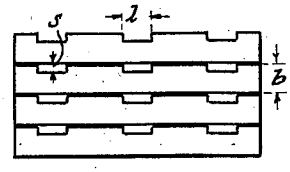


Fig. 7



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2,027,115

METHOD AND APPARATUS FOR CONCENTRATING BRISKLY FOAMING SOLUTIONS

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In Sweden February 21, 1930

5 Claims. (Cl. 159—16)

The present invention refers to apparatus for the concentration of liquids in which the gas is forced through a liquid layer on a perforated plate in order to bring about intimate contact between the gas and the liquid.

When water is evaporated from black liquor, for instance, that is to say from liquor obtained in the boiling of sulphate- and sodium cellulose, or from sulphite lye, with the aid of air, hot gases (flue gases) and the like, the foaming then produced, when the gases are pressed through the liquor, is apt to become so brisk as to render the whole operation impossible. Different kinds of liquor behave quite differently in this process. For example, fresh black liquor foams much more powerfully than such that has been stored for some time, which is believed to depend on the fact that in the latter case the resin-soap has had an opportunity to separate, or at least to condense into larger particles.

With an increasing concentration of the black liquor the tendency of the same toward foaming is reduced.

Obviously, the fall of pressure when the gas is pressed through the layer of liquor and through the bubble layer depends, inter alia, on the height of the bubble layer—with an increasing height of this layer the gas resistance becomes greater. As the power consumption increases with an increasing fall of pressure, it is evidently desirable to be able to keep the bubble layer as low as possible, but not so low but that complete balance is maintained between the temperature of the liquid and the saturation temperature of the gas.

In order to obtain a yield as large as possible with an apparatus of a certain bottom area, it is desirable to bring forth a volume of gas as large as possible per square meter of the bottom area, without the fall of pressure becoming great. This is attained, first, by the free surface per square meter of the bottom area being as large as possible, and, second, by making the holes or apertures as great as possible, or, if slit-like apertures are being used, by making the width thereof as great as possible. The area of each hole cannot be made too large, however, as balance is not then obtained between the gas and the liquid. This will also be the case if the width of the slits is increased too much. With a certain size of the holes the free surface can evidently be increased if the distance between the holes (equal to the pitch) is reduced. It is then found, however, that if the distance between the holes is reduced too much, the bubble layer and thus the fall of pressure will increase. If the distance between the holes is reduced still more, a powerful foaming will set in, and the method is rendered impossible.

In trials performed it has been found that, in order to attain a good result, it is not possible to use holes of a smaller diameter than 1 *mm.*, that is to say a surface of about 0.8 square mm., preferably not smaller than 2.5 to 3 mm., that is to say a surface of 5 to 7 sq. mm., and with the use of slits these cannot be narrower than 0.75 mm. preferably not narrower than 1.5 to 2.0 mm.

With a high concentration of the black liquor the lower limit is applicable, whereas, when the concentration of the liquor is low, the limit is at the greater limit values.

If holes are used it is possible in certain cases to go as far as to a diameter of 12 mm. that is to say to a surface of about 1 sq. cm.

If slits are used one may go as far as to a width of the slits of 12 mm.

It is of importance that the holes are not too small or that the width of the slits is not too small, as the work is then rendered entirely impossible by reason of the formation of foam. This is of greater importance than that the holes and slits should not be too large.

It is of importance that the pitch, that is to say the distance between the centers of the holes, or the distance between the center lines of the slits, shall not be too small, as violent foaming is then apt to set in. For round holes, the pitch must be at least 2.5, preferably greater than 2.8 times the diameter, and for slits the pitch must be at least 2.5 times the width of the slits.

As an example, the following may be mentioned:

(Black liquor of 13 to 14° Bé. (at 50° C.) and a trial temperature of 55°.)

Trial	Pitch in mm.	Relative free area	Ratio between pitch and hole diameter	Fall of pressure in mm. water column	Bubble layer in cm.
1	25	1.0	3.6	45	10
2	22.5	1.2	3.2	40	15
3	20	1.6	2.85	52	25
4	17.5	2.0	2.5	about 90	>60

The quantity of air was in all four cases 500 liters per minute per sq. dm. of the bottom area.

That the fall of pressure is lower in trial 2 than in trial 1 depends on the fact that in the first case the free surface is larger than in the second case, the free surfaces being related to each other as 1.0:1.2 for these two trials. For

all four trials the free surfaces are related to each other as 1.0:1.2:1.6:2.0, the ratio between the pitch and the hole diameter being 3.6; 3.2; 2.85 and 2.5 respectively.

From this it will be seen that in trial 4 the free area is twice as large as in trial 1; in the first case, however, the fall of pressure will be twice as great as in the latter case, depending on the fact that the height of the bubble layer has been considerably increased. It should be mentioned, in addition, that in trial 4 the formation of foam was so powerful as to render a technical use of this bottom impossible.

The invention is illustrated in the accompanying drawing in which Fig. 1 shows an evaporating apparatus, whereas Figs. 2–10 represent various embodiments of a strainer bottom adapted for the apparatus.

In Fig. 1, the vessel of the apparatus is designated by 1 and the perforated plate thereof by 2, to which vessel the black liquor is supplied from above through the conduit 3. The gas is supplied through the intake 4 and escapes in a saturated state through the outtake 5. The concentrated black liquor flows off through a pipe 6 to a lower vessel 7. The pipe 6 extends somewhat above the bottom 2. A water pressure gauge 8 is arranged for measuring the fall of pressure (mm. water column) in the bottom including the bubble layer.

Figs. 2–4 show various arrangements of circular perforations in the plate, *d* denoting the hole diameter and *a* the pitch.

Figs. 5–10 show some arrangements of slits in the perforated plate, *s* designating the width of the slits, *b* the pitch, and *l* the length of the slits.

A condition for the circular holes or for holes of other shapes, as well as for the slits, is that the limit values in regard to diameter and area respectively, and width and pitch as set forth hereinbefore must be maintained.

What we claim is:—

1. Apparatus for concentrating briskly foaming liquids without excessive foaming and without the necessity of employing special foam killing or breaking means which includes, in combination with a container, means for introducing and withdrawing the liquid to be treated and means for introducing and withdrawing the gaseous medium to be brought into intimate contact with said liquid, a substantially horizontal perforated plate in said container on which a layer of said liquid is maintained and beneath which said gaseous medium is introduced under pressure, said perforated plate being provided with a multiplicity of apertures the area of each of which is at least 0.8 square mm. and not more than 1.0 square cm. and whose pitch is at least 2.8 times the width of the aperture, whereby a relatively large volume of gaseous medium may be forced through said liquid without use of relatively high pressure and without generation of an excessive body of foam over said liquid.

2. Apparatus for concentrating briskly foaming liquids without excessive foaming and without the necessity of employing special foam killing or breaking means which includes, in combination with a container, means for introducing and withdrawing the liquid to be treated and means for introducing and withdrawing the gaseous medium to be brought into intimate contact with said liquid, a substantially horizontal perforated plate in said container on which a layer of said liquid is maintained and beneath which said gaseous medium is introduced under pressure, said perforated plate containing a multiplicity of circular apertures the diameter of each of which is at least 1.0 mm. and not more than 12.0 mm. and whose pitch is at least 2.8 mm., whereby a relatively large volume of gaseous medium may be forced through said liquid without use of relatively high pressure and without generation of an excessive body of foam over said liquid.

3. Apparatus for concentrating briskly foaming liquids without excessive foaming and without the necessity of employing special foam killing or breaking means which includes, in combination with a container, means for introducing and withdrawing the liquid to be treated and means for introducing and withdrawing the gaseous medium to be brought into intimate contact with said liquid, a substantially horizontal perforated plate in said container on which a layer of said liquid is maintained and beneath which said gaseous medium is introduced under pressure, said perforated plate containing a multiplicity of slit-like apertures the width of each of which is at least 0.75 mm. and not more than 12.0 mm. and whose pitch is at least 2.5 times the width, whereby a relatively large volume of gaseous medium may be forced through said liquid without use of relatively high pressure and without generation of an excessive body of foam over said liquid.

4. The method of concentrating briskly foaming liquids while avoiding excessive foaming thereof which consists of the steps of passing a current of gas under pressure through a layer of said liquid and dividing the current of gas into a multiplicity of streams substantially uniformly distributed with respect to said layer, said streams having individual cross-sectional areas of at least 0.8 square mm. and not more than 1.0 square cm. and pitches at least 2.8 times the width of said streams.

5. The method of concentrating briskly foaming liquids while avoiding excessive foaming thereof which consists of the steps of passing a current of gas under pressure through a layer of said liquid and dividing the current of gas into a multiplicity of streams substantially uniformly distributed with respect to said layer, said streams having an individual width of at least 1.5 mm. and not more than 12.0 mm. and pitches at least 2.5 times the width of each stream.

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