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METHOD FOR BREAKING FOAM

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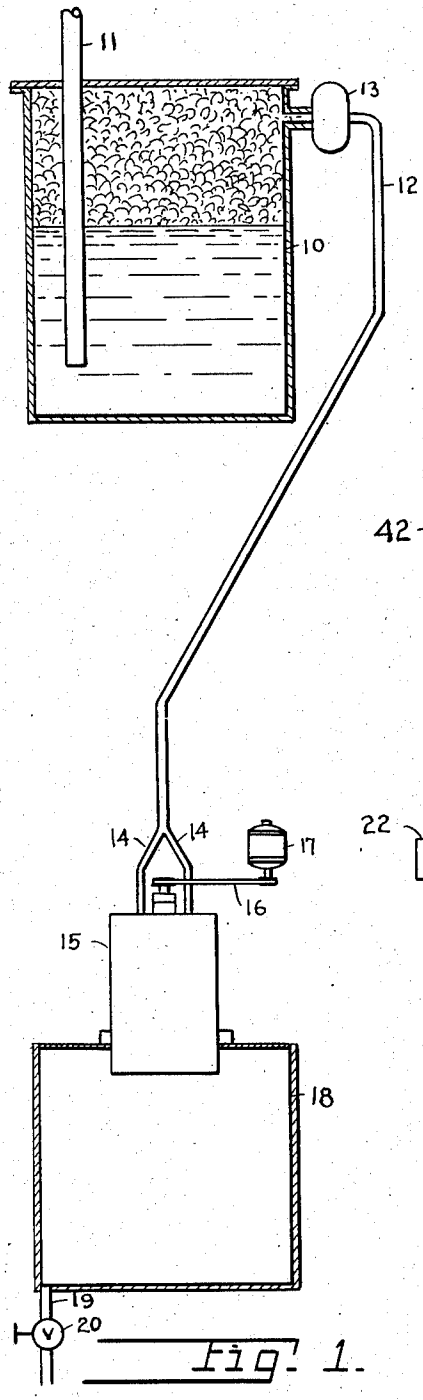


Fig. 1.

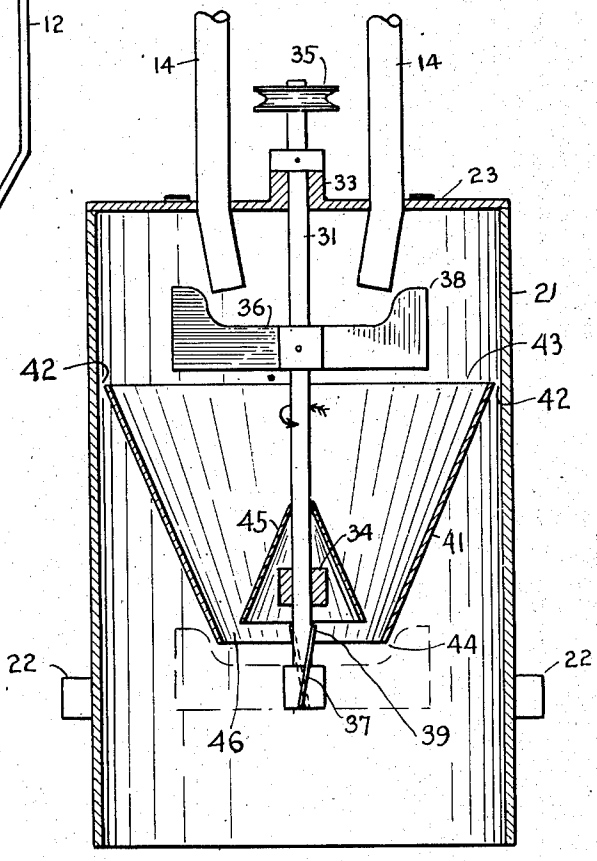


Fig. 2.

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METHOD FOR BREAKING FOAM

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6 Claims. (Cl. 252—321)

This invention relates to methods and apparatus for breaking foam. It has a particular utility in connection with the sulphate process of pulping resinous woods. In that process resin soaps are formed which cause large quantities of foam on the black liquor. This foam is very stable and its disposal constitutes a major problem in pulping some types of wood. It is particularly abundant and traublesome where vacuum type filters are used to separate the pulp from the liquor since large quantities of air are sucked in with the liquor by these devices. The foam further carries most of the resins as well as other valuable chemicals, which are lost unless the foam is broken and converted to a liquid which can be handled in the recovery plant.

The primary object of this invention is thus the provision of an easily operated and reliable method of converting stubborn and stable types of foam into a liquid which can be handled conveniently.

An allied object is the provision of an apparatus for this purpose which shall be simple, effective, small in size, and convenient in handling and in operation.

Other detailed objects of the invention will be apparent from the following description.

I have found that foam, even of the stable and persistent type described, can be substantially completely broken by, preferably, separating it from the parent liquid and then subjecting it in the form of a relatively small stream, projected through an otherwise substantially foam-free atmosphere, to impact against a substantially foam-free surface and then throwing it through an otherwise substantially foam-free atmosphere for a material distance, to allow the component parts of the foam to separate, against an advantageously imperforate and substantially foam-free surface. In order to assure complete breaking of all of the foam I find it advantageous to separate any residual unbroken foam from the liquor resulting from the breaking of the major part of the foam, and to subject this residual foam to a breaking operation like that already described. I have found that by this process I can convert foam which otherwise constitutes only a troublesome waste product, into a commercially foam-free liquor which can be conveniently handled for the recovery of valuable chemicals and by-products.

This process can, I find, be conveniently carried out by the use of two paddles which rotate rapidly one above the other on a substantially vertical axis in a cylindrical housing, the inside diameter of which is materially larger than the diameter of the paddles. One or more pipes or spouts, whose diameter is small relative to the radius of the paddles, introduce one or more streams of the foam downwardly into the plane of rotation of the upper paddle, in a zone intermediate its axis and the circumference of its path. Just below this paddle and above the lower paddle is a funnel shaped member whose upper rim is spaced a small and substantially uniform distance from the inside wall of the housing. Liquid can thus run down the housing wall while any residual foam is caught by the funnel and directed into the path of the lower paddle in a zone between its axis and the circumference of its path. The liquid resulting from the breaking of the foam flows from the bottom of the housing into a suitable container below.

The invention will be further described with reference to the accompanying drawing illustrating one embodiment thereof and in which:

Fig. 1 is a diagrammatic representation of the arrangement of a system for disposal of foam.

Fig. 2 is a cross sectional view of the foam breaking apparatus per se.

Referring to the drawing, foamy liquor, which may be black liquor from the sulphate pulping process, is introduced into a tank 10 through a pipe 11. From this tank the foam, with only its entrained liquid, flows out through a pipe 12 by virtue of pressure in tank 10. If this pressure is insufficient, a pump 13, advantageously a positive pressure pump such as a gear pump, may be provided in pipe 12. Branches 14 of pipe 12 deliver foam to the foam breaker 15, which may be driven by a belt 16 and motor 17. There the foam is converted to liquid which flows into a tank 18 from which it may be withdrawn through a pipe 19 under control of a valve 20, and passed if desired to a recovery plant where its chemical content may be recovered.

The foam breaking devices themselves are shown in detail in Fig. 2. A cylindrical housing 21 is provided with external support brackets 22 and a suitably hinged cover 23. Mounted for rotation within housing 21 is a shaft 31 carried substantially coaxially with housing 21 by bearings 33 and 34, and carrying a pulley 35 by which it may be driven by belt 16 and motor 17. Within housing 21, paddles 36 and 37 are fixedly mounted on shaft 31. The diameter of these paddles, i. e., the diameter of their disc-shaped paths, is materially smaller than the internal diameter of housing 21 thus leaving an ample clearance around paddles 36 and 37. The blades of these

paddles advantageously have a slight pitch, as illustrated in Fig. 2, in a direction which tends to impel the foam downward. This aids in maintaining continuity of flow through the machine and tends to prevent foam from being thrown upward into the space above the paddle where it otherwise might tend to accumulate at a location where a foam-free atmosphere is desired, and thus impair the efficiency of the device. The foam inlet pipes 14 direct the foam downwardly through the plane of rotation of upper paddle 36. Foam inlet pipes 14 should be small in diameter relative to the radius of paddle 36, and should not be so great in number, with reference to the rate of flow of foam through them, that paddle 36 is compelled to operate in an atmosphere of foam and thereby to largely lose its effectiveness. They are advantageously equal in number and distribution to the number of radial blades in paddle 36 in order that the impact load may be more perfectly balanced. The paddle 36 may advantageously have upwardly widened ends 38 which extend above the outlets of pipes 14 so that any foam which may be deflected horizontally will be struck and broken before passing beyond the reach of the paddle.

Below paddle 36 is a funnel shaped member 41 mounted substantially coaxially within housing 21 but preferably leaving a small and substantially uniform clearance 42 between its upper rim 43 and the inner surface of housing 21. This clearance allows liquid which results from breaking of the foam, to run down the walls of housing 21 while any residual foam is deflected into the funnel 41. The outlet 44 of funnel 41 is disposed immediately above the lower paddle 37. Advantageously a small cone 45 surrounds shaft 31 at the bottom of funnel 41 and provides an annular outlet 46 at the bottom of funnel 41, which delivers the residual foam to paddle 37 in a zone intermediate its axis of rotation and the circumference of its path. The paddle 37 advantageously also has upwardly widened ends 39, which extend above the mouth 44 of funnel 41 (as shown by the broken lines which indicate the path of paddle 37), as and for the same reason that the ends 38 of paddle 36 extend above the outlets of pipes 14.

The operation of the device is as follows: The shaft 31 with paddles 36 and 37 is rotated rapidly by the motor 17. Foam, with only its entrained liquid, is introduced in a downward direction through pipes 14 at a velocity so related to the rate of rotation of paddles 36 and 37 that the undeflected foam does not pass through the path of the paddle before being struck by the next blade, so that impact against all undeflected parts of the foam is assured. This initial impact is thought to break most of the foam. The resulting liquid together with any unbroken foam is thrown by centrifugal force outward, off of the paddles, through the air space where the component parts are thought to separate, and against the walls of housing 21, where most of the remaining foam appears to be broken. The liquid resulting from breaking of the foam runs down the walls through the narrow annular space 42 while any residual foam is caught in funnel 41 and directed downward through annular space 46 into the path of the lower paddle 37 which functions in the manner already described with reference to paddle 36.

While it is possible, on the one hand, to shorten the device by omitting the lower paddle 37, or, on the other hand to lengthen the device and provide additional paddles, I find that in practice the use of a second paddle 37 is justifiable as a safety measure in case the foam is not completely broken by the first paddle 36, but that these two stages are ordinarily ample to break the most stubborn types of foam on which I have so far used the device, so that additional stages are in general not necessary.

It should be noted that in order to break the foam, instead of rendering it finer and more stable by the beating action, I provide that the housing is filled with air rather than foam, that except for the relatively small streams of foam, the paddles operate in a substantially foam-free atmosphere, and that furthermore the surfaces of the paddles and the walls of the housing are maintained substantially free from the presence of foam which would cushion the impact and hinder breaking of the foam.

In one example of successful foam breaking, a device similar to that illustrated in Fig. 2 was used. The housing 21 was about 20 inches in diameter and 30 inches long. The paddles 36 and 37 were each composed of two diametrically opposite blades extending 6 inches from the center of the shaft 31. The width of each was 2 inches at the center and 4 inches at the widened ends 38 and 39. The blades were pitched at an angle of approximately 10 degrees with the axis of shaft 31 and were rotated at a speed of about 1150 R. P. M. The funnel 41 was approximately 12 inches in height while the clearance 42 was somewhat under ¼ inch. The annular outlet 46 of funnel 41 was about 6 inches inside and 8 inches outside diameter. There were two 1½ inch inlet pipes 14 set to deliver streams of foam into the path of paddle 36 at distances of about 3½ inches from the axis of shaft 31. Foam was thus introduced to the device at a rate of about 90 gallons per minute, and substantially foam-free liquid flowed from the bottom of the device at a rate between 1 and 5 gallons per minute, depending on the composition of the foam. A troublesome, difficultly-disposable residue was thereby converted into a form which could easily be handled for the recovery of the valuable by-products contained therein.

I claim:

1. Method of breaking foam which comprises projecting a stream, of relatively small cross sectional area, of foam through an otherwise substantially foam-free atmosphere into the path of rotation of a rapidly rotating paddle at a rate to assure impact against all parts of the foam which are undeflected in their passage through said path, and throwing the broken with the unbroken foam by centrifugal force through a material distance against an imperforate surface.

2. Method of breaking foam formed on a solution of resin soap, which comprises separating foam from unfoamed liquor, projecting a stream of relatively small cross sectional area, of the foam in a downward direction through the path of rotation of a rapidly rotating paddle, and throwing it by centrifugal force through a material distance against an imperforate surface, separating the residual foam from the liquor resulting from the breaking of a part of the foam, directing the residual foam into the path of rotation of a rapidly rotating paddle, and throwing it by centrifugal force against an imperforate surface.

3. Method of breaking foam which is formed on black liquor from the sulphate process of pulping resinous woods, in order to facilitate the re-

covery of the chemicals in the foam, which comprises separating the foam from the liquor, then in an otherwise substantially foam-free atmosphere: subjecting the foam to impact against a substantially imperforate surface by projecting a stream of relatively small cross sectional area, of foam in a downward direction through the path of rotation of a rapidly rotating paddle; and throwing the broken with the unbroken foam by centrifugal force through a material distance against a substantially imperforate surface.

4. Method of breaking foam produced on black liquor from the sulphate process of pulping resinous woods by the use of a vacuum filter, in order to facilitate the recovery of the chemicals in the foam, which comprises separating the foam from the liquor, then in an otherwise substantially foam-free atmosphere: subjecting the foam to impact against a substantially imperforate surface by projecting a stream, of relatively small cross sectional area, of the foam in a downward direction through the path of rotation of a rapidly rotating paddle; throwing the broken with the unbroken foam by centrifugal force against a substantially imperforate surface; separating the residual foam from the liquor resulting from the breaking of a part of the foam; subjecting this residual foam to impact against a substantially imperforate surface by feeding it into the path of rotation of a rapidly rotating paddle, and throwing the broken and unbroken portions of this residual foam by centrifugal force against a substantially imperforate surface.

5. Method of claim 4 in which the foam is thrown by centrifugal force through a material distance to allow the component parts of the foam to separate before striking the surface.

6. The method of claim 1 in which the foam is impelled in a downward direction by said impact.

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