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(54) **An agitation tank**

Rührertank

Réservoir d'agitation

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Description

[0001] The present invention relates to an agitation tank.

[0002] In fermentation or culturing processes, the fermenting liquids and culturing liquids are very prone to foam. Agitation foam causes foam during the process, and the foam often impairs operability of the process. In order to inhibit such foaming and to extinguish such foam, addition of anti-foaming agents such as silicone is generally adopted. The use of such anti-foaming agents, however, not only requires significant cost, but also poses a risk adversely affecting the fermentation and culturing processes, because these anti-foaming agents are, in themselves, foreign substances to the liquids. In addition, the anti-foaming agents are often included as impurities in the product until the product is degraded. It requires additional labor to remove them from the product. Furthermore, they contaminate waste liquid and impede a treatment of waste liquid. Accordingly, addition of anti-foaming agents is not desirable and should be controlled as little as possible.

[0003] Moreover, attempts have been made to carry out defoaming by a mechanical means which is to suppress the foam by shearing force by rotating a disk in a foam layer on the surface of the liquid or rotating a frusto-conical tube with allowing the lower opening of the larger diameter to be in the foam layer. However, such means requires a great power and besides, the foam is often merely subdivided and is not extinguished.

[0004] The inner wall surface of an agitating tank is contaminated owing to microorganisms or solid raw materials or products deposited thereon. This often causes decrease of reaction yield or reduction of heat transfer coefficient.

[0005] In this case, it is substantially impossible to clean the inner wall surface of agitating tank to remove the extraneous matters from the inner wall surface without stopping the operation in the agitating tank.

[0006] When jackets, coiled hoses and calandrias are provided on the outer wall surface and in the agitation tank as heating and cooling apparatuses, the liquid in the agitation tank reduces, for example, by evaporation and liquid level lowers with lapse of time. As a result, the heat transfer area of the heating and cooling apparatuses cannot be effectively utilized.

[0007] Supply of fresh liquid is only the means to increase and recover the reduced heat transfer area. However, supply of fresh liquid results in abrupt change of the composition of the liquid and requires change in operational conditions and furthermore, quality of product changes. Therefore, this means cannot be practically employed. Accordingly, practically applicable means to solve the defect that the heat transfer area cannot be effectively used has not yet been found.

[0008] DE-A-1658115, discloses an apparatus to introduce gases into liquids near the liquid level by liquid-transporting elements which throw liquid outwardly

above the liquid level. Said liquid-transporting elements protrude only partially with their lower suction end into the liquid with the purpose to suction in a mixture of liquid and gas. The mixture of liquid and gas which exits from the upper liquid-discharging end is thrown against a baffle plate which can be adjusted in its height and its inclination angle.

[0009] Preamble of appended claim 1 starts from DE-A 196 36 14. This document discloses an apparatus for aerating liquids, especially water and waste water. The apparatus comprises a conveying element located at the surface of a liquid, being movable around a vertical axis and having channels being formed concentrically to its rotating axis and extending upwardly and outwardly and being formed by continuous tubes with the section of any shape but having the same sectional area along the whole length. There shall be performed a roughening and therefore increasing of the surface of the liquid to improve its aerating, an introduction of gas bubbles into liquid and an agitating of all parts of the liquid to hinder any deposition of unsolved materials.

[0010] It is an object of the invention to provide a solution for the problem that the inner wall surface of an agitation tank has a tendency to be contaminated by micro-organisms or solid raw materials or other products deposited thereon. This often causes decrease of reaction yield or reduction of heat-transfer coefficient.

[0011] A solution of this object is achieved by an agitation tank according to claim 1. With the invention an agitation tank is provided, the inner wall of which is efficiently and permanently cleaned as long as the liquid transporting means transport liquid. Furthermore the heat exchange surface is being effectively used.

[0012] Subclaims 2 and 3 are directed towards advantageous embodiments of the inventive agitation tank having only one circumferential liquid transporting means in form of a cone body.

[0013] The inventors achieved the present invention after conducting elaborate researches regarding agitation blades and methods of agitation, which, overcoming by mere mechanical agitation the drawbacks in conventional defoaming by agitation and the drawbacks such as contamination and reduction in heat transfer area of the inner wall surface of agitation tank and the surface of heating and cooling apparatuses can clean the inner wall surface of agitation tank and the surface of heating and cooling apparatuses, can inhibit the reduction of heat transfer area of the inner wall surface of agitation tank and heating and cooling apparatuses.

[0014] The invention will be explained in the following by way of example and referring to the drawings, in which

Fig. 1 is a plan view of the agitator blade used in the present invention.

Fig. 2 is a side view of the agitator blade used in the present invention.

Fig. 3 is a longitudinal sectional view of an agitation tank in which the agitator blade shown in Figs. 1 and 2 is used.

Fig. 4 is a plan view of the mounting frame of the agitator blade used in the present invention.

Fig. 5 shows a spray shower type tube body which is the liquid transporting means of the present invention and (a) and (b) are a side view and a plan view, respectively.

Fig. 6 shows a spray shower type tube body which is the liquid transporting means used in the present invention, and (a) and (b) are a side view and an underside view, respectively.

Fig. 7 shows a spray shower type tube body which is the liquid transporting means used in the present invention, and (a) and (b) are a side view and an underside view, respectively.

Fig. 8 shows a spray type tube body which is the liquid transporting means used in the present invention, and (a) and (b) are a side view and a bottom view, respectively.

Fig. 9 show a gutter body which is the liquid transporting means used in the present invention, and (a), (b) and (c) are an oblique view, a side view and a plan view, respectively.

Fig. 10 shows a plate body which is the liquid transporting means used in the present invention and (a), (b) and (c) are an oblique view, a side view and a plan view, respectively and (d) and (e) are an oblique view and a plan view of a modified plate body, respectively.

Fig. 11 shows the agitator blade used in the present invention attached slidably to the agitator shaft, and (a) is a plan view and (b) is a sectional view taken along the line A-A.

Fig. 12 shows the agitator blade used in the present invention where the tube body which is the liquid transporting means is attached to the agitation shaft through a mounting frame at an angle of 0° to the radial direction of the rotating plane, and (a) is a plan view of the agitator blade and (b) is a sectional view of the agitator blade shown in (a); taken along the line B-B.

Fig. 13 shows the agitator blade used in the present invention where the liquid transporting means is a hollow truncated cone body, and (a) is a plan view of the agitator blade and (b) is a sectional view of the agitator blade shown in a, taken along the line

C-C.

Fig. 14 shows the agitator blade used in the present invention where the liquid transporting means comprises two hollow truncated cone bodies, and (a) is a plan view of the agitator blade and (b) is a sectional view of the agitator blade shown in (a), taken along the line D-D.

[0015] The mounting frame is designed to mount the agitator blade on an agitator shaft and to hold one or more liquid transporting means. The mounting frame may be formed of either rods, square bars, shaped steels, plates provided with many perforations (sometimes referred to as perforated plates hereinafter) or non-perforated plates. These non-perforated plates and perforated plates are preferably provided at the agitator shaft so as to reduce fluid resistance as much as possible when rotated in liquid.

[0016] The long and narrow liquid transporting means are arranged either perpendicular or inclined to the mounting frame. In operation, the liquid transporting means become almost parallel to the rotating axis in the former case, while inclined in the latter case. In practice, the inclined arrangement is preferred.

[0017] The long and narrow liquid transporting means are usually arranged so that the intake opening is allowed to go ahead in rotation of the agitator. When a plurality of the long and narrow liquid transporting means are arranged inclined, the angles of inclination may be the same or different.

[0018] When the inclined arrangement is adopted, the angle of inclination of the long and narrow liquid transporting means (the angle between the rotating axis and the long and narrow liquid transporting means) may vary depending on the viscosity of the liquid, the size of the long and narrow liquid transporting means, etc. and is not able to be generally fixed to a given angle. The range from about $15-75^\circ$ is preferable in practice.

[0019] A plurality of long and narrow liquid transporting means arranged on the mounting frame are generally same in size, shape and type, but may be different.

[0020] The long and narrow liquid transporting means can be rotatably attached to the mounting frame so as to be able to freely adjust the angle to the rotating axis and the angle to the radial direction of rotating plane.

[0021] In case the long and narrow liquid transporting means is a bottomless and hollow truncated cone body (sometimes referred to as hollow truncated cone body hereinafter), this hollow truncated cone body is attached to the agitation shaft through the mounting frame with allowing the longer axis to substantially coincide with the longer axis of the agitating axis.

[0022] One hollow truncated cone body may be used as the liquid transporting means. Alternatively, a plurality of hollow truncated cone bodies differing in diameter may be cocentrally arranged. Moreover, a baffle may be provided at the inner wall surface of the hollow trun-

cated cone body along the slant of the wall or in the inclined direction.

[0023] In the case of liquid transporting means of hollow truncated cone body, the opening corresponding to the bottom of the truncated cone is the opening of the liquid transporting means.

[0024] The space formed by side walls of a plurality of the hollow truncated cone bodies is a channel of liquid when the hollow truncated cone bodies are rotated.

[0025] The hollow truncated cone body is used in the truncated cone form or reverse truncated cone form by using the opening of smaller diameter as upper or lower opening depending on the purposes of use.

[0026] In this hollow truncated cone body, the opening of smaller diameter and the opening of larger diameter are respectively the intake opening and the discharge opening irrespective of rotating direction in use of the agitator blade.

[0027] In the present invention, the liquid in the agitation tank is transferred through the liquid transporting means according to Bernoulli's theorem and/or centrifugal force by rotating the liquid transporting means.

[0028] The agitator blade used in the present invention is rigidly fixed to the agitator shaft by means of the mounting frame or slidably fitted to the shaft.

[0029] Any fixing may be employed, for example, sealing, screwing, welding or bonding.

[0030] For slidably fitting the agitator blade, for example, grooves, projections or projected lines are provided on the surface of the agitator shaft along the longer axis and projections, projected lines or grooves which can be fitted with said grooves, projections or projected lines to slide the agitator blade are provided on the mounting frame.

[0031] The mounting frame slidably fitted to the agitator shaft can be automatically or manually moved. For example, floats are provided at the mounting frame and floated on the surface of liquid so that the mounting frame can be moved in correspondence to the rising and falling of the surface of liquid in the tank. Alternatively, the mounting frame can be moved up and down by remote handling outside the tank and stopped at a desired position. The mounting frame can be manually moved up and down by suspending the mounting frame by a wire connected to outside and stretching or relaxing the wire outside the tank.

[0032] The above floats can also serve as the mounting frame. The floats preferably have such a shape and structure as reducing fluid resistance as much as possible in agitation.

[0033] The rotating speed of the agitator blade is adequately selected according to kinds of liquid, the degree of foamability and the degree of foaming, preferably not smaller than about 2.5 m/sec as a speed of the tip of the blade in practice.

[0034] In order to discharge the liquid in the tank from the upper opening of the long and narrow liquid transporting means into the space above the surface of liquid,

when said long and narrow liquid transporting means is provided, for example, at substantially 90° to the radius of rotating plane, the upper opening and the lower opening are located in the space above the surface of liquid and in the liquid in the agitation tank, respectively and the agitator blade is rotated with allowing the lower opening to go ahead to scoop up the liquid in the tank from the lower opening of the liquid transporting means, thereby to discharge the liquid from the upper opening of the liquid transporting means.

[0035] When the long and narrow liquid transporting means is provided, for example, at 0° to the radius of rotating plane, the opening on circumferential side of the rotating plane is exposed above the surface of liquid and is used as an upper opening. Thus, irrespective of whether the long and narrow liquid transporting means is rotated clockwise or counterclockwise in respect to the rotating axis, the liquid in the tank can be scoop up into the liquid transporting means from the lower opening on the central side of the rotating plane and can be discharged from the upper opening into the space above the surface of the liquid.

[0036] When the liquid transporting means is a hollow truncated cone body, this can be used in the form of reverse truncated cone and the opening of larger diameter may be exposed from the surface of liquid as an upper opening. The liquid discharged from this upper opening is sprayed.

[0037] Furthermore, the liquid discharged from the upper opening is sprayed to the inner wall surface of the agitation tank and to the surface of heating-cooling apparatuses and is allowed to fall along these surfaces whereby the inner wall surface of the tank and the surface of heating cooling apparatuses are cleaned and the heat transfer area can be effectively used. This method is usually applied to unfoamable liquid, but can also be applied to foamable liquid.

[0038] It is also possible to use for defoaming the liquid discharged from the upper openings of a part of a plurality of the long and narrow liquid transporting means and to use the liquid discharged from the upper openings of the other liquid transporting means for cleaning of the inner wall surface of the tank and the surface of heating cooling apparatuses and increasing the heat transfer area.

[0039] When the agitator blade is rotated so as to allow the lower openings to go ahead, the lower liquid rises through the liquid transporting means and is discharged into the upper liquid from the upper openings.

[0040] When the long and narrow liquid transporting means is provided, for example, at 0° to the radius of rotating plane, irrespective of the direction of rotation, the opening on the circumferential side of the rotating plane and the opening near the center of the rotating plane are intake opening and discharge opening, respectively.

[0041] In the case of the liquid transporting means being a hollow truncated cone body, irrespective of the ro-

tating direction, the opening of smaller diameter is intake opening and the opening of larger diameter is discharge opening. Accordingly, when the hollow truncated cone body is used in the form of truncated cone in the agitation tank, the liquid is allowed to fall through the liquid transporting means which is a hollow truncated cone body, and when the hollow truncated cone body is used in the form of reverse truncated cone, the liquid is allowed to rise through the liquid transporting means which is a hollow truncated cone body.

[0042] For this agitation and mixing, it is preferred to select tube bodies as the long and narrow liquid transporting means.

[0043] The agitator blade used in the present invention may be used in combination with conventional agitation blades such as turbine blades, propellers, angled flat vanes, pitched flat vanes, flat vane disk turbines, flat vanes, curved vanes, or Pfandler vanes and Brungin vanes, as well as other agitating means such as agitation by jetting and/or ventilating agitation. The combination is preferable.

[0044] The mounting frame per se can be served as agitator blade.

[0045] The present invention will be explained in concrete by the examples referring to the drawings, but it is not limited thereto.

[0046] Reference is made to figures 1-4.

[0047] The agitator blade 1 includes a mounting frame 11 and a tube body 12 which is a liquid transporting means. A non-perforated plate of narrow width is used as the mounting frame 11. A total of six tube bodies 12 which are the liquid transporting means are provided, three on each side of the mounting frame 11. These tube bodies 12 are arranged tilting on the mounting frame 11, and inclined to the agitator shaft 2 (rotating axis) at the time of running. Angle of inclination is about 30°.

[0048] The tube body 12 consists of an upper straight portion 121 and a lower bent portion 122. The tube body 12 is formed here by screwing the bent portion 122 to the bottom end of the straight portion 121 at the junction point 123. The bent portion 122 is formed at an angle of 90° to the radial direction at rotating plane of the junction point 123, namely, formed to go along the tangent line to a circle drawn on the rotation plane of the junction point 123 with a radius equal to the distance between the junction point 123 and the agitating axis (the center of the rotating plane). The bent portion 122 is attached almost perpendicular (almost parallel to the rotating plane) to the rotating axis (agitator shaft 2).

[0049] The ends of the straight portion 121 and the bent portion 122 are opened in the agitation tank to form an upper opening 124 and a lower opening 125, respectively.

[0050] The upper openings 124 and the lower openings 125 are arranged to open on substantially the same rotating plane, respectively.

[0051] The shape of the upper openings 124 is a flat rectangular form substantially parallel to the mounting

frame 11 or the rotating plane, while the shape of the lower openings 125 is substantially circular.

[0052] The opening direction of the upper openings 124 and the lower openings 125 are upwardly inclined and horizontal, respectively.

[0053] The area of the upper opening 124 is smaller than that of the lower opening 125.

[0054] The agitator blade 1 is installed in the agitation tank 3 by fixing the mounting frame 11 with its center to the agitator shaft 2, the frame 11 becoming almost perpendicular to the agitator shaft 2.

[0055] The agitation tank 3 includes a cylindrical tank body 31, the center of the top plate of which is penetrated by the agitator shaft 2, the point of the penetration being sealed by a shaft seal 32. The lower end of the agitator shaft 2 is borne by a bearing 33 at the bottom of the tank body 31. The bottom plate and the top plate of the tank body 31 are provided with a gas inlet 34 and a liquid outlet 35 and a gas outlet 36, respectively. A pipe is extended from the gas inlet 34 to the inner bottom of the tank body 31, its end portion being provided with a ring gas distributor 37 drilled of many holes, while at the middle of the pipe said bearing 33 being mounted. The agitator shaft 2 is connected to a motor 4 at its top end. The agitator shaft 2 has three turbine blades 5, 5, 5 mounted thereon below the agitator blade 1.

[0056] The liquid thus discharged from the upper opening 124 is sprayed onto the inner wall surface of the tank body 31 and is dropped along the inner wall surface whereby the inner wall surface of the tank body 31 is cleaned and the heat transfer area is effectively used.

[0057] As other possible forms of the mounting frame 11, two frames such as perforated plate bodies of narrow width can be crossed at right angles on the same rotation plane on a plan view as shown in (a) of Fig. 4. Alternatively, the frame may be perforated disk as shown in (b) of Fig. 4.

[0058] The mounting frame shown here is fitted to the agitator shaft so that its plane is substantially parallel to the rotating plane of the agitator blade.

[0059] Reference is made to figures 5-8.

[0060] The tube portion 126 of the tube body 12 shown in Fig. 5 is curved upwardly viewing from the side and is also slightly curved viewing from above. The top end of the tube portion 126 is in the form of a funnel, namely, forms a funnel portion 127. The upper opening 124 is in the rectangular form and is covered with a perforated plate. The shape of the lower opening 125 is circular. The opening directions of the upper opening 124 and the lower opening 125 are inclined upwardly and horizontal, respectively.

[0061] The tube portion 126 of the tube body 12 shown in Fig. 6 is in the form of long S viewing from the side and the top end thereof is bent in downwardly inclined direction and is curved at a small curvature seeing from below. The top end of the tube portion 126 is in the form of a funnel, namely, forms a funnel portion 127. The

upper opening 124 is in the form of ellipse and is covered with a perforated plate. The shape of the lower opening 125 is circular. The opening directions of the upper opening 124 and the lower opening 125 are downwardly inclined and horizontal, respectively.

[0062] The tube portion 126 of the tube body 12 shown in Fig. 7 is in the form of long S viewing from the side and is slightly curved seeing from below. The top end of the tube portion 126 is in the form of a funnel, namely, forms a funnel portion 127. The upper opening 124 is in the form of circle and is covered with a perforated plate. The shape of the lower opening 125 is circular. The opening directions of the upper opening 124 and the lower opening 125 are side direction far off from the agitator shaft and horizontal direction, respectively.

[0063] The tube portion 126 of the tube body 12 shown in Fig. 8 is in the form of flat S viewing from the side and the lower end is curved at a small curvature seeing from below. The direction of the curving is such as the lower opening 125 coming near the rotating axis when fitted to the mounting frame.

[0064] The top end of the tube portion 126 is closed to form a blind tube. Many holes are drilled at the underside of the top end portion of the tube portion 126 to form the upper opening 124. The shape of the lower opening 125 is circular. The opening direction of the lower opening 125 is horizontal.

[0065] In the liquid transporting means shown in Figs. 5-8, the lower part of the tube body is thicker than the upper part and the opening area of the lower opening is larger than that of the upper opening.

[0066] The gutter body 8 shown in Fig. 9 is in the form of a long and nearly half hollow truncated cone with no bottom. The shape of the upper opening 81 and that of the lower opening 82 are both semicircular. Planar shape is long trapezoid and the lower portion is slightly curved. The curving direction is such that the lower opening 82 comes close to the rotating axis when fitted to the mounting frame.

[0067] In the liquid transporting means shown in Fig. 9, area of the lower opening is larger than that of the upper opening. The area of opening of these liquid transporting means is a length of the arc of the semicircle of the upper and lower end openings.

[0068] Fig. 10 shows a plate body 9 as the liquid transporting means.

[0069] The whole side shape of the plate body 9 shown in (a)-(c) of Fig. 10 is a long S and the whole planar shape is a long trapezoid.

(d) shows a plate body 91 which is upwardly bent at the lower end corner 911 (the right end in (d) which is allowed to go behind at the time of rotating).
(e) shows a plate body 92 having a whole front shape of long trapezoid curved at a small curvature.

[0070] In the liquid transporting means shown in Fig. 10, area of the lower opening is larger than that of the

upper opening. The area of opening of these liquid transporting means is a length of the straight line of the upper end opening and is defined to be a length of the straight line or the curve of the lower end opening.

[0071] In Fig. 11, (a) and (b) the floats 10, 10 are ring-shaped and have a section of nearly square and these are a float of larger diameter and a float of smaller diameter which are concentrically positioned on the same rotating plane. A plurality of tube bodies 12 are fixed to the inner circumferential side face of the floats 10 by fixers 101 (in Fig. 11, each two of four tube bodies 12 are fixed to the floats 10 on the same diameter symmetrically with respect to the rotating axis as an axis of symmetry and the agitator blade is omitted). The floats 10 are connected by a central ring 102 provided at the center and supporting rods 103. These supporting rods 103 cross each other at right angles. A protrusion 104 is provided at the inner peripheral face of the central ring 102. A groove 21 is cut on the outer peripheral face of the agitator shaft 2 along its longer axis. The agitator blade 1 can be slidably attached to the agitator shaft 2 by inserting the agitator shaft 2 through the central ring 102 and fitting the groove 21 of the agitator shaft with the protrusion 104.

[0072] Fig. 12 shows the agitator blade used in the present invention comprising an agitator shaft to which tube bodies are fitted at an angle of 0° to the radial direction, as seen in Fig. 1 of rotating plane by the mounting frame. (a) in Fig. 12 shows a plan view of the agitator blade and (b) shows a sectional view of the agitator blade shown in (a) taken along the line B-B. The tube body 12 is attached to the top end of the mounting frame 11 at an inclination angle of about 45° to the rotating axis 2. The tube 12 is provided at substantially 0° to the radial direction of its rotating plane, namely, on the radius of the rotating plane. The four mounting frames 11 provided with the tube bodies 12 are arranged on the outer periphery of the central ring 102 at a center angle of 90° . The tube body 12 is an almost straight cylinder. The upper end is nearly horizontally bent and the top end is flattened in horizontal direction. The shape of the lower opening is circle. The agitator shaft 2 is inserted through the central ring 102.

[0073] In this agitator blade, the upper opening 124 and the lower opening 125 of the tube body 12 are respectively a discharge opening and an opening irrespective of the direction of rotating direction of the agitator blade.

[0074] Figs. 13 and 14 show the agitator blades used in the present invention where the liquid transporting means are hollow truncated cone bodies. (a) in Fig. 13 shows a plan view of the agitator blade and (b) shows a sectional view of the agitator blade taken along C-C.

(a) in Fig. 14 shows a plan view of the agitator blade and (b) shows a sectional view of the agitator blade taken along D-D.

[0075] In this agitator blade shown in Fig. 13, the hollow truncated cone body 201 is the liquid transporting means which is attached to the agitator shaft 2 with the longer axis thereof being allowed to nearly coincide with the longer axis of the agitator shaft 2. Four baffles 203, 203, 203, 203 are provided at equal intervals on the inner peripheral face of this hollow truncated cone body along the inclination of the inner peripheral face.

[0076] This hollow truncated cone body 201 is in the form of a reverse truncated cone with the larger opening being an upper opening and arranged on the central ring 102 through mounting frame 11. Through this central ring 102 is inserted the agitator shaft 2.

[0077] In this hollow truncated cone body 201, the lower opening 204 of smaller diameter and the upper opening 205 of larger diameter are respectively an intake opening and a discharge opening irrespective of its rotating direction.

[0078] The liquid in the agitation tank is scooped up from the lower opening 204 as an intake opening and is allowed to rise along the inner peripheral face of this hollow truncated cone body 201 and discharged from the upper opening 205 as a discharge opening by rotating the agitator blade.

[0079] The agitator blade shown in Fig. 14 is substantially not different from the agitator blade shown in Fig. 13 except that a hollow truncated cone body 202 having a smaller diameter than that of the hollow truncated cone body 201 and equal in gradient of peripheral wall to the hollow truncated cone body 201 is concentrically provided in the hollow truncated cone body 201, no baffles are provided on the inner peripheral faces of the hollow truncated cone bodies 201 and 202, and the liquid in the agitation tank is allowed to rise through the space 206 between the hollow truncated cone bodies 201 and 202 and along the inner peripheral face of the hollow truncated cone body 202.

Example of use

[0080] The agitation tank shown in Fig. 3 was used as a fermentation equipment.

[0081] In this equipment, when a customarily employed turbine blade was used in place of the agitator blade used in the present invention, defoaming was not able to be performed only by the agitation machine using the turbine blade and when a defoamer was additionally used, the cost for silicone used as the defoamer for completely extinguishing foam was about 70,000 yen per day.

[0082] The inner peripheral face of the agitation tank and the surface of heating cooling apparatuses can be cleaned and the heating surface area can be effectively used without stopping the operation in the agitation tank.

Claims

1. Agitation tank, including
 - a tank body (31),
 - an agitator shaft (2) within said tank body (31),
 - a motor (4) for rotation of said agitator shaft (2),

an agitator blade (1) including a mounting frame (10; 11) mounted on said agitator shaft (2), said agitator blade (1) having one or more liquid-transporting means (12; 8; 9; 91, 92; 201, 202), each of which has an upper liquid-discharging end (124; 81; 205) and a lower liquid-suction end (125; 82; 204), said upper liquid-discharging end (124; 81; 205) being positioned above a level of liquid contained in the tank and said lower liquid-suction end (125; 82; 204) being positioned below said liquid level; wherein when the agitator shaft (2) is rotated, liquid is suctioned from said lower liquid-suction end (125; 82; 204) and discharged from said upper liquid-discharging end (124; 81; 205),

characterized in that

a heating/cooling apparatus with a heat exchange surface is provided and that

an inner wall surface of said tank (3), said heat exchange surface and said liquid transporting means (12; 8; 9; 91, 92; 201, 202) with said upper liquid-discharging end (124; 81; 205) are located and formed such that liquid discharged from said upper-discharging end (124; 81; 205), is sprayed onto the inner wall surface of the tank and said heat exchange surface and falls along these surfaces as to clean them and to effectively use the heat transfer area.

2. Agitation tank according to claim 1,

characterized in that

said liquid-transporting means is formed by a hollow truncated cone body (201) which is attached to the agitator shaft (2) with its axis thereof nearly coinciding with the axis of the agitator shaft (2), the hollow truncated cone body (201) being in the form of a reverse truncated cone with its larger opening being its upper opening and baffles (203) being provided on the inner peripheral face of the hollow truncated cone body and

an inner wall surface of said tank (3) and said upper liquid-discharging end of said cone body are formed such that liquid discharged from said upper-discharging end is sprayed onto the inner wall surface of the tank and is dropped along the inner wall surface.

3. Agitation tank according to claim 1,

characterized in that

said liquid-transporting means is formed by two hollow truncated cone bodies (201, 202) attached to the agitator shaft (2) with their longer axis

nearly coinciding with the axis of the agitator shaft (2) and with an inner hollow truncated cone body (202) having a smaller diameter than an outer hollow truncated cone body (2), with both hollow truncated cone bodies (201, 202) being in the form of reversed truncated cones equal in gradient of their peripheral walls and concentrically with each other, so that liquid in the agitation tank is allowed to rise through a space (206) between said truncated cone bodies (201, 202) and

an inner wall surface of said tank (3) and said upper liquid-discharging end of said cone bodies are formed such that liquid discharged from said upper-discharging end is sprayed onto the inner wall surface of the tank and is dropped along the inner wall surface.

Patentansprüche

1. Rührtank, enthaltend
 - einen Tankkörper (31),
 - eine Rührwelle (2) innerhalb des Tankkörpers (31),
 - einen Motor (4) für eine Drehung der Rührwelle (2),
 - eine Rührschaufel (1) mit einem an der Rührwelle (2) angebrachten Montagerahmen (10; 11), welche Rührschaufel (1) ein oder mehrere Flüssigkeitstransportmittel (12; 8; 9; 91, 92; 201, 202) aufweist, von denen jedes ein oberes Flüssigkeitsabgabeende (124; 81; 205) und ein unteres Flüssigkeitsansaugende (125; 82; 204) aufweist, wobei das obere Flüssigkeitsabgabeende (124; 81; 205) oberhalb eines Pegels von in dem Tank enthaltener Flüssigkeit angeordnet ist und das untere Flüssigkeitsansaugende (125; 82; 204) unterhalb des Flüssigkeitspegels angeordnet ist und wobei, wenn die Rührwelle (2) gedreht wird, Flüssigkeit von dem unteren Flüssigkeitsansaugende (125; 82; 204) angesaugt wird und von dem oberen Flüssigkeitsabgabeende (124; 81; 205) abgegeben wird,

dadurch gekennzeichnet, dass

eine Heiz-/Kühlvorrichtung mit einer Wärmetauscherfläche vorgesehen ist und dass

eine innere Wandfläche des Tanks (3), die Wärmetauscherfläche und das Flüssigkeitstransportmittel (12; 8; 9; 91, 92; 201, 202) mit dem oberen Flüssigkeitsabgabeende (124; 81; 205) derart angeordnet und ausgebildet sind, dass die von dem oberen Flüssigkeitsabgabeende (124; 81; 205) abgegebene Flüssigkeit auf die innere Wandfläche des Tanks und die Wärmetauscherfläche gesprüht wird und längs dieser Oberflächen herabfällt, so dass sie gereinigt werden und der Wärmeübertragungsbereich wirksam genutzt wird.

2. Rührtank nach Anspruch 1,

dadurch gekennzeichnet, dass

das Flüssigkeitstransportmittel durch einen hohlen, abgestumpften Kegelkörper (201) gebildet ist, der an der Rührwelle (2) befestigt ist, wobei seine Achse annähernd mit der Achse der Rührwelle (2) zusammenfällt, und der hohle, abgestumpfte Kegelkörper (2) in Form eines umgekehrten, abgestumpften Kegels ausgebildet ist, dessen größere Öffnung die obere Öffnung ist, und Schikanen (203) an der inneren Umfangsfläche des hohlen, abgestumpften Kegelkörpers vorgesehen sind, und

eine innere Wandfläche des Tanks (3) und das obere Flüssigkeitsabgabeende des Kegelkörpers derart ausgebildet sind, dass von dem oberen Abgabeende abgegebene Flüssigkeit auf die innere Wandfläche gesprüht wird und längs der inneren Wandfläche herabläuft.

3. Rührtank nach Anspruch 1,

dadurch gekennzeichnet, dass

das Flüssigkeitstransportmittel durch zwei hohle, abgestumpfte Kegelkörper (201, 202) gebildet ist, die an der Rührwelle (2) befestigt sind, wobei ihre längere Achse nahezu mit der Achse der Rührwelle (2) zusammenfällt und wobei ein innerer hohler, abgestumpfter Kegelkörper (202) einen kleineren Durchmesser als ein äußerer hohler, abgestumpfter Kegelkörper (201) aufweist, wobei die beiden hohlen, abgestumpften Kegelkörper (201, 202) in Form eines umgekehrten Kegels ausgebildet sind, deren Umfangswände die gleiche Steigung haben und konzentrisch zueinander sind, so dass Flüssigkeit im Rührtank durch einen Zwischenraum (206) zwischen den abgestumpften Kegelkörpern (201, 202) hindurch aufsteigen kann und

eine innere Wandfläche des Tanks (3) und das obere Flüssigkeitsabgabeende der Kegelkörper derart ausgebildet sind, dass von dem oberen Abgabeende abgegebene Flüssigkeit auf die innere Wandfläche des Tanks gesprüht wird und längs der inneren Wandfläche herabläuft.

Revendications

1. Réservoir d'agitation comprenant
 - un corps (31) de réservoir,
 - un arbre (32) d'agitateur dans le corps (31) de réservoir.
 - un moteur (4) destiné à faire tourner l'arbre (2) d'agitateur,
 - une lame (1) d'agitateur comprenant un cadre (10, 11) de montage monté sur le bras (2) d'agitateur, la lame (1) d'agitateur ayant un ou plusieurs moyens (12, 8, 9, 91, 92, 201, 202) de transport de liquide, chacun d'entre eux ayant une extrémité (124, 81, 205) supérieure de refoulement du liquide et une extrémité (125, 82, 204) inférieure d'aspira-

tion du liquide, l'extrémité (124, 81, 205) supérieure de refoulement de liquide étant disposée au-dessus d'un niveau de liquide contenu dans le réservoir et l'extrémité (125, 82, 204) inférieure d'aspiration de liquide étant disposée en-dessous de ce niveau de liquide ; dans lequel lorsque l'arbre (2) d'agitateur tourne, du liquide est aspiré de l'extrémité (125, 82, 204) inférieure d'aspiration de liquide et est refoulé par l'extrémité (124, 81, 205) supérieure de refoulement de liquide,

caractérisé en ce que

il est prévu un dispositif de chauffage/refroidissement ayant une surface d'échange thermique et **en ce qu'**une face intérieure de la paroi du réservoir (3), la surface d'échange thermique et les moyens (12, 8, 9, 91, 92, 201, 202) de transport de liquide ayant l'extrémité (124, 81, 205) supérieure de refoulement de liquide sont disposés et sont conformés de façon à ce que du liquide refoulé de l'extrémité (124, 81, 205) supérieure de refoulement soit projeté sur la surface intérieure de la paroi du réservoir et sur la surface d'échange thermique et tombe le long de ces surfaces de manière à les nettoyer et à utiliser efficacement la zone de transfert de la chaleur.

2. Réservoir d'agitation suivant la revendication 1, **caractérisé en ce que** les moyens de transport de liquide sont formés par un corps (201) creux tronconique qui est fixé au bras (2) de l'agitateur, en ayant son axe qui coïncide sensiblement avec l'axe du bras (2) de l'agitateur, le corps (201) creux tronconique étant sous la forme d'un tronc de cône inversé dont la grande ouverture est l'ouverture supérieure et des chicanes (203) sont prévues sur la face intérieure périphérique du corps creux tronconique et

une surface intérieure de paroi du réservoir (3) et l'extrémité supérieure de refoulement de liquide du corps conique étant formées de façon à ce que du liquide refoulé de l'extrémité supérieure de refoulement soit projeté sur la surface intérieure de paroi du réservoir et tombe le long de la surface intérieure de la paroi.

3. Réservoir d'agitation suivant la revendication 1, **caractérisé en ce que** les moyens de transport de liquide sont formés de deux corps (201, 202) creux tronconiques fixés à l'arbre (2) de l'agitateur, en ayant leur grand axe qui coïncide sensiblement avec l'axe de l'arbre (2) de l'agitateur et ayant un corps (202) creux intérieur tronconique qui a un diamètre plus petit qu'un corps (2) creux extérieur tronconique, les deux corps (201, 202) creux tronconiques étant sous la forme de tronc de cône inverse de gradient égal de leur paroi périphérique et concentrique l'un à l'autre, de sorte que du liquide du réservoir d'agitation peut passer dans un intervalle

(206) compris entre les corps (201, 202) tronconiques et

une surface intérieure de paroi du réservoir (3) et l'extrémité supérieure de refoulement de liquide des corps coniques sont conformées de façon à ce que du liquide qui est refoulé de l'extrémité supérieure de refoulement soit projeté sur la surface intérieure de paroi du réservoir et tombe le long de la surface intérieure de la paroi.

FIG. 1

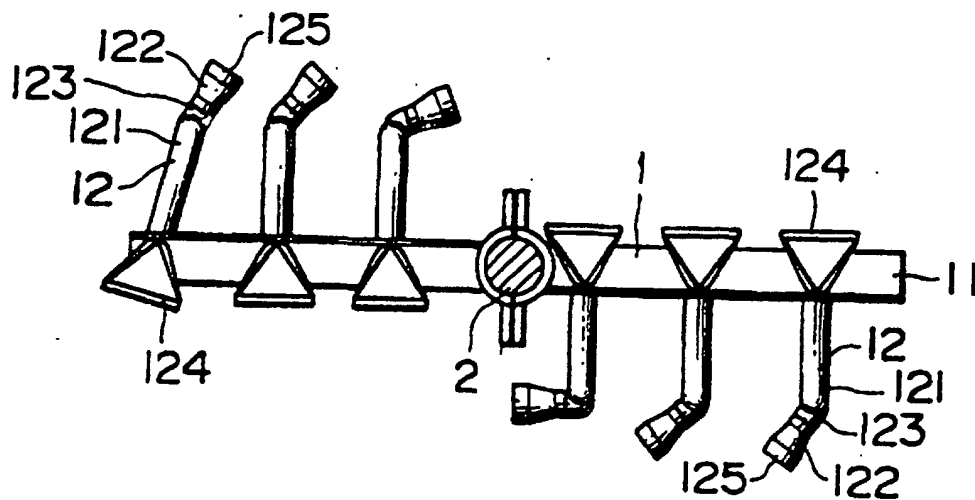


FIG. 2

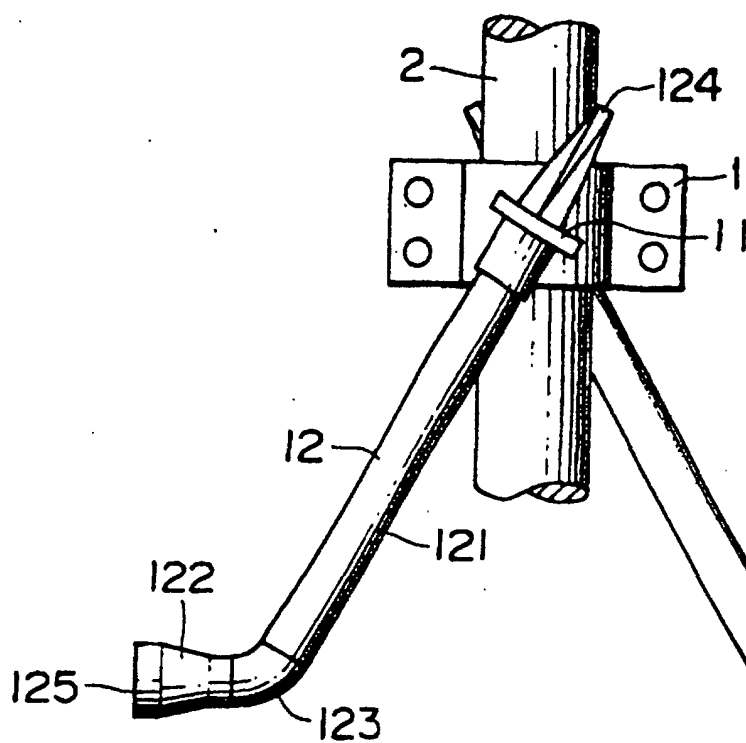


FIG. 3

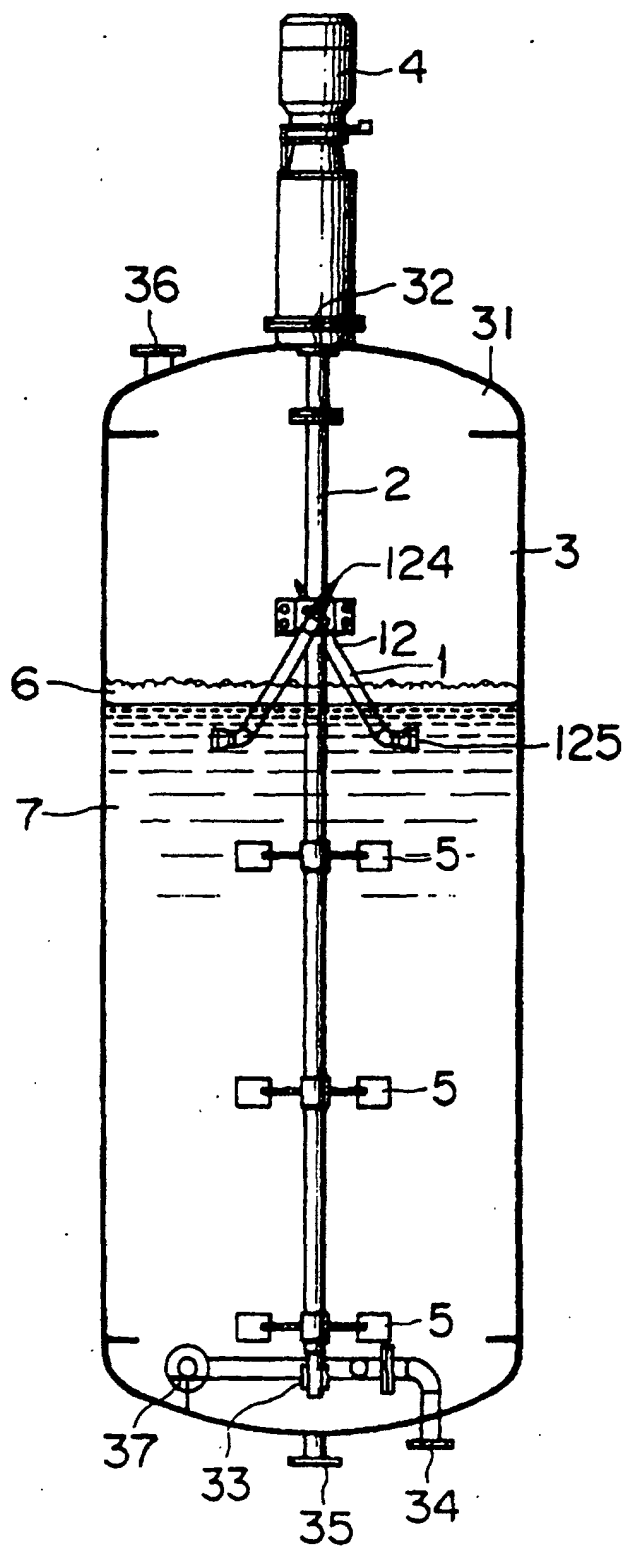
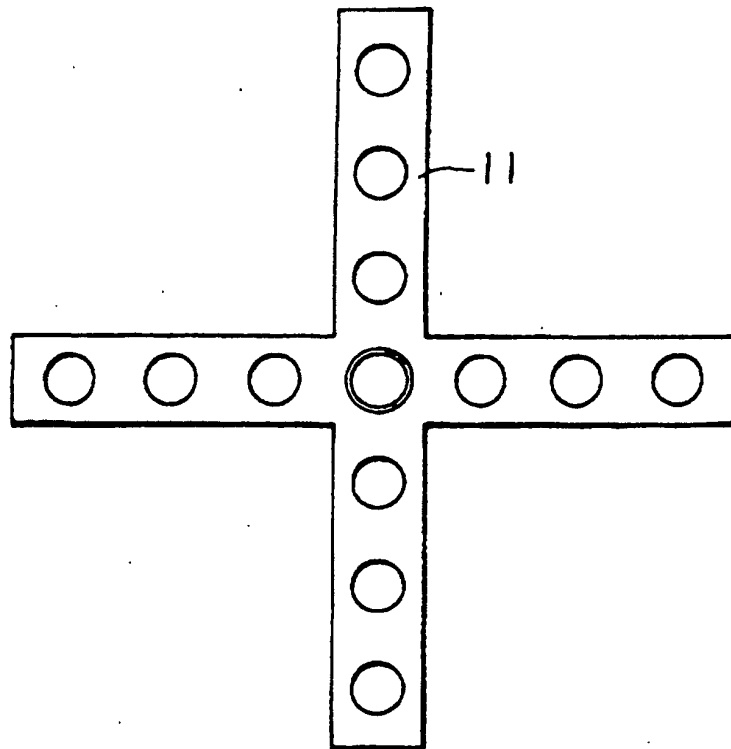


FIG. 4

a



b

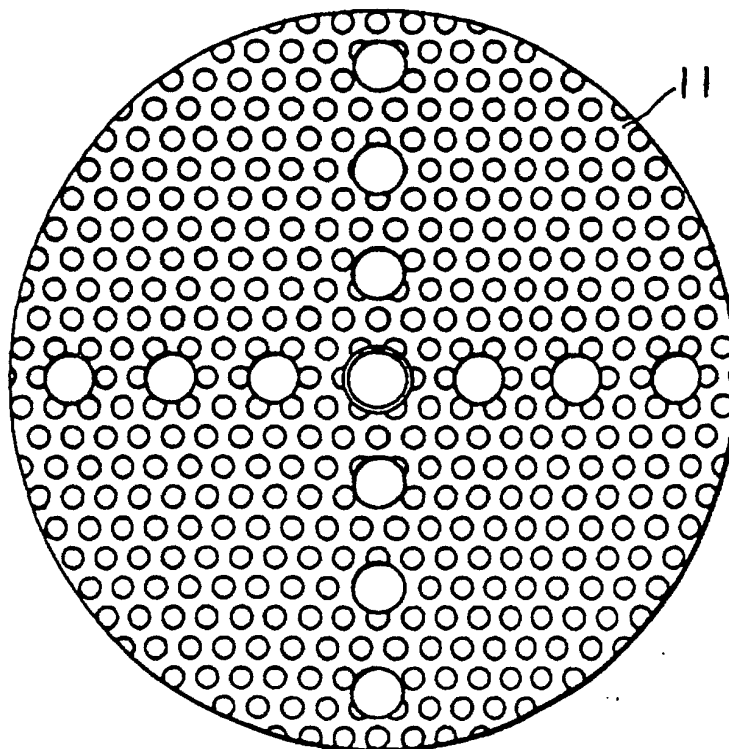


FIG. 5

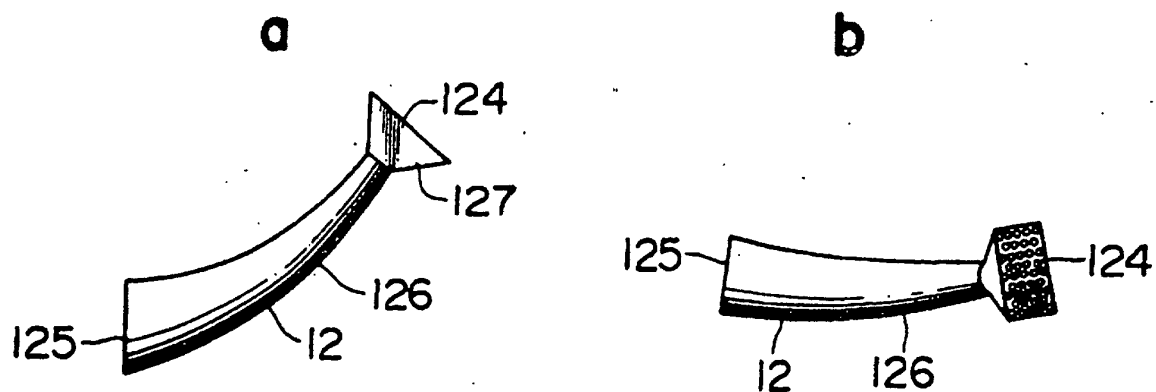


FIG. 6

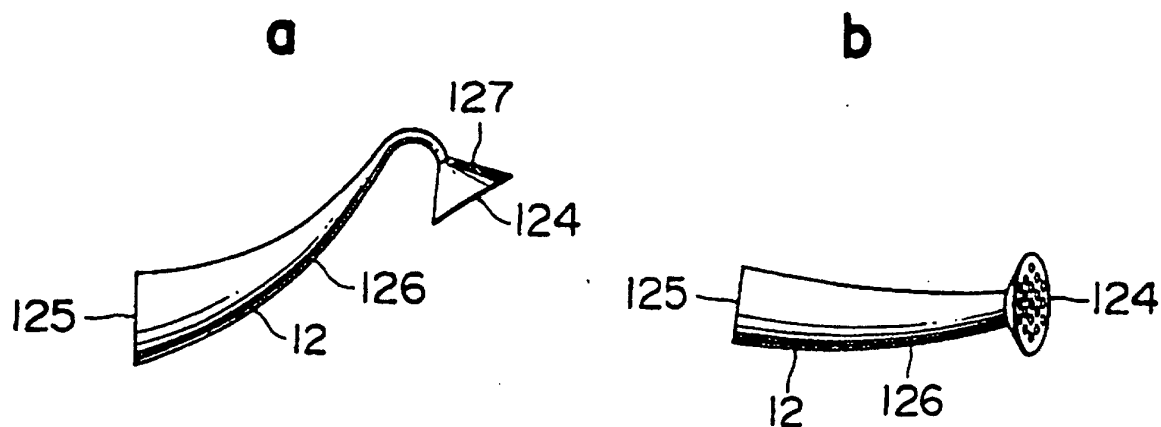


FIG. 7

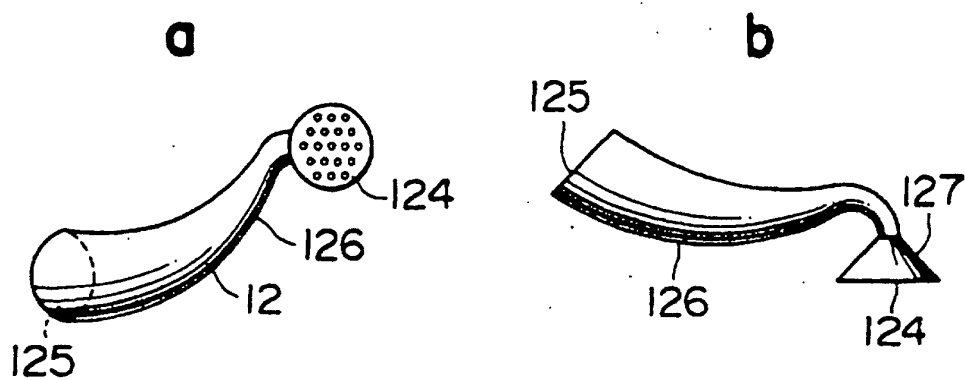


FIG. 8

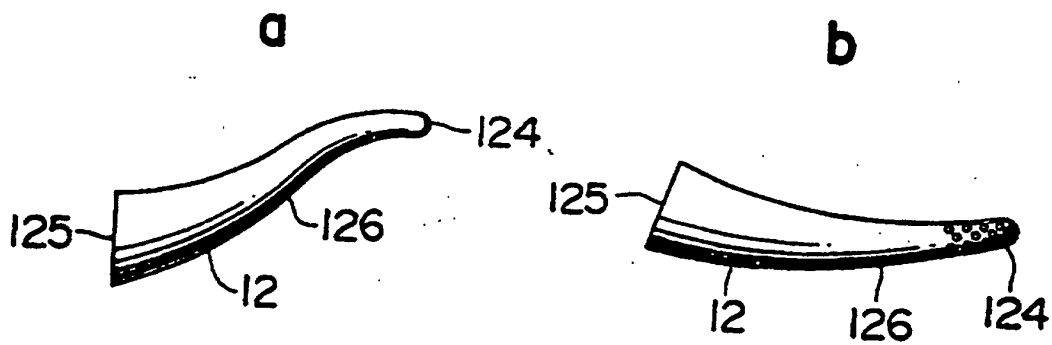


FIG. 9

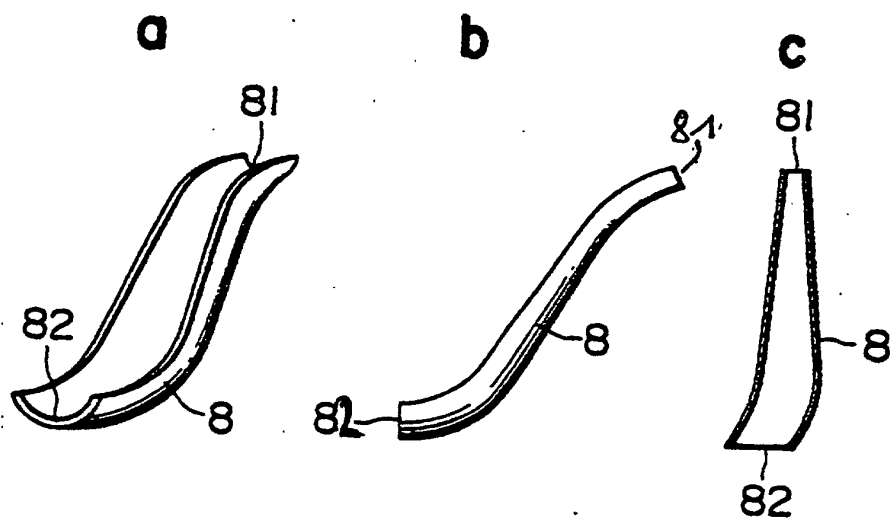


FIG. 10

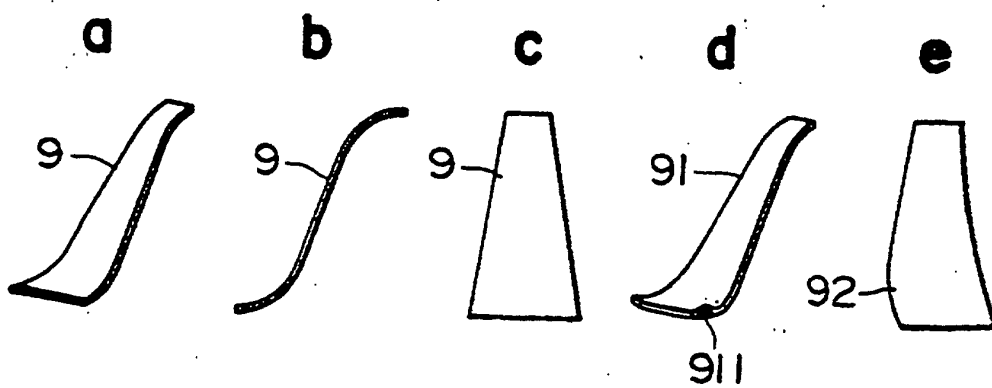


FIG. 11

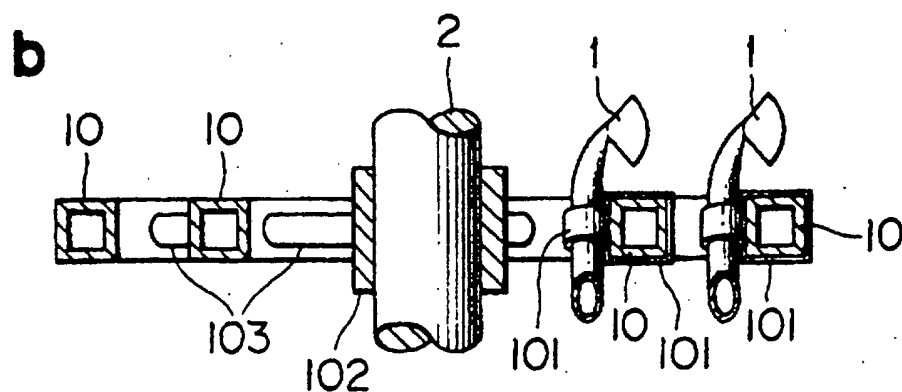
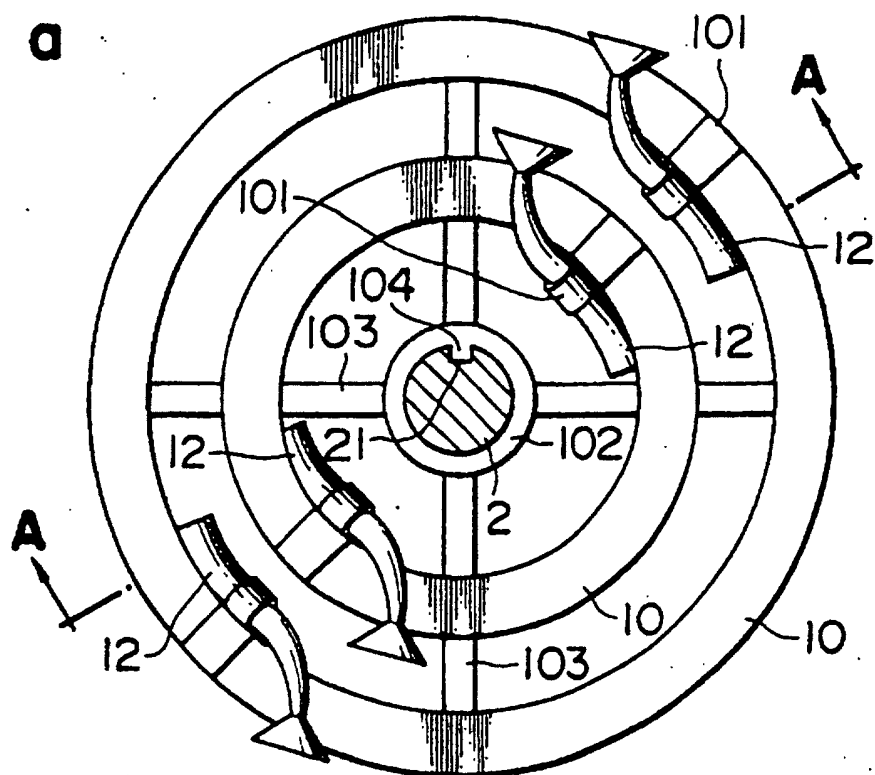


FIG. 12

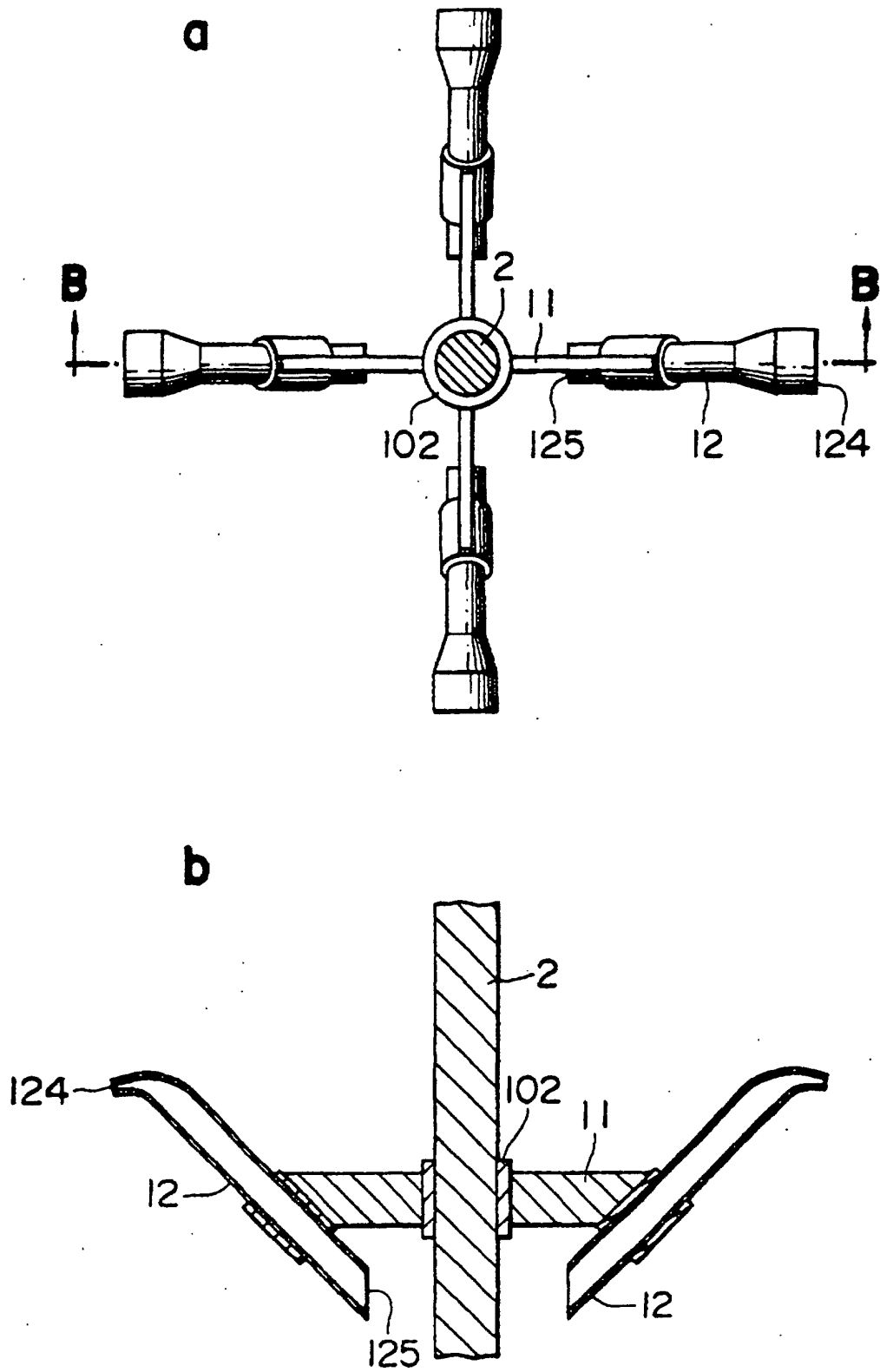


FIG. 13

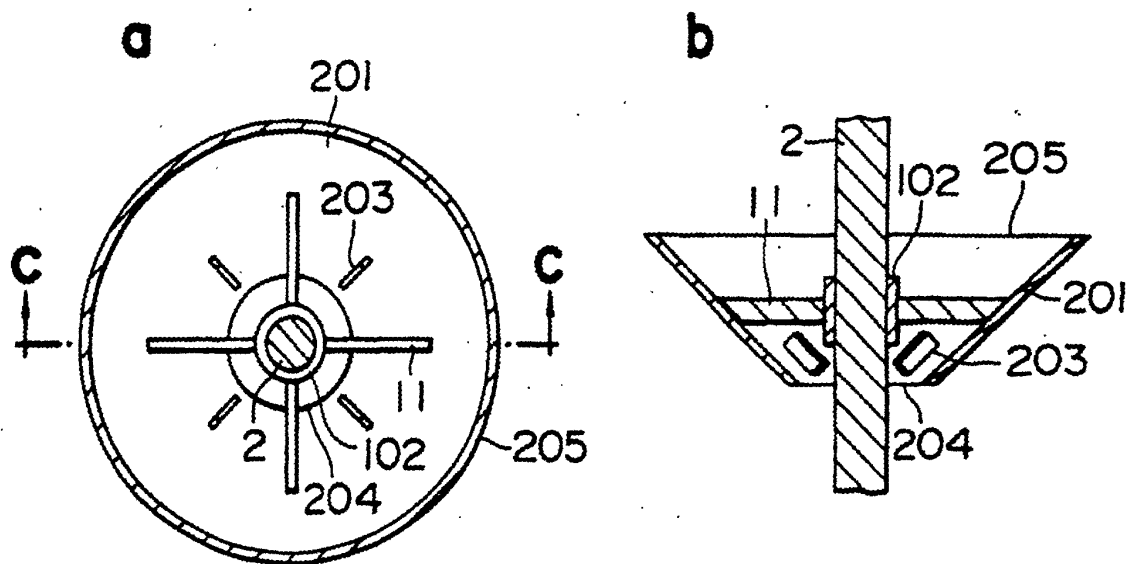


FIG. 14

