

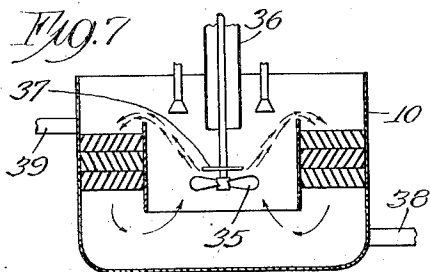
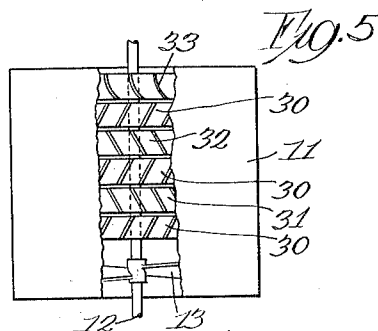
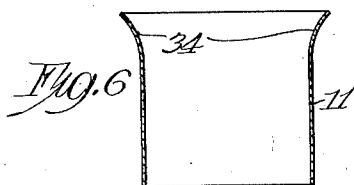
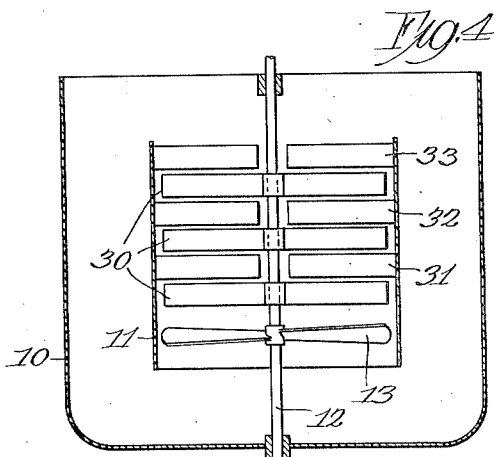
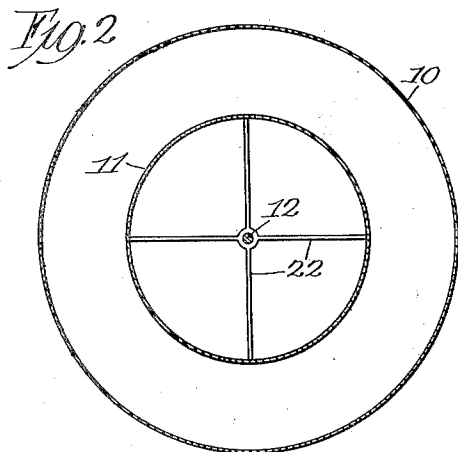
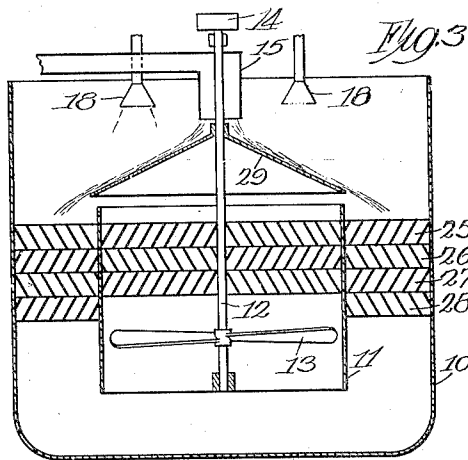
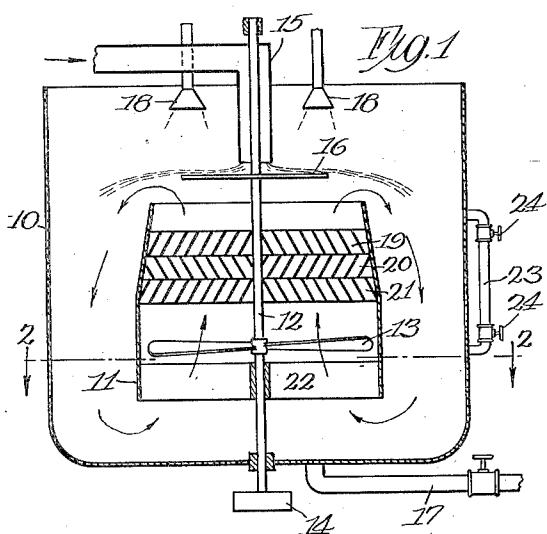
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APPARATUS FOR AND PROCESS OF MIXING

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR AND PROCESS OF MIXING.

Application filed June 19, 1925. Serial No. 38,157.

My invention relates to improvements in mixing apparatus and processes used for mixing substances with fluids, such for example as the operation of liming sugar juices, and the like.

An object of the invention is to provide means for circulating the liquid in such manner as to insure a smoother surface on the liquid for the reception of a re-agent and more uniform mixing than has been attained heretofore.

Another object is to provide means for adding the re-agent, in finely dispersed form, to the fresh incoming liquid, followed by a thorough mixing of said incoming liquid with the remainder of the liquid.

The form of the apparatus may vary widely, depending on the character of the service required. In the accompanying drawings I have illustrated several embodiments of the invention, adapted more particularly for the liming of sugar juices, these embodiments of the invention being shown somewhat diagrammatically.

Fig. 1 is a sectional elevation of one form of apparatus.

Fig. 2 is a section on line 2—2, Fig. 1.

Fig. 3 is a sectional elevation of a modified apparatus.

Fig. 4 is a similar elevation of a further modification.

Fig. 5 is a front elevation, partly in section, of part of the apparatus of Fig. 4.

Fig. 6 is a sectional elevation of a modification of the inner tank, and

Fig. 7 is a sectional elevation of a further modified form of mixing apparatus.

The mixing is carried out in a suitable container or tank 10, of any appropriate form or proportions, the one shown being cylindrical and containing an inner tank or compartment 11, which, in this case, is also substantially cylindrical, except for a contracted upper end, and is arranged concentrically within said outer tank. The rotatable shaft passes vertically through the inner compartment and has some suitable form of propeller blades 13 mounted thereon for driving the liquid upwardly when said shaft is rotated. Said shaft may have a pulley 14, or other suitable mechanical means for rotating it, mounted either on its upper or lower end, the latter arrangement being shown.

The fluid may be supplied to the apparatus through any suitable inlet or inlets, for

example, through a tube or pipe 15 surrounding the shaft 12. In order to spread this fresh incoming fluid so that it presents a smooth surface to which the re-agent may be added, I provide either a disk or cone beneath the opening at the lower end of said pipe 15, whereby said incoming fluid may be spread out in a thin sheet. This disk or cone is preferably rotated, whereby centrifugal force aids in discharging said fluid beyond the confines of the inner tank. In Fig. 1, a disk 16 is shown, which is mounted on shaft 12, whereby it rotates therewith, although it may be independently rotated, if desired. Said disk is preferably of such size and is so positioned above the top of the inner tank and rotates at such speed as to direct the incoming liquid into the annular space between the inner and outer tanks. The outlet 17, suitably located, may be controlled by a valve, whereby the liquid may be drawn off at intervals as the mixing reaches the desired degree of thoroughness, or the liquid may be drawn off continuously, if desired.

The substances to be mixed with the fluid may be introduced in whatever manner is most appropriate for the particular process being carried out. In treating the juices of beet sugar, cane sugar, or the like, it is preferable to add the re-agent in finely dispersed form and at a substantially constant rate to the fresh incoming fluid, which fluid is then circulated upon and in the main body of the liquid, the circulating and mixing taking place in a closed cycle. This results in a substantially uniform and progressive action of the re-agent upon the entire body of the juice. For this purpose, the re-agent may be introduced through spray heads 18 located above the disk 16, a sufficient number of spray heads being provided for the purpose. Other suitable re-agent dispensing means may be employed.

A series of baffle plates 19, 20 and 21 is arranged in the small chamber above the propeller 13, although a further series of baffles may be arranged below said propeller as well, if desired. These successive rows of baffles may be conical, the baffles of one group being arranged at an angle with reference to the group immediately above or below the same. With this construction a series of concentric openings is provided into which the fluid flows under the action

of the propeller so that the baffles of each group divide the flow and change the direction repeatedly, thus effecting a thorough mixing. The propeller forces the fluid upwardly through the inner chamber and through the baffles, whereupon it flows outwardly and downwardly through the annular clearance space between the larger tank 10 and the inner tank 11, flowing into the space beneath the smaller tank, and thence upwardly to the propeller.

Partitions 22 of any shape or arrangement, conformable to the laws of hydraulics, may be arranged below the propeller, if desired, as shown in Fig. 2, whereby the body of liquid approaching the propeller is divided into a plurality of separate streams to prevent excessive rotation thereof adjacent the rotating propeller, or above the same, or both above and below. The action is such that the reagent sprayed onto the surface of the incoming liquid is carried downwardly therewith and then inwardly and upwardly past the propeller and through the series of baffles, resulting in a thorough mixing without undue agitation or violent fluctuation of the liquid level, above the inner tank. Such agitation as does occur at this point, however, does not result in presenting to the reagent, which is being supplied from above, liquid surfaces which have been unevenly treated. On the contrary, the reagent is applied evenly to the fresh incoming fluid and the latter thereafter thoroughly mixed with the main body of the fluid.

If desired, suitable equipment may be added for heating or cooling the liquid, depending on the process. In some cases, the extent of the reaction taking place may be controlled by visual inspection by providing a by-pass having a transparent portion 23 equipped with valves 24 whereby a small portion of the liquid may be segregated at will from the rapidly circulating body of liquid with which the re-agent is being mixed. The liquid column between the valves 24 may thus be held quiescent momentarily for inspection, and, if found satisfactory, the addition of the reagent may be discontinued and the liquid discharged from the tank, or the process may be continued. It is also apparent that the process may be carried out continuously. In addition to controlling the temperature of the liquid, means may also be provided for maintaining the same under pressure to aid in securing the desired temperature.

In Fig. 3, the apparatus is similar to that previously described, except that an additional series of baffles 25, 26, 27, 28 is provided, said baffles being located within the space between the inner and outer tank walls. The liquid flowing downwardly through these baffles is therefore

further mixed, in the manner previously described, the flow being caused by gravity as the liquid in the inner tank is being raised by the propeller and forced upwardly through the inner series of baffles. The baffles 25, 26, 27, 28 are shown as arranged concentrically, but they may also be arranged radially, or in any other manner, depending on circumstances.

The ratio of the area, in the horizontal plane, of the inner tank as compared to the area of the annular space between the inner and outer tanks may be varied considerably. In this construction, a conical shaped distributor plate 29 is shown mounted so as to rotate with the shaft 12 and the driving pulley 14 is arranged at the upper end of said shaft, as illustrating other forms of apparatus. In case the conical plate 29 is not made rotatable, it is preferably extended beyond the inner tank so as to discharge the fresh incoming liquid outside of said inner tank.

In Fig. 4, the propeller shaft is surrounded by a series of rotatable blades or vanes 30, between which the fixed vanes 31, 32, 33, are located. The exact number of rotatable and fixed blades may vary within wide limits. These blades are arranged preferably radially and as the liquid is forced upwardly it causes rotation of the rotatable blades, insuring a somewhat different mixing action. The reagent leaves the uppermost row of fixed vanes at an incline, resulting in a swirling motion, or said motion may be checked by curving the blades 33, as shown more particularly in Fig. 5, thereby directing the stream of liquid more nearly upwardly, or guides may be provided for directing it horizontally. Where the arrangement is such that a smooth flowing surface of the liquid is presented, free from violent local turbulences, the distributing disk 16, or cone 29 may be omitted and the reagent applied directly to said smooth surface, if desired. Additional vanes may be arranged in the annular space between the inner and outer tanks, shown in Fig. 4, in somewhat the same manner as that illustrated in Fig. 3, and said vanes may be so arranged that alternate groups rotate between the remaining fixed groups, if desired. Furthermore, the propeller 13 may be omitted, under some conditions, and the rotatable blades 30 fixed to the propeller shaft so that they may be driven thereby to act as propellers, or said shaft may have a propeller and some fixed and some rotatable blades on it.

In Fig. 6, the tank 11 is shown provided with a flaring upward end to facilitate a smooth outward flow of the liquid. Such tank may be used in combination with the elements shown in the remaining figures.

In Fig. 7, the propeller 35 may either be

smaller, in proportion to the diameter of the inner tank, or it may be arranged at a different elevation, the purpose in either case being to throw the liquid upwardly and outwardly over the rim of the inner tank, as suggested in the drawings, whereby it overflows said rim and circulates as before, the normal level of the liquid being below said rim. The incoming liquid may be supplied through a central pipe 36 and spread out by a disk 37 on the shaft. The outlet 38 is regulated to maintain the liquid level at the desired height, the reagent being sprayed onto the surface of the liquid as before, as said liquid flows up and over the rim of said inner receptacle. The inlet 39 is arranged at a suitable height. In all of the forms of invention described, it will be seen that an exact control of the amount of reagent may be had without requiring a number of corrections in successive chambers, as in certain prior apparatus. It will also be seen that in all forms of the apparatus, the surface area of the liquid is enlarged as it issues from the central chamber, the increased area receiving the entering liquid which has been treated with the reagent, or receiving the reagent directly, in some cases, as previously explained. A rapid circulation facilitates thorough mixing, but too rapid circulation may break up the flocks as they become large. A critical speed may be determined, in each case, and the apparatus operated at or near that speed.

With the apparatus described, liquid containing heated coagulable colloids and colloids precipitated by change in electrical charge may be preheated to at least incipient coagulation, and thereafter continuously circulated, while presenting a smooth or non-turbulent continuously flowing surface, permitting a reagent to be supplied in finely dispersed form, capable of changing the electrical charge and thereby causing a gradual, progressive change of electrical charge and causing further agglomeration and precipitation of the colloids to the point of rapid settling thereof.

The process in question effects the removal of nitrogenous bodies, particularly those albumenoid in character. It is adapted to the treatment not only of cane and beet sugar juices, but glucose liquors derived from conversion of starch, laevulose containing solutions, sewage, and similar materials.

What I claim is:

1. Mixing apparatus comprising a tank, an inner chamber spaced from the side and bottom walls of said tank, circulating means located in said tank, a series of baffle plates arranged within said inner chamber, and additional baffle plates arranged between said inner chamber and the wall of said tank, said baffles being arranged to divide the streams of liquid as they flow therethrough

and combine part of one stream with part of another to insure thorough mixing, said circulating means operating to cause an upward flow through said inner chamber and a downward flow outside of said inner chamber.

2. In a mixing tank, an outer wall, an inner chamber, spaced apart baffle plates located within said inner chamber arranged relatively to each other for dividing and recombining streams of liquid flowing there-through and relatively inclined for changing the direction of flow of the streams, and a propeller located beneath said baffles for forcing said liquid upwardly through the same and downwardly between said inner chamber and the wall of said tank.

3. In a mixing tank, an outer wall, an inner chamber, spaced apart baffle plates located within said inner chamber arranged relatively to each other for dividing and recombining streams of liquid flowing there-through, and relatively inclined for changing the direction of flow of the streams, a propeller located beneath said baffles to force said liquid upwardly through the same and downwardly between said inner chamber and the wall of said tank, and additional baffle plates arranged to further mix the downwardly flowing fluid.

4. In a mixing tank, an outer wall, an inner chamber, spaced apart baffle plates located within said inner chamber arranged relatively to each other for dividing and recombining streams of liquid flowing there-through and relatively inclined for changing the direction of flow of the streams, liquid circulating means arranged to force said liquid upwardly through the baffles and downwardly between said inner chamber and the wall of said tank, and means for applying a reagent to the surface of the liquid in said tank.

5. In a mixing tank, an outer wall, an inner chamber, spaced apart baffle plates located within said inner chamber arranged relatively to each other for dividing and recombining streams of liquid flowing there-through and relatively inclined for changing the direction of flow of the streams, a propeller located beneath said baffles to force said liquid upwardly through the same and downwardly between said inner chamber and the wall of said tank, an upper central inlet for fresh incoming liquid, means for discharging a reagent from above said liquid, and means for spreading the incoming liquid laterally in the path of the reagent as it descends.

6. In a mixing tank, an outer wall, an inner chamber, spaced apart baffle plates located within said inner chamber arranged relatively to each other for dividing and recombining streams of liquid flowing there-through and relatively inclined for chang-

ing the direction of flow of the streams, a propeller located beneath said baffles to force said liquid upwardly through the same and downwardly between said inner chamber and the wall of said tank, an upper central inlet for fresh incoming liquid, means for discharging a reagent from above said liquid, and a rotatable element for spreading out the fresh liquid to receive said reagent.

10 7. A mixing tank comprising an outer wall, an inner chamber with open ends supported above the bottom of said tank, baffle plates within said chamber, and means for forcing a liquid upwardly through said chamber and baffle plates, said plates being spaced apart and relatively arranged for subdividing streams of the liquid and for uniting portions of one subdivided stream with portions of another subdivided stream and relatively inclined for changing the directions of the subdivided and united streams repeatedly, said means being adapted to force the liquid upwardly through the chamber outwardly into the tank and downwardly, thence upwardly again through the chamber.

8. A method of treating a liquid with a reagent comprising simultaneously introducing continuous streams of the two materials into a vessel in a predetermined ratio, dispersing each material during said introduction, merging the two materials while dispersed, adding the combined materials in finely dispersed form to a smoothly flowing surface of a body of liquid flowing in a closed circuit in the vessel, drawing the surface portions of the body downwardly into said body along with the newly added materials, repeatedly changing the directions of flow of the liquid within the body, subdividing streams of the flowing liquid and uniting the subdivided portions of one stream with subdivided portions of other streams to effect thorough and progressive intermingling of the liquid, and returning the intermingled portions to said surface.

9. A method of treating a liquid comprising circulating a body of the liquid in a closed circuit, causing portions of the liquid to rise to the surface, to flow smoothly therealong, to flow back into said body and to mix with other portions of the liquid by subdividing, reuniting and by repeatedly changing the directions of the currents within the circulating body, adding fresh liquid to the surface of said body in a widely dispersed stream, and just prior to its entry into said body regulatably adding to the last said stream a substance also in dispersed and finely divided form for treating the liquid, whereby the uniform temporary mixture of the substance and fresh liquid is almost instantaneously uniformly and thoroughly mixed into the entire body of liquid.

65 10. A method of treating a liquid compris-

ing circulating a body of the liquid in a closed circuit, causing portions of the liquid to rise to the surface, to flow smoothly therealong, to flow back into said body and to mix with other portions of the liquid by repeatedly changing the directions of the currents within the circulating body, adding fresh liquid to said body in widely dispersed form at the surface of said body adjacent to the points where the surface liquid re-enters the body in the cycle, and adjacent to the point of addition of the fresh liquid to said surface regulatably adding to the widely dispersed fresh liquid a finely divided and dispersed substance for effecting a treatment of the liquid, whereby the uniform temporary mixture of the substance and fresh liquid is almost instantaneously uniformly and thoroughly mixed into the entire body of liquid.

11. A method of treating a liquid comprising circulating a body of the liquid in a closed cycle, continuously adding fresh liquid to said body, circulating the liquid within the body with repeated change of direction of flow to cause thorough intermingling, continuously circulating portions of the body to an exposed smoothly flowing surface and immediately thereafter drawing the same exposed portions deeply into said body for subsequent upward circulation, widely dispersing the incoming fresh liquid to cause it to strike said surface and be drawn immediately into said body along with the other circulating liquid, and dispersing in finely divided form upon said dispersed incoming stream a substance to be thereby mixed with the incoming stream just prior to the entrance of said stream into said body, whereby the uniform temporary mixture of the substance and fresh liquid is almost instantaneously uniformly and thoroughly mixed into the entire body of liquid.

12. The method of treating a liquid with a reagent for flocculating the colloids in the liquid comprising circulating a body of the liquid in a closed circuit and successively presenting to the smoothly flowing surface of the body various portions of the liquid, thereafter drawing these exposed portions quickly into the body of the liquid and positively mingling them with other portions, repeatedly changing the directions of the flowing currents within the body, the operations within the body being sufficient to effect through intermingling to induce growth of the flocks and without such violence as would be adapted to break down the flocks, dispersing fresh liquid in a widely dispersed form onto said surface adjacent to said inward flow of said exposed portions, and adding to the fresh liquid while so dispersed a reagent in widely dispersed and divided form at a point adjacent the contacting of the fresh liquid with said surface, whereby the uniform temporary mixture of

the fresh liquid and reagent is almost instantaneously after being mixed dispersed on the surface of said body and uniformly and thoroughly mixed immediately into the entire body of the liquid.

13. A mixing apparatus comprising a tank, an inner chamber within the tank, means for circulating a liquid in a closed circuit through the chamber and the tank, spaced apart baffle plates interposed in the circuit relatively arranged and adapted for repeatedly changing the direction of flowing liquid, for subdividing the flowing streams and uniting subdivided portions of some streams with subdivided portions of other streams, the circulating means being adapted to present a smoothly flowing exposed surface of liquid in part of the circuit from which surface the exposed particles of liquid are quickly drawn back into the body of the

liquid to continue in the intermingling process, feeding means for supplying fresh liquid to the body adapted to add said liquid in widely dispersed form to said surface adjacent the points where said particles re-enter said body, and means for dispersing upon the incoming dispersed fresh liquid a substance in finely divided and dispersed form, the last said means and the fresh liquid feeding means being adapted to effect a uniform temporary mixture of the fresh liquid and the substance and almost instantaneously thereafter to disperse said mixture on the surface of said body, and the circulating means being adapted to draw said mixture immediately into said body for intermingling with the entire body of the liquid.

In testimony whereof, I have subscribed my name.

WILLIAM A. GILCHRIST.