Jan. 10, 1939. M. GAERTNER 2,143,652

POSITIVELY CONTROLLED VERTICAL AGITATOR AND CONDITIONER

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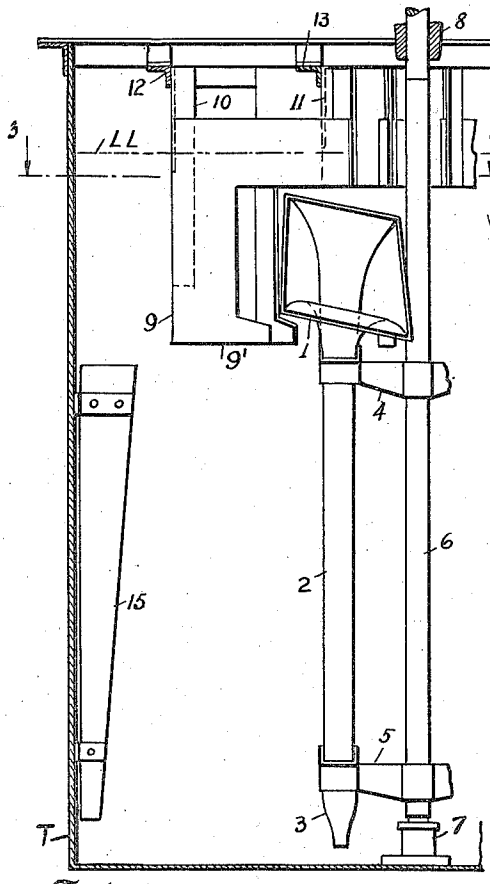


Fig. 1.

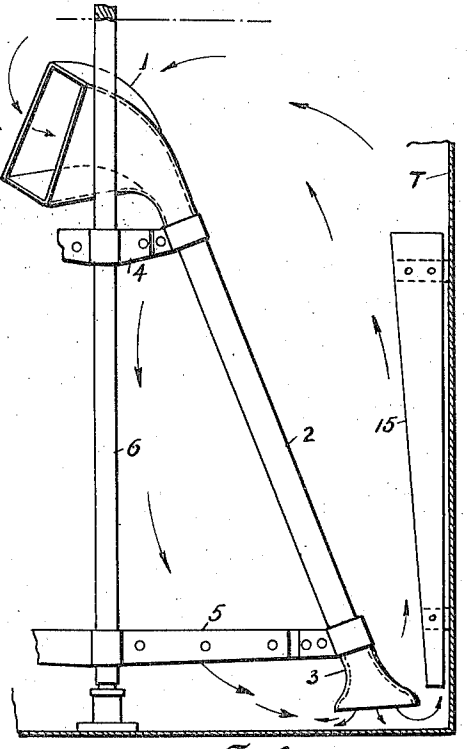
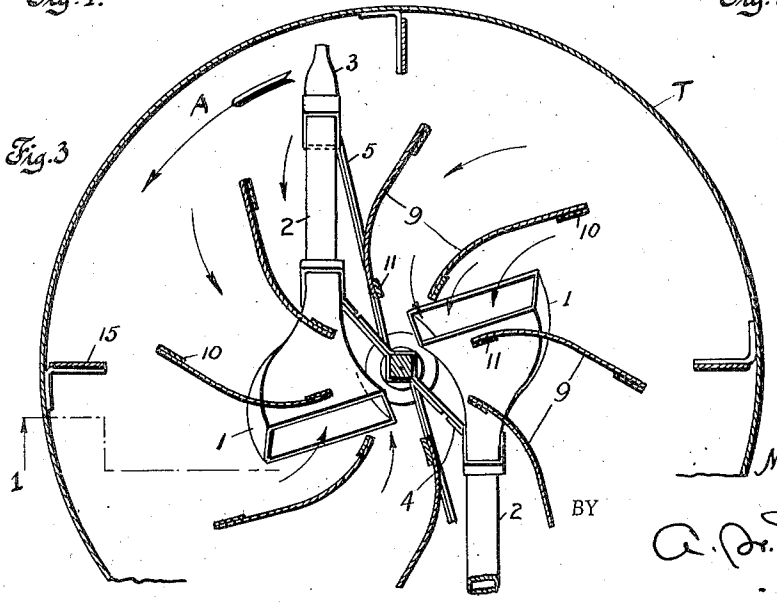


Fig. 2

Fig. 3



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POSITIVELY CONTROLLED VERTICAL AGITATOR AND CONDITIONER

Moritz Gaertner, New York, N. Y.

Application September 16, 1936, Serial No. 100,994

1 Claim. (Cl. 259—96)

The present invention relates to agitators and conditioners, and, more particularly, to an improved agitator for liquid substances in which positively controlled vertical circulation can be accomplished with or without aeration of the treated mixture.

Heretofore, in conventional agitators for mixing solid and relatively heavy materials with large quantities of liquids or in processes such as the cyanide process where conditioning or aeration of a mixture was desired, great amounts of energy and of time had to be employed without being able to obtain a completely satisfactory solution. Although not completely solved, the problem was a relatively simple one when it was desired to mix or to condition substances having similar specific gravities. Great practical difficulties, have been encountered, however, when substances of widely different specific gravity had to be mixed. Such was the case, for example, when one of the substances was of a very light or floating character, such as wood pulp, cellulose, or in the other extreme case when heavy minerals, comminuted ores and the like substances had to be treated, which had a tendency of settling, accumulating or collecting on the bottom of the tank. If it was desired to aerate the mixture, generally compressed air was introduced from a special compressor system or great amounts of additional power were employed to force air downward into the mixture. Of course, the aeration carried out in this manner was not satisfactory and could not be carried out successfully in tanks of accentuated height, since at best an incomplete and weak downward current was obtained and the conventional processes completely failed in lifting material to the top, unless the tanks were very low. The problem was further aggravated by the circumstance that the trend of development in the art was towards employing tanks of very large dimensions so that at present tanks as high as 30 feet and more are quite common. In agitators of this type generally, a plurality of propellers was provided set at a distance of not more than about 7 or 8 feet one from the others on a vertical shaft to produce a vertical current while a larger impeller was provided at the bottom to produce the desired rotating motion of the liquid. Plainly, a system of this character was extremely crude and of such low efficiency that excessive amounts of time and of power had to be employed to make up at least in part for the deficiencies of the operating principle. Results have been even more unsatisfactory when it was attempted to employ very high speeds since the resistance in the liquid medium increases as the third power of the speed, the liquid had a tendency to behave almost like a solid material. This detrimental effect almost completely nullified the benefit of additional power. It was generally found that each one of the propellers or similar appliances on a vertical shaft was of the character of an independent unit, the effect of which was confined within a sphere or zone of relatively small dimensions. The form of this zone, in which the propeller or impeller was able to maintain a circulation, varied according to the form or construction of the impelling member and could be of a spherical or of an ellipsical character, but, in all cases, the delivery of such appliances in a definite direction was extremely limited. For example, if a particle floating on the surface of the liquid was caught by the topmost propeller, chances of its being delivered to the second, third and fourth propeller were extremely small and usually such a particle would be circulated in an indefinite number of times around the one and the same propeller before finding its way at last to the bottom and up to the top again. In these conventional agitators, the chances and possibilities of by-passing have been so numerous and varied that no safe prediction or practical calculation could be attempted of the number of times the complete solution will travel through the full height of the tank. To bring up heavier material from the bottom of the tank up to or near the surface or particularly above the surface for the purpose of aeration was obviously entirely out of question. On the other hand, most liquids cannot be agitated and conditioned by merely floating up and down at wide intervals. In order to obtain a quick and homogeneous solution, it is imperative to continuously change and to break up the current preferably combined with contraction and expansion of the liquid to tear apart and to separate viscous, gummy or sticky materials. Although from time to time numerous suggestions and proposals have been made to solve the outstanding problem, none, as far as I am aware, of these various suggestions and proposals has been completely satisfactory and successful when carried into practice on a practical and industrial scale.

I have discovered that the outstanding problem may be solved in a remarkably simple manner.

It is an object of the present invention to provide an improved agitator and conditioner which is free from the above disadvantages and inconveniences of conventional agitators.

It is another object of the present invention to provide an improved agitator or conditioner which is equally adapted to mix and to treat small and large quantities of substances and which provides positive, definite and readily controllable up and down movement and vertical circulation of the liquid to be treated.

It is a further object of the invention to provide an agitator having means for controlling the quantity of solution treated within a definite time so that the time may be ascertained and adjusted within which the whole contents of the tank make a complete vertical circulation.

A further object of the invention is to provide an improved agitator in which the means producing the up and down or vertical circulation at the same time are capable of thoroughly agitating and conditioning the complete contents of the container and that the said means compress and expand the treated liquid both in the direction of the said vertical circulation and at approximately right angles thereto.

It is also within contemplation of the invention to provide an improved agitator and conditioner involving an aerator, a pump and mechanical means for breaking up solids and dividing substances of a viscous and sticky consistency which is simple in construction, efficient and foolproof in operation and which may be easily cleaned and maintained in perfect operating condition at a very low cost.

Other and further objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawing, in which:

Fig. 1 illustrates a vertical sectional view, somewhat fragmentary, of a preferred embodiment of the invention, taken on line 1—1 of Fig. 3;

Fig. 2 depicts a vertical sectional view, also fragmentary, of the agitator shown in Fig. 1, taken in a plane at right angles to that of Fig. 1; and

Fig. 3 is a fragmentary cross sectional view taken on line 3—3 of Fig. 1.

Broadly stated, according to the principles of the present invention, I provide a shaft rotatably mounted in a container or tank and provide driving means for said shaft. Rigidly fastened to this shaft, I provide a hollow tubular element which is open at both ends thereof and is preferably mounted at a greater distance from the shaft at one of its ends than at the other. I have found that a hollow tubular element of the described character provides an excellent agitating member which may be modified in various forms to be adapted to the most different agitating problems. The principal advantage of my hollow tubular agitating element is that it provides a double agitating action. First of all, the outer surface of the tubular member provides an agitating blade of highly efficient and economical character. In addition to this, due to the fact that one end of the hollow tubular agitating member, which in the following will be referred to as a flow pipe, is closer to the shaft than the other end thereof, when the agitating member or flow pipe is rotated the centrifugal force at the far end of the pipe will cause the liquid to flow therethrough and to be replaced by fresh liquid at the other end thereof. This will have the effect of providing a positive and highly desirable vertical or up and down circulation in the liquid so that always new and fresh particles are treated by the agitator member and the complete quantity of the liquid in the tank or container is successively and at short intervals exposed to the effect of the agitating member. This results in agitating efficiency which has been unobtainable heretofore by any of the conventional agitating devices in which the up and down circulation, if any, was accidental, indefinite and uncontrollable.

Of course, the hollow agitating member may be formed in various ways according to the type of liquid to be treated and to the dimensions of the tank. A plurality of agitating members or flow tubes may be arranged in groups of 2, 3 or more spaced equidistant from and parallel or at an angle to each other. The intake ends of the flow pipes may be provided with intake openings of special form, such as cup or funnel-like intake openings having such form including curved shapes which cause the liquid to readily enter the flow pipe during the rotation thereof. This effect may be further enhanced by means of baffle plates surrounding the rotating intake openings of the flow pipes so that churning or rotation of the liquid is prevented and that the liquid is forced into the flow pipe at a considerable pressure. Further baffle plates of conventional character may be provided on the side walls of the container or tank to break up the liquid currents therein in the usual manner. The discharge end of the flow pipes may be provided with nozzles of suitable form directing the outflowing liquid against baffle surfaces above or underneath of the liquid level in order to break up or in some cases to aerate the liquid and to finely divide floating or sedimentary solid substances in the liquid. Of course, the flow pipes may have various forms, such as straight line, curved, spiral and the like.

Referring now more particularly to Figs. 1 to 3, in a tank T a vertical shaft 6 is rotatably mounted in an annular or thrust bearing 7 located at the bottom of the tank and an upper bearing 8 which may be operatively associated with a reduction gear case (not shown) in conventional manner. Shaft 6 is preferably of a quadratic cross section in order to facilitate rotationless mounting of the various additional elements thereon. On shaft 6 is mounted a square tube forming the agitating member by means of an upper short arm 4 and a lower long arm 5. The square agitating tube 2 is provided with a funnel shaped intake cup 1 at the upper end thereof and with a flat outlet nozzle 3 at the lower end thereof. Preferably, the intake cup 1 rotating in the direction of the large arrow A against the liquid in the tank T is arranged below the liquid level L—L. In view of the fact that the intake area of cup 1 is much larger than the cross section of tube 2, the pressure within the tube and with it the speed of the flow will be increased. The speed of the flow will be further accelerated as the circumferential speed increases towards the outlet nozzle 3 whereby a larger quantity of liquid will be discharged. It is to be observed that the intake of the liquid will be at its highest efficiency when the fluid facing the intake opening is completely or nearly at rest at the intake area, and that little or no downward flow within the tube 2 would take place if the outside mass of the liquid would revolve at the same speed as the intake cup. To keep the liquid at rest in proximity of the intake opening, baffle plates 9 are fastened by straps 10 and 11 to rings 12 and 13 which are attached to the top portion of tank T by means of structural angles or beams 14. Further baffle plates

15 of conventional character are provided on the side walls of tank T to produce cross currents in the whirling mass of liquid and thereby thoroughly break up and mix the liquid. This partly rotating motion in direction of arrow A is utilized by the curvature of top baffles 9 which direct the current inwards towards the intake and are of a cross section to conform as closely as possible to the outline of intake cup 1 whereby the liquid is almost completely prevented from forming a current in the direction of rotation of the intake cup. However, underneath the bottom edge 9' of baffle plates 9 a very strong current will be created which is very desirable. Although only two agitator pipes 2 with associated intake cups 1 and outlet nozzles 3 have been illustrated, of course, any other number of agitating pipes such as 1, 3 or 4, etc., may be employed with similar results.

From the preceding description, the operation of my improved agitator will be readily understood by those skilled in the art. When the shaft 6 and in connection therewith agitating pipes 2 are rotated, two independent flows will be set up within the agitator. The first one of these flows is caused by displacements of the outer surface of agitator tubes 2 which act like agitator blades and create a circular and downward motion as this is disclosed and explained more fully in my copending application Ser. No. 758,552, filed December 21st, 1934, now Patent No. 2,082,796. This circular and downward motion of the liquid is broken up by baffles 15 in the conventional manner. The second flow is a positively controlled and exactly measurable downward flow within pipes 2, the liquid entering through intake cups 1, being subjected to compression as passing through the pipes and being discharged under further increased pressure close to the bottom of the tank in part against the current and exerting a powerful stirring and breaking effect on the liquid. The strong downward flow of liquid through intake cups 1 will draw in substantially all of the material floating on the top of the liquid and in addition a great volume of air depending on the distance of cups 1 from the liquid level L—L. Thus, a very powerful and well controlled positive up and down or vertical circulation and aeration of the liquid is assured.

Although the present invention has been described in connection with certain preferred embodiments thereof, variations and modifications may be resorted to by those skilled in the art without departing from the principles of the present invention. I consider all of these variations and modifications as being within the true spirit and scope of the present invention as disclosed in the present description and defined by the appended claim.

I claim:

An agitator which comprises a casing, a powered shaft at the center of said casing, a plurality of tubular agitating members mounted on said shaft and extending from the top to the bottom thereof and set further from the shaft at one end than at the other end, an intake opening for each of said agitating members, said intake opening being provided at the end of said agitating member which is closer to said shaft and having an intake area which is substantially in a plane radial with reference to the axis of rotation and facing the direction of rotation, discharge nozzles at the other end of said agitating members, and curved stationary baffle plates having substantially concave surfaces directed against the direction of rotation surrounding the path of movement of said intake openings and closely conforming to the outlines thereof whereby rotation of a liquid in said casing is prevented and said liquid is forced to flow through said tubular members to cause positive vertical circulation thereof.

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