Nov. 7, 1939. E. PICK 2,179,271

AGITATOR

Filed March 30, 1939

FIG.1

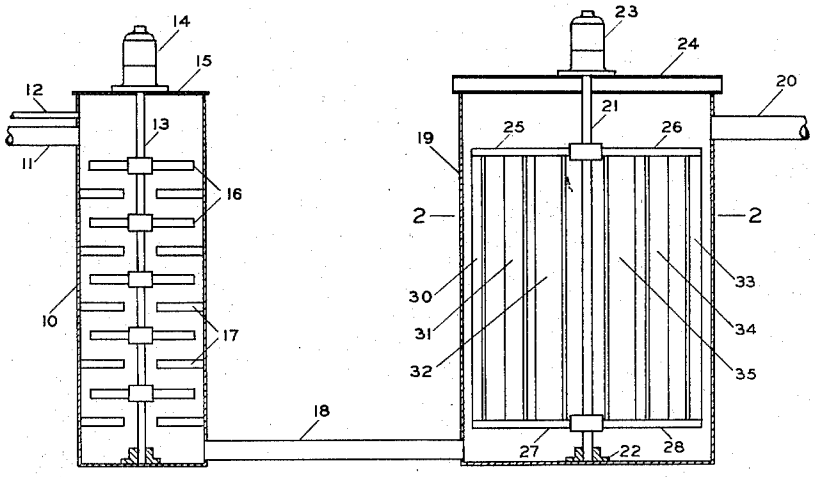


FIG.2

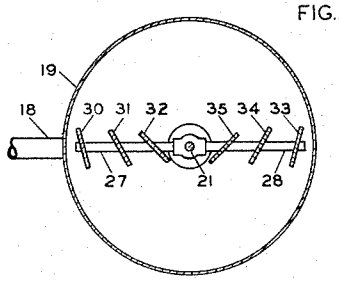


FIG.3

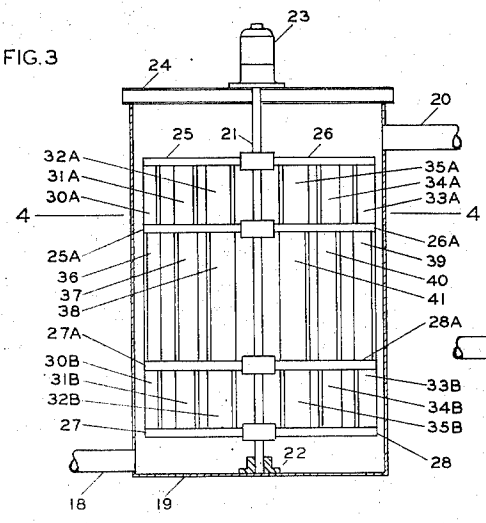
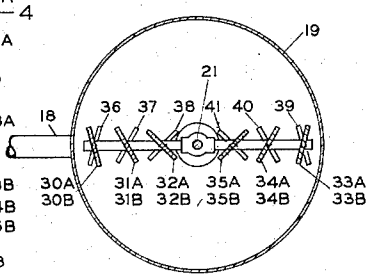


FIG.4



INVENTOR.

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AGITATOR

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5 Claims. (Cl. 259—107)

This invention relates to agitators for liquids, and it comprises a shaft with blades carried by the shaft and inclined at oblique angles on one side of said shaft and at oblique angles inclined in the opposite direction to the first mentioned angles on the other side of said shaft; all as more fully hereinafter set forth and as claimed.

In many processes gentle agitation of a liquid is practiced. In water treatment by chemical methods, for instance, where lime, soda, alum, ferric salts, etc. are added to water to form a precipitate or floc, it has been found that best results are obtained by first thoroughly mixing the water and chemical at relatively high speed for a short period of time and then gently agitating the mixture at relatively low speed for a longer period of time. The high speed mixing presents no great problem because an agitator running at high speed creates high turbulence and strong eddy currents so that the desired homogeneous mixture is readily obtained. In gentle low speed agitation, however, in which horizontal or vertical blades carried on an agitator shaft have been used with rotational peripheral speeds of the order of 2 feet per second, difficulties have been experienced due to lack of sufficient agitation near the shaft where the progressive movement of the agitator is quite slow, resulting in non-uniform treatment.

The objects of my improvement are first to provide a low speed agitator by which the liquid near the shaft is continuously being displaced so that the entire body of liquid is uniformly agitated and dead or stagnant spaces are avoided; and secondly, to provide an agitator in which the reaction forces are substanially balanced.

I attain these objects by agitators illustrated in the accompanying drawing, in which—

Fig. 1 is an elevation, partly in section, of a water treating apparatus including an agitator in accordance with my invention;

Fig. 2 is a horizontal section along lines 2—2 of Fig. 1;

Fig. 3 is an elevation, partly in section, of a modified agitator; and

Fig. 4 is a horizontal section along lines 4—4 of Fig. 3.

Similar reference numerals refer to similar parts throughout the several views.

An agitator of the general type shown in Figs. 1 and 2 has been illustrated and described, but not specifically claimed, in a co-pending application of Samuel B. Applebaum, Serial No. 163,843 filed Sept. 14, 1937.

Referring now to Fig. 1, a mixing chamber 10 is provided with an inlet 11 for water to be treated and an inlet 12 for chemical. Within chamber 10 is a vertical shaft 13 rotated at relatively high speed by a motor 14 which is mounted on a cover 15. The shaft 13 carries horizontal agitator arms 16. Stationary arms 17 arranged between the agitator arms 16 increase the turbulence so as to produce rapid and complete mixing. Near the bottom of chamber 10 is an outlet 18 leading to a low speed agitation chamber 19 which is provided with an outlet 20 near its top.

Within chamber 19 is arranged a vertical shaft 21 which is rotatable in a guide bearing 22 mounted on the bottom of chamber 19. Shaft 21 is rotated at relatively low speed by a motor 23 with integral gear reduction mounted on beams 24 on the top of chamber 19. The shaft 21 carries a cross member with arms 25 and 26 near the top and another cross member with arms 27 and 28 near the bottom of chamber 19. Between the arms of the cross members are mounted vertical blades 30, 31, 32, 33, 34 and 35. As shown in Fig. 2, all of these blades are mounted at oblique angles to the cross members. The blades 30, 31, and 32 are mounted between arms 25 and 27, and the oblique angle included between blades and cross members increases progressively from the center toward the periphery. The blades 33, 34 and 35 are similarly mounted on arms 26 and 28, but they are inclined towards members 26 and 28 in a direction opposite to that in which blades 30, 31 and 32 are inclined to arms 25 and 27.

Upon rotation of shaft 21 in a clock-wise direction the blades 30, 31 and 32 tend to move the liquid towards the shaft 21 while the blades 33, 34 and 35 tend to move the liquid away from the shaft 21 toward the periphery of the chamber 19. The outermost blades 30 and 33 which move at relatively high speed are inclined at a greater angle than the innermost blades 32 and 35 which move through the liquid at relatively low speed. While improved agitation is obtained within the scope of my invention if all the blades on each side of the shaft include the same angle with the cross members, the progressive increase in angularity described and illustrated provides a more uniform radial movement of the liquid, and thus more uniform agitation. In either case, my agitator creates a diagonal movement of liquid across a diameter of the tank and this diagonal movement rotates with the agitator. In this manner, any dead or stagnant spaces near the center of the tank are effectively prevented and the entire body of liquid is agitated.

In operation of the device illustrated in Figs. 1

and 2, water and chemical entering chamber 10 through inlets 11 and 12 respectively, are first mixed at high speed by the agitator blades 16. The mixture then passes through pipe 18 into the low speed agitation chamber 19 where it is gently and uniformly agitated by blades 30 to 35 until it flows through outlet 20 to a filter or sedimentation space (not shown) in which the floc or precipitate formed in chamber 19 is separated from the water.

As has been stated above, the low speed agitator illustrated in Figs. 1 and 2 produces a diagonal flow in the direction from blade 30 toward blade 33. This flow imparted to the water produces a reaction force on shaft 21 in the direction from blade 33 toward blade 30, and this reaction force rotates of course with the shaft. Especially in large size agitators this reaction force requires an unduly heavy shaft to resist the bending moment and also over-sized bearings at top and bottom of the shaft to take up the force. The reaction force exerted on the shaft and the bearings can be eliminated by a modification of my low speed agitator.

As shown in Fig. 3, two additional cross members 25A, 26A and 27A, 28A are arranged on shaft 21 between cross members 25, 26 and 27, 28. Blades 30A, 31A and 32A, and 33A, 34A and 35A are mounted between arms 25 and 25A, and 26 and 26A, respectively, and inclined in the same manner as blades 30 to 32, and 33 to 35, respectively, of the agitator illustrated in Figs. 1 and 2. Blades 30B, 31B and 32B, and 33B, 34B and 35B are similarly mounted between arms 27 and 27A, and 28 and 28A, respectively. An additional set of blades 36, 37, 38, 39, 40 and 41 is mounted between cross members 25A, 26A, and 27A, 28A and these blades are inclined to the cross members in a direction opposite to that of blades 31A to 35A and 31B to 35B as is clearly shown in Fig. 4. Blades 36 to 41 are preferably made twice as long as blades 30A and 35A and 30B to 35B.

Upon rotation of shaft 21 in Fig. 4 in a clockwise direction, blades 30A and 35A produce a liquid movement directed from blade 30A to blade 33A with a resulting force in the opposite direction. Blades 36 to 41 produce a flow of liquid from blade 39 toward blade 36 with a reacting force directed from blade 36 toward blade 39. Blades 30B to 35B produce a flow of liquid and a reaction force in the same direction as those produced by blades 30A to 35A. The length of blades 36 to 41 being equal to the sum of the lengths of blades 30A to 35A and 30B t o 35B the reaction force produced by blades 36 to 41 likewise equals the sum of the forces produced by blades 30A to 35A and 30B to 35B, and since they act in opposite directions they balance each other. The blades are mounted on the same cross members, so that these members take up the opposed forces with the result that no unbalanced reaction force acts on the shaft or on the bearings. Moreover, the reversal in direction of the radial flow as the liquid passes from one tier of blades to the next, further improves the effectiveness of agitation. It will be clear that a balancing of the reaction forces can be obtained by various modifications of the arrangement illustrated in Figs. 3 and 4.

The agitator in accordance with my invention produces a gentle diagonal flow across a rotating diameter of the chamber in which the agitator is installed, thus successfully preventing any dead or stagnant spaces. While my agitator has been shown in a water treating apparatus for purposes of illustration, it is to be understood that it is not limited to such use but may be applied in any case where gentle and uniform agitation of a liquid is desired.

What I claim is:

1. An agitator for liquids comprising a shaft, power means for rotating the shaft, cross means attached to the shaft, and blades extending in a direction parallel to the shaft and attached to said cross means on one side of the shaft at oblique angles to said cross means and on the opposite side of the shaft at oblique angles inclined in the opposite direction to the first mentioned angles, the oblique angles increasing progressively from blade to blade on each side of the shaft in a direction away from the shaft.

2. An agitator for liquids comprising a vertical shaft, power means for rotating the shaft, horizontally extending means mounted on the shaft, flat vertical blades attached to the horizontally extending means on one side of the shaft at oblique angles to the horizontally extending means, and other flat vertical blades attached to the horizontally extending means on the opposite side of the shaft at oblique angles inclined in the opposite direction to the first mentioned angles, the oblique angles increasing progressively from blade to blade on each side of the shaft in a direction away from the shaft.

3. An agitator for liquids comprising a shaft, power means for rotating the shaft, a plurality of spaced cross members attached to the shaft, blades mounted between a pair of said cross members at an oblique angle to the cross members on one side of the shaft and at an oblique angle inclined in the opposite direction to the first mentioned angle on the other side of the shaft, and other blades mounted between another pair of cross members at oblique angles inclined in a direction opposite to that in which said first mentioned blades are mounted, all of said oblique angles increasing progressively from blade to blade on each side of the shaft in a direction away from the shaft.

4. An agitator for liquids comprising a shaft, power means for rotating the shaft, four cross members attached to the shaft, a plurality of blades mounted between the first and second and between the third and fourth cross members at oblique angles to the cross members on one side of the shaft and at oblique angles inclined in the opposite direction to the first mentioned angles on the other side of the shaft, and other blades mounted between the second and third cross members at oblique angles inclined in a direction opposite to that of the angles at which said first mentioned blades are mounted, the blades mounted between the first and second and between the third and fourth cross members being substantially half as long as the blades mounted between the second and third cross members whereby radial reaction forces created upon rotation of the shaft by the blades mounted between the first and second and between the third and fourth cross members are balanced by radial reaction forces created upon rotation of the shaft by the blades mounted between the second and third cross members.

5. An agitator for liquids comprising a shaft, power means for rotating the shaft, four cross members attached to the shaft, a plurality of blades mounted between the first and second and between the third and fourth cross members at oblique angles to the cross members on one side

of the shaft and at oblique angles inclined in the opposite direction to the first mentioned angles on the other side of the shaft, and other blades mounted between the second and third cross members at oblique angles inclined in a direction opposite to that at which said first mentioned blades are mounted, said first mentioned blades being substantially half as long as said other blades, and all the oblique angles increasing progressively from blade to blade on each side of the shaft in a direction away from the shaft.

ERIC PICK.