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ACID-WATER MIXING DEVICE

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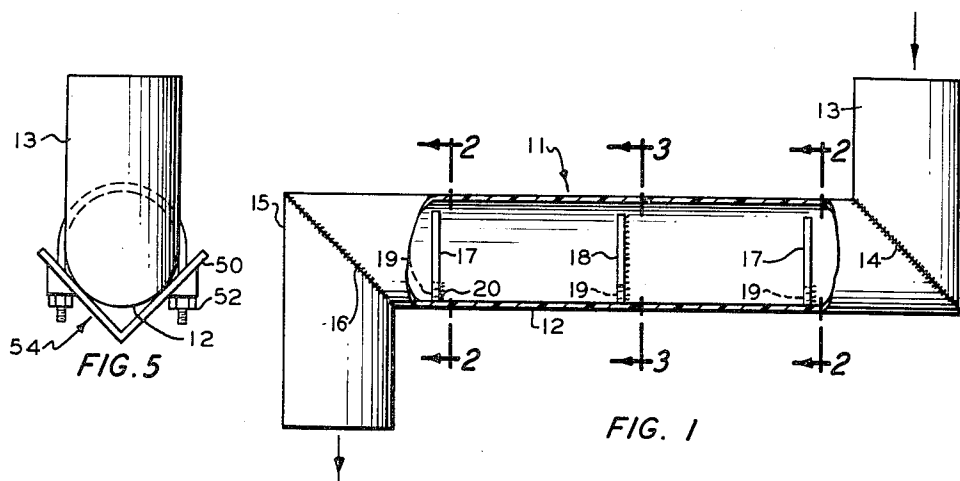


FIG. 1

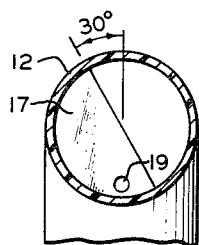


FIG. 2

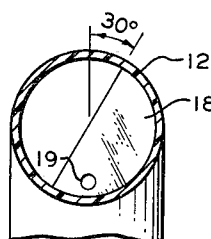


FIG. 3

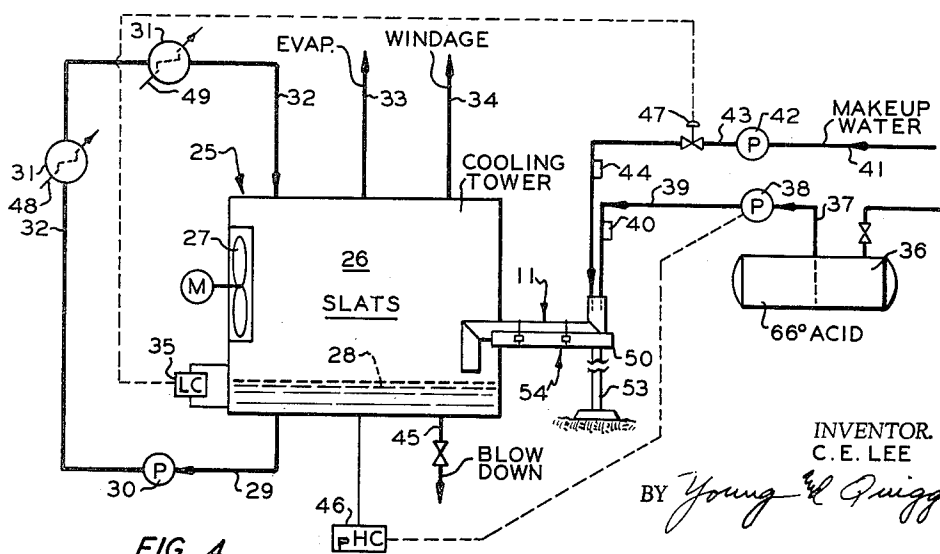


FIG. 4

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## ACID-WATER MIXING DEVICE

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This invention relates to a mixing device. In one aspect it relates to a mixing device suitable for mixing liquids one or more of which are corrosive to mixing devices of conventional materials. In another aspect it relates to a device suitable for mixing liquids, the mixture being corrosive to conventional steel structural materials. In yet another aspect it relates to a mixing device of a polyolefin material of such construction that concentrated sulfuric acid and water can be mixed therein continuously in an industrial cooling tower operation without evidence of acid corrosion.

As is well known in the chemical art, concentrated or 66 degree sulfuric acid can be stored and handled in conventional steel tanks, piping, etc. However, upon dilution of this concentrated acid with water, the solution becomes extremely corrosive to such equipment and special acid-resistant vessels, piping, etc., are required. Since the concentrated acid is not corrosive to steel, the acid for industrial purposes is ordinarily purchased, and transported in this form in steel vessels. For some purposes the acid is used in concentrated form but most uses require that it be diluted with water. It is under this latter condition that corrosion problems exist. The selection of mixing or dilution equipment which is resistant to acid corrosion is frequently a serious problem.

An object of this invention is to provide an efficient and relatively inexpensive device for mixing of liquids. Another object of this invention is to provide such a mixing device suitable for mixing liquids which are corrosive to mixing devices of conventional materials. Another object of this invention is to provide a relatively inexpensive mixing device suitable for mixing liquids, the mixture of which is corrosive to conventional steel structural materials. Yet another object of this invention is to provide a mixing device of a polyolefin material of such construction that concentrated sulfuric acid and water can be mixed therein continuously in an industrial cooling tower operation without evidence of acid corrosion.

According to this invention I provide an apparatus for mixing liquids comprising a first pipe adapted to be positioned with its longitudinal axis generally horizontal, a second pipe having one end attached fluid-tight to one end of the first pipe and extending upward therefrom, a third pipe having one end attached fluid-tight to the other end of said first pipe and extending downward therefrom, and with one or more 180 degree baffles positioned across the diameter of the first pipe in such a manner that the straight edge of the one or more baffles makes an angle with the vertical in such a manner that the semicircular edge of each baffle contacts at least the bottom of the first pipe.

In the drawing, FIGURE 1 illustrates, in detail and partly in section, a side elevational view of the mixing device of this invention. FIGURE 2 is a sectional view taken on the line 2-2 of FIGURE 1. FIGURE 3 is a sectional view taken on the line 3-3 of FIGURE 1. FIGURE 4 is a diagrammatic view of the mixing device of this invention as installed in a cooling tower assembly. FIGURE 5 is an end view of the apparatus illustrating construction and positioning of a support therefor.

On reference to the drawing, reference numeral 11 refers to a mixing device which is constructed of a polyolefin material such as that described and claimed in

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U.S. Patent 2,825,721. The main portion of this pipe or mixing device is a pipe 12 which is intended to be positioned substantially horizontally. This pipe 12 is provided with one or more baffles 17, 18, which are semi-circular in shape. Two baffles can be made from a circle or circular piece of a polyolefin material by cutting through its center to form two like halves. Thus, one edge of the baffle is a straight line passing through the center of the circle and the other edge of the baffle is a semi-circle. Baffle 17, as illustrated in FIGURE 1, is positioned in pipe 12 in such a manner that the straight edge of the baffle makes an angle of about 30 degrees with the vertical as illustrated in FIGURE 2. In FIGURE 1 there are illustrated two of these baffles 17, installed as illustrated in FIGURE 2. The third baffle 18 is positioned in pipe 12 in the same manner with the exception that the angle made by the straight edge of baffle 18 is opposite the angle made with baffle 17. Each of these baffles may or may not be provided with an opening 19 so positioned that the opening is at substantially the lowermost portion of the baffle. These openings are so positioned that at least some of the liquid flowing from one end of pipe 12 to the other can flow through the openings.

Baffles 17 and 18 are welded or fused to pipe 12 by heating pipe 12 and the baffles to a temperature of about 450° F. and positioning the baffle in its intended position and with pressure forming a permanent seal or weld.

The ends of the pipe 12 are beveled at approximately 45 degrees for the accommodation of correspondingly beveled end pipes 13 and 15. These end pipes are also made of the same or of other polyolefin material. Weld 14, joining pipe 13 to pipe 12, and weld 16, joining pipe 15 to pipe 12, are made in a manner similar to that mentioned relative to installation of the baffles.

In FIGURE 4 of the drawing is illustrated a cooling tower assembly employing the mixing device of this invention. Reference numeral 25 identifies the cooling tower assembly containing slats 26 and a motor driven fan 27 in case the tower is a forced draft tower. Coolant water 28 occupies the bottom of the tower assembly and conduit 29 leads this cooling water to a pump 30 which forces the water on through a conduit 32 through one or more heat exchangers 31 and thence the water is returned to the cooling tower. Reference numerals 48 and 49 identify conduits which pass materials to be cooled through the heat exchangers 31.

In the operation of such a cooling tower, there is a certain amount of evaporation of the water to provide the cooling for the operation. When the cooling tower is of the forced draft type there is a certain amount of blowing out of mechanical droplets of the water. The evaporation loss of the water is represented in FIGURE 4 by conduits 33. The windage or blowout loss of water is represented in FIGURE 4 by conduit 34. Also, since water normally used for such industrial cooling towers contains a certain amount of hardness, the water must be treated to prevent formation of scale. The evaporation of some of the water from the cooling tower results in concentration of the salts responsible for hardness. A certain amount of the water is withdrawn through a conduit 45 in such a manner as blowdown as practiced in steam boiler operation to prevent undue salt concentration.

Thus, water lost through evaporation, windage and blowdown presents the need for addition of make-up water. This make-up water must be treated to prevent scale formation on heat exchange surfaces. Such water is ordinarily treated merely by acidifying with sulfuric acid and then a corrosion inhibitor added to prevent acid

corrosion. The acidity is frequently described and spoken of in terms of pH and, according to this invention, it is preferable to maintain the acidity or pH of the solution within the limits of about 5 to about 7, preferably about 6.0 to 6.8. Although pH of such cooling water within a range of about 5 to 7 is generally suitable, pH outside that range is not desirable because as a pH above this range formation and precipitation of scale upon the walls of heat exchange equipment occurs with accompanying lowered efficiency of the heat exchange process. At a pH below this range corrosive effects of the cooling water on the heat exchange equipment are unduly high, requiring excessive amounts of corrosion inhibitor. However, when using the acid in conjunction with corrosion inhibiting additives, such as, for example, the phosphate-cyanide compositions disclosed in U.S. 2,515,529, it is preferable to maintain the pH at a value in the range from about 6.2 to about 6.8, as is well known in the art.

On reference again to FIGURE 4, the acid-water mixing device of this invention is positioned so as to extend through a side wall of the cooling tower in such a manner that liquid from the mixer is dropped gently into the liquid 28 in the bottom of the tower. 66-degree sulfuric acid is stored in vessel 36 and is pumped through a conduit 37 by pump 38 and passed through a conduit 39 into the section of pipe 13, identified in FIGURE 1, of the mixing device. Water or make-up water, from a source, not shown, is passed through a conduit 41 and is pumped by a pump 42 through a conduit 43 into the pipe section 13. The sulfuric acid from pipe 39 and the water from pipe 43 pass into the inlet section 13 of the mixer and drop into a small lake of liquid such as will be maintained on the right-hand side of the first baffle 17. On flowing around the straight side of baffle 17, there is a swirling action resulting in mixing of the water and acid. On flowing to the left through pipe 12, and on passing the straight side of baffle 18, there is a swirling action in the opposite direction, tending further to mix acid and water. On passing still further in pipe 12 and around the straight side of another baffle 17, swirling occurs in the opposite direction from that caused by baffle 18. By the time the acid and water pass the second baffle 17 on travel from right to left in pipe 12, mixing is complete. This acid-water solution is then passed downwardly through outlet pipe 15 into the main body of cooling water 28. The openings 19 allow a small volume of the liquid to pass therethrough, which operation results in further agitation and mixing of the acid and water.

A conventional pH or acidity sensing and control device 46 is provided for sensing the pH of the acid in the body of cooling water 28 and this controller 46 controls the acid pump 38 for metering the acid added to mixer 11. A look glass or look box 40 is provided in conduit 39 for visual inspection to determine whether acid is or is not flowing through conduit 39. Also, a look glass or box 44 is provided in conduit 43 for visual inspection of water flowing through this conduit. The rate of flow of water is regulated in response to the operation of a liquid level control assembly 35 so positioned in the cooling tower as to maintain a predetermined level of liquid in the bottom of the tower. Thus this liquid level control device actuates motor valve 47 for regulation of the rate of flow of water into the tower. Then, upon addition of acid and proper mixing in mixing device 11, the pH sensing device activates the controller and the controller regulates the rate of flow of acid by actuation of pump 37.

I have found that an acid-water mixing device such as that disclosed and described herein operates very satisfactorily for extended periods of time without any evidence whatever of acid corrosion in the mixing device,

A support device is provided for support of the portion of the mixing device which is outside of the cooling tower 25. This support device is illustrated in FIGURE 5 and comprises a trough made of a pair of boards, i.e., wooden boards attached to one another to form a wide angle V. Several U-bolts 51 are positioned around the polyolefin pipe 12 and extend through openings in boards 50 with nut assemblies 52 holding the polyolefin pipe rigidly to the trough 50. This entire support trough assembly is identified by reference numeral 54. This assembly at its outermost end from cooling tower 25 is supported from the earth by a support assembly 53.

The pH measuring portion of the pH controller 46 can comprise a glass electrode and a calomel electrode which communicate with the controller and the controller can be any instrument which is responsive to pH measured by such a pH measuring means and which thus actuates means to operate pump 38. A pH sensing and controller means such as identified by reference numeral 46 is available commercially as, for example, from Minneapolis-Honeywell Regulator Company.

Flow controllers such as liquid level controller 35 are well known in the art and description of the controller 35 is not made herein for purposes of brevity.

While certain embodiments of the invention have been described for illustrative purposes, the invention obviously is not limited thereto.

That which is claimed is:

1. An apparatus for mixing liquids comprising a pipe adapted to be positioned in a generally horizontal position; a plurality of baffles positioned in spaced-apart relation along the axis of said pipe and transversely thereto, each of said baffles being approximately a semi-circle the curved edge of which engages a lower wall section of said pipe, the straight line edge of which is oblique, alternate baffles being positioned with their straight edges in corresponding slope, the remaining baffles being positioned reversely as to slope.

2. The apparatus of claim 1 wherein the straight edges of said baffles form an angle of about 30° with the vertical so that planes passing thru the straight edges of each set of alternate baffles form an angle of about 60°.

3. The apparatus of claim 2 wherein each baffle is pierced by a hole in its lowermost section.

4. The apparatus of claim 1 wherein said pipe and baffles are constructed of polyolefin.

5. A cooling tower system comprising, in combination, a cooling tower adapted for cooling water having means for adding make-up water and acid to the water in said tower comprising an apparatus constructed substantially in accordance with the apparatus of claim 1, one end of said pipe being positioned inside of said tower near a water level therein and the other end outside thereof; and means for introducing water and acid to the outer end of said pipe.

6. The tower system of claim 5 wherein said apparatus is constructed entirely of polyolefin.

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