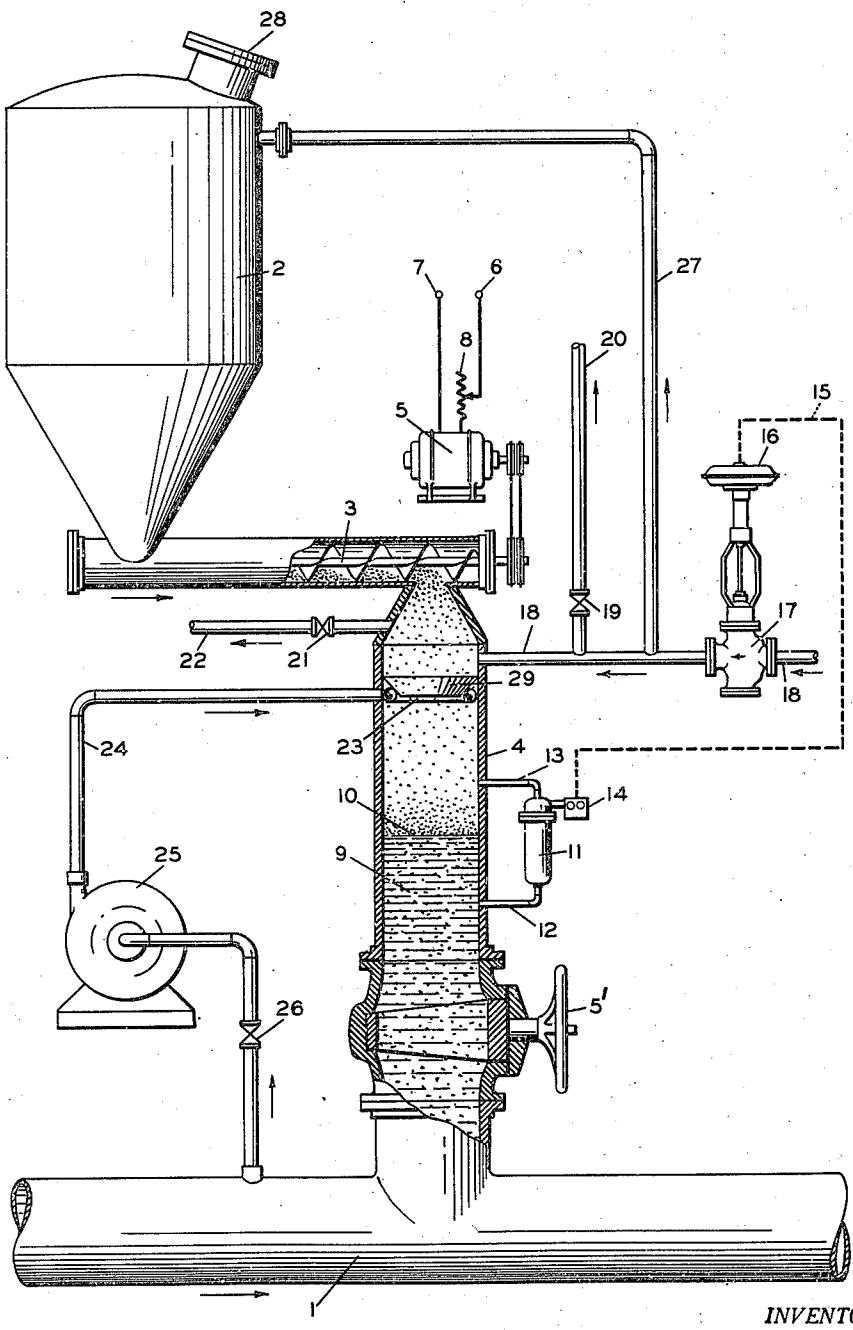
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SYSTEM FOR ADDING SOLIDS TO LIQUIDS UNDER PRESSURE

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SYSTEM FOR ADDING SOLIDS TO LIQUIDS UNDER PRESSURE

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This invention relates to apparatus for the controlled introduction of solid materials to a liquid system. In a more specific aspect, it relates to systems for adding solids to liquids under a pressure substantially different than atmospheric pressure. In a still more specific aspect, it relates to such a system in which the solid material is metered and washed down into the liquid while the liquid level is controlled.

The introduction of solid materials in granular or powdered form to systems operating at pressures greater than atmospheric or less than atmospheric has been an industrial problem unsolved by the prior art. For many years, the specific problem of continuously adding aluminum chloride to pressure reaction systems such as liquid phase alkylation, isomerization, and other systems utilizing aluminum chloride, either as such or as a fluid complex, has not been solved satisfactorily by the prior art. The aluminum chloride, of course, is generally used as a catalyst, as is well known in the prior art.

In the prior art, the aluminum chloride salt was sometimes pumped into the system as a slurry, with resulting difficulties of pump erosion and corrosion, check valve wear and other difficulties. In systems using a liquid aluminum chloride hydrocarbon complex, the complex is sometimes withdrawn from the system, aluminum chloride dissolved in the complex and the mixture pumped back into the system. Due to low solubility of aluminum chloride in the complex, such a system requires an excessively large volume of complex to be withdrawn and pumped back into the system with the added aluminum chloride. In the case of a viscous catalyst, the pumping of such quantities of fluid is difficult and, as mentioned above, corrosion may attack the pump.

In many instances, it is undesirable for the solids being added to the system to be wet by the liquids into which it is introduced until the solid is actually inside the system because such wetting may lead to premature chemical reaction, or the wetting may lead to caking of the solid material to choke up the opening and cause the material to bridge across the opening, making the feeding of the material impossible.

In accordance with the present invention, the above mentioned difficulties are all avoided and the following objects are easily obtained.

One object of this invention is to provide an efficient means of introducing a solid at a controlled rate to a liquid.

Another object is to provide such a means operable when the system is under a pressure different than atmospheric.

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Another object is to provide an efficient means of introducing activating solid granular anhydrous aluminum chloride to a reaction system such as one catalyzed by aluminum chloride, such as liquid phase alkylation, or isomerization.

Another object is to provide a simple means of metering solid material into a liquid under pressure while maintaining the level of the liquid at a predetermined elevation and washing down the inner sides of the apparatus adjacent said liquid level.

Numerous other objects and advantages will be apparent to those skilled in the art upon reading the accompanying specification, claims and drawings.

In the drawing, the single figure shows an elevational view of a system embodying the present invention with parts broken away.

In the drawing a container 1 is provided for the liquid. While this container may be a tank or other shaped container, it is preferred to have the container 1 in a form of a liquid flow line through which the liquid may be relatively rapidly pumped during the process of adding the solids. A container or closed hopper 2 is provided for the solid material which is in granular or powdered form, but which may be in any form that will feed by gravity through the hopper to a screw conveyor 3 preferably attached to the bottom of the hopper.

While we prefer to use a screw conveyor to handle the material, obviously other forms of metering means may be used, for example, hopper 2 could be directly over a conduit 4 and a rotating paddle wheel gate could be substituted for screw conveyor 3, as any means for providing controlled movement of the solids from hopper 2 to conduit 4 is within the scope of our invention.

Metering means 3 should be driven at a suitable rate of speed, and while it can be driven intermittently with comparable results, it is preferred to drive meter means 3 continuously. Any suitable means for driving 3 may be provided. For purposes of illustration, a variable speed electric motor 5 is shown operated from a power source 6 and 7 with a rheostat 8 as one of many possible ways of varying the speed of motor 5.

Conduit 4 connects the container 2 for the solids with the container 1 for the liquids and conduit 4 may be regarded as including such portions of metering device 3 as are accessible to gases from conduit 4. A valve 5' is provided in

conduit 4 to open or close the conduit and is shown in open position. Valve 5' obviously may be of any type such as a plug valve or a gate valve, and is conventionally illustrated.

In order to keep liquid 9 from rising through conduit 4 into container 2, it is necessary to maintain the top of the liquid somewhat adjacent a predetermined elevation such as 10. A float chamber 11 is provided which is connected to conduit 4 by pipes 12 and 13 so that the liquid level in 11 is the same as in 4. Floating inside 11 is a float which operates a liquid level control 14. Obviously, any other type liquid level control known to the art may be employed in place of parts 11 to 14, inclusive.

Control 14, by means of some suitable distance control 15 chosen from among the many suitable controls available in the prior art, operates motor 16 of motor valve 17 to open or close gas line 18. Any other suitable valve controlled from a distance may be used in place of 17. Gas line 18 leads directly into conduit 4 where the gas can oppose the liquid pressure at surface 10.

The right hand end of gas line 18 receives gas from a suitable source of pressure. In many instances, the gas might be air, but the use of air is not regarded as preferable with aluminum chloride. With aluminum chloride, we prefer to use hydrogen and/or methane as a suitable gas because it is non-reactive with the dry aluminum chloride and is not adsorbed to an extent substantially altering the properties of aluminum chloride.

In order to allow the liquid level 10 to rise, it is necessary to provide a leak between the interior of conduit 4 and the atmosphere and two alternative means for doing so are provided. Valve 19 may be opened to allow gas to leak out of pipe 20 or valve 21 may be opened to allow gas to leak out of pipe 22, or both valves 19 and 21 may be opened. Pipes 20 and 22 lead to suitable points of disposal depending on the nature of the gas employed.

In order to wash down the interior of conduit 4 and prevent a crust of material from forming around level 10, a spray ring 23 is provided which directs liquid onto the walls of conduit 4 whence the liquid flows down to join liquid 9 at level 10. Obviously, the liquid for ring 23 may be supplied from other sources and may be a different liquid than liquid 9, but it is preferred to withdraw some of liquid 9 from container 1 through bypass liquid line 24 to supply liquid to ring 23. In order to move liquid through line 24, we prefer to provide pump 25 which may be of any type and it is preferred to have a valve 26 in line 24 for purposes to be set forth later.

A pressure equalization line 27 may be provided between line 18 and container 2 for more rapid equalization of pressure between 4 and the upper portion of 2 than could be obtained through conveyor 3 and the material in bottom of container 2. With some types of dense material in conveyor 3 and container 2, it would take too long to equalize the pressure without having pipe 27; with more permeable materials, pipe 27 may be eliminated or pipe 18 can be closed before entering container 4. We prefer to have both pipes 18 and 27 for use of both types of materials.

In order to retain a pressure inside container 2 substantially different than atmospheric it is necessary to provide a closed covering 28 for the container.

In order that the solid material does not collect on the top of the spray ring 23, a frusto-conical skirt 29 is placed above the spray ring so that the top of the skirt preferably touches the side walls of the pipe and the lower edge of the skirt is preferably inside the inner circumference of the spray ring. With aluminum chloride, the skirt is preferably as shown with an acute angle to the pipe wall of less than 45°, other angles being suited to other materials.

Operation

In order to start the operation, valves 26 and 5' are closed and cover 28 of hopper 2 is removed and the hopper is filled with a granular or powdered material such as aluminum chloride. Cover 28 is then replaced and secured tightly to close container 2. Valves 26 and 5' are opened and liquid 9 flows from container 1 up into conduit 4 actuating liquid level control 14 to open valve 17. Gas then passes through pipe 18 to press against liquid 9 at surface 10 and prevent further rise of liquid 9. At the same time, the gas from pipe 18 goes up into container 2 either through conveyor 3 or pipe 27 when the latter is provided, or both. Valve 19 or 21 or both being open, some of the gas leaks out of the pipe 20 or 22 or both allowing the liquid 9 to rise and open valve 17 every now and then. Whereupon the gas drives liquid 9 down and liquid level control shuts valve 17. In this manner, level 10 is maintained substantially at a predetermined level such as 10.

When fumes of a reactive nature tend to rise off surface 10, it is better to open bleed valve 21 so that gas from 18 will carry the reactive vapor from 10 out pipe 22. Thereby, in great measure, preventing the vapor from reacting with the solid material in container 2. In other cases, valve 21 may be closed and valve 19 opened which minimizes disturbing the solid material falling through conduit 4.

The liquid 9 flowing in container 1 from left to right picks up the solid material falling through conduit 4 and takes it along to the right of the drawing.

Metering system 3 is provided for dumping measured amounts or rates of the solids into conduit 4 and metering means 3 may be operated intermittently, but preferably is operated continuously by any suitable variable speed means such as motor 5.

With certain solid materials, the solid materials tend to cake up and form a crust around the edge of surface 10 or walls of conduit 4, but we have found that such a crust can be prevented by spraying a suitable liquid on inner walls of conduit 4 to wash down the solid material into liquid 9 by a spray such as ring 23. One means of supplying liquid to ring 23, shown as pump 25, pumps liquid 9 from container 1 to ring 23.

When all the solid material in container 2 is exhausted, then valves 5' and 26 should be closed and the operations repeated.

By suitably changing the pressure maintenance system 11 to 18, this same apparatus may be applied to a system under a vacuum. For example, a steam ejector, on pipe 18, could be a suitable method of vacuum maintenance and then the flow would be reversed in pipes 20, 22, and 18 from the direction indicated in the drawing by the arrows. Valve 17 and control 14 would have to be oppositely connected as the rise of surface 10 should shut off the vacuum at 17 instead of turning on the pressure at 17 as shown. Gas would be leaking into conduit 4 through valves 19 and 21 and if the air was bad for the

process, suitable sources of inert gas would have to be provided attached to pipes 20 and 22.

While we have described one specific embodiment of our invention, the invention is not limited thereby as obviously numerous substitutions and changes of non-inventive nature may be made without departing from the spirit of our invention which is defined in the following claims.

Having described our invention, we claim:

1. A feeding system for feeding solids into a liquid under pressure comprising a first chamber for said solids, a second chamber for said liquid, a first conduit connecting said chambers, said liquid under said pressure extending from said second chamber to a liquid level in said first conduit, a feeding means for feeding said solid material through said first conduit from said first chamber to said liquid, and means for preventing said liquid from contacting said solid material in said feeding means comprising a second pressure gas supply conduit connected to discharge gas under pressure into said first conduit, a motor operated valve for controlling flow of gas in said second conduit, said first conduit having a restricted outlet for said gas and means actuated by said liquid level in said first conduit for controlling said motor operated valve to regulate said flow of gas into said first conduit to keep said liquid level down in said first conduit and thereby prevent said liquid from contacting said solid material in said feeding means.

2. A feeding system for feeding solids into a liquid under pressure comprising a first chamber for said solids, a second chamber for said liquid, a first conduit connecting said chambers, said liquid under said pressure extending from said second chamber to a liquid level in said first conduit, a feeding means for feeding said solid material through said first conduit from said first chamber to said liquid, and means for preventing said liquid from contacting said solid material in said feeding means comprising a second pressure gas supply conduit connected to discharge gas under pressure into said first conduit, a motor operated valve for controlling flow of gas in said second conduit, said first conduit having a restricted outlet for said gas whereby any vapors of said liquid are swept away before reaching said solid material in said feeding means, washing means disposed and operable for washing down a portion of the walls of said first conduit with said liquid drawn from said second chamber and means actuated by said liquid level in said first conduit for controlling said motor operated valve to regulate said flow of gas into said first conduit to keep said liquid level down in said first conduit and thereby prevent said liquid from contacting said solid material in said feeding means.

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