PRESSURE VALVE ASSEMBLY

CROSS-REFERENCE

[0001] This application claims the benefits of U.S. Provisional Application No. 63/087,077, filed on October 2, 2020, U.S. Provisional Application No. 63/146,608, filed on February 6, 2021, and U.S. Provisional Application No. 63/153,740, filed on February 25, 2021, each of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Valves are used to control the flow of materials in many industrial processes. The inside of a relief valve contains a plug that blocks or reduces the output of a source of material when the valve is pressurized. When the pressure behind the plug is released the plug is pushed back by the force of the pressure from this output. This allows the valve to be opened until the pressure behind the plug is equal or greater than the force of the output. If a valve is coupled to an actuator operating in response to the output, precise continuous movement is possible rather than with just a manual-operated or spring-operated valve.

[0003] When moving materials under pressure it can be difficult to control the pressure in the container through which they are transported. This is difficult for continuous or semi-continuous flow of a slurry of materials moving in one direction in critical operating states resulting from treatment of the media. In order to maintain a constant pressure and velocity of the moving material, a valve must be designed to operate to hold the pressure in the pipe or barrel at a constant while allowing for a certain velocity. This is especially true of particulate substances such as biomass moving in a liquid under high pressure where the valve is involved in further treatment and the flow of materials is rapid and surging. Such severe operating conditions can induce premature failure and leakage of the valve assembly, resulting in blowouts and extreme wear. Further, slurry particles can become trapped in the valve sealing cycle, resulting in performance degradation of the valve assembly. In general, pressure relief valves are not designed to handle such operations.

SUMMARY

[0004] In one aspect, the present disclosure refers to a valve assembly comprising a valve body having an input end, a discharge end, and a chamber formed therein in connection with the input end and the discharge end, the input end attachable to a tube with a fluid or slurry input that flows through the valve assembly, wherein the valve body has a

circular section at the discharge end, a circular collar at the input end that is smaller in inner diameter than the circular section at the discharge end, and an intercalary conical section therebetween; a conical valve needle that has a cone with a

containing one or more nozzles for liquid input, the valve body having a chamber formed therein that connects an input end and a discharge end of the valve body, wherein the small circular collar is smaller in inner diameter than the large circular section; a valve needle axially displaceable within the chamber of the valve body; and a housing attached to the discharge end of the valve body and enclosing the valve needle when the valve needle is disengaged with the valve body.

[0007] In another example, provided herein is a system for treating biomass through an extruder comprising: an extruder comprising one or more screws wherein an internal plug of biomass is formed due to action of the screws, thereby forming one end of a pressurized reaction zone; a means for supplying steam and chemicals to the reaction zone; and a valve assembly at an output end of the extruder that forms a downstream end of the reaction zone and adds a liquid to the reaction zone; wherein the valve assembly is capable of rapidly discharging pressurized treated biomass into a non-pressurized discharge area.

[0008] In one example, a valve assembly comprising a housing, a valve body, and a valve needle attached to a tube with an output that flows through the valve assembly is provided, wherein the valve comprises: a conical valve needle which is axially displaceable in an annular space of the valve body and on one end has a conical valve needle tip; and wherein the downstream inner diameter of the valve body is at least 4% larger than the inner wall of the housing. In one example, the valve assembly has an annular ring that is part of the valve body and is replaceable.

[0009] In another example, the valve assembly housing contains a detachable discharge ring. In another example, the valve body contains nozzles for the input of a liquid. In a further example, the valve needle seats when closed in the valve body at the discharge ring. In one example, the valve assembly forms a part of a reaction zone with the tube. In a further example, the valve needle is attached to an actuator. In one example, the actuator maintains a pressure on the valve needle, said pressure which is maintained over 1,800 lbf on the valve needle. In another example, the actuator maintains a pressure of between 50,000 to 500,000 lbf on the valve needle.

[0009a] In yet another aspect, the present disclosure refers to a valve assembly comprising a valve body comprising a large circular section, an intercalary conical section, and a small circular collar containing one or more nozzles for liquid input, the valve body having a chamber formed therein that connects an input end and a discharge end of the valve body, wherein the large circular section is located at the discharge end, wherein the small circular collar is located on the input end and is smaller in inner diameter than the

large circular section, and wherein the intercalary conical section is located between the large circular section and the small circular collar, a valve needle axially displaceable within the chamber of the valve body, and a housing attached to the discharge end of the valve body and enclosing the valve needle when the valve needle is disengaged with the valve body.

[00010] In one example, the tube attached to the valve assembly is an extruder. In a further example, the extruder is a twin screw extruder.

[00011] In another example, a conical valve needle for engagement with a valve body that comprises a valve needle that extends beyond the valve body into a discharge area when the valve is closed is provided. In one example, an annular ring is part of the valve body. In another example, the valve needle seats downstream of the annular ring. In a further

[00016] In another example, a system for treating biomass through an extruder is provided comprising: an extruder comprising one or more screws wherein an internal plug of biomass is formed due to action of the screws, thereby forming one end of a pressurized reaction zone; a method of supplying steam and chemicals to the reaction zone; a valve assembly at the output end of the extruder that forms the downstream end of the reaction zone and adds a liquid to the reaction zone and is capable of rapidly discharging pressurized treated biomass into a non-pressurized discharge area. In another example, the biomass is selected from the group consisting of: silage, agricultural residues, com stover, bagasse, sorghum, nuts, nut shells, coconut shells, Distillers Dried Solubles, Distillers Dried Grains, Condensed Distillers Solubles Distillers Wet Grains, Distillers Dried Grains with Solubles, woody materials, sawdust, wood chips, timber slash, mill scrap, municipal waste, waste paper, recycled toilet papers, yard clippings, and energy crops such as poplars, willows, switchgrass, alfalfa, and prairie bluestem, non-woody plant matter, cellulosic material, lignocellulosic material, hemicellulosic material, carbohydrates, corn, sugar cane, grasses, switchgrass, high biomass sorghum, bamboo, corncobs, and peels and pits. In a further example, the biomass is treated for less than 60, 55, 50, 45, 40, 35, 30, 25, 20, 19, 18, 17, 16, 15, 14, 13, 12, 10, 9, 8, 7, 6, 5, 4, 3, 2, or 1 seconds in the reaction zone. In one example, the temperature in the reaction zone is elevated to 50-500 °C, 75-400 °C, 100-350°C, 150-300°C, 200-250°C, 150-300°C, 50-1000 PSI, 100-750 PSI, 200-600 PSI, 300-500 PSI or 350-450 PSI. In another example, the chemical is an acid. In a further example, the acid is sulfuric acid.

[00016a] In yet another aspect, the present disclosure refers to a system for treating biomass through an extruder comprising an extruder comprising one or more screws wherein an internal plug of biomass is formed due to action of the screws, thereby forming one end of a pressurized reaction zone, a means for supplying steam and chemicals to the reaction zone, and a valve assembly in accordance with the first aspect at an output end of the extruder that forms a downstream end of the reaction zone and adds a liquid to the reaction zone, wherein the valve assembly is capable of rapidly discharging pressurized treated biomass into a non-pressurized discharge area.

[00017] In one example there is provided a system, wherein a valve assembly comprises a housing, and a valve body comprising: a large circular section; a middle conical section; a smaller circular collar containing one or more nozzles for liquid input; and a valve needle. In another example, the system has a valve assembly wherein the housing contains a removable discharge ring. In a further example, the discharge ring of the valve assembly is tapered. In