communicate a control signal to air regulating valve 64 and/or pump 46 as necessary to maintain proper water level in tank. The pump 46 uses a lot of energy in the process.

SUMMARY

[0011] This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

[0012] ~~In one aspect of the disclosure, a system includes an absorption tank having a compressor communicating gas thereto, a suspended solid filtration tank having a primary inlet, a secondary inlet, a primary outlet and a secondary outlet and a pump comprising a pump inlet coupled to the secondary outlet and a pump outlet communicating fluid to the absorption tank. The absorption tank forms a solution from the fluid and gas. A turbine mechanically couples the pump with a common shaft extending to the pump. The turbine has a turbine inlet coupled to the absorption tank and a turbine outlet coupled to the secondary inlet. The turbine depressurizes the solution.~~

[0013] ~~In another aspect of the disclosure, a method comprises communicating suspended solid fluid into a suspended solid filtration tank through a primary inlet, communicating reduced solid fluid from a secondary outlet of the suspended solid filtration tank to a pump inlet, pressurizing the reduced solid fluid, communicating reduced solid fluid from a pump outlet to an absorption tank, communicating compressed gas into the absorption tank, mixing the gas and reduced solid fluid to form a solution, communicating the solution to a turbine inlet, reducing the pressure of the solution in the turbine, communicating the solution from the turbine to the secondary inlet and skimming suspended solids from the suspended solid filtration tank using the gas from the solution.~~According to a first aspect of the present invention, there is provided a centrifugal pump in communication with a compressor comprising:

a fluid inlet;

a plurality of pumping stages having a common shaft, said plurality of pumping stages extending axially along said shaft;

a fluid outlet;

an inner housing enclosing the plurality of pumping stages;

an outer housing enclosing the inner housing and spaced apart from the inner housing to form an inter-shell clearance therebetween, said compressor communicating compressed gas into the inter-shell clearance;

a first stage of the plurality of adjacent pumping stages comprising one or more first holes through the inner housing, said one or more first holes have a first total opening area so that compressed gas is introduced into the first stage; and

a second stage of the plurality of adjacent pumping stages disposed toward the fluid outlet relative to the first stage, said second stage comprising one or more second holes through the inner housing so that compressed gas is introduced into the second stage, wherein the one or more second holes have a second total opening area greater than the first total opening area.

[0014] ~~In yet another aspect of the disclosure, a centrifugal pump includes a fluid inlet, a plurality of pumping stages having a common shaft. The plurality of pumping stages extends axially along said shaft. The pump further includes a fluid outlet and an inner housing enclosing the plurality of pumping~~

~~stages. The centrifugal pump further includes an outer housing enclosing the inner housing and spaced apart from the inner housing to form an inter-shell clearance therebetween. The compressor communicates compressed gas into the inter-shell clearance. A first stage of the plurality of adjacent pumping stages comprises one or more first holes through the inner housing. The one or more first holes have a first total opening area so that compressed gas is introduced into the first stage. A second stage of the plurality of adjacent pumping stages is disposed toward the fluid outlet relative to the first stage. The second stage comprises one or more second holes through the inner housing so that compressed gas is introduced into the second stage.~~According to a second aspect of the present invention, there is provided a system comprising

a suspended solid filtration tank has a primary inlet, a secondary inlet, a primary outlet and a secondary outlet; and

the centrifugal pump as defined in the first aspect wherein the fluid inlet is in communication with the secondary outlet and the fluid outlet is in fluid communication with the secondary inlet.

[0015] ~~In a further aspect of the disclosure, a method includes communicating reduced solid fluid from a suspended solid filtration tank to a multi-stage pump having an inter-shell clearance between an inner housing and an outer housing, communicating pressurized gas into the inter-shell clearance, communicating the pressurized gas from the inter-shell clearance into at least one of a plurality of stages of the multi-stage pump, dissolving the gas in the at least one of the plurality of stages to form a solution, communicating the solution to the filtration tank through a fluid outlet of the multi-stage pump and filtering suspended solids using the solution.~~ According to a third aspect of the present invention, there is provided a method comprising:

communicating reduced solid fluid from a suspended solid filtration tank to a multi-stage pump having an inter-shell clearance between an inner housing and an outer housing;

communicating pressurized gas into the inter-shell clearance;

communicating the pressurized gas from the inter-shell clearance into at least a first stage and a second stage of the multi-stage pump wherein the first stage has first holes in the inner housing having a first area less than a second area of second holes in the second stage;

dissolving the gas in the at least one of the plurality of stages to form a solution;

communicating the solution to the filtration tank through a fluid outlet of the multi-stage pump; and

filtering suspended solids using the solution.

[0016] Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

[0017] The drawings described herein are for illustrative purposes only of selected examples and not all possible implementations, and are not intended to limit the scope of the present disclosure.

[0018] FIG. 1 is a schematic view of a first air filtration system according to the prior art;

~~AMENDED CLAIMS~~
~~received by the International Bureau on 24 March 2014 (24.03.2014)~~

What is claimed is:

1. A centrifugal pump in communication with a compressor comprising:

a fluid inlet;

a plurality of pumping stages having a common shaft, said plurality of pumping stages extending axially along said shaft;

a fluid outlet;

an inner housing enclosing the plurality of pumping stages;

an outer housing enclosing the inner housing and spaced apart from the inner housing to form an inter-shell clearance therebetween, said compressor communicating compressed gas into the inter-shell clearance;

a first stage of the plurality of adjacent pumping stages comprising one or more first holes through the inner housing, said one or more first holes have a first total opening area so that compressed gas is introduced into the first stage; and

a second stage of the plurality of adjacent pumping stages disposed toward the fluid outlet relative to the first stage, said second stage comprising one or more second holes through the inner housing so that compressed gas is introduced into the second stage, wherein the one or more second holes have a second total opening area greater than the first total opening area.

2. The centrifugal pump as recited in claim 1 further comprising a third stage of the plurality of pumping stages comprising one or more third holes through the inner housing, said one or more third holes have a third total opening area greater than the first total opening area and the second total opening area.

3. The centrifugal pump as recited in claim 2 further comprising a fourth stage of the plurality of pumping stages comprising one or more fourth holes through the inner housing, said one or more fourth holes have a fourth total opening area greater than the first total opening area, the second total opening area and the third total opening area.

4. The centrifugal pump as recited in claim 1 wherein each of the plurality of adjacent pumping stages comprises an impeller disposed on the common shaft, and further comprising a motor coupled to the common shaft.

5. The centrifugal pump as recited in claim 1 wherein each of the plurality of pumping stages receives input fluid axially adjacent to the common shaft.

6. The centrifugal pump as recited in claim 1 wherein the one or more first holes are disposed through a lower portion of the inner housing.

7. The centrifugal pump as recited in claim 1 further comprising a gas trap coupled to the fluid outlet for capturing undissolved gas, wherein the gas trap is fluidically coupled to the inter-shell clearance.

8. A system comprising:

a suspended solid filtration tank has a primary inlet, a secondary inlet, a primary outlet and a secondary outlet; and

the centrifugal pump as recited in claim 1 wherein the fluid inlet is in communication with the secondary outlet and the fluid outlet is in fluid communication with the secondary inlet.

9. The system as recited in claim 8 further comprising the compressor.

10. A method comprising:

communicating reduced solid fluid from a suspended solid filtration tank to a multi-stage pump having an inter-shell clearance between an inner housing and an outer housing;

communicating pressurized gas into the inter-shell clearance;

communicating the pressurized gas from the inter-shell clearance into at least a first stage and a second stage of the multi-stage pump wherein the first stage has first holes in the inner housing having a first area less than a second area of second holes in the second stage;

dissolving the gas in the at least one of the plurality of stages to form a solution;

communicating the solution to the filtration tank through a fluid outlet of the multi-stage pump; and

filtering suspended solids using the solution.

11. The method as recited in claim 10 wherein communicating the pressurized gas from the inter-shell clearance into at least one of a plurality of stages of the multi-stage pump comprises communicating the pressurized gas from the inter-shell clearance into at least one of the plurality of stages of the multi-stage pump through one or more holes at least some of which are located through and near a bottom of the inner housing.

12. The method as recited in claim 10 wherein communicating pressurized gas into the inter-shell clearance comprises communicating pressurized gas into the inter-shell clearance from a compressor.

13. The method as recited in claim 10 wherein communicating pressurized gas into the inter-shell clearance comprises communicating pressurized gas into the inter-shell clearance from a gas trap of the fluid outlet of the multi-stage pump.