intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

SUMMARY

[0009] This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

[0010] The present disclosure provides a throttle valve and method for operating the same that reduces safety hazards. The present disclosure also provides a valve that protects upstream equipment and is relatively inexpensive to manufacture.

[0011] In one aspect of the disclosure, there is provided a throttle valve for communicating fluid comprising;

a throttle housing having an inlet end and an outlet end;

a shuttle housing disposed within the throttle housing, said shuttle housing having a first end cap at a first end and, at a second end, an orifice array having a plurality of openings therethrough, said shuttle housing comprising a shuttle therein, said shuttle comprising a first piston and a second piston spaced apart by an arm, said shuttle having an opened position and a closed position relative to the shuttle housing, said shuttle defining a varying control volume between the end cap, the first piston and the shuttle housing and said second piston varying the amount of flow through the plurality of openings in the orifice array through which fluid is communicated into the shuttle housing and into the outlet end; and

a control inlet fluidically communicating a control fluid to the control volume to control the position of the shuttle in the shuttle housing, wherein the control fluid is controlled through a valve assembly comprising a first valve selectively communicating fluid from a high pressure source to the control inlet and a second valve selectively communicating fluid from a low pressure source to the control inlet.

[0012] In another aspect of the disclosure, there is provided a method of operating a throttle valve having a control volume between a first piston of a shuttle, a shuttle housing and an end cap of the shuttle housing, said shuttle comprising an arm having the first piston at a first end and a second piston at a second end thereof, said shuttle disposed within the shuttle housing, said shuttle exposing an orifice array in the shuttle housing comprising:

generating a flow signal from a flow sensor in a throttle valve output;

when the flow signal is above a first control point, communicating fluid from a throttle valve input to the control volume, moving the shuttle toward the throttle valve output and reducing flow through the orifice array by moving the second piston to block a portion of the orifice array;

when the flow signal is below a second control point, communicating fluid from the throttle valve output to the control volume, moving the shuttle toward the throttle valve input and increasing flow through the orifice array by moving the second piston to increase the portion of the orifice array; and

when the flow signal is between the first control point and the second control point, maintain the position of the shuttle within the shuttle housing.

[0012a] In yet another aspect of the disclosure, there is provided a throttle valve comprising:

a throttle housing having an inlet end and an outlet end;

a shuttle housing disposed within the throttle housing, said shuttle housing having a first end cap at a first end and an orifice array having a plurality of openings therethrough, said shuttle housing comprising a shuttle therein, said shuttle having an opened position and a closed position relative to the shuttle housing, said shuttle defining a varying control volume between the end cap, the shuttle and the shuttle housing and varying the amount of flow through the plurality of openings in the orifice array;

a control inlet fluidically communicating a control fluid to the control volume to control the position of the shuttle in the shuttle housing wherein the control fluid is controlled through a valve assembly comprising a first valve selectively communicating fluid from a high pressure source to the control inlet and a second valve selectively communicating fluid from a low pressure source to the control inlet;

wherein fluid flowing through the first valve flows from the inlet end through the control inlet and fluid flowing through the second valve flows from the outlet end to the control inlet;

a flow sensor disposed proximate the outlet end, said flow sensor generating a flow signal;

a controller coupled to the first valve and the second valve, said controller controlling the first valve and the second valve in response to the flow signal; and

a third valve in communication with the controller coupling the control inlet to atmospheric pressure.

[0012b] In a further aspect of the disclosure, there is provided a throttle valve comprising:

a throttle housing having an inlet end and an outlet end;

a shuttle housing disposed within the throttle housing, said shuttle housing having a first end cap at a first end and an orifice array having a plurality of openings therethrough, said shuttle housing comprising a shuttle therein, said shuttle having an opened position and a closed position relative to the shuttle housing, said shuttle defining a varying control volume between the end cap, the shuttle and the shuttle housing and varying the amount of flow through the plurality of openings in the orifice array;

a control inlet fluidically communicating a control fluid to the control volume to control the position of the shuttle in the shuttle housing wherein the control fluid is controlled through a valve assembly comprising a first valve selectively communicating fluid from a high pressure source to the control inlet and a second valve selectively communicating fluid from a low pressure source to the control inlet;

wherein fluid flowing through the first valve flows from the inlet end through the control inlet and fluid flowing through the second valve flows from the outlet end to the control inlet;

a flow sensor disposed proximate the outlet end, said flow sensor generating a flow signal;

a controller coupled to the first valve and the second valve, said controller controlling the first valve and the second valve in response to the flow signal;

wherein the controller closes the first valve and opens the second valve when the flow is less that than a second control point; and

wherein the controller closes the first valve and closes the second valve when the flow is within a deadband between the first control point and the second control point.

[0013] 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.

CLAIMS

What is claimed is:

1. A throttle valve for communicating fluid comprising:

a throttle housing having an inlet end and an outlet end;

a shuttle housing disposed within the throttle housing, said shuttle housing having a first end cap at a first end and, at a second end, an orifice array having a plurality of openings therethrough, said shuttle housing comprising a shuttle therein, said shuttle comprising a first piston and a second piston spaced apart by an arm, said shuttle having an opened position and a closed position relative to the shuttle housing, said shuttle defining a varying control volume between the end cap, the first piston and the shuttle housing and said second piston varying the amount of flow through the plurality of openings in the orifice array through which fluid is communicated into the shuttle housing and into the outlet end; and

a control inlet fluidically communicating a control fluid to the control volume to control the position of the shuttle in the shuttle housing, wherein the control fluid is controlled through a valve assembly comprising a first valve selectively communicating fluid from a high pressure source to the control inlet and a second valve selectively communicating fluid from a low pressure source to the control inlet.

2. The throttle valve as recited in claim 1 wherein fluid flowing through the first valve flows from the inlet end through the control inlet and fluid flowing through the second valve flows from the outlet end to the control inlet.

3. The throttle valve as recited in claim 2 further comprising a flow sensor disposed proximate the outlet end, said flow sensor generating a flow signal.

4. The throttle valve as recited in claim 3 wherein the flow signal comprises a flow rate signal.

5. The throttle valve as recited in claim 3 further comprising a controller coupled to the first valve and the second valve, said controller controlling the first valve and the second valve in response to the flow signal.

6. The throttle valve as recited in claim 5 wherein the controller opens the first valve and closes the second valve when the flow is greater than a first control point.

7. The throttle valve as recited in claim 6 wherein the controller closes the first valve and opens the second valve when the flow is less than a second control point.

8. The throttle valve as recited in claim 7 wherein the controller closes the first valve and closes the second valve when the flow is within a deadband between the first control point and the second control point.

9. The throttle valve as recited in claim 5 further comprising a third valve in communication with the controller coupling the control inlet to atmospheric pressure.

10. The throttle valve as recited in claim 9 wherein the second piston has a plurality of intermediate positions wherein the array is partially obstructed by the second piston.

11. A method of operating a throttle valve having a control volume between a first piston of a shuttle, a shuttle housing and an end cap of the shuttle housing, said shuttle disposed within the shuttle housing, said shuttle comprising an arm having the first piston at a first end and a second piston at a second end thereof, said shuttle exposing an orifice array through the shuttle housing comprising:

generating a flow signal from a flow sensor in a throttle valve output;

when the flow signal is above a first control point, communicating fluid from a throttle valve input to the control volume, moving the shuttle toward the throttle valve output and reducing flow through the orifice array by moving the second piston to block a portion of the orifice array;

when the flow signal is below a second control point, communicating fluid from the throttle valve output to the control volume, moving the shuttle toward the throttle valve input and increasing flow through the orifice array by moving the second piston to increase the portion of the orifice array; and

when the flow signal is between the first control point and the second control point, maintain the position of the shuttle within the shuttle housing.

12. The method as recited in claim 11 wherein the first control point and the second control point are equal.

13. The method as recited in claim 11 wherein communicating fluid from the throttle valve input to the control volume comprises opening a first valve and closing a second valve.

14. The method as recited in claim 13 wherein communicating fluid from the throttle valve output to the control volume comprises opening the second valve and closing the first valve.

15. The method as recited in claim 11 further comprising when the flow signal is between the first control point and the second control point, closing flow to the control volume.

16. The throttle valve as recited in claim 8 wherein the first control point coincides with the second control point.

17. A throttle valve comprising:

a throttle housing having an inlet end and an outlet end;

a shuttle housing disposed within the throttle housing, said shuttle housing having a first end cap at a first end and an orifice array having a plurality of openings therethrough, said shuttle housing comprising a shuttle therein, said shuttle having an opened position and a closed position relative to the shuttle housing, said shuttle defining a varying control volume between the end cap, the shuttle and the shuttle housing and varying the amount of flow through the plurality of openings in the orifice array;

a control inlet fluidically communicating a control fluid to the control volume to control the position of the shuttle in the shuttle housing wherein the control fluid is controlled through a valve assembly comprising a first valve selectively communicating fluid from a high pressure source to the control inlet and a second valve selectively communicating fluid from a low pressure source to the control inlet;

wherein fluid flowing through the first valve flows from the inlet end through the control inlet and fluid flowing through the second valve flows from the outlet end to the control inlet;

a flow sensor disposed proximate the outlet end, said flow sensor generating a flow signal;

a controller coupled to the first valve and the second valve, said controller controlling the first valve and the second valve in response to the flow signal; and

a third valve in communication with the controller coupling the control inlet to atmospheric pressure.

18. A throttle valve comprising:

a throttle housing having an inlet end and an outlet end;

a shuttle housing disposed within the throttle housing, said shuttle housing having a first end cap at a first end and an orifice array having a plurality of openings therethrough, said shuttle housing comprising a shuttle therein, said shuttle having an opened position and a closed position relative to the shuttle housing, said shuttle defining a varying control volume between the end cap, the shuttle and the shuttle housing and varying the amount of flow through the plurality of openings in the orifice array;

a control inlet fluidically communicating a control fluid to the control volume to control the position of the shuttle in the shuttle housing wherein the control fluid is controlled through a valve assembly comprising a first valve selectively communicating fluid from a high pressure source to the control inlet and a second valve selectively communicating fluid from a low pressure source to the control inlet;

wherein fluid flowing through the first valve flows from the inlet end through the control inlet and fluid flowing through the second valve flows from the outlet end to the control inlet;

a flow sensor disposed proximate the outlet end, said flow sensor generating a flow signal;

a controller coupled to the first valve and the second valve, said controller controlling the first valve and the second valve in response to the flow signal;

wherein the controller closes the first valve and opens the second valve when the flow is less that than a second control point; and

wherein the controller closes the first valve and closes the second valve when the flow is within a deadband between the first control point and the second control point.