

WHAT IS CLAIMED IS:

1. A flow control apparatus comprising:
 - a housing configured to receive a feeding set;
 - a pumping device configured to produce a fluid flow in the feeding set;
 - an ultrasonic sensor configured to produce a sensor signal indicative of a condition of the feeding set based on a first ultrasonic signal or a second ultrasonic signal, wherein the ultrasonic sensor comprises a plurality of sensor components, the ultrasonic sensor being further configured to emit a first ultrasonic signal through a portion of the feeding set in a first direction from a first sensor component of the plurality of sensor components, and to emit a second ultrasonic signal through the portion of the feeding set in a second direction opposite the first direction from a second sensor component of the plurality of sensor components; and
 - a control circuit in communication with the ultrasonic sensor configured to receive the sensor signal from the ultrasonic sensor indicative of the condition of the feeding set.
2. The flow control apparatus according to claim 1, wherein the control circuit is configured to switch between a first sensor configuration whereby the first sensor component of the plurality of sensor components emits an ultrasonic signal directed to the second sensor component of the plurality of sensor components for detection by the second sensor component, and a second sensor configuration whereby the second sensor component emits an ultrasonic signal directed to the first sensor component for detection by the first sensor component.
3. The flow control apparatus according to claim 2 further comprising a switch connected to the ultrasonic sensor for switching between the first sensor configuration and the second sensor configuration.
4. The flow control apparatus according to claim 1, wherein the plurality of sensor components further comprises a first sensor pair including the first sensor component and the second sensor component for emitting ultrasonic signals between the first sensor component and the second sensor component, and a second sensor pair including a third sensor component and a fourth sensor component for emitting ultrasonic signals between the third sensor component and the fourth sensor component.

5. The flow control apparatus according to claim 4, further comprising one or more switches operatively connected to the ultrasonic sensor for switching between the first direction and the second direction.
6. The flow control apparatus according to claim 5, wherein the portion of the feeding set is a tube.
7. The flow control apparatus according to claim 1, wherein the plurality of sensor components further comprises a third sensor component for detecting the first ultrasonic signal emitted from the first sensor component, and a fourth sensor component for detecting the second ultrasonic signal emitted from the second sensor component.
8. The flow control apparatus according to claim 1, wherein the sensor signal is generated based on a comparison between the first ultrasonic signal and the second ultrasonic signal.
9. The flow control apparatus according to claim 8, wherein the plurality of sensor components further comprises a third sensor component for detecting the first ultrasonic signal emitted from the first sensor component, and a fourth sensor component for detecting the second ultrasonic signal emitted from the second sensor component.
10. The flow control apparatus according to claim 9, wherein the comparison compares an amplitude of the detected first ultrasonic signal and an amplitude of the detected second ultrasonic signal, and determines a higher amplitude.
11. The flow control apparatus according to claim 10, wherein the pumping device is further configured to operate only the first sensor component of the plurality of sensor components or the second sensor component of the plurality of sensor components based on the determined higher amplitude.
12. The flow control apparatus according to claim 1, wherein the condition of the feeding set is indicative of at least one of an occlusion of the fluid flow in the feeding set, the feeding set being improperly mounted in the housing, the feeding set being empty, and the fluid flow in the feeding set operating properly.

13. A method of operating a flow control apparatus, the method comprising:
 - emitting via a first sensor component a first ultrasonic signal in a first direction through a portion of a pump set;
 - emitting via a second sensor component a second ultrasonic signal in a second direction through the portion of a pump set, the second direction being opposite the first direction;
 - detecting the first ultrasonic signal to determine a first sensor reading;
 - detecting the second ultrasonic signal to determine a second sensor reading;
 - comparing an amplitude of the first sensor reading to an amplitude of the second sensor reading; and
 - detecting a condition of the pump set based on the comparing of the first sensor reading and the second sensor reading.
14. The method of claim 13, further comprising configuring:
 - detecting the condition of the pump set by the flow control apparatus based on a greater reading of the amplitude of the first sensor reading and the amplitude of the second sensor reading.
15. The method of claim 13, further comprising:
 - switching between emitting the first ultrasonic signal in the first direction and the second ultrasonic signal in the second direction.
16. The method of claim 13, wherein emitting the first ultrasonic signal in the first direction comprises emitting the first ultrasonic signal from a first sensor component directed to a second sensor component, and emitting the second ultrasonic signal in the second direction comprises emitting the second ultrasonic signal from the second sensor component directed to the first sensor component.
17. The method of claim 13, wherein emitting the first ultrasonic signal in the first direction comprises emitting the first ultrasonic signal between a first sensor pair of components, and emitting the second ultrasonic signal in the second direction comprises emitting the second ultrasonic signal between a second sensor pair of components.
18. The method of claim 13, wherein the portion of the pump set is a tube, and the flow control apparatus provides fluid to a user.

19. The method of claim 18, wherein the condition of the pump set is indicative of at least one of an occlusion of a flow of the fluid in the tube, the fluid being improperly mounted in the pump set, the fluid to the user being exhausted, and the flow of the fluid in the pump set operating properly.
20. A flow control apparatus comprising:
a memory; and
at least one processor coupled with the memory and configured to:
emit a first ultrasonic signal in a first direction through a portion of a pump set;
emit a second ultrasonic signal in a second direction through the portion of a pump set, the second direction being opposite the first direction;
detect the first ultrasonic signal to determine a first sensor reading;
detect the second ultrasonic signal to determine a second sensor reading;
compare an amplitude of the first sensor reading to an amplitude of the second sensor reading; and
detect a condition of the pump set based on the comparing of the first sensor reading and the second sensor reading.
21. The flow control apparatus of claim 20, further configured to detect the condition of the pump set based on a greater reading of the amplitude of the first sensor reading and the amplitude of the second sensor reading.
22. The flow control apparatus of claim 20, further configured to switch between emitting the first ultrasonic signal in the first direction and the second ultrasonic signal in the second direction.
23. The flow control apparatus of claim 20, wherein emitting the first ultrasonic signal in the first direction comprises emitting the first ultrasonic signal from a first sensor component directed to a second sensor component, and emitting the second ultrasonic signal in the second direction comprises emitting the second ultrasonic signal from the second sensor component directed to the first sensor component.

24. The flow control apparatus of claim 20, wherein emitting the first ultrasonic signal in the first direction comprises emitting the first ultrasonic signal between a first sensor pair of components, and emitting the second ultrasonic signal in the second direction comprises emitting the second ultrasonic signal between a second sensor pair components.

25. The flow control apparatus of claim 20, wherein the portion of the pump set is a tube, and the flow control apparatus provides fluid to a user.

26. The flow control apparatus of claim 25, wherein the condition of the pump set is indicative of at least one of an occlusion of a flow of the fluid in the tube, the fluid being improperly mounted in the pump set, the fluid to the user being exhausted, and the flow of the fluid in the pump set operating properly.

27. A flow control apparatus comprising:
a housing configured to receive a feeding set;
a pumping device configured to produce a fluid flow in the feeding set;
an ultrasonic sensor including a first sensor component and a second sensor component, the first sensor component configured to emit a first ultrasonic signal through a portion of the feeding set in a first direction and the second sensor component configured to emit a second ultrasonic signal through the portion of the feeding set in a second direction; and
a control circuit configured to switch between a first configuration and a second configuration, whereby the first configuration includes the first sensor component emits the first ultrasonic signal directed to the second sensor component for detection by the second sensor component, and wherein the second configuration includes the second sensor component emits the second ultrasonic signal directed to the first sensor component for detection by the first sensor component.

28. The flow control apparatus according to claim 27, further comprising one or more switches operatively connected to the ultrasonic sensor for switching between the first direction and the second direction.

29. The flow control apparatus according to claim 27, wherein the portion of the feeding set is a tube.

30. The flow control apparatus according to claim 27, wherein ultrasonic sensor is further configured to produce a sensor signal indicative of a condition of the feeding set based on the first ultrasonic signal or the second ultrasonic signal.

31. The flow control apparatus according to claim 30, wherein the control circuit is further configured to receive the sensor signal from the ultrasonic sensor indicative of the condition of the feeding set.

32. The flow control apparatus according to claim 30, wherein the sensor signal is generated based on a comparison between the first ultrasonic signal and the second ultrasonic signal.

33. The flow control apparatus according to claim 32, wherein the comparison compares an amplitude of the detected first ultrasonic signal and an amplitude of the detected second ultrasonic signal, and determines a higher amplitude.

34. The flow control apparatus according to claim 33, wherein the control circuit includes a switch for switching between the first configuration and the second configuration, and wherein the determined higher amplitude is configured to set the switch in the first configuration or the second configuration for operation of the flow control apparatus.