

23. The peristaltic pump according to claim **20**, further comprising:

- an inlet valve; and
- an outlet valve.

24. The peristaltic pump according to claim **23**, where the inlet valve, the outlet valve, the plunger, and the first cam are configured to compress the tube while the inlet and outlet valves are closed such that the processor can measure the first position of the plunger using the position sensor.

25. The peristaltic pump according to claim **24**, where the inlet valve, the outlet valve, the plunger, and the first cam are configured to open the outlet valve after the first position of the plunger is measured to discharge fluid out of the tube through the outlet valve, wherein the processor is configured to measure the second position of the plunger using the position sensor after the outlet valve is opened.

26. The peristaltic pump according to claim **25**, wherein the processor compares the first measured position to the second measured position to determine an amount of fluid discharged through the outlet valve.

27. The peristaltic pump according to claim **23**, wherein the inlet valve and the outlet valve are spring biased against the tube.

28. The peristaltic pump according to claim **27**, wherein the inlet valve includes an inlet-valve cam follower configured to engage with an second cam coupled to the first shaft.

29. The peristaltic pump according to claim **28**, wherein the outlet valve includes an outlet-valve cam follower configured to engage with an third cam coupled to the first shaft.

30. A peristaltic pump, comprising:

- a plunger configured to move relative to a tube;
- a spring configured to bias the plunger toward the tube;
- an actuator configured to move the plunger away from the tube, and the actuator is further configured to disengage from the plunger;

- a position sensor configured to determine a position of the plunger; and

- a processor coupled to the position sensor, wherein the processor is configured to estimate a volume of fluid discharged from a section of the tube utilizing at least two positions of the plunger as indicated by the position sensor.

31. A peristaltic pump, comprising:

- a plunger configured to move relative to a tube;
- a spring configured to bias the plunger toward the tube;
- an actuator configured to move the plunger away from the tube, and the actuator is further configured to disengage from the plunger, wherein the actuator is configured to move the plunger in a plurality of cycles each cycling having at least first and second phases, wherein the first

phase is configured to allow the spring to bias the plunger against the tube with a volume of fluid disposed within a section of the tube adjacent to the plunger, and the second phase allows the spring to bias the plunger against the tube to discharge the volume of fluid disposed within the section of the tube adjacent to the plunger;

- a position sensor configured to determine a position of the plunger; and

- a processor coupled to the position sensor, wherein the processor is configured to estimate fluid discharged during the second phase by comparing a first measured position of the plunger during the first phase to a second measured position of the plunger during the second phase as determined by the position sensor.

32. A method of estimating fluid flow of a peristaltic pump, the method comprising:

- moving a plunger toward a tube;
- disengaging an actuator from the plunger;
- biasing the plunger against the tube;
- measuring a first position of the plunger;
- engaging the actuator with the plunger;
- measuring a second position of the plunger; and
- estimating a volume of fluid discharged by comparing the first measured position of the plunger to the second measured position of the plunger.

33. The method according to claim **32**, further comprising the act of closing an inlet valve and an outlet valve prior to disengaging the actuator from the plunger.

34. The method according to claim **32**, wherein the biasing act is achieved using a spring.

35. The method according to claim **34**, wherein the spring is a torsion spring.

36. The method according to claim **32**, further comprising the acts of:

- moving an inlet valve closed prior to measuring the first position of the plunger; and
- moving an outlet valve closed prior to measuring the first position of the plunger.

37. A peristaltic pump, comprising:

- an end effector configured to move relative to a tube;
- a spring configured to bias the end effector toward the tube;
- an actuator configured to move the end effector away from the tube and disengage from the end effector;
- a processor configured to estimate fluid flow within the tube using the position of the end effector.

38. The peristaltic pump according to claim **37**, wherein the end effector is a plunger.

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