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TUBING PUMP DESIGN REFINEMENT

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This invention relates to a tubing pump.

SPECIFICATION

This pump has the addition of a housing completely surrounding the tube. The novel features that result from the design are the following:
1) prevents expansion of the tube,
2) acts as a hose clamp to prevent leakage around the hose barb,
3) holds the hose barbs in proper position, prevents axial stretch in the tubes, and
4) maintains plunger position contact with the tube.

The tube design requires a great amount of flexibility and, therefore is not capable of preventing expansion. If the tube is not constrained it will expand and not deliver the fluid.

A unique design of the tube is formed where the bottom of the tube is inverted by the center plunger to the shape of ½ moon. When the plunger pushes on the tube, the output is linear with the movement of the plunger. This design minimizes issues where output increased faster than the plunger moved and made the output very pulsitile.

Additionally, to compress the tube in the inverted position and to maintain compression with this uniform cross section change, a dual plunger is utilized. This pushes the center 2 times faster than the outside edges. This maintains the tube compression so that the tube is fully constrained, and there is no area that stretches to add capacitance. In this pump, the center plunger is directly actuated by the camshaft, the outside plungers are actuated by the center of a lever, which has one end fixed and one end moving with the plunger.

The one pump design has an inlet and outlet valve that is attached to opposite ends of the pump chamber tube. A second pump configuration could put both the inlet and outlet on the same end simplifying the assembly.

The tubing pump has the disadvantage of inadequate fill at elevated speeds.
There are methods to correct or avoid this problem.

A first modification can be to add input valves that can add restriction, whereas currently passive check valves are used. An active valve could be used instead; it could a pinch valve, a "trumpet valve" or stopcock valve. The valves can further be operated in time with the rotation of the camshaft of the pump.

A second way to reduce inadequate filling would be to add a pressurized input reservoir that would add enough pressure to overcome the pressure drop off the input lines and valves.

A third way to increase filling rates would to change the shape of the tubing in the pump. If the tube were made to have features that attached to the pump, the pump would pull the tube open. Therefore, it would be necessary to rely only on the restoration of the tube itself.

Essentially, the novel features of the design, include:

1) inverted tube squeeze section
2) fully supported tube section
3) complex dual action plunger compression
4) customized tube cross section
5) hose barbs which are automatically clamped with the pump housing
6) automatically retained rigid sections of the pump to prevent the flexible tubing to stretch in any direction
7) passive check valves, possibly active valves

These features are novel and different because ordinarily:

- Tube pumps squeeze the tube flat to deliver fluid.
- Tubes are not supported and have output that vary when the pressure rating of the tube is exceeded. Tube are limited to pressures that the tube is rated for.
- Tubes are normally squeezed by a flat roller travelling along a flat platen.
- Most tube use round design and they get the flow from the velocity of the moving roller.
- In a most tubing pumps all connections are away form the pump itself, and there might not be a tubing change.
- Tube pumps have some means to prevent the hose from moving through the pump, however all tubing walks or stretches in the direction of roller travel.
- Tube pumps use the clamping of the roller as a valve the pump delivers a section of fluid that is trapped between two adjoining rollers.