



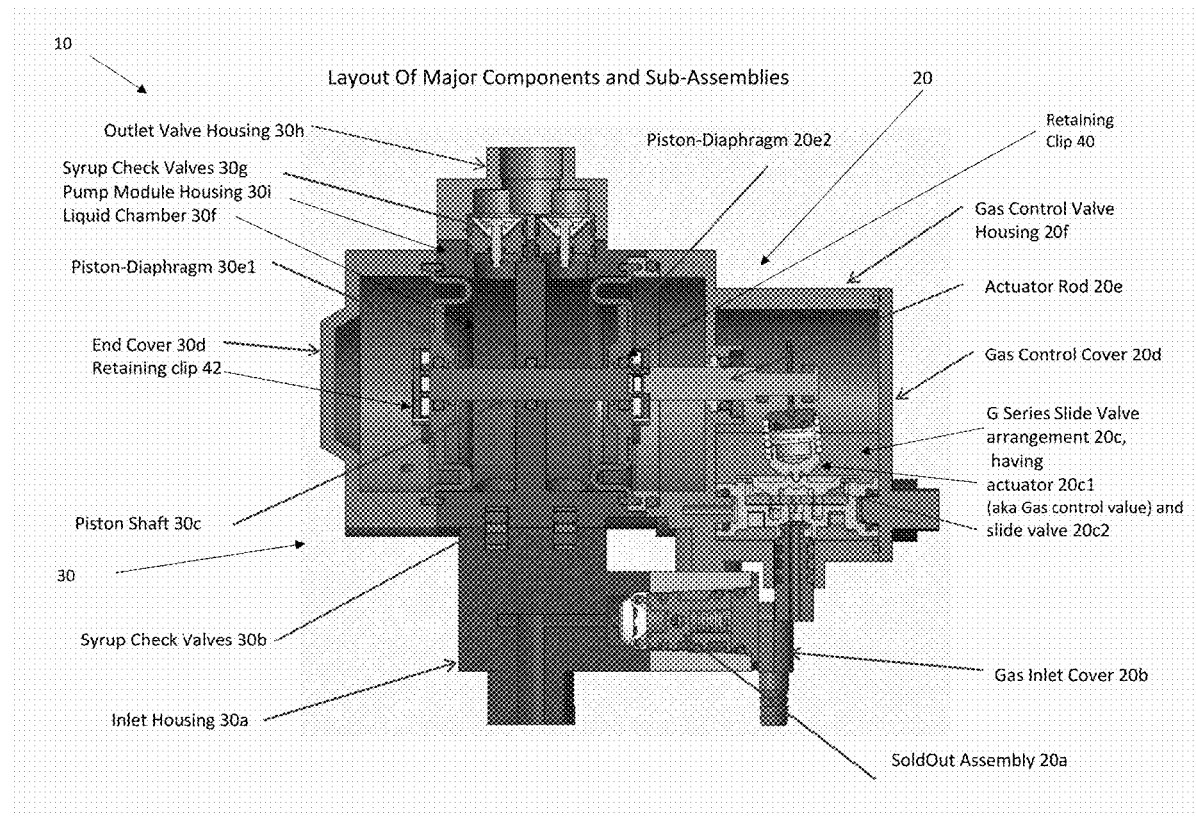
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(19) **United States**(12) **Patent Application Publication**  
**VERDUGO et al.**(10) **Pub. No.: US 2017/0298920 A1**(43) **Pub. Date: Oct. 19, 2017**(54) **MODULAR BIB PUMP**(71) Applicant: **FLOW CONTROL LLC**, Beverly, MA  
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**HAYASHI**, Westminister, CA (US)(21) Appl. No.: **15/474,523**(22) Filed: **Mar. 30, 2017****Related U.S. Application Data**(60) Provisional application No. 62/315,265, filed on Mar.  
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(57)

**ABSTRACT**

A modular pump features a gas-control-and-drive-unit (GCDU), a cartridge-style-pumping-module (CSPU) and a retainer clip (RC). The GCDU includes a GCDU-housing to receive/provide gas to a gas-passageway causing a GCDU-force in one direction; an actuator-rod-and-slide-valve-arrangement (AR/SVA) to respond to a CSPM-force and exhaust the gas from the GCDU-housing causing a GCDU-exhaustion-force in an opposite direction; and a GCDU-coupling-member. The CSPM includes a CSPM-housing to receive a fluid to be pumped, and a piston-and-dual-diaphragm-arrangement (PDDA) to respond to the GCDU-force, provide the CSPM-force and pump the fluid from the CSPM, and to respond to the GCDU-exhaustion-force and pump the fluid from the CSPM. The CSPM-housing includes a CSPM coupling member to detachably couple to the GCDU-coupling-member. The RC detachably couples a piston of the PDDA and an actuator rod of the AR/SVA, so the CSPM attaches/detaches from the GCDU using a three-step process for field replacement using the RC.



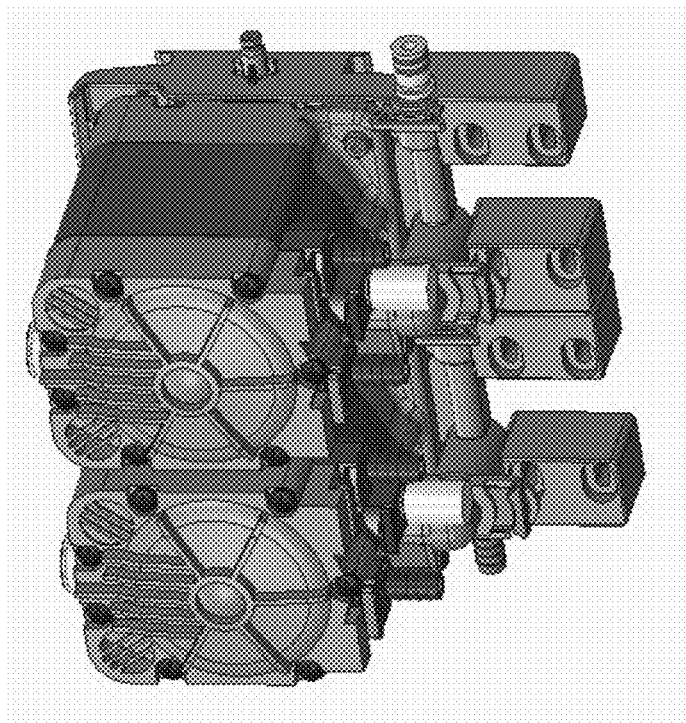


Fig. 1: Current Pump (Prior art)

Figure 2: Modular BIB Pump

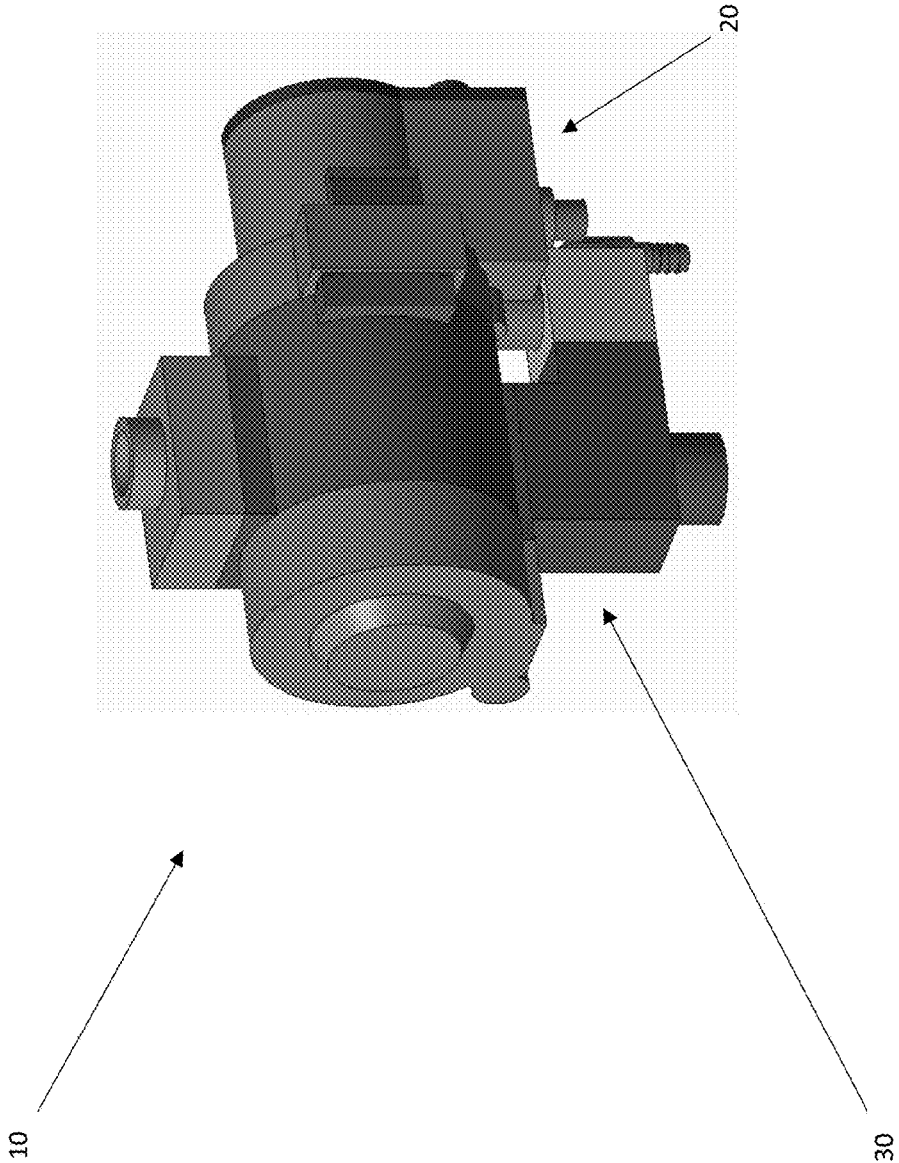
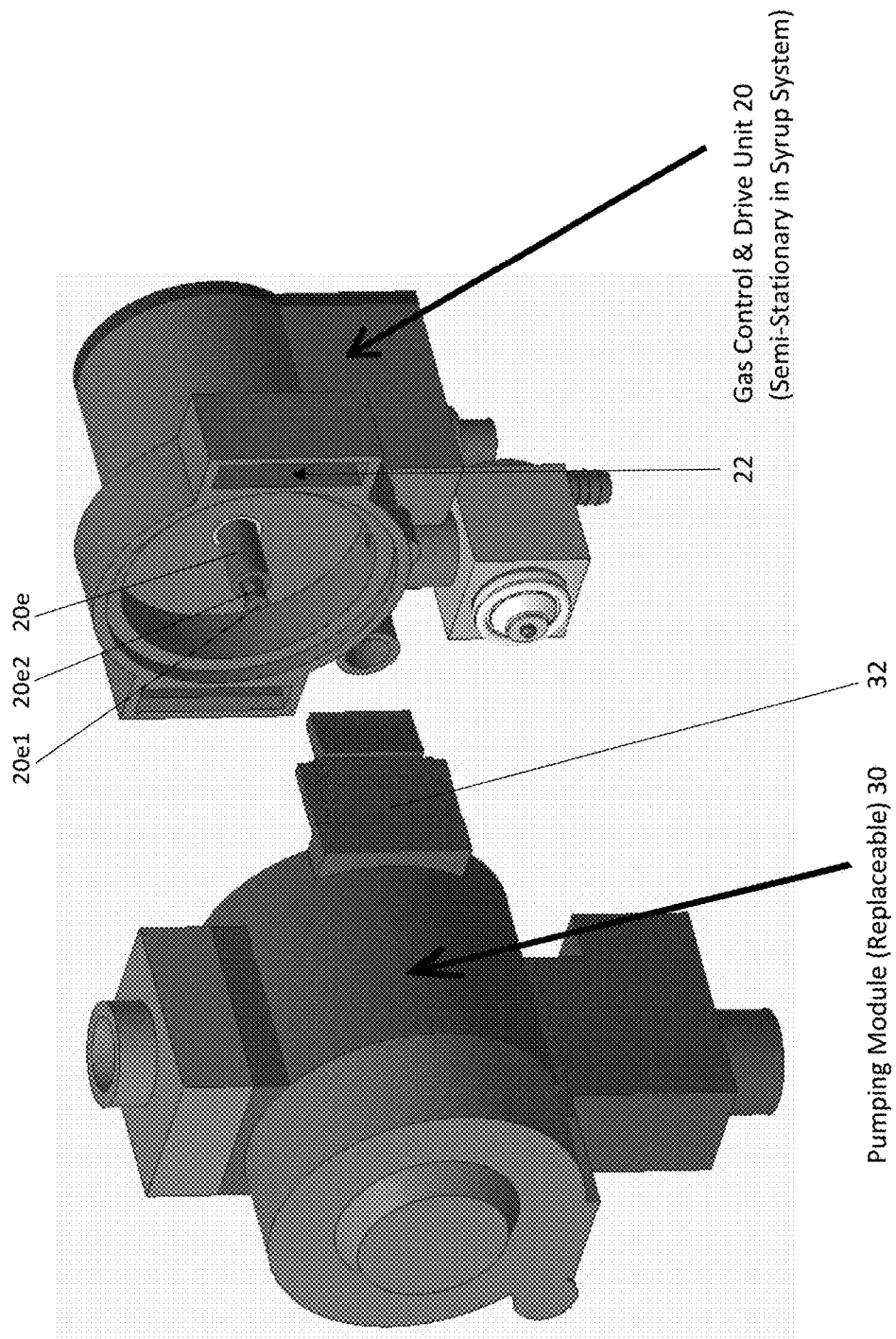


Figure 3: Basic Layout Of Key Differentiating Sub- Assemblies



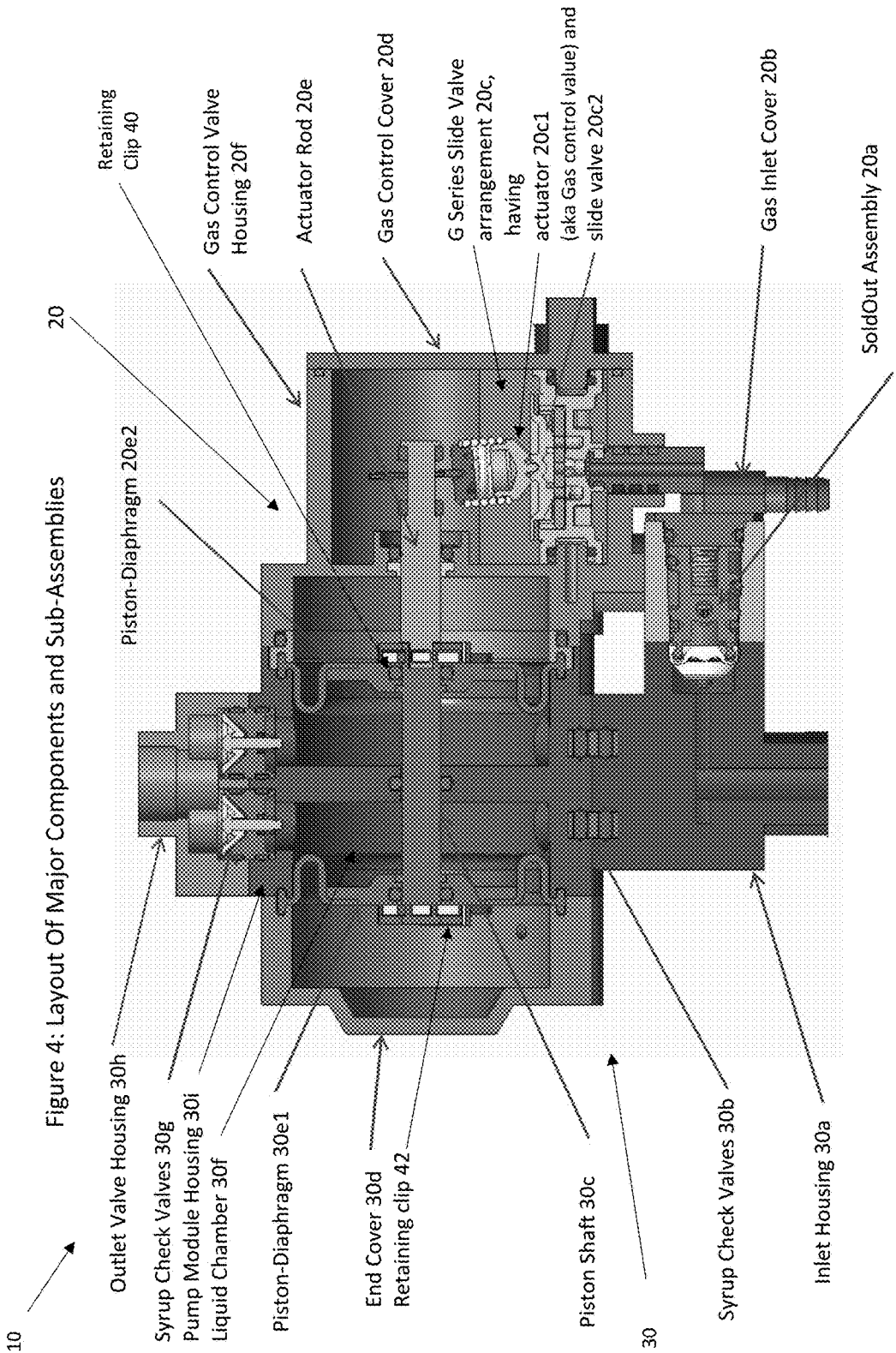
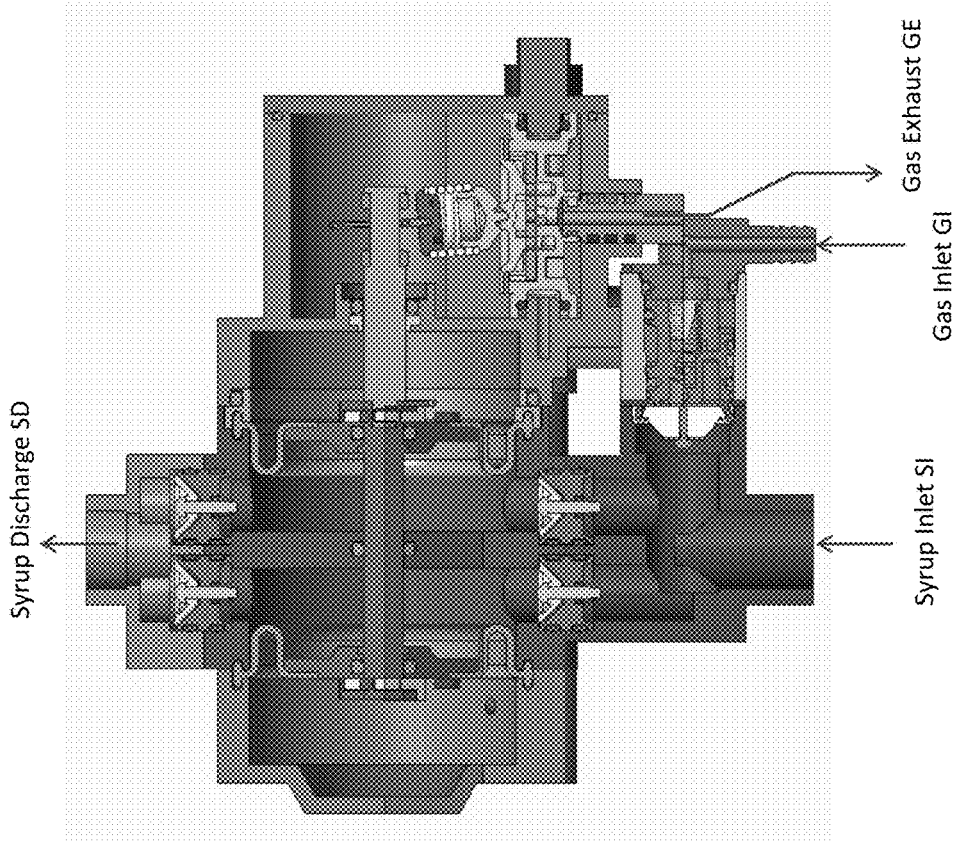
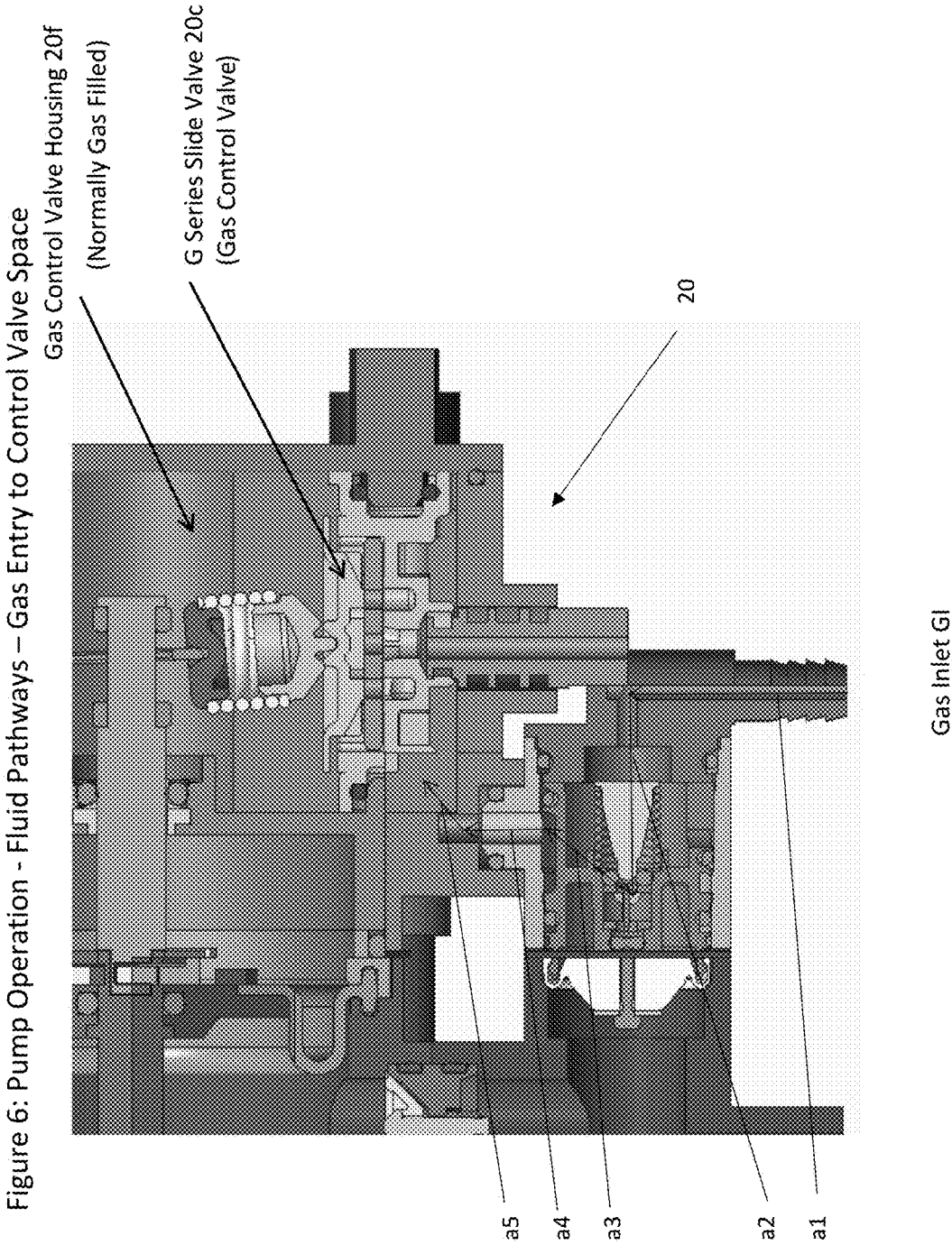
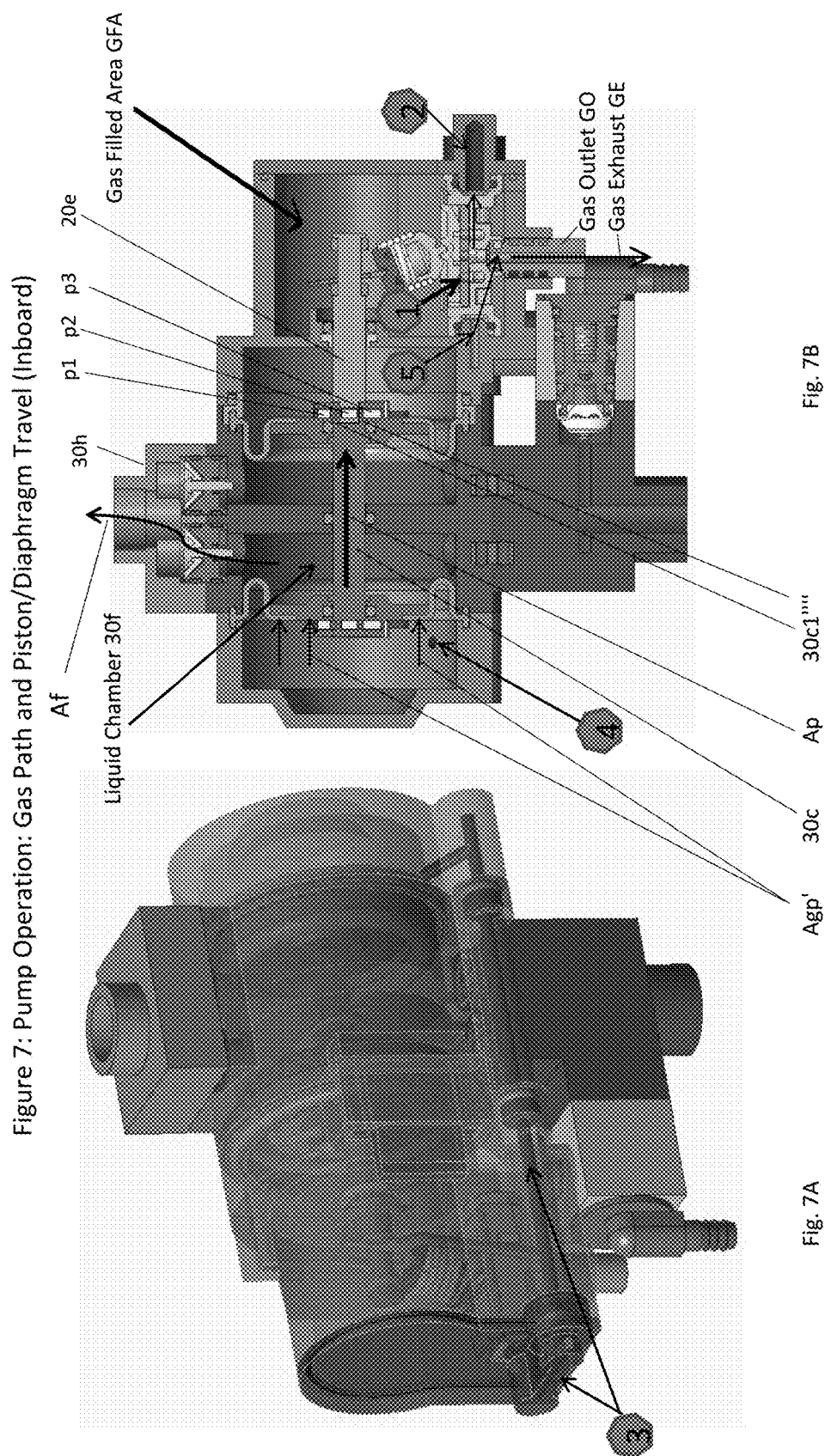


Figure 5: Modular BIB Pump Fluid Porting

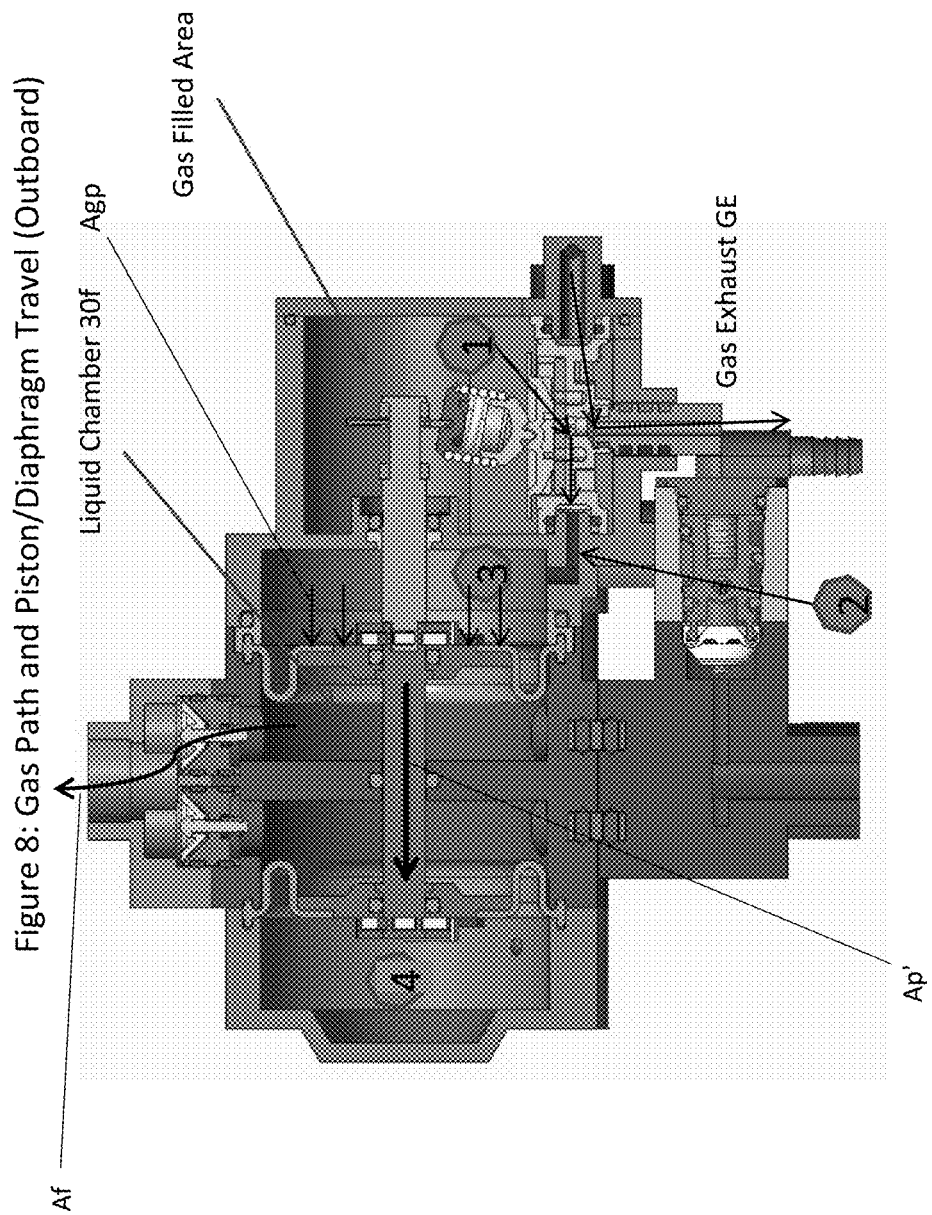


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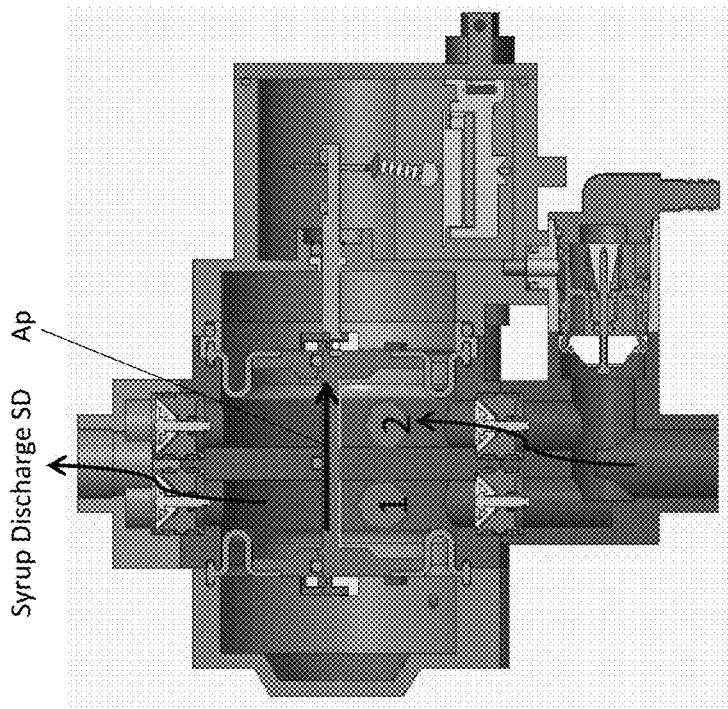


Fig. 9B: Piston Travel: Inboard

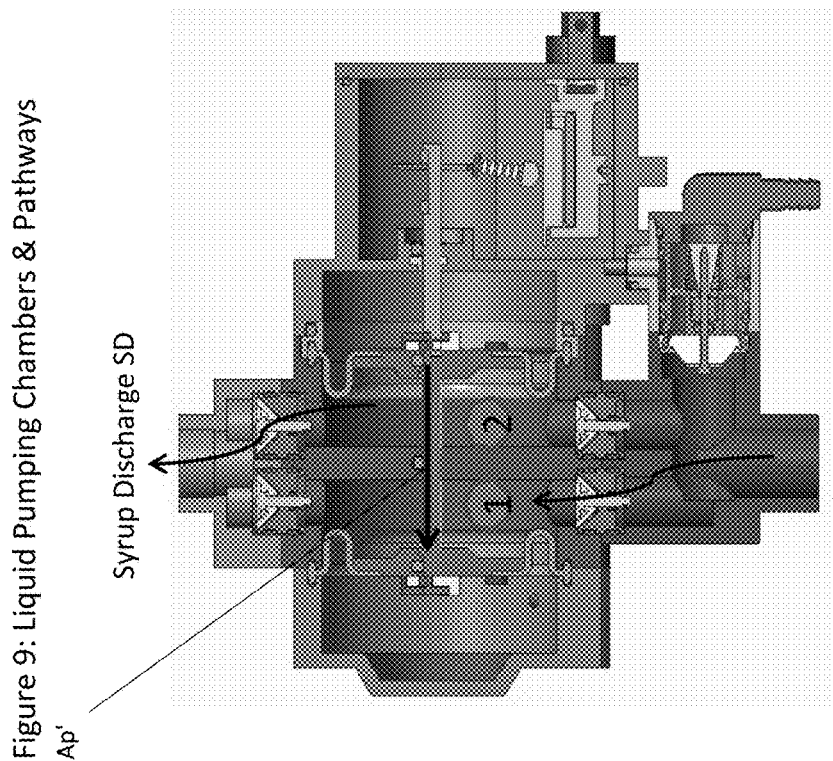


Fig. 9A: Piston Travel: Outboard

Fig. 10B: Sold-out Activation  
Restricted Syrup Flow

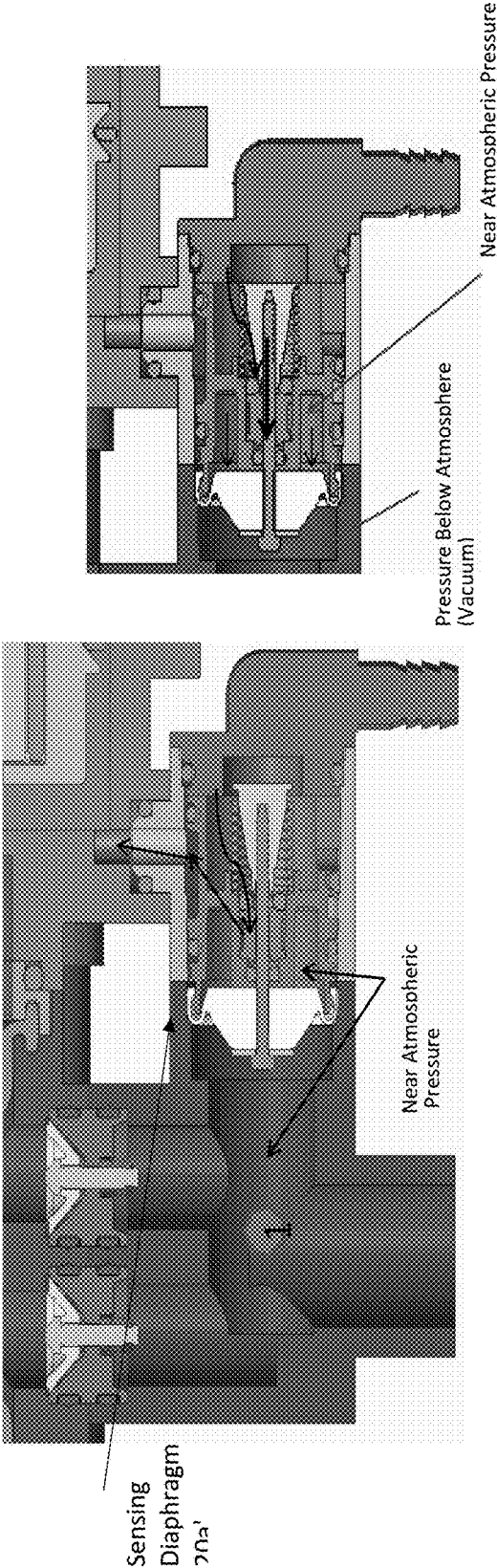
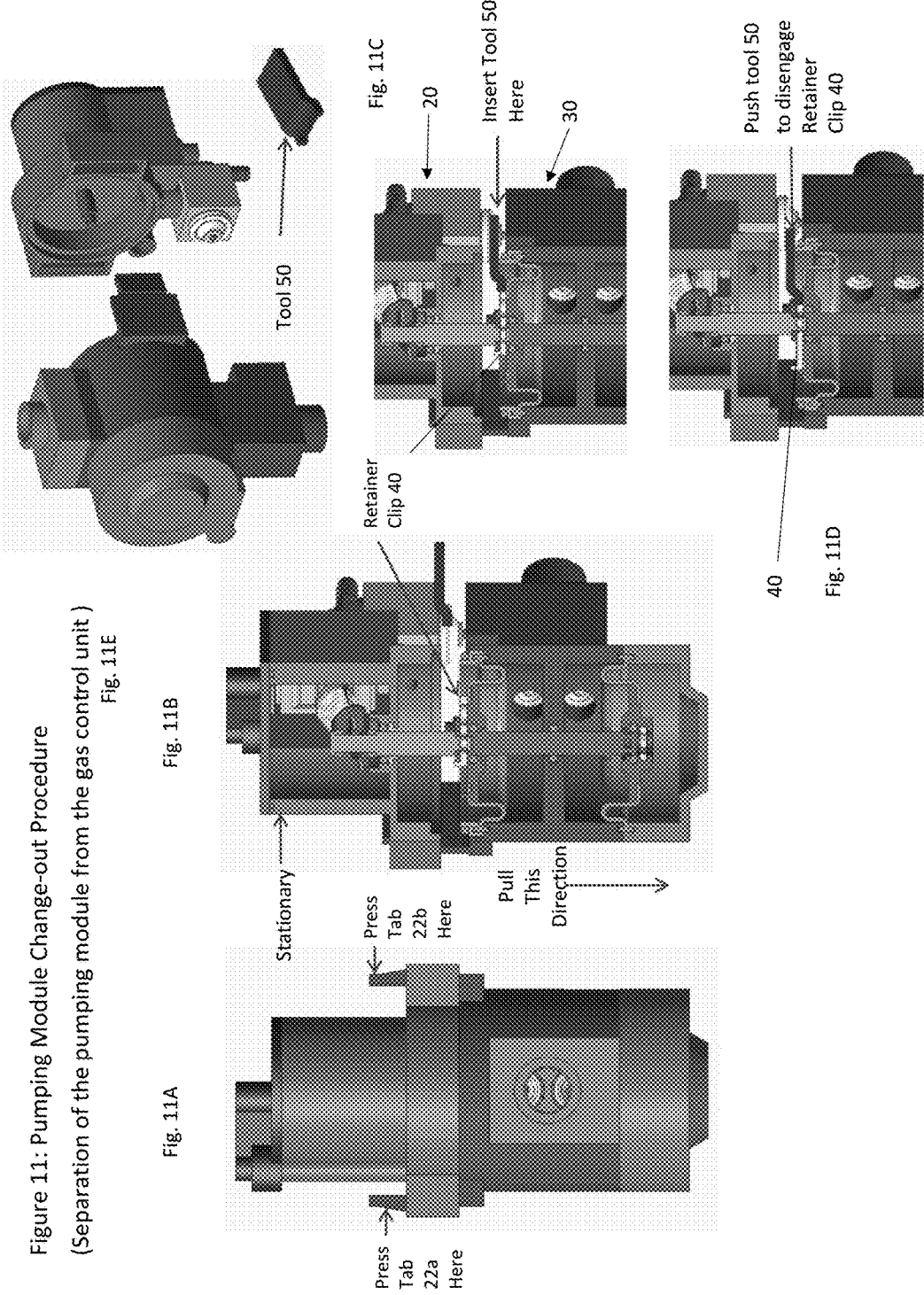


Figure 10: Pump Operation re Sold-Out Activation



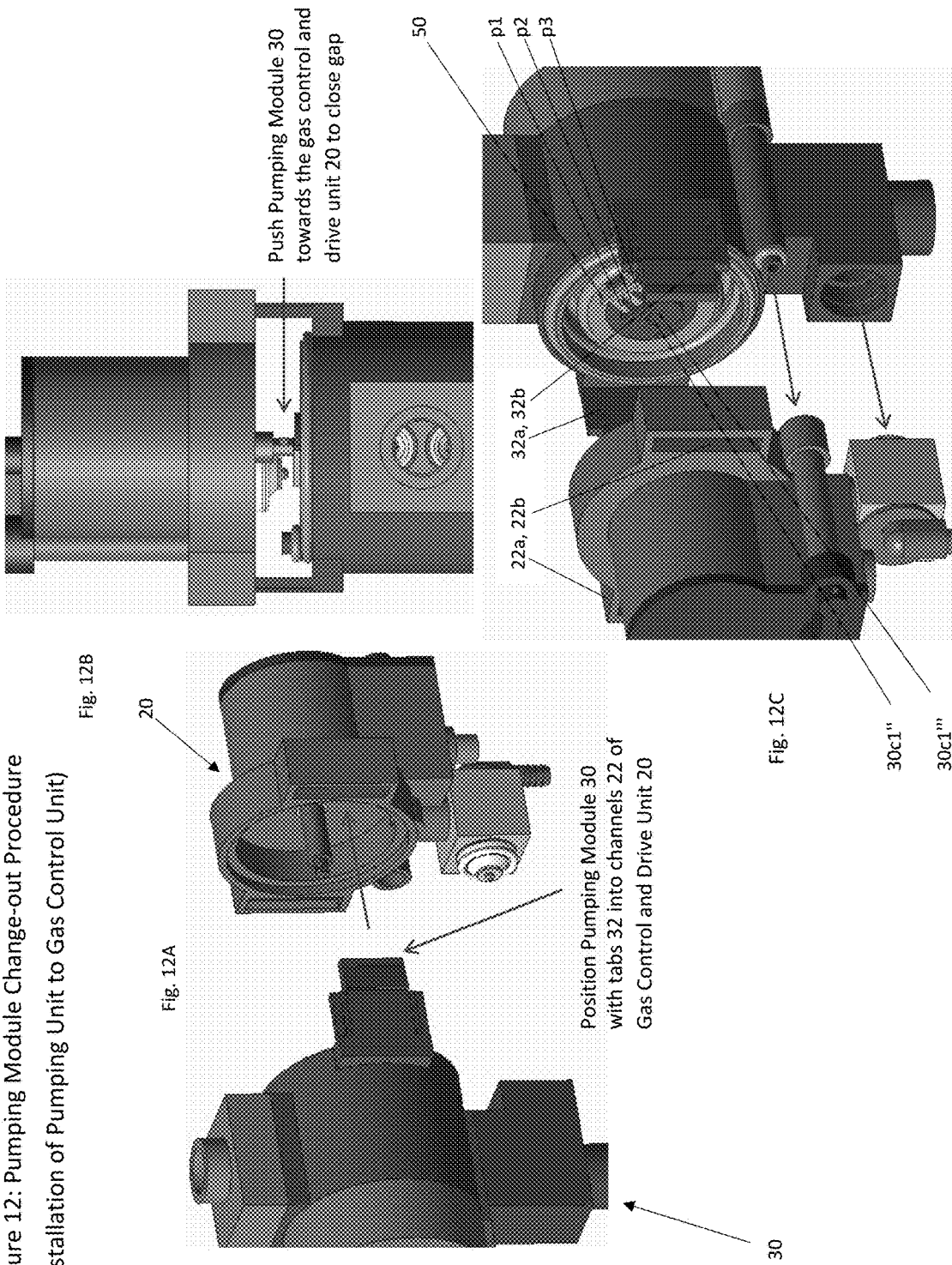


Fig. 12F

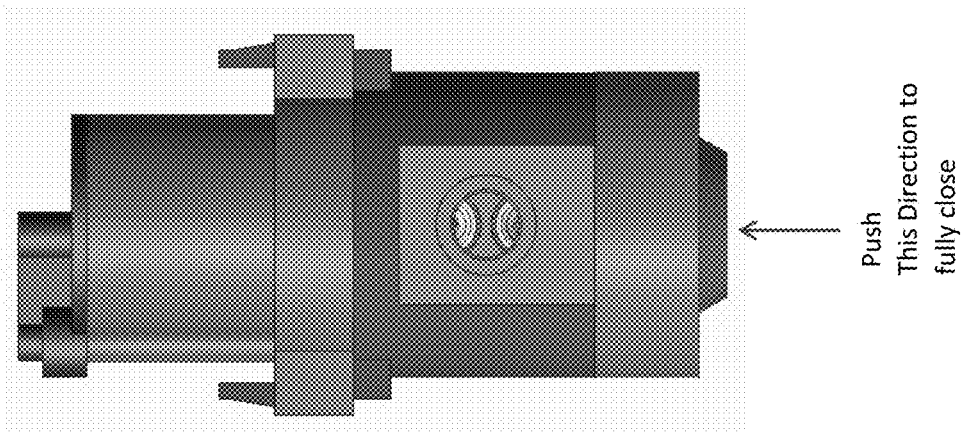
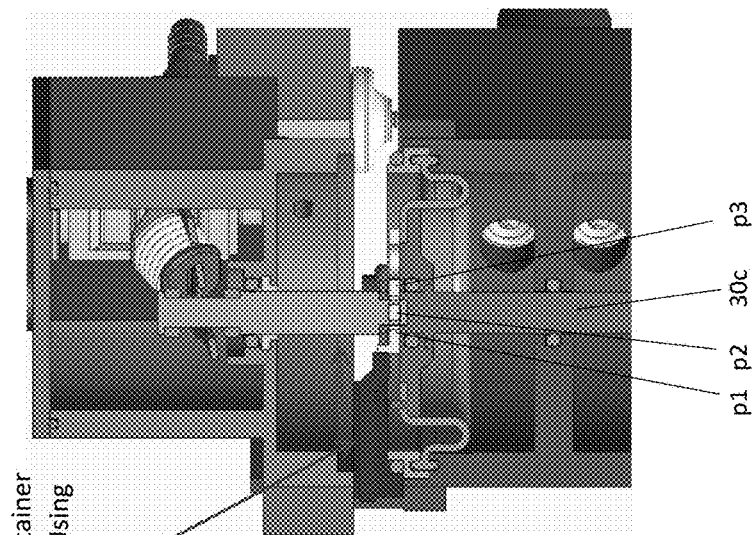
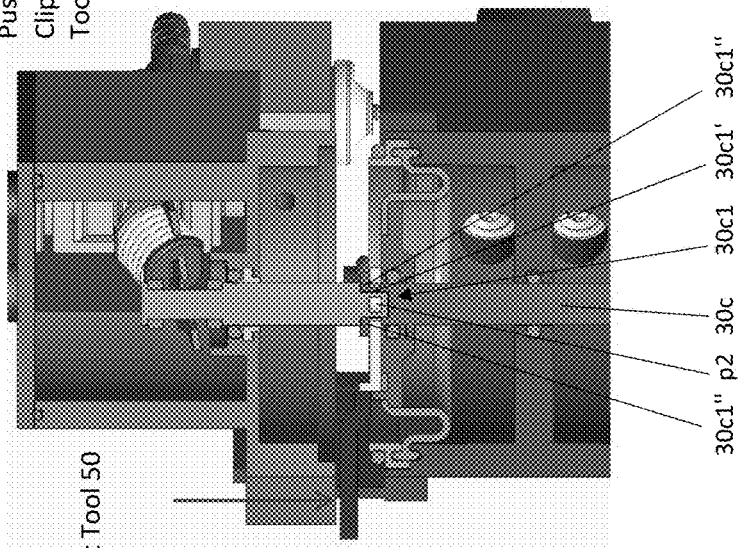


Fig. 12E



Push Retainer  
Clip 40 Using  
Tool 50

Fig. 12D



Insert Tool 50  
Here

## MODULAR BIB PUMP

### CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** This application claims benefit to provisional patent application serial nos. 62/315,265 (911-005.090-1/F-FLJ-X0026), filed 30 Mar. 2016, which is incorporated by reference in its entirety.

### BACKGROUND OF THE INVENTION

#### 1. Field of Invention

**[0002]** The present invention relates to a pump; and more particularly relates to a bag-in-the-box (BIB) pump.

#### 2. Description of Related Art

**[0003]** FIG. 1 shows a disposal pumphead known in the art, and disclosed in U.S. Pat. No. 8,616,862 (Atty dckt no. 911-005.067-2/F-FLJ-X0002, which is assigned to, commonly owned by the assignee of the instant application, and hereby incorporated by reference in its entirety.

**[0004]** The assignee of the instant application designs, manufactures and distributes BIB pumps for the post mix dispensing market, e.g., like the disposable pump in FIG. 1. There is an interest in the marketplace for a major configuration change to the prior art pump (e.g., see FIG. 1) in order to gain cost advantages being initiated throughout their organization. This effort focuses on the reduction of waste in the usage of BIB pumps. Currently, the pump life is approximately 100,000 gallons which translates to many years of service. Many pumps are removed far before their useful life and discarded due to restaurant shutdowns and flavors changes within the installation.

**[0005]** There is a need in the industry for a desired design change so the pump may be easily remanufacturable/replaceable in the field, e.g., by restaurant personnel as opposed to trained technicians. In addition to flavor changes, the need for store operator replacement of pumps due to breakdowns is a major driver.

### SUMMARY OF THE INVENTION

**[0006]** In summary, and by way of example, the present invention may consist of a gas operated modular BIB pump with a cartridge-style replaceable pumping module mated to a separate gas control drive unit, where the separate gas control drive unit is semi-permanent and the pumping module is designed to be field replaceable by untrained technicians.

**[0007]** The general solution is to re-situate the pistons involved in pumping the fluid in a way that makes it easier to modularize the pumping chamber from the gas control unit. Using some creative interfacing design features, the modular BIB pump according to the present invention should be easier to remove, e.g. without the need for tools.

#### Examples of Particular Embodiments

**[0008]** According to some embodiments, and by way of example, the present invention may include, or take the form of, a new and unique modular pump featuring a combination of a gas control and drive unit, a cartridge style pumping module and a retainer clip.

**[0009]** The gas control and drive unit may include a gas control and drive unit housing configured to receive gas from a gas inlet and provide the gas to a gas passageway so as to cause a gas control and drive unit force, as well as an actuator rod and slide valve arrangement configured to respond to a cartridge style pumping module force in an axial direction and exhaust the gas from a gas exhaust outlet of the gas control and drive unit housing so as to cause a gas control and drive unit exhaust force in an opposite axial direction, and also having a gas control and drive unit coupling member.

**[0010]** The cartridge style pumping module may include a cartridge style pump module housing configured to receive a fluid to be pumped from a fluid inlet, having a piston and dual diaphragm arrangement configured to respond to the gas control and drive unit force, provide the cartridge style pumping module force in the axial direction and pump the fluid from a fluid discharge outlet of the cartridge style pumping module, and also configured to respond to the gas control and drive unit exhaust force in the opposite axial direction and pump the fluid from the fluid discharge outlet of the cartridge style pumping module. The cartridge style pumping module housing may also include a cartridge style pumping module coupling member configured to detachably couple to the gas control and drive unit coupling member.

**[0011]** The retainer clip may be configured to detachably couple together a piston shaft of the piston and dual diaphragm arrangement and an actuator rod of the actuator rod and slide valve arrangement, so that the cartridge style pumping module can be attached and detached from the gas control and drive unit using a three step process so as to be field replaceable using a retainer clip attaching/detaching tool.

**[0012]** By way of example, the modular pump may include one or more of the following features:

**[0013]** The cartridge style pumping module may be attached to the gas control and drive unit using the three step process, as follows:

**[0014]** partially coupling together the cartridge style pumping module coupling member and the gas control and drive unit coupling member so as to leave a space between the cartridge style pumping module and the gas control and drive unit for accessing the retainer clip;

**[0015]** attaching together the piston of the piston and dual diaphragm arrangement and the actuator rod of the actuator rod and slide valve arrangement with the retainer clip using the retainer clip attaching/detaching tool to push the retainer clip into a locking position; and fully coupling together the cartridge style pumping module coupling member and the gas control and drive unit coupling member in a locking engagement.

**[0016]** The cartridge style pumping module may be detached from the gas control and drive unit using the three step process, as follows:

**[0017]** partially decoupling and unlocking the cartridge style pumping module coupling member and the gas control and drive unit coupling member from a locking engagement, so as to leave a space between the cartridge style pumping module and the gas control and drive unit for accessing the retainer clip;

**[0018]** detaching the piston of the piston and dual diaphragm arrangement and the actuator rod of the actuator rod and slide valve arrangement by removing

the retainer clip using the retainer clip attaching/detaching tool to pushing the retainer clip from a locking position; and

[0019] fully decoupling together the cartridge style pumping module coupling member and the gas control and drive unit coupling member.

[0020] The gas control and drive unit housing and the cartridge style pumping module housing may be configured along a common longitudinal axis; and the cartridge style pumping module coupling member may include a pair of tabs configured on opposite sides of the cartridge style pumping module housing and extending in parallel with the common longitudinal axis.

[0021] The gas control and drive unit coupling member may include a pair of channels configured on opposite sides of the gas control and drive unit housing and configured with openings to detachably couple to the pair of tabs.

[0022] The pair of tabs may be configured to deflect towards or away from the common longitudinal axis in order to couple or decouple to or from the pair of channels.

[0023] The modular pump may be a bag-in-the-box (BIB) pump for pumping syrup.

[0024] The actuator rod may include a tapered end with a slot or opening formed or configured therein; the piston shaft may include a flanged portion having a cylindrical recessed channel portion, a rim portion and an interior cavity formed within the recessed channel portion configured to receive the tapered end; and the retainer clip may include a multi-prong clip having multiple prongs. In operation, the tapered end may be configured in the slot or opening, the retainer clip may be pushed so a center prong passed into and through the slot or opening and the interior cavity of the flange portion of the piston shaft, and at least one of the multiple outer prongs may be adapted in the cylindrical recessed channel portion and engage the rim portion, so as to lock, fasten or couple the actuator rod and piston shaft together.

#### Solution to Problem in the Art

[0025] The present invention overcomes the above mentioned difficulties as follows:

[0026] The present invention provides a modular BIB pump that may be easily remanufactureable/replaceable in the field, e.g., by restaurant personnel as opposed to trained technicians. In addition to flavor changes, the new modular BIB pump allows for replacement by store operator replacement of pumps due to breakdowns.

#### BRIEF DESCRIPTION OF THE DRAWING

[0027] The drawing includes FIGS. 1-12 which are not necessarily drawn to scale, which are briefly described as follows:

[0028] FIG. 1 shows the current pump that is known in the art.

[0029] FIG. 2 shows a diagram of a modular BIB pump, according to some embodiments of the present invention.

[0030] FIG. 3 is an exploded view of the modular BIB pump showing the basic layout of key differentiating sub-assemblies of the modular BIB pump, according to some embodiments of the present invention. (Note: for the purpose of developing and illustrating the present invention in its simplest form, fasteners, ports and other essential geometry have been omitted from this Figure.)

[0031] FIG. 4 is a side cross-sectional view of the modular BIB pump in FIG. 2, showing a layout of major components and sub-assemblies of the modular BIB pump, according to some embodiments of the present invention.

[0032] FIG. 5 is a side cross-sectional view of the modular BIB pump in FIG. 2, showing modular BIB pump fluid porting, according to some embodiments of the present invention.

[0033] FIG. 6 is a partial side cross-sectional view of the gas control and drive unit of the modular BIB pump, showing the operation of the modular BIB pump, e.g., including fluid pathways and gas entry to control valve space, according to some embodiments of the present invention.

[0034] FIG. 7 includes FIGS. 7A and 7B, showing the operation of the modular BIB pump, e.g., including the gas path and piston/diaphragm travel (inboard), according to some embodiments of the present invention. FIG. 7A is a phantom perspective view of the modular BIB pump, showing a semi-transparent outer housing for seeing into the pump; and FIG. 7B is a side cross-sectional view of the modular BIB pump.

[0035] FIG. 8 is a side cross-sectional view of the modular BIB pump, showing the gas path and piston/diaphragm travel (outboard), according to some embodiments of the present invention.

[0036] FIG. 9 includes FIGS. 9A and 9B, showing liquid pumping chambers and pathways of the modular BIB pump, according to some embodiments of the present invention. FIGS. 9A and 9B are a side cross-sectional views of the modular BIB pump.

[0037] FIG. 10 includes FIGS. 10A and 10B, showing the pump operation in normal operation and sold-out activation with restricted syrup flow, according to some embodiments of the present invention. FIG. 10A is a partial cross-sectional view of the inlet housing of the pumping module and the gas inlet and sold out assembly of the gas control and drive unit; and FIG. 10B is a partial cross-sectional view of the gas inlet and soldout assembly of the gas control and drive unit shown in FIG. 10A.

[0038] FIG. 11 includes FIGS. 11A thru 11E, showing the pumping module change-out procedure, including the separation of the pumping module from the gas control unit, according to some embodiments of the present invention. FIG. 11A is a top view of the modular BIB pump showing the pump module and the gas control and drive unit coupled together; FIG. 11B is a top cross-section view of the modular BIB pump in FIG. 11A showing the pump module and the gas control and drive unit slightly separated after the tabs in FIG. 11A are pressed inwardly together; FIG. 11C is a partial top cross-sectional view of the modular BIB pump shown in FIG. 11B showing the tool positioned against the retainer clip between the pump module and the gas control and drive unit; FIG. 11D is a partial top cross-sectional view of the modular BIB pump shown in FIG. 11B showing the retaining clip disengaged releasing the piston shaft from the actuator rod; and FIG. 11E is an exploded view of the modular BIB pump shown in FIG. 11A showing the pump module separated from the gas control and drive unit.

[0039] FIG. 12 includes FIGS. 12A thru 12E, showing the pumping module change-out procedure, including the installation of the pumping module to the gas control unit, according to some embodiments of the present invention. FIG. 12A is an exploded view of the modular BIB pump



having the pump module separated and positioned with tabs for engaging channels/slots of the gas control and drive unit;

[0040] FIG. 12B is a top view of the modular BIB pump having the pump module partially separated from the gas control and drive unit; FIG. 12C is an exploded view of the modular BIB pump shown in FIG. 12A from the other side; FIG. 12D is a partial top cross-sectional view of the modular BIB pump shown in FIG. 12B showing the tool insert and retainer clip positioned to couple the piston shaft and actuator rod together; FIG. 12E is a partial top cross-sectional view of the modular BIB pump shown in FIG. 12B showing the retainer clip coupling the piston shaft and actuator rod together after the tool is pushed; and FIG. 12F is a top view of the modular BIB pump showing the pump module and the gas control and drive unit coupled together similar to that shown in FIG. 11A.

[0041] Not every element or arrow in every Figure is labeled with a lead line and reference numeral/label, so as to reduce clutter in the drawing as a whole.

#### DETAILED DESCRIPTION OF BEST MODE OF THE INVENTION

##### Detailed Description of the Operation of the Present Invention

[0042] In summary, and by way of example, and consistent with that shown in FIGS. 2-12, the present invention may take the form of, or consist of, a new and unique modular BIB pump generally indicated by 10 featuring a combination of a gas control and drive unit 20, a cartridge style pumping module 30 and a retainer clip 40. In particular, the reader is referred to FIGS. 4, 11 and 12, which show the basic components, as well as the decoupling and coupling of the gas control and drive unit 20 and the cartridge style pumping module 30, according to some embodiments of the present invention.

[0043] The gas control and drive unit 20 may include a gas control and drive unit housing 20' configured to receive gas from a gas inlet GI and provide the gas to a gas passageway so as to cause a gas control and drive unit force Agp, as well as an actuator rod and slide valve arrangement 20c, 20e configured to respond to a cartridge style pumping module force Ap in an axial direction and exhaust the gas from a gas exhaust outlet GE of the gas control and drive unit housing 20 so as to cause a gas control and drive unit exhaustion force Agp' in an opposite axial direction, and also having a gas control and drive unit coupling member(s) 22.

[0044] The cartridge style pumping module 30 may include a cartridge style pump module housing 30i configured to receive a fluid to be pumped from a fluid inlet SI, having a piston and dual diaphragm arrangement 30c, 20e1, 20e2 configured to respond to the gas control and drive unit exhaustion force Agp', provide the cartridge style pumping module force Ap in the axial direction and pump the fluid from a fluid discharge outlet SD of the cartridge style pumping module 30, and also configured to respond to the gas control and drive unit exhaustion force Agp' in the opposite axial direction and pump the fluid from the fluid discharge outlet SD of the cartridge style pumping module 30. The cartridge style pumping module housing 30i may also include a cartridge style pumping module coupling member(s) 32 configured to detachably couple to the gas control and drive unit coupling member(s) 22.

[0045] The retainer clip 40 may be configured to detachably couple together a piston 30c of the piston and dual diaphragm arrangement 30c, 20e1, 20e2 and an actuator rod 20e of the actuator rod and slide valve arrangement 20c, 20e, so that the cartridge style pumping module 30 can be attached and detached from the gas control and drive unit 20 using a three step process so as to be field replaceable, e.g., using a retainer clip attaching/detaching tool 50.

[0046] By way of example, and consistent with that shown in FIG. 4, the actuator rod 20e may include a tapered end 20e1 with a slot/opening 20e2 formed or configured therein. The piston shaft 30c may include a flanged portion 30c1 having a cylindrical recessed channel portion 30c1', a rim portion 30c1" and an interior cavity 30c1'" formed within the cylindrical recessed channel portion 30c1' configured and dimensioned to receive the tapered end 20e1. The retainer clip 40 may take the form of a multi-prong clip having multiple prongs, e.g., including prongs p1, p2 and p3. In operation, when the tapered end 20e1 is configured in the slot/opening 20e2, the retainer clip 40 is pushed so that a center prong p2 passed into and through the slot/opening 20e2 and the interior cavity 30c1'" of the flange portion 30c1 of the piston shaft 30c, and at least one of the multiple prongs such as outer prong(s) p1 and/or p3 are adapted in the cylindrical recessed channel portion 30c1' and engage the rim portion 30c1", so as to lock, fasten or couple the actuator rod 20e and piston shaft 30c together. The flanged portion 30c1 may also be configured with a second rim portion 30c1'" (see FIG. 7B), so that the outer prongs p1 and/or p3 engage the rim portion 30c1" on one side and the second rim portion 30c1'" on the other side to engage the flange portion 30c on both sides.

[0047] The scope of the invention is intended to include, and embodiment are envisioned, using other types or kinds of techniques for coupling the actuator rod 20e and piston shaft 30c together with the spirit of the underlying invention. By way of example, the coupling features of the actuator rod 20e and piston shaft 30c may be switched, so that the piston shaft 30c is configured with a corresponding tapered end with a corresponding slot/opening formed or configured therein; and the actuator rod 20e is configured with a corresponding flanged portion having a corresponding cylindrical recessed channel portion and a corresponding rim portion and a corresponding interior cavity formed within the corresponding recessed channel portion configured to receive the corresponding tapered end of the piston shaft 30c. By way of further example, the scope of the invention is intended to include, and embodiment are envisioned, using other types or kinds of techniques for coupling the actuator rod 20e and piston shaft 30c that are either now known or later developed in the future.

[0048] The cartridge style pumping module 30 may be attached to the gas control and drive unit 20 using the three step process, as follows::

[0049] partially coupling together the cartridge style pumping module coupling member(s) 32 and the gas control and drive unit coupling member(s) 22 so as to leave a space between the cartridge style pumping module 30 and the gas control and drive unit 20 for accessing the retainer clip 40;

[0050] attaching together the piston 30c of the piston and dual diaphragm arrangement 30c, 30e1, 30e2 and the actuator rod 20e of the actuator rod and slide valve arrangement 20c, 20e with the retainer clip 40 using the

retainer clip attaching/detaching tool **50** (aka herein as the “tool”) to push the retainer clip **40** into a locking position (e.g., see FIG. 12E, as well as FIGS. 4, 5, 7B, 8, 9, 11B, and 11C); and

[0051] fully coupling together the cartridge style pumping module coupling member **30** and the gas control and drive unit coupling member **20** in a locking engagement (e.g., see FIGS. 12F and 11A, as well as 1, 2, 4, 5, 6, 7B, 8 and 9).

[0052] The cartridge style pumping module **30** may be detached from the gas control and drive unit **20** using the three step process, as follows::

[0053] partially decoupling and unlocking the cartridge style pumping module coupling member(s) **32** and the gas control and drive unit coupling member(s) **22** from a locking engagement, so as to leave a space between the cartridge style pumping module **30** and the gas control and drive unit **20** for accessing the retainer clip **40**;

[0054] detaching the piston **30c** of the piston and dual diaphragm arrangement **30c**, **30e1**, **30e2** and the actuator rod **20e** of the actuator rod and slide valve arrangement **20c**, **20e** by removing the retainer clip **40** using the retainer clip attaching/detaching tool **50** to push the retainer clip **40** from the locking position; and

[0055] fully decoupling together the cartridge style pumping module coupling member(s) **32** and the gas control and drive unit coupling member(s) **22**.

[0056] The gas control and drive unit housing **20f** and the cartridge style pumping module housing **30i** may be configured along a common longitudinal axis; and the cartridge style pumping module coupling member **32** may include a pair of tabs **32a**, **32b** configured on opposite sides of the cartridge style pumping module housing **30i** and extending in parallel with the common longitudinal axis.

[0057] The gas control and drive unit coupling member **22** may include a pair of channels **22a**, **22b** configured on opposite sides of the gas control and drive unit housing **20f** and configured with channel openings to detachably couple to the pair of tabs **32a**, **32b**.

[0058] The pair of tabs **32a**, **32b** may be configured to deflect towards or away from the common longitudinal axis in order to couple or decouple to or from the pair of channels **22a**, **22b**.

[0059] The modular pump **10** may be used as, or take the form of, a bag-in-the-box (BIB) pump for pumping syrup.

FIG. 4

[0060] By way of example, FIG. 4 shows the basic layout of major components and sub-assemblies of the modular BIB pump, according to some embodiments of the present invention.

[0061] For example, the gas control and drive unit **20** includes the following components:

[0062] a soldout assembly **20a**;

[0063] a gas inlet cover **20b**;

[0064] a G series slide valve **20c**;

[0065] a gas control cover **20d**;

[0066] an actuator rod **20e**; and

[0067] a gas control valve housing **20f**;

[0068] The pump module **30** includes the following components:

[0069] an inlet housing **30a**;

[0070] syrup input check valves **30b**;

[0071] a piston shaft **30c**;

[0072] an end cover **30d**;

[0073] piston-diaphragms **30e1**, **30e2**;

[0074] a liquid chamber **30f**;

[0075] syrup output check valves **30g**;

[0076] an outlet housing **30h**.

[0077] In modular BIB pump also includes a retainer clip **40** for coupling together the actuator rod **20e**, and a second retainer clip **42** for coupling together the piston-diaphragm **30e1** and the piston shaft **30c**.

[0078] The basic structural and functional cooperation between these components is described in further detail in relation to FIGS. 5-12 below.

FIG. 5

[0079] By way of example, FIG. 5 shows the modular BIB pump fluid porting, according to some embodiments of the present invention. For example, gas enters the gas control and drive unit **20** via a gas inlet port GI of the gas inlet cover **20b** (FIG. 4), and gas exhaust GE exits the gas control and drive unit **20** via a gas outlet port GO. Syrup enters the pump module **30** via a syrup inlet SI of the inlet housing **30a** (FIG. 4), and the syrup exits the pump module **30** via a syrup discharge SD of the outlet valve housing **30h** (FIG. 4).

FIG. 6

[0080] By way of example, FIG. 6 show the basic operation of the modular BIB pump, e.g., including fluid pathways and gas entry to control valve space, according to some embodiments of the present invention. In operation, and as indicated in FIG. 6, the gas control valve housing **20f** is normally filled with gas. Moreover, arrows labeled and identified as a1 thru a5 show the pathway of the gas passing into and from the gas inlet GI, through the soldout assembly **20a** to the slide valve **20c**.

FIG. 7

[0081] By way of example, FIG. 7 shows the operation of the modular BIB pump, e.g., including the gas path and piston/diaphragm travel (inboard), according to some embodiments of the present invention.

[0082] As shown in FIG. 7, gas under pressure enters the slide valve **20c** from the gas filled chamber (e.g., aka as area **1**) that forms part of the gas control valve housing **20f** (see also FIGS. 4 and 6) and is routed through the slide valve **20c** to a passage located at an arrow labeled **2**. From point **2**, the gas is routed to the end cover **30d** via the passage labeled by arrow **3** (FIG. 7A). The gas then enters an interior cavity of the end cover **30d** at a point number/opening labeled by arrow **4** (FIG. 7B).

[0083] Once the gas is in the end cover **30d**, gas pressure will act on the piston/diaphragm **30e1** resulting in an applied force **Ap** which will cause the piston shaft **30c** to move in the direction of the arrow labeled **Ap**. As the piston shaft **30c** moves, fluid in the liquid chamber **30f** will be displaced through the outlet/discharge valves **30g** of the outlet valve housing **30h**, e.g., as indicated by the arrow shown and labeled **Af**.

[0084] The gas in area labeled **5** is allowed to be vented (connected) to atmosphere to allow for piston travel in the direction of the applied force, as shown. The gas exhaust GE escapes through the gas outlet or exhaust port GO, as shown.

FIG. 8

[0085] By way of example, FIG. 8 show the gas path and piston/diaphragm travel (outboard), according to some embodiments of the present invention.

[0086] As shown in FIG. 8, when the piston shaft 30c and actuator rod 20e arrive at the end of the stroke (direction indicated in previous Figure), the G series slide valve 30c will change state (e.g., sliding from a rightward position in FIG. 7 to a leftward position in FIG. 8) and route gas from the area labeled 1 through a passage labeled 2 and into an area labeled 3. The gas flow is indicated by the arrows included in FIG. 8. The gas pressure indicated by arrows labeled Agp will act over the surface of the piston-diaphragm 20g to produce an axial force on the piston shaft 30c in the direction of the arrow Ap' in the opposite direction from the arrow labeled Ap (FIG. 7B). Any fluid contained in the liquid chamber 30f will be displaced out the outlet/discharge valves 30g of the outlet valve housing 30h, e.g., as indicated by the arrow Af shown. The gas in the interior cavity or area labeled 4 of the end cover 30d is allowed to pass via the passageways labeled 3 in FIG. 7A back to the point 2 in FIG. 7B, to be vented (connected) to atmosphere to allow for piston shaft 30c travel in the direction labeled Ap, as indicated. The gas escapes through the exhaust outlet or port GO.

FIG. 9

[0087] By way of example, FIG. 9 shows the liquid pumping chambers & pathways of the modular BIB pump, according to some embodiments of the present invention.

[0088] In FIG. 9A, the liquid chamber LC has two chambers, labeled chamber 1 and chamber 2. As piston-diaphragm 30e1, 30e2 moves outboard (e.g., leftwardly as shown), liquid/fluid in chamber 2 is displaced through the discharge check valves 30g (see also FIG. 4). Simultaneously, as the volume in chamber 1 expands liquid/fluid is drawn in through inlet check valves 30b (see also FIG. 4).

[0089] In FIG. 9B, as piston-diaphragm 30e1, 30e2 moves inboard (e.g., rightwardly as shown), liquid/fluid in chamber 2 is displaced through the discharge check valves 30g. Simultaneously, as the volume in chamber 1 expands, liquid/fluid is drawn in through inlet check valves 30b.

[0090] The piston-diaphragm 30e1, 30e2 reciprocates back and forth in order to draw liquid/fluid into a respective chamber, and displaced fluid from a respective chamber.

FIG. 10

[0091] By way of example, FIG. 10 shows the pump operation in normal (FIG. 10A) and sold out activation (FIG. 10B), according to some embodiments of the present invention.

[0092] For example, during normal operation the pressure in the inlet area labeled (1) is near atmosphere and gas is routed through the soldout valve assembly 20a and into the pump. When the liquid/fluid (e.g., syrup) source runs out, the pressure in the inlet area (1) will be reduced to less than atmosphere. The pressure difference acting on the sensing diaphragm 20a' will cause movement indicated by the arrow. The movement will cause the gas flow through the soldout valve assembly 20a to cease thereby stopping the modular BIB pump from continued operation. When the liquid/fluid (e.g., syrup) source is restored, pressure across the sensing

diaphragm 20a' will return to normal, and the soldout valve assembly 20a will allow gas to flow into the modular BIB pump 10.

[0093] By way of example, the processes happens whenever a liquid/fluid/syrup bag empties and needs to be replaced with a new liquid/fluid/syrup bag.

FIG. 11

[0094] FIG. 11 shows the pumping module change-out procedure, including the separation of the pumping module 30 from the gas control and drive unit 20, according to some embodiments of the present invention.

[0095] In FIG. 11, FIG. 11A shows the pump module 30 and the gas control and drive unit 20 coupled together. FIG. 11B shows the pump module 30 and the gas control and drive unit 20 slightly separated after the tabs in FIG. 11A are pressed inwardly together. FIG. 11C shows the tool 50 positioned against the retaining clip 40 between the pump module 30 and the gas control and drive unit 20. FIG. 11D shows the retaining clip 40 disengaged releasing the piston shaft 30c from the actuator rod 20e. FIG. 11E shows the pump module 30 separated from the gas control and drive unit 20.

[0096] The pumping module change-out procedure for decoupling the pumping module 30 and the gas control and drive unit 20, e.g., including the following steps:

[0097] 1). Press tabs 22a, 22b and pull the pumping module 30 away from gas control and drive unit 20 to expose interior of the pump 10, e.g., as shown in FIGS. 11A and 11B.

[0098] 2) Locate retainer clip 40 and disposable tool 50, as shown in FIG. 11B.

[0099] 3) Insert the disposable tool 50 between the housings of the pumping module 30 and the gas control and drive unit 20 and push the retainer clip 40 to disengage the actuator rod 20e and the piston shaft 30c, e.g., as shown in FIGS. 11C and 11D.

[0100] 4) Pull the pumping module 30 and the gas control and drive unit 20 away from each other to fully disengage the pumping module 30 and the gas control and drive unit 20, e.g., as shown in FIG. 11E.

FIG. 12

[0101] FIG. 12 shows the pumping module change-out procedure, including the installation of the pumping module to the gas control unit, according to some embodiments of the present invention.

[0102] In FIG. 12, FIG. 12A shows the modular BIB pump 10 having the pump module 30 separated and positioned with tabs 22a, 22b for engaging channels/slots 32 of the gas control and drive unit 30. FIG. 12B shows the modular BIB pump 10 having the pump module 10 partially separated from the gas control and drive unit 30. FIG. 12D shows the tool insert 50 and retainer clip 40 positioned to couple the piston shaft 30c and actuator rod 20e together. FIG. 12E shows the retainer clip 40 coupling the piston shaft 30c and actuator rod 20e together after the tool 50 pushes the retainer clip into place. FIG. 12F shows the pump module 30 and the gas control and drive unit 20 coupled together similar to that shown in FIG. 11A.

[0103] The pumping module change-out procedure for coupling the pumping module 30 and the gas control and drive unit 20 together, e.g., including the following steps:

[0104] 1) Insert the pumping module 30 with tabs 22a, 22b aligned with the channels 32a, 32b in the gas control and drive unit 20, e.g., as shown in FIGS. 12A and 12B.

[0105] 2) Push the pumping module 30 to close gap between the piston shaft 30c and the actuator rod 20e, e.g., as shown in FIGS. 12D, 12E.

[0106] 3) Assure other fits are aligned before full insertion of the pumping module 30 and the gas control and drive unit 20 together, e.g., as shown in FIG. 12C.

[0107] 4) Locate the retainer clip 40 and disposable tool 50; and position the retainer clip 40 in relation to the piston shaft 30c and the actuator rod 20e, e.g., as shown in FIGS. 12C and 12D.

[0108] 5) Insert the disposable tool 50 between the housings of the pumping module 30 and the gas control and drive unit 20 and push the retainer clip 40 to close and couple the piston shaft 30c and the actuator rod 20e, then remove the tool 50, e.g., as shown in FIG. 12E.

[0109] 6) Push the pumping module 30 and the gas control and drive unit 20 together to fully fully seat the tabs 22a, 22b, e.g., as shown in FIG. 12F.

#### Possible Applications

[0110] Possible Applications may include one or more of the following: Beverage PostMix Dispensing Systems

#### The Scope of the Invention

[0111] While the invention has been described with reference to an exemplary embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention.

[0112] In addition, may modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment(s) disclosed herein as the best mode contemplated for carrying out this invention.

What is claimed is:

1. A modular pump comprising:

a gas control and drive unit having a gas control and drive unit housing configured to receive gas from a gas inlet and provide the gas to a gas passageway so as to cause a gas control and drive unit force, having an actuator rod and slide valve arrangement configured to respond to a cartridge style pumping module force in an axial direction and exhaust the gas from a gas exhaust outlet of the gas control and drive unit housing so as to cause a gas control and drive unit exhaust force in an opposite axial direction, and also having a gas control and drive unit coupling member;

a cartridge style pumping module having a cartridge style pump module housing configured to receive a fluid to be pumped from a fluid inlet, having a piston and dual diaphragm arrangement configured to respond to the gas control and drive unit force, provide the cartridge style pumping module force in the axial direction and pump the fluid from a fluid discharge outlet of the cartridge style pumping module, and also configured to respond to the gas control and drive unit exhaust force in the opposite axial direction and pump the fluid from the fluid discharge outlet of the cartridge style pumping module, the cartridge style pumping module

housing having a cartridge style pumping module coupling member configured to detachably couple to the gas control and drive unit coupling member; and

a retainer clip configured to detachably couple together a piston of the piston and dual diaphragm arrangement and an actuator rod of the actuator rod and slide valve arrangement, so that the cartridge style pumping module can be attached and detached from the gas control and drive unit using a three step process so as to be field replaceable using a retainer clip attaching/detaching tool.

2. A modular pump according to claim 1, wherein the cartridge style pumping module is attached to the gas control and drive unit using the three step process, as follows:

partially coupling together the cartridge style pumping module coupling member and the gas control and drive unit coupling member so as to leave a space between the cartridge style pumping module and the gas control and drive unit for accessing the retainer clip;

attaching together the piston of the piston and dual diaphragm arrangement and the actuator rod of the actuator rod and slide valve arrangement with the retainer clip using the retainer clip attaching/detaching tool to push the retainer clip into a locking position; and

fully coupling together the cartridge style pumping module coupling member and the gas control and drive unit coupling member in a locking engagement.

3. A modular pump according to claim 1, wherein the cartridge style pumping module is detached from the gas control and drive unit using the three step process, as follows:

partially decoupling and unlocking the cartridge style pumping module coupling member and the gas control and drive unit coupling member from a locking engagement, so as to leave a space between the cartridge style pumping module and the gas control and drive unit for accessing the retainer clip;

detaching the piston of the piston and dual diaphragm arrangement and the actuator rod of the actuator rod and slide valve arrangement by removing the retainer clip using the retainer clip attaching/detaching tool to push the retainer clip from a locking position; and

fully decoupling together the cartridge style pumping module coupling member and the gas control and drive unit coupling member.

4. A modular pump according to claim 1, wherein

the gas control and drive unit housing and the cartridge style pumping module housing are configured along a common longitudinal axis; and

the cartridge style pumping module coupling member comprises a pair of tabs configured on opposite sides of the cartridge style pumping module housing and extending in parallel with the common longitudinal axis.

5. A modular pump according to claim 4, wherein the gas control and drive unit coupling member comprise a pair of channels configured on opposite sides of the gas control and drive unit housing and configured with openings to detachably couple to the pair of tabs.

6. A modular pump according to claim 5, wherein the pair of tabs are configured to deflect towards or away from the common longitudinal axis in order to couple or decouple to or from the pair of channels.

7. A modular pump according to claim 1, wherein the modular pump is a bag-in-the-box (BIB) pump for pumping syrup.

8. A modular pump according to claim 1, wherein the actuator rod comprises a tapered end having a slot or opening formed or configured therein;

the piston shaft comprises a flanged portion having a cylindrical recessed channel portion, a rim portion and an interior cavity formed within the recessed channel portion configured to receive the tapered end;

the retainer clip comprises a three prong clip having prongs;

so that the tapered end is configured in the slot or opening, and the retainer clip is pushed so a center prong passed into and through the slot or opening and the interior cavity, and two outer prongs are adapted in the cylindrical recessed channel portion and engage the rim portion, so as to lock, fasten or couple the actuator rod and piston shaft together.

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