

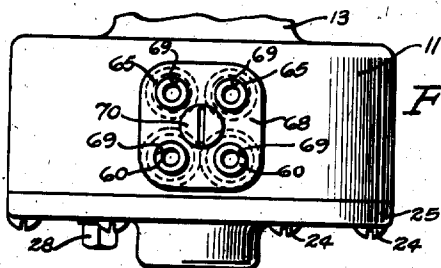
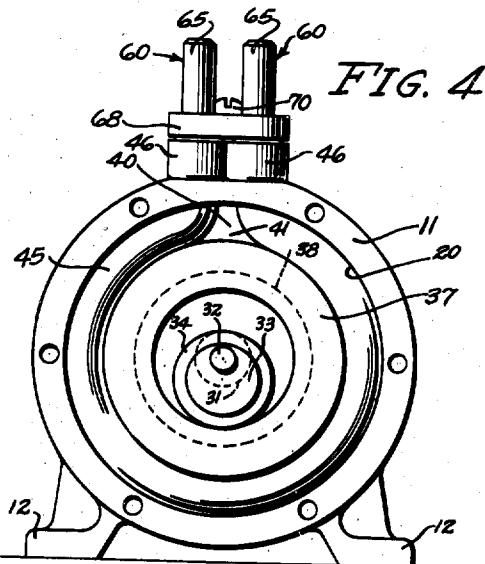
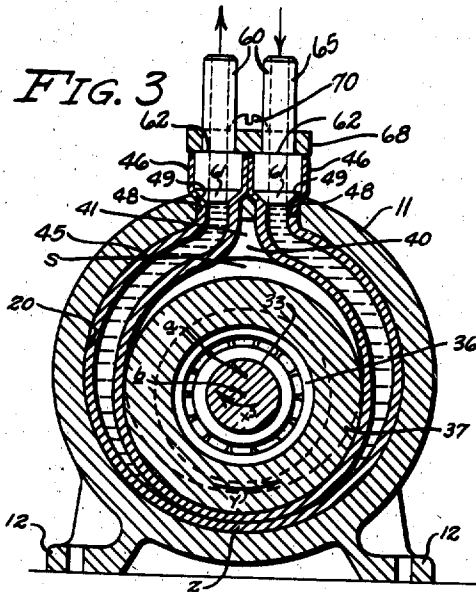
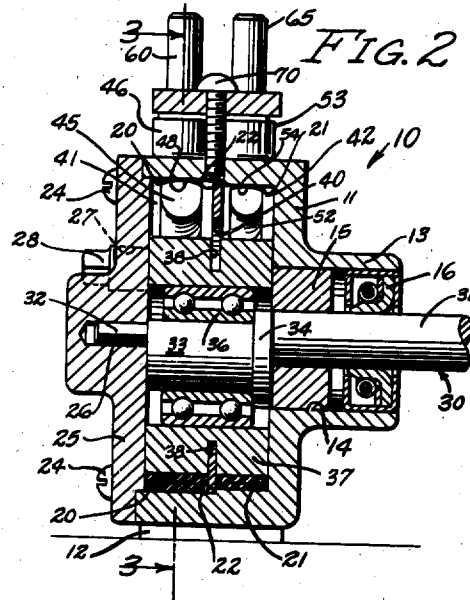
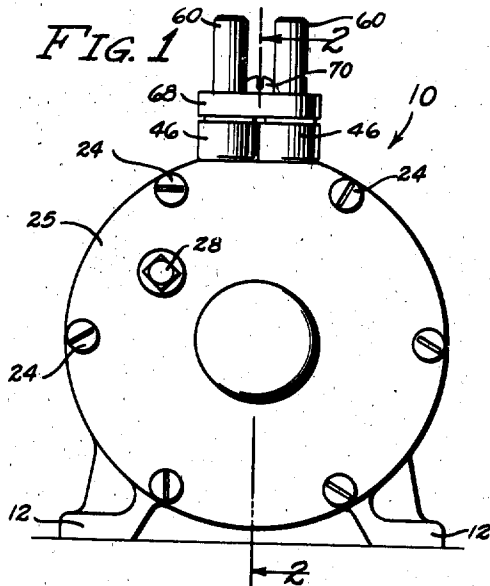
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PUMP

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The present invention relates to pumps and more particularly to a chemical pump for simultaneously feeding a plurality of fluids.

This invention resulted from a difficult problem encountered in perfecting a machine for generating gas. The problem in this instance was to feed a plurality of fluids from separate sources of supply to a common point where the fluids were mixed to produce the required gas. As the gas in question is the result of a chemical action requiring definite relative proportions of the fluids involved, it was necessary that the fluids be fed in the correct proportion as an excess of any one fluid over the amount required for the chemical action results in waste.

In addition to maintaining a constant proportion between the fluids being fed, this problem also involved varying the rate at which the fluids were fed in order to vary the rate at which the gas was produced, without disturbing the relative proportions of the fluids.

The general type of pump to which this invention relates in principle is such as disclosed in U. S. Letters Patent No. 2,123,781, issued July 12, 1938, to C. J. Huber. This principle involves the idea of progressively collapsing and releasing a resilient tube to produce a pumping action.

In adapting this principle to the above mentioned problem, it is an object of my invention to provide a unitary pump which is adapted to simultaneously pump proportionate amounts of a plurality of separate fluids.

Another object of the present invention is to provide a pump embodying the resilient tube principle in which wear of the tube is reduced to a minimum.

A further object thereof is to provide a pump which may be easily assembled and disassembled.

Another object of the present invention is to provide a pump embodying the resilient tube principle in which novel and efficient means is employed for mounting the tube in the pump housing.

Still another object thereof is the provision of a pump of the type referred to in which the housing is effectively sealed to prevent leakage of the lubricant provided within the housing.

Other objects and advantages will be made manifest in the following description, taken in connection with the accompanying drawing, in which:

Fig. 1 is an end elevational view of a preferred embodiment of the pump of this invention.

Fig. 2 is a vertical sectional view taken on the line 2-2 of Fig. 1.

Fig. 3 is a vertical sectional view taken on the line 3-3 of Fig. 2.

Fig. 4 is a view similar to Fig. 1 with the cover plate removed and showing the manner in which the pump is assembled.

Fig. 5 is a fragmentary plan view of the pump.

Referring specifically to the drawing, a preferred form of pump 10 of the invention comprises a housing 11 having a pair of feet 12. A boss 13 projecting from the housing 11 is bored at 14 to receive a bearing 15 and a conventional form of grease seal 16, this bearing and seal being pressed into the bore 14. As seen in Fig. 2, the housing 11 is provided with a primary bore 20 and a smaller, secondary bore 21, there being an annular shoulder 22 formed where these bores meet.

Secured on the housing by screws 24 is a cover plate 25 having a bore 26 (see Fig. 2) which is aligned with the bearing 15. Threaded into a hole 27 extended through the plate 25 is a removable pipe plug 28.

Rotatably mounted in the bearing 15 is a shaft 30 having a drive end 31 which extends through the seal 16. An extension 32 of the shaft 30 is journaled in the bore 26 of the cover plate 25, the extension 32 being concentric with the drive end 31. Between the portions 31 and 32 of the shaft 30 is an eccentric crank 33 and an enlarged portion 34 which is concentric with the crank 33.

Slidable on the crank 33 is a ball-bearing 36 upon which a rotor 37 is slidably mounted. Formed in the periphery of the rotor 37 is a groove 38, the latter receiving a ring 40 which is also disposed against the shoulder 22 of the housing 11. The ring 40 forms an annular wall which serves to divide the housing 11 into primary and secondary compartments 41 and 42 respectively. The inside diameter of the ring 40 is slightly greater than the outside diameter of the rotor 37 to permit installing the rotor in the housing 11 after the ring 40 is in position as will be described hereinafter.

Mounted in the primary compartment 41, as shown in Figs. 2, 3, and 4, is a primary tube 45. End portions 46 of the tube 45 extend through holes 48 formed in the top wall of the housing 11. The holes 48 are countersunk as indicated at 49 in Fig. 3. Mounted in the secondary compartment 42 is a smaller secondary tube 52, end portions 53 of the latter extending through holes 54 which are smaller but otherwise identical to the holes 48. The tubes 45 and 52 are made of resilient corrosion-resisting material such as rubber or the like.

Inserted into the ends 46 of the primary tube 45 are nipples 60 having beveled ends 61 and shoulders 62 (see Fig. 3). Similar nipples 65 are inserted into the ends 53 of the secondary tube 52.

Engaging the shoulders 62 of the nipples 60 and 65 is a clamp plate 68 having holes 69 (see Fig. 5) through which the upper portions of these nipples extend. A screw 70 extends centrally through the plate 68 and is threaded into the housing 11 as shown in Fig. 2. When the screw 70 is tightened, the plate 68 forces the nipples 60 and 65 downwardly toward the housing 11. The end portions 46 and 53 of the tubes 45 and 52 respectively are firmly clamped between the countersunk portions of the holes 48 and 54 and the beveled ends 61 of the nipples 60 and 65. This clamping of the tube ends accomplishes three results: First, it seals the connection between the tubes and nipples 60 and 65; second, the tubes are secured against creeping during operation of the pump 10; and third, the holes 48 and 54 are effectively sealed to prevent leakage of lubricant with which the housing 11 is filled.

In Fig. 3, *a* indicates the axis of the shaft 30 and *b* indicates the axis of the crank 33. The distance *a-b* is the throw of the crank 33 and twice the distance *a-b* is the total stroke of the crank 33. I have found that the outside diameter of the rotor 37 is preferably equal to or slightly less than the normal inside diameter of the primary tube 45, as is seen in Fig. 4. The choice of such a diameter for the rotor 37 results in the following three advantages:

1. Smaller sections of the tubes 45 and 52 are collapsed at any given instant, thus increasing the capacity of the pump per revolution.

2. The rotor 37 may be inserted into the housing 11, prior to insertion of the bearing 36, without collapsing the tube 45. This step is shown in Fig. 4 and its advantages are made apparent hereinafter.

3. As only about one-half of the periphery of the rotor 37 contacts the tubes 45 and 52 at any given instant, the wear on the tubes resulting from contact with the rotor is greatly reduced.

The importance of the third advantage is apparent when the movement of the rotor 37 is analyzed. In Fig. 3 the arrow *X* indicates the direction of rotation of the shaft 30. The arrow *Y* indicates the direction of the rotation of the rotor 37 as it rolls on and progressively collapses the tubes 45 and 52. Theoretically, there is no relative movement between the periphery of the rotor 37 and the tubes at the point *Z* of greatest collapse of the tubes by the rotor. Relative movement between the rotor 37 and tubes does exist, however, at the opposite side of the rotor indicated at *S* in Fig. 3. The clearance between the periphery of the rotor and the tubing at *S* relieves the tubing of considerable wear. It is therefore desirable to reduce the amount of contact between the rotor and tubes, this being accomplished in the pump 10 by reducing the diameter of the rotor and proportionately increasing the throw of the crank. The rotor must not be too small, however, because a rotor too small in diameter has a tendency to buckle the innermost walls of the tubes.

The bore 20 of the housing 11 is greater in diameter than the bore 21 because the thickness of the primary tube 45, when collapsed, is greater than that of the secondary tube 52. It is important that the difference between the collapsed thicknesses of the primary and secondary tubes be compensated for in the bore of the housing.

One result of this is that two diameters in the housing provide the shoulder 22 which facilitates assembly of the pump by aligning the ring 40 with the groove of the rotor 37. Another result is to permit a single rotor to operate on two tubes of different diameters without causing excessive friction between the rotor and one of the tubes.

In assembling the pump 10, the tube 52 is first placed in the bore 21 with the tube ends extending through the holes 54. The ring 40 is then placed in the bore 20 against the shoulder 22. The primary tube 45 is now mounted in the bore 20 and the nipples 60 and 65, plate 68, and screw 70 assembled as shown.

With the shaft 30 in place as seen in Figs. 2 and 4, the rotor 37 is now positioned within the housing before the bearing 36 is installed. This permits installing the rotor 37 concentrically within the housing 11, as shown in Fig. 4, without collapsing the tubes.

The next step is to force the rotor 37 radially into concentric relation with the crank 33 of the shaft 30 as shown in Figs. 2 and 3 and slide the bearing 36 into place.

After the cover plate 25 is mounted on the housing 11 to complete the assembly of the pump, the housing 11 is substantially filled with a suitable lubricant by removing the plug 28. When rubber tubes are used in the pump, a lubricant such as glycerine should be selected which is non-injurious to rubber.

When the shaft 30 is driven by a suitable source of power in the direction of the arrow *X* of Fig. 3, the fluid being pumped is drawn into and forced through the tubes 45 and 52 in the directions indicated by the arrows above the nipples 60 in Fig. 3. The pump 10 may be driven in either direction and at any desirable speed. During operation of the pump 10, the ring 40 serves to separate the tubes 45 and 52 to retain these in proper alignment with the respective bores of the housing 11.

I claim as my invention:

1. In a pump, the combination of: a housing having a bore and a counterbore; a shaft rotatable in said housing, said shaft having an eccentric portion; a rotor rotatably mounted on the eccentric portion of said shaft; and primary and secondary resilient tubes forming a pair of juxtaposed loops in said housing, said loops encircling said rotor, said primary tube having a thickness when collapsed which exceeds the collapsed thickness of said secondary tube by an amount equal to the difference between the radii of said bore and said counterbore, said secondary tube being located in said bore and said primary tube in said counterbore, said tubes being progressively collapsed between said rotor and said housing in response to rotation of said shaft.

2. In a pump, the combination of: a housing having a bore and a counterbore; a shaft rotatable in said housing, said shaft having an eccentric portion; a rotor rotatably mounted on the eccentric portion of said shaft; primary and secondary resilient tubes forming a pair of juxtaposed loops in said housing, said loops encircling said rotor, said primary tube having a thickness when collapsed which exceeds the collapsed thickness of said secondary tube by an amount equal to the difference between the radii of said bore and said counterbore, said secondary tube being located in said bore and said primary tube in said counterbore, there being an annular shoulder formed in said housing at the junction between the bore and the counterbore of said

housing; and an annular ring disposed in the counterbore of said housing adjacent said shoulder, said ring forming a separating wall between the loops of said primary and secondary tubes, said tubes being progressively collapsed between said rotor and said housing in response to rotation of said shaft.

3. A combination as in claim 2 in which said rotor is formed to provide an annular groove for slidably receiving said ring and maintaining said ring adjacent said shoulder.

4. In a pump, the combination of: a housing having a circular bore; a shaft rotatably mounted in concentric relation with said bore, said shaft having an eccentric portion within said housing; a rotor rotatably mounted on said eccentric portion; a resilient tube extending about said rotor between said rotor and the bore of said housing, opposite ends of said tube extending externally of said housing through adjacent holes provided in a wall of said housing; a pair of nipples inserted into the ends of said tube extending externally of said housing, the diameters of the portions of said nipples disposed within said tube ends being greater than the diameter of the holes in said housing through which said tube extends, the outermost portion of each of said nipples being reduced in diameter to provide a shoulder adjacent the end received by said tube end; a single clamp plate having holes for receiving the outermost portions of said nipples; and means for urging said clamp plate toward said housing, said plate engaging the shoulders of said nipples to urge said nipples into clamping relation with the portions of said tube disposed between said housing and said nipples.

5. In a pump, the combination of: a housing having a substantially circular bore; a resilient tube forming a loop in said housing; a rotatable

shaft in said housing, said shaft having an eccentric crank portion; a rotor in said housing, the outside diameter of said rotor being less than the bore of said housing by an amount substantially twice the normal outside diameter of said resilient tube, said rotor having a bore which is substantially twice the radial distance from the axis of said shaft to the outermost point of said crank portion; and a bearing having a bore in which said crank portion is slidable, said bearing itself being slidable in the bore of said rotor.

6. In a pump for handling two fluids at different rates of flow, the combination of: a housing having a chamber surrounded by substantially cylindrical surfaces; a rotor, the exterior face of which is formed by substantially cylindrical surfaces; means for mounting said rotor in said chamber with the axis of said rotor disposed eccentrically in said chamber, and for revolving said rotor in said chamber while thus disposed while permitting said rotor to rotate about its own axis, the space within said chamber being divided by a plane perpendicular to the axis thereof into primary and secondary sections; primary and secondary resilient tubes forming a pair of loops and disposed respectively in said primary and secondary sections, said primary tube having a larger passage therein and a greater thickness when collapsed than the passage and collapsed thickness respectively of said secondary tube, the minimum radial space provided between said rotor and said housing in said primary section being equal to the collapsed thickness of said primary tube, while in said secondary section said minimum radial space is equal to the collapsed thickness of said secondary tube; and means for feeding said fluids to said tubes.

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