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FLUID-ACTUATED PULSATING DEVICE

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Fig. 1.

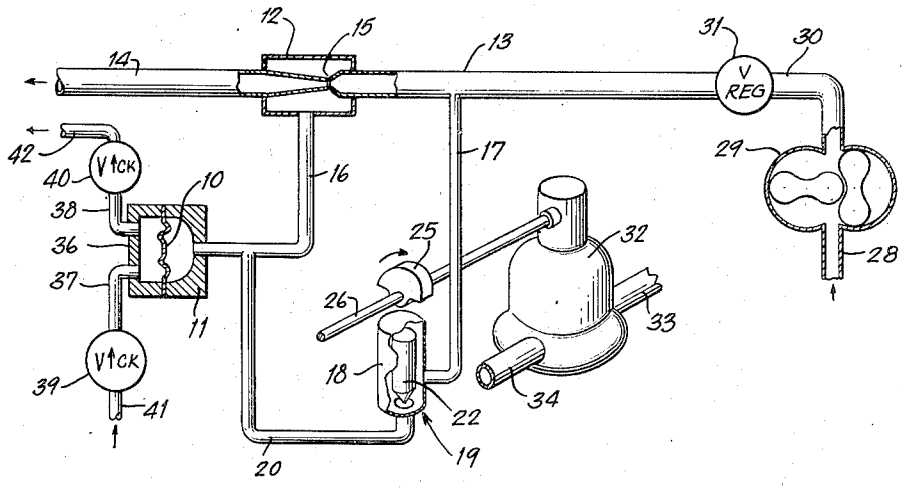
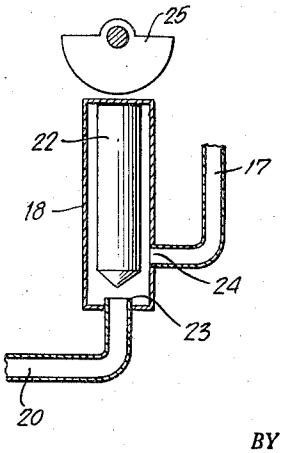


Fig. 2.



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FLUID-ACTUATED PULSATING DEVICE

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4 Claims. (Cl. 60—60)

This invention relates to fluid-actuated pulsating devices and more particularly to devices whereby a diaphragm or other movable element of an expansible chamber is caused to pulsate under repeated application and withdrawal of a driving fluid which may be a gas such as air, or a liquid.

An important use of such devices is in the actuation of pumping or like instrumentalities, for example in the feeding of a fluid in accordance with the rate or other characteristics of pulsation of the mechanism. Since the pulsating device is in effect of the nature of a fluid-actuated motor, it its manifest that the pulsating element may be employed for a variety of purposes requiring a reciprocating drive.

It is an important object of the invention to provide apparatus of the character described which embodies a novel, effective and reliable mechanism, especially for control of pulsation, a further object being to afford improved pulsating devices of simple and convenient structure and adapted to a variety of uses.

To these and other ends, certain basic features of the invention comprise the combination of an expansible chamber with an ejector (i. e. a venturi) having a throat capable of developing appropriate suction and arranged for passage by fluid under pressure, together with connections for applying suction from the ejector throat to the expansible chamber, and supplemental passage means or the like for communicating the fluid under pressure directly to the expansible chamber. The device embraces valve means for controlling the last-mentioned passage or connection, so that the chamber, with its driving diaphragm or other element, is alternately connected to receive fluid under pressure, overcoming the effect of ejector suction, and to have such suction when the supplemental passage means is closed, to the end that suction and supply of liquid under pressure are alternately effected in the chamber for corresponding reciprocation of the diaphragm or equivalent element. The valve means is arranged to be driven in an appropriately repetitive manner, viz. so that there is in effect continuous alternation of the position of the valve means and corresponding pulsation of the diaphragm or the like in accordance with the valve actuation.

As illustrative of these and other features described below, the drawing illustrates one example of the invention, as follows:

Fig. 1 is a largely schematic view of the pulsating device or system, with the several parts shown in considerably simplified form for clarity of illustration; and

Fig. 2 is a fragmentary view showing the control valve of Fig. 1 in its opposite position.

Referring to the drawing, the device comprises a diaphragm **10** enclosed on one side by a chamber-defining structure **11**, so as to constitute an expansible chamber of which the movable element or wall is the diaphragm **10**.

An ejector **12** has an inlet or inlet conduit **13** and an outlet or outlet conduit **14** arranged so that as fluid traverses the ejector from inlet to outlet, suction or reduced pressure is developed at the throat **15**, the throat being provided with a small open space or one or more openings. The ejector throat, i. e. exteriorly of the path of flow in the conduit system **13**, **14**, communicates with the chamber **11**, as by a conduit **16**.

A supplemental passage between the source of fluid under pressure and the chamber is afforded by the conduit **17**, the chamber **18** (shown partly broken away) of the magnetic valve **19**, and conduit **20**, extending in series to the chamber **11**.

While any of a variety of repetitively operable control valve means can be employed, the magnetic device **19** is particularly convenient. It includes a valve member **22**, within the casing **18**, arranged to seat, as by gravity, on the opening **23** in the bottom of the casing. Other communication with the valve is afforded by an opening **24**. Thus the valve may be appropriately included in the line **17—20**, for example by connection of the conduit **17** with the opening **24** and the conduit **20** with the opening **23**. One example of means for actuating the valve may involve constructing the valve member **22** so that it is wholly or partly a permanent magnet, and providing an armature **25**, of soft iron or other impermanently magnetic material, which periodically approaches and retreats from the upper end of the casing **18**. Thus the member **25** may comprise a semi-circular element, as shown, mounted on a shaft **26** so that upon rotating the shaft the armature member periodically (e. g. once each turn) comes close to the top of the casing **18**, attracting and elevating the magnetized valve element **22** and opening the valve, as seen in Fig. 2. When the member **25** is in its remote position, as seen in Fig. 1, the element **22** remains seated in the opening **23**, keeping the valve closed. Alternatively, the actuating element, such as member **25**, may comprise a permanent magnet, and the valve element **22** may constitute an impermanently magnetic member.

Although the pulsating device is applicable to actuation by any fluid, either liquid or gas, the device is shown as connected to a supply of gas under pressure, e. g. air, entering the conduit **28**, wherein it is advanced under pressure by the blower **29** and after traversing a further conduit section **30**, reaches the inlet portion **13** of the ejector **12**, such inlet being connected with the conduit **30**. If desired, the fluid supply system may include a regulating valve **31** in the conduit **30**, arranged to provide appropriately constant or regulated pressure downstream of the valve.

It is contemplated that the shaft **26** be subject to continuing drive, e. g. in a continuous or periodic manner, one example of useful driving means being a fluid-flow responsive meter generally indicated at **32**, it being understood that the meter **32** is arranged to rotate the shaft **26** in proportion to flow of fluid in a pipe line **33—34**.

For completeness of illustration, means are shown for utilizing the pulsations of the diaphragm **10**. Although such means may in some cases involve mechanical connection or linkage to the diaphragm, a simple arrangement for certain purposes involves structure **36** defining a chamber on the opposite side of the diaphragm and having inlet and outlet passages **37**, **38** respectively, with corresponding directional check valves **39**, **40**. Thus if the inlet **41** for the check valve **39** is connected with a source of fluid and the outlet **42** of the valve **40** to a locality for use of such fluid, pulsations of the diaphragm **10** will be effective to change the volume of the chamber **36** periodically and pump fluid, e. g. in successive determinable amounts, for delivery through the outlet **42**. Although in some cases appropriate spring loading or the like may be provided for the diaphragm **10** (for example as to increase the force of the pumping stroke when the delivery through conduit **42** is to be effected against a

high pressure) the simple arrangement shown is useful for many purposes where regulated quantities of liquid or gas must be delivered in a continuing manner.

It will now be seen that with the source of fluid under pressure (such as the blower 29) connected for continuous supply to the ejector inlet 13, the diaphragm 10 will be reciprocated in accordance with the position of the valve element 22. When the magnet 25 is in upper positions such that the valve 19 is closed, suction or subatmospheric or other reduced pressure is communicated through the line 16 by the ejector throat and withdraws fluid from the chamber 11, causing the diaphragm 10 to retract, i. e. to the right as seen in the drawing. When the valve 19 is opened upon the shaft 26 turning the magnet member to lower positions such as in Fig. 2, fluid under pressure may directly travel from the source through the conduit 17, the valve 19 and conduit 20 to the pulsator chamber 11, thus short-circuiting the ejector suction or overcoming it. In consequence the diaphragm 10 is advanced in a driving stroke, the enclosed space of the chamber being enlarged by displacing the diaphragm to the left as seen in the figure. Continuing rotation of the shaft 26 successively closes and opens the valve 19, and correspondingly applies suction and fluid under pressure at alternate times to the chamber 11. The diaphragm is thereby reciprocated or pulsed, at a rate determined by the movement of the shaft 26.

Where the pulsator is utilized to afford a pumping or feeding action, for example as in Fig. 1, the desired liquid or gas is directly pumped for delivery through the outlet line 42, by virtue of the pump chamber 36 on the opposite side of the diaphragm, together with the associated check valves. The pumping action, i. e. feed of liquid or other fluid, is correspondingly proportioned to the rate of reciprocation of the valve 19. Where it is desired to proportion such delivery to the rate of flow of a master fluid, such as water in a main, gas to be treated, or the like, a shaft 26 is readily driven by a flow-responsive device, such as the meter 32 as shown.

The mechanism thus affords an essentially simple and effective device for producing pulsating or reciprocating actuation of an element such as the diaphragm 10, and conveniently at a rate which may be directly controlled by the rate of drive of the shaft 26 for the valve actuating magnet 25. While the driving means for the valve control element 25 may constitute other motor means of continuous or intermittent character, the illustrated apparatus is notably well adapted for control by a flow meter or the like, for example as schematically represented by the device 32 having connections to drive the shaft 26. In all cases, so long as fluid under pressure is continuously supplied to the inlet of the ejector, and the valve 19 is repetitively operated by automatic means, the pulsating function is achieved at the diaphragm 10, the device in its entirety being simple but highly reliable.

It is to be understood that the invention is not limited to the specific devices herein shown and described, but may be embodied in other ways without departure from its spirit.

I claim:

1. A fluid-actuated reciprocating device comprising movable means, means defining a drive chamber opening on said movable means, fluid-conducting means comprising an ejector having an inlet passage and an outlet passage, the inlet passage being connected to receive fluid under pressure, said ejector having a throat and passage means opening to said throat for communicating a fluid withdrawing lower pressure to the aforesaid drive chamber, supplemental passage means for directing fluid under pressure from the fluid-conducting means to the drive chamber, and means including valve means controlling flow through said supplemental passage means independently of flow through the ejector, for alternately and repeatedly interrupting and initiating fluid flow through

said supplemental passage means, respectively to effect withdrawal of fluid from the drive chamber under the aforesaid lower pressure and introduction of fluid into the drive chamber under pressure, for reciprocating said movable means.

2. In a reciprocating device adapted to be actuated by fluid under pressure, in combination, means defining an expansible drive chamber having a passage for fluid communication thereto, and means for alternately and repeatedly advancing fluid into said chamber through the passage and withdrawing fluid from the chamber through the passage, to effect repeated expansions and contractions of the chamber, said last-mentioned means comprising an ejector having an inlet having continuous connection to receive the fluid under pressure, an outlet connected for continuous discharge of fluid, and a throat to which the aforesaid passage opens for communication of reduced pressure to the chamber, supplemental passage means connected to receive the fluid under pressure, for delivering said fluid to the chamber under pressure to overcome the reduced pressure communicated from the ejector throat and to expand the chamber, a valve controlling the flow through said supplemental passage means and movable between closed and open positions, and driving means operatively connected to said valve to move it alternately and repeatedly between its closed and open positions while the inlet of the ejector remains connected to the fluid source.

3. A fluid-actuated reciprocating device comprising a diaphragm, means defining a drive chamber on one side of the diaphragm, an ejector having an inlet passage and an outlet passage, the inlet passage being connected to receive fluid under pressure, said ejector having a throat and passage means providing communication between said throat and the aforesaid drive chamber, supplemental passage means for directing fluid under pressure from the inlet passage to the drive chamber, a valve controlling the flow through said supplemental passage means and movable between closed and open positions, and driving means operatively connected to said valve to move it alternately and repeatedly between its closed and open positions to effect, respectively, alternating application of fluid-withdrawing lower pressure and introduction of fluid under pressure, to the aforesaid drive chamber.

4. A fluid-actuated reciprocating device, comprising means defining an expansible chamber and including a chamber wall element movable with expansion and contraction of the chamber, and mens for automatically and continuously reciprocating said wall element, comprising means defining a passage for fluid flow and having an inlet and an outlet and comprising an ejector through which the fluid flows from the inlet to the outlet, said passage means being connected to receive the fluid under pressure at said inlet, said ejector having a throat, means defining a passage between said throat and said expansible chamber, means defining a passage for fluid flow from the first-mentioned passage means upstream of the ejector to the expansible chamber, a valve for controlling flow of fluid through said last-mentioned passage means and movable between open and closed positions, and driving means operatively connected to said valve for moving it alternately and repeatedly between its open and closed positions, respectively to initiate and interrupt fluid flow through said last-mentioned passage means, for alternating, successive applications, to the expansible chamber, of the fluid under pressure and of fluid-withdrawing low pressure from the ejector throat.

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