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Johansson

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[54] **PISTON AND CYLINDER APPARATUS WITH CLEANING ARRANGEMENT**

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[52] **U.S. Cl.** ..... **92/13.1,** 73/419, 91/402, 92/13.6, 92/79, 92/80, 92/82, 92/87, 92/158, 92/162 R, 92/169

[51] **Int. Cl.** **F01b 31/14,** F15b 15/24

[58] **Field of Search** ..... 92/78, 79, 80, 82, 87, 92/158, 159, 13.4, 13.5, 13.6, 169, 162 R, 174, 13.1, 162 P; 91/400, 401, 402; 73/419

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[57] **ABSTRACT**

At its opposite ends, the piston has annular seals which, in a cleaning position of the piston, are located in respective separated zones of the cylinder where its internal diameter is greater than the diameter of the seals, so that cleaning liquid from an inlet opening of the cylinder can be forced directly into one of these zones, thence to the other zone by way of a longitudinal recess in the piston, and then through an outlet opening of the cylinder, whereby the two seals are flushed. Limiting means are provided which, during normal reciprocation of the piston, prevent it from moving to this cleaning position but which are adjustable to permit such movement when cleaning is desired.

9 Claims, 4 Drawing Figures

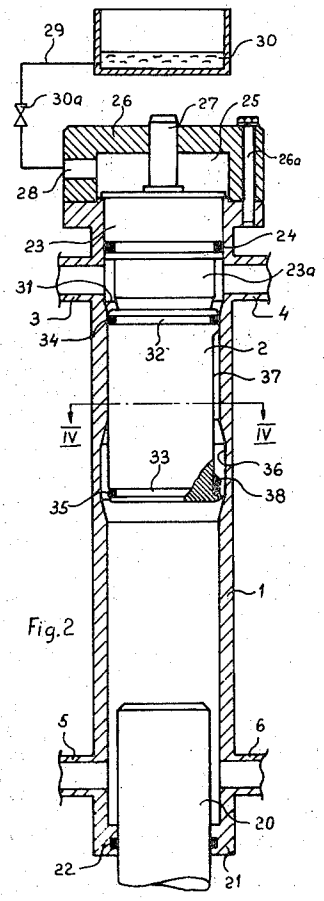


Fig.2

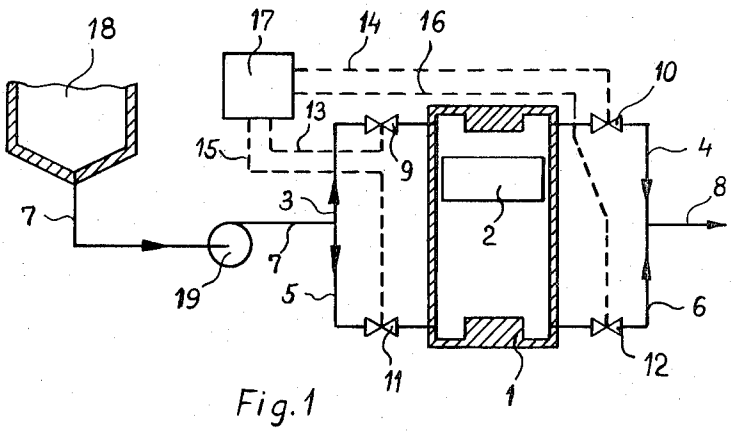


Fig. 1

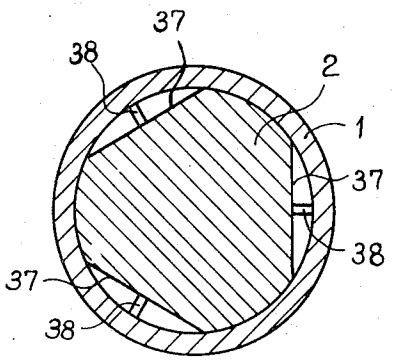
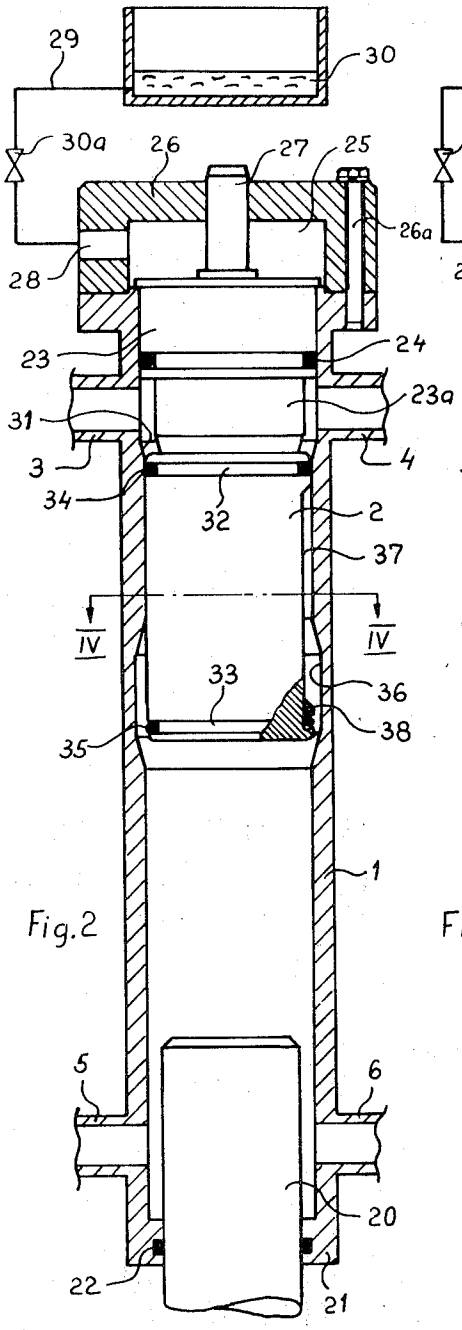


Fig. 4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30a
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26a
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24
23a
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37
IV
IV
33
36
38
35
1
5
6
20
22
21

Fig. 2

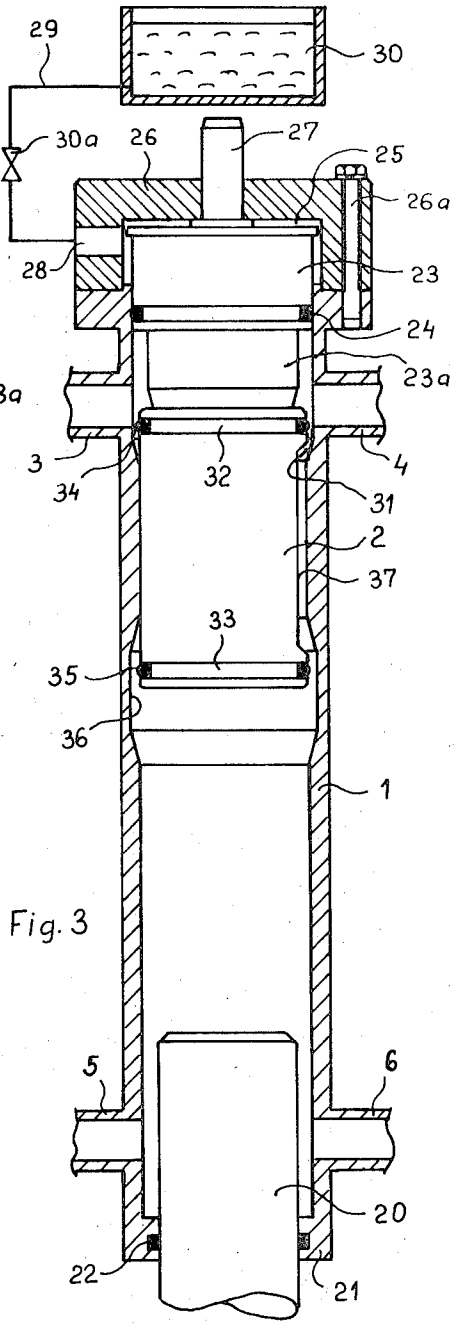
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Fig. 3

PISTON AND CYLINDER APPARATUS WITH CLEANING ARRANGEMENT

The present invention relates to an apparatus comprising a cylinder and a piston adapted to reciprocate therein between two end positions, and having annular sealing means at each of its ends, the cylinder being provided with at least one opening on each side of the piston which serves as inlet and outlet for liquid. The piston may be reciprocated within the cylinder either by a piston rod connected therewith or by means of the liquid which is supplied to the cylinder, by causing the liquid pressure to act alternately on opposite sides of the piston.

Apparatuses of this kind are used in different fields, as for measuring liquids (see, for instance, French Pat. No. 1,595,934). With the food stuff industry they have been used to a relatively limited extent, however, as they are very difficult to clean. It is especially difficult to obtain a satisfactory cleaning of the piston sealing means and the grooves therefor in the piston. Such cleaning has hitherto required removal of the piston from the cylinder.

In connection with cleaning, it is also desirable that the apparatus be adapted to constitute one of several interconnected units in a plant arranged to be cleaned in such a manner that the same cleaning liquid is forced through all of the plant units in sequence. For the fullfillment of this desire by means of a previously known apparatus, the cleaning operation must be performed so that the piston is allowed to continue its reciprocating movements as in normal operation, the apparatus being passed through by cleaning liquid instead of liquid to be measured. As indicated, the piston sealing means will not be effectively cleaned, however, and the piston movements cause a discontinuous flow of cleaning liquid through the apparatus and thus through the entire plant. This makes it difficult or impossible to effectively clean other units of the plant which are interconnected with the particular apparatus.

The principal object of the present invention is to eliminate these disadvantages of previously known apparatus of the kind described.

According to the invention, the inside of the cylinder of the apparatus has two axially separated annular zones in which the internal diameter of the cylinder along a substantial part of its periphery is greater than the diameter of the piston sealing means, one of the zones being in communication with one of the cylinder openings, and the other zone being situated between the first zone and the other cylinder opening. Also, the piston has between its sealing means at least one recess, the axial extension of which is larger than the distance between the parts of the two annular zones situated nearest each other; and limiting means are provided which, during the normal reciprocating movements of the piston, prevent the piston from moving so far in the direction towards the said one annular zone that the piston recess will come into communication therewith. Such limiting means are adjustable to allow such a piston movement to a position in which the two piston sealing means are situated opposite the respective annular zones, whereby the piston recess interconnects these two zones so that liquid may flow past the piston within the cylinder.

On cleaning of an apparatus constructed in this way, the piston will thus occupy a special position at one end of the cylinder, and cleaning liquid will be forced past the same. A strong flow of cleaning liquid may be forced to pass continuously through the apparatus, so that the two piston sealing means will be effectively rinsed and other units in the same plant, interconnected in a sequence with the apparatus, will also be effectively cleaned.

Within the scope of the present invention, the cylinder and the piston may be shaped in different manners. In a preferred embodiment, the cylinder has an annular recess in each of the said zones, while the piston has a number of axially extending recesses evenly distributed around its periphery. As an alternative, if so desired, the piston may be provided with a recess extending around the whole of its periphery, the cylinder instead being provided in the said zones with axially extending recesses evenly distributed around the cylinder periphery. Further embodiments are, of course, possible within the scope of the principle that a substantial part of the piston sealing means shall be uncovered in the annular zones within the cylinder, and the piston shall always be guided within the cylinder.

In the said preferred embodiment, one of the cylinder openings is situated in the recess of the said first annular zone.

The adjustable means for limiting the piston movement in one direction within the cylinder may be constructed in different ways depending upon the arrangement used for driving the piston. If the piston is arranged to be driven by the pressure of the liquid supplied to the cylinder, the said means may comprise a member forming an axially movable wall within the cylinder, arranged to seal against the inside of the cylinder. This wall may border on a pressure chamber which is arranged to be connected to a fluid source, preferably a liquid source.

The present invention is described in more detail below with reference to the accompanying drawings, in which FIG. 1 is a flow diagram of a system including an apparatus according to the invention; FIGS. 2 and 3 are longitudinal sectional views of one form of apparatus according to the invention; and FIG. 4 is a cross-sectional view along the line IV — IV in FIG. 2.

In FIG. 1, a cylinder 1 contains a piston 2 reciprocable therein between two end positions. An inlet conduit 3 opens into the cylinder and an outlet conduit 4 leads from the cylinder at one side of the piston 2, and an inlet conduit 5 opens into the cylinder and a outlet conduit 6 leads from the cylinder at the other side of the piston. The two inlet conduits 3 and 5 start from a common conduit 7, and the two outlet conduits 4 and 6 open into a common conduit 8. In the inlet and outlet conduits are shut-off valves 9–12 which, via connections 13–16, are connected to a common control unit 17. The conduit 7, common to the inlet conduits, leads from a container 18. A pump 19 in the conduit 7 is arranged to pump liquid from the container 18 to and through the cylinder 1.

By means of the pump 19, liquid is constantly pumped to the inlet conduits 3 and 5. In a starting condition, the inlet valve 9 is kept open and the inlet valve 11 is kept closed by means of the control unit 17. Simultaneously the outlet valve 12 is kept open and the outlet valve 10 is kept closed. By the pressure from the liquid entering the cylinder, the piston 2 will then move downwards, as seen in FIG. 1, so that liquid situated below the piston is forced out through the conduit 6 and further through the conduit 8. When the piston 2

reaches its lower position, this is sensed in a conventional manner, as by mechanical, electrical or magnetic means (not shown), a signal being transferred to the control unit **17** so that it acts to close the valves **9** and **12** and open the valves **10** and **11.** By the pressure from the liquid below the piston **2,** the latter will now move upwards in the cylinder, liquid being forced out through the conduit **4** and further through the conduit **8.** In a corresponding manner, upon sensing of the piston reaching its upper end position, the valves **10** and **11** will be reclosed, after which the valves **9** and **12** will be opened. The piston **2** in this manner moves to and fro within the cylinder **1,** and liquid is dosed out through the conduit **8.**

In FIGS. **2** and **3,** the apparatus is provided at the bottom with means for controlling the length of the piston stroke in the cylinder, and on the top the apparatus is provided with means for putting the piston in a particular position when the apparatus is to be cleaned.

The means for controlling of the length of the piston stroke comprises a rod **20** which extends into the cylinder **1** through its lower end wall **21.** The rod **20** is axially movable within the cylinder and may be set in a desired position for limiting the downward movement of the piston **2.** A sealing ring **22** is arranged between the piston **20** and the cylinder end wall **21.**

The cylinder **1** is provided at the top with an end wall **23** axially movable therein. A sealing ring **24** is arranged between this end wall and the inside of the cylinder **1.** The end wall **23** has a lower part **23***a* with a smaller diameter than the inside of the cylinder, which part extends into the cylinder and limits the upward movement of the piston **2.** At its upper side, the end wall **23** borders on a pressure chamber **25** which is formed by a cap **26** fastened to the cylinder by means of a screw **26***a.* A guiding pin **27** connected to the end wall **23** extends out through an opening in the cap **26.** The pressure chamber **25** has an opening **28** which communicates through a conduit **29** with a liquid source, schematically shown at **30.** in the conduit **29** is a shut-off valve **30***a* which is connected to the control unit **17** of the apparatus. When the valve **30***a* is closed, a certain amount of liquid is enclosed in the pressure chamber **25,** the end wall **23** being prevented from moving into the pressure chamber. When the valve **30***a* is opened, an over-pressure prevailing within the cylinder **1** is allowed to displace the end wall **23** into the pressure chamber, so that liquid therein is forced back through the conduit **29** to the liquid source **30.**

Opposite the inlet **3** and the outlet **4,** the cylinder **1** has on its inside an annular recess **31.** The piston **2** is provided at its ends with grooves **32** and **33** which receive sealing rings **34** and **35,** respectively. The part **23***a* of the cylinder end wall **23,** during normal operation of the apparatus, prevents piston **2** from reaching the zone in the cylinder **1** in which the recess **31** is situated. Between the recess **31** and the other cylinder inlet **5** and cylinder outlet **6,** there is a similar annular recess **36** on the inside of the cylinder. In the normal operation of the apparatus, and with the cylinder **1** forming an angle with the horizontal plane, the recess **36** prevents gas accompanying the liquid into the cylinder from accumulating therein below the piston. Thus, when the piston is in its upper end position, any gas bubbles in the liquid will be collected below the piston in the cylinder recess **36.** When the piston then moves downwards, and the cylinder recess **36** comes into communication with the cylinder chamber above the piston, the air bubbles will leave the recess **36** and accompany the liquid out through the outlet **4** upon the next upward movement of the piston.

Between the seals **34** and **35,** the piston **2** has three axially extending recesses **37** evenly distributed around its periphery. These recesses are intended to be used upon cleaning of the apparatus, which is performed in the following manner:

By means of the control unit **17,** the inlet valve **9** and the outlet valve **12** are closed, while the inlet valve **11** and the outlet valve **10** are kept open. Simultaneously, the mechanism (not shown) for the reciprocating movement of the piston **2** is disconnected, and a cleaning liquid is pumped in through the inlet conduit **5.** Further, the valve **30***a* in the conduit **29** communicating with the pressure chamber **25** is opened. The piston **2** then is displaced at first to its upper end position against end wall **23,** after which the pressure from the cleaning liquid causes the piston to force the cylinder end wall **23** upward into the pressure chamber (see FIG. **3**). The liquid therein is forced out through the opening **28** and further through the conduit **29** to the liquid source **30.**

When the piston **2** and the end wall **23** have reached the positions shown in FIG. **3,** the piston seals **34** and **35** will be situated opposite the cylinder recesses **31** and **36,** respectively, and these recesses communicate with each other through the recesses **37** in the piston **2.** Simultaneously, the cylinder chamber below the piston **2** is communicating with the lower cylinder recess **36,** so that cleaning liquid may flow past the piston within the cylinder and out through the outlet conduit **4.** Thus, a continuous flow of cleaning liquid can pass through the entire cylinder chamber, and the piston sealing means **34** and **35,** which are uncovered in the cylinder recesses **31** and **36,** respectively, are effectively rinsed.

For the cleaning of conduits **3** and **6,** all of the valves **9–12** can be maintained in an open position by the control unit **17** during one stage of a cleaning operation.

As shown in FIGS. **2** and **4,** each piston recess **37** communicates at its lower end through an opening **38** with the groove **33** for one sealing means **35** of the piston. In a similar manner (not shown), the piston recesses **37** communicate at their upper ends with the groove **32** for the other sealing means **34** of the piston. The grooves **32** and **33** preferably have a dovetail cross section.

I claim:

1. Apparatus comprising a cylinder, a piston reciprocable in the cylinder between two end positions and having an annular seal at each end of the piston, whereby said seals are interposed between the interior portions of the cylinder on opposite sides of the piston, the cylinder having at least one opening on each side of the piston, said openings serving as inlet and outlet for liquid, the inside of the cylinder having two annular zones which are axially separated from each other and in which the internal diameter of the cylinder along a substantial part of its periphery is larger than the diameter of said annular seals, the first of said zones communicating with one of said cylinder openings, the second zone being located between said first zone and the other cylinder opening, the piston having between said seals at least one recess which extends in the axial direction of the cylinder for a distance greater than the

distance separating said annular zones, and limiting means operable during normal reciprocation of the piston to prevent movement of the piston so far toward said first annular zone that said piston recess will come into communication with said first zone, said means being adjustable to allow such movement of the piston to a cleaning position in which said two piston seals are opposite said two annular zones, respectively, whereby the piston recess interconnects said two zones so that liquid may flow past the piston within the cylinder.

2. The apparatus of claim **1,** in which the cylinder has an annular internal recess forming each of said zones.

3. The apparatus of claim **1,** in which one of said cylinder openings is located in said first annular zone.

4. The apparatus of claim **1,** in which the piston has a plurality of said recesses extending in the axial direction of the cylinder and evenly distributed around the piston's periphery.

5. The apparatus of claim **4,** in which the piston has grooves wherein said seals are located, said piston recesses communicating with said grooves.

6. The apparatus of claim **1,** in which said limiting means include a wall member movable in the cylinder axially thereof, said member having a peripheral portion in sealing engagement with the inside of the cylinder.

7. The apparatus of claim **6,** wherein said limiting means define a pressure chamber on which said wall member borders and which is located on the side of said wall member remote from the piston, said limiting means also including a fluid supply line connected to said pressure chamber.

8. The apparatus of claim **7,** in which said limiting means also include a normally closed valve in said supply line for trapping fluid in said chamber to hold said wall member against displacement by the piston, said valve being adjustable to an open position to permit escape of fluid from said chamber and thereby release the wall member to allow movement of the piston to its said cleaning position.

9. The apparatus of claim **1,** in which the axis of the cylinder forms an angle with the horizontal to provide the cylinder with a lower part in which the piston is movable toward said other cylinder opening, said second annular zone being located to be passed by both of said piston seals during normal reciprocation of the piston, whereby collection of gas is avoided in said lower part of the cylinder.

* * * * *