

April 8, 1969

P. HAMMELMANN

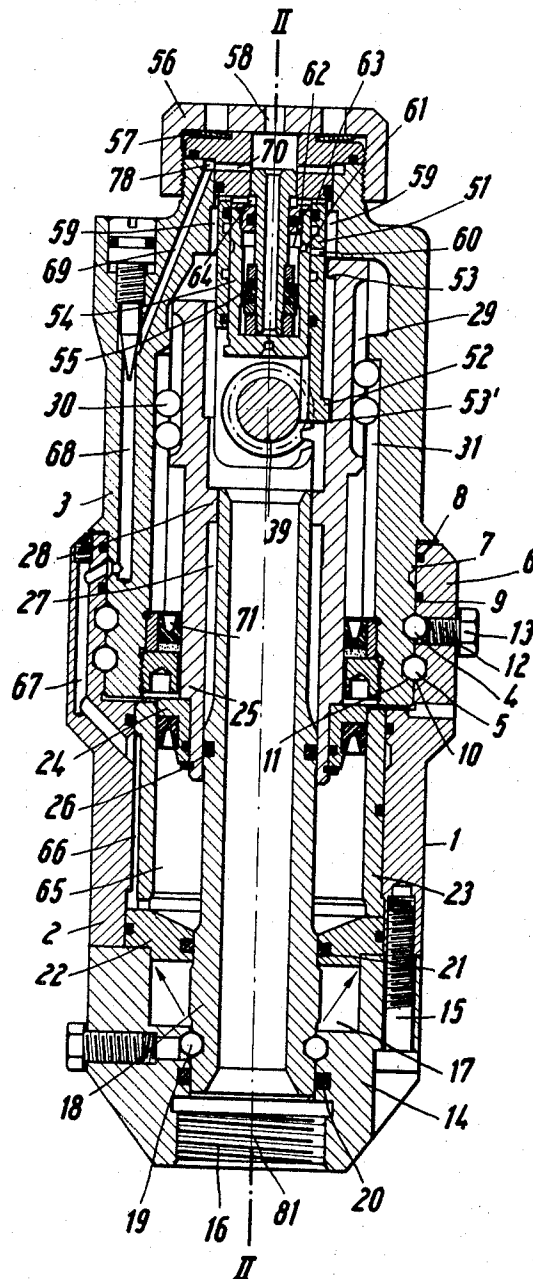
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NOZZLE HEAD OPERATING ARRANGEMENT

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Fig. 1



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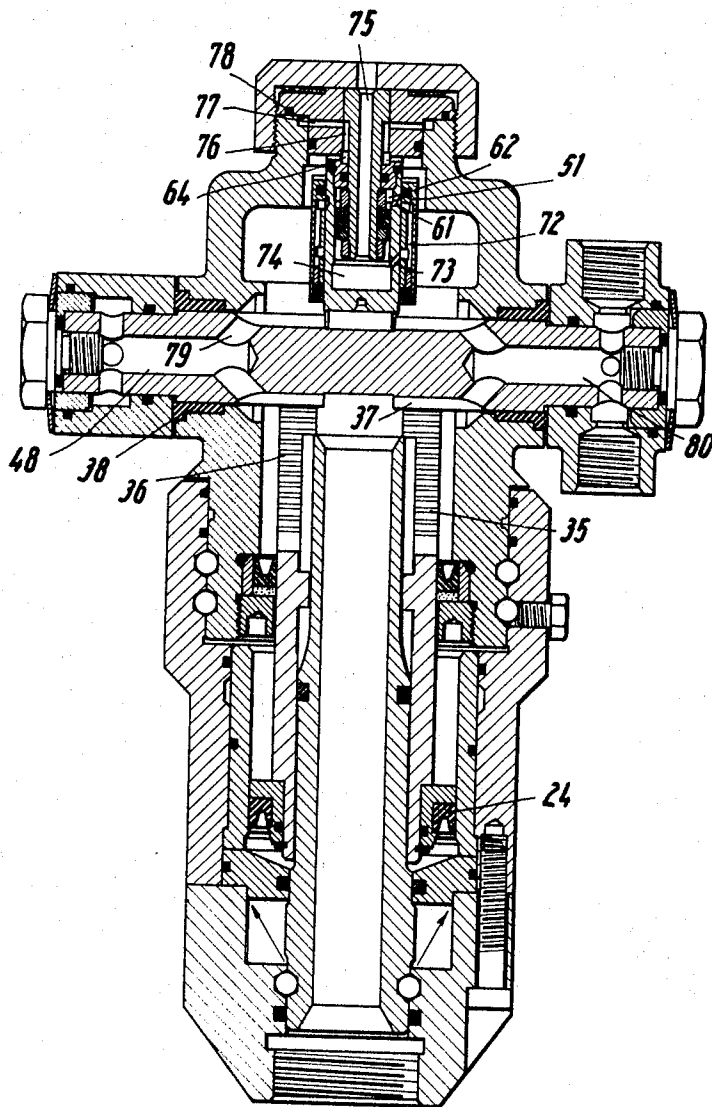
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Fig. 2



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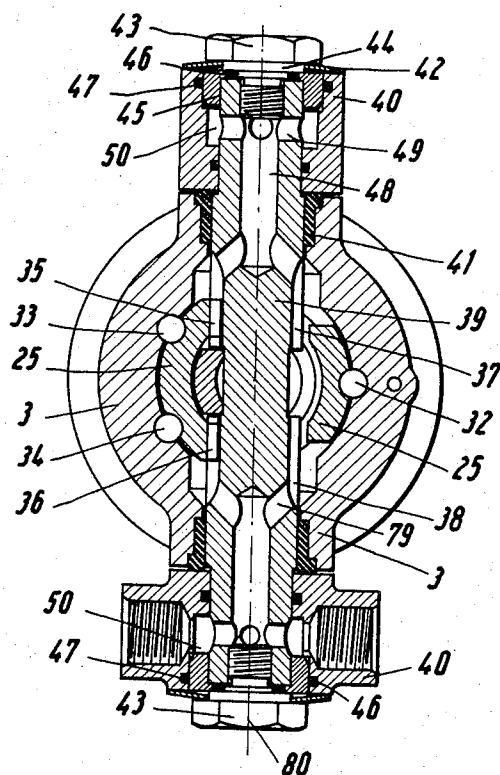
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Fig. 3



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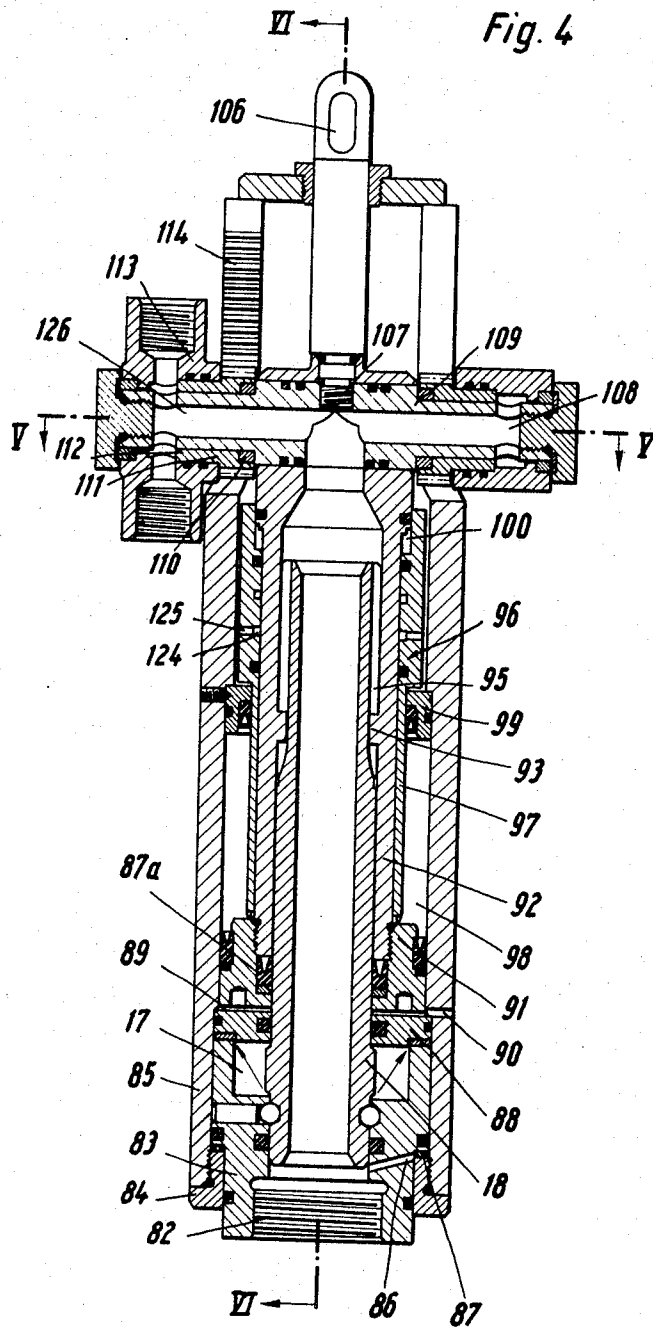
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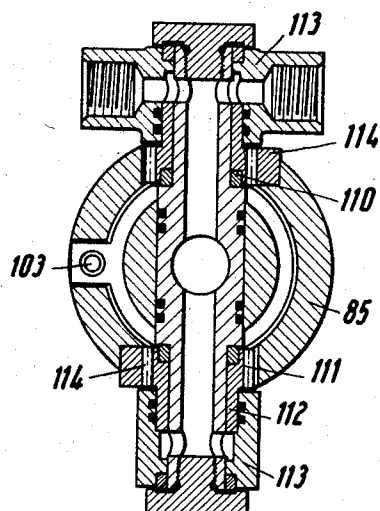
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Fig. 5



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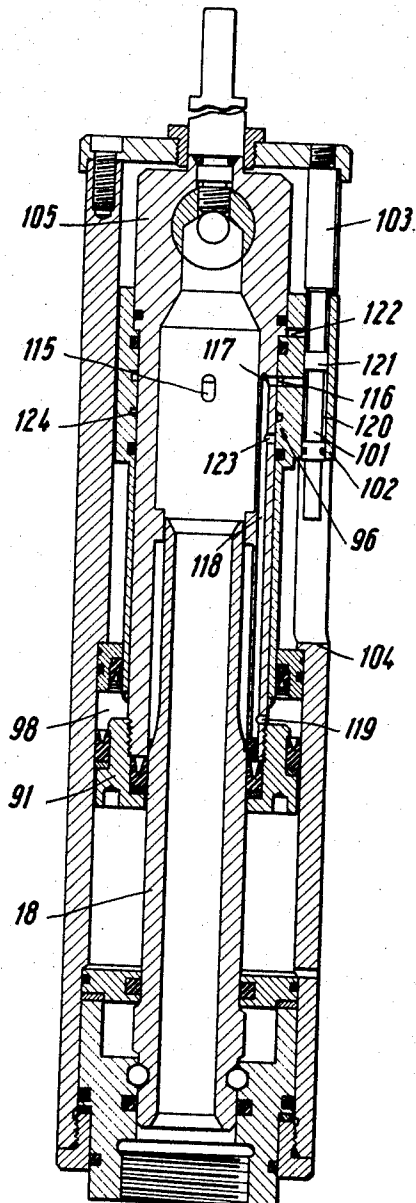
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Fig. 6



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NOZZLE HEAD OPERATING ARRANGEMENT

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Filed Aug. 1, 1967, Ser. No. 657,676

Claims priority, application Germany, Aug. 2, 1966,
H 60,139

Int. Cl. B05b 3/04, 3/16; F01b 3/00

U.S. Cl. 239-227

20 Claims

ABSTRACT OF THE DISCLOSURE

The inlet pipe of the apparatus is connected to a stationary support by one-directional clutch, and has helical guideways for turning a piston during reciprocation of the same by liquid supplied through the inlet pipe. A nozzle head is mounted on the piston or on a rotary housing part connected with the same, so that the nozzle head is step-wise rotated whenever rotation of the inlet pipe is blocked in one direction of rotation. The reciprocating motion of the piston is also used for rotating the nozzle head about a second axis.

Background of the invention

The present invention relates to a nozzle head operating arrangement which effects a very thorough distribution of liquid discharged from rotating nozzles, so that the apparatus is particularly suited for cleaning containers, tanks, barrels and like vessels.

Apparatus of this type is known in which nozzles are step-wise turned. However, the apparatus according to the prior art is complicated and consists of a great number of parts which are difficult to assemble and result in the high weight of the apparatus.

Summary of the invention

It is one object of the invention to provide a nozzle head operating arrangement, particularly for cleaning purposes, which has a comparatively small number of parts, a low weight, and is constructed to provide large flow cross sections and few deflections in the conduits through which the liquid passes so that the flow resistance is low.

Another object of the invention is to provide a nozzle head operating arrangement suitable for liquid supplied at high pressure, and having stronger walls than prior art constructions, while the total weight is reduced due to the reduction of the number of parts. It is also an object to provide a construction in which the parts of the apparatus can be easily exchanged.

With these objects in view, an embodiment of the invention has an inlet pipe turnably mounted in a stationary support and extending into the region of a nozzle head. The inlet pipe is provided with helical guideways engaged by projections of a hollow piston rod which surrounds the inlet pipe and is prevented from rotating in one direction by a one-directional clutch provided between the inlet pipe and the stationary support.

A preferred arrangement according to the invention comprises supporting means forming a cylinder chamber and including a stationary support and a rotary housing means mounted on the support; an inlet pipe mounted on the supporting means for rotation and communicating with an inlet opening for liquid provided in the supporting means; piston means located in the cylinder chamber and mounted on the supporting means for rotary movement about an axis and for reciprocation in axial direc-

tion; means connecting the piston means with the rotary housing means for rotation and relative axial movement; transmission means, such as helical guideways and projections in the same, connecting the piston means with the inlet pipe for transforming the reciprocating motion of the piston means into a rotary motion; a nozzle head having nozzle means and being connected for rotation with the rotary housing means and the piston means; conduit means connecting the inlet pipe with the nozzle means; and a one directional clutch connecting the inlet pipe with the stationary support.

During a reciprocating stroke of the piston means in one direction, which is caused by the liquid flowing into the inlet pipe, the inlet pipe freely turns relative to the stationary support in one direction of rotation. However, during the return stroke of the piston means in the opposite direction of reciprocation, the inlet pipe is blocked against rotation in the respective opposite direction of rotation so that the piston means, the rotary housing means and the nozzle head are step-wise turned during alternate reciprocating strokes of the piston means, while the nozzle means discharge liquid supplied through the inlet pipe.

In one embodiment of the invention, the nozzle head is mounted on the piston rod, and in another embodiment, the nozzle head is mounted on the rotary housing means. A transmission including gears and rack bars is provided between the piston means and the nozzle means so that the same are rotated about a second axis perpendicular to the axis of rotation of the piston means and of the inlet pipe during reciprocating strokes of the piston means.

In order to obtain a fluid-tight seal of the nozzle head which includes a nozzle shaft, and nozzle blocks with nozzles mounted on the shaft, the nozzle blocks are mounted in one embodiment of the invention for axial movement on the nozzle shaft, and pressure liquid is supplied to chambers in the nozzle blocks for pressing the same against sealing bushings. The surface pressure between the nozzle blocks and the bushings depends on the pressure of the liquid so that at high pressure, the sealing pressure between the nozzle blocks and the bushings is also high.

In another embodiment of the invention, the nozzle blocks are secured to cylindrical pinion projections which are rotatably mounted on nozzle shaft which has conduits for the liquid. At one end, the projections are subjected to the pressure of the liquid, while a sealing ring supports the pinions. In this construction, the sealing means between the nozzle blocks and the cylindrical projection of the pinions are subjected only to static loads, and serve at the same time as slip clutches preventing damage to the nozzle blocks by heavy jolts while the apparatus is transported.

A particularly simple and efficient control of the reversal of the reciprocating motion of the piston means is obtained by a stepped annular reversing valve member which surrounds the piston and has one end projecting into a cylinder chamber bounded by the piston. The reversing valve member has a projection in which an auxiliary valve slide is mounted which is shifted by abutments.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

Brief description of the drawing

FIG. 1 is an axial sectional view of one embodiment of the invention;

FIG. 2 is a sectional view taken on line II—II in FIG. 1;

FIG. 3 is a cross-sectional view taken on line III—III in FIG. 1;

FIG. 4 is an axial sectional view illustrating another embodiment of the invention;

FIG. 5 is a cross-sectional view taken on line V—V in FIG. 4; and

FIG. 6 is a sectional view taken on line VI—VI in FIG. 4.

Description of the preferred embodiments

Referring first to FIGS. 1 to 3, a stationary support 1 has a tubular portion 2 ending in an annular flange 7. A rotary housing 3 is mounted on support 1 and has an annular end portion 7 surrounded by flange 9. Two circular rows of balls 4, 5 are mounted in annular races 10 and 11 provided in flanges 6 and 7 which are sealed by sealing rings 8 and 9. Bores 12 are provided for inserting the balls into the races, and are normally closed by screws 13.

A cap 14 is secured by screws 15 to the tubular housing part 2 of stationary support 1 and has an inlet opening 16 provided with threads for attaching an inlet tube supplying a liquid.

A one-directional annular clutch 17 is mounted in cap 14 and connects the same with an inlet pipe 18 which is mounted for rotation in cap 14 of support 1 by means of balls 19 located in annular races in cap 14 and inlet pipe 18. A threaded bore for the insertion of balls 19 is closed by a screw. A sealing ring 20 surrounds inlet pipe 18 and is mounted in a groove of cap 14. The front end of cap 14 surrounds a cylindrical shoulder of a disk 22 on which a cylinder member 23 forming a cylinder chamber 66 abuts.

A piston 24 is mounted in cylinder member 23 for rotation and axial reciprocating movement, and is connected with a hollow piston rod 25 into which part of inlet pipe 18 is inserted. A sealing ring 26 is provided between inlet pipe 18 and piston rod 25.

Inlet pipe 18 has helical guideways 27 at its free end engaged by inner projecting portions 28 of the hollow piston rod 25 so that projecting portions 28 and guideways 27 form a transmission for transforming axial movement of the piston means 24, 25 into oscillatory turning movement of inlet pipe 18.

Piston rod 25 has axially extending grooves 29 in which balls 30 are located. The inner surface of tubular portion 7 of housing means 3 has axially extending grooves 39 also receiving balls 30 so that piston rod 25 and housing means 3 are connected for rotation, while axial reciprocation of the piston rod 25 with piston 24 is possible.

As best seen in FIG. 3, piston rod 25 is mounted in rotary housing 3 at three points where the connecting means 29, 30, 31 are located. Piston rod 25 has rack bars 35, 36 on one side of a nozzle shaft 39, which has peripheral gear teeth 37, 38 meshing with rack bars 34, 35. Consequently, reciprocating axial movement of piston rod 25 will cause angular oscillation of nozzle shaft 39 about an axis 80 which is perpendicular to the axis 81 of housing means 3, piston rod 25, and inlet pipe 18. At the ends of nozzle shaft 39, nozzle blocks 40 are provided, each of which has a pair of nozzles respectively located in planes intersecting at right angles, as also shown in FIG. 2. Each block 40 abuts a bushing 41 which is secured to the housing means 3. Bushings 41 may be made of a synthetic plastic material. Nozzle shaft 39 and the nozzle blocks 40 form a nozzle head rotatably mounted in rotary housing 3.

Each nozzle block 40 is biased by a dished spring 42 abutting the head of a screw 43 which is threaded into

nozzle shaft 39. A boss 44 of screw head 43 abuts a bushing 45 which is sealed by sealing rings 46 and 47.

Liquid flows to the nozzle blocks 40 through channels 48 and transverse bores 49 which communicate with pressure chambers 50 in the nozzle blocks. Pressure chambers 50 have annular pressure faces on which the pressure of the liquid acts with a reaction force for urging nozzle blocks 40 against bushings 41 so that the pressure between each bushing 41 and the respective nozzle block 40 depends on the pressure of the liquid in pressure chambers 50.

This construction has the advantage that a perfect seal between the nozzle blocks 40 and the bushings 41 is obtained even at high pressure of the liquid, while the sealing parts are not worn substantially. The dished springs 42 assure a minimum surface pressure between nozzle blocks 40 and bushings 41, which is maintained under all operational conditions independently of the liquid pressure.

Piston means 24, 25 is reciprocated in axial direction under the automatic control of reversing valve means. An annular slide 51 having a projecting part 52 which cooperates with abutment, 53, 53' in piston rod 25, surrounds a cylindrical control slide 54 in which reversing valve member 55 is mounted for reciprocating movement between the positions shown in FIGS. 1 and 2.

A closure cap 56 is attached by threads to the end portion of rotary housing 3, and is biased by a dished spring 57. Cap 56 has a central outlet opening 58 communicating with the reversing valve means.

The apparatus operates as follows:

The liquid to be sprayed or discharged from the nozzles of the nozzle blocks 40 is supplied through the inlet opening 16 and inlet pipe 18 to conduits 48 of nozzle shaft 39 and discharged from the nozzles. In the position of the reversing valve means shown in FIG. 1, the liquid also flows through an annular chamber 59, a bore 60 in annular slide 51, and bore 61 of the cylindrical control slide 54 into the control chamber 62. At the same time, liquid flows through bore 63 into the annular chamber 64. Since the effective pressure surface of chamber 62 is greater than the effective pressure surface of chamber 64, reversing valve member 55 assumes the position shown in FIG. 1.

Cylinder chamber 65 is connected by a conduit 66, a conduit 67, conduits 68, 69, and bore 70 with the discharge opening 58. The effective pressure surface between the sealing means 26 and 71, continuously produces a force acting on the hollow piston rod 25 in downward direction and driving piston means 24, 25 from the position shown in FIG. 1 to the position shown in FIG. 2. At the end of this reciprocating downward stroke of piston means 24, 25, abutment 53 on piston rod 25 abuts the projecting portion 52 of the annular slide 51 and shifts the latter to the position shown in FIG. 2.

In this position of annular slide 51, the control chamber 62 is connected with the discharge outlet 58 through bore 61, channel 72, bore 73, chamber 74 and the longitudinal central bore of reversing valve member 55.

In the position shown in FIG. 2, the liquid flows from the annular channel 64 into the conduit 76 and through bore 77 into the annular chamber 78. As shown in FIG. 1, the liquid then flows through the conduits 69, 68, 67, 66 into the cylinder chamber 65 where the pressure increases so that piston means 24, 25 is urged to perform a reciprocating stroke in upward direction back to the position shown in FIG. 1. During this reciprocating stroke, the abutment 53' on piston rod 25 engages projecting portion 52 of the annular slide 51 and moves the same back to the position shown in FIG. 1.

Thus, piston means 24, 25 are reciprocated by the liquid flowing into the apparatus under the automatic control of reversing valve means, while the liquid is simultaneously discharged through the nozzles of the nozzle blocks 40.

During the reciprocating movement of the piston means 24, 25, rack bars 35, 36 meshing with the gear portions 37, 38 of nozzle shaft 39 turn the nozzle shaft 39 with the nozzle blocks 40 and the nozzles in an angular oscillatory movement while the liquid flows through the slanted conduits 79, conduits 48, and conduits 49 into chambers 50 and from there through the two pairs of nozzles while the nozzle head performs an angular oscillatory motion about axis 80 of nozzle shaft 39.

In addition to this oscillatory motion, the nozzle means 39, 40 also perform a step-wise rotary movement about the main axis 81 in one direction of rotation. This rotary movement is obtained by the helical guideways 27 on inlet pipe 18 which are engaged by the projecting portions 28 of piston rod 25.

As explained above, a one-directional clutch 17 of conventional construction, which may have balls in wedge-shaped grooves, connects the stationary support 1, and more particularly cap 14 with inlet pipe 18, so that the latter can rotate in one direction only, and is blocked against rotation in the opposite direction.

During a reciprocating stroke of piston means 24, 25 in one direction, the transmission 28, 27 transforms the axial reciprocating stroke of piston means 24, 25 into a rotary motion of inlet pipe 18 which is ineffective since the one-directional clutch 17 does not lock in this direction of rotation. During the opposite reciprocating stroke of piston means 24, 25, transmission means 28, 27 urges inlet pipe 18 to turn in the opposite direction which is not possible since one-directional clutch 17 connects inlet pipe 18 with the stationary support 1, 14 so that rotation of inlet pipe 18 is blocked. Consequently, piston means 24, 25 must turn, and since the piston rod 25 is connected by the grooves 29, 31 and balls 30 to the rotary housing 3 which is mounted for rotation by means of balls 4 and 5, rotary housing 3 with nozzle head 39, 40 turns in one direction of rotation during the respective reciprocating stroke of piston means 24, 25, and angularly displaces nozzle head 39, 40 about axis 81. During the following reciprocating stroke of piston means 24, 25, inlet pipe 18 turns freely so that no force is transmitted by the transmission 29, 30, 31 to the rotary housing 3 and nozzle head 39, 40 so that the same stop until piston means 24, 25 starts its next following reciprocating stroke. As a result, the nozzles rotating about axis 80 also turn step-wise about axis 81, resulting in a thorough distribution of the streams discharged by the four nozzles.

FIGS. 4 to 6 illustrate another embodiment of the invention which has the advantage of a very simple construction.

The liquid is supplied through the inlet opening 82 of a stationary support 83 on which the rotary housing 85 and cap 84 are mounted for rotation. Inlet opening 82 is connected by a transverse passage 86 with an annular pressure face 87 which compensates the longitudinal force resulting from the liquid pressure on the circular face having the inner diameter of sealing means 87a. This permits a more economical construction.

Inlet pipe 18 is mounted in support 83 for rotation, and is surrounded by the one-directional clutch 17 which is fixed to support portion 83.

Inlet pipe 18 passes through a transverse wall 88 which limits the cylinder chamber 89 at one end. A bore 90 relieves the pressure in cylinder chamber 89.

Piston 91 is secured to a piston rod 92 which has inner projections 93 engaging helical guideways 95 of inlet pipe 18.

Piston rod 91 slidably supports an annular reversing valve member 96 constructed as a stepped piston whose cylindrical end portion 97 projects into a cylinder chamber 98 bounded by piston 91 and a transverse annular wall 99. In order to reciprocate the reversing valve member 96, a control chamber 100 is supplied with a liquid, or relieved to discharge the liquid.

Reversing valve member 96 cooperates with an aux-

iliary valve slide 101 which is mounted in lateral projecting portion 102 of reversing valve member 96. It is also possible to construct the auxiliary valve slide as an annular slide. The shifting of the auxiliary valve slide 101 is accomplished by abutments 103, 104.

End portion 105 of the piston rod 92 carries a suspending member 106 with an opening. A threaded portion 107 of suspending member 106 is threaded into the nozzle shaft 109 which has a longitudinal axial conduit 108. Nozzle shaft 109 passes through a bore in the end portion of the piston rod 92. Nozzle shaft 109 is stepped and carries rings 110 to which pinions 111 are secured. Pinions 111 are integral with cylindrical projections 112 on which the nozzle blocks 113 with pairs of nozzles are rotatably mounted. The pressure between pinions 111 and rings 110 depends on the pressure of the liquid. Nozzle blocks 113 turn with the pinions 111, but the construction permits a turning of the nozzle blocks 113 relative to the pinions 111, which is a safety factor.

Pinions 111 mesh with racks 114 secured to the rotary housing 85. As shown in FIG. 5, rack bars 114 are not located on the same side of nozzle shaft 109 so that during a rotation of rotary housing 85 with the nozzle head 109, 111, 113; precise meshing of the pinions 111 with the racks 114 is assured.

In the position of the reversing valve member 96 shown in FIG. 6, the liquid which is to be discharged through the nozzles and which also operates the piston, flows through inlet pipe 18 and the slot 115 in piston rod 105 into the annular chamber 116, and then through bores 117, 118, 119 into cylinder chamber 98. Due to the pressure built up in cylinder chamber 98, piston 91 is moved from the position shown in FIG. 6 to the position shown in FIG. 4, against the action of the upwardly directed force resulting from the liquid pressure acting on the annular face having the inner diameter of sealing means 87a. At the end of this stroke, auxiliary valve slide 101 engages abutment 104 and is shifted. Piston 121 passes bore 122 so that the liquid medium flows through annular chamber 120 and bore 122 into the control chamber 100 of the reversing valve member 96. Reversing valve member 96 is moved by the liquid ahead of the piston rod 92 so that the reversal of the auxiliary valve slide 101 is sooner accomplished.

When reversing valve member 96 assumes the position shown in FIG. 4, cylinder chamber 98 can discharge the liquid medium through bores 119, 118, 123, annular channel 124 and bore 125 so that piston 91 is moved into the position shown in FIG. 6. During this stroke, auxiliary valve slide 101 is shifted by abutment 113, and assumes the position shown in FIG. 6. When piston 121 passes bore 122, control chamber 100 can discharge the liquid through bore 122. Reversing valve member 96 is shifted due to the liquid pressure in cylinder chamber 98 and moved into the position shown in FIG. 6 ahead of the piston rod 92 so that auxiliary valve slide 101 is earlier shifted.

During the reciprocating movement of piston 91, pinions 111 mesh with rack bars 114 so that the nozzle head 109, 113 turns about the transverse axis 126 of nozzle shaft 109. At the same time, projecting portions 93 of piston rod 92 slide along the helical guideways 95 of inlet pipe 18. The one-directional clutch 17 permits a step-wise turning movement of the rotary housing 3 with the nozzle head about a longitudinal axis of rotation which coincides with the axis of the inlet pipe 18 and of piston rod 92.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of cleaning apparatus for containers, tanks, barrels and other vessels differing from the types described above.

While the invention has been illustrated and described as embodied in a nozzle head operating arrangement for rotating nozzles about two axes extending at right angles

by the action of a liquid discharged by the nozzles, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. Nozzle head operating arrangement comprising, in combination, supporting means forming a cylinder chamber and including a stationary support and a rotary housing means mounted on said support, said supporting means having an inlet opening for a liquid; an inlet pipe mounted on said supporting means for rotation and communicating with said inlet opening; piston means located in said cylinder chamber and mounted on said supporting means for rotary movement about an axis and for reciprocation in axial direction; means connecting said piston means with said rotary housing means for rotation and relative axial movement; transmission means connecting said piston means with said inlet pipe for transforming reciprocating motion of said piston means into a rotary motion; a nozzle head having nozzle means and being connected for rotation with said rotary housing means and said piston means about said axis; conduit means connecting said inlet pipe with said nozzle means; and a one-directional clutch connecting said inlet pipe with said stationary support so that during a reciprocating stroke of said piston means in one direction, said inlet pipe freely turns relative to said stationary support in one direction of rotation, and so that said inlet pipe is blocked against rotation in the opposite direction of rotation during the return stroke of said piston means whereby said piston means, said rotary housing means, and said nozzle head are stepwise turned while said nozzle means discharge liquid supplied through said inlet pipe.

2. Nozzle head operating arrangement as claimed in claim 1 including other conduit means connecting said inlet pipe with said cylinder chamber; and reversing valve means in said other conduit means controlling the flow of liquid into said cylinder chamber so that said piston means reciprocates when a liquid is supplied to said inlet pipe.

3. Nozzle head operating arrangement as claimed in claim 1, wherein said piston means includes a piston and a hollow piston rod; wherein said inlet pipe is located in said hollow piston rod; and wherein said transmission means includes helical guide means on said inlet pipe and projections on said piston means guided in said helical guide means so that axial reciprocating movement of said piston means causes rotary movement of said inlet pipe.

4. Nozzle head operating arrangement as claimed in claim 3 wherein said nozzle head is mounted on said rotary housing means for rotation about a second axis perpendicular to said axis; and including a transmission connecting said piston means with said nozzle head for angularly oscillating said nozzle head about said second axis during axial reciprocation of said piston means.

5. Nozzle head operating arrangement as claimed in claim 3, wherein said stationary support has a tubular portion; wherein said rotary housing means has a tubular portion located in said tubular portion; and comprising ball bearing means between said tubular portions concentric with said axis.

6. Nozzle head operating arrangement as claimed in claim 5, wherein said ball bearing means include confronting circular grooves in said tubular parts and balls arranged in a circle in said grooves.

7. Nozzle head operating arrangement as claimed in claim 3, wherein said stationary support includes a tubular member and a cap closing said tubular member, said cap having said inlet opening; wherein one end of said inlet pipe is located in said cap; ball bearing means between said inlet pipe and said cap; and wherein said one-directional clutch is annular and located within said cap surrounding said inlet pipe.

8. Nozzle head operating arrangement as claimed in claim 7, wherein said inlet pipe has substantially the same diameter as said inlet opening, and extends into the proximity of said nozzle head.

9. Nozzle head operating arrangement as claimed in claim 3, wherein said piston and said piston rod are slidably mounted on said inlet pipe which passes through said piston and said piston rod.

10. Nozzle head operating arrangement as claimed in claim 3, wherein said means for connecting said piston means with said rotary housing means include axially extending grooves in said piston rod and in said rotary housing means located at three circumferentially spaced points, and balls in said grooves connecting said rotary housing means with said piston means for rotation and for axial movement of said piston means relative to said rotary housing means.

11. Nozzle head operating arrangement as claimed in claim 3, wherein said nozzle head includes a nozzle shaft and a pair of nozzle blocks mounted at the ends of said nozzle shaft and having said nozzle means; wherein said nozzle shaft is mounted in said rotary housing means for rotation about an axis perpendicular to said axis; including bushings mounted in said rotary housing means and surrounding said nozzle shaft; and wherein said conduit means include pressure chambers in said nozzle blocks so that liquid in said chamber urges said blocks against said bushings at a force depending on the pressure of the liquid.

12. Nozzle head operating arrangement as claimed in claim 11 and including spring means for biasing said nozzle blocks against said bushings in addition to the liquid pressure.

13. Nozzle head operating arrangement as claimed in claim 3 including other conduit means connecting said inlet pipe with said cylinder chamber; and comprising reversing valve means in said other conduit means controlling the flow of liquid into said cylinder chamber so that said piston means reciprocates when a liquid is supplied to said inlet pipe; said reversing valve means including an annular reversing valve member slidably mounted on said piston rod surrounding the same, said reversing valve member being a stepped cylinder and having a reduced portion projecting into said cylinder chamber and cooperating with said piston.

14. Nozzle head operating arrangement as claimed in claim 13, wherein said reversing valve member has a lateral projection formed with a cavity, and comprising an auxiliary valve slide located in said cavity and cooperating with abutments on said rotary housing means.

15. Nozzle head operating arrangement as claimed in claim 3, wherein said nozzle head is mounted on said piston rod for rotation about a second axis perpendicular to said axis of said piston means; and including a transmission connecting said rotary housing means with said nozzle head for angularly oscillating said nozzle means about said second axis during axial reciprocation of said piston means.

16. Nozzle head operating arrangement as claimed in claim 15 and including a suspending member secured to the end of said piston rod and coaxial with said axis of said piston means.

17. Nozzle head operating arrangement as claimed in claim 15, wherein said nozzle head includes a nozzle shaft fixed to said piston rod, and a pair of nozzle blocks mounted at the ends of said nozzle shaft for rotation, each nozzle block having a pinion; and wherein said rotary hous-

ing means has rack bars meshing with said pinions so that during reciprocation of said piston means with said nozzle head, said nozzle blocks are rotated with said nozzle means.

18. Nozzle head operating arrangement as claimed in claim 17, wherein said rack bars are located on opposite sides of said nozzle shaft for rotating said nozzle blocks with said nozzle means in opposite directions about said second axis during reciprocation of said piston means.

19. Nozzle head operating arrangement as claimed in claim 15, wherein said stationary support is surrounded by a portion of said rotary housing means and forms with the same an annular pressure chamber; and wherein said stationary support has a transverse bore connecting said inlet opening with said annular pressure chamber.

20. Nozzle head operating arrangement as claimed in claim 3 wherein said nozzle head includes a shaft and nozzle means at the ends of said shaft fixedly secured to the same; wherein said shaft is mounted for rotation on

said rotary housing means and has a second axis perpendicular to said axis of said piston means; including gear means on said nozzle shaft; and wherein said piston rod has rack bar means meshing with said pinion means so as to rotate said nozzle head about said second axis during reciprocation of said piston and piston rod.

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U.S. Cl. X.R.

239—239, 240, 241, 242; 92—31, 32, 33