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(54) **Tank Washers.**

(57) In a tank washer of the kind in which jets of cleaning, and subsequently, rinsing liquid under pressure are delivered from opposed nozzles (23) which oscillate through, preferably, 90° about the first horizontal (as illustrated) axis of a tubular carrier (21) of said nozzles (23) whilst said carrier (21) and nozzles (23) are also rotated in steps about a second vertical (as illustrated) axis, the oscillation of the tubular nozzle carrier (21) is brought about by the axial reciprocation of a piston (42) which piston (42) is directly connected by means (28,29,30) to that carrier (21) at a location (Figure 5) which is spaced from said first axis. The liquid under pressure causes the operating movements of the tank washer and means (14) is described and illustrated to counterbalance the high axial pressure exerted on a framework member of the tank washer by such liquid entering the latter through a tubular inlet fitting (1).

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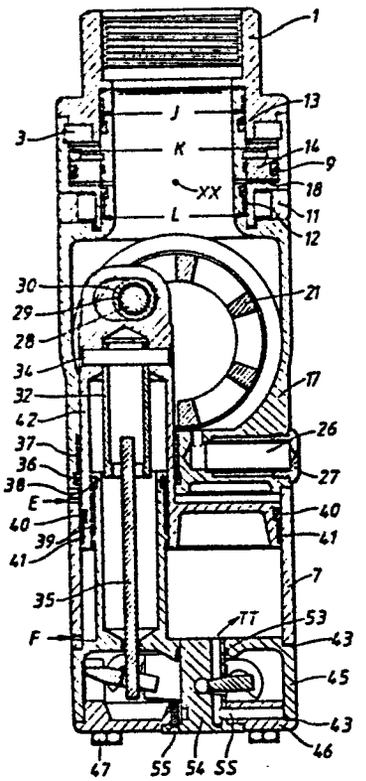
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FIG. 5.

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TANK WASHERS

This invention relates to tank washers and to devices for washing out tanks and vats in breweries, food factories, chemical works and the like, all referred to herein as "tank washers". Two jets of cleaning liquid are traversed by the tank washer over the inside surface of the tank being cleaned in such a way that every part of the interior surface of the tank is washed by at least one of the liquid jets.

According to the invention, there is provided a tank washer comprising means to direct a plurality of jets of liquid under pressure from the washer towards the interior walls of a tank or the like that is to be washed and mechanism substantially continuously to move said directing means whereby said jets will impinge upon various regions of said walls whilst the tank washer is in use, characterised in that said directing means comprises a plurality of nozzles which are angularly displaceable about a first axis, a reciprocable piston and means directly connecting said piston to a carrier of said nozzles at a location which is spaced from said first axis whereby, upon axial reciprocation of the piston, the nozzles and their carrier will be caused to oscillate about said first axis.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is a side elevation of a tank washer constructed in accordance with the invention,

Figure 2 is a front elevation of the tank washer,

Figure 3 is a plan view of the tank washer to an enlarged scale,

Figure 4 is a section taken on the line E-E in Figure 2,

Figure 5 is a section taken on the line F-F in Figure 1,

Figure 6 is a section, to an enlarged scale, taken on the line A-A in Figure 1,

Figure 7 is a section, to an enlarged scale, taken on the line B-B in Figure 2,

Figure 8 is a section, to an enlarged scale, taken on the line C-C in Figure 2, and

Figure 9 is a section, to an enlarged scale, taken on the line D-D in Figure 2.

The general operation of the tank washer can be understood from Figures 1, 2, 3 and 5 of the drawings. Cleaning, and later rinsing, liquid under pressure is supplied into a screw-threaded inlet fitting 1 from a pipe on which the tank washer is mounted. The liquid passes through the unit and issues through each of two nozzles 23. These nozzles 23 oscillate through 90°, going from the vertical position shown in the drawings to the horizontal. At the same time, the whole tank washer moves in steps about a second vertical axis. Each step occurs once during one 90° nozzle sweep. The whole action is driven by the liquid passing through the unit and the control of the movement is in a precise manner. The terms "horizontal" and "vertical" used in this paragraph assume that the tank washer is mounted at the end of a vertically disposed pipe but other dispositions thereof are, of course, equally possible.

Figures 4 and 5 should now be referred to for a detailed description of the tank washer. The tank washer is connected to the vertical pipe supplying the cleaning and rinsing liquids by the internal screw-thread of the inlet fitting 1. This fitting 1 has six flats to allow the unit to be tightened in place by a spanner or wrench.

Around the lower end of the inlet fitting rotates a cast base 17. This base 17 is the main framework member of the tank washer unit and all other parts are mounted within, or are secured to, this part 17. Within the base 17 is formed a vertical hole and a horizontal hole. These two holes are the route through which the

cleaning and rinsing liquids are fed to the nozzles 23. Mounted in the horizontal hole is a carrier for the nozzles 23 in the form of a tube 21 which is a single casting. It rotates freely, located by ball bearings 8 mounted in two replaceable bearing rings 24 screwed into the main framework member or base 17. This carrier tube 21 is finally retained in position by a bearing cap 22 and clamped by three countersunk screws 57. The main liquid flow is retained inside the tube 21 by two seals 25 made of a carbon-fitted polytetrafluoroethylene (PTFE) material having built into them O-rings of a nitrile material to give an initial sealing tension. The centre of the tube 21 is cut away and is apertured to allow the liquid flow to pass through.

The carrier tube 21 described above is fitted with seals 25 at each end, of the same diameter, which seals 25 straddle the main liquid flow going through the centre. This has the important effect of substantially eliminating any axial hydraulic thrust on the tube 21 so that no net forces are present due to the liquid pressure. The ball bearings 8 thus have to carry loads attributable to the weight of the parts alone.

Liquid jet directing means comprising two complete nozzle assemblies 23 are screwed into diametrically opposed bosses formed at one end of the tube 21. The tip of each nozzle 23, forming the emerging jet, may be of a size typically 10 or 12 mms in diameter. This tip has a tapered internal form to allow the liquid to accelerate smoothly before emerging as a concentrated parallel-sided jet. Each nozzle 23 is fixed to the matching screwed boss which forms a right-angled extension at one end of the carrier tube 21. Fitted within each extended boss is a figure-of-eight vane 59. This straightens the liquid jet before it reaches the nozzle tip, removing much of the swirl and assisting in the formation of a coherent long-throw jet.

The tube 21 with the attached nozzles 23 rotates

through 90° and back again. This oscillating action about a first axis coinciding with the longitudinal axis of the tube itself is derived from a piston 42 working in the vertical bore of a cylinder 7. This piston 42 is linked directly through a pin 28 to the tube 21. The pin 28 is located in a boss in the tube 21, at one end. At the other end, it lodges in another hole in the tube 21 and is locked into place by the bearing cap 22. It is prevented from rotating. Within a recess in the pin 28 is a sleeve 29 of a low-friction material, which acts as a bearing within a steel roller 30. This roller 30 operates within a slot in the end of an extension of the piston 42. One complete vertical stroke of the piston 42 turns the tube 21, and therefore the nozzles 23, through 90°.

The piston 42 is located in the cylinder 7 by a bearing strip 41 and liquid is prevented from getting past the piston 42 by a seal 40. The extension of the piston 42 is also located at its top end by similar bearing strips 37 and is sealed by carbon-filled PTFE seals 36. O-rings again provide initial tension for sealing.

The cylinder 7 in which the piston 42 reciprocates is a tube sealed at the bottom end by a housing 45 and an end cap 46. The whole assembly is clamped together by four bolts 47 passed through the cylinder 7 and screwed finally into the base 17. Sealing gaskets 43 constitute filters between each section.

The inlet fitting 1 and an associated underlying cylinder 58 (Figure 1) serve to secure the whole assembly to the supply pipe and also to allow the tank washer to be supported as it is rotated about its vertical axis. It has an important second function in providing means by which the downward hydraulic force due to the pressure on the top end of the base 17 may be counterbalanced by an equal and opposite hydraulic force.

The two separate functions, the location of the

whole assembly, and the counterbalance of the hydraulic forces will now be described in turn.

Secured at the top of the base 17 is an inner hydraulic balance piston 14 located by a split retaining ring 5 which is itself locked into place by a ring 4 itself secured by four countersunk screws 6. The piston 14 is fitted with a seal 9 of carbon-filled PTFE, again with a nitrile tensioning O-ring. Two strips of a bearing material 12, again of a carbon-filled PTFE material, locate into the whole assembly contained in the base 17 within the inlet fitting 1.

Below the piston 14 are four small holes XX diverting liquid from the main flow to a location under the piston 14. This pressure counterbalance liquid coming through said holes XX is contained under the piston 14 by another seal 18. The diameter of the piston 14 is related to the diameter of the top of the base 17. Three important diameters are marked in Figure 5. Diameter "J" represents the cross-section acted on by the incoming liquid flow. Diameters "K" and "L" represent the net cross-section acted on by the upward pressure counterbalancing liquid. The cross-sectional area represented by diameter "J" is equal to the difference betweeen the two diameters represented by diameters "K" and "L". The downward thrust acting on the area represented by diameter "J" is substantially counterbalanced by the upward thrust on the annular area represented by outer and inner diameters "K" and "L". Since this hydraulic thrust can be very high at elevated operating pressures, the balancing thereof is very important. Thrust washers 10 are required therefore to take no more pressure than that represented by the mechanical load imposed by the weight of the tank washer. The top of the piston 14 is separated from the incoming liquid by a seal 13.

The screw-threaded inlet fitting 1 is secured to the cylinder 58. This is effected by a circular split

ring 3 (Figure 4), which locates into a groove in the cylinder 58. It is locked into place by six screws 2 evenly spaced around the circumference of the ring 3. This ring 3 has an important second function. When a tank washer, as a whole, is screwed into place, it is common for the operator to use nozzles equivalent to the nozzles 23 for leverage. This imposes a heavy load on the mechanism and can cause it to break. Should an attempt be made to use the nozzles 23 in this way, rotation of the whole assembly in relation to the screwed inlet fitting 1 takes place. Damage is thus prevented.

The movement of the piston 42 is effected by a differential pressure across it. This again is controlled by a valve mechanism within a housing 45 and mounted on an end cap 46. The operation of this valve can be seen by referring to Figures 5 and 6. A small part of the total flow, typically 0.5%, is fed from the main liquid flow through a filter 26.

In operation, the valve mechanism directs the flow of liquid to either side of the piston 42 to move it in the axial direction required to oscillate the nozzles through 90°. Within the walls of the cylinder 42 are two small leakage orifices, "E" and "F" (Figure 5). If the controlling liquid is fed to the chamber at the top of the piston 42, some of it will escape through the hole "E". The total liquid supplied is, however, greater per unit time than that which can escape through hole "E" and the pressure build-up above the piston 42 forces it down. At the end of its stroke, the flow of liquid is reversed and is directed to the chamber beneath the piston 42. It cannot escape through hole "F" fast enough, and the rise in pressure below the piston 42 causes it to rise. In both directions of movement, the two holes "E" and "F" act as leakage orifices for the discharge of liquid on the low pressure side of the piston 42.

The two holes "E" and "F" have an important second function. Tank washers are often used in cold climates

at temperatures below the freezing point of water. If the cylinder 7 is not drained, the trapped liquid may freeze, expand and damage the mechanism. By having a constant drain through these holes "E" and "F", the tank washer can drain out, or be blown out with compressed air, and any liquid remaining in the unit can be removed.

The control of the flow of liquid to either side of the piston 42 is an important feature of the invention.

The piston 42 is hydraulically operated: the flow of liquid to the top and bottom of the piston being controlled by a valve mechanism. In known designs, the valve mechanism is operated by the piston at the end of each stroke to reverse the liquid flow. It is a disadvantage of such known layouts that, as the piston moves the valve, a deadspot occurs. The piston locks and no further movement takes place. It is necessary for the valve to operate independently from the piston to overcome this deadspot. The valve must be "loaded" by the piston movement and then be triggered at the end of the stroke to reverse the flow. This is the function of the valve which is described as follows:

Liquid supply to the valve mechanism flows from inside the base 17 through a hole in the bottom of the casting and through the filter 26 retained in place by a nut 27. It is then directed via deep-drilled holes through the cylinder 7 into a chamber encompassed by a housing 45. A flap valve 48 described below then directs this liquid flow through a valve post 54 to either the bottom or the top of the piston 42.

The valve mechanism has two main moving parts. The flap valve 48 itself and a trigger bar 56. The valve 48 and trigger bar 56 are located in small V-grooves formed in pivot posts 51 and are locked into a cap 46 by grub screws 52. The contact edges of the flap valve 48 and trigger bar 56 are machined to a 30° inclusive angle so that they pivot freely in the posts 51. The movement

of the flap valve 48 is limited by a 30° inclusive angle groove cut into a valve post 54. By moving to either of two settings, the flap valve 48 controls the supply of liquid to move to the top, or to the bottom, of the piston 42. The valve post 54 is located firmly into the bottom cap 46 and is secured with countersunk screws 55. An O-ring 53 seals the part 54 at the top end where it enters on the underside of the piston 42. The trigger bar 56 similarly pivots about the pivot posts 51 and its motion is limited by two stops cast into the cap 46. Between the flap valve 48 and the trigger bar 56 are resilient members in the form of two powerful springs 50. Into the ends of these are screwed spring ends 49 that are linked over pivot points on the flap valve 48 and the trigger bar 56. The effect of these powerful springs 50 is to pull the two parts together against the pivot posts 51. The valve 48 seals against one of the parts in the valve post 54 and is also located by this post. The trigger bar 56 is also located firmly against a stop in the cap 46 by the springs 50.

The trigger bar 56 has a link 35 located within it. This link 35 moves, at its other end, within the piston 42. At the top end, when the piston 42 is moving, the link 35 will make contact with a pin 34. This pin 34 also secures a tube 32 within the piston 42. The link 35 moves within this tube 32 and has a projection which makes contact at the bottom end of the tube 32. The chamber within which these parts are located is isolated from the general flow of liquid by a piston-like extension of the housing 45. Seals 38 with O-ring tensioning and bearing tape 39 keep the assembly sealed and located in place.

Now consider the rotation of the nozzles 23 as a whole, the movement of the piston 42 and the action of the valve 48 which directs the operating liquid above and below the piston 42. In Figure 5, assume the piston 42 is about to move down. Pressurised liquid flows through

the filter 26 and down through a drilled passageway QQ and through the bottom cap - and into the valve post 54. The flap valve 48 now directs flow through a drilled passageway SS and then on to act on the top of the piston 42, forcing it down. The flow to the top of the piston 42 is greater than that escaping through the hole "E" and the pressure above the piston 42 builds up. As the piston 42 descends, the volume of liquid beneath it exhausts through the hole "F". This action of the piston 42 rotates the nozzle tube 21 through 90° and, with rotation of the nozzles 23 attached to it, moves the jets of cleaning or rinsing liquid across the walls of the tank.

When the piston 42 gets close to the bottom of its stroke, the pin 34 strikes the link 35 forcing it down. The trigger bar 56 also moves down, rotating about its pivots against the pivot posts 51. At the same time, the tension in the springs 50 increases: they are "loaded". Finally, when the trigger bar 56 and the valve 48 are in line, the trigger bar "fires" or snaps over to the other stop. The valve 48 moves independently of the piston 42 and snaps into the opposite position. Liquid flow is now directed through a passageway TT to beneath the piston 42. It moves up again, traversing the jets of cleaning or rinsing liquid across the walls of the tank being cleaned. The liquid above the piston 42 is exhausted through the hole "F". When the piston 42 nearly reaches the bottom of its stroke, a projection on the link 35 is pulled up by a similar projection on the bottom tube 32. The trigger bar 56 is pulled up and the spring-loaded inlet valve 48 is again "fired" to fly over. The direction of piston movement is reversed and the sequence is repeated as often as is required.

To complete the action of the nozzles 23, the "stripes" they lay on the wall of the tank need to be moved around. The whole body assembly of the tank washer, including its nozzles 23, needs to be indexed in

steps around the vertical second axis of the tank washer. Figure 7 shows how this is done. An index ring 11 (Figure 1) has, projecting from its underside, a peg (Figure 4). This peg engages in a slot in the bearing cap 22. The 90° oscillation of this cap 22 has the effect of moving the peg, and therefore the index ring 11, backwards and forwards. In one direction, the index ring 11 moves freely but, in the other, it locks tight. The locking effect is achieved by rollers 16 moved against the sloping sides of machined recesses in an extension to the base 17. Compression springs 15 maintain these rollers 16 in constant contact with the wedging slopes. In one direction of the movement, the index ring 11 will lock, whilst in the other direction, it will freewheel. As the bearing cap 22 oscillates through 90°, it pushes in one direction against the locked index ring 11. The effect is to move the whole body assembly, including the jets from the nozzles 23, about the vertical second axis of the tank washer. The jets now each trace another "stripe" on the wall of the tank being cleaned. The index ring 11 has no fixed steps, such as a ratchet with a fixed number of teeth. This has the important effect that the cleaning jets never retrace the same path. The longer the tank washer is operated, the more thorough is its cleaning and subsequent rinsing effect.

CLAIMS:-

1. A tank washer comprising means to direct a plurality of jets of liquid under pressure from the washer towards the interior walls of a tank or the like that is to be washed and mechanism substantially continuously to move said directing means whereby said jets will impinge upon various regions of said walls whilst the tank washer is in use, characterised in that said directing means comprises a plurality of nozzles (23) which are angularly displaceable about a first axis, a reciprocable piston (42) and means (28,29 30) directly connecting said piston (42) to a carrier (21) of said nozzles (23) at a location (Figure 5) which is spaced from said first axis whereby, upon axial reciprocation of the piston (42), the nozzles (23) and their carrier (21) will be caused to oscillate about said first axis.

2. A tank washer according to claim 1, characterised in that the direct connection of said piston (42) to the carrier (21) of the nozzles (23) is such that, upon axial reciprocation of the piston (42), the nozzles (23) and their carrier (21) will be caused to oscillate through substantially 90^{o} about said first axis.

3. A tank washer according to claim 1 or 2, characterised in that said piston (42) is hydraulically reciprocated in a cylinder (7) by pressure differential between the opposite sides of that piston (42), there being a flap valve (48) arranged to occupy a setting to supply liquid under pressure to a chamber of said cylinder (7) at either one side, or the other side, of a portion of said piston (42), said cylinder chambers being formed with respective leakage orifices (E,F) which orifices (E,F) are of such sizes that the maximum possible rate of escape of liquid therefrom is substantially less than the rate at which liquid under pressure is supplied to one cylinder chamber, or to the other, when the tank washer is in use, and characterised

in that means (35) which is displaceable by said piston (42) is arranged to move said flap valve (48) from one liquid supply setting to the other as the piston (42) approaches either end of its stroke in the cylinder (7).

4. A tank washer according to claim 3, characterised in that said flap valve (48) is urged by at least one resilient member (50) into either said one, or the other, of said liquid supply settings, the or each resilient member (50) being capable of occupying an intermediate additionally stressed position from which it will tend to move automatically to urge the flap valve (48) towards one of said liquid supply settings, and characterised in that said means (35) which is displaceable by the piston (42) is arranged also to move the or each resilient member (50) from a position in which it urges said flap valve (48) into either one, or the other, of said liquid supply settings and through said intermediate position thereof so that, subsequently and as said piston (42) closely approaches one end of its stroke in the cylinder (7), the flap valve (48) is urged by the or each resilient member (50) into the setting corresponding to the supply of liquid under pressure to that cylinder chamber which, at that time, is approaching its minimum possible volume.

5. A tank washer according to any preceding claim, characterised in that a hydraulic balance piston (14) is fastened to a main framework member (17) and at least one orifice (XX) is formed downwstream of said piston (14) with respect to the intended direction of flow of liquid into the tank washer so that liquid under pressure passing into that orifice (XX) acts upon an annular area (K-L) in a direction opposing the hydraulic pressure acting upon a substantially equal area (J) of said framework member (17) exposed to the fluid pressure of the liquid supply whereby the latter pressure is substantially counterbalanced.

6. A tank washer according to any preceding claim,

characterised in that said carrier (21) of the liquid nozzles (23) is in the form of an apertured tube that is angularly displaceable about said first axis which latter substantially coincides with the longitudinal axis of the tube, and characterised in that said tube (21) has substantially the same diameter at each of its opposite closed ends at one of which said nozzles (23) are provided, whereby, during use, there will be no significant hydraulic thrust upon said tube (21) acting lengthwise thereof.

7. A tank washer according to any preceding claim, characterised in that means (11, 15, 16, 22) is provided to displace at least said nozzles (23) and their carrier (21) in one direction about a second axis, said means (11,15, 16, 22) being in the form of a one-way stepping mechanism whose angular steps, during operation, about said second axis are not of uniform magnitude.

8. A tank washer according to claim 7, characterised in that said means (11, 15, 16, 22) comprises a plurality of rollers (16) urged by corresponding springs (15) in one direction along corresponding wedging slopes, said rollers (16), springs (15) and wedging slopes being equiangularly spaced apart from one another around said second axis so as readily to allow movement of at least said nozzles (23) and their carrier (21) in one direction about said second axis relative to a fixed, during use, part of the tank washer whilst effectively preventing such relative movement in the opposite direction.

9. A tank washer according to any preceding claim, characterised in that two diametrically opposed nozzles (23) are provided, each nozzle (23) being carried by a corresponding boss inside which latter is fitted an anti-swirl vane (59).

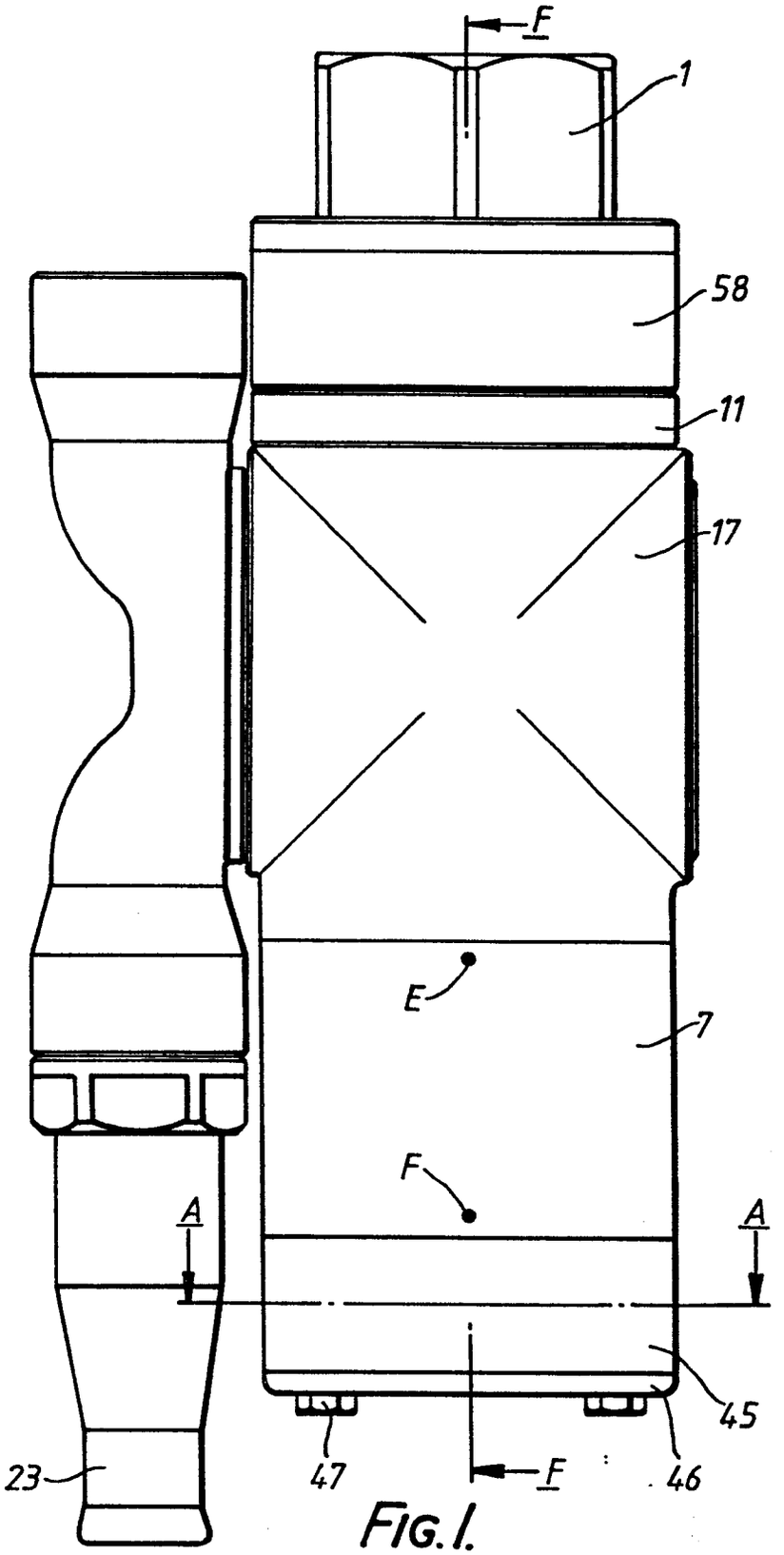

FIG. 1.

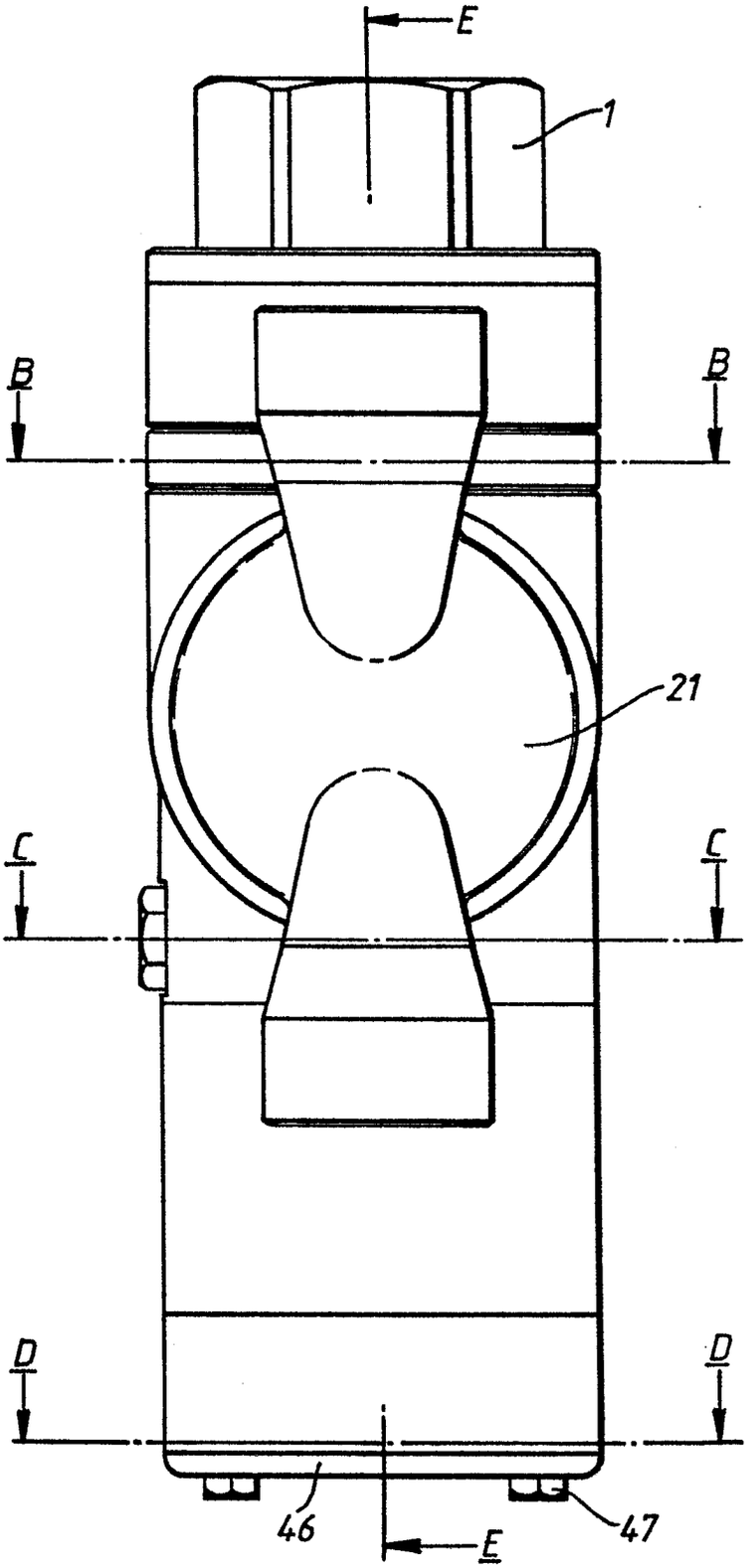

FIG. 2.

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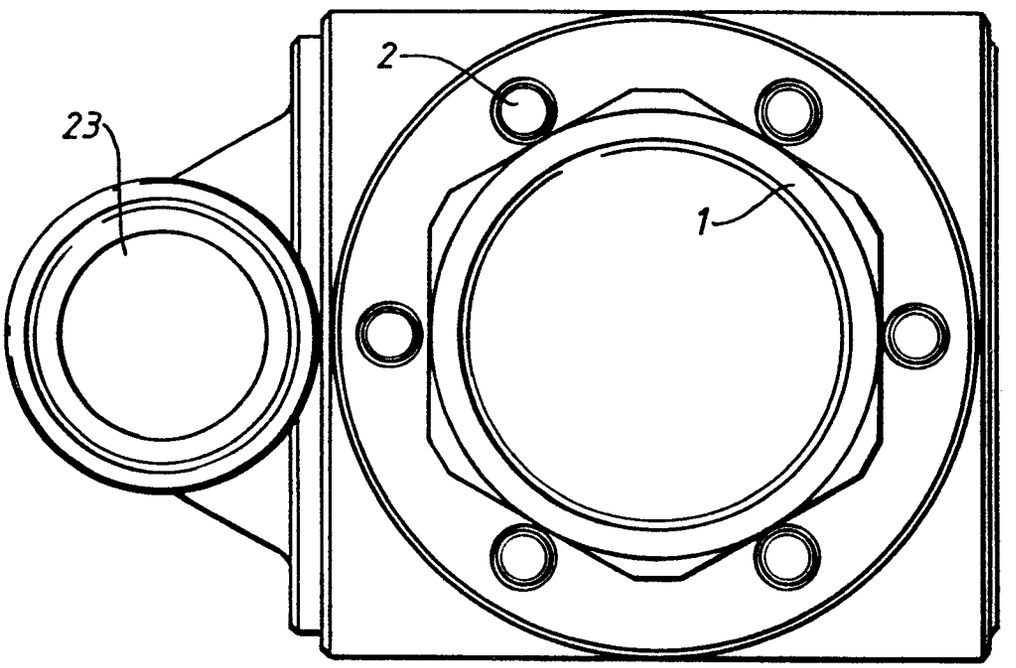

FIG. 3.

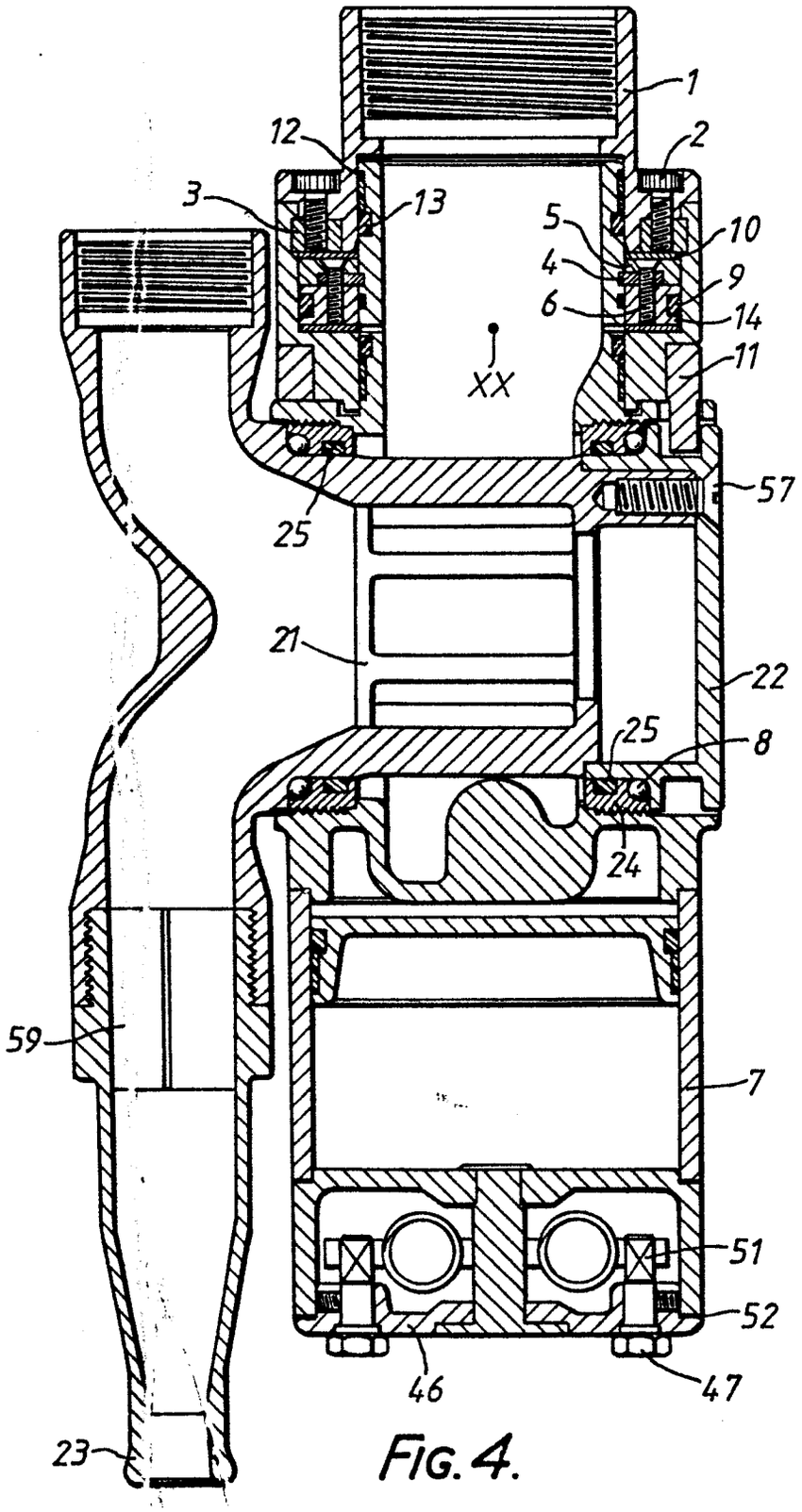

FIG. 4.

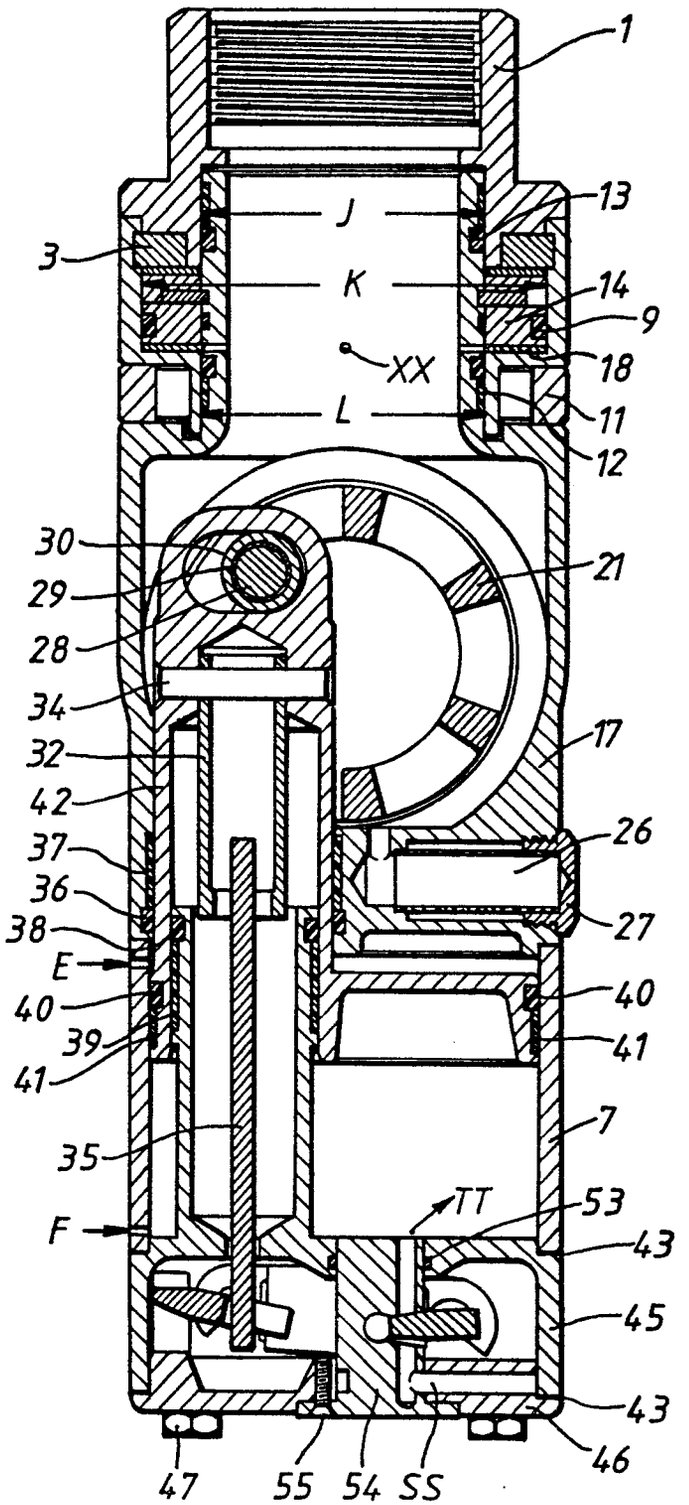
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FIG. 5.

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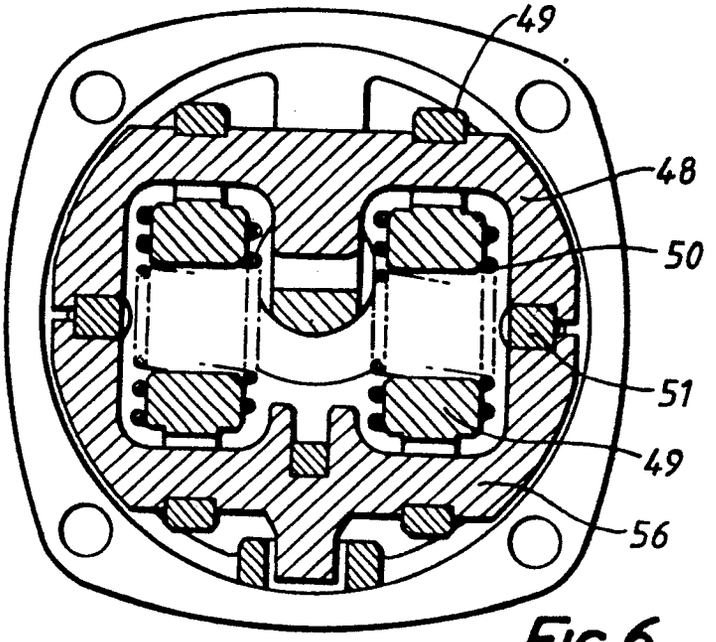

FIG.6.

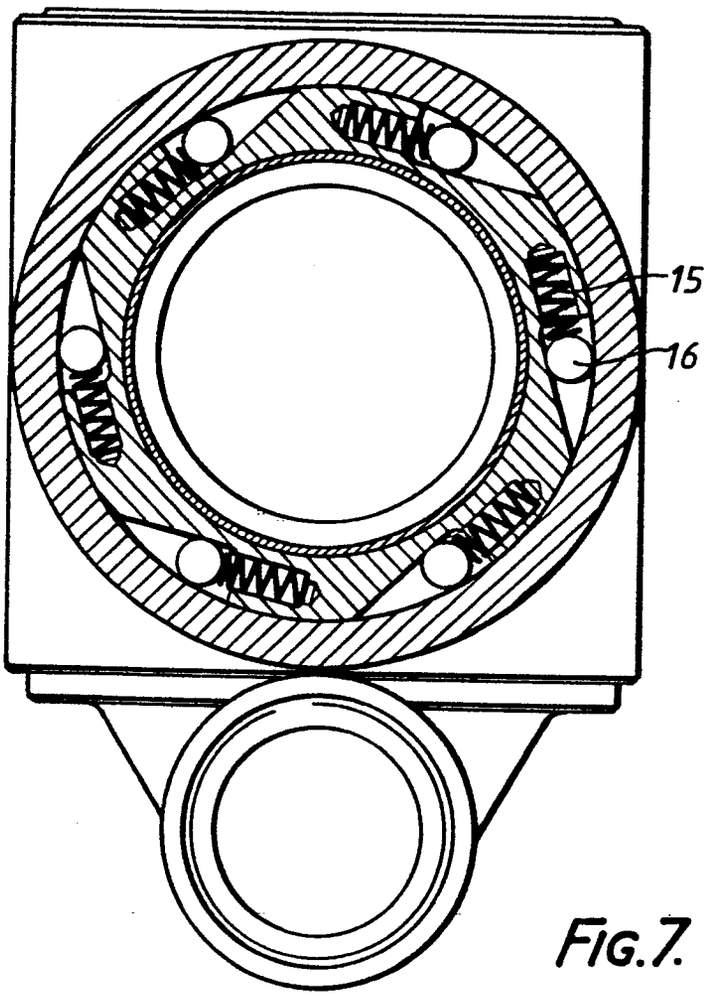

FIG.7.

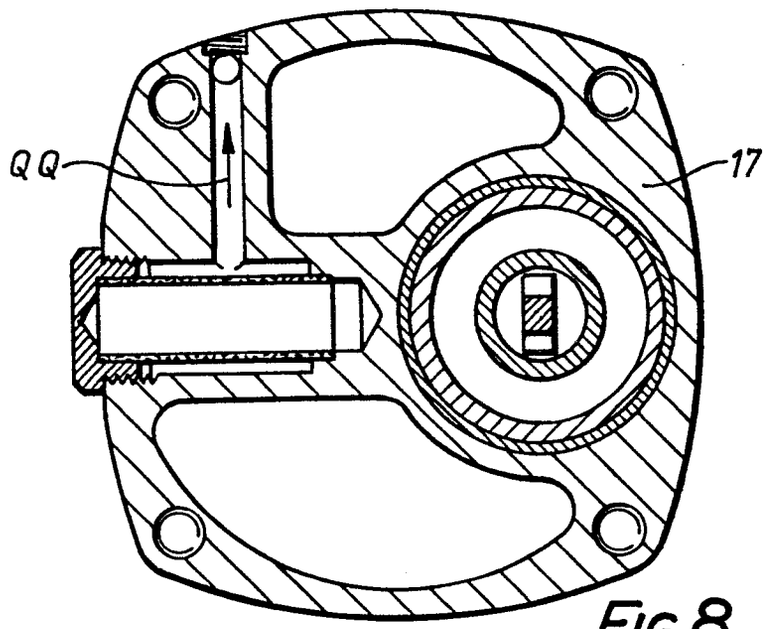

FIG. 8.

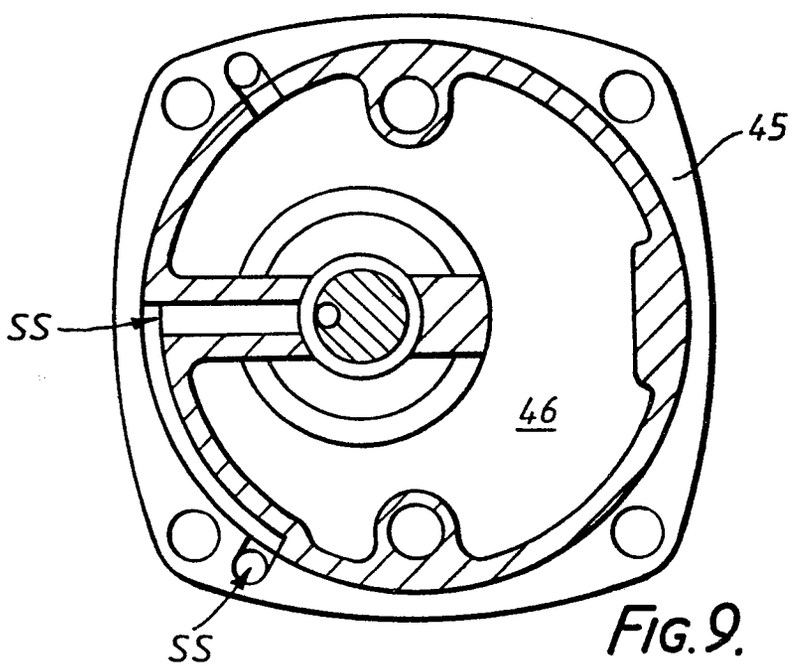

FIG. 9.

European Patent Office

EUROPEAN SEARCH REPORT

0172689

Application number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 85305486.4

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl 4)
X	US - A - 3 625 425 (ROBINSON) * Column 1, lines 60-63; column 2, line 52 - column 3, line 69; fig. 1-7 *	1,2,6, 7,9	B 08 B 9/08
A		3,4	
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A	DE - B - 1 229 485 (HAMMELMANN JUN.) * Column 3, lines 40-49; fig. 1 *	3	
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A	GB - A - 1 601 042 (PARLOUR HYGIENE SERVICES LIMITED) * Page 2, lines 78-85; fig. 1,2 *	5	
	--		
A	GB - A - 1 534 764 (FISMEN) * Page 2, line 128 - page 3, line 30; fig. *	8	
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A	US - A - 3 696 825 (GUIGNON) * Fig. 1,10,11 *		B 08 B 9/00 B 05 B 3/00

TECHNICAL FIELDS SEARCHED (Int. Cl 4)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	18-11-1985	TROJAN

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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