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Fluid dispensing piston pump

The present invention relates to dispensing and metering devices for fluid materials. In particular it relates to a fluid dispensing piston pump which is adapted to be sterilized in place without requiring disassembly of the apparatus.

Various pumping systems have been proposed for use particularly with the dairy industry, where the device may be cleaned in place without requiring disassembly of the unit. Such systems are of benefit to the packaging industry as substantial time savings are possible because the frequency of pump disassembly is reduced. Furthermore, the constant assembly and disassembly of the pump components makes the units more susceptible to damage and wear thus reducing their expected life.

It is apparent that a pump and dispensing system which did not require constant assembly and disassembly for sterilization would be favourably received by the dairy industry however, they are also concerned with high quality control standards which can not easily be achieved with a system that is not sterilized daily.

One system that is designed to overcome a number of these problems is disclosed in United States Patent 3,693,640 which issued to Wettlan et al, September 26, 1972. This system uses a separate pumping chamber in combination with a dosing tube which dispenses the product to the individual containers. The system is such that the dosing tube may be connected to the piston chamber allowing cleaning fluid, which is circulated throughout the device, to contact the rear face of the piston and the stem of the piston to assure the working surfaces of the pump are contacted by the cleaning fluid. Although this is an improvement over the prior art, it is not completely satisfactory for the dairy industry as rinsing of the dispensing device is only part of the problem with the other requirement being a system that can be sterilised in place such that the quality control standards can be met.

According to the invention, there is provided a fluid dispensing piston pump comprising a cylinder having a closed end and an open end, a piston sealingly engaged with said cylinder during the dispensing stroke of the piston, an inlet check valve for admitting fluid to the cylinder, an outlet check valve for discharging fluid from said cylinder and actuating means extending from the piston and through the open end of the cylinder for displacing the piston within the cylinder, characterised in that the cylinder is enlarged towards the closed end thereof beyond the dispensing stroke of the piston, the inlet and outlet valves communicate with said enlarged portion of the cylinder, the actuating means comprises a piston stem extending freely through the cylinder and the open end thereof and sealing means is opera-

tively associated with the stem for closing the open end of the cylinder when the piston is displaced beyond its dispensing stroke into the enlarged portion of the cylinder whereby high temperature steam or a cleaning fluid may be introduced through the inlet check valve to fill the cylinder when the piston is displaced beyond its dispensing stroke to clean and sterilise the components of the pump including the piston and the piston stem without disassembling the pump.

The enlarged portion of the cylinder may be closed by a nozzle member which houses the outlet check valve and closing means may be associated with the nozzle member for engaging the nozzle member during cleaning and sterilising of the pump. The closing means may be a plate member adapted to sealingly engage the nozzle member. When the pump is cleaned and sterilised by steam control means may be provided for determining the rate of steam discharge through the pump and this means may be a valve controlling release of steam through the closing means. When the pump is cleaned using a cleaning fluid means may be provided for recirculating the fluid through the pump.

Embodiments of the invention will now be described by way of example, reference being made to the accompanying drawings in which:—

Figure 1 is a vertical cross-section through a combination pump and nozzle;

Figure 2 is a similar cross-section to that of Figure 1 showing the piston during the intake stroke;

Figure 3 is a vertical cross-section through the combination pump and nozzle with the piston member positioned for cleaning;

Figure 4 is a front view of several combination pump and nozzle units located side by side above a conveyor;

Figure 5 is a rear view of the combination pump and nozzle units of Figure 4;

Figure 6 is a cross-section taken along the line 6—6 of Figure 4 and

Figure 7 is a perspective view of a steam plate used during cleaning of the units.

As shown in Figure 1, a pumping unit 10 has been combined with a distribution nozzle 12 and product feed system 14. The product is fed through the header 16 to the inlet check valve 18 and subsequently to the cylinder chamber 20. On the downward stroke of the piston 22 the product that has been drawn into the cylinder chamber is discharged through outlet check valve 24 and subsequently through ports 26 and 28 to the filling position below.

Cylinder chamber 20 has been provided with an enlarged bottom portion 30 which allows the O-ring 32 to break its seal with the cylinder wall when lowered into this enlarged portion. The piston 22 during the pumping cycle recipro-

cates between the position shown in Figure 1 to a position near the upper extremity of the cylinder. During the pumping cycle the piston face 34 and O-ring 32 do not enter the enlarged cylinder portion 30. On the intake stroke of the pump product is drawn in through the inlet check valve 18, and the outlet check valve 24 remains sealed. On the downward stroke of the pump the inlet check valve is sealed due to the pressure build-up within the cylinder chamber and the outlet check valve 24 opens due to the valve member 25 moving downward and opening the ports 27.

A steam plate 40 has been shown in Figure 1 in dashed lines and is only used when the pump and distribution system are to be cleaned. To clean the unit the piston member 22 is lowered into the enlarged cylinder portion 30 such that the sealing block 42, which is secured to the piston stem 35, engages the upper portions of the cylinder and forms a seal therewith. The steam plate is then secured to the lower portion of the distribution system and also forms a seal with this system. The steam plate has been designed with an outlet valve for controlling the rate at which steam is discharged from the unit. Steam is introduced through the product feed system 14 and discharged through this control valve and thus the temperature within the complete unit is sufficient to provide sterilization of the working surfaces.

This can be more fully appreciated with reference to Figure 3 where the device is in the cleaning position. High temperature steam or super heated steam is introduced into the system through header 16 and due to the pressure differential between the header 16 and the outlet valve provided in the nozzle plate, the inlet check valve 18 and the outlet check valve 24 pulse between the open and closed position thus assuring all surfaces of these check valves are exposed to the steam. Furthermore, the O-ring 32 which is normally made of silicone material to withstand the steam temperature is positioned approximately opposite the inlet check valve such that steam that passing through the inlet check valve strikes the piston member and the O-ring and associated piston groove. Furthermore, the piston face tends to deflect the flow in two directions, one into the upper part of the cylinder chamber and the other towards the outlet check valve. Normally only a mechanical seal is maintained at the upper extremity the cylinder between the cylinder and sealing means 42, and therefore some steam may escape at this point.

As can be appreciated all surfaces of the cylinder wall and majority portion of the piston stem are exposed to the high temperature steam and are sterilized during the cleaning operation. It is important to be able to control the rate of discharge of the steam through the device as a higher temperature can be maintained within the device if it is pressurized, and this is accomplished by providing a control

valve on the steam plate for varying the rate at which steam is discharged.

Although the pumping unit has been explained with reference to cleaning with steam it can also be sterilized by use of a sterilizing fluid, such as iodine, which is circulated through the pump following the same path as the steam. If this is the case, the normal procedure would include flushing the unit with a cleaning fluid, then circulate an acid solution such as vinegar, followed by the sterilizing solution. Often the sterilizing solution may be left to sit in the unit until the next start-up at which time the unit will be flushed. During the cleaning cycle, the piston will be in the cleaning position and the fluids will be circulated or supplied by another pump. If it is preferred to clean in place with a sterilizing solution, it may be necessary to enlarge the control valve on the steam plate, such that a higher flow rate is possible. Means for recirculating cleaning fluid through the pump may be provided.

The intake piston stroke is shown in Figure 2 with the product being drawn in through the inlet check valve and into the cylinder chamber due to the upward movement of the piston, and with the subsequent pumping stroke of the piston, product is dispensed through the outlet ports 26 and 28 into containers stationed below. As mentioned previously the piston member stops before entering the enlarged cylinder portion 30 and therefore a certain amount of product remains in this enlarged cylinder portion. Although this is somewhat of a problem during start up of the device, several cycles of the piston will prime the pump and assure all subsequent intake strokes of the piston cause product to fill the cylinder chamber. The enlarged cylinder portion always has product in it and as such provides a buffer stock between the piston and the outlet valve. It is clear from Figure 2 that product is dispensed due to the pressure build up of the piston moving downwards in the cylinder chamber and the fact that the piston does not bottom out, but acts through buffer stock results in a more accurate metering system. Therefore, although this enlarged cylinder portion causes problems during start up these can be easily overcome and actually result in a more efficient metering system during normal running which overshadows the initial start up problems.

Turning to Figure 4, it can be seen that a number of the pumping and dispensing units 10 have been placed above, and transversing a conveyor bed 100. The device has been shown with a common steam cleaning plate 41 which is secured in the cleaning position by bolts 47. This figure also shows the position of the control valve 49 which enables the user to vary the rate at which steam is discharged from the overall apparatus during the cleaning process.

The steam plate 41 has been provided with an alignment bracket 43 which is secured to the steam plate and cooperates with aligning pegs

45 and the outer surface 39 of the body of the combined dispensing units for accurate aligning of the steam plate. As can be appreciated from Figure 2, each of the pumping units is designed to feed several filling stations and according to this embodiment the output of the pump is distributed to two filling nozzles which are aligned along the length of the conveyor and thus, each container is filled in two steps to reduce the fill rate without affecting the overall output rate of the machine. This particular method provides accurate product fill quantities as any error between outlet ports in the pump should be constant and hence is corrected due to the same container being filled by both distribution ports.

In some circumstances, it will be advantageous to use one pumping unit and several distribution ports such that one pump may feed two or more lanes of the conveyor. Where the pump feeds two lanes, it is preferred to locate the pump centrally such that the distance to each nozzle is essentially equal and the ports are identical such that a consistent even distribution of product between nozzles is achieved. Although some accuracy in the fill quantity may be lost, it may still be within acceptable tolerances, and the resulting cost savings could justify such a system. As can be appreciated the cost savings is not only the initial cost of purchasing the pumping unit but also the cost to maintain the units.

It should be pointed out that although this pumping system is designed to be cleaned in place the high quality control standards set by the dairy industry will necessitate the units being completely disassembled and thoroughly sterilized on an intermittent basis. However, the present invention allows the required frequency for disassembly to be decreased and it is therefore an attractive machine from a producers point of view without sacrificing the high quality control demanded by the industry as a whole.

As can be seen in Figure 5 the pumping unit is shown above the conveyor bed 100 with the spacing between the nozzles 102 and this bed being quite small. It can be appreciated that it is desirable to have this spacing fairly small as problems due to product splash tend to increase as the spacing becomes larger. Products splash is also a function of the speed of the product as it is filling the container and the fill rate has been decreased according to this invention by providing two filling stations.

The small spacing between the conveyor bed 100 and the nozzles 102 causes difficulties in securing the steam cleaning plate 41. The components of the pumping system and the steam plate normally are made of stainless steel and can be of considerable weight which increases the difficulty in properly locating and securing the steam plate, to seal the unit for cleaning. This problem has been overcome due

to the unique method in which the steam plate is secured and aligned as shown in Figure 4.

The operator need only place the steam plate on the conveyor roughly aligned with the pumping unit and then on the upper side of the pumping unit through bolts 47 engaging threaded apertures 51 start to lift the nozzle plate towards the nozzles 102. As the steam plate is lifted bracket 43 contacts the aligning pins 45 and the surface 39 to assure proper location of the steam plate with the nozzles. Therefore, the operator can readily secure the steam plate by adjusting the bolts 47 which are accessible at the top of the pumping units with the steam plate adapted to self-align. As shown in the drawings, the nozzles used in the combined pumping units are each held in a common nozzle support member 63. This is a preferred feature to simplify the sealing of the nozzles with the steam plate by providing one integral planar surface for engaging the steam plate.

A more full appreciation of the steam plate can be obtained from reviewing Figure 7 where it is shown the plate has a number of recesses 120 for sleeving the nozzles 102 with all these recesses being interconnected by channels 122. To the exterior of the recesses a groove 124 has been provided for housing a suitable sealing O-ring 126 made of a silicone material.

Figure 6 is a cross-section taken along line 6—6 of Figure 4 and clearly indicates how the apertures 150 which journal bolts 47 are clearly accessible at the top of the pumping unit and can be adjusted by socket wrench for positioning and securing steam plate 41 for steam cleaning.

The present invention provides a unique compact system and allows the overall pumping unit to be cleaned in place while maintaining the high quality control standards required of the dairy industry. Furthermore, the pump has been combined with a nozzle arrangement such that the two components cooperate with one another to provide a very compact and simple system. Due to this simple design and cooperation of components, effective cleaning of the device in place is possible. Furthermore, the design allows piston face and particularly the O-ring of the piston to be placed in flow path of the steam during the cleaning operation, thus assuring a more thorough and effective cleaning of these ports. This thorough cleaning is required as any bacteria remaining on the surfaces would quickly grow and contaminate the product being dispensed and hence reduce the shelf life of the products.

Claims

1. A fluid dispensing piston pump comprising a cylinder having a closed end and an open end, a piston sealingly engaged with said cylinder during the dispensing stroke of the piston, an inlet check valve for admitting fluid to the cylinder, an outlet check valve for discharg-

ing fluid from said cylinder and actuating means extending from the piston and through the open end of the cylinder for displacing the piston within the cylinder, characterised in that the cylinder is enlarged towards the closed end thereof beyond the dispensing stroke of the piston, the inlet and outlet valves communicate with said enlarged portion of the cylinder, the actuating means comprises a piston stem extending freely through the cylinder and the open end thereof and sealing means is operatively associated with the stem for closing the open end of the cylinder when the piston is displaced beyond its dispensing stroke into the enlarged portion of the cylinder whereby high temperature steam or a cleaning fluid may be introduced through the inlet check valve to fill the cylinder when the piston is displaced beyond its dispensing stroke to clean and sterilise the components of the pump including the piston and the piston stem without disassembling the pump.

2. A fluid dispensing pump as claimed in Claim 1 characterised by control means for determining the rate of steam discharge through the pump during the steam cleaning operation.

3. A fluid dispensing pump as claimed in claim 1 or 2 characterised in that said sealing means is secured to said stem and adapted to engage the upper end of said cylinder when said piston face is positioned within the enlarged portion of the cylinder.

4. A fluid dispensing pump as claimed in any preceding claim characterised in that a nozzle member closes the enlarged portion of the cylinder and houses the outlet check valve, and closing means is associated with the nozzle member during cleaning and sterilising of the pump.

5. A fluid dispensing pump as claimed in claim 4 adapted to be steam cleaned in place and characterised by a valve for controlling the release of steam from the pump through the nozzle member.

6. A fluid dispensing pump as claimed in claim 5 characterised in that the valve is part of the closing means.

7. A fluid dispensing pump as claimed in claim 4, 5 or 6 characterised in that the closing means is a plate member adapted to sealingly engage the nozzle member.

8. A fluid dispensing pump as claimed in claim 7 characterised in that the plate member is adapted to self-align with the nozzle member through the interaction of a bracket secured to the plate member and pin members associated with the nozzle member.

9. A fluid dispensing pump as claimed in claim 7 characterised in that the plate member is liftable and securable to said nozzle member by bolts which threadingly engage said plate member and extend through the pump with the head of said bolts being accessible from above the pump.

10. A fluid dispensing pump as claimed in any preceding claim characterised in that the sealing means includes a stationary member secured to the piston stem and sized to provide abutting contact with the open cylinder when the piston has been displaced into the enlarged portion of the cylinder.

11. A fluid dispensing pump as claimed in any preceding claim characterised in that the inlet check valve is positioned adjacent the periphery of the piston face when the piston is in the enlarged portion of the cylinder.

12. A fluid dispensing pump as claimed in claim 1 adapted for cleaning with a cleaning fluid and characterised by means for recirculating such fluid through the pump.

Patentansprüche

1. Kolbenabfüllpumpe für Fluid, mit einem ein geschlossenes und ein offenes Ende aufweisenden Zylinder, einem mit dem Zylinder während des Abgabehubes des Kolbens abgedichtet in Eingriff stehenden Kolben, einem Einlaß-Rückschlagventil zum Einlaß von Fluid in den Zylinder, einem Auslaß-Rückschlagventil zur Abgabe von Fluid aus dem Zylinder sowie einer sich von dem Kolben und durch das offene Ende des Zylinders erstreckenden Betätigungseinrichtung zur Verlagerung des Kolbens innerhalb des Zylinders, dadurch gekennzeichnet, daß der Zylinder in Richtung auf sein geschlossenes Ende jenseits des Abgabehubes des Kolbens verbreitert ist, die Einlaß- und Auslaßventile mit dem verbreiterten Abschnitt des Zylinders in Verbindung stehen, die Betätigungseinrichtung einen sich frei durch den Zylinder und sein offenes Ende erstreckenden Kolbenschaft aufweist und eine Abdichteinrichtung mit dem Schaft wirkverbunden ist, um das offene Ende des Zylinders zu schließen, wenn der Kolben über seinen Abgabehub hinaus in den verbreiterten Abschnitt des Zylinders verlagert wird, wodurch Hochtemperaturdampf oder ein Reinigungsfluid durch das Einlaß-Rückschlagventil zur Füllung des Zylinders eingeführt werden kann, wenn der Kolben über seinen Abgabehub hinaus verlagert ist, um die Komponenten der Pumpe einschließlich des Kolbens und des Kolbenschaftes zu reinigen und zu sterilisieren, ohne die Pumpe auseinanderzunehmen.

2. Abfüllpumpe für Fluid nach Anspruch 1, gekennzeichnet durch Steuereinrichtungen zur Bestimmung der Dampftladungs-Geschwindigkeit durch die Pumpe während des Dampfreinigungsvorganges.

3. Abfüllpumpe für Fluid nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Abdichteinrichtung an dem Schaft befestigt und derart ausgebildet ist, daß sie an dem oberen Ende des Zylinders angreift, wenn die Kolbenfläche innerhalb des verbreiterten Abschnittes des Zylinders angeordnet ist.

4. Abfüllpumpe für Fluid nach einem der

vorhergehenden Ansprüche, dadurch gekennzeichnet, daß ein Düsenelement den verbreiterten Abschnitt des Zylinders verschließt und das Auslaß-Rückschlagventil beherbergt, und dem Düsenelement während des Reinigens und Sterilisierens der Pumpe eine Verschlusseinrichtung zugeordnet ist.

5. Abfüllpumpe für Fluid nach Anspruch 4 zur Dampfreinigung an Ort und Stelle, gekennzeichnet, durch ein Ventil zur Steuerung der Freigabe von Dampf von der Pumpe durch das Düsenelement.

6. Abfüllpumpe für Fluid nach Anspruch 5, dadurch gekennzeichnet, daß das Ventil Teil der Verschlusseinrichtung ist.

7. Abgabepumpe für Fluid nach Anspruch 4, 5 oder 6, dadurch gekennzeichnet, daß die Verschlusseinrichtung ein Plattenelement ist, das derart ausgebildet ist, daß es an dem Düsenelement abdichtend angreift.

8. Abgabepumpe für Fluid nach Anspruch 7, dadurch gekennzeichnet, daß das Plattenelement derart ausgebildet ist, daß es sich mit dem Düsenelement durch die Wechselwirkung einer an dem Plattenelement befestigten Klammer und dem Düsenelement zugeordneten Zapfenelementen selbst ausrichtet.

9. Abgabepumpe für Fluid nach Anspruch 7, dadurch gekennzeichnet, daß das Plattenelement anhebbar und an dem Düsenelement mit Hilfe von Schrauben befestigbar ist, die mit einem Gewinde an dem Plattenelement angreifen und sich durch die Pumpe erstrecken, wobei der Kopf der Schrauben von oberhalb der Pumpe zugänglich ist.

10. Abgabepumpe für Fluid nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Abdichteinrichtung an dem an dem Kolbenschaft befestigtes stationäres Element mit einer derartigen Größe aufweist, daß es einen Anschlagkontakt mit dem offenen Zylinder vorsieht, wenn der Kolben in den verbreiterten Abschnitt des Zylinders verlagert wurde.

11. Abgabepumpe für Fluid nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das Einlaß-Rückschlagventil benachbart zum Umfang der Kolbenfläche angeordnet ist, wenn der Kolben in dem verbreiterten Abschnitt des Zylinders ist.

12. Abgabepumpe für Fluid nach Anspruch 1, zur Reinigung mit einem Reinigungsfluid ausgebildet, gekennzeichnet durch Einrichtungen zum Rezirkulieren des Fluids durch die Pumpe.

Revendications

1. Une pompe doseuse à piston pour fluides comprenant un cylindre ayant une extrémité fermée et une extrémité ouverte, un piston en contact d'étanchéité avec le cylindre pendant la course de distribution du piston, un clapet de retenue d'entrée pour admettre du fluide dans le cylindre, un clapet de retenue de sortie pour

évacuer le fluide du cylindre et un dispositif d'actionnement partant du piston et traversant l'extrémité ouverte du cylindre pour déplacer le piston à l'intérieur du cylindre, caractérisé en ce que le cylindre est élargi en direction de son extrémité fermée au-delà de la course de distribution du piston, les clapets d'entrée et de sortie communiquent avec ladite partie élargie du cylindre, le dispositif d'actionnement comporte une tige de piston s'étendant librement à travers le cylindre et l'extrémité ouverte de celui-ci et un moyen d'étanchéité est associé en fonctionnement avec la tige pour fermer l'extrémité ouverte du cylindre lorsque le piston est déplacé au-delà de sa course de distribution dans la partie élargie du cylindre, de sorte que de la vapeur à haute température ou un fluide de nettoyage peut être introduit à travers le clapet d'entrée pour remplir le cylindre lorsque le piston est déplacé au-delà de sa course de distribution afin de nettoyer et de stériliser les composants de la pompe y compris le piston et la tige de piston sans démontage de la pompe.

2. Une pompe doseuse pour fluides suivant la revendication 1, caractérisée en ce qu'elle comprend un moyen de commande pour déterminer le débit de sortie de la vapeur à travers la pompe pendant l'opération de nettoyage à la vapeur.

3. Une pompe doseuse pour fluides suivant la revendication 1 ou 2, caractérisée en ce que le moyen d'étanchéité est fixé sur la tige et adapté pour venir en contact avec l'extrémité supérieure dudit cylindre lorsque la face du piston est placée dans la partie élargie du cylindre.

4. Une pompe doseuse pour fluides suivant l'une des revendications précédentes, caractérisée en ce qu'une buse ferme la partie élargie du cylindre et reçoit le clapet de sortie et en ce que des moyens de fermeture sont associés avec la buse pendant le nettoyage et la stérilisation de la pompe.

5. Une pompe doseuse pour fluides suivant la revendication 4, adaptée pour être nettoyée sur place par de la vapeur et caractérisée par une soupape pour commander la décharge de la vapeur de la pompe à travers la buse.

6. Une pompe doseuse pour fluides suivant la revendication 5, caractérisée en ce que la soupape est une partie des moyens de fermeture.

7. Une pompe doseuse pour fluides suivant la revendication 4, 5 ou 6, caractérisée en ce que les moyens de fermetures, sont constitués par une plaque adaptée pour venir en contact d'étanchéité avec la buse.

8. Une pompe doseuse pour fluides suivant la revendication 7, caractérisée en ce que la plaque est adaptée pour s'aligner d'elle-même avec la buse grâce à l'interaction d'un support fixé sur la plaque et de doigts associés à la buse.

9. Une pompe doseuse suivant la revendication 7, caractérisée en ce que la plaque peut être levée et fixée sur la buse au moyen de boulons qui sont vissés dans la plaque et s'étendent à travers la pompe, la tête de ces boulons étant accessible au-dessus de la pompe.

10. Une pompe doseuse pour fluides suivant l'une des revendications précédentes, caractérisée en ce que le moyen d'étanchéité comprend un élément stationnaire fixé sur la tige du piston et dimensionné pour assurer un contact de butée avec le cylindre ouvert lors-

que le piston a été déplacé dans la partie élargie du cylindre.

11. Une pompe doseuse pour fluides suivant l'une des revendications précédentes, caractérisée en ce que le clapet d'entrée est placé au voisinage de la périphérie de la face du piston lorsque le piston se trouve dans la partie élargie du cylindre.

12. Une pompe doseuse pour fluides suivant la revendication 1, adaptée pour être nettoyée avec un fluide de nettoyage et caractérisée par des moyens pour recycler ce fluide à travers la pompe.

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FIG.1.

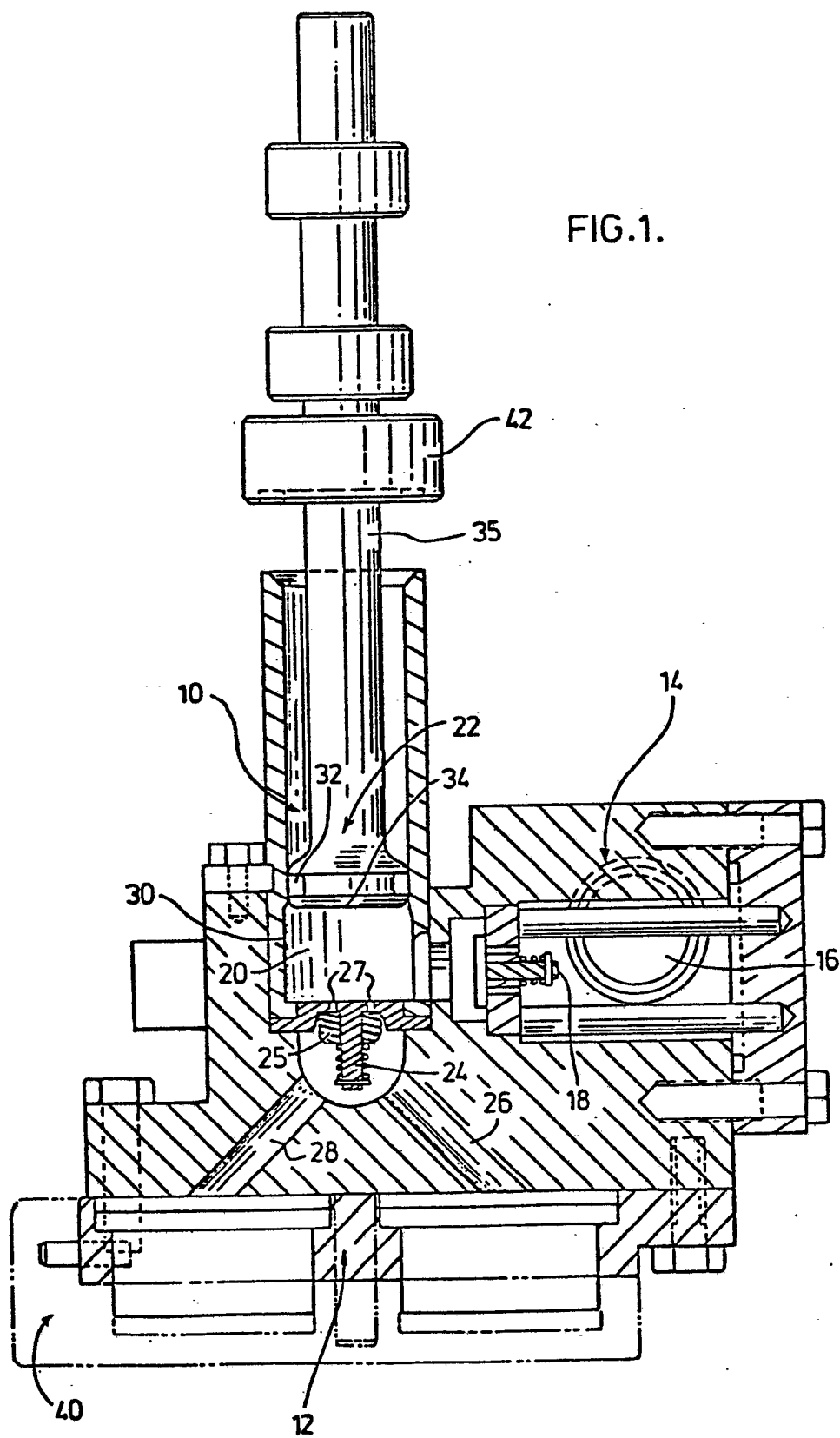


FIG.2.

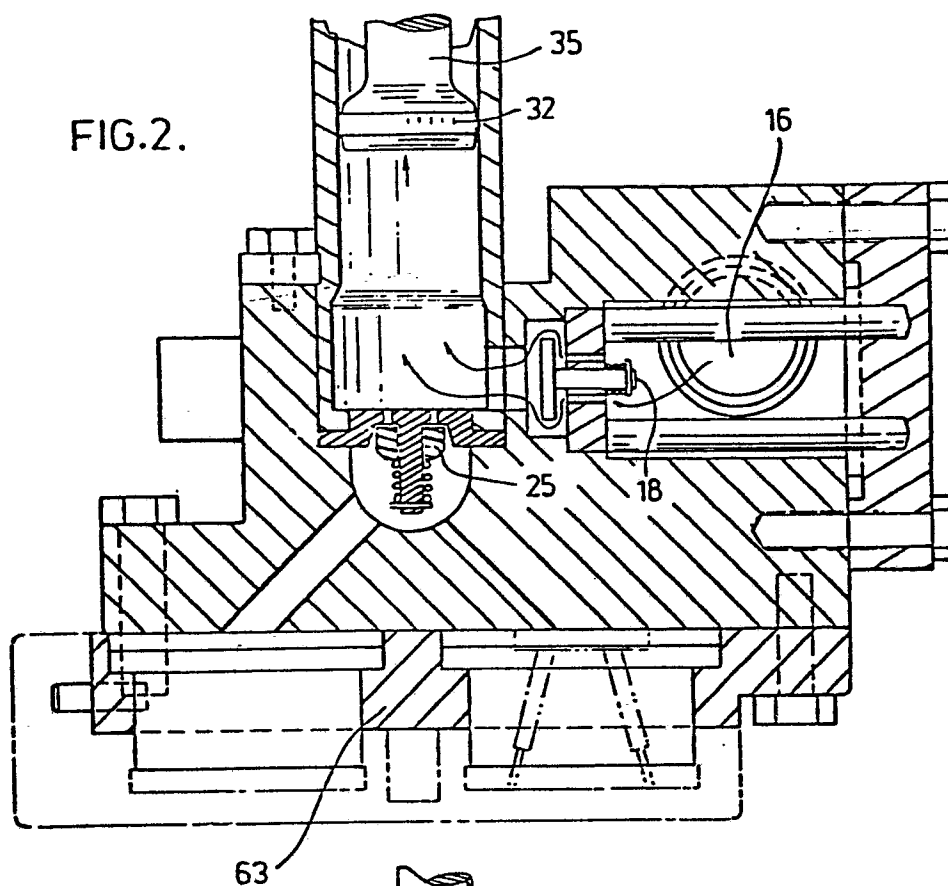


FIG.3.

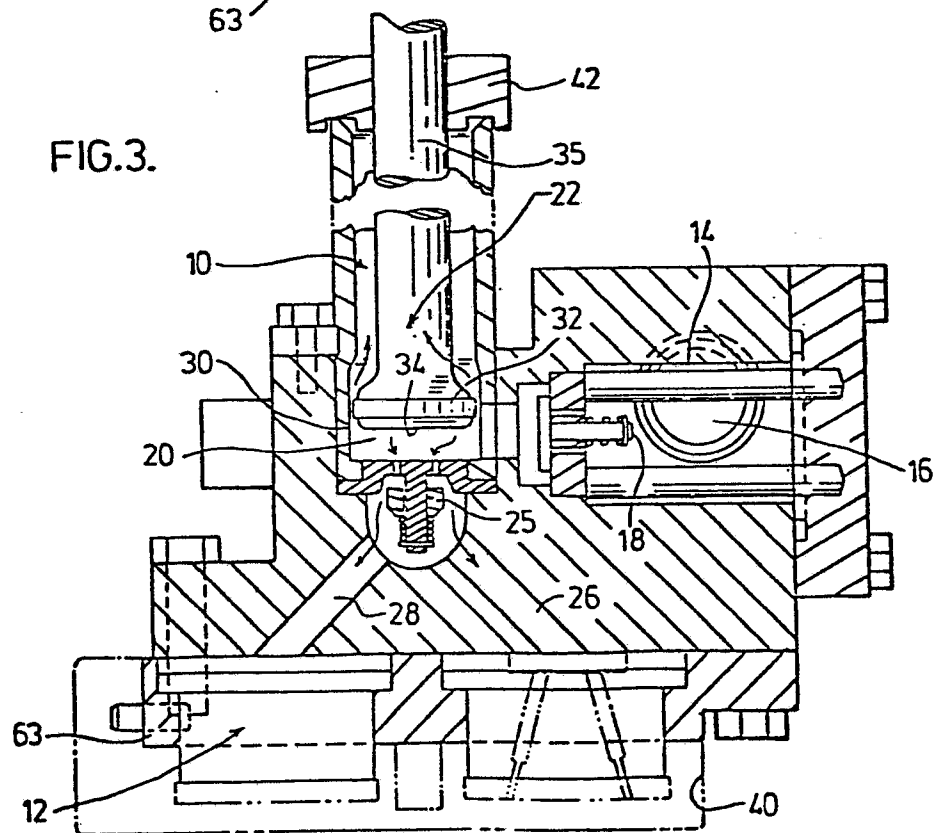


FIG. 4.

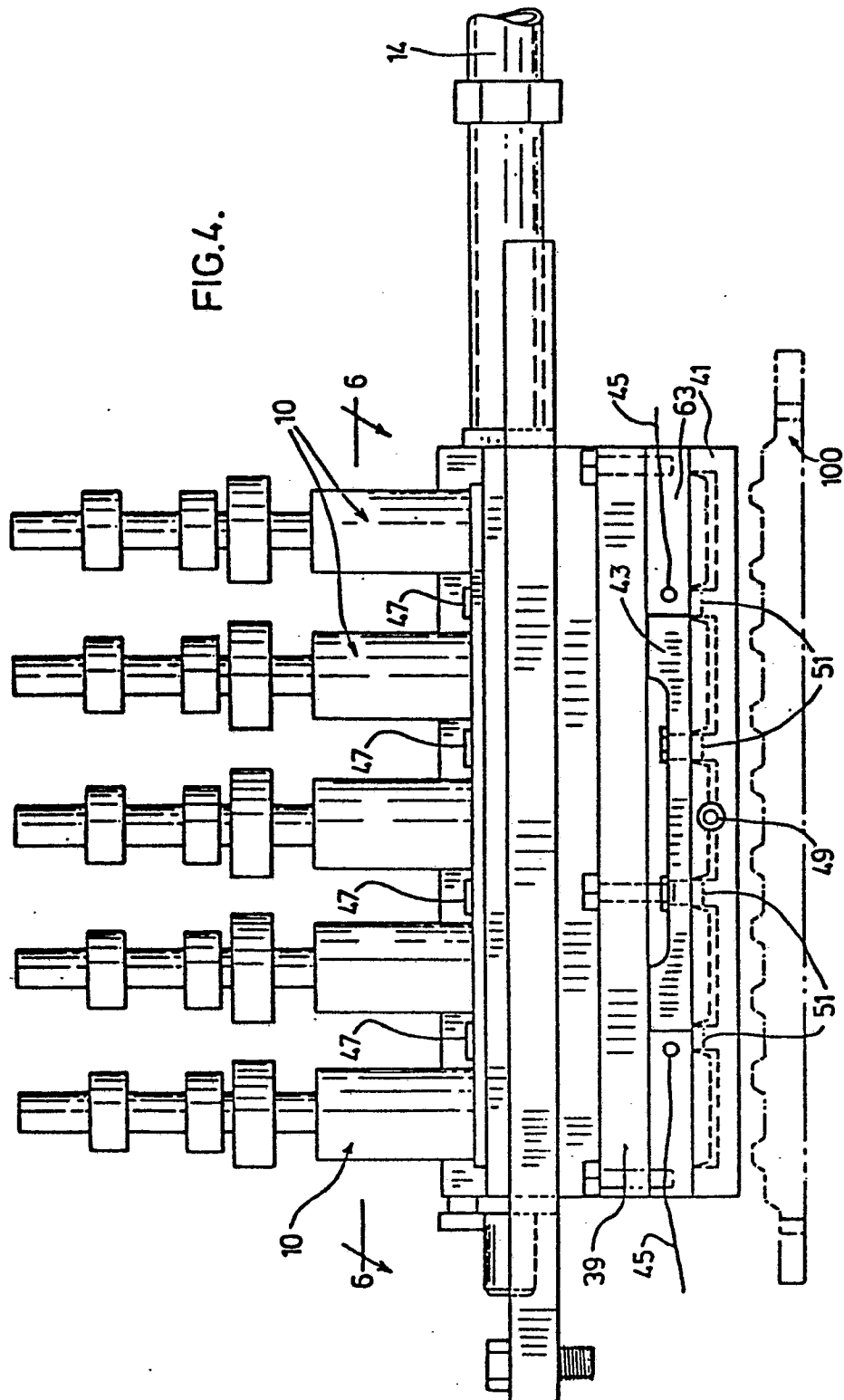
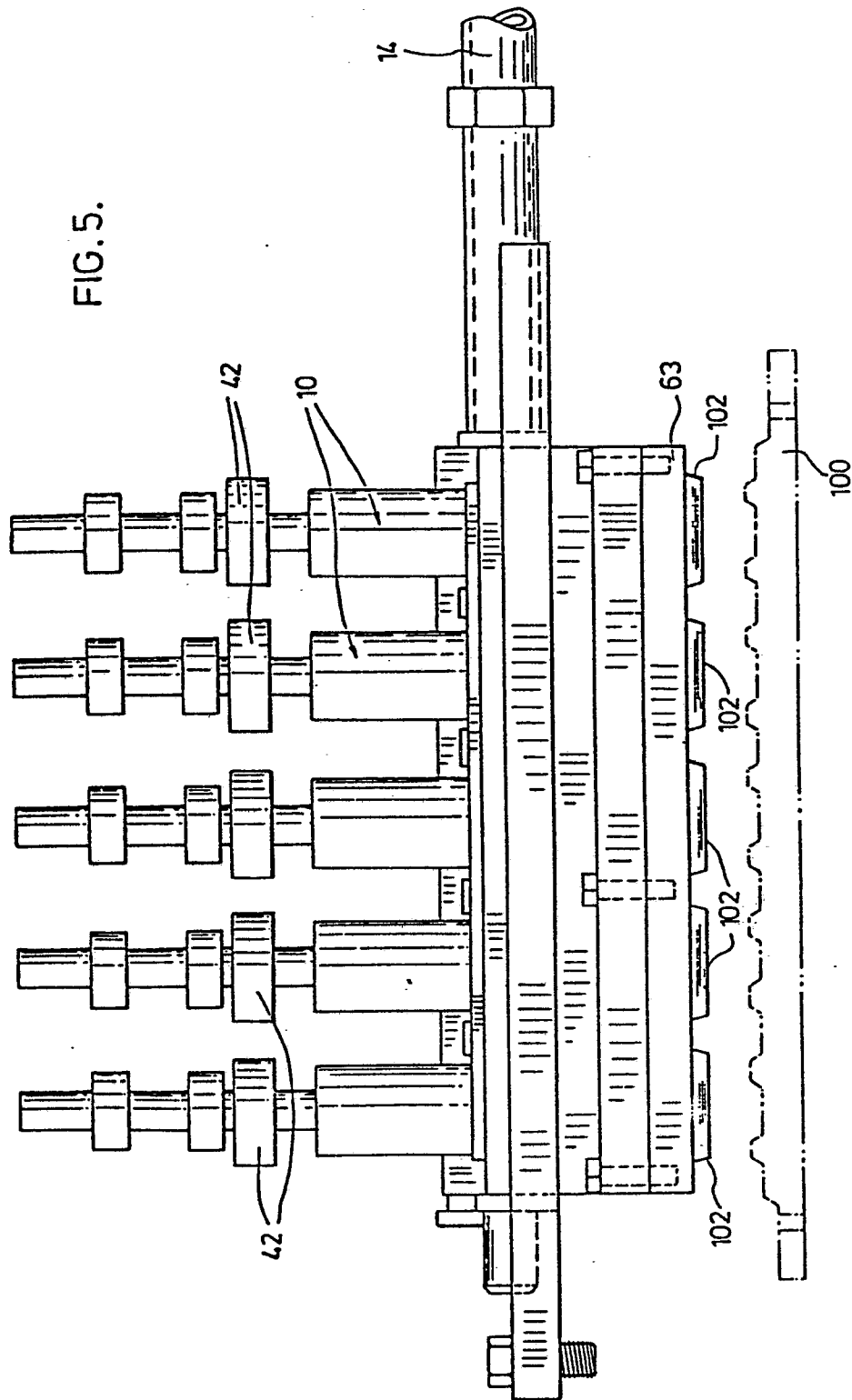


FIG. 5.



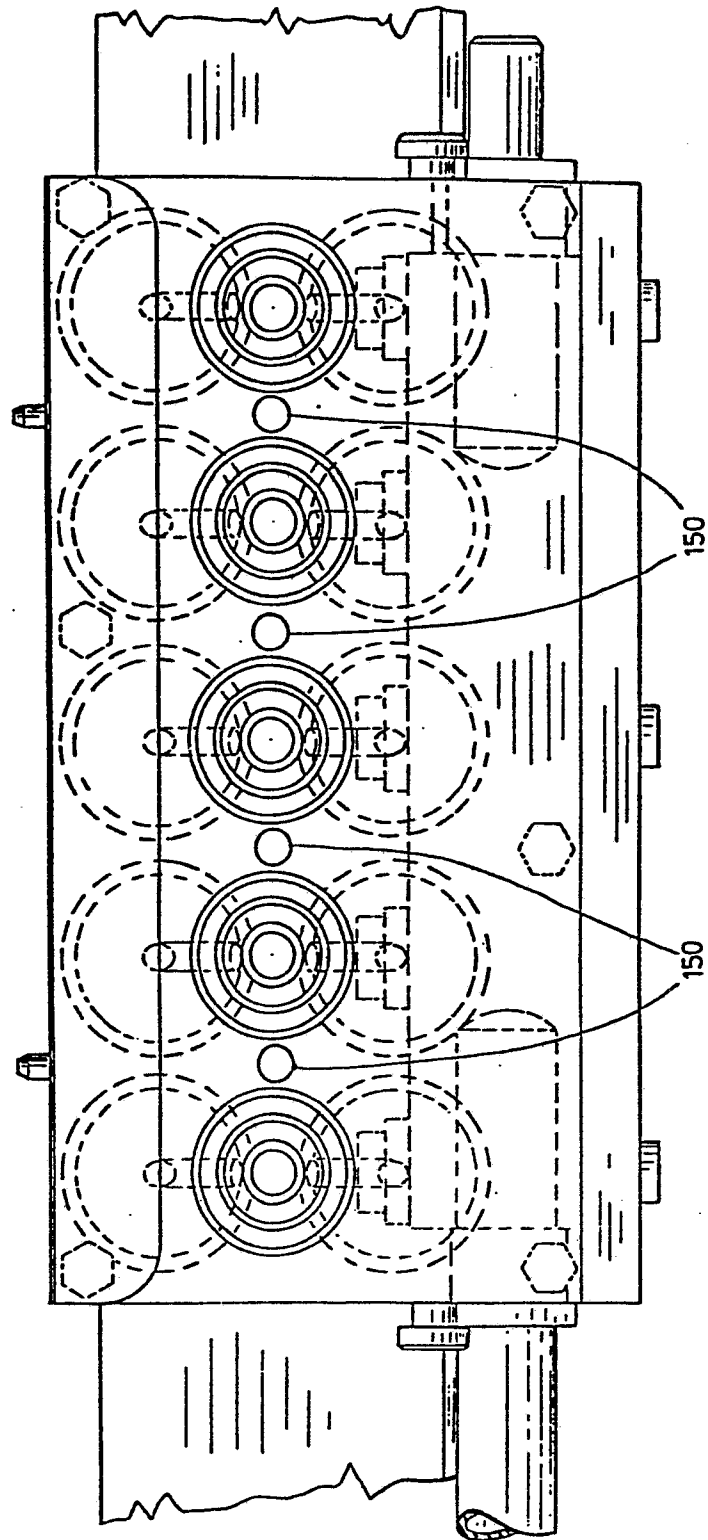


FIG. 6.

