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(72) Inventor: **Nunn, Roy N.
Mold, Flintshire CH7 5QU (GB)**

(74) Representative: **Lyons, Andrew John et al
ROYSTONS,
Tower Building,
Water Street
Liverpool L3 1BA, Merseyside (GB)**

(71) Applicant: **Nu-Image Packaging (Clwyd) Limited
Alyn Bridge Works
Rhydymwyn, Flintshire CH7 5HD (GB)**

(54) **Apparatus for dispensing fluids**

(57) An apparatus (2) for positive and continuous dispensation of fluids, particularly highly viscous or thixotropic materials, the apparatus having an inlet (12) for delivering fluid to a chamber and at least three pumping means, such as pistons (22) which are arranged to act on the fluid in the chamber sequentially whereby at least one pumping means is acting on the fluid in the chamber at any one time thereby causing continuous discharge of fluid from an outlet (38). Two or more apparatuses may be linked together and controlled independently to allow production of two or more component mixtures in definite mixed ratios. The ratios may be varied by simple adjustment of the controls.

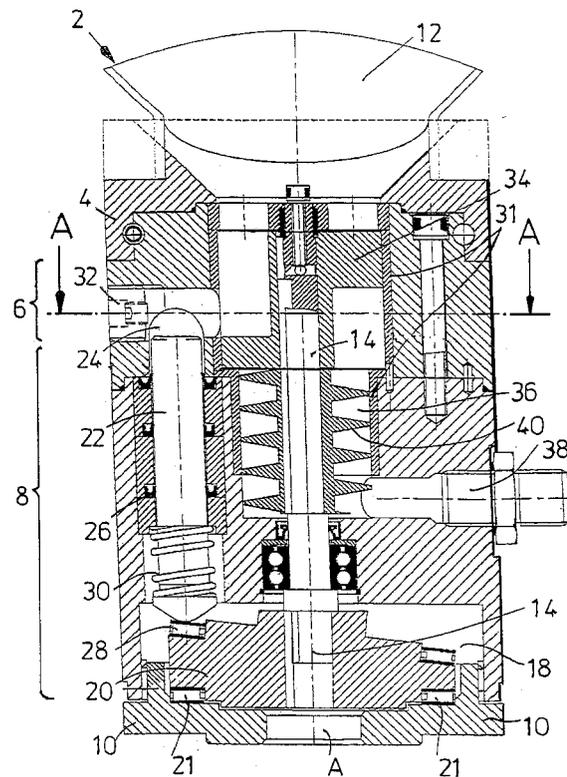


FIG. 1

Description

[0001] The present invention relates to an improved apparatus for dispensing fluids, particularly but not exclusively for dispensing viscous and thixotropic fluids, such as adhesives.

[0002] A variety of pumps are currently in existence for dispensing fluids. Positive displacement systems are particularly suitable for pumping the more viscous, thixotropic materials whereby a piston is employed acting onto the fluid within a pump tube. This piston is typically driven by hydraulic or pneumatic cylinders of determined stroke length. If continuous flow or precise control in the rate of delivery of the fluid is required, positive displacement pumps of this nature may not be suitable.

[0003] Continuous pumping systems also exist, such as gear, vane or peristaltic. The positive aspects of these systems are their ability to accurately dispense lighter industrial fluids and gases and to vary delivery rates by simple control mechanisms. However, these systems become less efficient on viscous and thixotropic fluids.

[0004] As a consequence of these limitations of the dispensing systems currently available, viscous fluids cannot be efficiently introduced to one another on a continuous basis therefore requiring a batch process by addition of fluids to a holding vessel for mixing/blending for further processing.

[0005] A further example is in the application of a two component reactive adhesive. Both resin and hardener have to remain in isolation to one another until the point/time of application. Positive displacement pumps are most widely used in applications such as this but as a consequence of the aforementioned limitations, for example, in continuity of delivery, accuracy and control are not ideal for this purpose. Additionally, mix ratios of the resin and hardener may require alteration as dictated by chemistry, climatic conditions or cure times required and this is not readily achievable with the prior art pumps without major change to the apparatus. This would necessitate a substantial change of parts within the pump system.

[0006] Two component cartridges have been specifically designed for the purpose of positively dispensing adhesives at dedicated mix ratios. Whilst these cartridges are accurate and convenient, a change of capacity and the ability to modify mix ratios are not available without major tooling investment cost.

[0007] It is clear that neither the pumps nor the cartridges are readily adjustable to allow the mix ratio of a two or more component system to be altered to account for daily changes in climatic, viscosity and/or reactivity of the materials.

[0008] It is an object of the present invention to provide an apparatus for dispensing fluids which overcomes the abovementioned drawbacks.

[0009] Accordingly, a first aspect of the present invention provides an apparatus for positive and continuous dispensation of fluids, the apparatus having an inlet for

allowing delivery of fluid to a chamber, an outlet for discharging fluid from the chamber and at least three pumping means arranged to act on the fluid in the chamber sequentially whereby at least one pumping means is acting on the fluid at any one time thereby causing continuous discharge of the fluid from the outlet.

[0010] The positive and continuous dispensing system of the present invention is achieved by linking together a number of elements of both rotary and linear design.

[0011] The pumping means is preferably in the form of a displacement piston. Alternatively or additionally, a screw mechanism may be used. The apparatus is preferably provided with a non-return valve to prevent backflow of the fluid through the inlet.

[0012] In one embodiment of the present invention, each pumping means is in the form of a piston which is arranged to contact an oblique surface which is rotatable about its axis wherein rotation of the surface imparts linear movement to the pistons, for example being mounted on a swash plate. Alternatively, the pistons may be provided on a captive piston wobble plate. Preferably, the pistons are mounted co-axially with a shaft on which the plate is mounted obliquely. The pistons are preferably spaced equidistantly apart. The pistons are sealed within piston chambers which are linked to the inlet and outlet, for example by the provision of porting, such as cross drillings. Rotation of the plate causes movement of the pistons up and down to act sequentially on the fluid in the chambers thereby causing a continuous discharge of the fluid. A rotary non-return valve is preferably provided whereby rotation of the valve allows fluid to be transferred from a piston chamber to the outlet during the upstroke of that piston. Each piston is preferably provided with a spring or captive return and is preferably mounted on a roller bearing.

[0013] In another embodiment of the present invention, sequential linear movement of the pistons may be achieved by radial movement of the pistons which are attached to a carrier within a housing, wherein the displacement between the carrier and the housing varies around the circumference of the carrier to effect linear movement of the pistons. Preferably, the pistons are mounted within a rotary carrier which is rotatable about a cam profile thereby causing the pistons to move inwardly and outwardly in turn to act on the fluid in the chamber. The pistons are preferably located substantially perpendicularly to the longitudinal axis of the apparatus.

[0014] It is to be appreciated that at least three pistons must be provided to achieve a continuous flow of fluid through the apparatus. Preferably, 3 to 7 pistons are provided in the apparatus. The required diameter of the piston, angle of the plate and/or dimensions of the displacement between the carrier and the housing will be determined by the volume and type of material to be dispensed.

[0015] It is preferable to provide an auger to assist in

fluid motion through the apparatus. The auger serves to remove any slight pulsing that may occur between discharge of the fluid from each of the piston chambers.

[0016] Preferably, the components of the apparatus are provided within a housing assembly to enable easy access to the component parts, being secured together by suitable fastening means. It is preferable to provide an attachment for appropriate fluid supply which may be gravity or pressure fed, for example by means of a hopper, hose and/or hydraulic pumping means. Preferably a support plate is provided for supporting and/or mounting of the housing and/or pumping drive system.

[0017] The apparatus is preferably driven by an electric motor, for example being located at the base of the housing. The motor may be powered, for example, by a mains supply or be battery operated. The motor preferably drives rotation of the shaft which effects rotation of the swash plate or rotary housing, non-return valve (if applicable) and auger.

[0018] The rate of rotation of the shaft is preferably controlled by appropriate electronic means. In this manner, the rate of discharge of the fluid from the outlet can be adjusted by altering the output of the motor. Preferably, the electronic means are connected to a controller whereby the output of fluid from the apparatus may be determined.

[0019] The apparatus may be provided in a variety of sizes depending upon the amount of fluid to be dispensed and the intended application of the fluid. For example, the apparatus may comprise a bench-top apparatus or may be small enough to be portable, for example being battery driven, whereby the apparatus may be transported on a trolley, carried on the back of an individual or hand-held.

[0020] It is to be appreciated that the material of the component parts will depend on the fluid to be dispensed through the apparatus. All engineering materials may therefore be regarded as suitable, such as metals, plastics or ceramics.

[0021] Preferably, wear replacement bushes are provided within the apparatus to minimize the cost of replacing worn components.

[0022] According to a second aspect of the present invention there is provided a system for positive and continuous dispensation of two or more fluids, the system comprising two or more apparatus, each apparatus having an inlet for allowing delivery of fluid to a chamber, an outlet for discharging fluid from the chamber and at least three pumping means arranged to act on the fluid in the chamber sequentially whereby at least one pumping means is acting on the fluid at any one time thereby causing continuous discharge of the fluid from the outlet, the action of the pumping means on the fluid being linked to control means whereby the amount of fluid discharged from each apparatus may be controlled.

[0023] Preferably, each apparatus is as hereinbefore described, being linked together by control means, such as a computer. The action of the pumping means in each

apparatus is set to deliver a prescribed flow pattern of the component thereby enabling the dispensing of two or more components of a precise mixed ratio. Each apparatus is preferably closely monitored and adjustable to enable infinitely variable mix ratios to be achieved thereby allowing the mixed ratios of the components to be readily altered according to outside influences without major component change.

[0024] For a better understanding of the present invention and to show more clearly how it may be carried into effect reference will now be made by way of example only to the accompanying drawings in which:-

Figure 1 is a longitudinal cross-sectional diagram of an apparatus for dispensing fluids according to one embodiment of the present invention, showing the non-return valve 90° out of phase;

Figure 2 is a cross-sectional view along line A-A of Figure 1;

Figure 3 is a longitudinal cross-sectional diagram of an apparatus for dispensing fluids according to another embodiment of the present invention, showing the non-return valve 90° out of phase;

Figure 4 is a longitudinal cross-sectional diagram of an apparatus for dispensing fluids according to yet a further embodiment of the present invention;

Figure 5 is a cross-sectional view along line B-B of Figure 4; and

Figure 6 is a schematic diagram of an apparatus for dispensing a two component composition according to the present invention.

[0025] Referring to Figures 1 and 2 of the accompanying drawings, an apparatus 2 for continuously dispensing fluids according to one embodiment of the present invention is illustrated. The components of the apparatus 2 are contained within a housing having a fluid supply fitting 4, a upper pump body 6, a lower pump body 8 supported on a bedplate 10. A gravity feed hopper 12 is attached to the top of the upper pump body by a conventional quick release fastening mechanism, to allow source material to be supplied to the apparatus.

[0026] The apparatus 2 is driven by a motor which is located at position A and drives a rotating shaft 14 which extends through the centre of the housing. The lower pump body 8 has a cavity 18 for housing a swash plate 20 which is located to the bedplate 10. The swash plate is mounted on needle roller bearings 21 to minimize frictional losses and support potentially high compressive loads/back pressure.

[0027] The swash plate is provided with an odd number of pistons 22 extending upwardly therefrom in the lower pump body. In the illustrated example, five pistons are provided but three or more pistons may be used. The pistons are radially spaced equidistantly apart around the axis of the swash plate and are each sealed within a piston chamber 24 having shaft seals 26 to prevent seepage of material into the lower base sec-

tion and to prevent ingress of air into the material chamber. Each piston is mounted on an axial needle roller bearing 28 and the lower section of each piston is provided with return springs 30.

[0028] The piston chambers 24 terminate in the upper body 6 of the housing and are provided with bleed ports 32. Rotary non-return valve 34 and cross drillings are also provided in the upper body 6 for linking the piston chambers 24 with the outlet chamber 36 and outlet port 38, thereby enabling fluid to pass from source to the pistons and from the pistons to the point of delivery, via a non-return valve. Additionally, the lower body 8 is provided with an auger screw 40. The swash plate, non-return valve and auger are rotated by means of the common drive shaft 14 which is driven by to the motor (not shown).

[0029] In operation, liquid material such as an adhesive is fed into the hopper 12 and flows by means of gravity and scavenge into the piston chamber 24. Activation of the motor causes rotation of the swash plate, auger and rotary valve by means of the common drive shaft, the rate of rotation of the shaft being controlled by suitable electronic means. Rotation of the swash plate results in continuous linear movement of the pistons up and down in sequence, the consequence of which is a continuous dispensing of material from the apparatus as explained below.

[0030] Each piston is displaced in turn by means of the inclined rotating disc of the swash plate which imparts reciprocating motion to the piston thereby forcing fluid which has entered the piston chamber under the influence of gravity to pass into the outlet chamber via the rotary non-return valve. On the return stroke of each piston (ie., downstroke), achieved by means of the spring return of the piston, material is able to flow from the hopper into the piston chamber. The apparatus is controlled such that correct phasing of the displacement pistons with the non-return valve is achieved to ensure positive scavenge and delivery. The swash plate enables the five pistons to move up and down sequentially thereby providing continuous flow of the material into the outlet chamber and out of the outlet port. The phased movement of the pistons sets up a periodically recurring sequence of movement of the pistons wherein, at any point in time, at least one piston will be delivering fluid to the outlet thereby effecting continuous flow.

[0031] The provision of the auger screw in the outlet chamber enhances the continuous flow of the material by removing any slight pulsing that may occur between the discharging of the material from each of the piston chambers into the outlet chamber. The provision of the auger is particularly beneficial for the dispensing of viscous materials where regular flow is important.

[0032] Figure 3 of the accompanying drawings illustrates an alternative embodiment of an apparatus for dispensing fluids according to the present invention. Identical features already discussed in relation to Figure 1 are given the same reference numerals and only the

differences will be discussed in detail. The rotary non-return valve 34 is shown 90° out of phase to demonstrate its operation. The swash plate of the apparatus shown in Figure 1 is replaced with a captive piston drive plate 50 supported between two axial needle roller bearings 52. The pistons 22 are attached to the drive plate by means of a cap return 54. This arrangement ensures positive linear movement of the pistons 22 in both directions thereby enabling accurate and unhindered movement of the piston within the piston chamber.

[0033] Figures 4 and 5 of the accompanying drawings illustrate a further embodiment of the present invention. The pumping means for effecting a continuous flow of fluid from the apparatus is achieved by the provision of five pistons 62 located in a rotary housing 64 which is rotatable about a cam 66 provided in the body of the apparatus. The pistons lie substantially perpendicularly to the longitudinal axis of the apparatus. The pistons are rotated about the axis of the cam by means of a motor or gear driven shaft 68 which causes the pistons to move inwardly and outwardly in turn thereby acting on the fluid in the piston chambers 70 to ensure positive scavenge and delivery. The recurring sequence of operation of the pistons results in a continuous flow of fluid through the outlet 72. A static non-return valve 74 is provided to prevent backflow of the fluid entering the apparatus and an auger 76 is provided to enhance the continuous flow of the fluid.

[0034] It is to be appreciated that at least three pistons should be provided in the apparatus of the present invention to provide a continuous means for dispensing fluids. Any number of pistons above this amount may be utilized but preferably 3 to 7 pistons are used.

[0035] The motor of the apparatus is preferably monitored by encoders to allow the rate of flow of material to be controlled via a computer. The rate of rotation of the shaft will determine the flow of material through the apparatus. Thus, the amount of material dispensed by the apparatus can be altered simply by adjusting the rate of movement of the pistons by altering the rate of rotation of the shaft by means of reducing or increasing the output of the motor. In this manner, the present invention provides means for continuous dispensation of material in variable amounts.

[0036] Additionally, the apparatus may be provided with clearance between the sliding parts of the apparatus to reduce the amount of wear and tear which occurs as a result of the moving parts of the apparatus. The apparatus may also be provided with wear replacement bushes (identified by the numeral 31 in Figures 1 and 3) to minimize the cost of consumable items. The component parts of the apparatus are secured by conventional methods of fixing.

[0037] The apparatus of the present invention may also be used to provide compositions of two or more components which have to be provided in specified mixed ratios but wherein the ratios may need to be altered depending upon, for example, the ambient temperature or

the intended application of the mixture. Figure 6 of the accompanying drawings illustrates an apparatus for continuously dispensing a two-component mixed ratio composition. The apparatus consists of two dispensing apparatus 200, 400 of the present invention as hereinbefore described which are placed adjacent to each other and controlled to dispense the separate components in specified amounts. For example, Figure 6 illustrates a system for dispensing components B and C. Apparatus 200 for dispensing component B may be set at a higher rate of pumping than apparatus 400 which dispenses component C such that the resultant mixture contains a higher level of component B than component C. The rate of dispensation of the components may be maintained and controlled by electronic means 600 which is linked to both apparatuses but which allows separate control of the motors 500 of each apparatus thereby enabling different ratios of the components to be produced simply by adjusting the controls of the system. It is to be appreciated that this system could be extended to mixtures having more than two components by the provision of a corresponding number of dispensing machines.

[0038] Material may be fed into the apparatus by gravity or alternative means may be used, for example a hydraulic transfer mechanism to assist the material into the piston chamber. This may be desirable for example, if the material is particularly viscous. Conventional means, such as a foot switch, may be employed to commence the flow of material through the apparatus.

[0039] The apparatus may be provided in a variety of sizes depending upon application and fluids to be dispensed. For example, the apparatus may be free-standing, mounted on a bench or trolley, provided within a backpack or hand-held. The apparatus may also be provided in a variety of materials depending upon application, fluid types and environment. Suitable materials may include, for example, metals, plastics and ceramics, sometimes in combination. Two or more pumps may be placed within a backpack for feeding two or more fluids via hoses to the hand of the user. Controls may be provided to vary the flow of each fluid through the apparatus and thereby allow the mixed ratio of the components to be varied by simple adjustment of the controls.

[0040] The apparatus of the present invention allows fluids of one, two or more components to be continuously dispensed. The apparatus also allows the amount of fluid discharged to be varied by altering the rate of flow of the material through and from the apparatus by simply adjusting the rate of movement of the pistons by altering the rate of rotation of the shaft. Previously, the existing dispensing systems would have had to have been disassembled to adapt the system for the dispensation of a different amount of material. The ability to use two or more systems in combination with each other allows variable mixed ratios of two or more components to be achieved accurately on a continuous basis.

Claims

1. An apparatus (2) for positive and continuous dispensation of fluids, the apparatus having an inlet (12) for allowing delivery of fluid to a chamber and an outlet (38) for discharging fluid from the chamber **characterized in that** the apparatus has at least three pumping means (22) arranged to act on the fluid in the chamber sequentially whereby at least one pumping means is acting on the fluid at any one time thereby causing continuous discharge of the fluid from the outlet.
2. An apparatus as claimed in claim 1, wherein each pumping means is in the form of a positive displacement piston (22) sealed within a piston chamber which is linked by appropriate porting to the inlet (12) and outlet (38).
3. An apparatus as claimed in claim 1 or claim 2, wherein a non-return valve (34) is provided to prevent backflow of the fluid through the inlet (12).
4. An apparatus as claimed in claim 2 or 3, wherein each piston is arranged to contact an oblique surface which is rotatable about its axis whereby rotation of the surface imparts linear movement to the pistons.
5. An apparatus as claimed in claim 4, wherein the oblique surface is provided by a swash plate (20).
6. An apparatus as claimed in claim 4, wherein the oblique surface is provided by a captive piston wobble plate (50).
7. An apparatus as claimed in claim 4, 5 or 6, wherein the pistons (22) are mounted co-axially with a shaft (14) on which the plate is mounted.
8. An apparatus as claimed in any one of claims 2 to 7, wherein each piston is provided with a spring or captive return (54).
9. An apparatus as claimed in any one of claims 4 to 8, wherein a rotary non-return valve (34) is provided to allow fluid to be transferred from the piston chamber (24) during the upstroke of that piston.
10. An apparatus as claimed in claim 1, 2 or 3, wherein the pistons (62) are attached to a carrier within a housing, the displacement between the carrier and the housing varying around the circumference of the carrier whereby radial movement of the pistons within the housing causes linear movement of the pistons to act sequentially on the fluid in the chamber (70).

11. An apparatus as claimed in claim 10, wherein the pistons are mounted within a rotary carrier (64) which is rotatable about a cam profile (66).
12. An apparatus as claimed in any one of the preceding claims, wherein 3 to 7 pumping means are provided to act on the fluid. 5
13. An apparatus as claimed in any one of the preceding claims further comprising an auger (40) to assist in fluid motion through the apparatus. 10
14. An apparatus as claimed in any one of the preceding claims wherein the component parts are provided within a housing assembly having an attachment (4) for appropriate fluid supply to the inlet. 15
15. An apparatus as claimed in any one of the preceding claims, wherein the apparatus is motor driven. 20
16. An apparatus as claimed in claim 15, wherein movement of the pumping means is controlled by appropriate electronic means whereby the rate of flow of fluid through the apparatus may be adjusted by alteration of the output of the motor. 25
17. A system for positive and continuous dispensation of two or more fluids, the system comprising two or more apparatus (200, 400), each apparatus being as claimed in any one of claims 1 to 16, the action of the pumping means on the fluid in each apparatus being linked to control means whereby the amount of fluid discharged from each apparatus may be controlled. 30

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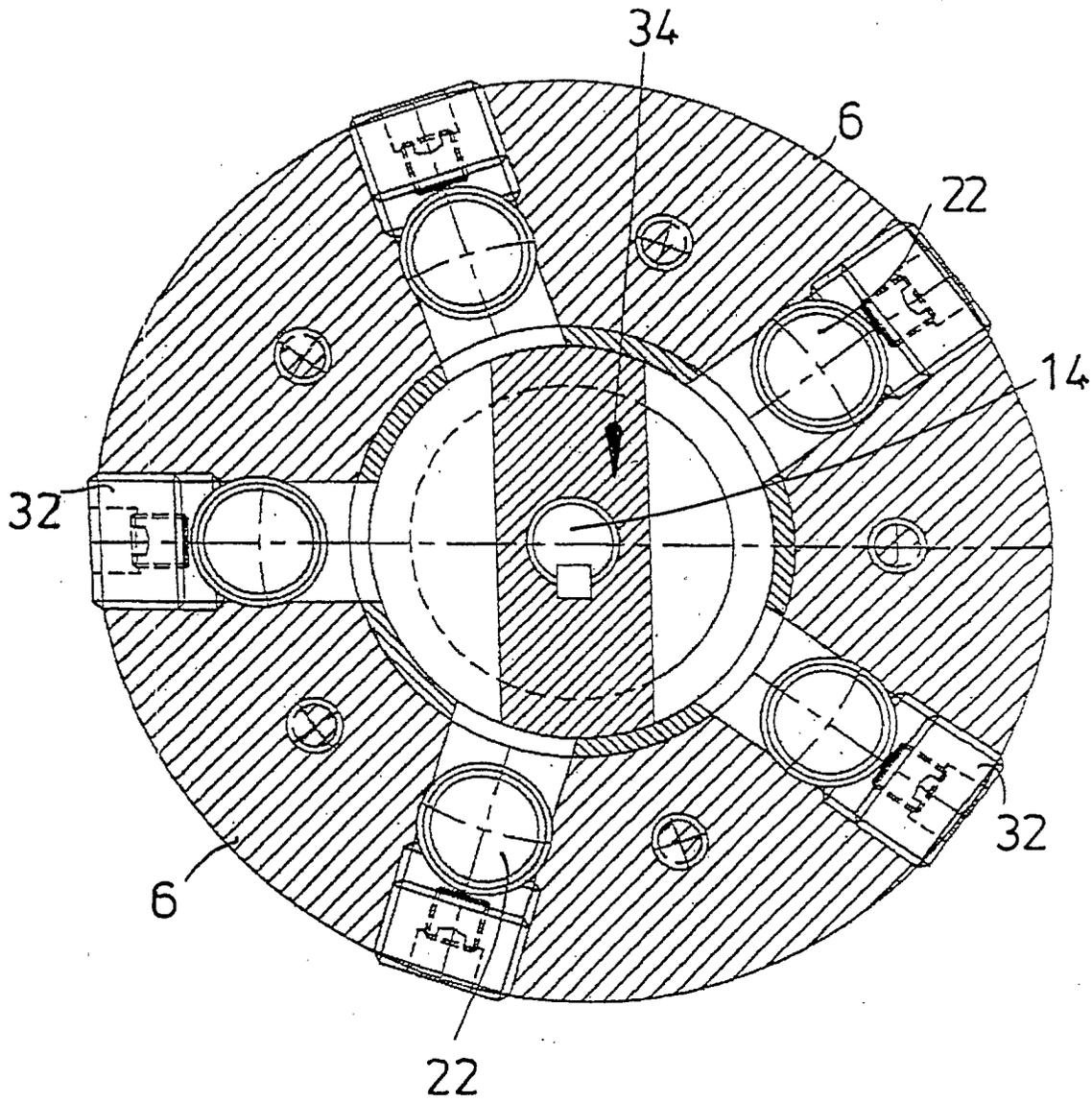


FIG. 2

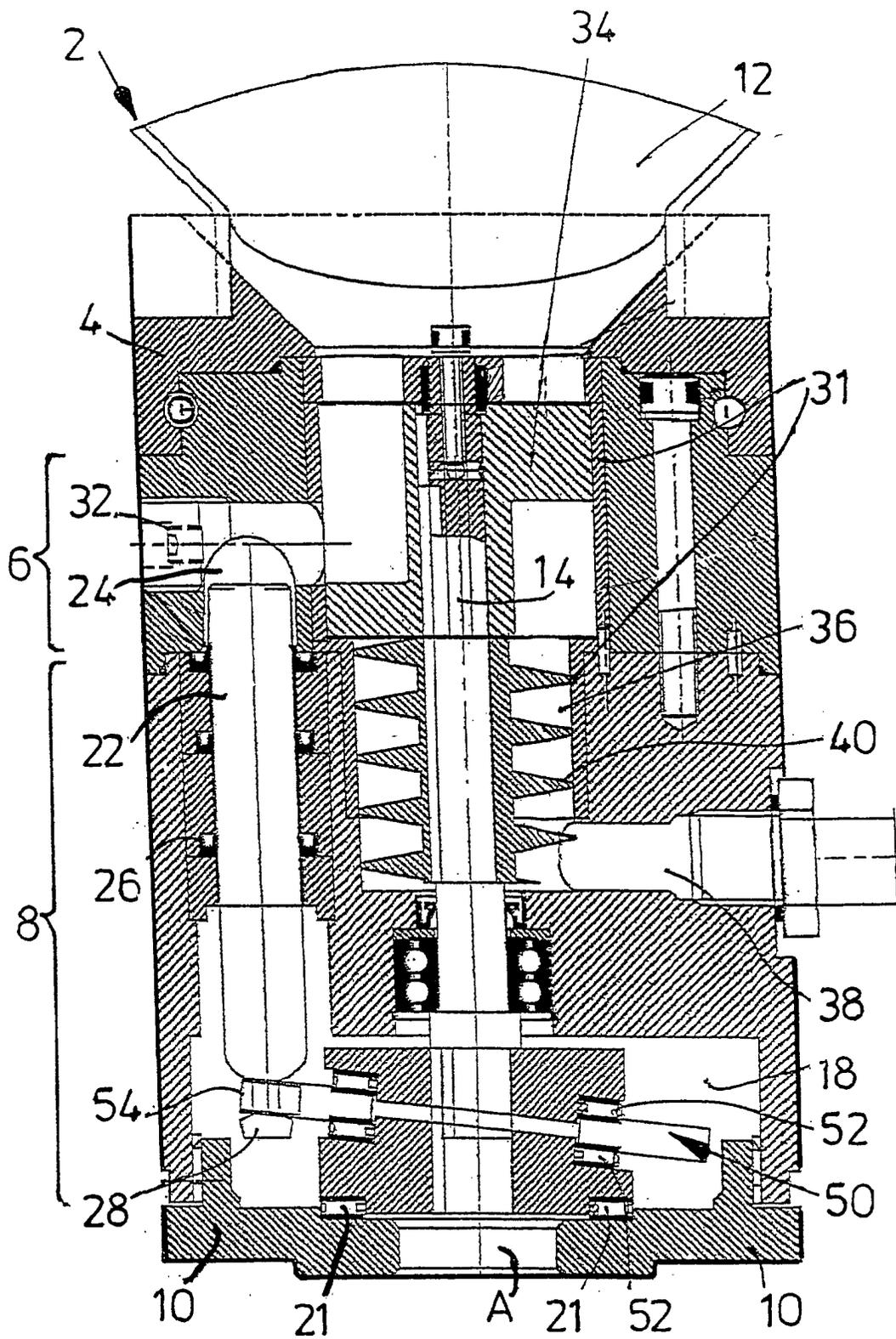


FIG. 3

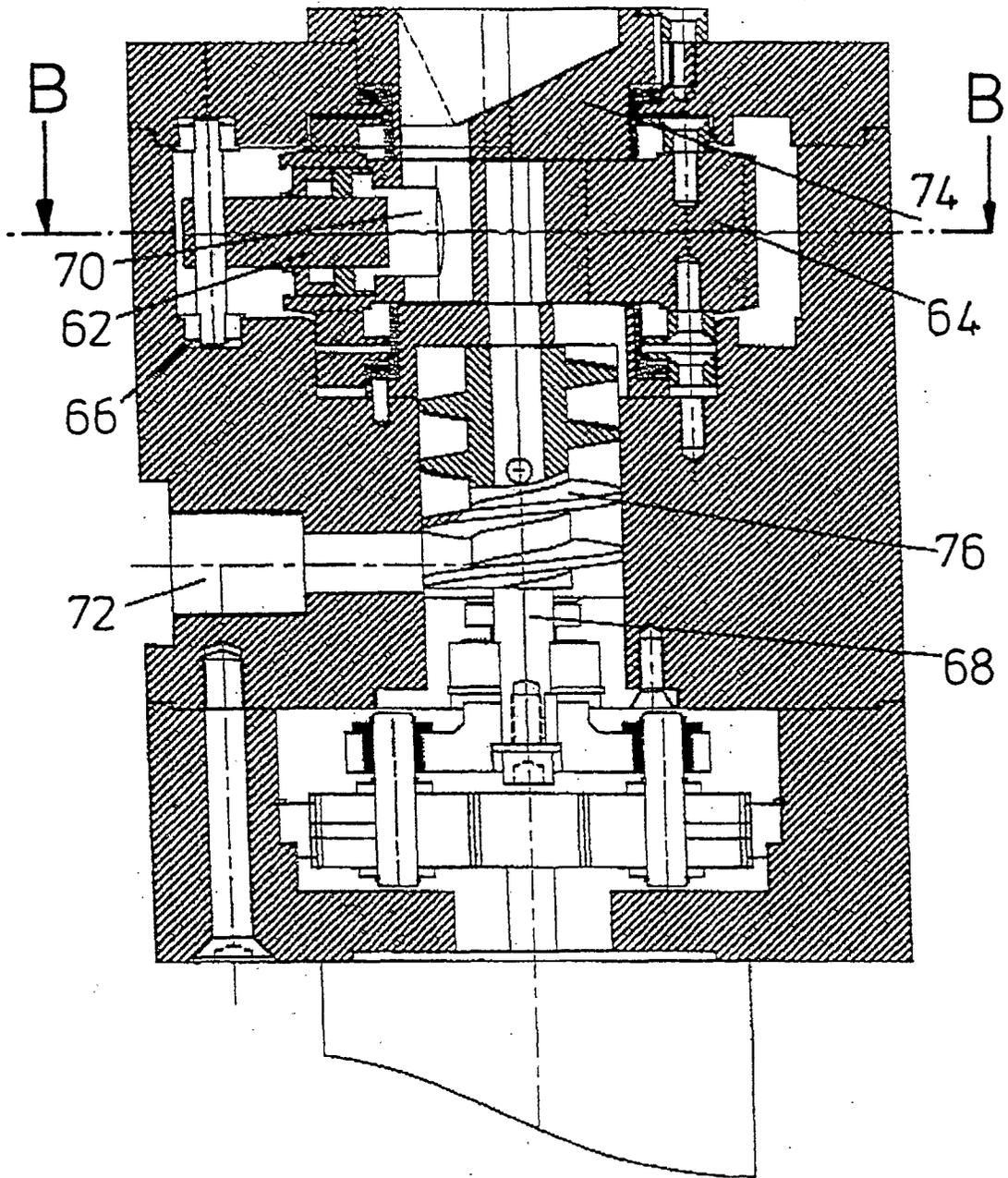


FIG. 4

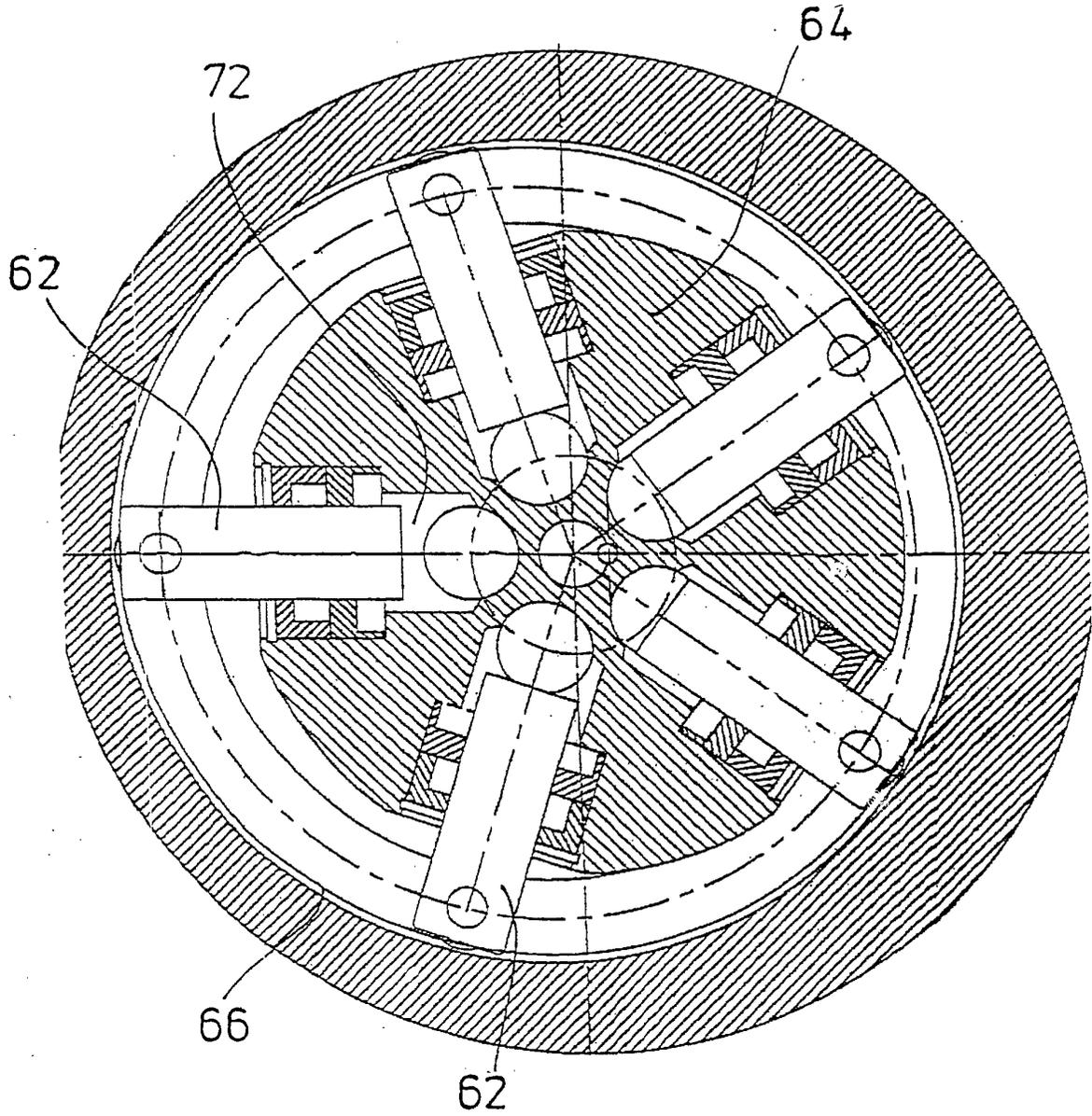


FIG. 5

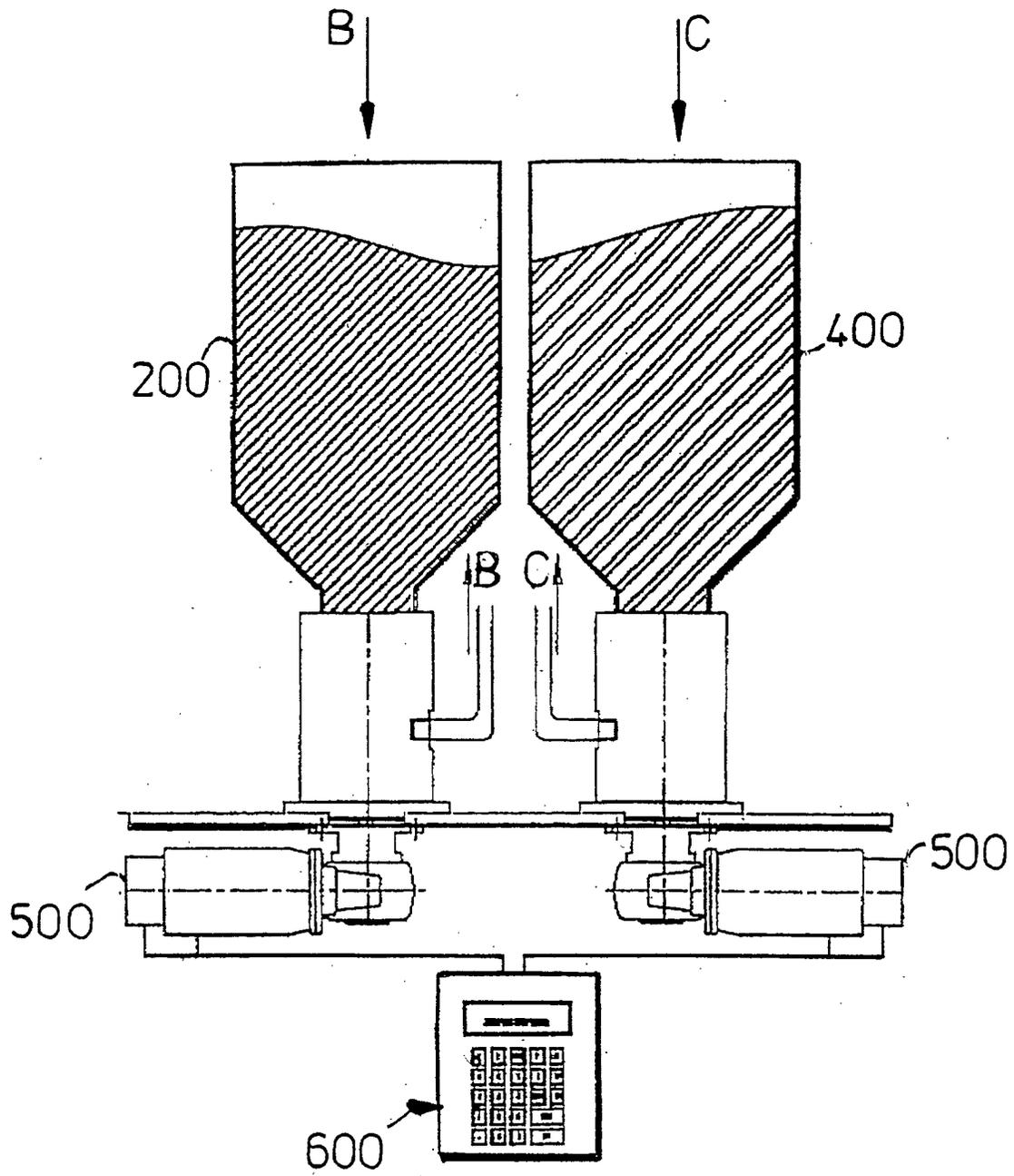


FIG. 6



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 8441

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