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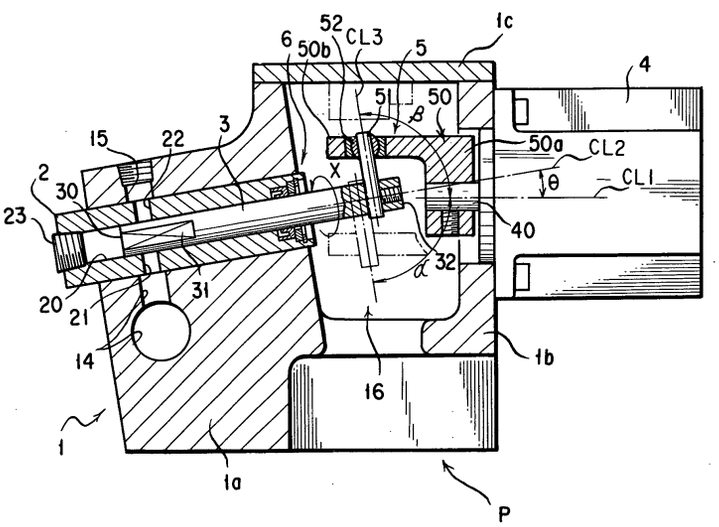
(54) **Leakproof pump for use in an inking mechanism of a rotary printing press**

(57) A pump capable of metering a fluid such as ink to an offset printing press, comprising a pump body (1), with or without a cylinder (2), defining a bore (10 or 20) which is pressure-tightly closed at a first end thereof, a piston (3) slidably received in the bore for both rotation and linear reciprocation and having one end projecting from a second end of the bore, the piston being capable of blocking both suction port and discharge port and alternately placing the same in communication with the bore during each complete revolution thereof, a drive motor (4) mounted to the pump body (1) and having a drive shaft (40) rotatable about an axis (CL_1) intersecting the axis (CL_2) of rotation of the piston at a prescribed angle (θ), and a drive linkage (50, 51 and 52)) connecting the drive shaft of the drive motor to the piston so as to cause joint rotation and linear reciprocation of the latter in response to the rotation of the former. The second end of the bore (10 or 20) is sealed by an end seal (6, 6*a* or 6*b*) against the leakage of the printing ink from between the pump body (1) or cylinder (2) and the piston (3).

FIG. 2



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Description

BACKGROUND OF THE INVENTION

Filed of the Invention

[0001] This invention relates generally to pumps and particularly to a pump that is best suited for use in inking mechanisms of rotary printing presses as typified by those of the offset lithographic variety. More particularly, the invention pertains to a pump of the kind having a motor-driven piston that concurrently undergoes linear, relatively short-stroke reciprocation and rotation for metering ink toward the plate cylinder of the press.

Description of the Invention

[0002] Out of a variety of inking pumps heretofore suggested and used with offset printing presses, the one disclosed in Japanese Patent No. 2,864,447 is hereby cited as bearing particular pertinence to the present invention. It has a piston slidably mounted in a cylinder for combined rotation and linear reciprocation relative to the same. The cylinder has an ink suction port and an ink discharge port formed in diametrically opposite positions thereon. The piston has a recess cut in its surface along a chordal plane, the recess being of such depth that the piston closes both suction and discharge ports twice during each complete revolution thereof and alternately places these ports in communication with the cylinder bore in the other phases of revolution.

[0003] One end of the cylinder is pressure-tightly closed, and the piston projects through the other end of the cylinder for connection to a variable speed drive motor via a drive linkage including a crank. The axis of the drive motor is at an angle to that of the cylinder, and the drive linkage connects the motor output shaft to the piston in such a manner that the piston not only rotates but reciprocates linearly in response to the rotation of the drive motor.

[0004] Such being the construction of the prior art inking pump, the piston makes one complete revolution and one complete reciprocation with each complete revolution of the drive motor. The piston blocks both suction and discharge ports in dead-center positions at both extremities of its linear travel and places the cylinder bore in communication with the suction port during its travel in one direction and in communication with the discharge port during its travel in the other direction. Thus the piston completes one suction stroke and one delivery stroke during each complete revolution thereof, supplying the ink toward the plate cylinder by well metered quantities.

[0005] Serious inconveniences have been experienced with this known type of inking piston pump. The inconveniences arose from the fact that, although pressure-tightly closed at one end, as by a plug screw-threadedly engaged therein, the cylinder is open at the other end except for the sliding fit of the piston, it being necessary for the piston to project out of this other end of the cylinder for connection to the drive linkage. The ink within the cylinder is highly pressurized by the piston on its delivery stroke, and the ink drops in viscosity as the drive motor heats up by excitation. These reasons have combined to make unavoidable the leakage of the ink from between the cylinder and the piston in the prior art inking pumps of this kind, necessitating frequent cleaning.

[0006] Ink leakage could of course be lessened through reduction of the difference between piston diameter and cylinder bore diameter to a minimum. This solution is unsatisfactory, however, because the resulting close fit of the piston and cylinder necessitated the hardening of their contacting surfaces as by electroless nickel plating. These hardened surfaces were, moreover, incapable of thoroughly resisting abrasion by the solid matter, as of pigments, contained in the printing ink, resulting in gradual increase in their dimensional difference and, in consequence, in the rate of ink leakage.

[0007] Thus the leakage of ink from this type of pump was more or less taken for granted. Actually, the pump was so constructed that its leaking end was open to the floor, for ease of collecting the leaking ink. The trouble was that most of the leaking ink did not drop down but flowed over the drive linkage toward drive motor, eventually intruding into the interior of the motor through its shaft bearing. The resulting motor trouble made the pump, and sometimes the complete press, inoperable.

[0008] Another trouble was that, left sticking to the pump while it was out of operation, the leaking ink was easy to coagulate by exposure to the air. The ink clot offered considerable resistance to the required rotation and linear motion of the piston and so prevented the pump from restarting smoothly.

[0009] The noted conventional attempt at avoidance of ink leakage through reduction of the dimensional difference between piston and cylinder is objectionable for some additional reasons. The electroless nickel plating of their contacting surfaces is expensive. Also expensive and time-consuming is the machining of the piston and cylinder to very close dimensional tolerances for their sliding fit with a minimum of dimensional difference. All in all the manufacturing cost of the inking pump was unnecessarily high.

SUMMARY OF THE INVENTION

[0010] It is a primary object of this invention to make the pump of the kind defined, free from leakage without necessarily reducing the dimensional difference between piston and cylinder, and hence to make the pump free from trouble due to leakage, easier of maintenance, and less expensive of manufacture.

[0011] Another object of the invention is to make the most of the preexisting parts of the pump in making the same leakproof.

[0012] Still another object of the invention is to seal the pump against leakage in a manner permitting easy mounting, dismounting, and maintenancing of the sealing means.

[0013] Briefly, the present invention may be summarized as a pump capable of metering a fluid such as printing ink, comprising pump body means defining a bore which is pressure-tightly closed at a first end thereof, together with a suction port and a discharge port which are both open to the bore in preassigned different angular positions thereon. Slidably received in the bore in the pump body means, a piston has one end projecting from a second end of the bore for connection to a drive motor via a drive linkage such that the piston undergoes joint rotation and linear reciprocation in response to motor rotation. Also included is an end seal means sealing the second end of the bore against the leakage of the fluid from between the pump body means and the piston.

[0014] In one embodiment of the invention the bore is defined by a cylinder, or cylindrical vessel, mounted fast to a pump body, and the end seal means comprises a sealing ring received in a bore enlargement formed in the cylinder at the second end of the bore, and a retainer ring engaged in the bore enlargement for retaining the sealing ring in fluid-tight contact with both the piston and the cylinder. In another embodiment the end seal means comprises a sealing ring surrounding the piston and held against the end of the cylinder, and a mounting ring screw-threadedly engaged with the cylinder for retaining the sealing ring in position. In still another embodiment the bore is defined directly in the pump body, and the end seal means comprises a sealing ring surrounding the piston and held against the pump body, and a mounting ring surrounding the piston and fastened to the pump body for retaining the sealing ring in position.

[0015] In all these embodiments the sealing ring has a pair of annular, concentric lips formed thereon. The lipped sealing rings are sufficiently elastic radially thereof that the piston and pump body, or piston and cylinder, need not be machined to no such stringent dimensional tolerances as have been required heretofore. The dimensional difference between the two mating parts can be greater, either at the time of manufacture or as a result of wear in use, without the fear of leakage.

[0016] The above and other objects, features and advantages of this invention will become more apparent, and the invention itself will best be understood, from a study of the following description and appended claims, with reference had to the attached drawings showing the preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a plan view of a typical inking pump arrangement for an offset printing press, comprising eight pump units each constructed according to the novel concepts of the invention;

FIG. 2 is an enlarged vertical section taken along the line II-II in **FIG. 1** and showing the construction of each pump unit in detail;

FIG. 3 is a still more enlarged, fragmentary vertical section through the **FIG. 2** pump unit, showing in particular the sealing means according to the invention;

FIG. 4 is a view similar to **FIG. 2** but showing an alternative embodiment of the invention;

FIG. 5 is a view similar to **FIG. 3** but showing the sealing means of the **FIG. 4** embodiment;

FIG. 6 is a view similar to **FIG. 2** but showing another alternative embodiment of the invention; and

FIG. 7 is a view similar to **FIG. 3** but showing the sealing means of the **FIG. 6** embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] The present invention is believed to be best applicable to the inking mechanism of an offset printing press. In ***FIG. 1,*** therefore, is shown a typical inking pump arrangement *A* for an offset printing press. The pump arrangement *A* incorporates any required number of, eight shown by way of example, pump units *P* of like design which are arranged side by side in a transverse direction of the web of paper, not shown, traveling along a predefined path in the press. This invention particularly concerns the construction of each pump unit *P.* Since all the pump units *P* are alike in construction, only one of them will be described in detail with reference to **FIGS. 2** and **3, FIG. 2** being taken along the line II-II in **FIG. 1,** with the understanding that the same description applies to all the other pump units.

[0019] Referring more specifically to **FIG. 2,** the representative pump unit *P* has a pump body 1 which is common to all the individual pump units. The pump body 1 is a one-piece construction of a relatively thick front part 1*a*, shown directed to the left, and a thin rear part 1*b*, which are opposed to each other across a hollow 16. The front part 1*a* of the pump body 1 will be hereinafter referred to as the front body part, and the rear part 1*b* as the rear body part. A cover plate 1*c*, which also is common to all the pump units *P*, openably closes the top of the hollow 16.

[0020] Immovably mounted to, and extending through, the front body part 1*a* is a hollow, angled cylinder, or cylindrical vessel, 2 defining a bore 20. A piston 3 is slidably but pressure-tightly mounted in the bore 20 for both rectilinear reciprocation and angular motion. One end of the bore 20 is pressure-tightly closed by a plug 23 whereas the other end thereof is open to permit the piston 3 to project into the hollow 16. The piston end thus projecting into the hollow 16 is operatively coupled, in a manner yet to be detailed, to a variable speed drive motor 4 which is mounted fast to the rear body part 1*b*.

[0021] The cylinder 2 has an ink suction port 21 and an ink discharge port 22 formed in diametrically opposite positions and in axial alignment with each other for the ingress and egress, respectively, of ink into and out of the cylinder bore 20. The suction port 21 communicates with an ink reservoir, not shown, via a system of conduits 14, and the discharge port 22 with the familiar ink rail, not shown, of the press via another system of conduits 15. The piston 3 has a recess 31 extending rearwardly from its front end 30 to a relatively short extent. The recess 31 is of such depth (i.e. dimension radially of the piston) that the piston 3 is capable of opening only either of the suction port 21 and discharge port 22 to the cylinder bore 20 at one time. The suction port 21 and discharge port 22 are therefore alternately placed in communication with the cylinder bore 20 at each half revolution of the piston 3, and both out of communication therewith in the other angular positions of the piston.

[0022] Mounted as aforesaid to the rear body part 1*b*, the drive motor 4 has a drive shaft 40 projecting into the hollow 16. The drive motor 4 is so angled in relation to the cylinder 2 that the axis CL_1 of the drive shaft 40 crosses the axis CL_2 of the piston 3 at an angle θ. A preferred example of the drive motor 4 is a known stepper motor capable of rotation by discrete increments in response to stepping pulses. It is also preferred that the drive motor 4 be so controlled as to rotate through a prescribed angle of, say, forty-five degrees in response to each series of stepping pulses, standing still pending the arrival of the next series of such pulses.

[0023] The reference numeral 5 generally denotes a drive linkage connecting the drive shaft 40 to the piston 3 so as to cause both rotation and linear reciprocation of the piston in response to the rotation of the drive shaft. The drive linkage 5 comprises an overhung crank 50 mounted fast to the drive shaft 40 for joint rotation therewith, and a connecting pin 51 connecting the crank to the piston 3. The crank 50 is composed of a crank base portion 50*a* proximally fastened to the drive shaft 40, and a crank arm 50*b* extending forwardly from the distal end of the crank base portion in parallel relationship to the drive shaft and, in consequence, nonparallel relationship to the piston 3. Thus, as indicated in phantom outline in **FIG. 2,** the crank arm 50*b* revolves around the exposed rear end portion of the piston 3 with the incremental rotation of the drive shaft 40.

[0024] The connecting pin 51 of the drive linkage 5 is fastened at one end to the piston 3, with the axis CL_3 of the pin crossing the axis CL_2 of the piston at a prescribed angle which is ninety degrees in this particular embodiment. The other end of the connecting pin 51 slidably extends through a spherical bearing 52 mounted to the crank arm 50*b.* The spherical bearing 52 permits variation in the angular attitude of the connecting pin 51 relative to the crank arm 50*b* with the rotation of the drive motor 4, with the consequent combined rotation and linear reciprocation of the piston in response to the rotation of the crank arm.

[0025] Although the axis CL_3 of the connecting pin 51 is at the constant angle to the axis CL_2 of the piston 3, the angle between connecting pin axis CL_3 and drive shaft axis CL_1 is subject to change with motor rotation. The angular position of the recess 31 on the piston 3 must be predetermined in relation to the angular relationship between the axes CL_1 and CL_3. To be more specific, when the piston 3 is blocking both suction port 21 and discharge port 22 as depicted in **FIG. 2,** the angle between drive shaft axis CL_1 and connecting pin axis CL_3 maximizes at β at the end of the suction stroke of the piston 3 and minimizes at α at the end of the discharge stroke of the piston.

[0026] The piston 3 makes one complete revolution and one complete reciprocation with each complete revolution of the drive motor 4. The recess 30 is so angularly positioned on the piston 3 that both suction port 21 and discharge port 22 are closed when the piston is in dead-center positions at both extremities of its stroke. Further the piston 3 places the suction port 21 in communication with the cylinder bore 20 during its suction stroke, which is to the right as viewed in **FIG. 2,** and places the discharge port 22 in communication with the cylinder bore 20 during its discharge stroke.

[0027] As illustrated on an enlarged scale in **FIG. 3,** a cylinder end seal 6 is provided at the rear end of the cylinder 2 in order to prevent leakage of the ink from between the cylinder and the piston 3. As indicated at 20*a* in this figure, the cylinder bore 20 is enlarged at its end open to the hollow 16, **FIG. 2,** in the pump body 1. A sealing ring 71, complete with a pair of annular lips 74, is snugly received in this cylinder bore enlargement 20*a* so as to concentrically surround the piston 3. Both formed on one side surface of the sealing ring 71, the annular lips 74 are spaced from each other radially of the sealing ring. A wear-resisting synthetic rubber is a preferred material of the sealing ring 71 complete with the lips 74.

[0028] The sealing ring 71 is positively retained in position in the cylinder bore enlargement 20*a* by a retainer ring 73 via a washer 72. Both washer 72 and retainer ring 73 are shown engaged in the cylinder bore enlargement 20*a*. The sealing ring 71 makes fluid-tight contact with the surfaces of the cylinder 2 and piston 3. The annular lips 74 of the sealing ring 71 extend therefrom in a direction away from the exposed rear end of the piston 3 in order to even more effectively oppose ink flow in the leaking direction.

[0029] It will be appreciated that the cylinder end seal 6 of this particular embodiment is compactly mounted in the enlargement 20*a* of the cylinder bore 20. This sealing design is intended for the ease with which the prior art ink pumps of this type may be reconstructed for freedom from ink leakage, all that is required to attain this objective according to the teachings of the instant invention being the modification of the internal configuration of the cylinder 2 and the provision of the sealing ring 71, washer 72 and retainer ring 73.

Operation

[0030] The cylinder bore 20 is conventionally pressure-tightly closed at its front end by the plug 23 but is open at its rear end, permitting the piston 13 to project into the hollow 16 in the pump body 1 for coupling to the drive motor shaft 40. The present invention specifically concerns how to most effectively and economically seal the rear end of the bore 20 against the leakage of the printing ink.

[0031] The rotation of the drive motor 4 will be transmitted by the drive linkage 5 to the piston 3, causing the latter to rotate as indicated by the arrow *X* in **FIG. 2.** The piston 3 will make one complete revolution with each complete revolution of the drive motor 4. Moreover, since the axis CL_1 of the drive motor 4 is at the angle *è* to the axis CL_2 of the piston 3, the piston 3 will make one complete reciprocation with each complete revolution of the drive motor 4. The recess 31 in the piston 3 will alternately place the suction port 21 and discharge port 22 in communication with the cylinder bore 20 with approximately half a complete revolution of the piston. The piston 3 is on its suction stroke when the suction port 21 is in communication with the bore 20, and on its delivery stroke when the discharge port 22 is in communication with the bore. The piston 3 will retreat into the hollow 16 in the pump body 1 on its suction stroke, drawing the ink into the cylinder bore 20 through the suction port 21, and advance deeper into the cylinder bore on its delivery stroke, forcing the ink out through the discharge port 22.

[0032] As all the pump units *P* of the **FIG. 1** inking pump arrangement *A* operate in the above described manner, the complete pump body 1 and of course the cylinders 2 will gradually warm up owing to the heat generated by the excitation of the drive motors 4. The result will be a drop in ink viscosity. Now much easier to flow than at room temperature, the ink will find its way through the gap between cylinder 2 and piston 3 toward the sealed rear end of the cylinder. The ink will be dragged rearwardly by the piston 3 retreating on its suction stroke and, during its discharge stroke, urged in the same direction under the force being exerted thereon by the advancing piston.

[0033] The cylinder end seal 6 of **FIG. 3** is well calculated to prevent ink leakage from the rear end of the cylinder 2. The cylinder end seal 6 features the sealing ring 71 installed between cylinder 2 and piston 3, with the pair of annular lips 74 oriented forwardly therefrom, and firmly retained in position by the retainer ring 73 via the washer 72. The lipped sealing ring 71 will block the passage of the ink between cylinder 2 and piston 3, scraping the ink off the surface of the piston as the latter both rotates and linearly reciprocates in sliding contact therewith.

[0034] Furthermore, having sufficient elasticity radially of the piston 3, the sealing ring 71 will serve its intended purposes for a prolonged period of time in the face of possible wear of the piston. It is also possible to provide sufficient clearance between cylinder 2 and piston 3 to preclude the difficulties and inconveniences that might arise from solid particles contained in the ink. All in all, each pump unit *P,* and of course the complete pump arrangement *A* will be much more extended in useful life than in the absence, as has been the case heretofore, of the cylinder end seal 6. It will unnecessary, moreover, to make the contacting surfaces of the cylinder 2 and piston 3 as hard as when, also as has been the case heretofore, they had a minimum clearance therebetween to avoid ink leakage.

Embodiment of FIGS. 4-5

[0035] **FIG. 4** shows another preferred form of pump unit P_a according to this invention, for use in the inking pump arrangement *A* of **FIG. 1** in substitution for each pump unit *P.* A comparison of **FIGS. 2** and **4** will reveal that the **FIG. 4** pump unit P_a differs from its **FIG. 2** counterpart *P* only in the constructions of its cylinder end seal 6*a* and some associated parts of the pump body 1 and cylinder 2. Only this alternative end seal 6*a*, as well as the correspondingly modified parts of the pump body 1 and cylinder 2, will therefore be discussed in detail with reference directed mostly to **FIG. 5,** an enlargement of the alternative end seal.

[0036] The alternative cylinder end seal 6*a* includes a sealing ring 81, similar in both construction and material to the sealing ring 71 of the **FIG. 3** seal 6, which is fitted over the piston 3 and which is held against the rear end 26 of the cylinder 2. The sealing ring 81 is firmly retained in position by a mounting ring 82 concentrically surrounding the cylinder 2 and piston 3. In order to permit the mounting ring 82 to be mounted thereto, the cylinder 2 is formed to include a reduced diameter end portion 24 which is partly screw threaded at 25.

[0037] Generally tubular in shape, the mounting ring 82 has a stepped bore composed of, from its rear end forwardly, a first portion 82*a* of smallest diameter through which the piston 3 extends with clearance, a second portion 83 of greater diameter accommodating the sealing ring 81, a third portion 84 of still greater diameter in sliding fit with the reduced diameter portion 24 of the cylinder 2, and a fourth portion 85 of approximately the same diameter as the third portion 84 which has an internal screw thread cut therein to mesh with the external thread 25 on the cylinder 2. The third bore portion 84 has an annular groove 86 cut therein to receive an O-ring seal 88.

[0038] Thus the sealing ring 81 can be mounted in position between cylinder 2 and piston 3 simply as the mounting ring 82, together with the sealing ring received in its second bore portion 83, is placed around the piston and turned over the reduced diameter end portion of the cylinder for threaded engagement therewith. The mounting ring 82 can be axially positioned with respect to the cylinder 2 simply by turning the ring until the shoul-

der 87 between its bore portions 83 and 84 comes into abutment against the rear end 26 of the cylinder. When so mounted in position, the lipped sealing ring 81 will make leakproof engagement with the confronting surfaces of the piston 3 and the mounting ring 82. Further the O-ring seal 88 will seal the joint between cylinder 2 and mounting ring 82, making it impervious to the ink.

[0039] At 89 in **FIG. 5** are seen two or more tool holes bored in the mounting ring 82 at circumferential spacings. A suitable tool, not shown, is to be inserted in any of these holes 89 for turning the mounting ring 82 into and out of threaded engagement with the cylinder 2.

Embodiment of FIGS. 6-7

[0040] Still another preferred form of pump unit according to the invention, shown in its entirety in **FIG. 6** and therein generally labeled P_b, is also for use in the inking pump arrangement *A* of **FIG. 1** in substitution for each pump unit *P.* As will be noted upon comparison of **FIGS. 2** and **6**, the **FIG. 6** pump unit P_b differs from its **FIG. 2** counterpart *P* primarily in that the piston 3 is mounted in a bore 10 of cylindrical shape that is cut directly in the front part 1*a* of the pump body 1. The pump body 1 here should therefore be construed to serve the additional purpose of the cylinder 2 of the foregoing embodiments. The cylinder end seal 6*b* of this pump unit P_b is modified accordingly.

[0041] As illustrated on an enlarged scale in **FIG. 7,** the pump body front part 1*a* has formed in its rear surface a relatively shallow bore 17 concentric with the cylinder bore 10, and another, similarly shallow bore 18 of reduced diameter cut centrally in the bottom of the bore 17, with an annular shoulder 19 between the bores 17 and 18. The modified cylinder end seal 6*b* features a sealing ring 91, similar in both construction and material to the sealing ring 71 of the **FIG. 3** cylinder end seal 6, which is fitted over the piston 3 and which is held against the bottom of the smaller diameter bore 18 in the pump body front part 1*a*.

[0042] Employed for positively retaining the sealing ring 91 in place is a mounting ring 92 which is received in the larger diameter bore 17 in the pump body front part 1*a* and which loosely surrounds the piston 3. The mounting ring 92 is fastened to the pump body front part 1*a* with a plurality of, one seen, screws 98. The mounting ring 92 is formed to include a boss 94 projecting concentrically therefrom to be received in the smaller diameter bore 18 in the pump body front part 1*a*. The boss 94 is hollow, defining a space 93 for accommodating the sealing ring 91 in fluid-tight contact with the piston 3. The sealing ring 91 functions mostly to seal the joint between piston 3 and mounting ring 92.

[0043] The mounting ring 92 has formed therein an annular groove 96 to receive part of an O-ring seal 97 which is held against the shoulder 19 between the bores 17 and 18 in the pump body front part 1*a*, sealing the joint between the pump body and the mounting ring 92. Thus is prevented the leakage of ink from between piston and pump body.

Conclusion

[0044] The three preferred forms of cylinder end seals 6, 6*a* and 6*b* disclosed above offer numerous and substantive advantages despite their simplicity of construction. They will be effective, preventing ink leakage and making it unnecessary to clean the pump units or units at regular intervals, even if the clearance between piston and cylinder is intentionally made greater than heretofore or becomes greater with the lapse of time. The cylinder 2, or piston body 1, and the piston 3 need not be machined so close tolerances as heretofore since the clearance therebetween can be made greater without the fear of ink leakage. The lipped sealing rings 71, 81 or 91 are sufficiently elastic radially of the piston 30 to stay in fluid-tight contact with the pertinent members in the face of such greater clearances. As an additional advantage the contacting surfaces of the cylinder 2, or pump body 1, and piston 3 need not be so hard as to resist wear for any prolonged period of time because the end seals 6, 6*a* or 6*b* will maintain their sealing functions even if the contacting surfaces are worn to a certain extent.

[0045] The advantages gained by the instant invention may be recapitulated in more concrete terms as follows:

1. The pump units are no longer stained with ink, so that no regular cleaning is needed.
2. There is no intrusion of leaking ink onto the drive linkage or, least of all, into the drive motor, making them free from trouble due to ink leakage.
3. There is no firm adhesion of the leaking ink to the exposed surfaces of the pump body, cylinder, and piston while the pump is out of operation, greatly lessening the load on the drive motor when it is started up.
4. The dimensional tolerances of the cylinder bore and the piston are made greater than heretofore thanks to the elastic sealing members in use.
5. The pump will stay leakproof and operable for an extended period of time as the wear of the contacting surfaces of the mating members of the piston in use is taken up by the annular lips, in particular, of the sealing rings.
6. The hardening of the contacting surfaces of the pump by expensive surface treatment is not needed as the piston need not fit in the cylinder bore so closely as heretofore.
7. Inking pumps of conventional design are easily and inexpensively modifiable to incorporate the teachings of this invention.
8. The cylinder end seals of **FIGS. 5** and **7** in particular are designed for ease of disassembly for maintenance and repair.

Despite the showing of **FIG. 1** the leakproof pump according to the invention need not be used in juxtaposition of two or more but may be singly employed for inking and other purposes. A variety of additional modifications, alterations and adaptations of the illustrated embodiments may be resorted to without departure from the spirit or scope of the claims which follow.

Claims

1. A pump capable of metering a fluid such as printing ink, comprising pump body means (1 with or without 2) defining a bore (10 or 20) which is pressure-tightly closed at a first end thereof, together with a suction port (21) and a discharge port (22) which are both open to the bore in preassigned different angular positions thereon, a piston (3) slidably received in the bore in the pump body means for both rotation and linear reciprocation relative to the same and having one end projecting from a second end of the bore, the piston being capable of blocking both suction port and discharge port and alternately placing the same in communication with the bore during each complete revolution thereof, a drive motor (4) mounted to the pump body means and having a drive shaft (40) rotatable about an axis (CL_1) intersecting the axis (CL_2) of rotation of the piston at a prescribed angle (θ), and a drive linkage (50, 51 and 52)) connecting the drive shaft of the drive motor to the piston so as to cause joint rotation and linear reciprocation of the latter in response to the rotation of the former, **characterized in that** the second end of the bore (10 or 20) is sealed by an end seal means (6, 6*a* or 6*b*) against the leakage of the fluid from between the pump body means (1 with or without 2) and the piston (3).

2. A pump capable of metering a fluid such as printing ink as claimed in claim 1, wherein the pump body means comprises a pump body (1) and a cylinder (2) mounted fast thereto and defining the bore (20), **characterized in that** the end seal means (6) is received in a bore enlargement (20*a*) formed in the cylinder (2) at the second end of the bore (20).

3. A pump capable of metering a fluid such as printing ink as claimed in claim 2, **characterized in that** the end seal means (6) comprises a sealing ring (71) in fluid-tight contact with both the cylinder (2) and the piston (3), and a retainer ring (73) positively engaged in the enlargement (20*a*) of the bore (20) in the cylinder for retaining the sealing ring in position.

4. A pump capable of meting a fluid such as printing ink as claimed in claim 3, **characterized in that** the sealing ring (71) has a pair of annular, concentric lips (74) formed thereon and elastically held against the cylinder (2) and the piston (3).

5. A pump capable of metering a fluid such as printing ink as claimed in claim 1, wherein the pump body means comprises a pump body (1) and a cylinder (2) mounted fast thereto and defining the bore (20), **characterized in that** the end seal means (6*a*) comprises a sealing ring (81) fluid-tightly surrounding the piston (3) and fluid-tightly held against one end of the cylinder (2), and a mounting ring (82) surrounding the piston and screw-threadedly engaged with the cylinder for positively retaining the sealing ring (81) in position on the piston.

6. A pump capable of metering a fluid such as printing ink as claimed in claim 5, **characterized in that** the end seal means (6*a*) further comprises a second sealing ring (86) mounted between the cylinder (2) and the mounting ring (82) for sealing a joint therebetween.

7. A pump capable of meting a fluid such as printing ink as claimed in claim 5, **characterized in that** the sealing ring (81) has a pair of annular, concentric lips formed thereon and elastically held against the piston (3) and the mounting ring (82).

8. A pump capable of metering a fluid such as printing ink as claimed in claim 1, wherein the pump body means comprises a pump body (1) having the bore (10) formed directly therein, and wherein the end seal means (6*b*) comprises a sealing ring (91) fluid-tightly surrounding the piston (3) and fluid-tightly held against the pump body (1), and a mounting ring (92) surrounding the piston and fastened to the pump body for positively retaining the sealing ring (91) in position on the piston.

9. A pump capable of metering a fluid such as printing ink as claimed in claim 8, **characterized in that** the end seal means (6*b*) further comprises a second sealing ring (96) mounted between the pump body (1) and the mounting ring (92) for sealing a joint therebetween.

10. A pump capable of meting a fluid such as printing ink as claimed in claim 8, **characterized in that** the sealing ring (91) has a pair of annular, concentric lips formed thereon and elastically held against the piston (3) and the mounting ring (92).

FIG. 1

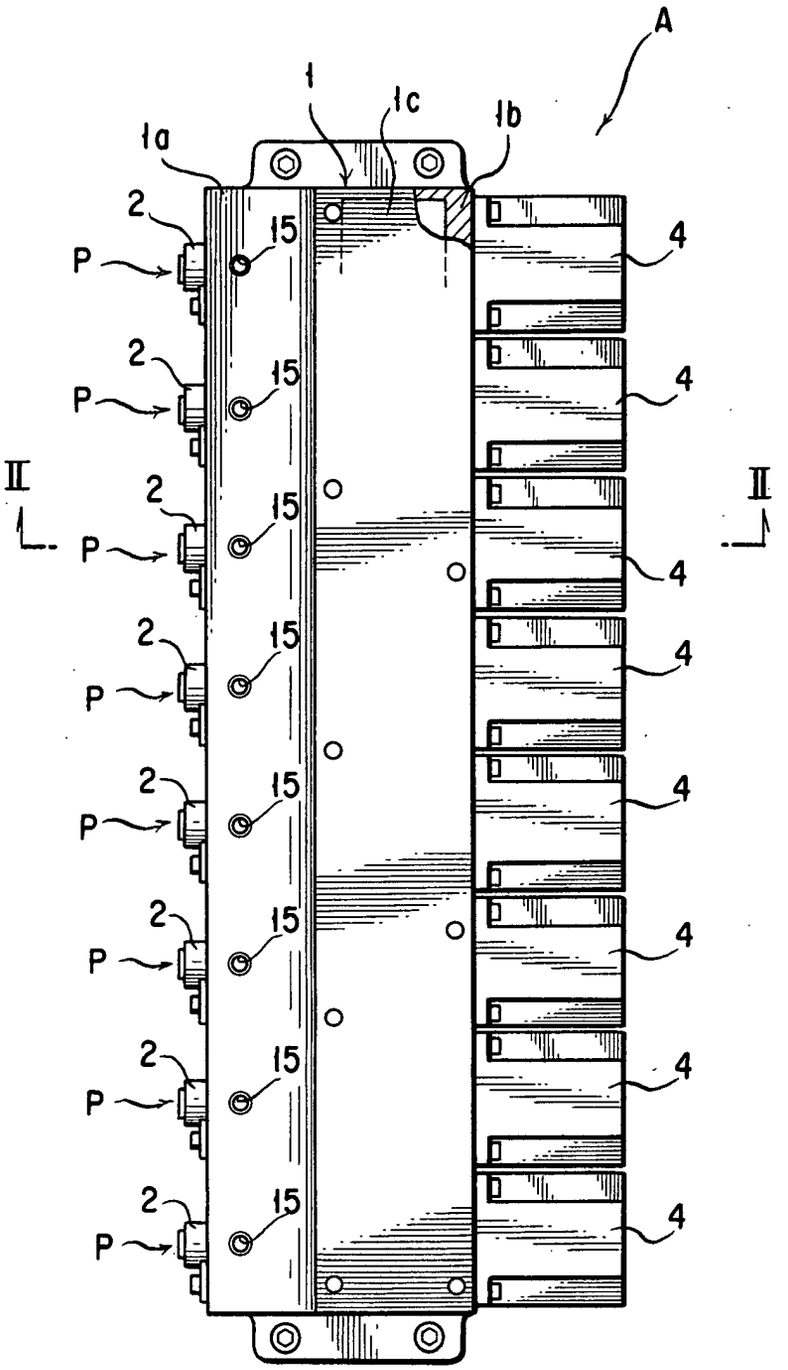


FIG. 2

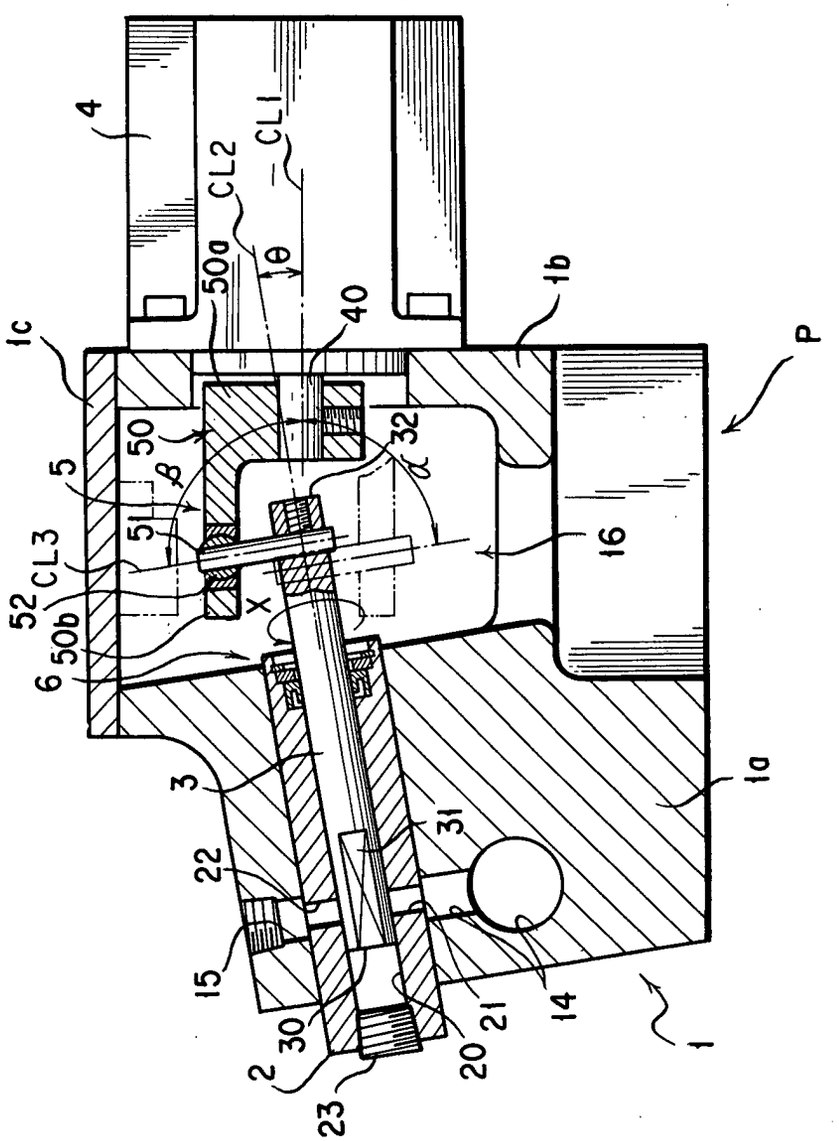

4
CL2
CL1
θ
50a
40
1b
1c
P
50
32
5
β
α
51
16
CL3
52
X
50b
6
3
1a
31
22
15
30
2
23
20
21
14
1

FIG. 3

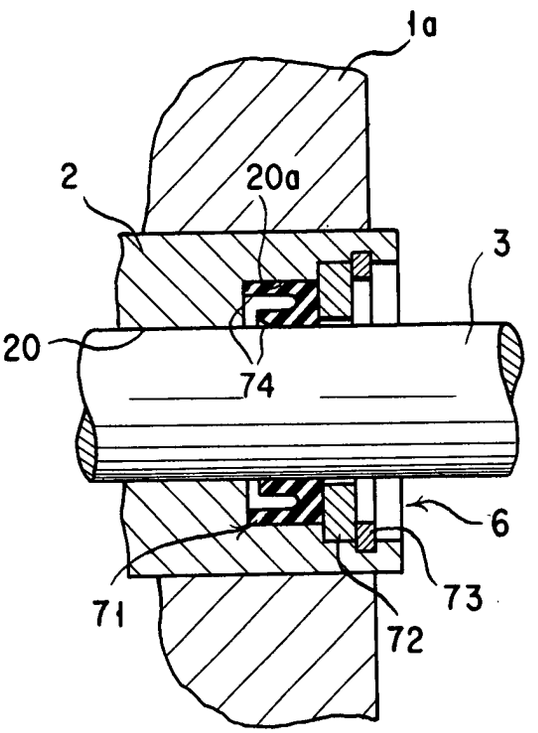


FIG. 4

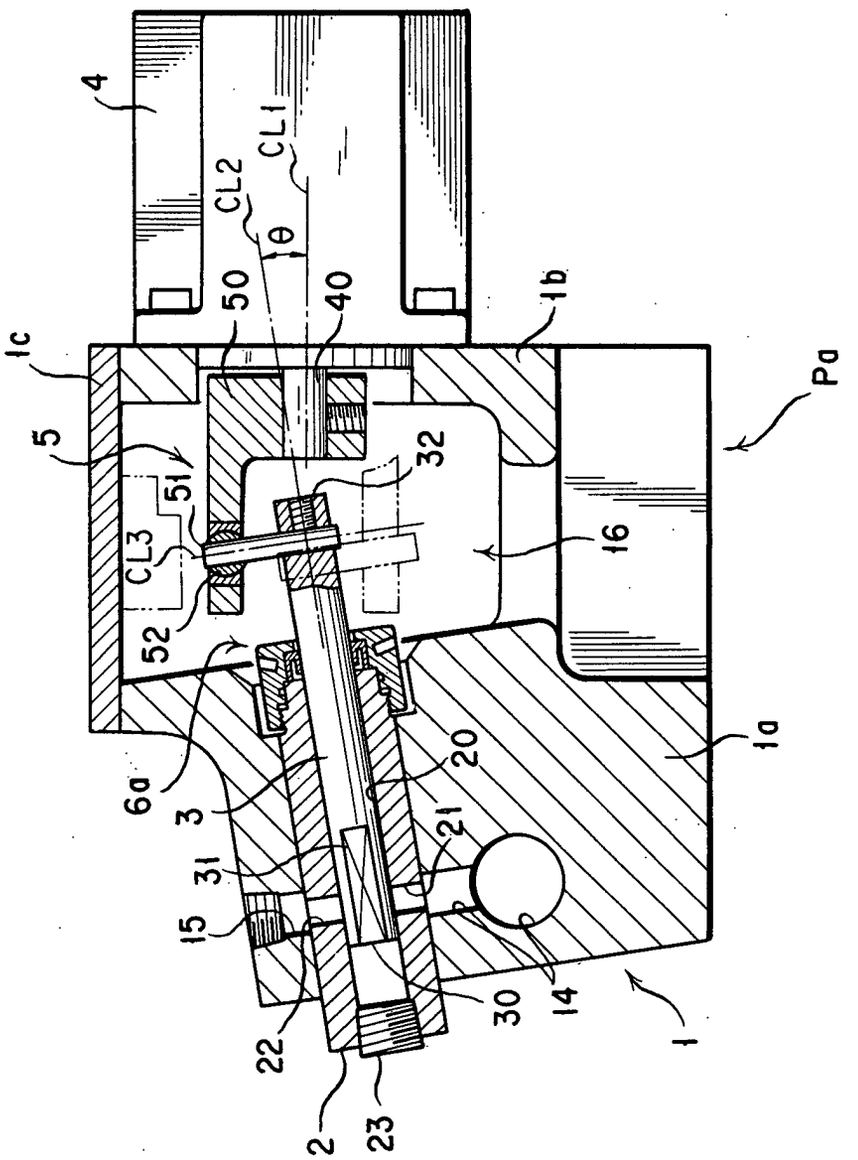

4
CL1
CL2
θ
50
40
1b
1c
Pa
5
51
32
CL3
16
52
6a
20
1a
3
21
31
15
30
14
22
1
2
23

FIG. 5

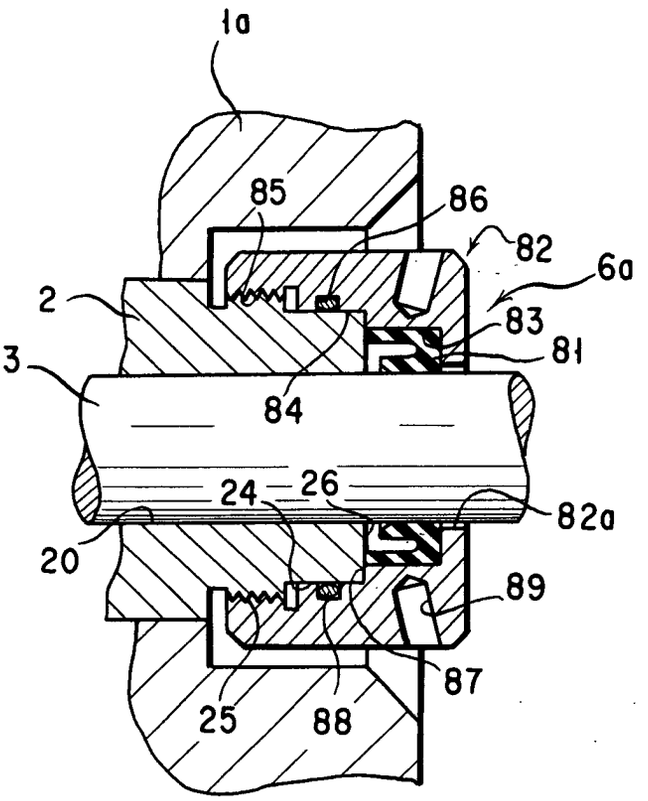
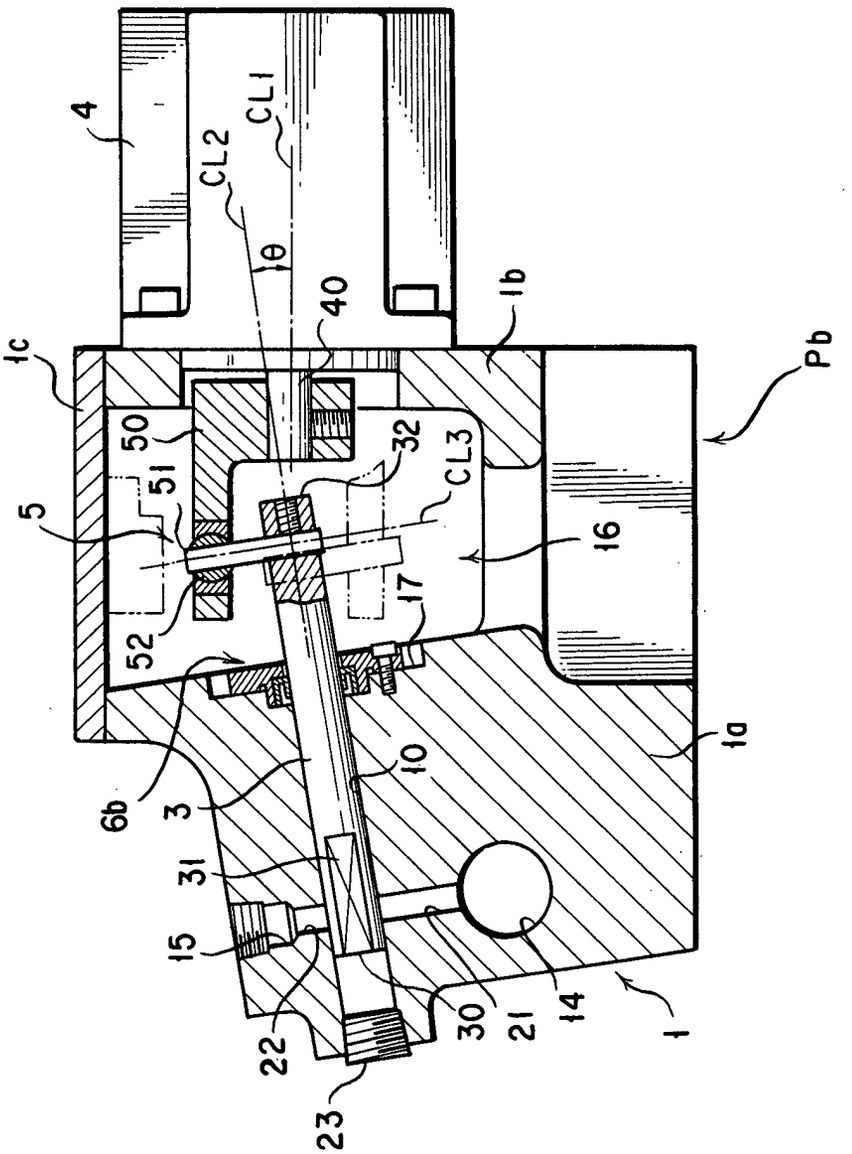


FIG. 6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1c
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6b
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10
1a
31
15
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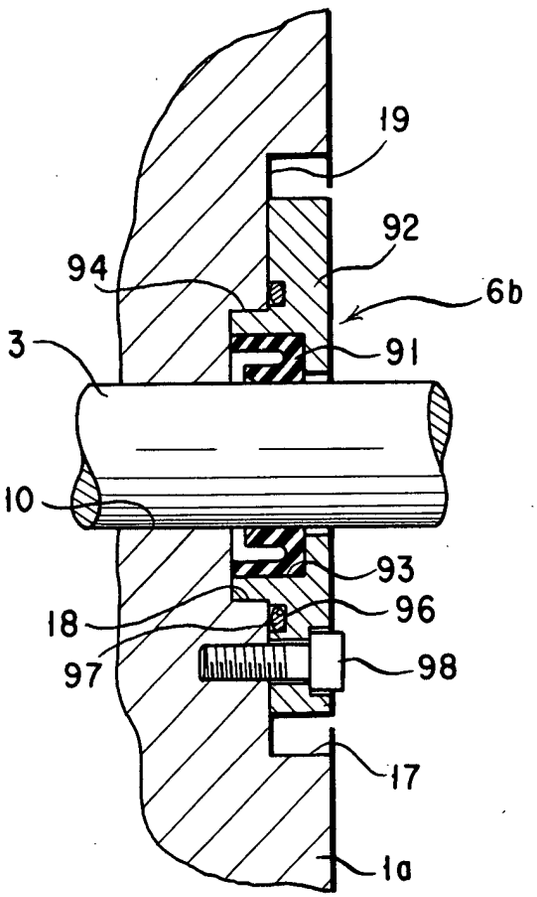
23
30
21
14
1

FIG. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 02 00 7471

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	DE 195 12 777 A (SEISAKUSHO) 7 December 1995 (1995-12-07) * the whole document *	1-3,5,8	B41F31/08
Y	EP 0 298 140 A (DOZSA MEZÖGAZDASAGI TERMELÖSZÖVETKETZET) 11 January 1989 (1989-01-11) * column 3, line 11 - line 18; figure 1 *	1,2,5	
Y	DE 226 560 C (ARIYA INOKUTY) * page 1, line 39 - line 44; figure 1 *	1-3	
Y	US 5 246 354 A (ABBOTT LABORATORIES) 21 September 1993 (1993-09-21) * column 4, line 21 - line 28; figure 3 *	1,8	
A	EP 1 078 740 A (SEISAKUSHO) 28 February 2001 (2001-02-28) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7) B41F F04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 August 2002	Loncke, J

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05-08-2002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19512777 A	07-12-1995	JP 2864447 B2	03-03-1999
		JP 7323520 A	12-12-1995
		DE 19512777 A1	07-12-1995
		US 5526745 A	18-06-1996
EP 0298140 A	11-01-1989	EP 0298140 A1	11-01-1989
DE 226560 C		NONE	
US 5246354 A	21-09-1993	NONE	
EP 1078740 A	28-02-2001	JP 3095744 B2	10-10-2000
		JP 2001063004 A	13-03-2001
		EP 1078740 A1	28-02-2001
		US 6336405 B1	08-01-2002

EPO FORM P0459

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