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(71) Applicant: **Van Bortel, Augustinus Johannes Petrus Maria, Violierstraat 19, NL-5014 EL Tilburg (NL)**

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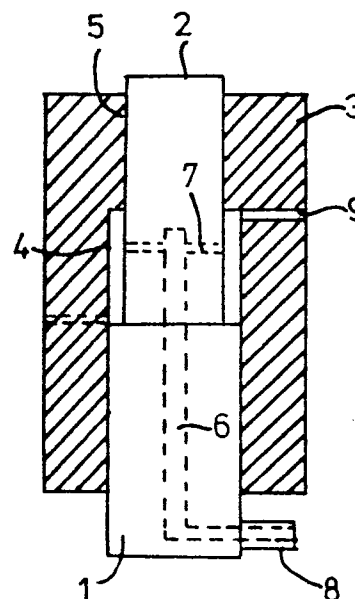
(72) Inventor: **Van Bortel, Augustinus Johannes Petrus Maria, Violierstraat 19, NL-5014 EL Tilburg (NL)**

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(74) Representative: **Noz, Franciscus Xaverius et al, Algemeen Octrooibureau P.O. Box 645, NL-5600 AP Eindhoven (NL)**

(54) **Plunger pump.**

(57) The invention relates to a plunger pump comprising a housing, a plunger adapted to reciprocate in a compression chamber provided in the housing and an inlet port and an outlet port for the inlet and outlet respectively of fluid to and from the compression chamber respectively, the inlet port being closed by the plunger at the beginning of the compression stroke wherein portions of the plunger located on both sides of the plunger portion actively operating in the compression chamber are guided in sealing relationship in portions of the housing so that the compression chamber is bounded only by one side of the plunger and an opposite portion of the pump.



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Plunger pump

The invention relates to a plunger pump comprising a housing, a plunger adapted to reciprocate in a compression chamber provided in said housing and an inlet port and an outlet port for admitting and evacuating fluid respectively to and from the compression chamber respectively, the inlet port
5 being closed by the plunger at the beginning of the compression stroke.

The invention has for its object to provide a pump of the kind set forth, which can be manufactured in a simple manner with high accuracy and by means of which even very small amounts of fluid, for example, a gas or a liquid, can be accurately and reproduceable dosed.

10 According to the invention this can be achieved in that plunger portions located on both sides of the plunger portion actively operating in the compression chamber are guided in sealing relationship in parts of the housing in a manner such that the compression chamber is only bounded by one side of the plunger and a part of the pump opposite thereto.

15 In such a pump the volume of the compression chamber can be imparted any desired magnitude by using means that can be manufactured in a simple manner whilst nevertheless an effective displacement and/or compression of the fluid can take place.

Such a pump, which is particularly suitable for the displacement of
20 very small quantities, may be employed for many purposes, for example, for atomization of fuel or other liquids, the accurate displacement of small amounts of fluid in certain processes and so on.

The invention will be described more fully hereinafter with reference to a few embodiments of a plunger pump in accordance with the invention
25 on shown schematically in the accompanying figures.

Fig. 1 is a schematic sectional view of a first embodiment of a

plunger pump in accordance with the invention.

Fig. 2 is a schematic sectional view of a second embodiment of a plunger pump in accordance with the invention.

Fig. 3. is a plan view of the plunger employed in the plunger pump illustrated in fig. 2.

Figs. 4 and 5 show further embodiments of part of the plunger used in the pump illustrated in fig. 2.

Fig. 6 shows a third embodiment of a plunger pump in accordance with the invention.

Fig. 7 shows a fourth embodiment of a plunger pump in accordance with the invention.

Fig. 8 shows a fifth embodiment of a plunger pump in accordance with the invention.

Fig. 9 is a sectional view of the pump of Fig. 8. taken on the line IX-IX in fig. 8, the housing of the pump being omitted.

Fig. 10 shows an embodiment of a pump in accordance with the invention with a pressure accumulation chamber.

Fig. 11 illustrates a potential embodiment of a pump in which the pressure variation is acted upon during the compression stroke.

Fig. 12 shows a further embodiment of the pump.

Fig. 13 shows part of the plunger in a further embodiment.

Fig. 14 shows a further embodiment of a pump.

Fig. 15 shows a pump in which the outlet is performed in a thrust-wise manner.

Fig. 16 shows an effective embodiment of a pump for mixing fluids.

Fig. 17 shows a double-acting pump with adjustable stroke volume.

Fig. 18. shows part of a plunger allowing control of the inlet port.

Fig. 19 shows a valve embodiment

The pump shown in Fig. 1 comprises a plunger consisting of a first cylindrical portion 1 and a second cylindrical portion 2 the diameter of which is smaller than that of the portion 1.

The plunger is adapted to reciprocate in a bore provided in a pump housing 3. The bore 4 communicates with a bore 5, in which the plunger portion 2 is guided in sealing relationship.

In the plunger 1 is furthermore provided a passage 6, which communicates through one or more radial transverse bores 7, which may also extend

at an angle to the radial line, with the outer circumference of the thinner portion 2 of the plunger. Near the lower end of the plunger the passage 6 communicates with a connecting stud 8, for example, for connecting a flexible hose or the like.

5 At the top end of the bore 4 an outlet passage 9 is provided in the housing 3. The plunger 1, 2 may be reciprocated, for example, with the aid of a lug or the like (not shown). A flexible supply conduit for the feed of fluid, for example, gas or liquid will be connected with the connecting stud 8. At the instant when the openings of the bores 7 are located in the bore 5 the inlet passage is blocked so that the fluid can be pressed away only through the outlet passage 9 out of the compression chamber formed by the bore 4. It will be obvious that though in the embodiment shown the outer diameter of the plunger portion 2 differs appreciably from the inner diameter of the bore 4 for the sake of clarity of re-
10 presentation, these differences may be reduced at will in a simple manner to particularly low values, for example, less than 0.1 mm without involving difficulties in manufacture so that the compression chamber may have a very small volume, as a result of which with the aid of such a plunger pump very small amounts of fluid can be displaced and/or compressed whilst
15 the quantity of fluid displaced at every stroke of the plunger will be the same.

 Instead of providing the inlet port in the plunger itself, it may, as an alternative, be provided in the housing, as is indicated in fig. 1 by broken lines for the inlet port 10. As soon as the top end of the portion
25 1 of the plunger blocks the opening of the passage the compression stroke will start.

 If, desired, the end of the plunger portion 1 joining the plunger portion 2 may extend in helical fashion around the centre line of the plunger, which provides the possibility of varying the instant of blocking
30 of the inlet port 10 by turning the plunger so that the magnitude of the compression stroke can be controlled. As a further alternative the lug drive of the plunger may be constructed so that it permits of obtaining an adjustable compression stroke.

 In the embodiment shown in fig. 2 the plunger portion 11 of smaller diameter is disposed eccentrically to the plunger portion 12 of larger diameter. These two portions may be integral with one another or the por-

tions 11 and 12 may be manufactured independently of one another and be interconnected, for example, by pressing a ping 13 integral with the portion 11 into a matching bore of the portion 12. In the embodiment illustrated in fig. 2 the housing consists of two portions 14 and 15, whilst the
5 the portion 11 is accommodated in sealing relationship in a bore 16 of the portion 14 and the portion 12 can reciprocate in a bore 17 in the housing portion 15. With the top end of the bore 17 again communicates an outlet port 18. The portion 11 has a bore 19 opening out at the top end of the plunger, which end is located at a connecting stud 20, which
10 is integral with the housing portion 14 and which serves for connecting a fluid feed conduit. In the embodiment shown in fig. 2 the bore 19 communicates through one or more transverse passages with the outer circumference of the plunger portion 11. From fig. 2 it will be seen that the cross sectional area of the passage 21 decreases in the direction towards
15 the thicker portion 12 of the plunger. This structure is advantageous in the event of a variable stroke of the pump plunger so that according as the stroke increases and hence the passage 21 emerges further beneath the bottom side of the housing 14 a larger flow passage is obtained for feeding fluid to the compression chamber.

20 It will be obvious, particularly from fig. 3 that with such an eccentric disposition of the two plunger portions a compression chamber is obtained, the cross section of which is more or less crescent shaped. Such a shape of the compression chamber may be advantageous for displacing viscous fluids, since such fluids will pass more readily through such a
25 compression chamber than through an annular compression chamber in the embodiment shown in fig. 1, if the differences between the diameters of the plunger and the compression chamber are small.

For varying the outlet passage of the feed conduit several variants of the embodiment of fig. 2 are possible. In the embodiment shown in fig. 4
30 for example, a plurality of feeding slots 22 are provided instead of the feeding passage 21, said slots being relatively off-set in the direction of movement of the plunger.

As a further alternative several passages 23 may be provided one below the other in the direction of movement of the plunger the diameter
35 of said passages gradually decreasing towards the thicker plunger portion.

In the embodiment shown in fig. 6 the parts corresponding with those

described with reference to fig. 1 are designated by the same reference numerals. From fig. 6 it will be seen that the portion 1 of the reciprocating plunger has a bore consisting of two portions 24 and 25 accommodating a further plunger comprising a first portion 26 sealingly fitting in the bore 24 and a portion 27 of larger diameter sealingly fitting in the bore 25. Like the plunger of fig. 1, the plunger 26, 27 has an inlet passage 28 through which fluid can be fed into the compression chamber, which is bounded by the outer periphery of the plunger portion 26 and the inner circumference of the bore 25. This compression chamber communicates through a bore 29 in the plunger 1, 2 with the compression chamber bounded by the outer periphery of the plunger portion 2 and the inner circumference of the bore 4.

Moreover, the plunger 26, 27 preferably has a further bore establishing an open communication between the bore 24 and the atmosphere.

When the plunger 26, 27 is driven with the aid of a lug, the fluid fed into the compression chamber bounded by the plunger portion 26 and the wall of the bore 25 will be compressed in the manner described above and displaced respectively and pumped through the passage 29 towards the compression chamber of smaller volume, bounded by the plunger portion 2 and the wall of the bore 4. At the end of the stroke of the plunger 26, 27 in the compression chamber in the plunger 1, 2 the plunger 1, 2 will also be displaced upon a further displacement of the plunger 26, 27 so that the fluid fed under pressure into the compression chamber bounded by the plunger portion 2 and the bore 4 can be further compressed. In this way a stepwise densification of the fluid can be achieved. If desired, the plunger 1, 2 may be spring-loaded in order to avoid premature displacement of this plunger 1, 2.

In the embodiment shown in fig. 7 the plunger employed comprises three cylindrical portions 30, 31 and 32 which have stepwise larger diameters and are located in matching bores in the housing 33 in a manner such that two compression chambers 34 and 35 are formed. With the compression chamber 34 communicate an inlet port 36 and an outlet port 37 whereas an inlet port 28 and an outlet port 39 communicates with the compression chamber 35. It will be obvious that with such a pump during the compression stroke a desired amount of fluid can be conducted away simultaneously through the ports 37 and 39. It is thus possible for example, for mixing two fluids to displace simultaneously small metered amounts of said fluids to feed them, for example, to an atomizer. By a correct choice of the diameters of the

various parts any desired volume ratio may be obtained whilst by varying the lengths of the compression chambers variations in the pressures by which the fluids are pressed away can be achieved.

A further variant of the construction in accordance with the invention is illustrated in figs. 8 and 9.

In this embodiment one end of a cylindrical pin 41 is fastened in a housing 40 in a matching opening provided in said housing. The end of a plunger 42 is furthermore arranged in an opening in the housing, whilst as shown in fig. 8 the lower end of the pin 41 and the top end of the plunger 42 have recesses so that these ends bound a compression chamber, the cross section of which is most clearly illustrated in fig. 9.

With this compression chamber communicate an inlet passage 44 extending through the housing 40 and the pin 41 and an outlet passage 45 also extending through the housing 40 and the pin 41. Referring to fig. 8 it will be obvious that at an upward movement of the plunger 42 joining the recessed portion of the plunger 42 will block the opening of the inlet passage 44, after which the fluid contained in the compression chamber will be pressed away through the outlet passage 45.

Obviously further variants of the embodiments described above are possible, in which compression chambers of very small volume can be obtained with the aid of parts that can be readily and accurately manufactured with the desired tolerances from the desired materials. The pump may or may not have an adjustable plunger stroke and valves may be joined to the outlet ports to prevent a return flow of fluid after the termination of the compression stroke.

For example, in the embodiment described with reference to fig. 1 with the inlet passage 10 the plunger may be constructed so that the transition between the thicker and the thinner portions extends helically or stepwise so that after the compression chamber is filled via the passage 10 the plunger can be turned about its centre line into a position, in which the thicker portion of the plunger blocks the passage 10 so that via the passage 10 no fluid can flow back, whereas the plunger is still in its initial position.

The embodiment may furthermore be constructed so that the plunger can be displaced stepwise mechanically or manually, for example,

when used as a syringe and be fixed in various position so that the amount of fluid contained initially in the compression chamber can be dispensed in portions. The plunger pump shown in fig. 10 structurally corresponds largely with the plunger pump shown in fig. 1 and
5 corresponding parts are designated by the same reference numerals.

In this embodiment, however, the plunger portion 1 has a transverse bore 46 in which two partitions 47 are disposed, between a hose 48 of flexible material is arranged. The ends of said hose 48 whose diameter in the no-load state is smaller than the inner diameter of the
10 bore 46, communicate freely through apertures provided in the partitions 47 with the ends of the bore 46. One end of the bore 46 communicates through a bore 49 extending axially in the plunger 1 with the compression space.

It will be obvious that during a compression stroke the medium
15 to be compressed is pressed into the space bounded by the hose 48, which can expand under the action of the exerted pressure for receiving the pressurized fluid. At the termination of the compression stroke one end of the bore 46 gets into open communication with an outlet passage 50 so that the pressurized fluid accumulated in the expandable accumulation
20 space formed by the hose 48 will be abruptly expelled through the passage 50.

Fig. 11 shows that at the level of the opening of the feed channel 7 the outer periphery of the plunger portion 2 may be provided with a constriction becoming shallower in the direction towards the plunger portion 1. Although in the embodiment shown said construction is bounded by
25 the portion 51 of a conical surface, said portion 51 may obviously have any desirable shape.

When at the beginning of a suction stroke the plunger moves downwards, as seen in fig. 11, the lower boundary edge of the surface
30 51 will arrive at a given instant at the plane where the bore having a diameter corresponding with the diameter of the plunger 2 changes over to the bore having a diameter corresponding with that of the plunger 1. At a further downward movement the connection between the fluid inlet conduit 6,7 in the plunger at the space located above the plunger 1
35 will gradually increase and at an upward movement of the plunger the passage of said connection will gradually decrease. It will be obvious

that the shape of the surface 51 thus influences the supply of fluid into the compression chamber during the suction stroke and the increase in pressure during the compression stroke; therefore the surface 51 may be shaped in the form most suitable for the operational conditions and
5 the fluids to be handled.

Instead of a circular constriction the outer surface of the plunger may have a local notch at the opening of the passage 7.

In the embodiment shown in fig. 11 the plunger 1 has a circular recess 52 bounded by a wall portion 53 of the plunger surface shaped so
10 that the circumference of said wall portion 53 becomes gradually smaller in a direction away from the plunger 2.

The housing 3 has a channel 54 opening out at one end in the top ends of the bore 4 and at the other end at a given distance from said top end. In the lowermost position of the plunger 1 the lower end of the
15 channel 54 is blocked by the plunger 1 as is indicated in fig. 11. During the compression stroke the pressure increase in the compression chamber is controlled on the one hand by the shape of the surface 51, but on the other hand also by the shape of the surface 53, since at a given instant the lower end of the conduit 54 will come at the level of the surface 53 and the shape of this surface will be determinative
20 of the manner in which this opening 54 and hence the outflow of fluid from the compression chamber during the compression stroke through the conduit 54 are enabled. The outlet of the pressurized fluid then takes place from the space 52 through the passage 55.

A further possibility of acting upon the feed of fluid from
25 the passage 6,7 of the plunger is illustrated in fig. 12. From this figure it will be seen that the outer periphery of the plunger portion 2 has a helical groove 56 communicating with the opening of the passage 7 and extending from the opening of the bore 7 towards the plunger portion 1. The cross-section of the groove 56 may be gradually varied so that the
30 cross section is largest at the level of the opening of the bore 7 and decreases gradually in the direction towards the end remote from the opening of the bore 7. It will be obvious that at the beginning of the suction stroke, at the instant when the end remote from the bore 7 comes into communication with the compression chamber, a comparatively
35 small amount of fluid can flow into the compression chamber, as a result of the loss of pressure occurring in the helical groove 56, whereas at

an increase in suction stroke this loss of pressure across the groove 56 will rapidly decrease, whilst a free outflow of fluid can take place from the part of the helical groove 56 already released. During the compression stroke an inverse action will occur.

5 A further alternative is illustrated in fig. 13, in which the bore 7 opens out in a recess extending at right angles to the longitudinal axis of the plunger portion 2 and having a semi circular cross section 57. It will be evident that during the downward suction stroke of the plunger portion 2 the lower part of the recess 57, as seen in
10 fig. 13., will first communicate with the interior of the bore 4 forming the compression chamber, said communication gradually increasing in accordance with the variation of the recess 57 during the suction stroke. Also in this the inverse will occur during the compression stroke so that the pressure increase in the compression chamber can be influenced.

15 In the embodiment illustrated in fig. 14 the fluid inlet passage 58 in the plunger portion 2 has a stepped shape, the resulting shoulder 59 in the passage 58 supporting a cover plate 60 having at the circumference a plurality of equidistant pass slots. 61.

To the lower side of said plate is fastened a hose 62 of flexible material, which is closed at its lower end 63. During the suction
20 stroke fluid can flow through the passages 61 and along the outer periphery of the hose 62 and transverse bores 64 provided in the plunger portion 2 into the bore 4 forming the compression chamber. At the beginning of the compression stroke pressure will be built up in the compression chamber 4, as a result of which the flexible hose 62, 63 will be
25 deformed so that this hose will contact the inner wall of the part of the bore 58 located below the plate 60 so that rapidly a seal of large surface will be formed, a return flow of fluid being thus effectively counteracted at the very beginning of the compression stroke.

30 When the hose 62 is suitably sealed in its connection at the top, the hose 62 may be left open on the lower side so that during the compression stroke pressurized fluid is pressed into the hose which is thus firmly pressed against the wall of the bore 58.

Fig. 15 shows an embodiment in which the top side of the bore
35 forming the compression chamber communicates with one end of a passage 65, the other end of which communicates with that part of the bore in which the plunger portion 1 can reciprocate. The plunger portion 1 is provided

at the outer periphery with a plurality of grooves 66 extending one above the other around the plunger. The housing has an outlet port 67 located at the same level as the lower end of the passage 65.

Obviously when during the compression stroke an annular groove
5 gets into communication with the end of the passage 65 fluid will be conducted away through the outlet passage 67, whereas when the lower end of the passage is located opposite a portion of the plunger 1 between two grooves an increase in pressure of the fluid in the compression
10 chamber 4 will occur during the compression stroke so that in this embodiment the pressurized fluid will be ejected thrust-wise. The duration of the ejection thrust can be controlled by a choice of the height of the grooves 66.

Fig. 16 shows an embodiment having a three-step plunger, in
15 which a first plunger portion 68 of comparatively large diameter is connected with a plunger portion 69 of considerably smaller diameter, whilst the end of the plunger 69 remote from the plunger 68 is provided eccentrically with a third plunger 70 in the manner shown in figs. 2 and 3.

The plungers are adapted to reciprocate in known manner in a
20 housing 71 having matching bores. The fluid can be fed into the compression space located above the plunger 71 through passages 72 in the housing.

The fluid can be fed to the compression spaces located above the plunger 69 in a manner similar to that described for the embodiment shown in figs. 2 and 3 and this is not shown in this figure.

25 The fluid is conducted away from the compression space located above the plunger 68 through a conduit 73 and the pressurized fluid is conducted out of the compression space located above the plunger 69 through a conduit 74. These conduits may open out in a common conduit 75 or the like so that the two amounts of fluid are mixed up. It will be obvious that
30 in this way a possibility is created to effectively mix a large amount of a first fluid with a small or very small amount of another fluid. Therefore, such a pump may be employed in a very efficacious manner for mixing combustion air and heavy oil for a fuel system and for mixing air and water for an air-conditioning device.

35 Fig. 17 shows an embodiment of a double-acting plunger pump comprising a housing 76 having a bore 77, in which a plunger 78 having a diameter matching that of the bore is displaceable. To the distal ends

of the plunger 78 are fastened plungers 79 and 80 having smaller diameters. In the plungers is provided a fluid inlet channel 81, which opens out through transverse bores 82 and 83 respectively in the compression chambers formed in the respective parts of the bore 77 located below and
5 above the plunger 78 respectively. The plunger 83 is passed through a wall of the housing 76, which also has an outlet port 84.

The plunger 81 is located in a sleeve 85, in which an outlet port 86 is provided. The sleeve 85 is screwed into the open end of the bore 77 and at will the sleeve 85 can be screwed to a greater or smaller depth
10 into the housing in order to control the pump displacement. If desired, the two outlets 86 and 84 may be arranged on a common member or they may control separate members. As a matter of course, such an adjustable stroke volume may also be achieved for the other side of the pump shown in fig. 17, whilst adjustment of the stroke volume may as well be achieved
15 in a single-acting pump in the manner described above.

Fig. 18 shows a plunger part 2 with a passage 6, a transverse bore 7 for the supply of fluid to be compressed. In this embodiment the bore 6 extending up to the top end of the plunger portion 2 holds a pin 87, the thickened top end 88 of which has external screwthread and is screwed
20 in the screwthreaded top end of the bore 6 having a larger diameter. It will be obvious that by screwing the pin 87 to a greater or smaller depth the size of the passage 7 and hence the inflow of fluid during the suction stroke can be varied.

Fig. 19 shows a valve structure which can be very effectively
25 employed in conjunction with one of the plunger pumps described above. The valve housing 89 has an inlet conduit 90, which opens out in a chamber 91, which communicates in a manner not shown with the suction side of a pump or the like. The chamber 91 accommodates a spiral spring 92, one end of which surrounds the opening of the inlet port 90 and the
30 other end of which engages a plate 93 connected with the spring. During the suction stroke the spring 92 will be in the position shown in the figure, in which a large passage is free between the turns of the spring for the incoming fluid. As soon as the pressure in the chamber 91 rises during a compression stroke, the pressure exerted on the plate 93 on the
35 side remote from the spring will increase more rapidly than the pressure

on the side near the spring so that the spring will be compressed as a result of which the turns of the spring will rigidly engage one another and the passage for the fluid from the conduit 90 is closed. In this way a very light quick-action valve is obtained, which will release a large
5 passage already at a very small opening stroke.

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Claims

1. A plunger pump comprising a housing, a plunger adapted to reciprocate in a compression chamber provided in the housing and an inlet port and an outlet port for the inlet and outlet respectively of fluid to and from the compression chamber respectively, the inlet port
5 being closed by the plunger at the beginning of the compression stroke characterized in that portions of the plunger located on both sides of the plunger portion actively operating in the compression chamber are guided in sealing relationship in portions of the housing so that the compression chamber is bounded only by one side of the plunger and an
10 opposite portion of the pump.

2. A pump as claimed in claim 1 characterized in that the plunger comprises at least two portions, one of which has a smaller diameter than the other portion, said portions being guided in portions of
15 the housing having matching diameters.

3. A pump as claimed in claim 2 characterized in that one portion of the plunger is arranged eccentrically with respect to the other portion of the plunger.
20

4. A pump as claimed in claim 3 characterized in that the two portions of the plunger are disposed so that they have a common generatrix.

25 5. A pump as claimed in anyone of the preceding claims characterized in that the inlet port is provided in the plunger.

6. A pump as claimed in anyone of the preceding claims characterized in that the opening of an inlet passage(s) located in the outer periphery of the plunger has a variable cross section.

5 7. A pump as claimed in anyone of the preceding claims characterized in that in the plunger is located a second plunger, which bounds a compression chamber of the first plunger in a similar manner as the first plunger, said compression chamber communicating with the compression chamber bounded by the first plunger, whilst the first plun-
10 ger is moved along by the second plunger after the second plunger has displaced from the second compression chamber towards the first compression chamber.

15 8. A pump as claimed in anyone of the preceding claims characterized in that the plunger comprises at least three portions of different diameters, which are located in bores of the housing of matching diameters so that the plunger and the housing define two compression chambers.

20 9. A pump as claimed in claim 8 characterized in that each compression chamber has its own inlet port and its own outlet port.

10. A pump as claimed in claim 1 characterized in that the plunger has a recess at one end and co-operates with a pin having a corresponding recess.
25

11. A pump as claimed in anyone of the preceding claims characterized in that the inlet port in the plunger has several openings in the outer periphery of the plunger.
30

12. A pump as claimed in anyone of the preceding claims 5 to 11 characterized in that in the plunger means are provided for adjusting the size of the inlet passage.

35 13. A pump as claimed in anyone of the preceding claims 5 to 12 characterized in that the inlet passage provided in the plunger opens

out in a helical groove provided in the outer periphery of the plunger.

14. A pump as claimed in claim 12 characterized in that the magnitude of the cross section of the groove gradually decreases in a direction away from the opening.

15. A pump as claimed in anyone of the preceding claims 5 to 14 characterized in that the inlet passage provided in the plunger opens out at the outer periphery of the plunger in an interrupted or non-interrupted recess in the plunger.

16. A pump as claimed in anyone of the preceding claims 2 to 15 characterized in that the plunger portion of larger diameter has a part having a profiled surface, which part controls the opening and closure of an outlet conduit communicating with the compression chamber.

17. A pump as claimed in anyone of the preceding claims characterized in that the compression chamber communicates with an accumulator space, the outlet of which is released with the aid of the plunger of the pump.

18. A pump as claimed in claim 17 characterized in that the accumulator space is formed by a flexible hose accommodated in the plunger.

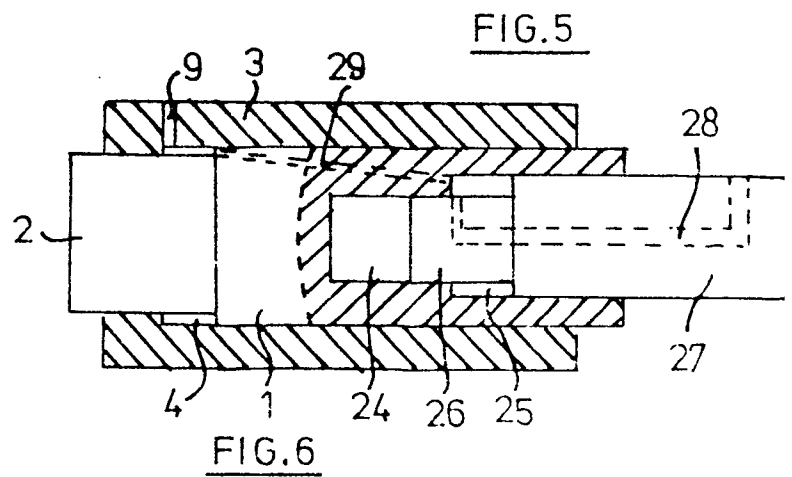
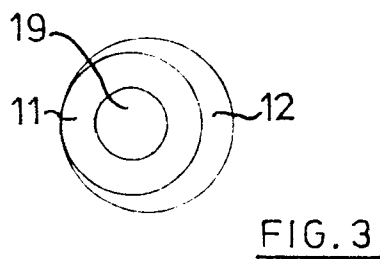
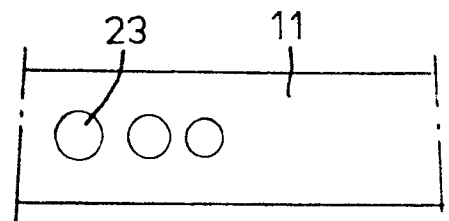
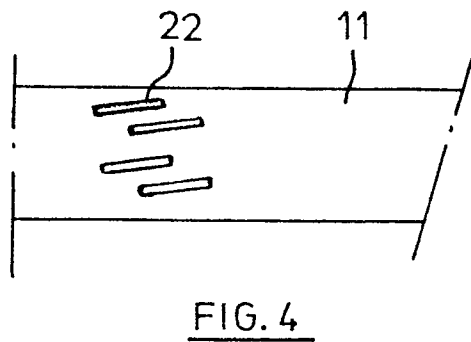
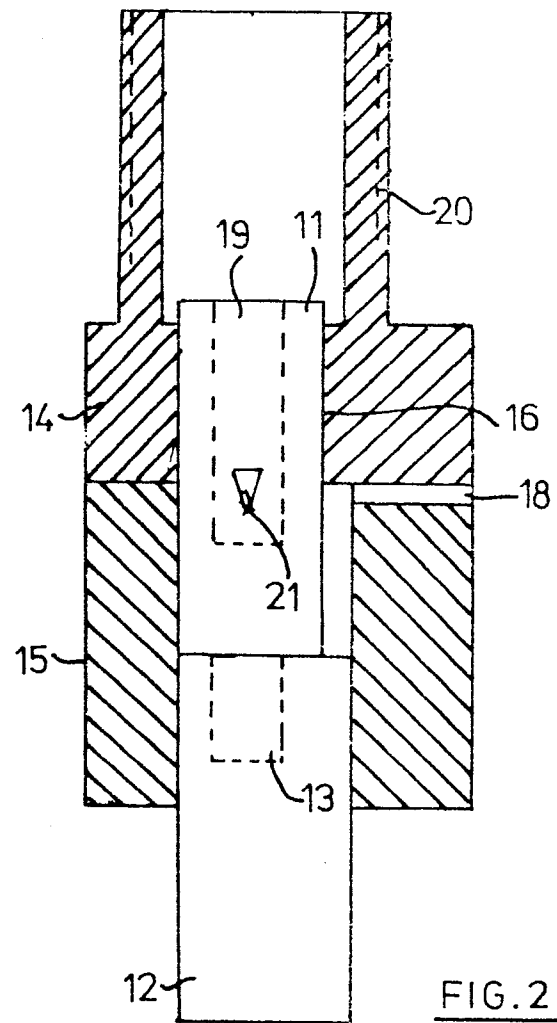
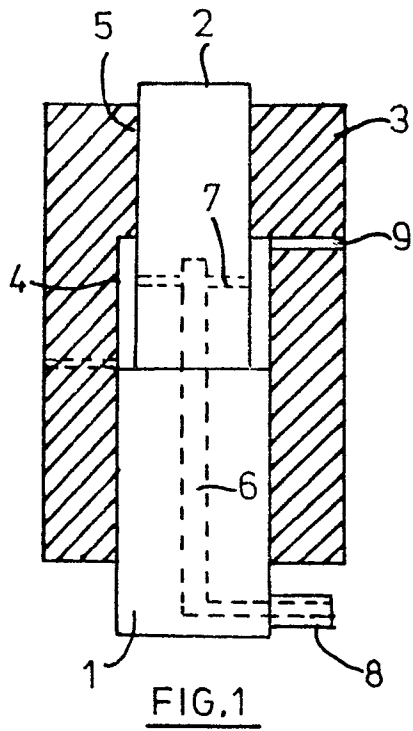
19. A pump as claimed in anyone of the preceding claims characterized in that the inlet passage provided in the plunger accommodates a flexible member, the outer circumference of which is located at a small distance from the inner wall of the inlet passage so that during a suction stroke fluid can flow in around the flexible member and during a compression stroke the flexible member is slightly compressed and jammed against the inner wall of the inlet passage.

20. A pump as claimed in anyone of the preceding claims characterized in that means are provided for varying the capacity of the compression chamber.

21. A pump as claimed in anyone of the preceding claims characterized in that the compression chamber communicates with a passage which opens out opposite a plunger portion having at its outer periphery several relatively spaced grooves with the aid of which during the compression stroke, a communication can be established intermittently between said passage and an outlet conduit.

22. A pump as claimed in anyone of the preceding claims characterized in that in the construction comprising three plunger portions and two compression chambers the outlet conduits of the two compression chambers are interconnected for mixing the fluids displaced through the two compression chambers.

23. A pump as claimed in anyone of the preceding claims characterized in that the pump is provided with a valve formed by a spiral spring, between the turns of which the fluid comes in during the suction stroke, whereas during the compression stroke the turns are pressed together for closing the passage.



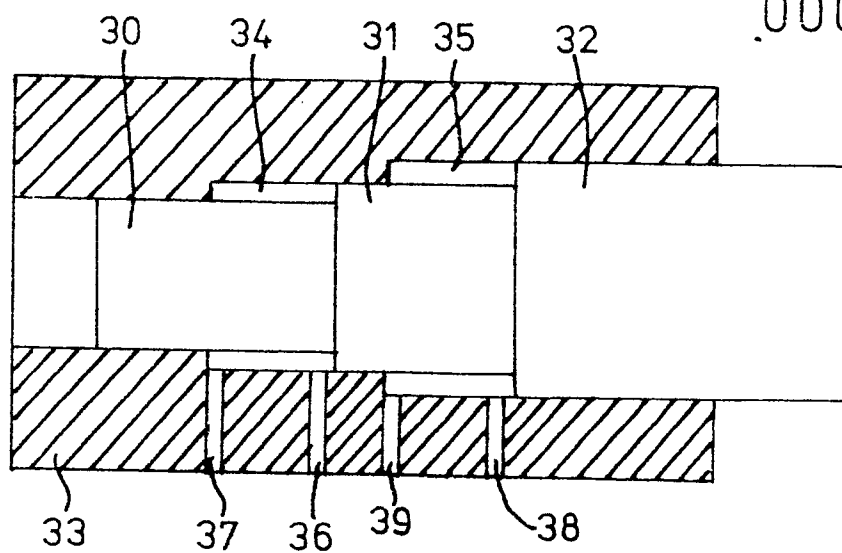


FIG. 7

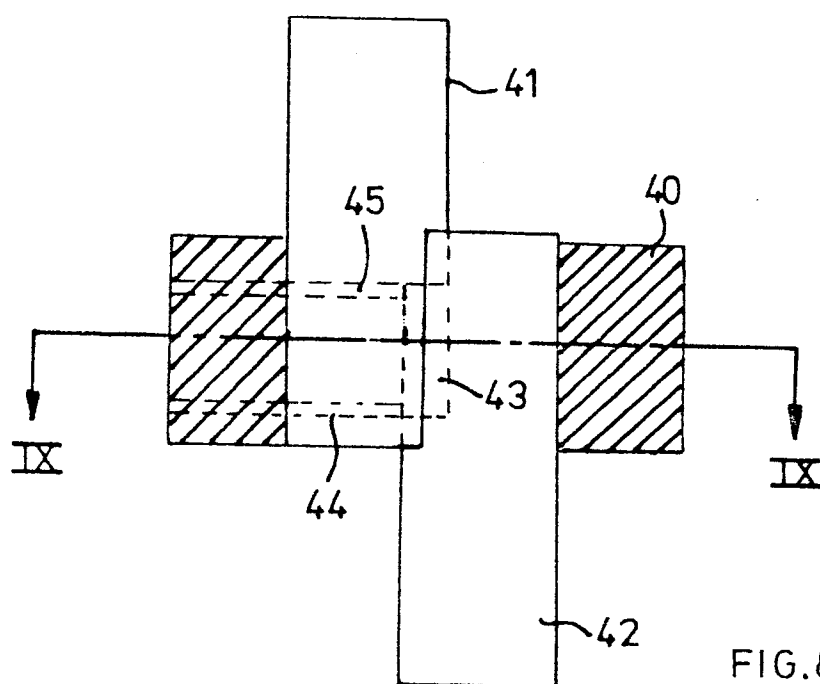


FIG. 8

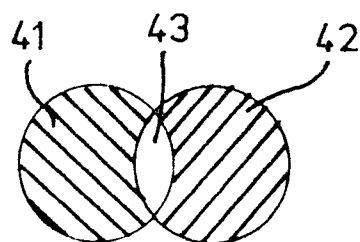


FIG. 9

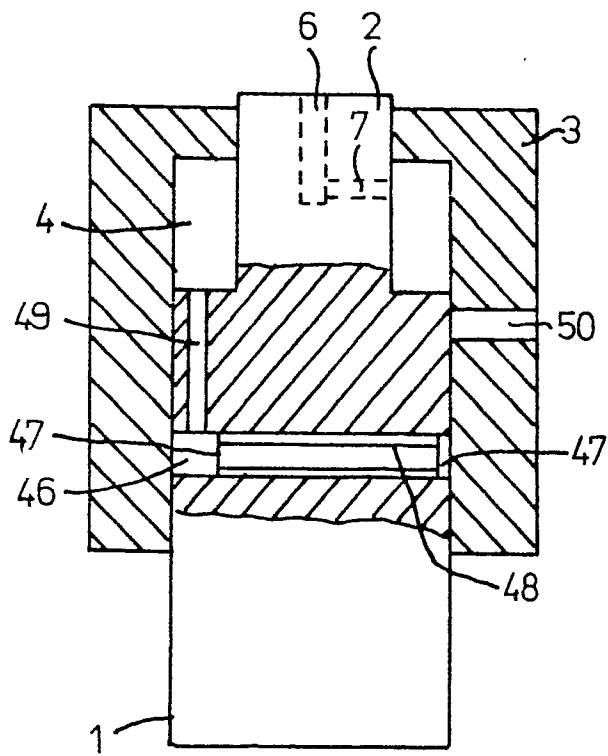


FIG. 10

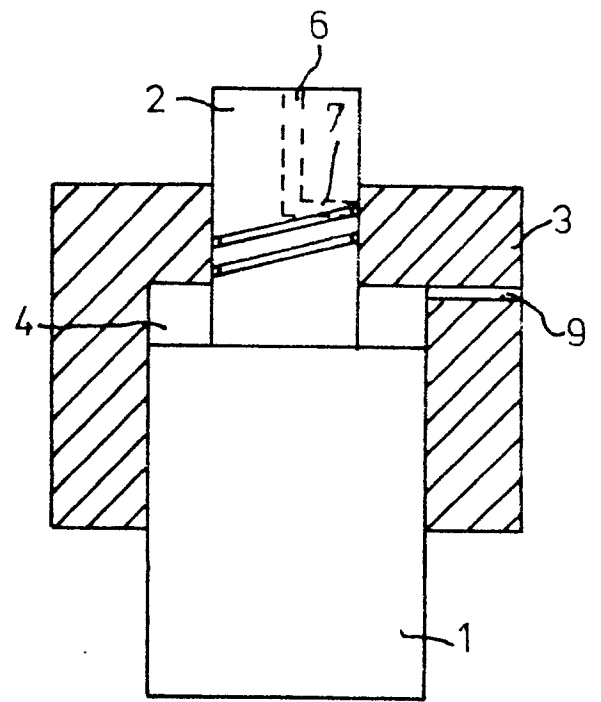


FIG. 12

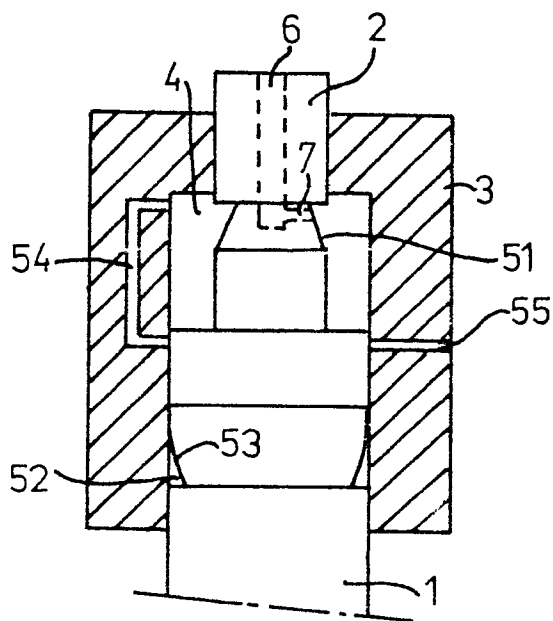


FIG. 11

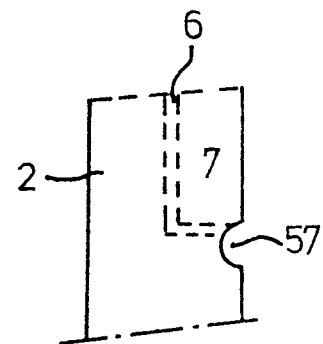


FIG. 13

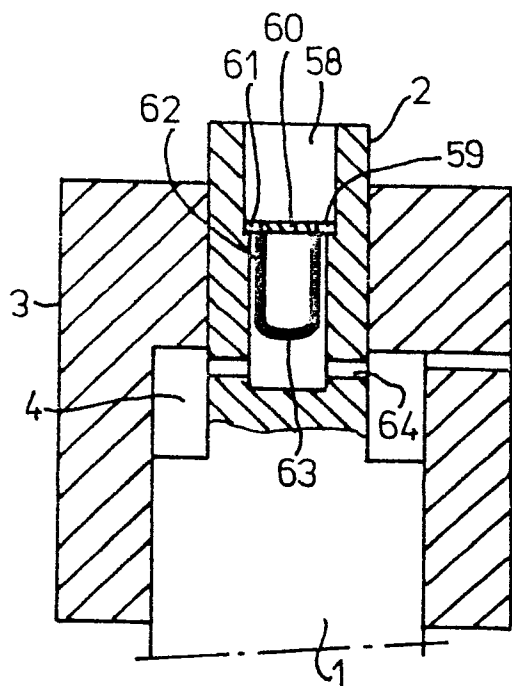


FIG. 14

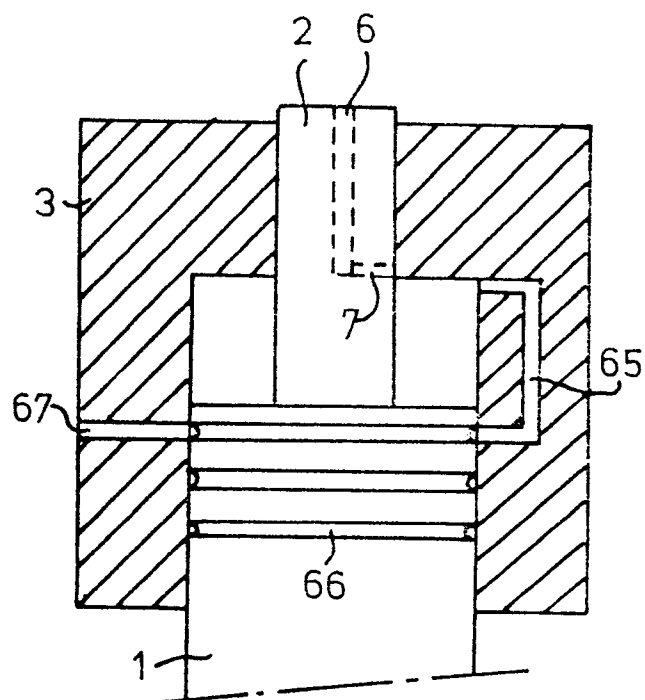


FIG. 15

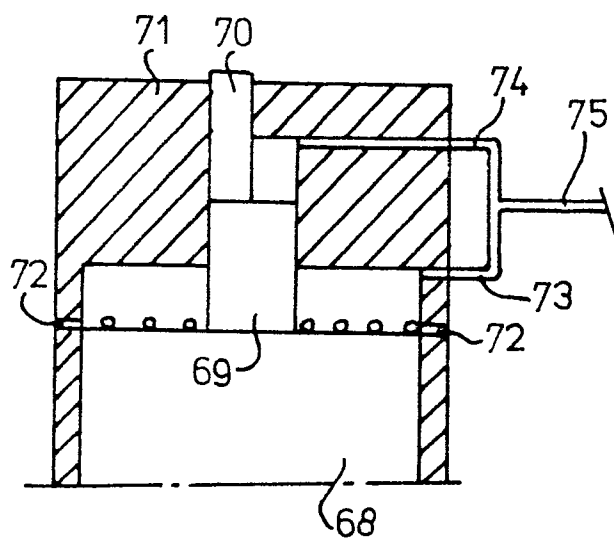


FIG. 16

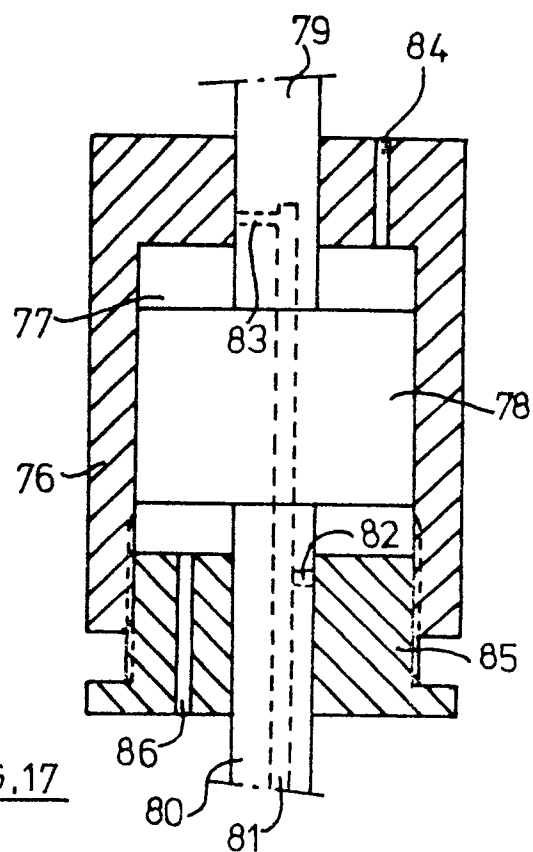


FIG. 17

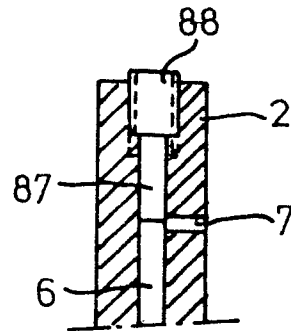


FIG. 18

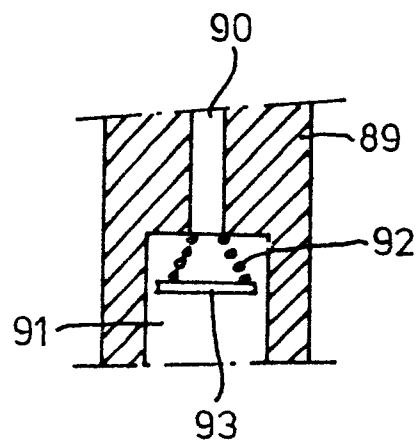


FIG. 19



DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ²)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<u>DE - A - 2 203 135</u> (BADE) * Figures 1 and 6; claims 3.1 to 3.10 * --	1,2,7- 9,22	
	<u>GB - A - 171 858</u> (FELL) * Page 4, lines 25-70; figures 1-5 * --	7	
	<u>DE - C - 115 508</u> (LENTZ) * Figure 2; claim 2 * --	1,2,8, 9	TECHNICAL FIELDS SEARCHED (Int. Cl. ²)
	<u>FR - A - 875 379</u> (VOGEL) * Figure, claims 1 and 2 * --	1,2,8, 9	F 02 M 59/16 F 01 B 7/18 7/20
	<u>US - A - 1 511 962</u> (HANSON) * Figures 1-7; claims 1 and 2 * --	10	
	<u>FR - E - 44 670</u> (760 761)(GRAUCE) * Figures 1 and 2; page 2, lines 12-15 * --	12	
	<u>FR - A - 813 057</u> (LOEWENSTEIN) * Figure 1; claim 5, page 2, lines 81-88 * --	13	
	<u>DE - A - 2 128 635</u> (LANGEN & CO) * Figure 1, claim 2 * -- ./.	16	

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ²)	
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim		
X	<u>GB - A - 662 097</u> (WILTON ROW EX-TENSIONS) * Page 2, lines 10-52; figure * --	1,2,5, 11	F 04 B 5/00 7/04 F 16 J 1/00	
X	<u>DE - C - 415 434</u> (STANNEBEIN) * Figures 1 and 2; claim *	1,2		
X	<u>GB - A - 1 447 011</u> (STERLING-WINTHROP GROUP LTD.) * Figures 3 and 6; page 4, lines 68-119 * --	1,2,5, 12		TECHNICAL FIELDS SEARCHED (Int.Cl. ²)
	<u>US - A - 2 383 324</u> (LE CLAIR) * Figure 1; claim 1 * --	1,2,5, 21	F 04 B 7/04 5/00 3/00 21/02 21/04 25/02 39/10 F 16 N 13/02 13/00 13/22 B 01 L 3/02 G 01 F 11/02 F 02 M 43/02 45/05 ./.	
	<u>FR - A - 588 150</u> (EHRHARDT & SEHMER A.G.) * Figures 1 and 2; page 1, lines 38-56 * --	1,2,8		
	<u>DE - C - 261 425</u> (A. HINZ) * Figures 1 and 2; claim 1 * --	3		CATEGORY OF CITED DOCUMENTS
	<u>US - A - 3 737 258</u> (KRAUJA) * Figures 1-5; column 3, lines 17-45 and column 4, lines 8-34 * --	6		X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document	
The present search report has been drawn up for all claims				
Place of search	Date of completion of the search	Examiner		
The Hague	21-12-1978	ANDRIES		



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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>US - A - 1 651 682 (EISENHAUER)</u> * Figures 1-3; claim 1 *	23	
	<u>FR - A - 441 684 (POKORNY & WITTEKIND)</u> * Figures 1-3; claim *	1	
	<u>US - A - 2 356 511 (DESCOURTIS)</u> * Figures 1-6; claim 1 *	11,13	
	<u>CH - A - 225 029 (TEVES)</u> * Figures; claim *	1	
	<u>FR - A - 2 205 636 (SMIRNOV)</u> * Figure 3 *	1,17	
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)



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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<u>GB - A - 232 286</u> (HUGHES) * Figures 1 and 2; claims 1-3 * --	17	
	<u>FR - A - 957 405</u> (MALETY) * Figure; claim * --	17	
	<u>DE - C - 419 438</u> (KRUPP) * Figure 1, claims 1 and 2 * --	17	
	<u>GB - A - 1 054 366</u> (CONTROLS COMPANY OF AMERICA) * Figures 1,3,6 and 7; claims 4 and 11 * --	19	TECHNICAL FIELDS SEARCHED (Int. Cl.)
	<u>GB - A - 166 678</u> (GORDON) * Claim; figures 1, and 2 * --	19	
	<u>US - A - 3 327 633</u> (DUINKER) * Figures 1-3; claim 3 * --	20	
	<u>GB - A - 20 995 A.D. 1909</u> (BLATTNER) * Figure, claims 1 and 2 * --	21	
	<u>GB - A - 28 981 A.D. 1911</u> (CASH) * Figure ; claim 1 * --	21	
	<u>US - A - 3 347 264</u> (BUNN) * Figures 1-6; claims 1-3 * --	23	
		./.	