

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 966 596 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

30.10.2002 Bulletin 2002/44

(21) Application number: **97901087.3**

(22) Date of filing: **13.01.1997**

(51) Int Cl.7: **F01L 9/02**, F01L 31/24

(86) International application number:
PCT/FI97/00013

(87) International publication number:
WO 98/030787 (16.07.1998 Gazette 1998/28)

(54) **A DEVICE FOR CONTROLLING THE VALVES OF AN INTERNAL COMBUSTION ENGINE**

VORRICHTUNG ZUR KONTROLLE DER VENTILE EINES VERBRENNUNGSMOTORS

DISPOSITIF SERVANT A COMMANDER LES SOUPAPES D'UN MOTEUR A COMBUSTION
INTERNE

(84) Designated Contracting States:
CH DE ES FR GB IT LI SE

(43) Date of publication of application:
29.12.1999 Bulletin 1999/52

(73) Proprietor: **Stenman, Tapio**
02230 Espoo (FI)

(72) Inventor: **Stenman, Tapio**
02230 Espoo (FI)

(74) Representative: **Söderman, Päivi Karin Lisbeth**
Innopat Ltd,
P.O. Box 556
02151 Espoo (FI)

(56) References cited:

WO-A-85/01984	DE-A- 2 636 944
DE-A- 2 825 316	DE-B- 2 448 311
DE-C- 3 909 822	US-A- 5 152 258

EP 0 966 596 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The subject of the invention is a device defined in the introduction of patent claim 1 for controlling valves in an internal combustion engine.

[0002] The cams of a camshaft are alone insufficient in controlling the function of the valves, since once the shape of the cam is determined it is always a result of several compromises. Therefore the purpose of this invention is to modify the valve function after the cam shape has been defined. The background for this invention is a valve operation system for internal combustion engines, where the cam controlling the function of the valve is functionally connected with the cam end piston, and the valve end piston is controlled by releasing transmitting fluid, like oil, from the chamber connecting the pistons, as well as by the movement provided by the cam. Several similar devices are known.

[0003] In several devices mentioned above there are only one filling hole and one discharge hole, along with some system controlling the discharge. An example of a device with more than one discharge hole, as in the invention in question, is a device presented in the German patent publication DE 26 36 944 A1. From this patent publication, concerning a device with two discharge holes from the space between the pistons, can be seen that it is possible to remove transmitting fluid from the space between the valve end piston and the cam end piston, shut by the cam end piston, with a non-return valve only to ensure a good refill of fluid. Moreover, the above mentioned patent publication presents a possibility to discharge transmitting fluid with an adjusting valve further away from the space between the said pistons, at a location which neither of the said pistons opens or closes. The space for pressurized oil can thus be opened with an adjusting valve without making up enough pressure to open the engine valve, hence the engine valve is made idle. Contrary to the invention under discussion, this known solution does not achieve alteration in the timing of the valve. Furthermore, this known device contains a valve end piston, which is equipped with a hydraulic damping system, where a damping component connected to the valve end piston settles in a socket made for it. In this case a flow resistance is achieved for the return motion of the piston in question and hence for the closing travel of the valve; which is needed after discharging the transmitting fluid. However, there is no graduation in the damping as there is in the invention under discussion, where the first the part of the piston with a smaller diameter creates a larger annular space, and then the part of the piston with a larger diameter creates a smaller annular space. Moreover, the damping does not include a possibility to adjust the resistance that is made up, whereas the different type of damping structure of the invention in question does, as is seen in patent claim no. 5.

[0004] Another example is PCT publication WO 85/01984, which also has two discharge holes from the

space between the pistons. The cam end piston closes one discharge channel for transmitting fluid controlled by a controlling valve. What is achieved is the opening of the valve, and also a change in the timing of the closing and a change in the amount of the lift. However, there is no possibility to change the opening moment of the valve in relation with the rotation angle of the crankshaft. This is because there is no channel with control valves to open the valve end piston and/or some other way to merely to make the closing of the valve earlier, without the opening of the valve being at the same time delayed. In addition to the said channel it is possible to discharge transmitting fluid from the space between the cam end piston and the valve end piston with another control valve through another channel, which will not be closed by the cam end piston, or opened by the valve end piston. The means mentioned last is not associated with controlling the timing of the valve. The valve end piston is larger than the cam end piston in the implementation of the known device. However, the opportunity to damp the stroke of the valve made possible by the implementation is not used, so that the said piston would enter the smaller space partially forming a diminishing annular space, as a device conforming to the invention in question does, to say nothing of there being stepless adjusting linked with the entering, whereas the invention in question includes also this feature.

[0005] The purpose of the invention under discussion is to achieve an improved controlling device, with more diversified control of the function of the valves of an internal combustion engine, especially so that there is a possibility to change the open time of the valve in relation to the rotation angle of the crankshaft in addition to the length of the open time of the valves.

[0006] This purpose of the invention is achieved with an invention of which the characteristic features are presented in the attached patent claim no. 1. This invention makes it possible to choose the time of the discharge of the transmitting fluid. The timing takes place generally as follows. The opening of the engine's valve is delayed, that is, the open time of the valve is reduced from the beginning, when transmitting fluid shut up by the cam end piston is released at the beginning of movement of the controlled valve provided by the camshaft cam, although this moves also the closing of the engine's valves earlier. Discharging transmitting fluid opened by the valve end piston during the opening movement of the valves causes the closing of the engine's valve to be made earlier, in other words, it shortens the open time of the valve only in the end of the valve's movement. In this case the open time of the engine's intake or exhaust valve is earlier compared with the previous case. In both cases the said discharge hole is closed and opened by the said piston, so that the discharge is limited to the part of the movement controlled by the said cam end piston, or the valve end piston. The control valves can remain open or closed for extended periods of time, if the running condition of the engine so demands, without

having to make wearing reciprocation motion.

[0007] Beneficial applications of the invention are presented in dependent patent claims 2 - 18. The invention is described in more detail with the help of sample applications by referring to enclosed figures where:

Figure group 1 represents the invention in an implementation where the camshaft is under the cylinder cover and is not displayed in the figures. Figure group 1 includes figures 1A - 1D, which differ from each other in switching systems for releasing transmitting fluid, plus figure 1E where end 48 of piston 6 has been slimmed. In the said group of figures the cam end piston is lowermost resting on the pushrod and the valve end piston is topmost bounded by a control screw, which can for instance be part of a rocker arm depressing the valve. If the end of the cam end piston is shaped differently, it can have direct contact with the cam of the camshaft, and the camshaft can be at the level of the cover to one side, instead of a pushrod, which demonstrates the system's versatility.

In figure group 2A - 2E the cam end piston is topmost and the valve end piston lowermost, so the functions in it are inverted, compared with figure group 1A - 1E. The main functions are or could be the same as in figure group 1, although the cylinder arrangement in figure group 2 is different comprising inner cylinder 7 and outer cylinder 21. Corresponding parts and channels are identically numbered for easy comparison and to make it clear that the same invention is in question, only in a different environment.

Figure group 2 displays an implementation of the invention with an overhead camshaft. Figure group 2 includes figures 2A - 2E plus specification 2F of the device's measuring component, which is presented as a diagram in figure 2D. The said components of device 2F measure and adjust in each channel that all the discharges from the channels for initial discharge of the corresponding units remain of equal amount. The systems in figures 2A - 2E of figure group 2 differ only in the way of controlling the transmitting fluid.

Figure group 3 - 8 describe camwheels that can be used with the invention to utilize some of their benefits better, except figure 6, where the valve movements caused by camwheels 3 and 4 are presented as functions A2a and A2b of the rotation angle of the crankshaft.

Figures 9 - 11 present the structure damping the strike of the inner end of the valve end piston presented in figure group 1A - 1E and the valve connected to it into its sleeve during the "lost motion".

Figure 12 presents the cylinder cut open and spread out by its discharge channels.

Figure 13 presents a set of curves conforming to a certain cam shape of the intake and exhaust cams, where the valve motions are represented as a function of the rotation angle of the crankshaft.

Figures 14A - 14D loosely represent a basic cam shape corresponding to figure 13 and in particular the effects on the valve motions achieved by solutions conforming to the invention, when the effects are described by presenting the motions of the valves as a function of the rotation angle of the crankshaft.

Figures 15A and 15B represent the valve motion in devices in which the valve lift is not substantially reduced regardless of whether the initial discharge is opened or not. Figure 15A can in a certain way be linked with figure 2E. The valve function described in figures 15A, 15B can be achieved in the way referred to in patent claim 7.

Figures 1A - 1E and 2A - 2E aim to illustrate two different types of solutions; both of them apply, however, to the same invention as regards their means of control and their principles of functioning.

[0008] When the ignition key (not displayed in the figures), which in a system described in figures 1A - 1E is placed between the battery and the pressure switch, is turned, power from the battery turns on the electric motor 38, which runs oil pump 38B. The pressure of transmitting fluid is directed to pressure switch 39 through control channel 40, and when the pressure is sufficiently high, it will make a connection between starter motor 43 and its power source, in this case battery 35. The pressure switch can alternatively transmit for example a control impulse which opens a connection for pressurised air produced by a separate air pump to enter into the starter system. Pressure, measured by pressure switch 39, is directed through a distribution network to channels 8, 9, and 10 of the valve control system units. Starting the engine is therefore not possible until the pressure of transmitting fluid is sufficient. The pressure of the transmitting fluid can be possible in lubrication points if the capacity of oil pump 38B is chosen in the design stage with this in mind.

[0009] When the engine is run by starter motor 43, the engine's own oil pump 41 will start rotating in order to take care of lubricant pressure and also oil pressure in the valve control system, if motor oil is used as transmitting fluid. The engine's starter and oil feed system 37 include also pressure regulator 42, oil filter 45, and intake filter 44. Also one or more pressure accumulators, like for example pressure accumulators 28 and 29, can be included in the oil feed line. Figure group 2A - 2E

does not define the oil feed system in more detail.

[0010] Figure group 1A - 1E displays control unit CU21, which controls the function of the system with the help of input information 22I.

[0011] Figures 1A - 1E as well as figures 2A - 2E endeavor to illustrate that all the figures in the figure groups have at least one discharge hole for initial discharge, such as 20, or 20A, and 20B, which is closed by piston 4 at the beginning of the motion of the intake or exhaust valve; and at least one discharge hole for final discharge, 13A, 11A, 11B, which is opened by piston 6 at the end of the motion of the intake or exhaust valve. The opening in question can be either allowed or not allowed with control valve 15D, 16D, 20D, 20F. Throttling device 20E, seen in figures 2B and 2E, can also be used, instead of the control valve; in this device discharge is throttled, for instance, so that the relative amount of discharge for each working motion of piston 4 reduces as the running speed grows. Instead of or in addition to the intake or exhaust valve, in an engine using gaseous fuel, for example, the valve controlling the gaseous fuel can be controlled. These functions are expressed in patent claims 1 - 4.

[0012] Under discussion, therefore, is a device for controlling the function of the valves of an internal combustion engine, where the engine includes in each cylinder at least one intake valve and/or at least one exhaust valve or at least one control valve for gaseous fuel. The device includes a camshaft 1 cam 2 end piston 4 and a valve end piston 6, as well as a cylinder space 5 between pistons 4, 6; which is connected to a filling channel 8, 9, 10 for fluid transmitting power between the pistons, and a discharge channel 20, 20A, 20B, or 20C with their discharge holes 20, 20A, 20B, which the cam end piston 4 closes at the beginning of the opening motion of the valve. The device is such that the cam end piston 4 closes one or more discharge holes 20, 20A, 20B of the first discharge channel 20, 20A, 20B, or 20C at the beginning of the opening motion of the valve, whereupon the opening moment of the valve can be made later and correspondingly the closing moment can be made earlier by allowing discharge flow through the first discharge channel 20, 20A, 20B, or 20C. Besides the function in connection with said piston 4, the other, valve end, piston 6 opens one or more discharge holes 13A, 11A, 11B of the other discharge channel 15, 16, at the end of the opening motion of the valve, whereupon the opening distance of the valve can be shortened and the closing moment be made earlier by allowing discharge flow through the said other discharge channel 15, 16. Hence, in the case of discharge in connection with piston 6, the open time of the intake, exhaust, or gas control valve of the engine compared to the rotation angle of the crankshaft, will be earlier than in the case mentioned before, involving piston 4.

[0013] This change in timing can be seen by comparing the curves caused by opening the said initial and final discharges, as displayed in exemplary figures 14A

- 14D. Curves I1, III1, I4, I5, III4, III5, caused by opening the initial discharges (through channels 20, 20A, 20B, 20C), show, for example, the valve beginning to open later than in curves I2, I3, III2, III3, caused by opening the final discharges (through channels 15, 16), which show, for example, earlier closing of the valve. These curves and corresponding functions will be returned to later, as the explanation of the invention progresses.

[0014] In addition, the device is designed so that at least two discharge channels 15, 16, 20, 20A, 20B, 20C are connected to discharge flow adjusting devices 15D, 16D, 20D, 20F, 20E, 20G, with which the discharge flows of channels 15, 16, 20, 20A, 20B, 20C can be separately adjusted.

[0015] The controls of the device include controllable valves 15D, 16D, 20D, 20F for opening or closing the discharge channels. These function as control valves for the system.

[0016] The controls of the device include a throttling device 20E, 20G for adjusting the amount of discharge flow, at least in the discharge channel 20, 20A, 20B, 20C, controlling the beginning of the motion of the valve.

[0017] Also the following components can be seen in the device. In figures 1A - 1E grooves 46 on piston 6 and grooves 47 on piston 4, with functions of spreading and distributing oil, for example. Discharge route 19 to reduce pressure around piston 6 at the end 49 of piston 6. Annular groove 19C, which, among other things, lubricates piston 6. Cylinder support edging 19B. Springs 4J, 5J, and locking device 17B, seen in figures 1A - 1E and 2A - 2E. Discharge holes 13A, 11A, 11B, inner annular groove 12A and outer annular groove 12B. In figures 2A - 2E a discharge route 23 for excess oil, air venting 116, lock rings 17A, 17C, mounting 22. Discharge route 19, function same as 19 in figures 1A - 1E.

[0018] Patent claim 5 expresses a means of damping the impact of the intake or exhaust valve, for instance, on its seating. The means is displayed in figure group 1A - 1E. How this happens is seen in more detail in figure group 9 - 11. The flow route of oil is reduced as piston 6 approaches its tolerance 48A, when, for example, the intake or exhaust valve of the engine approaches its closed position. In this case the flow route is reduced from flow route 48E in figure 10 to flow route 48F in figure 11.

[0019] In the device presented in figure group 1A - 1E, the cam end piston 4 is smaller in diameter than the valve end piston 6. Hence, the motion distance of the cam end piston 4 is longer than the motion distance of the valve end piston 6, caused by cam end piston 4 through transmitting fluid. The end 48 of the valve end piston 6 and its parts 48D and 48C together with step 18A connected with the change in diameter 18C - 18B of the cylinder 18 of the pistons border a larger annular space 48E, which is reduced to the designated size by adjusting screw 4S. This adjusting screw can determine how deep into the cylinder section 18B, with a smaller diameter, the adjusting screw 4S pushes parts 48D, 48C

of the end 48 of piston 6, pressed by the valve spring. In this case flow takes place, if it is so adjusted, partially or completely through the smaller annular space 48F as the valve approaches its closed position. The flow resistance of flow from annular space 48E, 48F into cylinder space 5, that can be adjusted with adjusting screw 4S in the manner presented above, increases significantly by the designated motion distance before the closing of the valve, if the speed of the valve exceeds a certain limit. Thus the impact of the valve on its seating is reduced, which is needed during the phenomenon known as the "lost motion", which happens when transmitting fluid is allowed out of the space 5 between the pistons.

[0020] The device includes channel 15 for larger final discharge, and channel 16 for smaller final discharge, as well as respective control valves 15D and 16D, or at least control valve 15D for larger final discharge. Larger final discharge 15 makes, for instance, the closing of the valve earlier than smaller final discharge 16.

[0021] Figure 2E shows an example of the device that in addition to the features presented can also include following features. The device includes channel 15 for larger final discharge and open channel 16 for smaller or small final discharge. As an alternative, it can include only open channel 16 for small final discharge. The lift part of cam 2 on camshaft 1 has been made higher than, for example, the valve spring structure in connection with the device in question would allow, if there were no discharge flow out of cylinder space 5. In this case the lift caused by the lift part of cam 2 on camshaft 1 remains sufficient also when the amount of discharge through throttling device 20E and/or 20G is large, due to small running speed, and/or when the control channel 20D, 20F of one of the discharge channels 20, 20A, 20B, 20C for initial discharge is open. This principle can be applied to any of the presented implementations of the device.

[0022] Without control valve 16D, channel 16 remains an open channel. In this case, preventing discharge flow with adjusting device 20D, 20F for initial discharge, or with throttling device 20E, 20G, included in the controls, causes transmitting fluid to discharge through channel 16 for final discharge. This prevents piston 6 from moving too far, thus preventing lift excessive to the opening system structure of the valve, during the lift of the high lift part on cam 2 on camshaft 1, when the initial discharge is closed, or significantly throttled. Allowing discharge flow with adjusting device 20D, 20F, or increasing discharge relatively through throttling device 20E, 20G as running speed is reduced, reduces the said discharge through channel 16, or ends the discharge in question. In both cases the inner end 48 of the valve end piston 6 rises, with reasonable amounts of discharge, almost to the level of the inner entrance of discharge hole 11B of channel 16 in question. In this case the rise height of the valve remains also the same or almost the same as the relation of the length of the open time and timing of the valve to the rotation angle AM of

the crankshaft changes. The ways in question of maximizing the lift of the valve work best, when at least some transmitting fluid is discharged, either through the route opened by the valve end piston of the device, or by the route closed by the cam end piston, or through both, as long as the engine is running, and the discharge is not at least completely disabled in any operation situation.

[0023] An example of the achieved valve function can be seen in the sets of curves 15A and 15B. In both sets of curves the basic curve III0, caused by a cam on the camshaft (not displayed), is not achieved, because channel 16 is not closed. Basic curve III0 begins at point 20K and merges with curve III2, presenting the actual lift of the valve, at point 16E, when control valves 20D, optional 20F, and 15D, are closed. Curve III2 is achieved by final discharge through open channel 16. In figure 15A the height and end part of curve III1, which is achieved by opening control valve 20D, are the same as in curve III2, which merges with it at point 16F. In this case the valve opens later, at point 20J as shown by curve III1.

[0024] Alternatively, the rise of the valve remains on the level of curve III3. When for example control valve 20D is closed, the curve begins at point 20K, and when control valve 15D is open, the discharge of transmitting fluid begins at point 15F through channel 15. When control valve 20 is open, and control valve 15D is opened simultaneously, the curve begins at point 20J, and follows curve III3 from point 15H. Either curve III1, or the different curve III2, matching curve III0 at its first part, or alternatively curve III3, the lowest and displaying the earliest closing, starting at point 20K or 20J, can be achieved similar as regards to the rise of the valve.

[0025] In figure 15B, with functions and numbering corresponding with figure 15A, curve III3 does not exist, because here channel 15 with its components have been left out of the structure of the device conforming to the invention. The device (not displayed) achieving the curves in figure 15B includes only channel 20, controlled by control valve 20D, and the open channel 16. In this case curve III1, beginning at point 20J, is achieved with control valve 20D being open. When control valve 20D is closed, the first part of curve III0 (solid line), starting at point 20K, and curve III2 (broken line), connected to it, beginning at point 16E, are achieved. The part presented with a broken line in curve III2 shows the greatest possible opening and latest possible closing of the valve.

[0026] Figure group 3 - 8 presents as diagrams camwheels on the camshaft, which include in addition to the main lift part at least one additional lift part, either connected to the main lift part or separate of it, or an additional part. Patent publication FI 67130 gives an account on improving the efficiency ratio of an engine equipped with exhaust camwheels including main lift parts 2 and additional lift parts 3, like in figures 3 or 4. This method is represented in the set of curves describing the function of the valves in figure 6, where curve

A2b corresponds to the camwheel in figure 3 and curve A2a corresponds to the camwheel in figure 4. A method like this, for example, can be employed better, when the function conforming to additional lift part 3 can be disabled when needed and the valves of the engine can function in accordance with the main lift part 2.

[0027] The camwheels in question, as in figures 3, 4, and also in figures 5, 7, and 8, can function in connection with the system conforming to figures 1A - 1E, for instance. The function controlled by an additional part connected to them, or an additional lift part, can be disabled either completely or partially with a device conforming to the invention. Figure 5 presents as a diagram the known cam shape of the camwheel used in connection with a compression pressure brake. It includes a main lift part 3, and gradual additional lift parts 1 and 2 in order to lead the exhaust pressure caused by a throttling device out of the discharge distribution pipework back into the cylinder for the duration of the compression stroke (1) and out of the cylinder for the duration of the working stroke (2). For example, one must at all times be able to, some way, switch off the compression pressure brake for most of the time while the engine is running. Figures 7 and 8 describe cams equipped with additional parts 1, or 1 and 3, like additional lift parts, connected to the main lift part 2. All additional parts on the camwheel or additional lift parts, mentioned above, can be disabled from their function of lifting the valve, while the main lift part of the camwheel remains in its function of lifting the valve, by opening one or more of the control valves 20D, 20F, controlling initial discharge. In this case the part of the cam in question, or the one preceding it, will cause discharge of transmitting fluid into the reservoir, but the cam part in question will cause no valve lift at all, or at least not the usual extent of valve lift. The cam parts in question are re-enabled to their function of lifting the valve by closing the control valves mentioned above, 20D and/or alternatively 20F.

[0028] If disabling additional part 3, in figure 8, following main lift part 2 in its rotation direction, from its function of moving the valve, is desired, it can also be done by opening one of the control valves 15D, 16D, controlling final discharge. This applies also to other cam parts connected to the main lift part 2, following main lift part 2 in its rotation direction, like camwheel part 3 in figure 3. The additional function caused by additional lift part 3 in figure 3 achieves, when desired, four different positions of the valve of the engine, for instance. First, when all control valves 15D, 16D, and 20D are closed, the valve of the engine opens according to the height of the additional lift part 3. Secondly, control valve 16D achieves a position, where the valve of the engine is slightly more closed than the height of additional lift part 3 determines. Thirdly, control valve 20D achieves an almost closed position. Fourthly, control valve 15D achieves a complete closed position.

[0029] The effect of opening control valve 15D or 16D does not reach, however, the function caused by, for ex-

ample, the additional part 1 on the camwheel, located before the main lift part 2 in its rotation direction, as seen in figure 8. Hence, the closing of the valve can be controlled with additional part 3 and control valves 15D, 16D without the effect of additional part 1, located before the main lift part 2 of the camwheel in its rotation direction, reaching the opening of the valve. The effect of initial discharge 20D, 20F reaches the valve motion caused by both additional parts 1 and 3.

[0030] The main lift part 3 of the camwheel in figure 5, for example, remains in its function of moving the valve, when the control valve 20D, 20F mentioned above is open, even though the rise of the valve of the engine is somewhat reduced and the additional lift parts 1 and 2 are not lifting the valve. If the ways maximizing the rise of the valve mentioned before are applied here, the device will be equipped with open channel 16 and the camwheel in question will be equipped with a main lift part 3, which is made higher, and both components are appropriately dimensioned. In this case, also additional lift parts 1 and 2 can be made somewhat higher in relation to the camwheel than is shown, yet they still can be disabled from their function of moving the valve by opening initial discharge 20D, 20F in a sufficiently large amount. By closing the control valve 20D, 20F in question, the additional lift parts 1 and 2 of the camwheel in question can be re-enabled to their function of moving the valve.

[0031] Also, when needed, the main lift part 2 of a camwheel with an additional lift part in figure 3 or 4, for example, can be made higher than the valve spring structure, for example, would allow without additional arrangements, whereupon the rise of the valve caused by the main lift part remains sufficient even when control valves 20D, 20F are opened in order to disable additional lift part 3. Control valve 20D, and/or 20F is closed in order to enable any of the additional lift parts mentioned above or to enable additional part 1, 3. In this case transmitting fluid is discharged through discharge hole 11B, of the smaller final discharge 16, into annular groove 12B and further through discharge channel 16 into the reservoir during the lift of the main lift part. This cancels the damaging lift effect of the high main lift part, as required, in a way similar to already described in connection with a camwheel without additional lift parts.

[0032] Discharge of transmitting fluid can be measured in the way presented in figure 2C by allowing it through valve 106, located between throttling device 20E, of the initial discharge, and closed control valve 20D, into the measuring device. Discharge can be adjusted by changing the flow aperture of throttling device 20E. In this case the function of the valves between the cylinders can be balanced, when it is needed when imbalance in the function of the valves of the engines is caused, for example, by varying degrees of stiffness in the valve springs, so that reducing the flow aperture of throttling device 20E decreases the amount of transmitting fluid reaching the measuring device, increases the

rise of the valve and extends the open time of the valve. Enlarging the flow aperture, on the other hand, increases the amount of transmitting fluid reaching the measuring device, reduces the rise of the valve and shortens the open time of the valve. In this way a desired open time level can be adjusted for the entire engine, and hence, a desired operating level for the engine achieved in a function where control valves 20D are kept open.

[0033] The balancing of the function of the valves between the cylinders of the engines can also be done continually. This is done by adding into the channel for initial discharge, like into channel 20 after control valve 20D, as seen in figure 2D, of the control devices of the valves in all the cylinders of the engine, a retreating piston 107, performing constant measuring. More details are seen in figure 2F. Piston 107 moves from its location in cylinder space 113 into a position, where discharge holes 114 are essentially closed. This retreating motion allows a certain amount of fluid in place of piston 107. The amount is determined mainly by the size and position of holes 114 and 111, and the dimensions of piston 107. However, the retreating motion mentioned above will not allow more transmitting fluid in place of piston 107 from space 5 between the valve end piston 6 and the cam end piston 4 than designed.

[0034] The discharge route from the bottom of the cylinder space 113 through channel 111, with a small diameter, into the groove 109 encircling the device and channel 110 for circulating oil remains open. Spring 108, the pressure of circulating oil, and flow from channel 20 through hole 115 into space 113, cause piston 107 to return back to measuring position. Corresponding motion and measuring the amount of fluid takes place at the beginning of each opening motion of each valve for as long as the control valve 20D, for the said initial discharge, is kept open. Component 117 holds the measuring device in its proper location.

[0035] Figure 12 shows cylinder 18, 7 cut open and unrolled on a plane. Examining both figure 12 and the figures in either figure group 1A - 1E or figure group 2A - 2E reveals that when the inner end of valve end piston 6 opens a pressure connection, transmitting fluid is allowed, through venting and discharge holes 13A distributed on the circumference of cylinder 18, 7, into circular groove 12A. Through circular groove 12A the transmitting fluid is allowed, through discharge holes 11A, for larger final discharge, distributed on the circumference of cylinder 18, 7, into a pressure connection around the valve end piston (6). This situation is repeated when the discharge holes 11B, for smaller final discharge, are opened by the inner end of piston 6 in question. In this case a connection to outer circular groove 12B and further to pressure holes 13B is formed. The pressure centers piston 6, pushing piston 6 symmetrically away from the walls of cylinder 18, 7, from three directions, and thus prevents wear between components. The centering takes place best when control valves 15D, 16D are closed, or when some component of discharge route 15,

16 causes counterpressure to the discharge of transmitting fluid into the reservoir.

[0036] The valve of the engine can be disabled from opening completely or partially in the way seen in figures 1B and 2B. From the space 5 between pistons 4 and 6 a sufficient connection to the reservoir of transmitting fluid is opened, through the filling channel 10 of transmitting fluid, equipped with check valve 10A. This is done with control valve 23D for filling channel 10 in question. Alternatively, or additionally, the discharge of transmitting fluid can be done with control valve 15D, for larger final discharge, through discharge hole 13A (not displayed), enlarged for that particular purpose, and through circular groove 12A, to which a connection is partly open, for example, in the way presented in figure 1E through the slimmed end 48 of piston 6, or opened by piston 6. The function last mentioned could cause, when used alone, the low curve 13 of the exhaust valve, seen for example in figures 14C, 14D. The function can be secured in both mentioned implementations by partially closing the feed of transmitting fluid from oil pump 41 with control valve 24D. The solutions in question could in some operating circumstances be advantageous in an engine, for instance, with more than one intake and/or exhaust valve for each cylinder, or, among other things, in cold circumstances when one desires at times to leave some exhaust gas in the cylinder in rhythmic intervals to raise the running temperature of the ignition chamber of a compression ignition engine.

[0037] It can be seen in both figure group 1A - 1E and figure group 2A - 2E, that despite the differences in implementation between the figure groups, a similar structure causing whirl slowing down and preventing reflux of transmitting fluid is formed in both. Filling channel 8 and boosting channel 9 are connected to the space 5 between the cam end piston 4 and the valve end piston 6, so that an appropriate structure causing whirl in reflux is formed, such as a stepped structure, for example, suitable in relation with holes 8, 9, and channel 8A. When the pressure of transmitting fluid is greater in the space 5 between the pistons in question than in filling channels 8, 9, and when either one or both of the filling channels has all open connection to the space between pistons in question, reflux toward the oil pump deliberately causes whirling and flow resistance in some section of the filling channels in question. This will reduce reflux toward the oil pump. This can be achieved regardless of whether the channels in question are equipped with check valves. If check valves are used, their wear is reduced, because the pressure stroke on them will not be as sharp. A connection can be made from the channels in question to a third filling channel 10, which is equipped with check valve 10A. The inner entrance of channel 10 will not be closed by either of the pistons 4, 6 in question. This makes it possible for space 5 to be filled after a running halt, for instance, after sufficient pressure of transmitting fluid is produced, but channels 8 and 9 are closed by piston 4.

[0038] Figure 1E reveals, that it is identical with figure 1A, except for the end 48 of piston 6, which is made slimmer. This achieves a similar effect in connection with channel 16 as discharge channels 13A achieve when control valve 15D is opened in connection with channel 15 in figures 1A - 1D. The discharge begins with a smaller amount already through discharge channels 13A into channel 15, when control valve 15D is open as the end 48 of the piston opens the holes in question. With a slimmer end 48 of piston 6, the pressure that is present in the space 5 between the pistons, when the valve of the engine is opened, will also discharge into channel 16 while control valve 16D is open, or when control valve 16D does not exist, starting gradually, so that the discharge begins earlier and with a smaller amount at first, as the slimmed part reaches entrances 11B. The discharge begins in full only when the end 48 of piston 6 completely opens discharge holes 11B. In this case the pressure stroke on the discharge channel and possible discharge pipeworks is not as sudden and powerful. This reduces disadvantageous vibration in the possible discharge pipework. If one desires even greater graduality of the opening, the end 48 of piston 6 can be made conical. Alternatively or additionally the entrance of discharge hole 11A, 11B can be made in the shape of a triangle standing on one corner, or an oval or ellipse, so that the discharge increases gradually as the end 48 of piston 6 opens the hole in question. As a further alternative, if there are, for example, three discharge holes in the same cylinder 18, 7, the inner entrances of discharge holes 11A, 11B can be placed on slightly different levels in their cylinder in question, so that the end 48 of the piston reveals them, at least partly, at different moments.

[0039] The curves describing the basic principle of valve motion in figures 14A - 14D are formed within the limits of cam geometry and the limits set by each device, when the amounts of discharge of transmitting fluid and/or the position of discharge holes are designed in specific ways, differing from each other. Also curves 10 and III0 are achieved differing from figures 15A and 15B, because also channel 16 can be closed with control valve 16D. The curves caused by final discharges can merge at their intersecting point with curves III0, I0, determined by cam shape alone, and/or with curves caused by initial discharges, with a similar mechanism as in figures 15A, 15B. For example, in figure 14A, curve III3 merges with curve III1. In figure 14D curve I2 merges with curve I0, I1, and 14, whereupon in addition to the timing of the other valves in view three different opening moments can be selected, while the closing moment remains the same, conforming to curve 12. The curves, the valve control system, and controlling the system can be connected with each other in the following way: Curves 10 and III0: no discharge of transmitting fluid. Curves I2 and III2: discharge of transmitting fluid through channel 16. Curves I3 and III3: discharge of transmitting fluid through channel 15. In connection with curves I3 and

III3, in some curves, like for example in figure 14A, the effect of discharge hole 13A is presented, which, for instance causes curve 13 to begin gradually along curve 10, and to separate from it at point A15. Furthermore, curve III3 merging with curve III1 in figure 14A is formed, when control valves 20D and 15D are open at the same time and the amount of discharge through channel 15 is relatively large.

[0040] The initial discharges achieve following curves: Curves I1 and III1: discharge through channel 20, or 20A in figures 1A, 1B, 1D, 1E, 2A - 2E, for example. Figure 14D, curves 14 and III4: discharge through channel 20C with control valve 20F in figure 1C; or through channel 20B in figure 1D; in both figures through throttling device 20G while the flow aperture of the mentioned throttling device or the discharge of transmitting fluid is larger than the discharge through throttling device 20E. In figures 1C and 1D curve I1, III1 is achieved with control valve 20D. Figure 14D, curves I5 and III5: discharge in figures 1C, 1D simultaneously through both control valve 20D and control valve 20F through both throttling devices 20E and 20G. Curve I3 in figures 14C, 14D: discharge through enlarged channel 13A and the inner circular groove 12A with control valve 15D.

[0041] The initial discharge of the device, through channel 20, 20A, 20B, 20C, primarily, and/or also the final discharge through channel 15, 16, can be equipped with a throttling device 20E, 20G, or a part of the discharge route functioning as a throttling device, which limits the largest discharge possible. Alternatively, the limiting of the mentioned discharge and/or at what stage of its motion piston 4, 6 closes the corresponding discharge hole 20, 20A, 20B, 11A, 11B, is dimensioned so that the amount of discharge through the limiting component is significantly larger per each working motion of piston 4, 6 in low running speeds of the engine than in higher running speeds. This can be achieved because, among other things, the flow time for each motion of piston 4, 6 is reduced as the running speed grows. In this case, for example, the open time of the valve controlled by the device presented in figure 2E increases as the running speed of the engine grows. Correspondingly, the open time of the valve is shortened automatically as the running speed of the engine is reduced, when discharge takes place increasingly through throttling device 20E, as the duration of the discharge grows, and decreasingly through channel 16, which limits the greatest rise of the valve. The open time of the valve is adjusted in this case by the running speed while the rise of the valve remains constantly almost unchanged, except when control valve 15D is opened. Changing the valve timing in this way and simple structure is advantageous in several engine types.

[0042] As a simple example a device (not displayed) can be mentioned, which includes one initial discharge 20, and one final discharge 15. The function is controlled, for example, with a control valve which, while opening the other channel 15 closes the other channel 20,

and while opening channel 20 closes channel 15. The device has only one filling channel 8.

[0043] As an example of more versatile valve control, in figure 1C an opportunity to use control valve 20D, 20F to select either one or both of throttling devices 20E, 20G, with different sized flow apertures. In figure 1D one can choose whether to open discharge channel 20A, closing earlier, or discharge channel 20B, closing later, or both. Throttling devices 15E, 112, some throttling devices 20E, and throttling points in certain control valves function as parts of the air venting route, but the flow resistance caused by the mentioned throttles can, when desired, be dimensioned so that the opening time of the valve can be somewhat limited in low running speeds of the engine.

Claims

1. A device for controlling the function of the valves of an internal combustion engine, when the engine contains at least one intake valve and/or at least one exhaust valve and/or at least one control valve for gaseous fuel for each cylinder, the device containing a camshaft (1) cam (2) end piston (4) and a valve end piston (6) as well as a cylinder space (5) between the pistons (4, 6), which is connected to a filling channel (8, 9, 10) for fluid transmitting power between the pistons, and a discharge channel (20, 20A, 20B, 20C) with its discharge holes (20, 20A, 20B), which the cam end piston (4) closes at the beginning of the opening motion of the valve, the cam end piston (4) closing from the opened state one or more discharge holes (20, 20A, 20B) of the first discharge channel (20, 20A, 20B, 20C) during the motion caused by the cam (2), directed away from the cam (2) at the beginning of the opening motion of the valve, whereupon the opening moment of the valve can be made later and correspondingly the closing moment of the valve can be made earlier by allowing discharge flow through the first discharge channel (20, 20A, 20B, 20C) before the said closing; **characterized by** the valve end piston (6) opening one or more discharge holes (13A, 11A, 11B) of the second discharge channel (15, 16) at the end of the opening motion of the valve, whereupon the opening distance of the valve can be reduced and the closing moment can be made earlier by allowing discharge flow through the said second discharge channel (15, 16), and the discharge flow can be prevented either completely or partially by keeping closed or by partially or completely closing the said second discharge channel (15, 16) by means of a control device or control valve (15D, 16D, 15E)
2. A device conforming to patent claim 1, **characterized by that** at least two discharge channels (15,

16, 20, 20A, 20B, 20C) are connected to discharge flow control devices (15D, 16D, 20D, 20F, 20E, 20G), with which the discharge flows of the channels (15, 16, 20, 20A, 20B) can be controlled separately.

3. A device conforming to patent claims 1 and 2, **characterized by that** the control devices include controllable valves (15D, 16D, 20D, 20F), in order to open or close the discharge channels.
4. A device conforming to patent claims 1 to 3, **characterized by that** the control devices include a throttling device (20E, 20G) to adjust the amount of discharge flow, at least in the discharge channel (20, 20A, 20B, 20C) controlling the beginning of the opening motion.
5. A device conforming to any of patent claims 1 to 4, **characterized by that** the cam end piston (4) is smaller in diameter than the valve end piston (6), whereupon the traveling distance of the cam end piston (4) is longer than the traveling distance of the valve end piston (6) that is caused by the cam end piston (4) and transmitted with transmitting fluid; and that the end (48) of the valve end piston, together with a step (18A) in connection with the changing of diameter of the cylinder (18) of the pistons, confines a larger annular space (48E), which is made smaller with an adjusting screw (4S) down to the designated size when the flow occurs, if the flow is so adjusted, partially or completely through the smaller annular space (48F) as the valve nears its closed position and the flow resistance of the flow from the annular space (48E, 48F) into the cylinder space (5), adjusted by the control screw (4S) in the way mentioned above, grows significantly before the closing of the valve by the designated traveling distance, if the speed of the valve exceeds a certain limit, thus reducing the valve's impact power on its seat.
6. A device conforming to patent claim 1, **characterized by that** the device includes a channel (15) for a larger amount of final discharge and a channel (16) for a smaller amount of final discharge and also control valves (15D and 16D) corresponding with both said channels, respectively, or at least the corresponding control valve (15D) for a larger amount of final discharge.
7. A device conforming to patent claim 1 or 6, **characterized by that** the device includes the channel (15) for a larger amount of final discharge and the channel (16) for a smaller amount of final discharge, or alternatively, only a channel (16) for a small amount of final discharge, and that the lift part of the camshaft cam is made higher than, for example, the

valve spring structure would allow without discharge flow from the cylinder space (5), whereupon the lift of the valve caused by the lift part in question remains sufficient even when one of the channels (20, 20A, 20B, 20C) for initial discharge is open, and the channel (16) for a smaller or small amount of final discharge has been left without control devices as an open channel, whereupon excessive lift of the valve is prevented, when needed, while the channel (20, 20A, 20B, 20C) for initial discharge is partially or completely closed.

8. A device conforming to patent claim 1 or 7, **characterized by that** when using an additional camshaft cam lift part (3) separate from the main lift part (2) of the cam, or an additional part (1, 3) of the main lift part, the said part can be partially or completely disabled from its function of lifting the valve, while the main lift part (2) of the cam remains in its function of lifting the valve, by opening one or more of the control valves (20D, 20F) controlling initial discharge, and that then the main lift part (2) of the camwheel can, when needed, be made higher than the valve spring structure, for example, would allow without additional arrangements, whereupon the lift of the valve caused by the main lift part (2) remains sufficient also when the control valves in question (20D, 20F) are opened in order to partially or completely disable the additional lift part (3) or the additional part (1, 3) from its function of lifting the valve, and that while the said control valves (20D, 20F) are closed in order to enable the additional lift part (3) or the additional part (1, 3), transmitting fluid is discharged through the discharge hole (11B) of the channel (16) for a smaller amount of final discharge into an annular groove (12B) and through the discharge channel (16) into a reservoir, during the lift of the main lift part, thus reversing the harmful lift effects of the high main lift part.

9. A device conforming to patent claim 1, **characterized by that** the discharge of transmitting fluid can be measured by allowing it through a valve (106), placed between the throttling device (such as 20E) for initial discharge and the control valve (such as 20D) for initial discharge, into a measuring device; and it can be adjusted by changing the flow aperture of the throttling device (such as 20E), whereupon balancing valve function between the cylinders of the engine, when it is needed when imbalance in the function of the valves of the engines is caused, for example, by varying degrees of stiffness in the valve springs, can be achieved by reducing the flow aperture of the throttling device (such as 20E) which reduces the amount of transmitting fluid reaching the measuring device, adds to the lift of the valve, and lengthens the open time, whereas enlarging the flow aperture increases the amount of transmitting

fluid reaching the measuring device, reduces the lift of the valve, and shortens the open time.

10. A device conforming to patent claim 1, **characterized by that** the balancing of valve function between the cylinders of the engine can be done continually by adding into the discharge channel (20) for initial discharge, after the control valve (20D), in corresponding valve control system units of all the cylinders, a retreating piston (107), performing continual measuring, moving from its location in its cylinder space (113) into a position where discharge holes (114) are essentially closed allowing transmitting fluid into the location of the moved piston (107) from the space (5) between the valve end piston (6) and the cam end piston (4) at the beginning of each opening motion of the valve for as long as the said control valve (20D) for initial discharge is kept open.

Patentansprüche

1. Gerät zur Kontrolle der Funktion der Ventile eines internen Verbrennungsmotors, wenn der Motor mindestens ein Einlassventil und/oder mindestens ein Auslassventil und/oder mindestens ein Kontrollventil für gasförmigen Treibstoff für jeden Zylinder aufweist, und das Gerät wie folgt beinhaltet: eine Nockenwelle (1), Nocken (2), einen Kolben am Nockenende (4), einen Kolben am Ventilende (6) sowie einen Zylinderraum (5) zwischen den Kolben (4, 6), der mit einem Füllkanal (8, 9, 10) für kraftübertragende Flüssigkeit zwischen den Kolben verbunden ist, und einen Abflusskanal (20, 20A, 20B, 20C) mit Abflusslöchern (20, 20A, 20B), welchen der Kolben am Nockenende (4) am Beginn der Öffnungsbewegung des Ventils schließt; der Kolben am Nockenende (4), der im geöffneten Zustand ein oder mehrere Abflusslöcher (20, 20A, 20B) des ersten Abflusskanals (20, 20A, 20B, 20C) während der durch den Nocken verursachten Bewegung schließt, weggerichtet von dem Nocken (2) am Beginn der Öffnungsbewegung des Ventils, wobei der Öffnungsmoment des Ventils später, und entsprechend der Schließungsmoment des Ventils früher gemacht werden kann, dadurch, dass man bevor der genannten Schließung den Abfluss durch den ersten Abflusskanal (20, 20A, 20B, 20C) erlaubt, **gekennzeichnet durch** den Kolben am Ventilende (6), der ein oder mehrere Abflusslöcher (13A, 11A, 11B) des zweiten Abflusskanals (15, 16) am Ende der Öffnungsbewegung des Ventils öffnet, wobei die Öffnungsdistanz des Ventils reduziert werden kann und der Schließungsmoment **durch** den erlaubten Abfluss **durch** den genannten zweiten Abflusskanal (15, 16) früher gemacht werden kann, und der Abfluss entweder vollständig oder teilweise verhindert werden kann, wenn der genannte zweite Ab-

flussskanal (15, 16) mittels eines Kontrollgerätes oder Kontrollventils (15D, 16D, 15E) geschlossen halten wird oder teilweise oder vollständig geschlossen wird.

2. Gerät nach Anspruch 1, **dadurch gekennzeichnet, dass** zumindest zwei Abflusskanäle (15, 16, 20, 20A, 20B, 20C) zu Kontrollgeräten (15D, 16D, 20D, 20F, 20E, 20G) für Abfluss verbunden sind, mit denen die Abflüsse der Kanäle (15, 16, 20, 20A, 20B) getrennt kontrolliert werden können.
3. Gerät nach Ansprüchen 1 und 2, **dadurch gekennzeichnet, dass** die Kontrollgeräte regulierbare Ventile (15D, 16D, 20D, 20F) aufweisen, um die Abflusskanäle zu öffnen oder zu schließen.
4. Gerät nach Ansprüchen 1 bis 3, **dadurch gekennzeichnet, dass** die Kontrollgeräte ein Drosselgerät (20E, 20G) aufweisen, um die Menge des Abflusses, zumindest im Abflusskanal (20, 20A, 20B, 20C) kontrollierend am Beginn der Öffnungsbewegung, anzupassen.
5. Gerät nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** der Kolben am Nockenende (4) im Durchmesser kleiner als der Kolben am Ventilende (6) ist, wobei der zurückgelegte Weg des Kolbens am Nockenende (4) länger als der zurückgelegte Weg des Kolbens am Ventilende (6) ist, was durch den Kolben am Nockenende (4) verursacht wird und mit übertragender Flüssigkeit übertragen wird; und das Ende (48) des Kolbens am Ventilende, zusammen mit einem Schritt (18A) in Verbindung mit der Änderung des Durchmessers von dem Zylinder (18) der Kolben, beschränkt einen größeren kranzförmigen Raum (48E), der mit einer Einstellschraube (4S) zur bezeichneten Größe vermindert wird, wenn der Fluss auftritt, wenn der Fluss so angepasst ist, teilweise oder vollständig durch den kleineren kranzförmigen Raum (48F), wenn das Ventil sich der geschlossenen Position nähert und der Flusswiderstand des Flusses vom kranzförmigen Raum (48E, 48F) in den Zylinderraum (5), angepasst durch die Einstellschraube (4S) wie oben erwähnt, bezeichnenderweise wächst bevor die Schließung des Ventils durch den bezeichneten zurückgelegten Weg, wenn die Geschwindigkeit des Ventils eine bestimmte Grenze übersteigt und somit die Anschlagkraft des Ventils an ihren Sitz reduziert.
6. Gerät nach Anspruch 1, **dadurch gekennzeichnet, dass** das Gerät einen Kanal (15) für eine größere Menge an endgültigem Abfluss und einen Kanal (16) für eine kleinere Menge an endgültigem Abfluss aufweist, und auch Kontrollventile (15D und 16D) dementsprechend mit beiden genannten Ka-

nälen, beziehungsweise, oder zumindest ein entsprechendes Kontrollventil (15D) für eine größere Menge an endgültigem Abfluss.

7. Gerät nach Ansprüchen 1 bis 6, **dadurch gekennzeichnet, dass** das Gerät einen Kanal (15) für eine größere Menge an endgültigem Abfluss und einen Kanal (16) für eine kleinere Menge an endgültigem Abfluss aufweist, oder alternativ dazu, nur einen Kanal (16) für eine kleinere Menge an endgültigem Abfluss, und dass der Hubteil des Nockens der Nockenwelle höher gemacht worden ist, als zum Beispiel die Struktur der Ventiltfeder ohne Abfluss vom Zylinderraum (5) erlauben würde, wobei der durch den betreffenden Hubteil verursachte Hub des Ventils genügend bleibt, auch wenn einer der Kanäle (20, 20A, 20B, 20C) für einen anfänglichen Abfluss geöffnet ist, und der Kanal (16) für eine kleinere oder kleine Menge an endgültigem Abfluss übrig bleibt ohne Kontrollgeräte wie ein offener Kanal, wodurch der überschüssige Hub des Ventils verhindert wird, wenn nötig, während der Kanal (20, 20A, 20B, 20C) für anfänglichen Abfluss teilweise oder vollständig geschlossen ist.
8. Gerät nach Ansprüchen 1 bis 7, **dadurch gekennzeichnet, dass** wenn ein zusätzlicher Hubteil des Nockens der Nockenwelle (3) separat vom Haupthubteil (2) des Nockens, oder ein zusätzlicher Teil (1, 3) des Haupthubteils verwendet wird, kann der genannte Teil teilweise oder vollständig von seiner Funktion des Hubs des Ventils verhindert sein, während der Haupthubteil (2) des Nockens durch Öffnen von einem oder mehreren Kontrollventile (20D, 20F), die den anfänglichen Abfluss kontrollieren, in der Funktion des Hubs des Ventils bleibt, und dass dann der Haupthubteil (2) der Nockenwelle, falls nötig, höher gemacht werden kann als die Struktur der Ventiltfeder, was zum Beispiel ohne zusätzliche Einteilung erlaubt sein würde, wobei der durch den Haupthubteil (2) verursachte Hub des Ventils genügend bleibt, auch wenn die betreffenden Kontrollventile (20D, 20F) geöffnet sind, um den zusätzlichen Hubteil (3) oder den zusätzlichen Teil (1, 3) teilweise oder vollständig von ihrer Funktion des Hubs des Ventils unfähig machen, und dass während die genannten Kontrollventile (20D, 20F) geschlossen sind, um den zusätzlichen Hubteil (3) oder den zusätzlichen Teil (1, 3) zu aktivieren, übertragende Flüssigkeit durch die Abflusslöcher (11 B) des Kanals (16) abgelassen wird, um eine kleinere Menge an endgültigem Abfluss in eine kranzförmige Rinne (12B) und durch den Abflusskanal (16) in einen Behälter abzulassen, während der Hub des Haupthubteils, somit umkehrend den abträglichen Hub des höheren Haupthubteils bewirkt.
9. Gerät nach Anspruch 1, **dadurch gekennzeichnet,**

dass der Abfluss von übertragender Flüssigkeit gemessen werden kann, durch Ablassen der Flüssigkeit durch das Ventil (106), das zwischen dem Drosselgerät (wie 20E) für anfänglichen Abfluss und dem Kontrollventil (wie 20D) für anfänglichen Abfluss angeordnet ist, in ein Messgerät; und er kann durch Änderung der Flussöffnung des Drosselgeräts (wie 20E) angepasst werden, wobei die Ventilfunktion zwischen den Zylindern des Motors balanciert wird, wenn es nötig ist, wenn Ungleichgewicht in der Funktion der Ventile der Motoren verursacht wird, zum Beispiel, durch Variieren des Grades an Steifheit in den Ventilfeuern, was durch das Reduzieren der Flussöffnung des Drosselgeräts (wie 20E) erreicht werden kann, was die Menge an übertragender Flüssigkeit reduziert, die das Messgerät erreicht, den Hub des Ventils hinzufügt und die Öffnungszeit verlängert, wogegen das Erweitern der Flussöffnung die Menge an übertragender Flüssigkeit, die das Messgerät erreicht, erhöht, den Hub des Ventils reduziert und die Öffnungszeit verkürzt.

10. Gerät nach Anspruch 1, **dadurch gekennzeichnet, dass** das Gleichgewicht der Ventilfunktion zwischen den Zylindern des Motors fortsetzend gemacht werden kann, durch Hinzufügen in den Abflusskanal (20) für anfänglichen Abfluss, nachdem das Kontrollventil (20D), dementsprechend die Ventilkontrollsystemeinheit von allen Zylindern, ein zurückziehender Kolben (107), stetiges Messen ausführend, der sich von seiner Lage in seinem Zylinderraum (113) in eine Position bewegt, wo Abfluslöcher (114) essentiell geschlossen sind, erlaubend das Ablassen der übertragenden Flüssigkeit in die Lage des sich bewegenden Kolbens (107) vom Raum (5) zwischen dem Kolben am Ventilende (6) und dem Kolben am Nockenende (4) am Beginn jeder Öffnungsbewegung des Ventils für solange, als das genannte Kontrollventil (20D) für anfänglichen Abfluss offen gehalten wird.

Revendications

1. Un dispositif contrôlant le fonctionnement des soupapes d'un moteur à explosion interne lorsque celui-ci contient au moins une soupape d'admission et/ou au moins une soupape de refoulement et/ou au moins une soupape contrôlant la combustion gazeuse pour chaque cylindre, incluant un arbre à cames (1) une came (2) un piston de came (4) et un piston de soupape (6), ainsi qu'un vide cylindrique (5) entre les pistons (4, 6) qui est raccordé aux canaux de remplissage (8, 9, 10) du liquide transmettant l'énergie entre les pistons, et un canal d'échappement (20, 20A, 20B, 20C) avec ses orifices de vidange (20, 20A, 20B), que le piston de came (4) ferme lors du mouvement d'ouverture de la soupape,

le piston de came (4) fermant un ou plusieurs orifices de vidange (20, 20A, 20B) du premier canal d'écoulement (20, 20A, 20B, 20C) durant le mouvement causé par la came (2), dirigé loin de la came (2) au commencement du mouvement d'ouverture de la soupape, de sorte qu'il est possible de retarder le moment d'ouverture de la soupape et, respectivement, d'avancer le moment de sa fermeture, en admettant un écoulement par le premier canal d'écoulement (20, 20A, 20B, 20C) avant sa fermeture; **se caractérise par** l'ouverture d'un ou de plusieurs orifices de vidange (13A, 11A, 11B) du second canal d'écoulement (15, 16) par le piston de soupape (6) à la fin du mouvement d'ouverture de la soupape, de sorte que la distance d'ouverture de la soupape peut être réduite et que le moment de fermeture peut être avancé par un écoulement à travers les canaux d'écoulement (15, 16) et l'écoulement peut être stoppé, complètement ou partiellement, en maintenant fermé le second canal d'écoulement (15, 16) par l'intermédiaire d'un appareil de contrôle ou d'une soupape de contrôle (15D, 16D, 15E).

2. Un dispositif conformément à la revendication du brevet 1, **se caractérise par le fait qu'au moins** deux canaux d'écoulement (15, 16, 20, 20A, 20B, 20C) sont connectés aux dispositifs de contrôle du flux d'écoulement (15D, 16D, 20D, 20F, 20E, 20G), permettant ainsi un contrôle autonome de l'écoulement au sein des canaux (15, 16, 20, 20A, 20B).
3. Un dispositif conformément aux revendications des brevets 1 et 2, **se caractérise par le fait que** les appareils de contrôle comprennent des soupapes réglables (15D, 16D, 20D, 20F), pour l'ouverture ou la fermeture des canaux d'écoulement.
4. Un dispositif conformément aux revendications des brevets 1 à 3, **se caractérise par le fait que** les appareils de contrôle comprennent un mécanisme de réglage (20E, 20G) pour la régulation du flux d'écoulement, au moins dans le canal d'écoulement (20, 20A, 20B, 20C) qui régit le mouvement initial d'ouverture.
5. Un dispositif conformément à l'une des revendications des brevets 1 à 4, **se caractérise par le fait que** le piston de came (4) a un diamètre inférieur à celui du piston de soupape (6), de sorte que le temps de déplacement du piston de came (4) est plus long que le temps de déplacement du piston de soupape (6), causé par la transmission d'énergie du piston de came (4) par le fluide; et par le fait que l'extrémité (48) du piston de soupape, associée à un changement de niveau (18A) en relation avec un changement de diamètre du cylindre (18) des pistons, limite un espace annulaire plus large (48E) qui

peut être ajusté au moyen d'une vis de réglage (4S) à la dimension voulue lorsque l'écoulement a lieu, si l'écoulement est ainsi réglé, partiellement ou complètement à travers un espace annulaire plus petit (48F), alors que la soupape approche de sa position fermée, et que la résistance de l'écoulement de l'espace annulaire (48E, 48F) dans l'espace cylindrique (5), ajustable avec la vis de réglage (4S) comme décrit ci-dessus, augmente considérablement avant la fermeture de la soupape, de la distance choisie, si la vitesse de la soupape dépasse une certaine limite, réduisant ainsi la puissance du choc de la soupape sur son socle.

6. Un dispositif conformément à la revendication du brevet 1, **se caractérise par le fait que** l'appareil comprend un canal (15) pour un débit d'écoulement plus important et un canal (16) pour un débit d'écoulement final moins important ainsi que les soupapes de contrôle (15D et 16D) qui correspondent, respectivement, à ces deux canaux ou au moins à celui (15D) du débit d'écoulement final le plus important.
7. Un dispositif conformément aux revendications des brevets 1 ou 6, **se caractérise** par le fait que l'appareil comprend le canal (15) pour un débit d'écoulement final plus important et le canal (16) pour un débit d'écoulement final moins important, ou alternativement, seulement un canal (16) pour un petit débit d'écoulement final ; et par le fait que la partie ascendante de l'arbre à cames est conçue plus élevée que, par exemple, ne le permettrait la structure de la soupape à ressort sans écoulement au niveau de l'espace cylindrique (5), de sorte que la montée de la soupape, causée par la partie ascendante en question, demeure suffisante même lorsque le canal (20, 20A, 20B, 20C) pour l'écoulement initial est ouvert, et que le canal (16) pour un plus petit ou petit débit d'écoulement final est laissé sans mécanisme de contrôle comme un canal ouvert, de sorte que l'ascension excessive de la soupape est empêchée, si besoin est, lorsque le canal (20, 20A, 20B, 20C) pour un écoulement initial est partiellement ou complètement obstrué.
8. Un dispositif conformément aux revendications du brevet 1 ou 7, **se caractérise par le fait que** lorsqu'on emploie une partie ascendante additionnelle à l'arbre à cames (3) séparée de la partie ascendante principale de la came (2) ou une partie additionnelle (1, 3) de la partie ascendante principale, la partie en question peut être libérée partiellement ou complètement de sa fonction de soulever la soupape, pendant que la partie ascendante principale (2) de la came maintient sa fonction d'élévation de la soupape, en ouvrant une ou plusieurs des soupapes de contrôle (20D, 20F) régissant le débit initial ; et **par le fait que** la partie ascendante prin-

cipale (2) de la roue de came peut, si nécessaire, être conçue plus élevée que ne le permettrait la structure de la soupape à ressort, par exemple, sans réglage supplémentaire, de sorte que l'ascension de la soupape causée par la partie ascendante principale (2) demeure suffisante même lorsque les soupapes de contrôle en question (20D, 20F) sont ouvertes pour libérer partiellement ou complètement la partie ascendante additionnelle (3) ou la partie additionnelle (1, 3) de l'action de soulèvement de la soupape, et que, lorsque les soupapes de contrôle mentionnées (20D, 20F) sont fermées pour laisser active la partie ascendante additionnelle (3) ou la partie additionnelle (1, 3), le liquide transmetteur s'évacue à travers l'orifice de vidange (11B) du canal (16) pour un plus petit écoulement final dans la rainure annulaire (12B) et à travers le canal d'écoulement (16) vers le réservoir, pendant l'ascension de la partie ascendante principale, renversant ainsi les effets nuisibles d'une ascension excessive de la partie ascendante principale.

9. Un dispositif conformément à la revendication du brevet 1, **se caractérise par le fait que** l'écoulement du liquide transmetteur peut être mesurée en le laissant circuler par la soupape (106), placée entre l'appareil de réglage (tel que 20E) et la soupape de contrôle (telle que 20D) lors de l'écoulement initial, dans un appareil de mesure ; et ajustée en changeant le flux d'écoulement de l'appareil de réglage (tel que 20E), de sorte que l'équilibrage du fonctionnement des soupapes entre les cylindres du moteur, suite à un déséquilibre causé, par exemple, par la raideur des ressorts de la soupape, se fasse, si besoin est, par la restriction de l'ouverture d'écoulement de l'appareil de réglage (tel que 20E) qui réduit le débit du liquide transmetteur atteignant l'appareil de mesure, augmente le temps d'ascension de la soupape et prolonge le temps d'ouverture, tandis qu'un agrandissement de l'ouverture d'écoulement augmente la quantité de liquide transmetteur atteignant l'appareil de mesure, réduit le temps d'ascension de la soupape et raccourcit le temps d'ouverture.
10. Un dispositif conformément à la revendication du brevet 1, **se caractérise par le fait que** l'équilibrage du fonctionnement entre la soupape et les cylindres du moteur peut être réalisé de façon continue par l'ajout au sein du canal d'écoulement (20) lors d'un écoulement initial, après la commande de la soupape de contrôle (20D), dans les unités correspondantes du système de contrôle des soupapes de tous les cylindres, d'un piston de retrait (107), assurant une mesure continue, se déplaçant de sa position dans le vide cylindrique (113) à une autre position où les orifices de vidange (114) sont principalement fermés, permettant ainsi au liquide

transmetteur de passer de la position du piston de retrait (107) au vide cylindrique (5) entre le piston de soupape (6) et le piston de came (4) au début de chaque mouvement d'ouverture de la soupape durant le temps nécessaire dicté par la soupape de contrôle (20D) lorsque l'écoulement initial est maintenu ouvert.

5

10

15

20

25

30

35

40

45

50

55

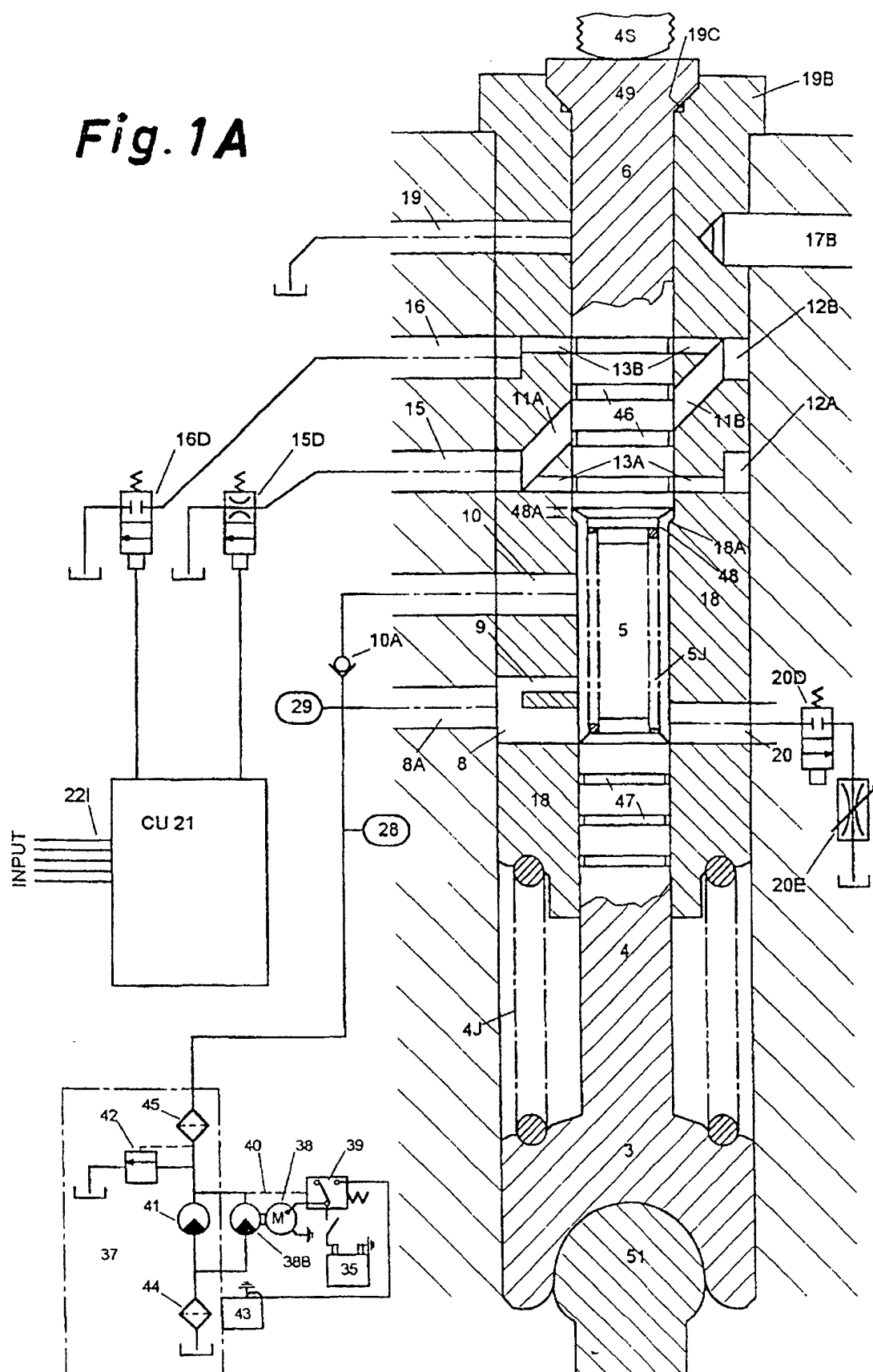
Fig. 1A

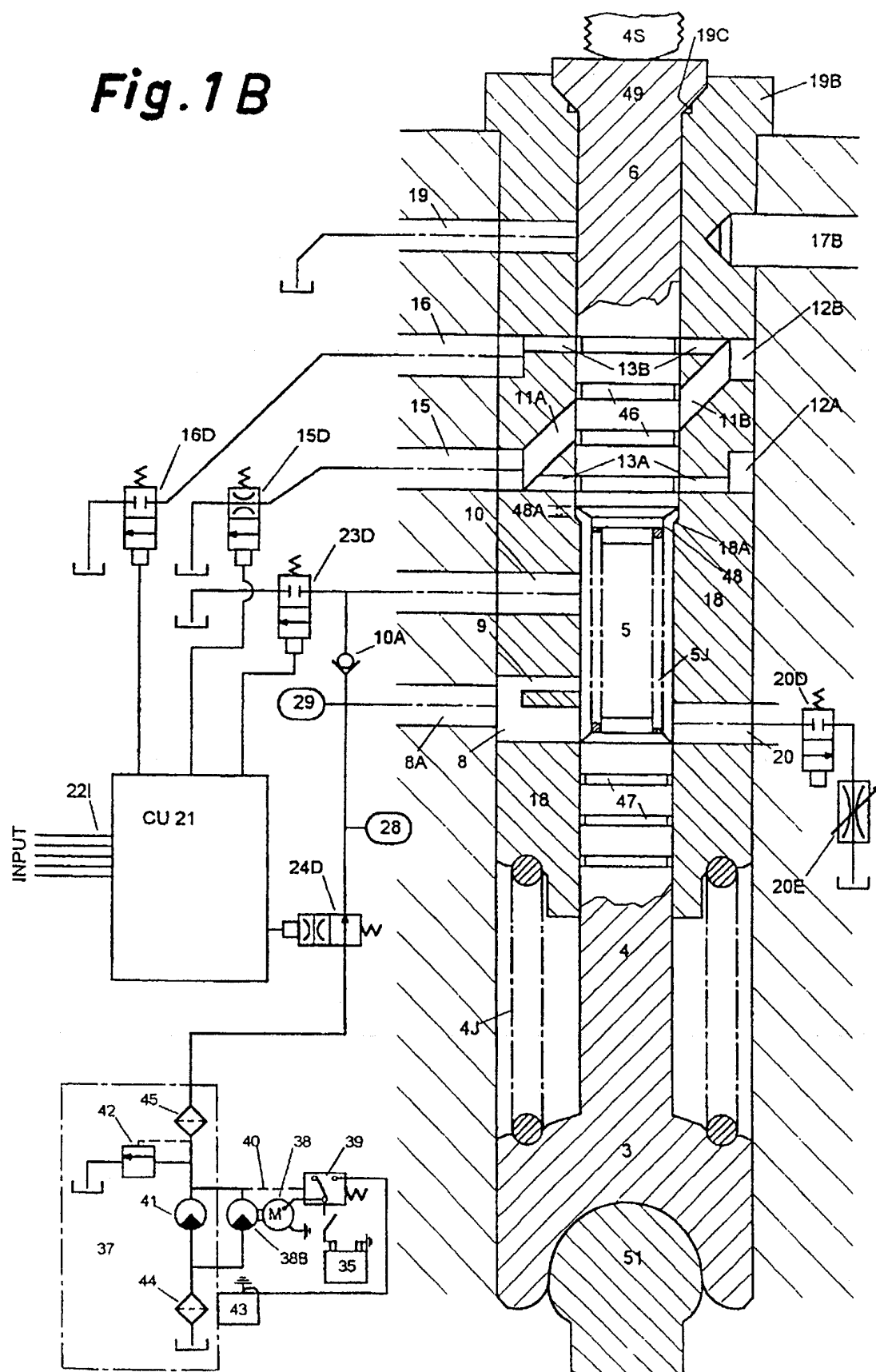
Fig. 1 B

Fig.1 C

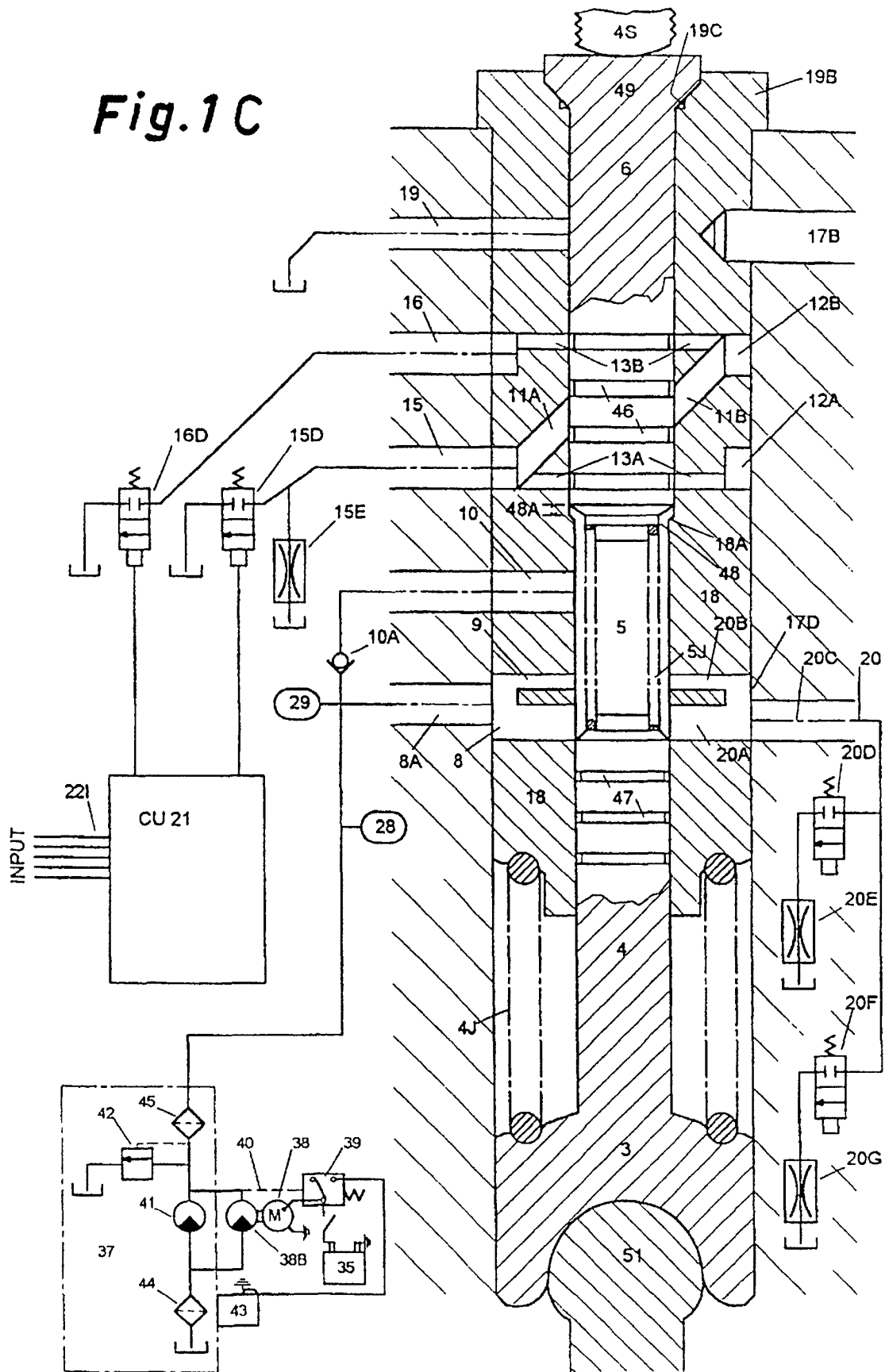


Fig. 1D

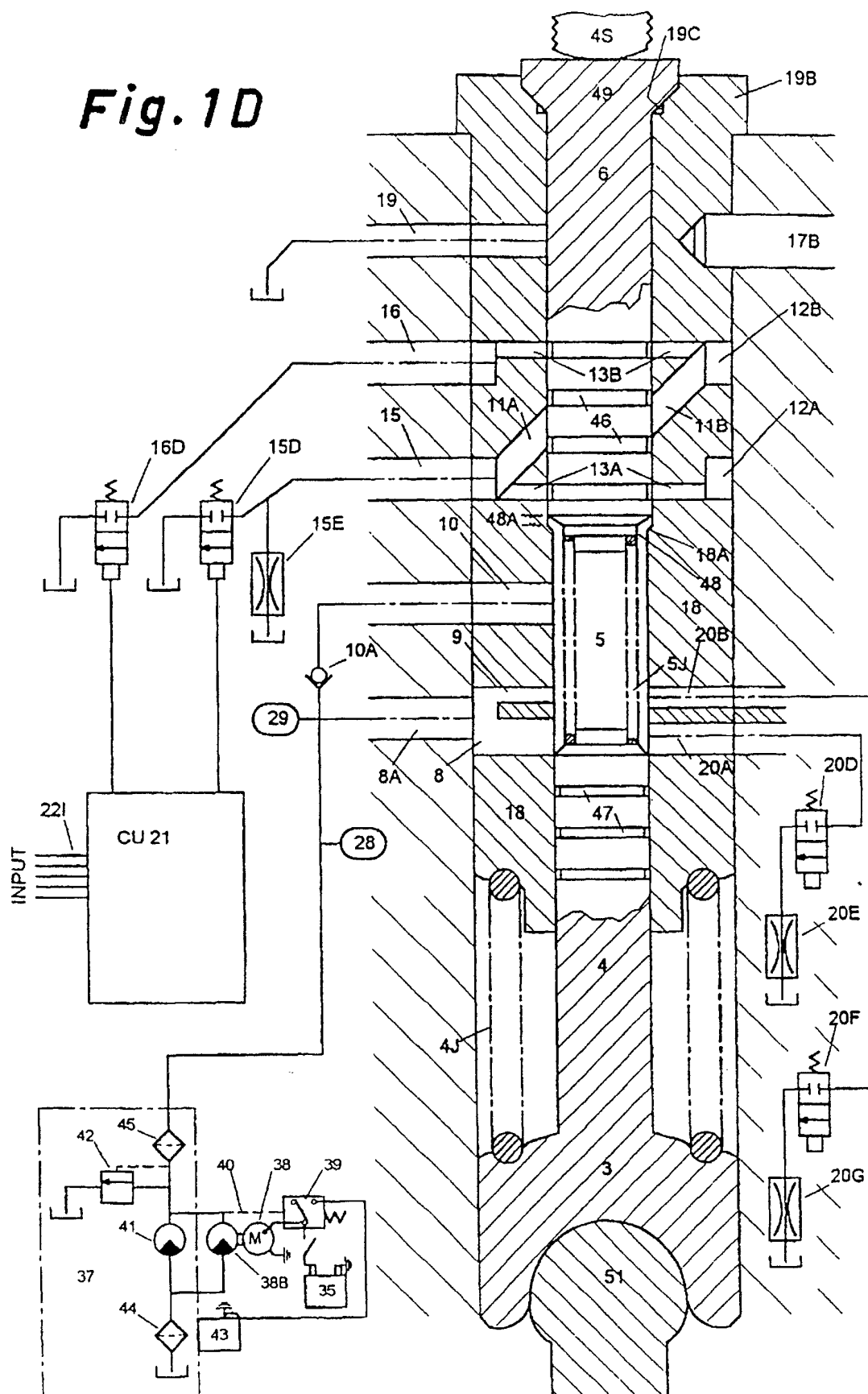


Fig. 1E

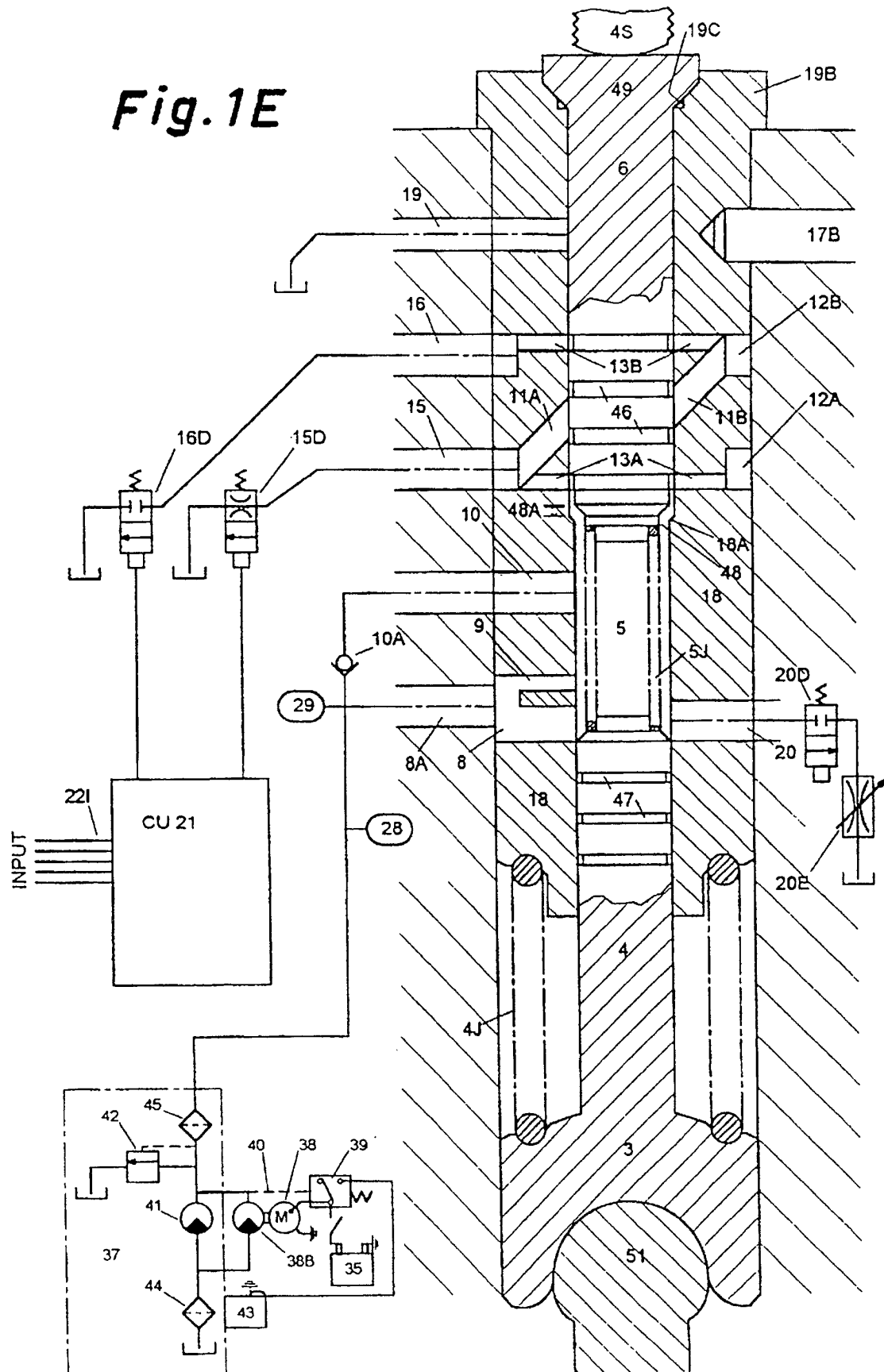


Fig. 2A

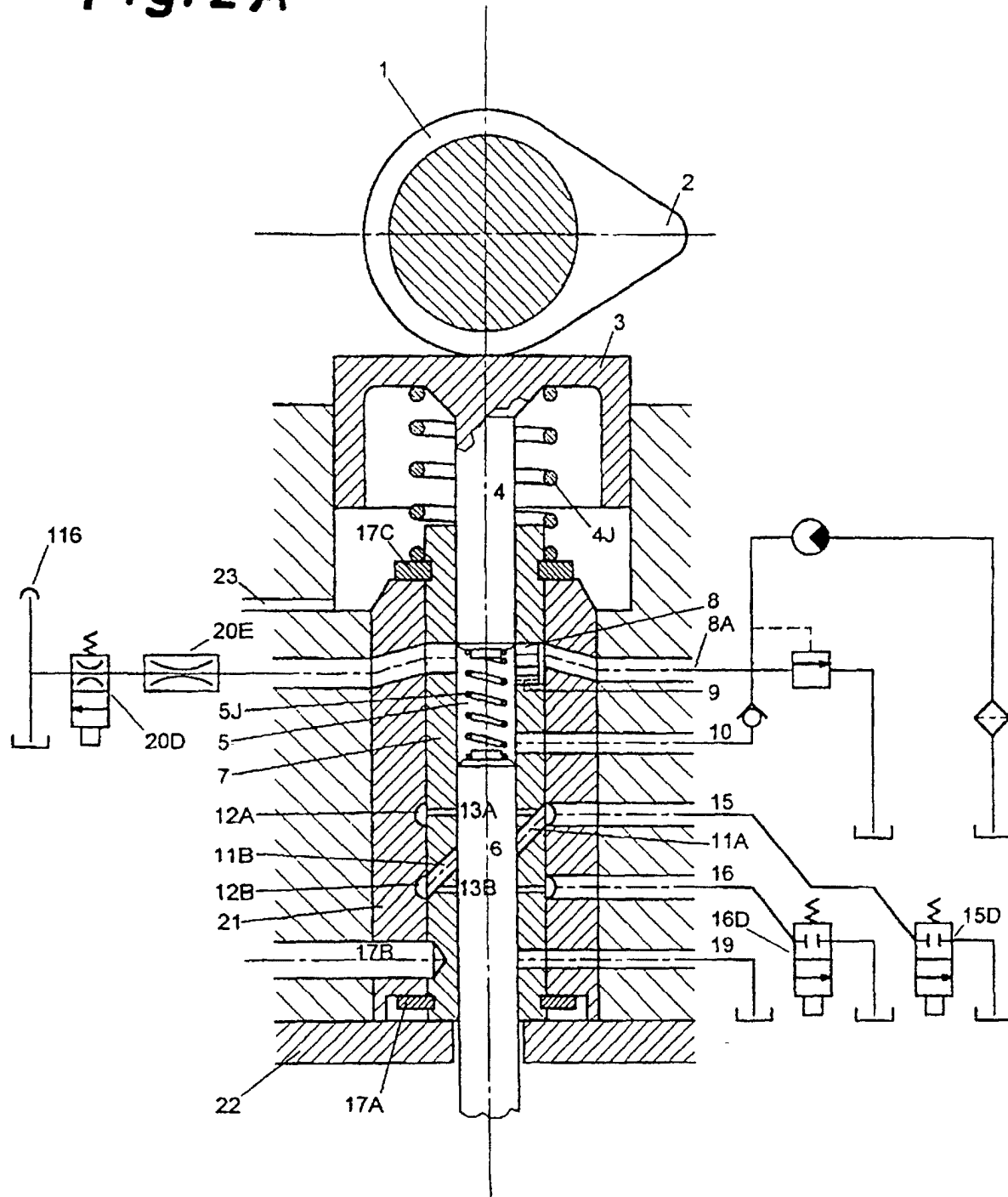


Fig. 2B

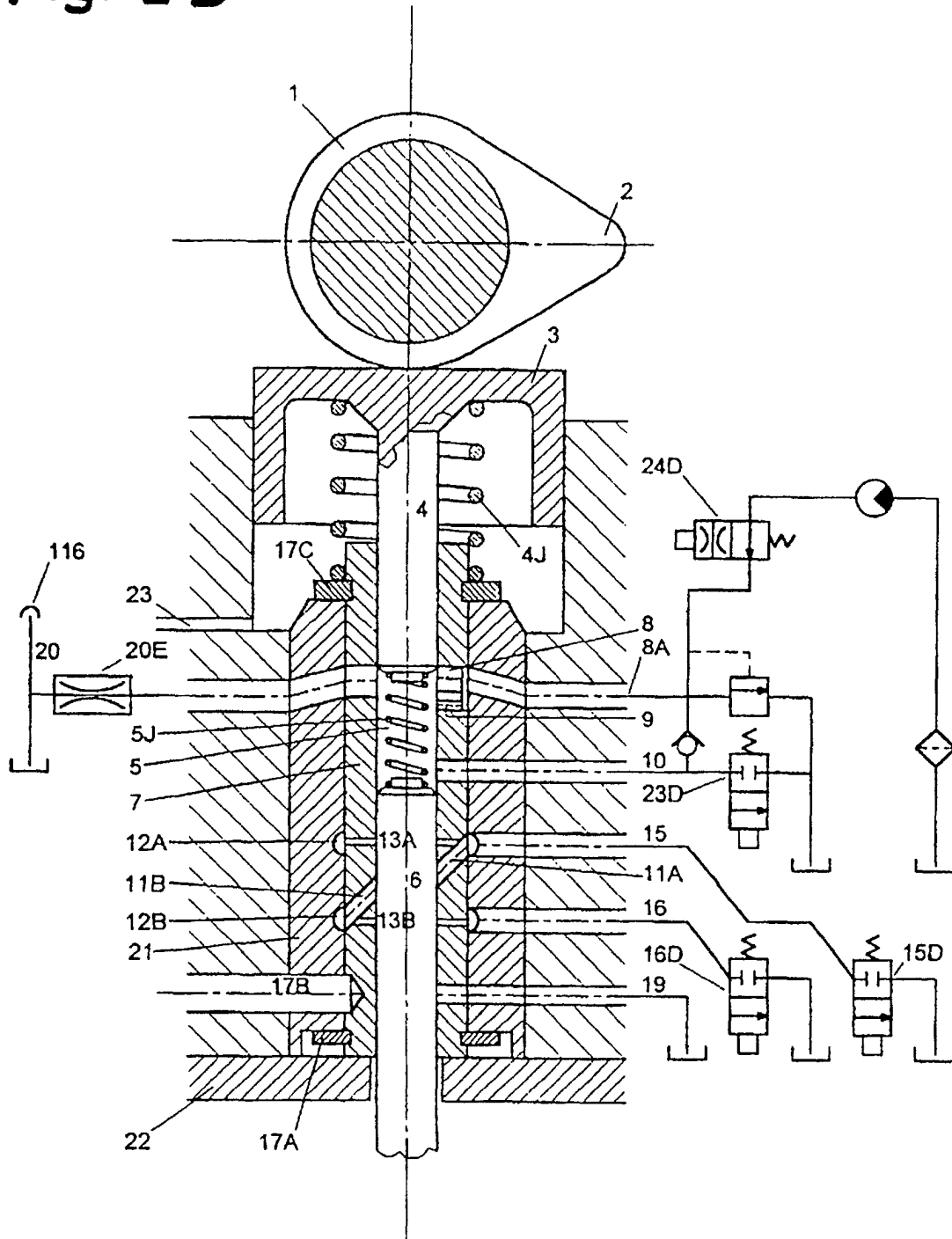


Fig. 2C

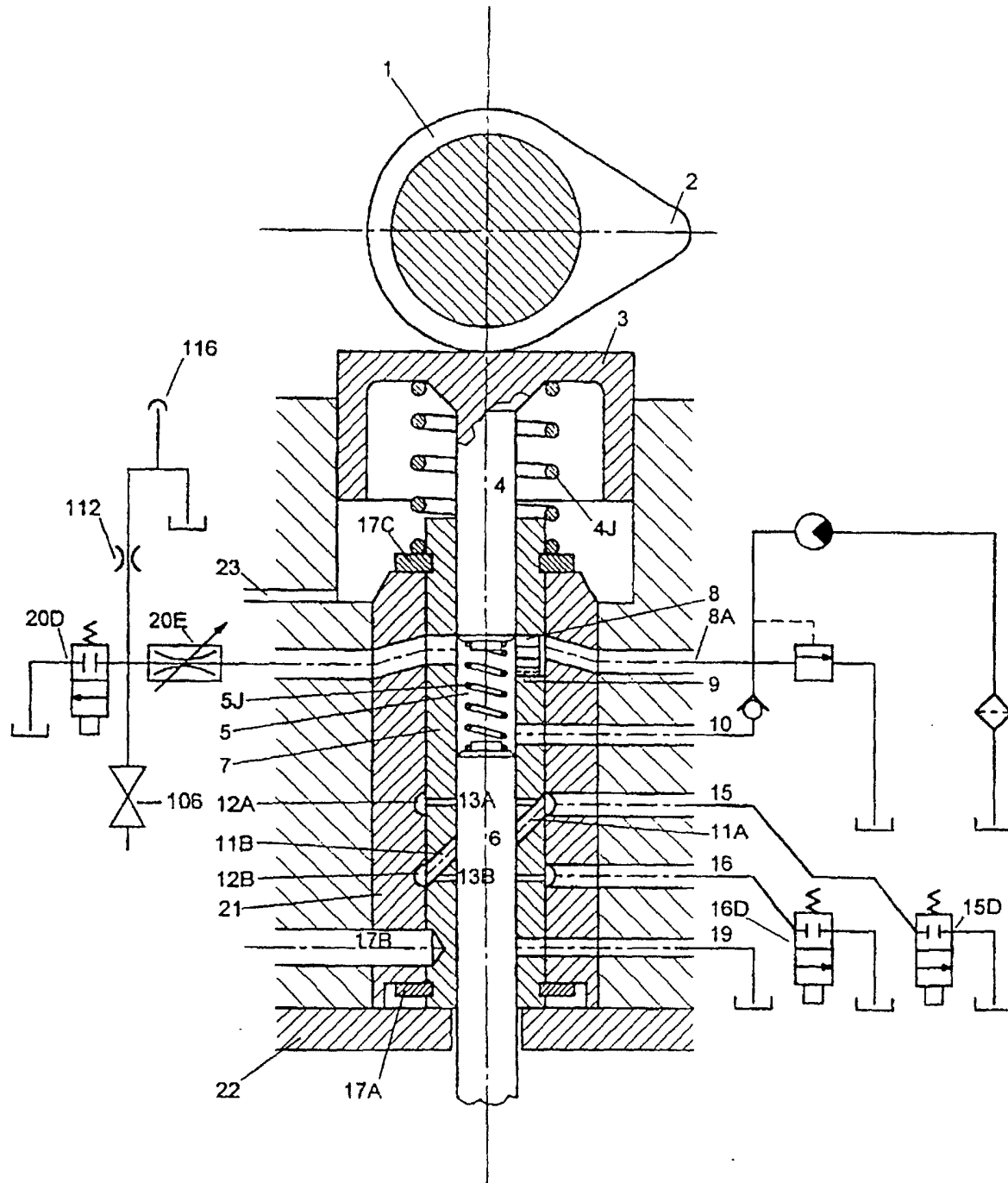


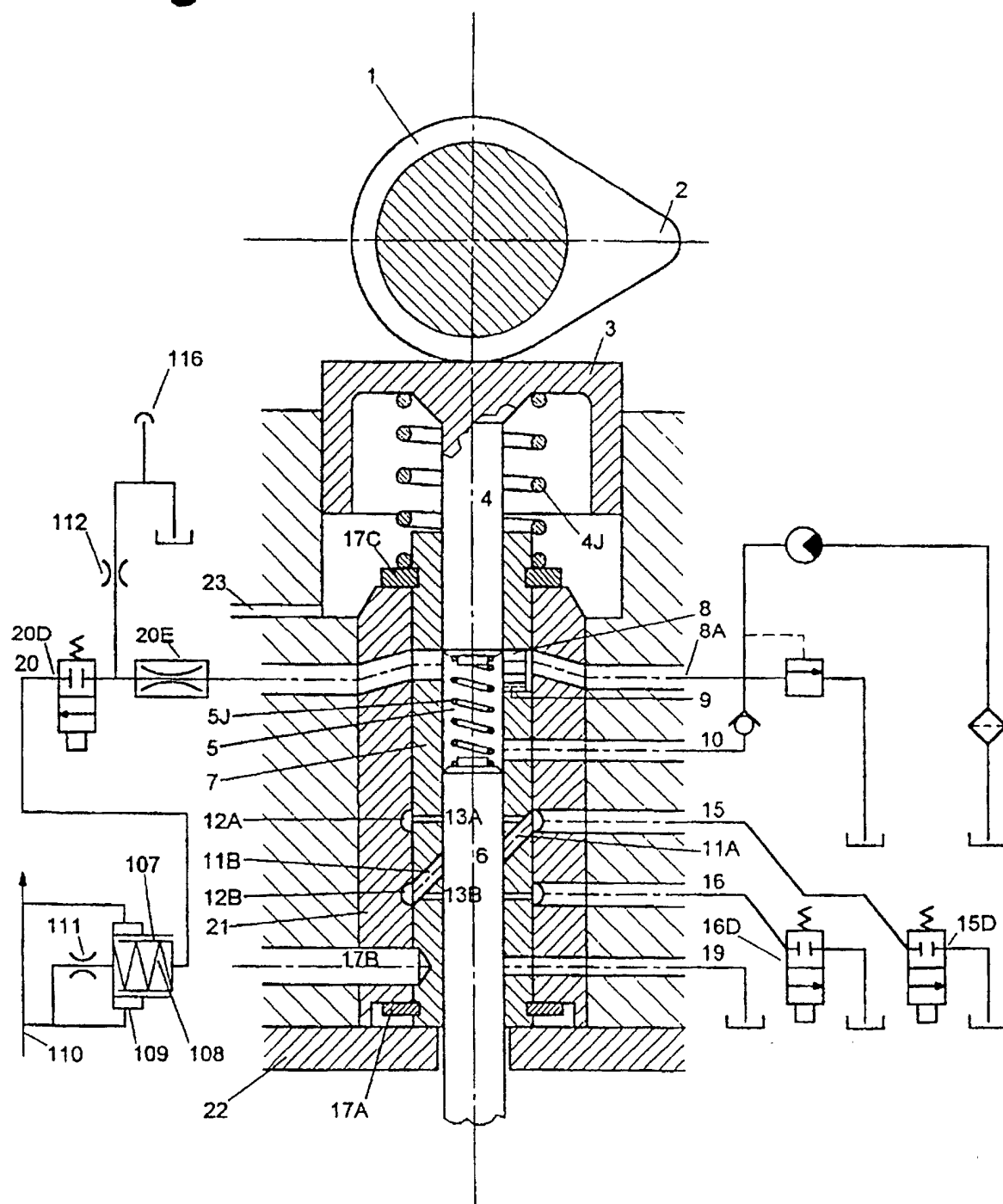
Fig.2D

Fig. 2E

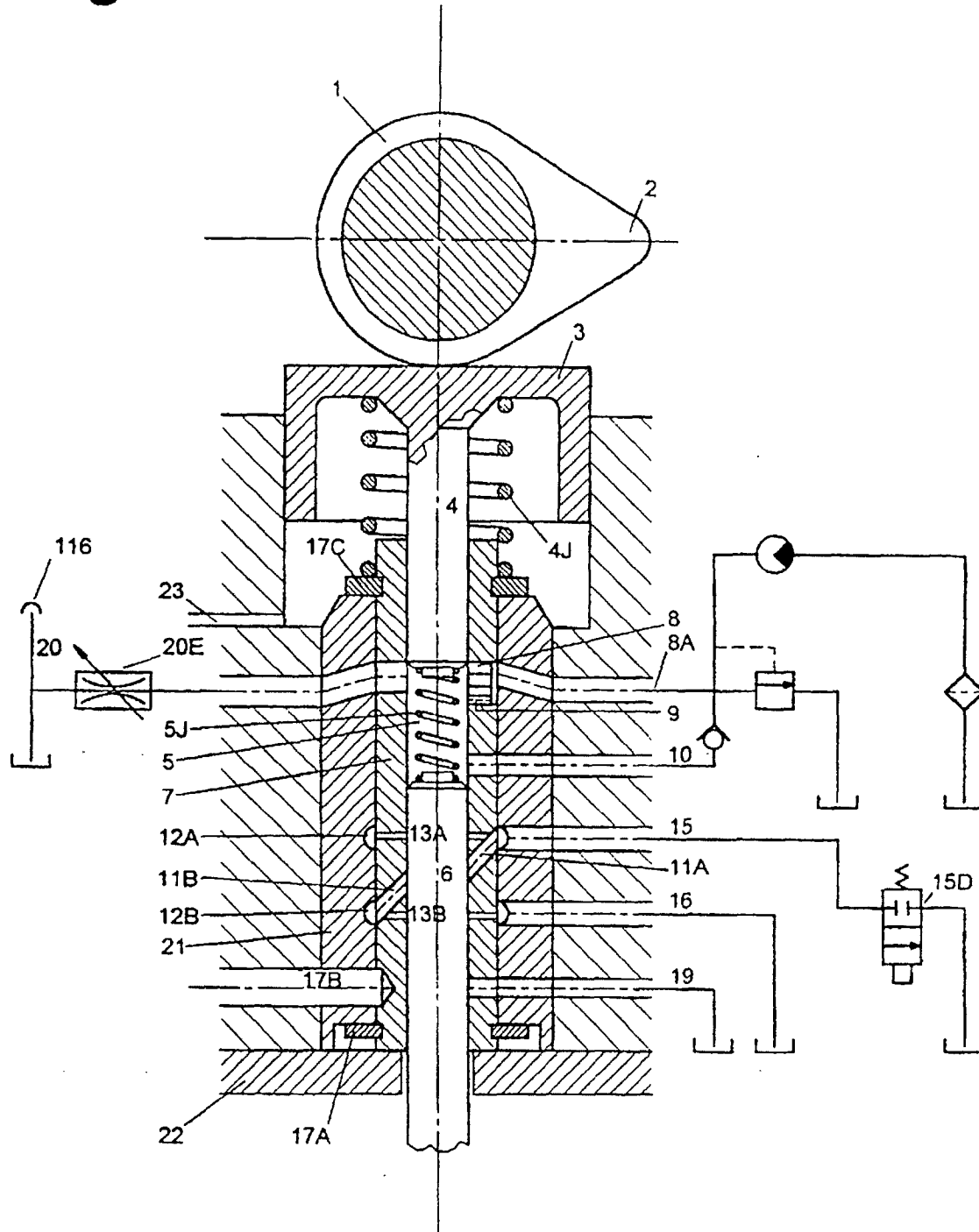
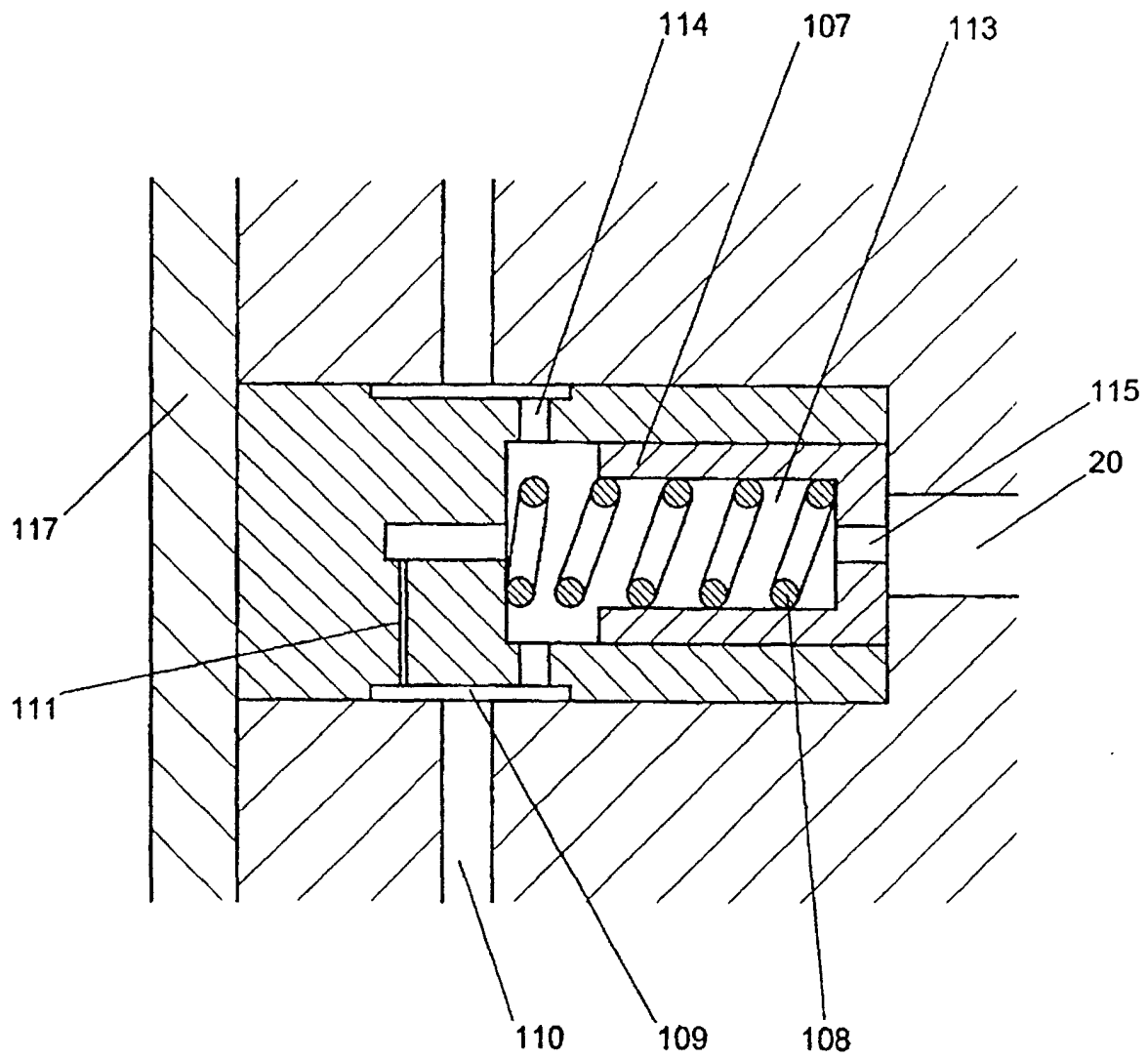


Fig. 2F



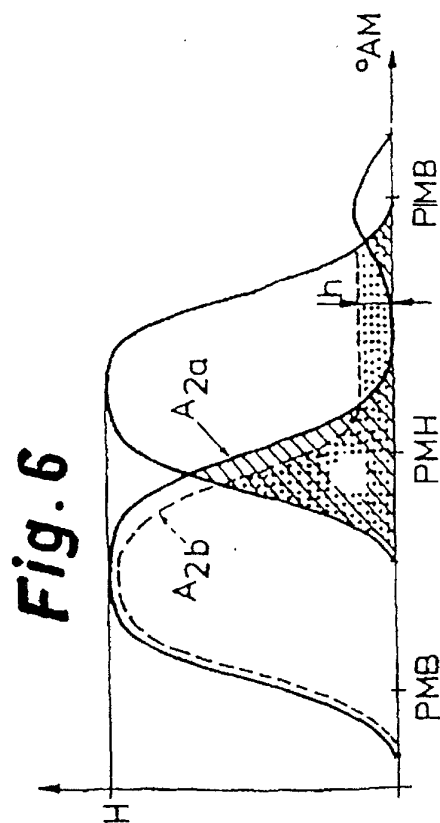
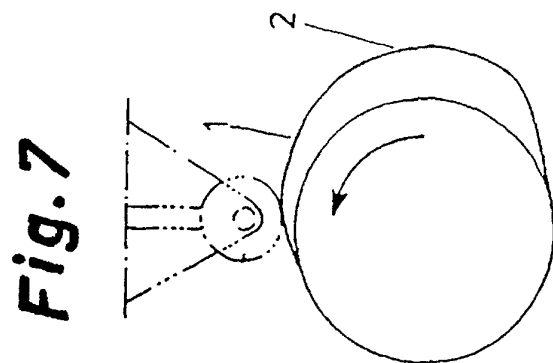
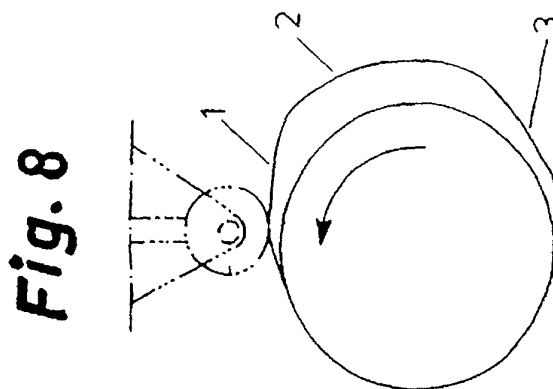
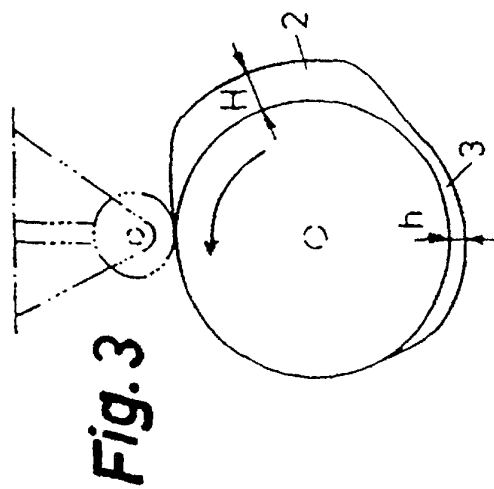
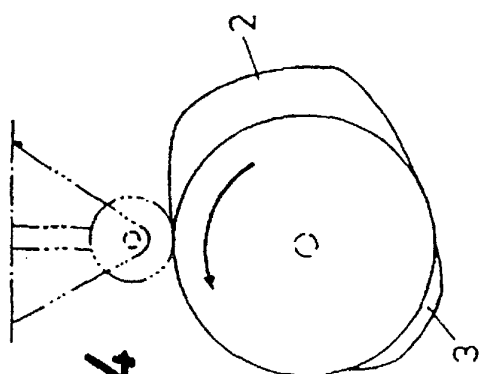
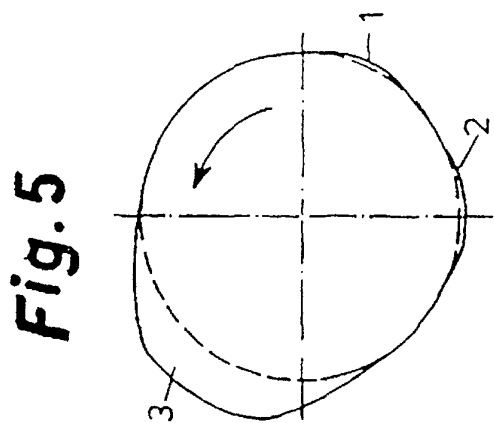


Fig. 9

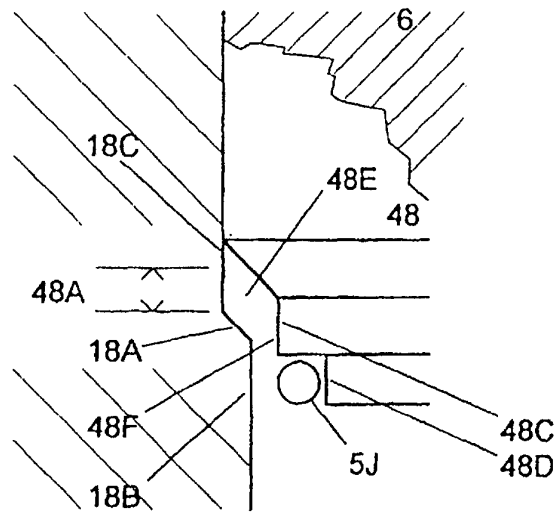


Fig. 10

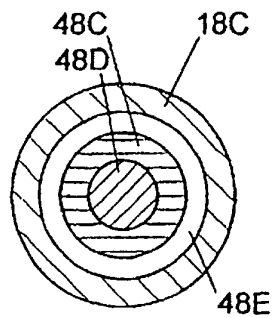


Fig. 11

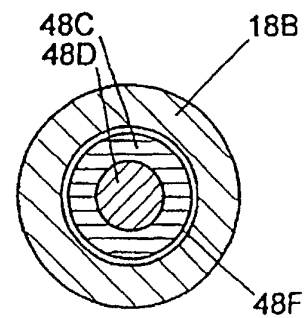


Fig. 12

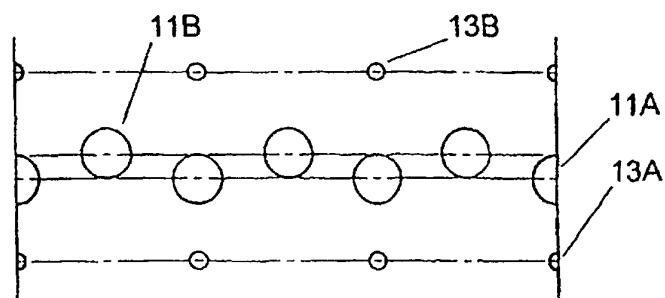


Fig. 13

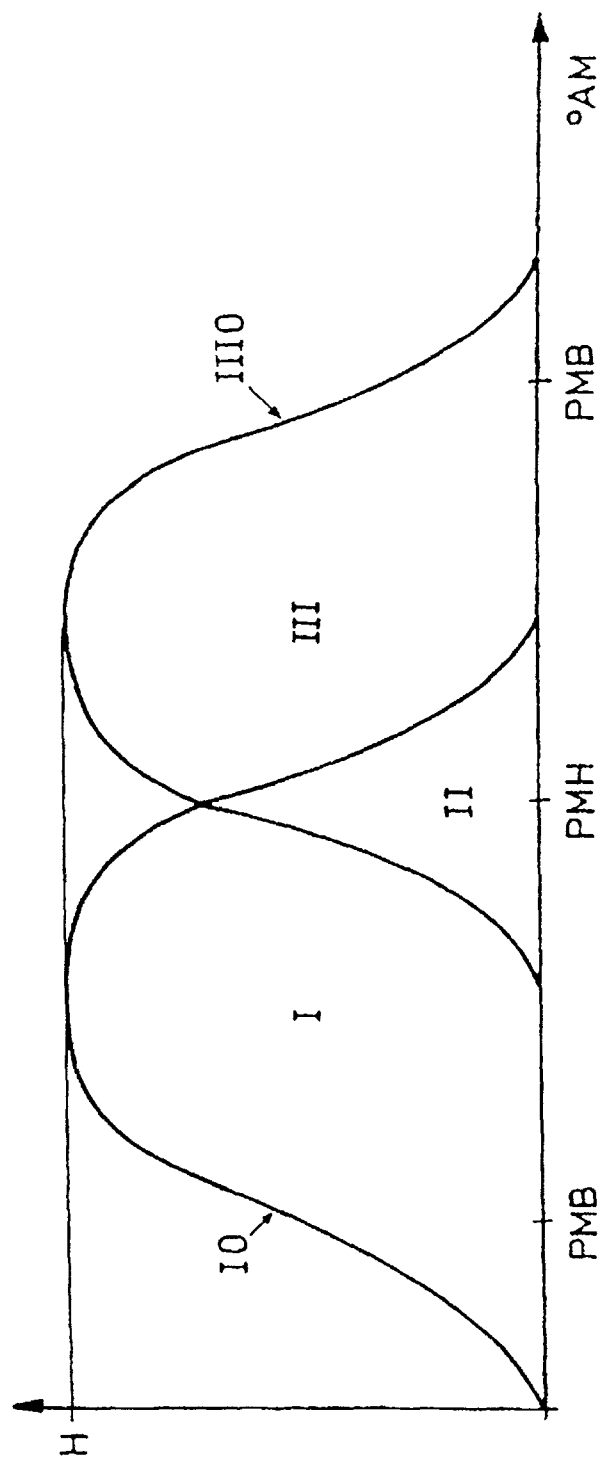
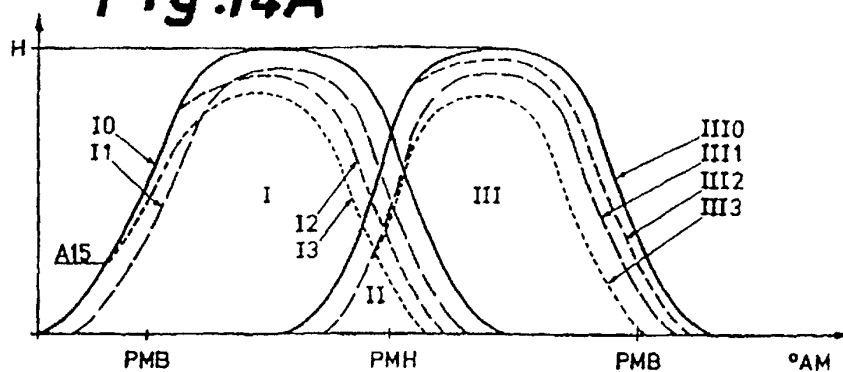
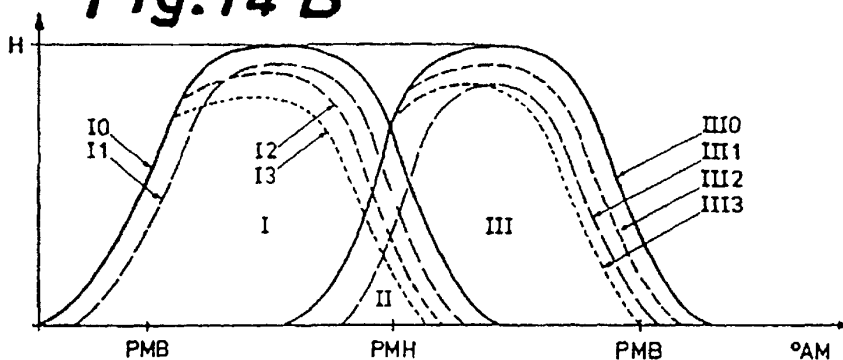
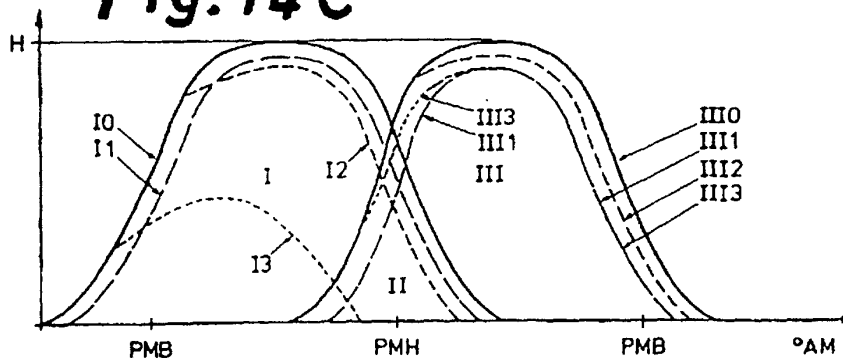


Fig.14A**Fig.14 B****Fig.14 C****Fig.14 D**