



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.01.2007 Bulletin 2007/04

(51) Int Cl.:
F24H 1/00 (2006.01) B08B 3/02 (2006.01)

(21) Application number: **06015151.1**

(22) Date of filing: **20.07.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

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(54) **Method and device for generating heated liquid with increased pressure**

(57) A method is described for generating heated liquid under increased pressure, wherein the liquid is sucked from a reservoir (1) through a suction line (2) by a pump (5), and wherein the liquid is heated by means of at least one first heat exchanger (4) arranged in the suction line (2). Further, a device is described for generating heated liquid under increased pressure, comprising a liquid reservoir (1); a pump (5), of which an input is connected to the liquid reservoir (1) through a suction

line (2); and a first heat exchanger (4) arranged in the suction line (2).

The device has two output lines (7;8) connected in parallel to an output of the pump (5); and a second heat exchanger (11) arranged in a first of these output lines (7). Thus, the liquid flow delivered by the pump (5) under increased pressure is divided into a first subflow and a second subflow, wherein the first subflow is further heated by the second heat exchanger (11).

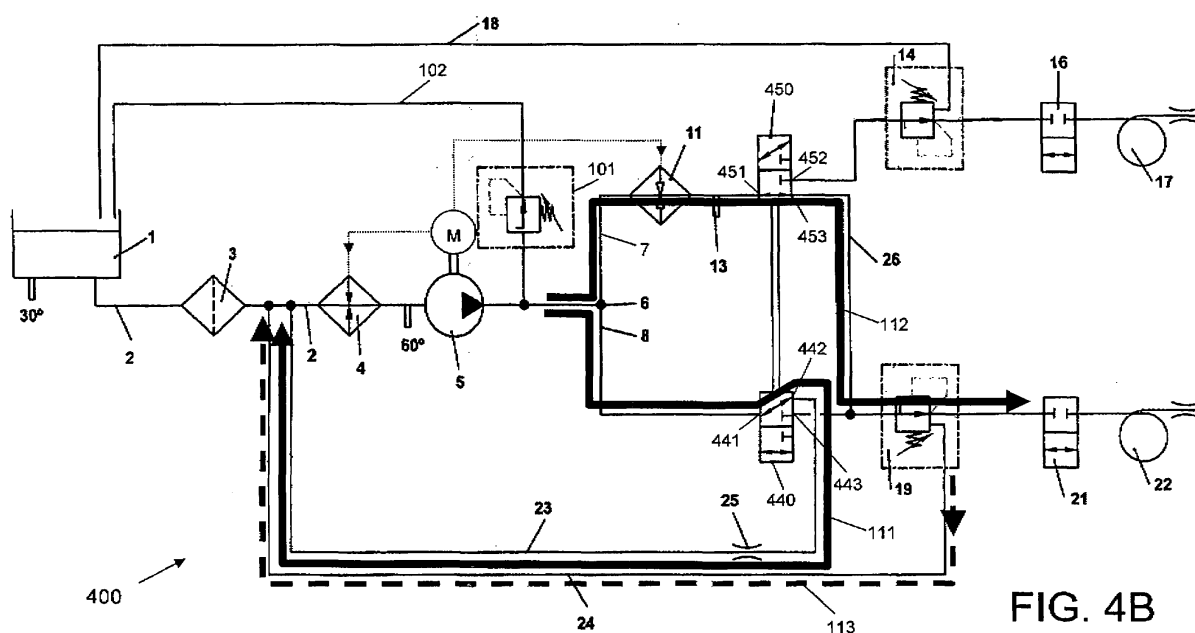


FIG. 4B

Description

[0001] The present invention relates in general to generating heated liquid under increased pressure. Thus, a jet of liquid can be provided, suitable for cleaning purposes, such as for instance clean-spraying walls, floors or the inner walls of pipings such as waste water pipings or sewer water pipings. However, the invention is not limited to this area of application.

[0002] For such cleaning operation, normally water is used, to which possibly chemical substances are added for obtaining an improved cleaning effect. In the following, the liquid will for the sake of convenience also be indicated by the simple phrase "water", it being noted that the present invention is also applicable to other liquids.

[0003] For providing water under increased pressure and at elevated temperature, a pump is needed for providing the required water pressure, as well as heating means for increasing the temperature of the water. In order to actually use this water for cleaning purposes, means are needed for providing a jet of liquid, such as a hose with a mouthpiece. In principle, it is possible to use any suitable components for this. However, for mobile applications, it is customary that the pump is driven by an internal combustion engine, which can be a separate, "dedicated" combustion engine or the internal combustion engine of a transport vehicle carrying the cleaning apparatus. In that case, useful use can be made of the loss heat of this engine for heating the cleaning water. In general, one can say that combustion engines have a disadvantageous mechanical efficiency: about one third of the energy content of the fuel is converted into useful mechanical energy at the output axle of this engine. The energy lost is converted into heat, of which about half is used for heating the exhaust gasses and the other half is discharged through the cooling water of the motor.

[0004] The present invention relates particularly to a system making advantageous use of the waste heat of a combustion engine, preferably the engine driving the pump, for heating the rinsing water. However, the invention is also applicable in combination with other heat sources, although this will involve increased costs.

[0005] It is desirable that the pumping installation for providing rinsing water can operate at different operational conditions. Depending on the spraying tool which is used, the required water flow rate may be higher or lower. The pump must be capable of providing the maximum possible flow rate at the required water pressure. When the required flow rate is lower than the maximum capacity of the pump, the problem occurs that the pump can operate at reduced efficiency.

[0006] Further, the required temperature of the provided rinsing water may vary. The heating means for heating the water must have sufficient capacity for being capable of providing the required water temperature at the required water flow rate. When the required water flow rate becomes less, the possibility exists that the temperature of the provided water increases undesirably.

[0007] It is known per se that heating means for rinsing water are implemented as a heat exchanger, wherein it is known per se to use the loss heat of a combustion engine to heat liquid using a heat exchanger. In a first variation, it is known to use the cooling water of this combustion engine for this purpose. However, the cooling water of a combustion engine will typically have a temperature lower than 100 °C, so that the final temperature that can be achieved by this is limited.

[0008] Further, in another variation, it is known to use the heat present in the exhaust gasses. The exhaust gasses of a combustion engine have a temperature which typically is much higher than 100 °C, so that hereby in principle a higher final temperature is possible. However, a problem is that the heat transfer from a gas to a wall of a heat exchanger is relatively difficult. In order to provide a heat exchanger with a good heat-transferring capacity from the exhaust gasses to the water to be heated, relatively thin and long flow channels are needed with a large heat-transferring service. As a consequence, such heat exchanger will be relatively large, heavy and expensive, and furthermore a large pressure drop will occur in this heat exchanger, both for the exhaust gasses and for the liquid to be heated. These problems are more important as the required water temperature is higher.

[0009] Thus, it is an objective of the present invention to provide a method and device for providing rinsing water at increased pressure and increased temperature, wherein the said problems are overcome or at least reduced, and wherein the water is heated in a relatively efficient way.

[0010] According to an important aspect of the present invention, at least a part of the liquid flow rate produced by the pump is recirculated to the suction side of the pump. Then, the recirculated water can pass the heat exchanger again, so that the final temperature reached by the water can be higher while using a relatively small heat exchanger pump. In this case, the pump produces more water than is consumed by the cleaning tool.

[0011] According to another important aspect of the present invention, the output line of the pump divides itself into two parallel branches, wherein a second heat exchanger is arranged in one of those two branches. The flow of liquid in this one branch has its temperature increased further by the second heat exchanger, wherein the flow rate of the liquid in this branch is lower than the liquid flow rate through the first heat exchanger. Therefore, the second heat exchanger can be designed for a relatively small flow rate and a relatively high output temperature. Depending on the required application, it is now possible to have those two branches join again or to use the water from the one branch and to recirculate the water from the other branch.

[0012] The European patent application 0.615.791 discloses a system wherein a washing machine is integrated with a transport vehicle. The installation comprises pump means for providing rinsing water, and heating means for heating this rinsing water. The pump means are driven

by a combustion engine that is also used for driving the vehicle, and the heating means use both the waste heat in the cooling water of this engine and the waste heat in the exhaust gasses of this engine. However, the installation has two separate systems. The one system has a pump 21, and a heat exchanger 22/25 using the heat of the exhaust gasses of the engine. The second system has a separate pump 33, and a second heat exchanger 36/34 receiving heat from the motor cooling system. The two systems are completely separated from each other, so that this here in fact only involves a first system using cooling water heat and a second system using exhaust gas heat. In both cases, the heat exchanger is arranged at the low pressure side of the pump in question.

[0013] The US patent 3.341.081 discloses a cleaning apparatus with a spray gun, wherein the pump 21 for the rinsing water is driven by a combustion engine, and wherein the washing water is heated by means of cooling liquid of this driving engine. The heat exchanger 30/17 there is arranged at the low pressure side of the pump 21. The exhaust gas heat is not used in this device.

[0014] The US patent 4.284.127 discloses a device for cleaning carpet, wherein washing water is heated in a two-stage process by heat from the cooling water and the exhaust gasses of a combustion engine, respectively. To this end, the washing water passes a first heat exchanger 7 receiving heat from the cooling water of the engine, and a second heat exchanger 13 receiving heat from the exhaust gasses of this engine. The water thus heated in two steps arrives in a reservoir 17. The water flow in this case is driven by the water pressure at the input 1. When the reservoir 17 is full, a valve 12 controlled by a float switch 18 is closed to stop the water flow through the two heat exchangers. For actually using the heated water for cleaning purposes, a pump 19 extracts the warm water from the reservoir 17. No heat exchanger is located in the suction line of the pump 19. Under normal circumstances, wherein the water from the reservoir 17 is consumed for cleaning purposes, no circulation of the water sucked in by the pump 19 takes place. In a condition wherein the supply of fresh water from the input 1 has stopped, water is pumped by the pump 19 through a feed back line 37 to the second heat exchanger 13, in order to cool this heat exchanger and thus to guard this heat exchanger against the high temperatures of the exhaust gasses.

[0015] These and other aspects, features and advantages of the present invention will be further clarified by the following description with reference to the drawings, in which same reference numerals indicate same or similar parts and in which:

figure 1A schematically illustrates a first device for generating heated water under increased pressure;
figure 1B schematically illustrates a variation of this first device;
figure 1C schematically illustrates liquid flows in this first device;

figure 2A schematically illustrates a second device for generating heated water under increased pressure;

figure 2B schematically illustrates liquid flows in this second device;

figure 3A schematically illustrates a third device for generating heated water under increased pressure;

figure 3B schematically illustrates liquid flows in this third device;

figure 4A schematically illustrates a fourth device for generating heated water under increased pressure;

figures 4B-4E schematically illustrate liquid flows in this fourth device, in different operational conditions;

figures 5A and 5B schematically illustrate the second heat exchanger;

figure 6 schematically shows a three dimensional view of different parts of the device.

[0016] Figure 1A is a block diagram schematically illustrating a first device 100 for generating heated water under increased pressure. The device 1 comprises a supply reservoir 1, of which the content preferably is at least 800 litre. The installation 100 is for instance intended for high-pressure cleaning of surfaces such as walls and floors with heated rinsing water, and is for instance mounted on a two-wheeled trailer (not shown) or in a commercial vehicle (not shown).

[0017] The reservoir 1 is connected to an input of a high-pressure pump 5 through a suction line 2, in which a filter 3 is accommodated. A T-piece 6 connects to the output of the pump 5, to which T-piece two output lines 7 and 8 are connected, respectively. A safety valve 101 monitors the pressure of the liquid pumped by the pump 5. If the pressure at the output of the pump 5 becomes too high, the safety valve 101 passes liquid to be fed back to the reservoir 1 through a feed back line 102.

[0018] A first heat exchanger 4 is arranged in the suction line 2. The first heat exchanger 4 preferably is connected to the cooling water circuit of a combustion engine, schematically indicated by the letter M, which combustion engine advantageously also drives the pump 5.

[0019] In the following, the flow rate of the liquid provided by the pump 5 will be indicated by P. In an experimental setup, use was made of a plunger pump capable of delivering a liquid flow rate $P = 72 \text{ l/m}$ at an output pressure 200 bar at 1000 revolutions per minute. This pump was driven by a diesel engine as combustion engine with a power at the axle of 29.8 kW at 2800 revolutions per minute.

[0020] The first output line 8 connects to a recirculation line 23 with a throttle valve 25. The throttle valve 25 allows part of the liquid flow delivered by the pump to pass; the liquid flow passing through this throttle valve 25 will be indicated by X. The throttle valve may have a fixed setting, but it is also possible that the throttle valve 25 is adjustable, so that said liquid flow X can be varied by a user. The output of the recirculation line 23 connects to the suction line 2, preferably and as illustrated at a loca-

tion upstream of the first heat exchanger 4, so that the recirculated flow X passes the first heat exchanger 4 again.

[0021] In the example shown, the output of the recirculation line 23 is connected to the suction line 2. As a consequence, the recirculated liquid flow X is guided directly to the first heat exchanger, causing the rinsing water to be heated relatively fast. A problem might be that the temperature of the rinsing water then becomes too high. Alternatively, it is possible therefore that the output of the recirculation line 23 ends in the reservoir 1, such as sketched for the safety feedback line 102. The recirculated liquid flow X, which has obtained a temperature raised by the first heat exchanger 4 in the order of for example about 50 to 60 °C, is mixed with the relatively cold supply water in the reservoir 1. Hereby, the rinsing water heats only slowly. However, this may be a disadvantage in case a quick heating of the rinsing water is desired. In a variation, it is therefore possible that the recirculation line 23 connects to two feedback lines through a three way valve (not shown) of which a first feedback line connects to the suction line 2 and of which the second feedback line ends in the reservoir 1. Depending on the position of the three way valve, the recirculated liquid flow will then enter the reservoir 1 or directly the suction line 2. Then, a user may choose, during a start-up phase, to set the three way valve in a position where the recirculated liquid flow is supplied to the suction line 2 directly, and, as soon as the temperature of the rinsing water has achieved a suitable value, to set the three way valve in a different position wherein the recirculated liquid flow is fed back to the reservoir 1. Thus, the three way valve may be implemented as manually operated, but it may also operate automatically on the basis of a sensor detecting the temperature of the rinsing water.

[0022] The second output line 7 connects to a pressure regulator 19 through a connection line 26. A second heat exchanger 11 is accommodated in the second output line 7. Preferably, this second heat exchanger 11 receives heat from the hot exhaust gasses of a combustion engine, preferably the same engine M as the one driving the pump 5. In such preferred embodiment, this combustion engine thus provides both mechanical energy to the pump and, through the cooling water, thermal energy to the first heat exchanger 4, and through its exhaust gasses thermal energy to the second heat exchanger 11, so that the fuel of this combustion engine M is used particularly efficient.

[0023] The second heat exchanger 11 thus only receives a part of the flow rate P produced by the pump 5. In the said experimental setup, wherein the liquid flow P delivered by the pump was maximum 72 l/m, a second heat exchanger 11 was used that was designed for a flow rate of about 15 to 20 litre per minute. When the second heat exchanger 11 should be capable of processing the entire pump flow rate P, this second heat exchanger 11 would become bigger, heavier and more expensive. In

the dimensioning of the experimental setup, the recirculation flow rate X in the recirculation line 23 is about 52 to 57 litre per minute. Then, the water delivered by the pump 5 can reach a temperature of about 60 °C: this can be seen as an equilibrium temperature if 15 to 20 litre is continuously removed through the second output line 7 and thus is supplemented through the suction line 2. The second heat exchanger 11 was capable to further heat the received water of about 60 °C to a temperature of about 80-90 °C. This hot water becomes available for use at the output of the pressure regulator 19.

[0024] A cleaning tool 103 can be connected to the pressure regulator 19, typically a spray gun with a suitably chosen mouth piece, which is connected to the output of the pressure regulator 19 through a long line, schematically shown as a hose reel. In that case, a control valve 21 is provided, having two operational positions, namely a closed operational position (as illustrated) wherein no liquid is delivered to the tool 103, and an open operational position wherein the liquid flows out through the tool 103 with a powerful jet. In that case, the tool 103 behaves as a throttle valve, wherein the used flow rate Y of the rinsing water may be less than the flow rate (P-X) made available through the connection line 26. The pressure regulator 19 has a return line 24 which feeds the superfluous flow rate (P-X-Y) of the rinsing water back to the suction side of the pump 5. Thus, the heat of this excess is utilized usefully again.

[0025] In the example sketched, the feedback line 24 connects to the suction line 2; this contributes to a faster heating of the water. Alternatively, the feedback line might end in the reservoir 1, in a similar manner as sketched for the first feedback line 102 of the safety valve 101. This variation is sketched in figure 1B, with a pressure regulator 14, a feedback line 18, a switch valve 16, a hose reel 17, and a tool 104.

[0026] Figure 1C, which is comparable to figure 1A, illustrates the liquid flows during operation of the device 100. The part of the liquid flow delivered by the pump 5 that is recirculated through recirculation line 23 is indicated by arrow 111. The liquid flow which is further heated by the second heat exchanger 11 is indicated by arrow 112. The possible excess, of which the flow rate depends on the flow rate required by the tool 103, and which is fed back through feedback line 24, is indicated by arrow 113.

[0027] By recirculating water that has been heated in a heat exchanger, the heat taken up by this water is largely contained in the system. Furthermore it is noted that pumping water around at an increased pressure, against the flow resistance of long lines and/or throttles, requires relatively much power, which also leads to a heating of the water; also this heat, actually loss heat in pumping, is utilized by the recirculation by conversion to thermal heat of the water.

[0028] Figure 2A shows a block diagram of a second embodiment of a device for generating heated liquid under increased pressure according to the present inven-

tion. This device, that is indicated by the reference numeral 200, distinguishes itself from the first device 100 because the first output line 8 connects through a second connection line 27 to the first connection line 26 at the output of the second heat exchanger 11.

[0029] In a similar manner as figure 1C, figure 2B illustrates the flows occurring in this second device 200 during operation. The liquid flow through the first output line 8 is indicated by arrow 211. The flow through the second output line 2 and thus through the second heat exchanger 11 is indicated by arrow 212. The combination of these two flows becomes available at the output of the pressure regulator 19. Thus, the tool 103 obtains the full disposal of the flow rate delivered by the pump 5, which was about 72 l/m in the said experimental setup. This embodiment 200 is used for situations where the tool 103 requests a lot of water (in the order of 70 litre per minute) at a temperature which is raised with respect to the temperature in the reservoir 1 (about 20-25 °C). If the tool 103 does not consume the full pump flow rate P, the excess of this flow (P-Y) is fed back through the feedback line 24, as shown by arrow 213.

[0030] In comparison to embodiment 100, a throttle in the branches 7/26 and 8/27 is lacking in the case of embodiment 200. The quantitative distribution of the liquid flows is now especially determined by the flow resistance of the second heat exchanger 11.

[0031] Figure 3A shows a block diagram of a third embodiment 300 of the device for generating heated liquid under increased pressure according to the present invention. This third embodiment 300 distinguishes itself from the second embodiment 200 in that the output of the second heat exchanger 11 does not connect to the input of the pressure regulation valve 19 through a connection line but is fed back to the suction side of the pump 5 through a recirculation line 33, with accommodated therein a (possibly variably adjustable) throttle valve 35. In this case, the recirculation line 33 ends in the reservoir 1, but alternatively the recirculation line 33 could also connect to the suction line 2, and then preferably at a location upstream of the first heat exchanger 4, as shown in figure 1A for the recirculation line 23. Starting from the first embodiment 100, one could obtain this third embodiment 300 by displacing the second heat exchanger 11 from the second output line 7 to the first output line 8.

[0032] Comparable to figures 1C and 2B, figure 3B illustrates the liquid flows occurring in this third embodiment 300. The liquid flow P delivered by the pump 5 is divided into two sub-flows in the first output line 8 and in the second output line 7. The first subflow in the first output line 8, to the regulating valve 19 and, depending on the position of the switch valve 21, to the tool 103 is indicated by arrow 311. The second subflow in the second output line 7 and thus through the second heat exchanger 11 and the recirculation line 33 is indicated by arrow 312. The possible excess of the flow delivered to the regulating valve 19, which is fed back through feedback line 24, is indicated by arrow 313.

[0033] In the above, three embodiments have been described, specifically designed for different applications. The embodiment 200 of figure 2A is intended for applications wherein it is desired to have the disposal of a relatively large output flow rate with a relatively low temperature, while the embodiments 100 and 300 of figure 1A and figure 3A are intended for situations wherein the required liquid flow rate is lower and the required liquid temperature is higher. Since both situations may occur in practice, it is desirable to have the disposal of a device which is adjustable to be adapted to the application situation concerned. Figure 4A shows a block diagram of a preferred embodiment 400 of the device for generating heated liquid under increased pressure according to the present invention, which may be considered as a combination of the embodiments discussed in the above. Like the first, second and third embodiments 100, 200 and 300, this fourth embodiment has a first pressure regulator 19 with a hose reel 22 and tool 103 which are connectable to the pressure regulator 19 through a switch valve 21. The regulator valve 19 has an output for excess flow, which is connected to the suction line 2 through a feedback line 24. As discussed in the above, this feedback line might alternatively also end in the reservoir 1. As discussed for the first embodiment 100 with reference to figure 1A, the fourth embodiment 400 comprises a recirculation line 23 with a throttle valve 25. The output of the recirculation line 23 is connected to the suction line 2 but could alternatively, as discussed, end in the reservoir 1.

[0034] The fourth embodiment 400 has a first selection valve 440, of which an input 441 is connected to the first output line 8. The first selection valve 440 has a first output 442 connected to the recirculation line 23, and a second output 443 connected to the input of the regulating valve 19. The selection valve 440 has at least two operational conditions, i.e. a first operational condition in which the input 441 is connected to the first output 442, and a second operational condition in which the input 441 is connected to the second output 443.

[0035] In a manner similar as discussed with reference to figure 1B, the fourth embodiment 400 has a second regulating valve 14 of which the output can be connected to a second hose reel 17 and a second tool 104 through a second switch valve 16. The second regulating valve 14 has an output for excess liquid flow, which feeds back the excess liquid flow to the suction side of the pump 5 through a second feedback line 18. The second feedback line 18 in this example ends in the reservoir 1, but alternatively the output of the second feedback line 18 could be connected to the suction line 2.

[0036] In a manner comparable as discussed with reference to figures 1A and 2A for the first and second embodiments 100 and 200, the fourth embodiment 400 has a connection line 26 of which the output is connected to the input of the first regulating valve 19.

[0037] The fourth embodiment 400 further has a second selection valve 450, of which an input 451 is con-

nected to the output of the second heat exchanger 11. The second selection valve 450 has a first output 452 connected to the input of the second regulating valve 14 and a second output 453 connected to the connection line 26. The second selection valve 450 has two operational conditions. In a first operational condition, the input 451 is connected to the first output 452. In a second operational condition, the input 451 is connected to the second output 453.

[0038] Figure 4B shows the fourth embodiment 400 in an operational condition in which the first selection valve 440 is in its first operational condition, i.e. the input 441 is connected to the first output 442, and in which the second selection valve 450 is in its second operational condition, i.e. the input 451 is connected to the second output 453. In this operational condition, the operation of the fourth embodiment 400 is identical to the operation of the first embodiment 100. In figure 4B, therefore, the occurring liquid flows are indicated by arrows 111, 112 and 113, comparable to figure 1C.

[0039] Figure 4C shows the fourth embodiment 400 in another operational condition, in which the second selection valve 450 is switched over to its first operational condition, i.e. the input 451 is connected to the first output 452. Hereby the device, through the second regulating valve 14, provides rinsing water to the second tool 104, and the operation of the device is the same as discussed with reference to figure 1B.

[0040] Figure 4D shows the fourth embodiment 400 in a third operational condition which distinguishes itself from the operational condition of figure 4B in that the first selection valve 440 is switched over to the second operational condition, i.e. the input 441 is connected to the second output 443. In that case, the operation of the fourth embodiment 400 is identical to the operation of the second embodiment 200, for which reason the liquid flows occurring in the device are indicated by arrows 211, 212, and 213, comparable to figure 2B.

[0041] Figure 4E illustrates a variation of the fourth embodiment 400, in which the second selection valve 450 has a third output 454, connecting to a second recirculation line 33 with a second throttle valve 35, which second recirculation line 33 ends in the reservoir 1, comparable to the third embodiment 300. Figure 4E shows the fourth embodiment in an operational condition in which the second selection valve 450 is brought to a third selection position in which the input 451 is connected to the third output 454. In that case, the operation of the fourth embodiment 400 is identical to the operation of the third embodiment 300, for which reason the liquid flows occurring are indicated by the reference numerals 311, 312 and 313, comparable to figure 3B.

[0042] In a possible embodiment, the two selection valves 440 and 450 can be set independently from each other, in order to be able to effect the variations in configuration as discussed above. However, it is also possible that the two selection valves 440 and 450 are coupled to each other, such that both valves are either in a first

operational position or in a second operational position. In that case, the user, by means of the coupled switching valves 440, 450, can switch the fourth embodiment 400 between the configuration of figure 4C and the one of figure 4D, i.e. the use of a relatively low flow rate with relatively high temperature for second tool 104 (figure 4C) or the use of a relatively large flow rate with a relatively low temperature for the first tool 103 (figure 4D).

[0043] In figures 5A and 5B, an embodiment of the second heat exchanger 11 is shown in a schematical manner. Figure 5A shows a schematic perspective view of the second heat exchanger 11, wherein an outer cylindrical envelope is partly omitted. The figure shows that the second heat exchanger 11 has a spiral 51 for the preheated rinsing water, with an input 52 and an output 53. An input and an output for passing exhaust gasses of the combustion engine are indicated at 54 and 55, respectively.

[0044] Figure 5B shows a schematic perspective view of the second heat exchanger in longitudinal section, from which it appears that the spiral 51 is wound twice, i.e. has an inner winding 51a and an outer winding 51b. The flow of the exhaust gasses is indicated at 56. It can clearly be seen that this flow, through a flow pattern going back and forth, is first guided along the inner spiral winding 51a, then is guided back in the space between the two spiral windings 51a and 51b, and then is guided again along the outer spiral winding 51b.

[0045] Figure 6 shows a schematic three-dimensional view of several parts of the device, and a location in the process diagram of figure 4A.

[0046] It will be clear to a person skilled in the art that the invention is not restricted to the exemplary embodiments discussed in the above, but that several variations and modifications are possible within the protective scope of the invention as defined in the attached claims.

Claims

1. Method for generating heated liquid under increased pressure, wherein the liquid is sucked from a reservoir through a suction line by a pump, and wherein the liquid is heated by means of at least one first heat exchanger arranged in the suction line;

characterized in:

that the liquid flow delivered by the pump under increased pressure is divided in at least a first subflow and a second subflow, wherein the first subflow is further heated by a second heat exchanger.

2. Method according to claim 1, wherein at least a part of the first subflow further heated by the second heat exchanger is recirculated to the suction side of the pump.

3. Method according to claim or 2, wherein at least a part of the second subflow is recirculated to the suction side of the pump.
4. Method according to claim 1, wherein the first subflow further heated by the second heat exchanger is merged with the second subflow to a combined liquid flow.
5. Method according to claim 4, wherein at least a part of the combined liquid flow is recirculated to the suction side of the pump.
6. Method according to any of the previous claims, wherein the second heat exchanger takes up heat from exhaust gasses of a combustion engine.
7. Method according to any of the previous claims, wherein the first heat exchanger takes up heat from cooling liquid of an combustion engine.
8. Method according to any of the previous claims, wherein the pump is driven by a combustion engine, wherein the first heat exchanger takes up heat from cooling liquid from this combustion engine, and wherein the second heat exchanger takes up heat from exhaust gasses of this combustion engine.
9. Method according to any of the previous claims 2-8, wherein at least a part of the recirculated liquid is guided to the reservoir.
10. Method according to any of the previous claims 2-9, wherein at least a part of the recirculated liquid is guided to the suction line.
11. Method according to any of the previous claims 2-10, wherein at least a part of the recirculated liquid is guided to the suction line, at a location upstream of the said first heat exchanger.
12. Device for generating heated liquid under increased pressure, comprising:
 - a liquid reservoir (1);
 - a pump (5), of which an input is connected to the liquid reservoir (1) through a suction line (2);
 - a first heat exchanger (4) arranged in the suction line (2); **characterized by:**
 - two output lines (7; 8) connected in parallel to an output of the pump (5);
 - and a second heat exchanger (11) arranged in a first of these output lines (7).
13. Device (100) according to claim 12, wherein a second (8) of said output lines connects to a recirculation line (23).
14. Device according to claim 13, wherein the recirculation line (23) ends in the reservoir (1) or in the suction line (2).
15. Device according to claim 13 or 14, wherein the output of the second heat exchanger (11) is connected to an output to which a tool (103, 104) such as a spray gun can be connected, preferably through a regulating valve (19; 14) and a switching valve (21; 16).
16. Device (200) according to claim 12, wherein the output of the second heat exchanger (11) is connected to the second (8) of said output lines through a connection line (26), and wherein this second output line (8) is connected to an output to which a tool (103, 104) such as a spray gun can be connected, preferably through a regulating valve (19; 14) and a switching valve (21; 16).
17. Device (300) according to claim 12, wherein the output of the second heat exchanger (11) connects to a recirculation line (33).
18. Device according to claim 17, wherein the recirculation line (33) ends in the reservoir (1) or in the suction line (2).
19. Device according to claim 17 or 18, wherein a second (8) of said output lines is connected to an output to which a tool (103, 104) such as a spray gun can be connected, preferably through a regulating valve (19; 14) and a switching valve (21; 16).
20. Device (400) according to claim 12, further comprising:
 - a first switching valve (440) with an input (441), a first output (442), and a second output (443), which first switching valve (440) has a first position in which the input (441) is connected to the first output (442), and has a second position in which the input (441) is connected to the second output (443);
 - a second switching valve (450) with an input (451), a first output (452), and a second output (453), which second switching valve (450) has a first position in which the input (451) is connected to the first output (452), and a second position in which the input (451) is connected to the second output (453);
 - wherein the second (8) of said output lines is connected to the input (441) of the first switching valve (440);
 - wherein the output of the second heat exchanger (11) is connected to the input (451) of the second switching valve (450);
 - wherein the first output (442) of the first switch-

ing valve (440) is connected to a first recirculation line (23);

wherein the second output (443) of the first switching valve (440) is connected to a first output to which a first tool (103) such as a spray gun can be connected, preferably through a first regulating valve (19) and a first switching valve (21) ;

wherein the first output (452) of the second switching valve (450) is connected to a second output to which a second tool (104) such as a spray gun can be connected, preferably through a second regulating valve (14) and a second switching valve (16);

wherein the second output (453) of the second switching valve (450) is connected to the second output (443) of the first switching valve (440).

21. Device according to claim 20, wherein the two switching valves (440, 450) can be operated independently from each other.
22. Device according to claim 20, wherein the two switching valves (440, 450) are coupled to each other, and are always together in their respective first operational positions or in their respective second operational positions.
23. Device according to claim 20, wherein the first recirculation line (23) ends in the reservoir (1) or in the suction line (2).
24. Device according to claim 20 or 23, wherein the second switching valve (450) has a third output (454), connected to a second recirculation line (33).
25. Device according to claim 24, wherein the second recirculation line (33) ends in the reservoir (1) or in the suction line (2).

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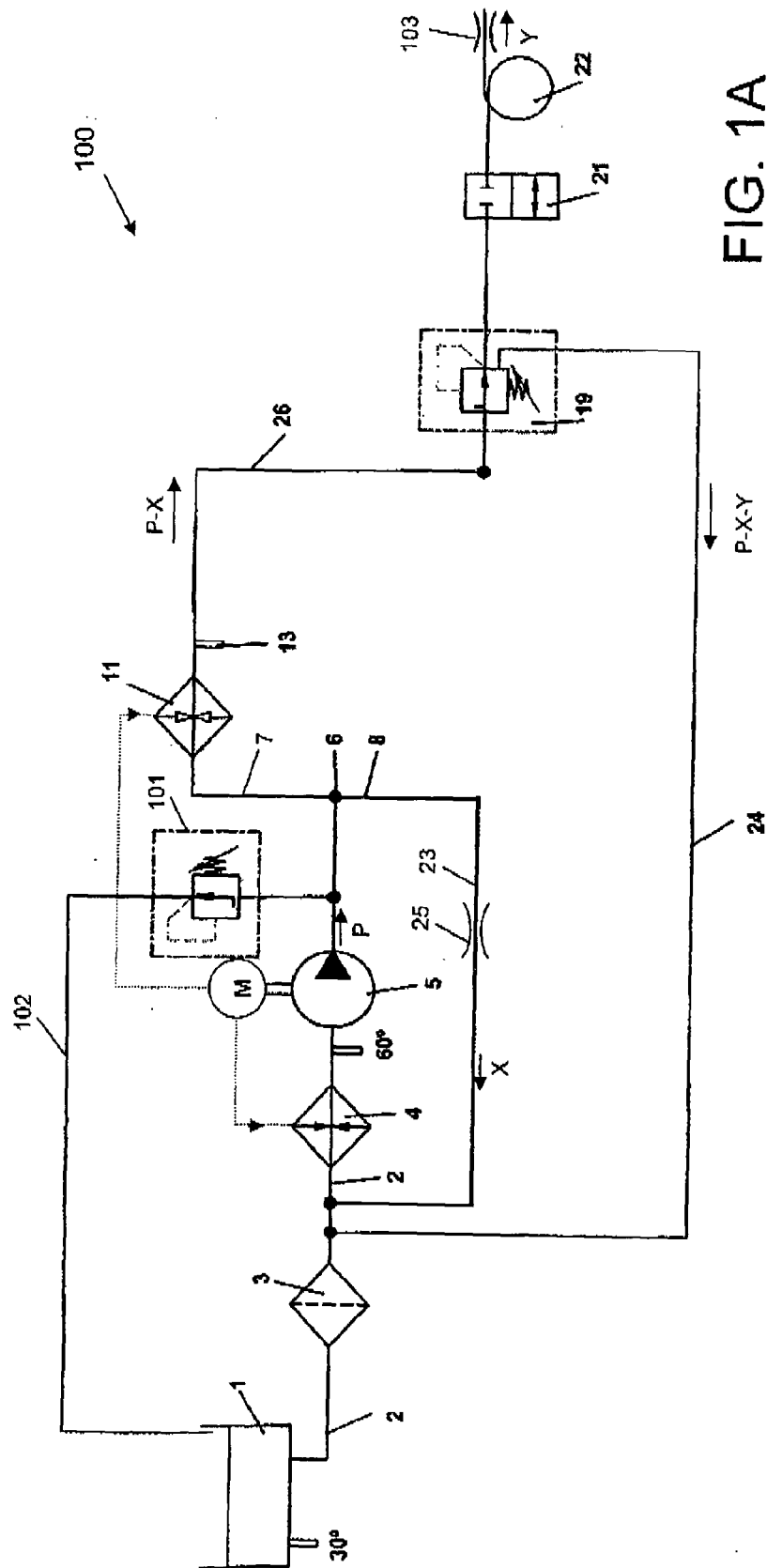


FIG. 1A

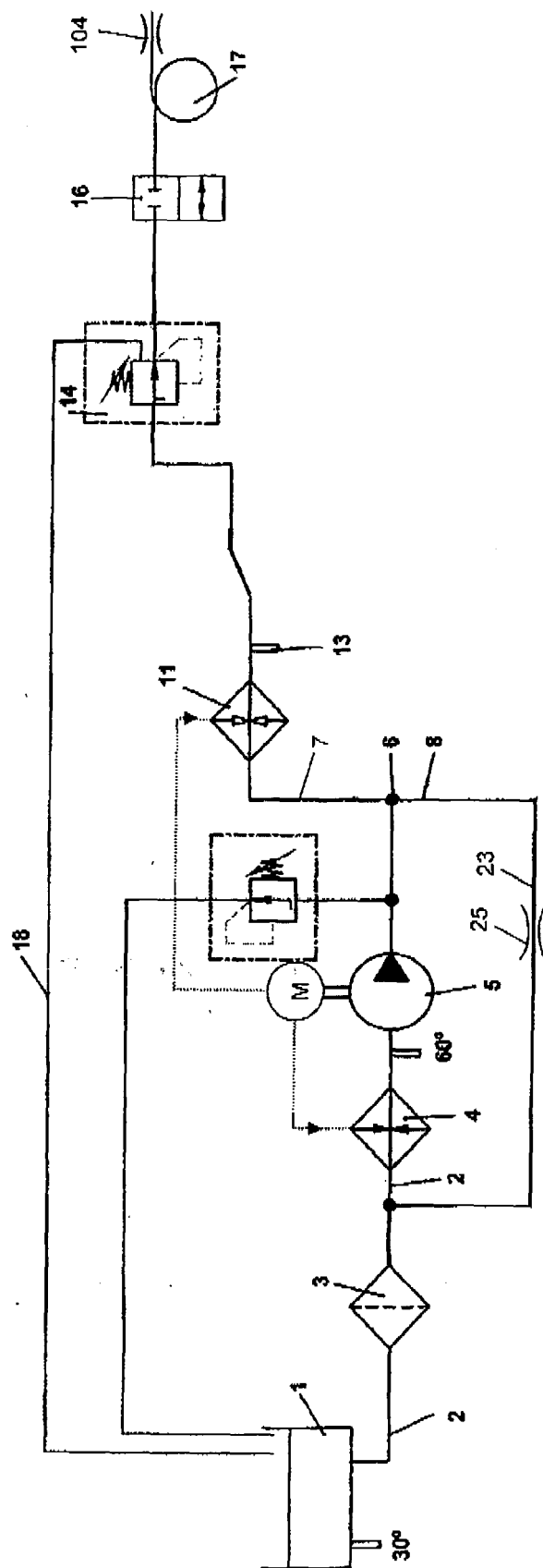


FIG. 1B

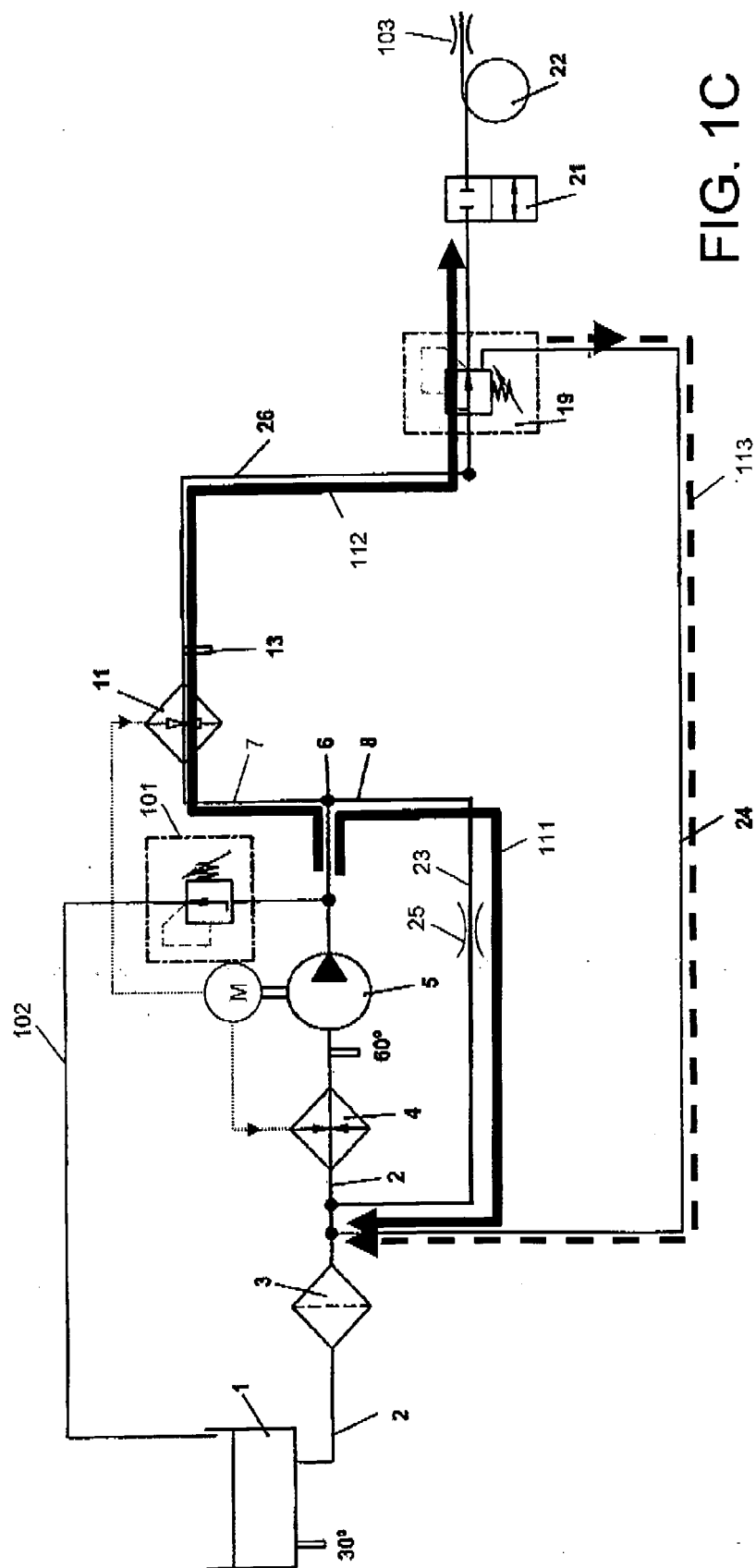
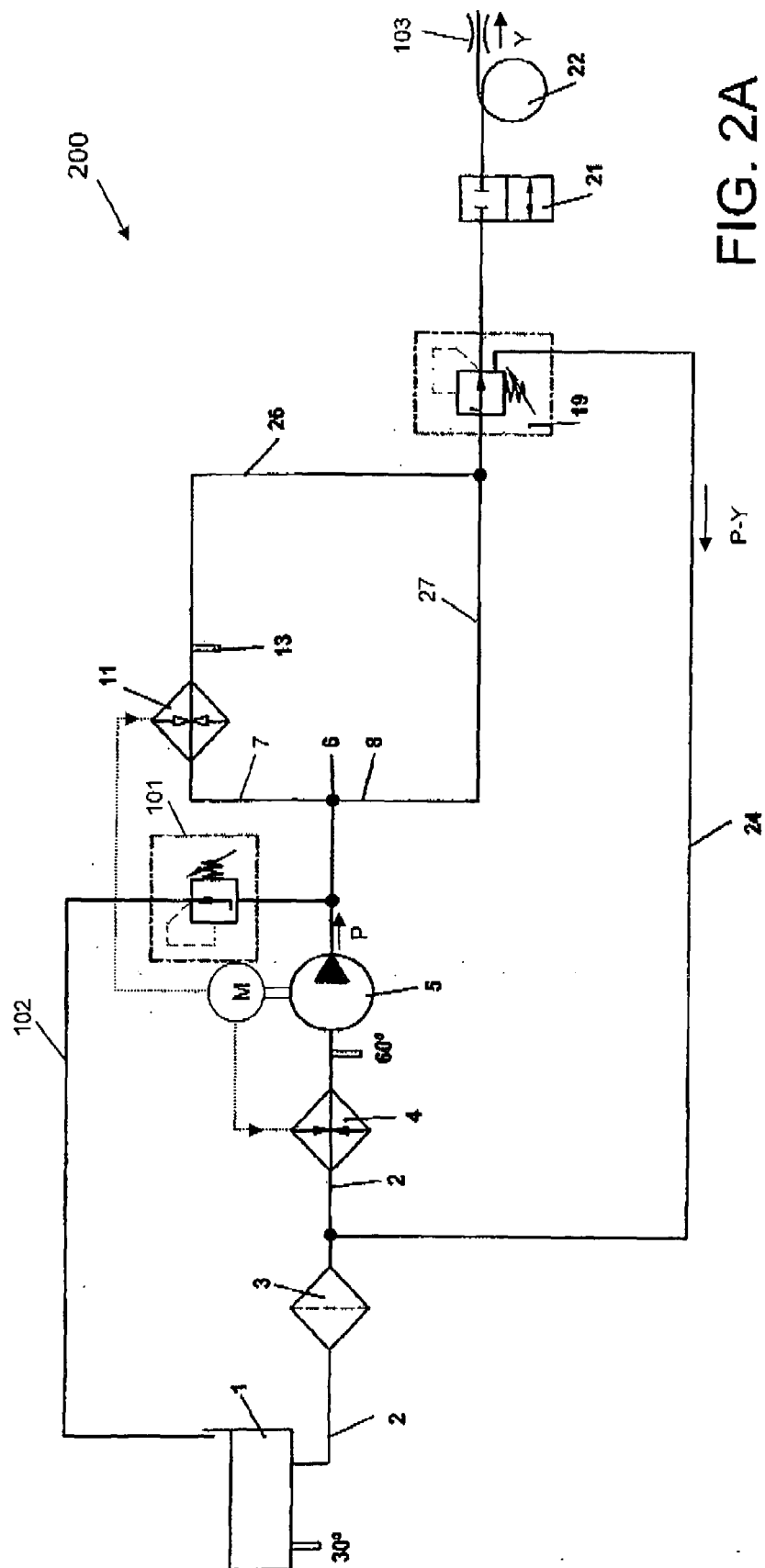
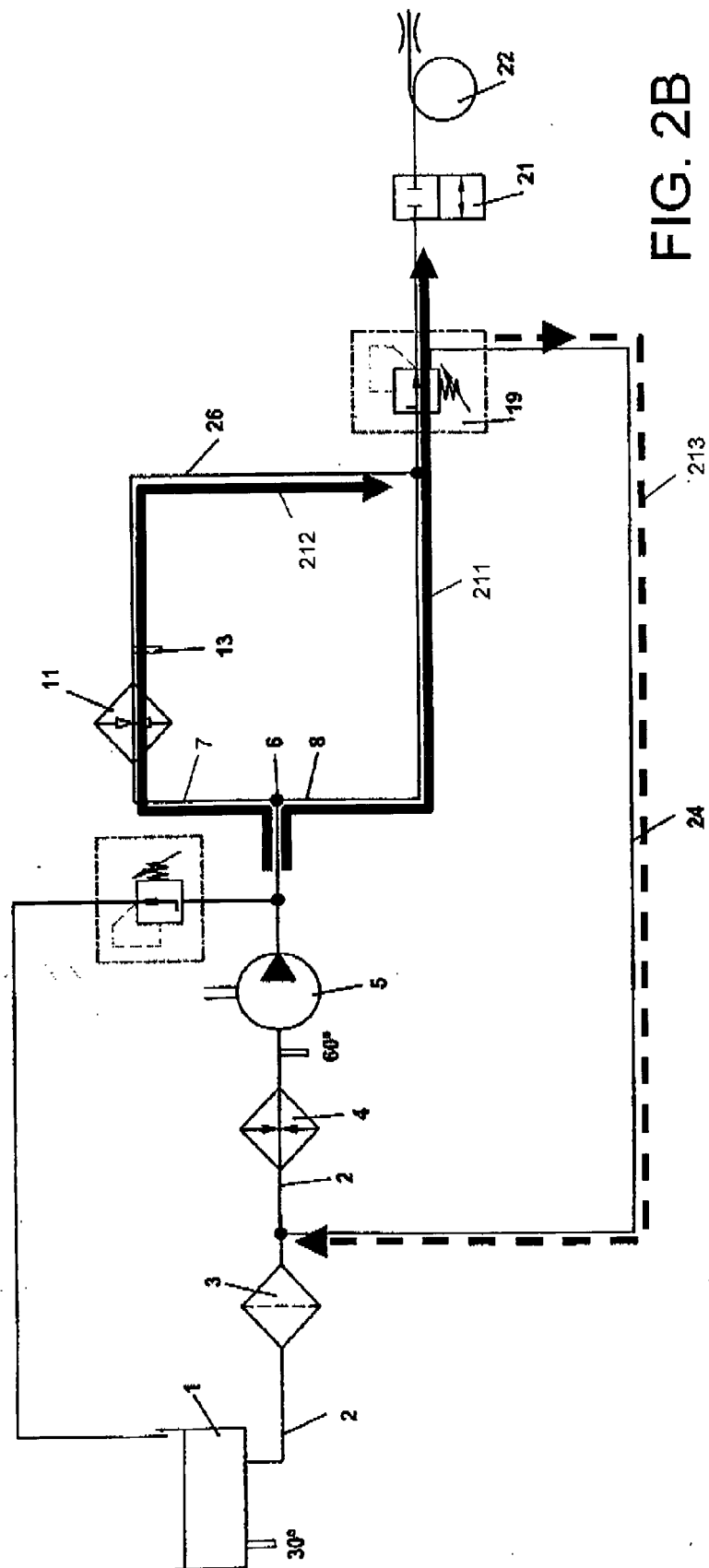


FIG. 1C





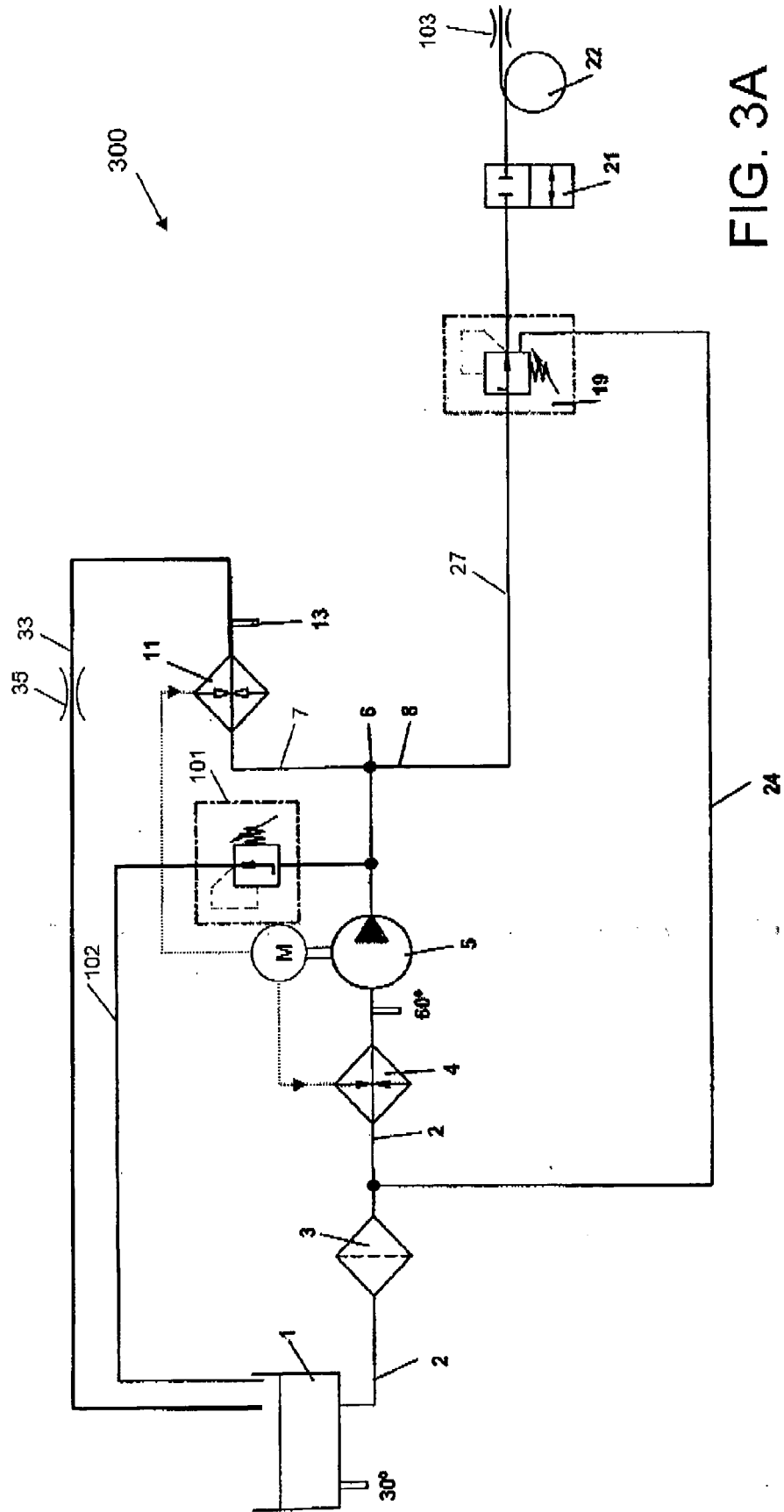


FIG. 3A

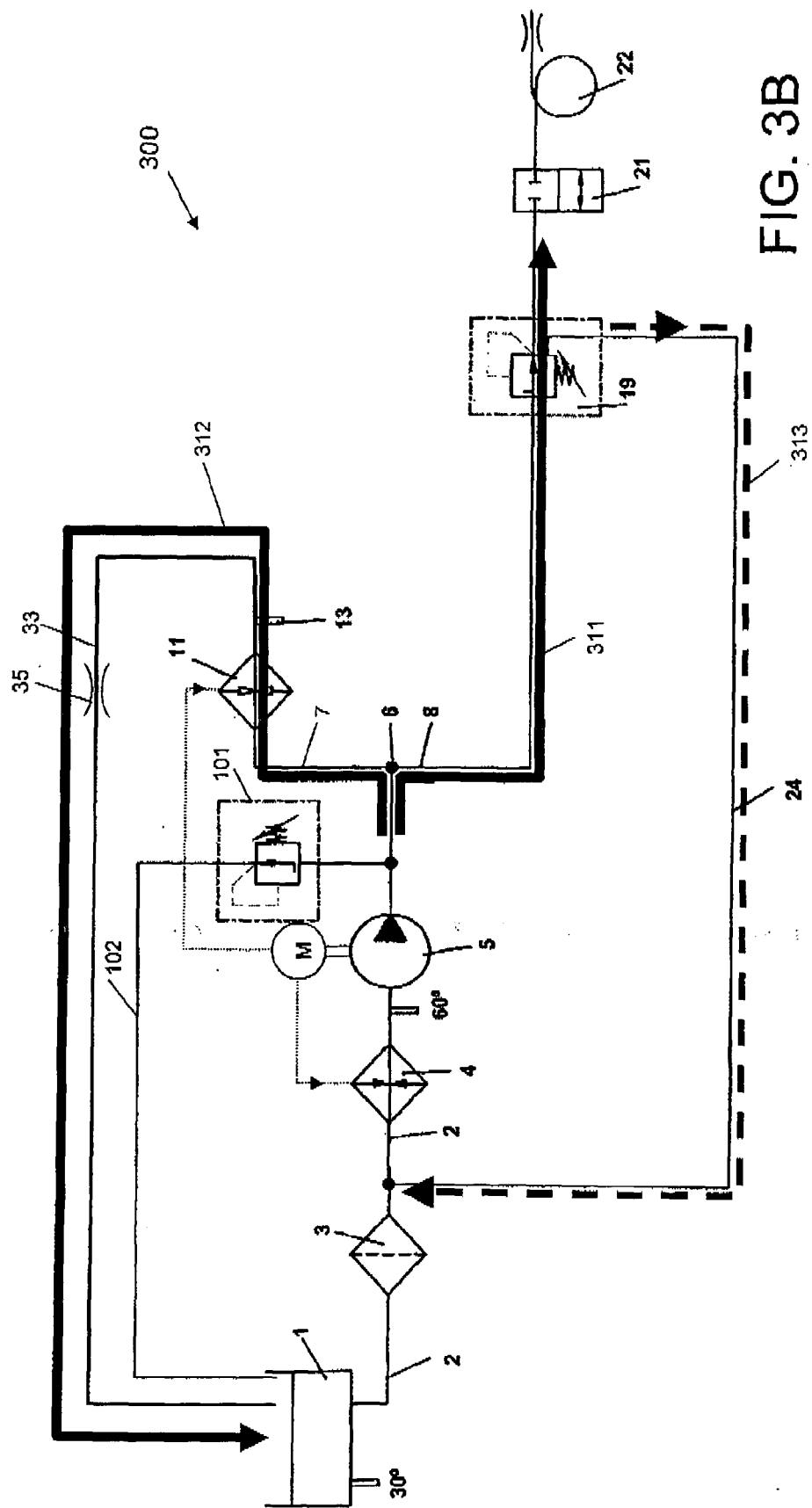
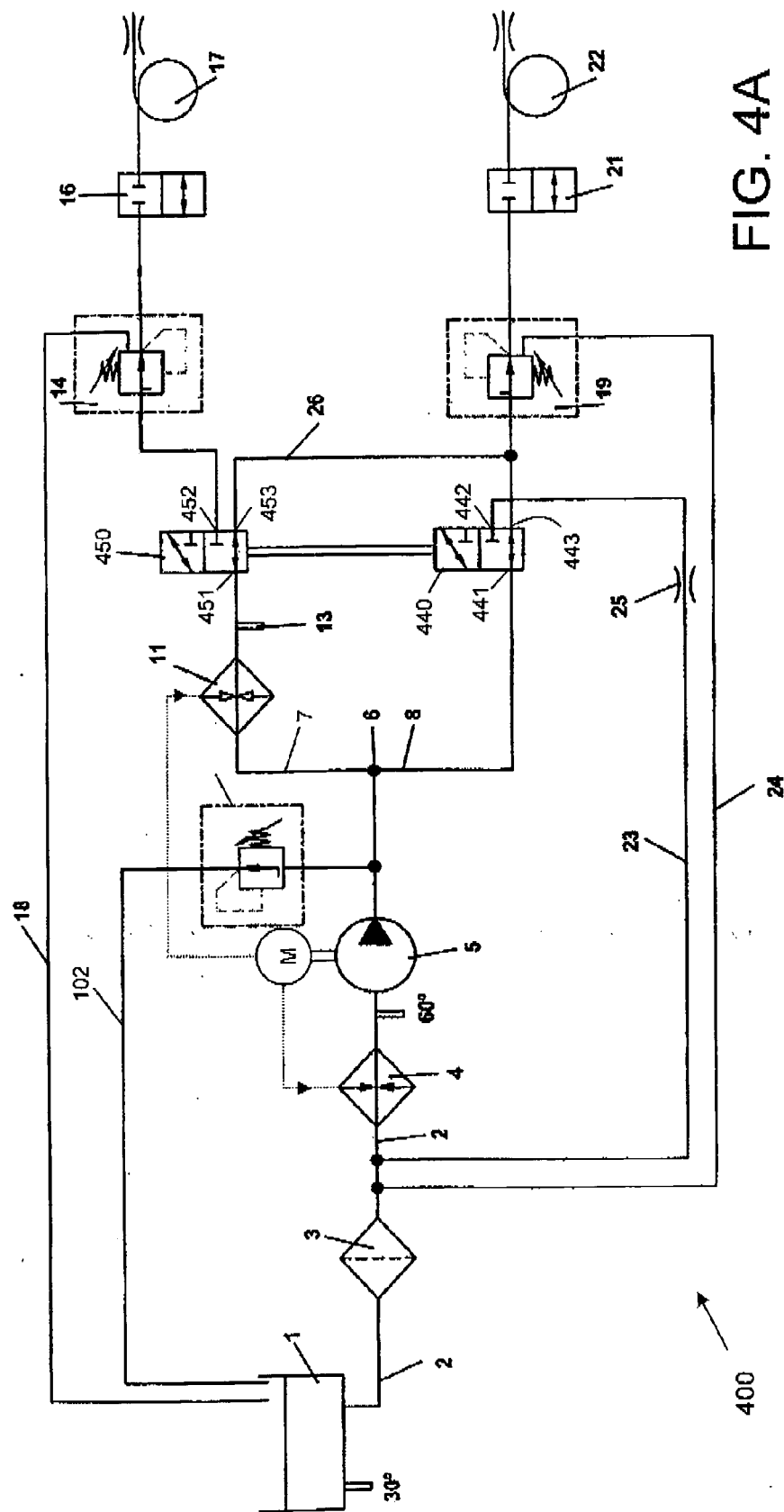


FIG. 3B



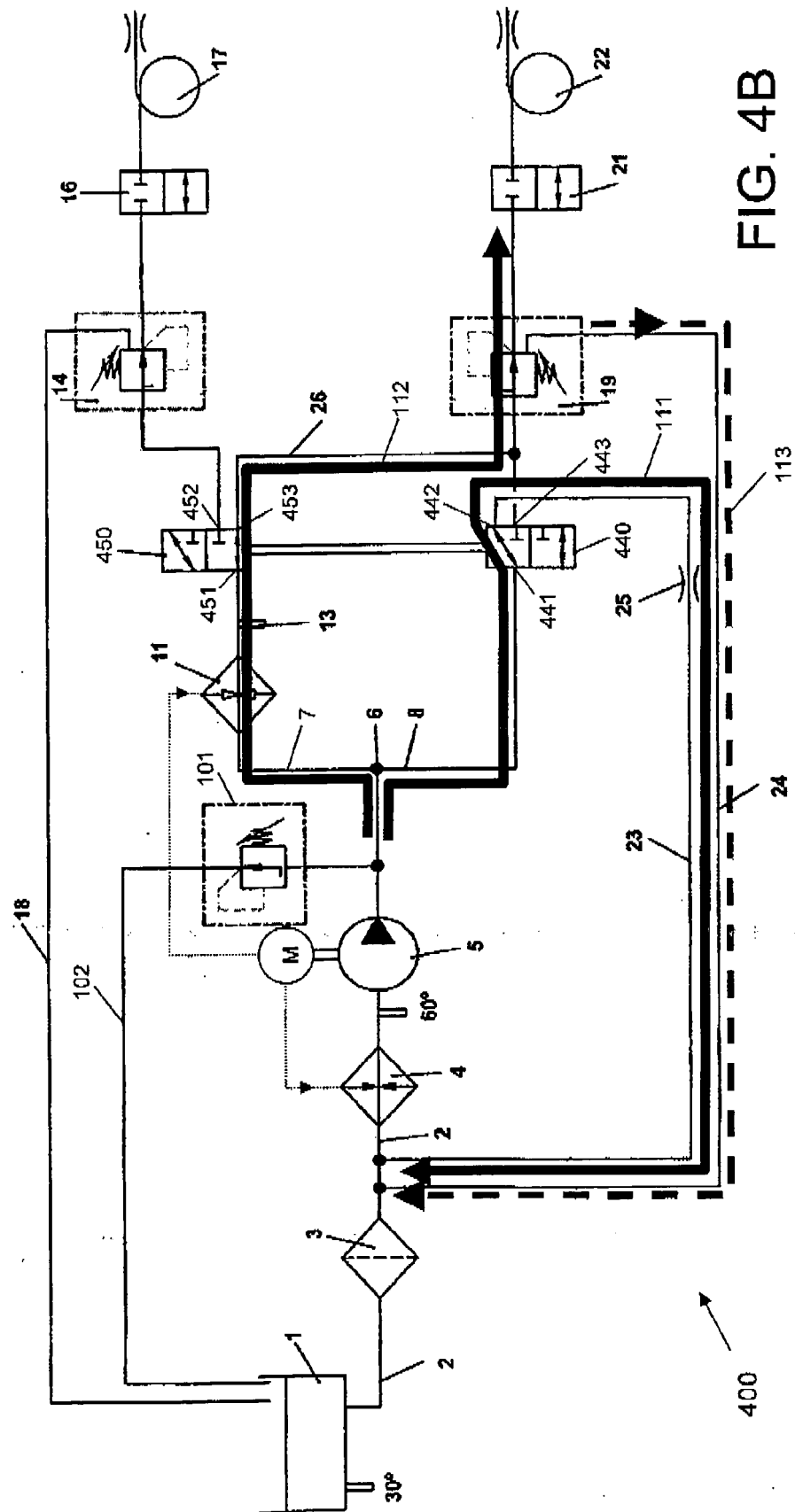
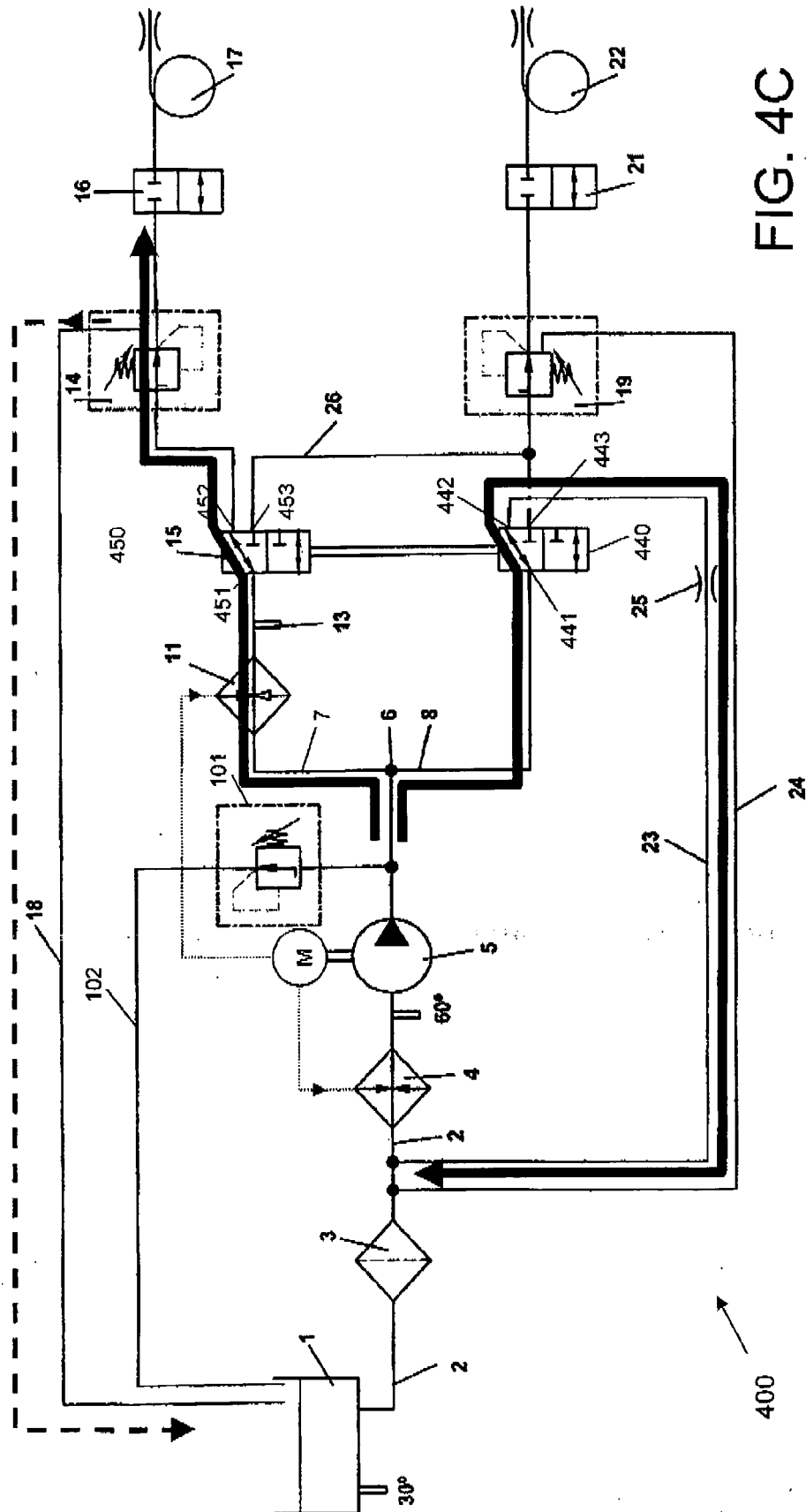


FIG. 4B



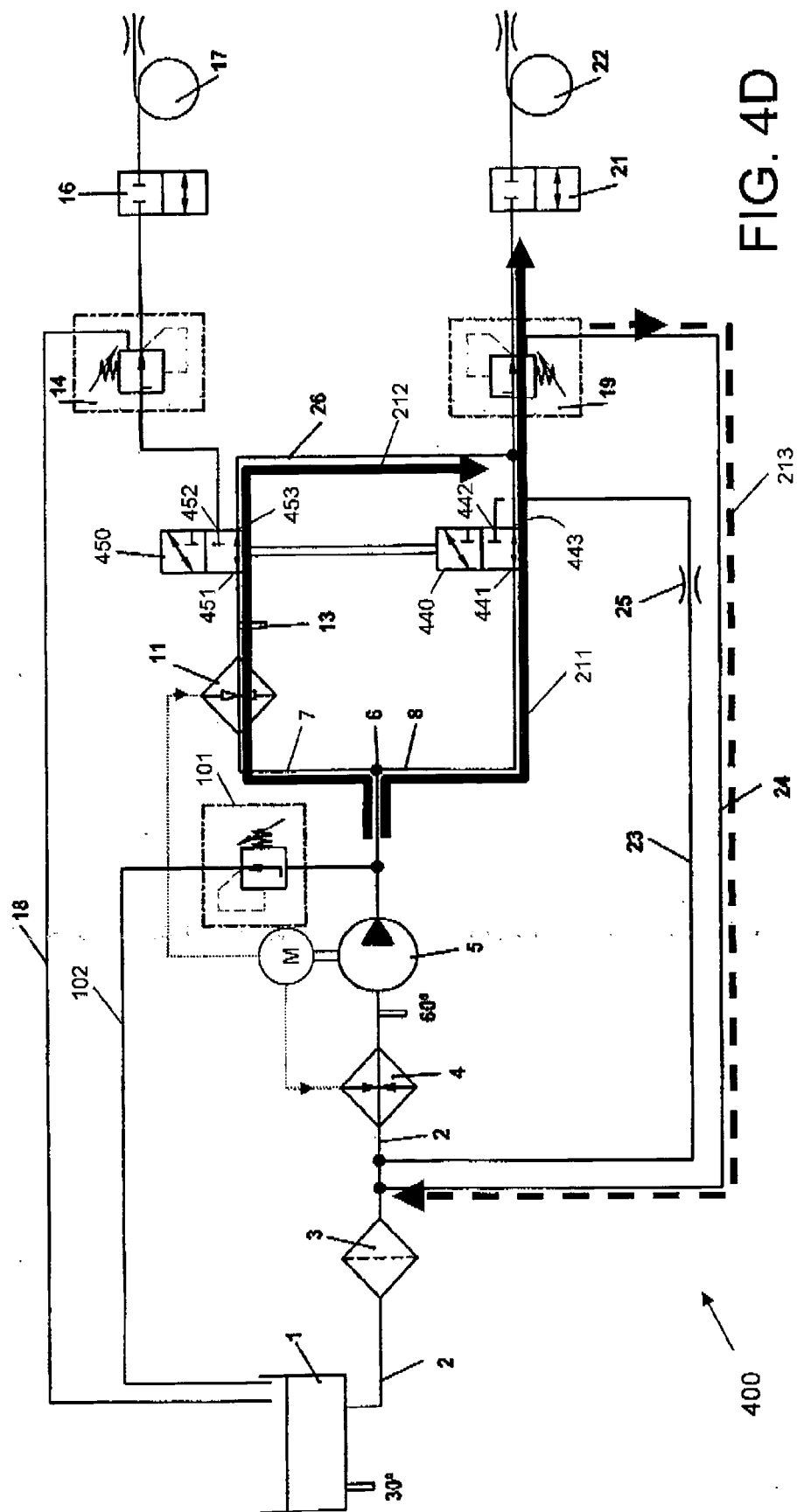


FIG. 4D

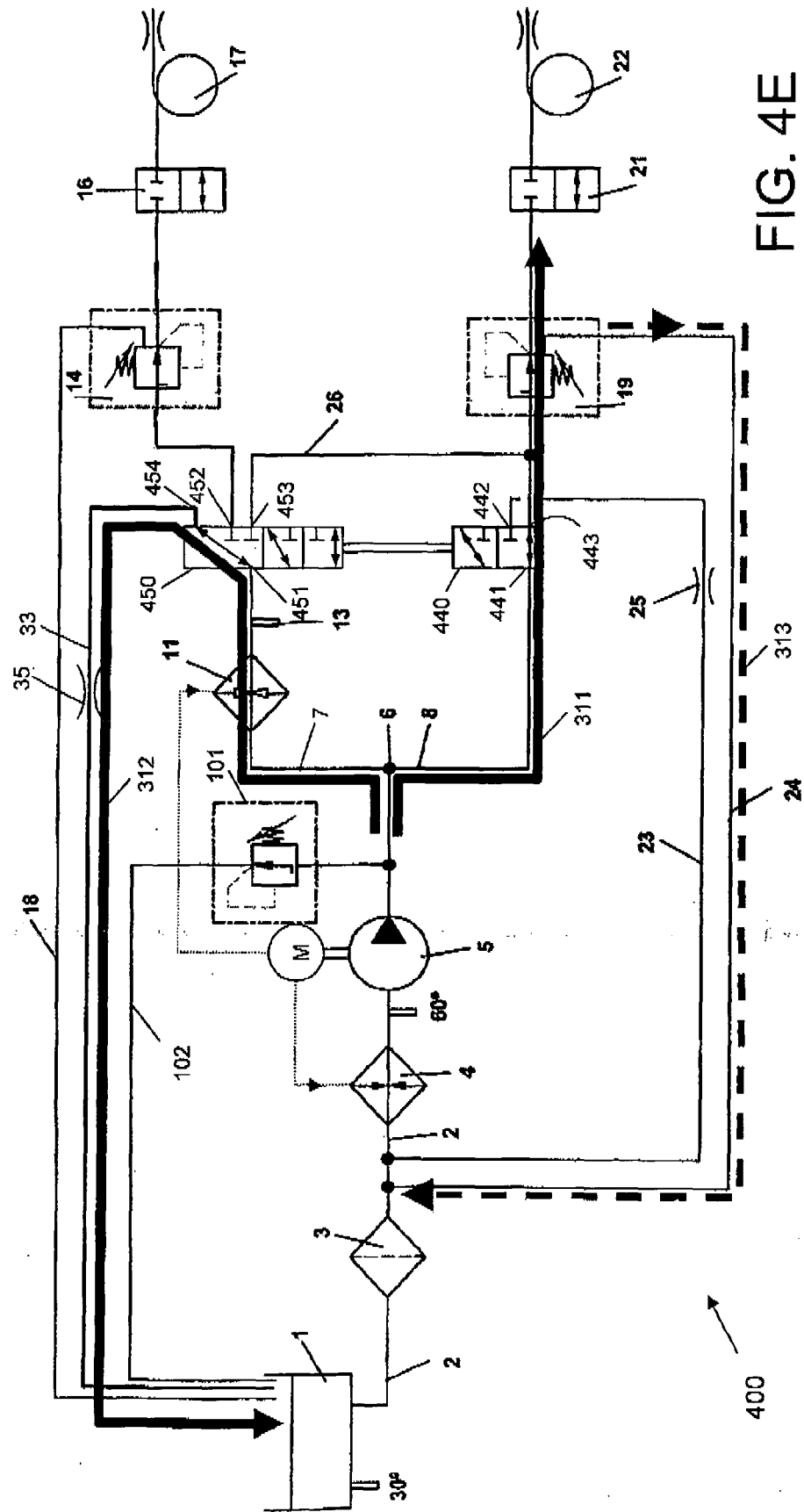


FIG. 4E

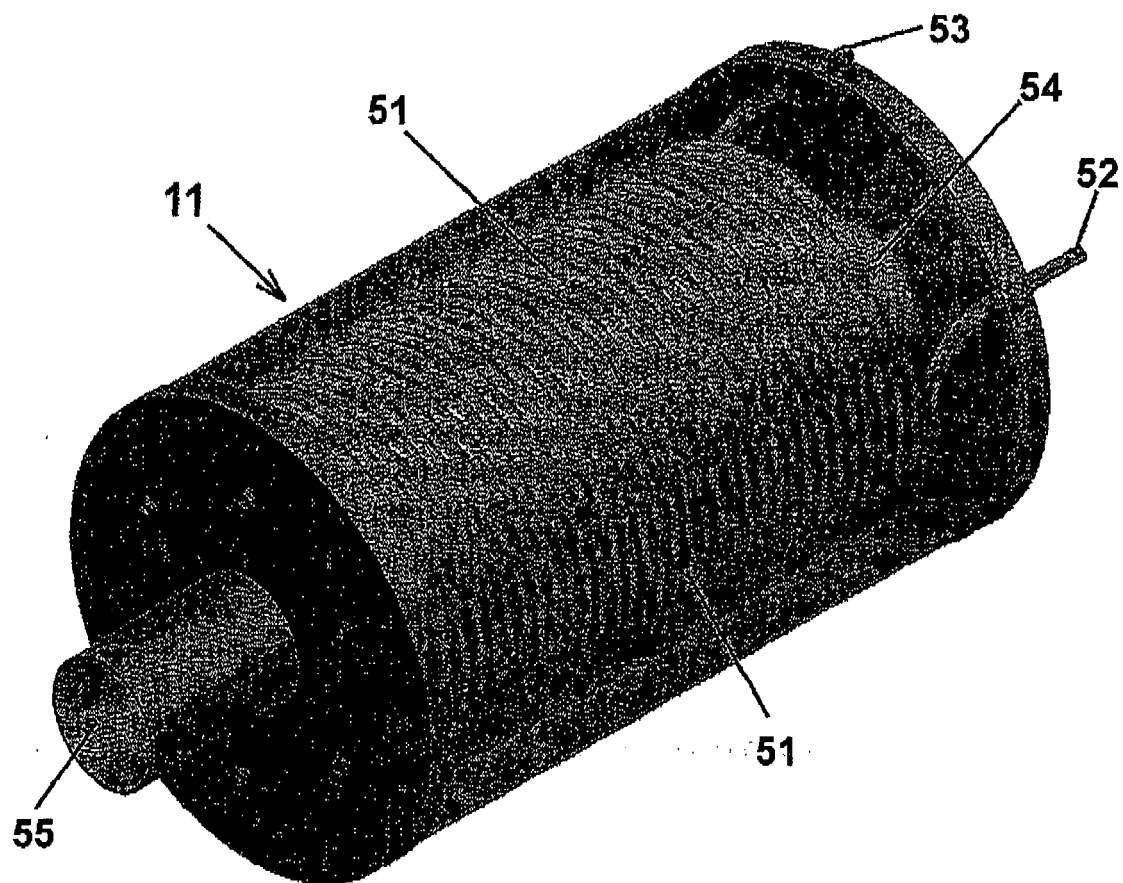


FIG. 5A

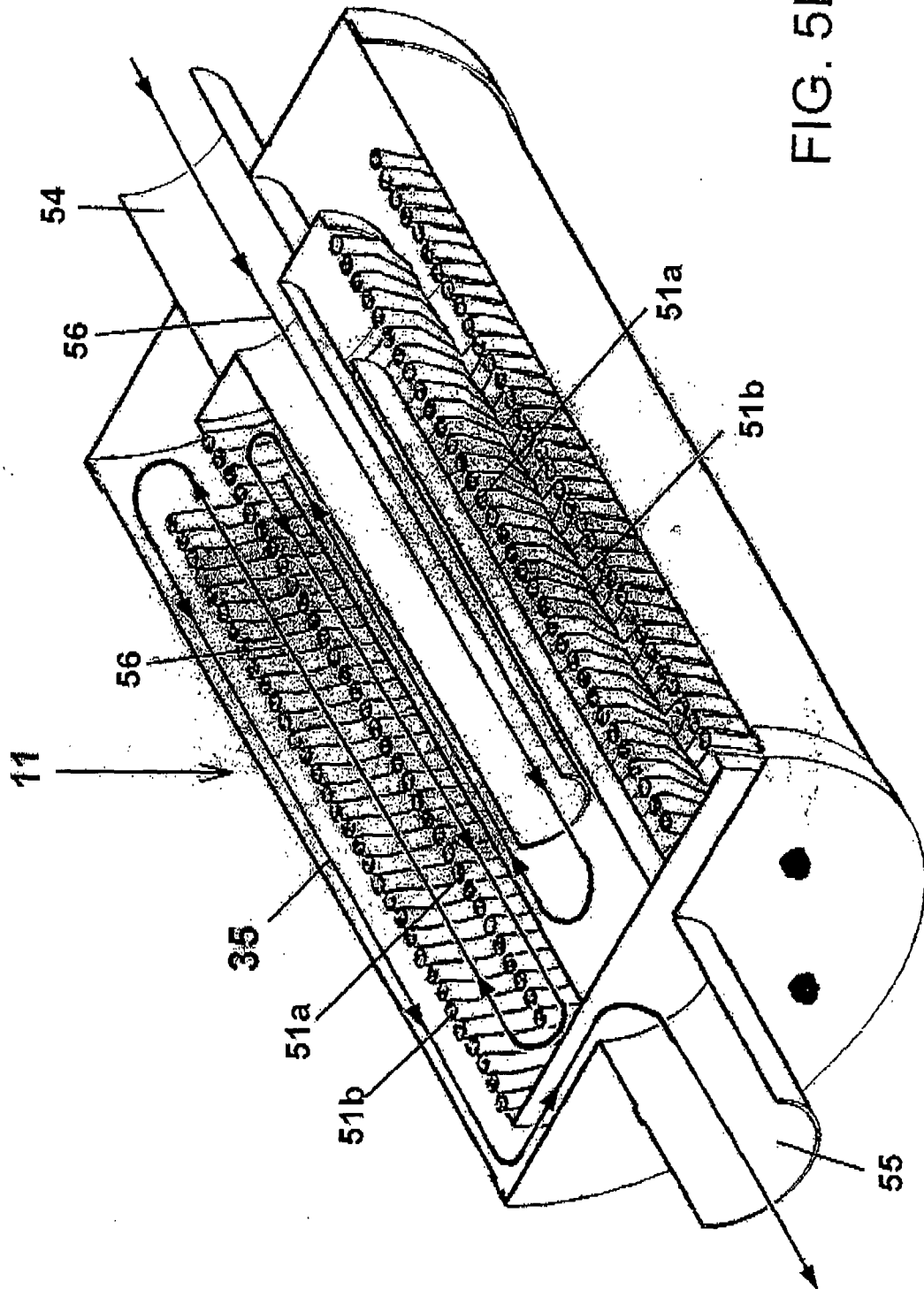


FIG. 5B

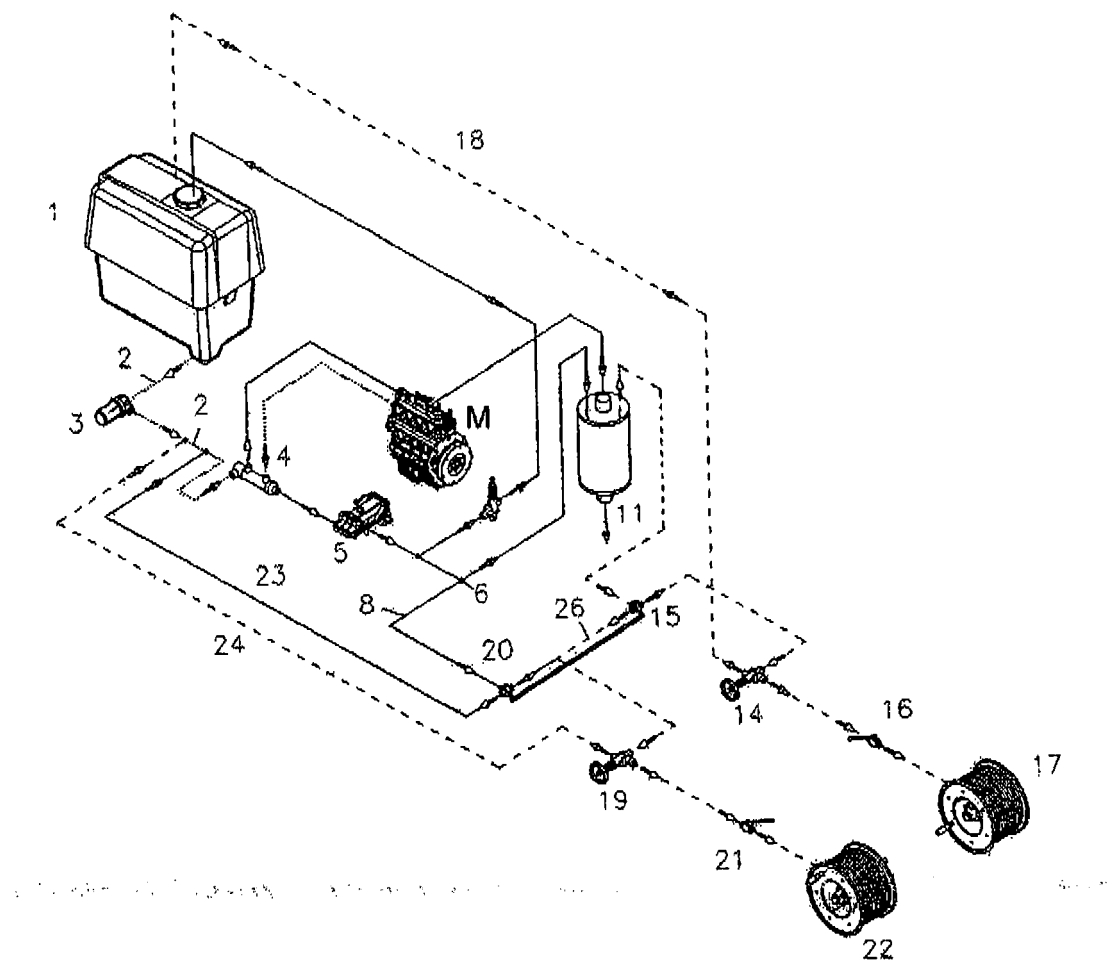


FIG. 6



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Y A	DE 100 41 154 A1 (KUPS UMWELTECHNIK GMBH & CO. KG ET AL) 14 March 2002 (2002-03-14) * abstract * * paragraph [0001] - paragraph [0002] * * paragraph [0004] - paragraph [0005] * * paragraph [0007] - paragraph [0010] * * paragraph [0015] - paragraph [0027] * * figure * -----	2,17-19 1,3,9, 10, 12-16, 20,23-25	TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 1 November 2006	Examiner van der Zee, Willem
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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EUROPEAN SEARCH REPORT

Application Number
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Place of search The Hague		Date of completion of the search 1 November 2006	Examiner van der Zee, Willem
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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