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(54) Engine coolant flush filtering apparatus and method.

(57) A method for rapid and efficient cleaning of an internal combustion engine cooling system includes:

a) forcing the coolant liquid from the cooling system to the exterior of that system,

b) treating the coolant liquid from the cooling system to the exterior of that system,

b) treating the coolant liquid in a zone or zones outside the cooling system, such treating including removing contaminant from the coolant liquid,

c) returning the treated coolant liquid to the cooling system,

d) the forcing step including supplying pressurized gas to the cooling system to drive coolant liquid therefrom,

e) the cooling system including a heat radiator including a container having a coolant liquid fill opening, and the forcing step including employing the gas to drive coolant liquid from the radiator via the container fill opening,

f) and including the step of controllably venting fluid including gas from the container via the fill opening, during the step of returning the treated coolant liquid to the cooling system.

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ENGINE COOLANT FLUSH-FILTERING METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

This invention relates generally to cleaning of an internal combustion engine cooling system, and more particularly to treatment of used coolant exteriorly of such a system for subsequent return to the system.

Studies show that over-heating is a major cause of vehicle breakdowns on highways. Engine cooling systems must operate efficiently at all times to avoid costly repairs that result from excessive temperature. In this regard, cooling systems contaminated by rust, scale build-up and sludge cannot provide adequate heat transfer and cooling system efficiency. In addition, thermostats fail to open, hoses deteriorate, impellers bind or break-off, and engine blocks can become distorted or crack. Accordingly, there is a need for efficient engine cooling system flushing methods and apparatus. However, flushing of such systems in the past required draining of the removed liquid to sewer or waste lines, which is environmentally objectionable. Thus, a need has developed for an apparatus and method to clean engine coolant systems without such drainage.

SUMMARY OF THE INVENTION

The invention may provide procedures and apparatus for overcoming the problems and meeting the needs set forth above, whereby rapid and efficient cleaning of the engine coolant system may be accomplished in an environmentally non-objectionable manner.

The method of the invention may embody the following steps:

a) forcing the coolant liquid from the cooling system to the exterior of that system,

b) treating the coolant liquid into a zone or zones outside the cooling system, including removing contaminants from the coolant liquid,

c) returning the treated coolant liquid to the cooling system,

d) the forcing step including supplying a pressurized gas to the cooling system to drive coolant liquid therefrom,

e) the cooling system including a heat radiator having a container with a coolant liquid fill opening, and the forcing step including employing the gas to drive coolant liquid from the radiator via the container fill opening, and

f) controllably venting fluid including gas from the container via the fill opening during the step of returning the treated coolant liquid to the cooling system.

An alternative to e) above comprises the cooling system including a container having a coolant liquid fill opening, and a valve controlled discharge port proximate the bottom of the radiator, the forcing step employing the gas to drive coolant liquid from the radiator via the discharge port.

The invention may provide for the supply of a pressurized gas such as air to the cooling system in such a way as to drive coolant therefrom, for external treatment as in a holding tank zone.

The invention may also provide a siphoning probe insertible into the radiator associated with the engine to provide a path for coolant to exit the radiator from its lower interior, for external treatment. The probe is associated with a closure for the radiator fill port, to keep that port closed during performance of the steps a) - f) referred to above, preventing ejection of hot fluid which could harm the operator.

The invention may further provide a path for pressurized coolant to exit the radiator from its lower interior, for external treatment, while a radiator fill port is maintained closed to prevent injury to the user, which could occur by hot fluid discharge from the radiator interior, via an open fill port.

Additional steps may include filtering contaminant particulate from the coolant as it flows to the external treatment zone; adding fresh chemicals to the radiator after completion of service; employing gas pressure to drive the coolant from the holding zone back to the coolant system at the engine, and filtering the returning coolant. Further, the driving gas pressure may be employed to test the coolant system for any leakage.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view of apparatus employing a first embodiment of the invention;

Fig. 2 is an enlarged section showing details of a radiator fill port closure shown in Fig. 1 at a by-pass valve;

Fig. 3 is a front view of a control console;

Fig. 4 is a schematic view of a second embodiment of apparatus employing the invention; and

Fig. 5 is an enlarged section of the second embodiment showing details of a radiator fill port closure shown in Fig. 4 at a by-pass valve, and drain valve.

DETAILED DESCRIPTION OF THE DRAWINGS

In Fig. 1, there is schematically shown an internal combustion engine 10 having a block 11 defining coolant passages through which liquid coolant (such as water, and anti-freeze additive including polyethylene glycol, etc.) is adapted to pass. The engine 10 includes a radiator 12, and a coolant pump 13 connected to pump coolant between the block and radiator, via lines or ducts 14 and 14a. Also shown is a heater 15 connected at 17 with the block, for use in a vehicle to be heated. From the heater, coolant may pass at 18 to the engine block 11. During continued operation of the engine, the coolant tends to become contaminated with particulate such as rust particles and precipitate (calcium salts, etc.), and the additive degenerates. In the past, the coolant was drained from the system to sewer lines, and the system flushed with liquid which was also drained. The present invention preferably eliminates such environmentally objectionable draining, and also protects the operator.

In accordance with the invention, apparatus generally designated at 20 is provided, and comprises:

a) first means for forcing the coolant liquid from the cooling system to the exterior of that system,

b) second means in communication with the first means for receiving the coolant liquid at the exterior of the cooling system, for treatment thereof, and

c) third means in communication with the second means for returning the treated coolant liquid to the cooling system.

While specific means are shown within the overall block 20, it will be understood that other, or equivalent means are usable to perform the following steps:

a) forcing the liquid coolant from the cooling system to the exterior of that system,

b) treating the coolant liquid in a zone or zones outside the cooling system, the treating including removing contaminant from the coolant liquid, and

c) returning the treated coolant liquid to the cooling system.

The method and apparatus of the invention make possible the re-use of the coolant by withdrawing it from the coolant system, treating it externally of that system, and re-circulating the rejuvenated coolant back into the system so as to avoid disposal of the coolant by drainage to the environment.

The first means for forcing the liquid coolant from the coolant system may advantageously include an elongated tube or tubular probe 21 insertible endwise into the outer container or shell 22 of the radiator, and via the usual fill opening 23a of that shell to extract coolant from the lower interior of the radiator for passage from the radiator via duct 23. Means 24 associated with, and typically carried by, that tubular probe 21, is provided for maintaining the fill opening otherwise closed during removal of coolant from the radiator. Such means may comprise a screw-on cap 24 which is annular to pass the elongated tube 21. The cap is screwed onto the neck 25 of the radiator fill-opening so that the probe then reaches near the bottom interior of the radiator so that substantially all liquid may be removed, extracted or siphoned from the radiator, to the line 23. Liquid in the heater and block flows to the radiator for such removal, and typically under pressure within the radiator so as to flow up the tubular probe to the external line 23 and then to a treatment zone. Figs. 2 and 5 show cap details.

The second means for treating the removed coolant may advantageously comprise a liquid receiver in the form of a holding tank 27 to which liquid flows via line 23, a filter 28 connected in series with that line, and valve 29 in the line. Particulate and congealed substances in the flowing liquid are removed by the filter 28, which may be replaced at intervals. The used-up filter is disposed of in accordance with environmentally acceptably safe procedures. The normally aqueous liquid received into the holding tank interior zone 31, via inlet 30, may then be treated by addition of a chemical agent or agents introduced via port 32. Such chemicals may include corrosion inhibitor i.e. anti-rust compound, pH adjustment chemicals, and fresh anti-freeze compound (for example, glycol). Such chemicals may also be added to the radiator, after return of treated coolant thereto. If any sludge develops in tank 27 after prolonged use, it may be removed to a container 34 and disposed of in an environmentally safe manner. See line 35 and valve 36.

The third means for returning the treated coolant to the engine cooling system includes a line or duct 37 extending from the tank 27 to a connection 38 with the cooling system. The connection 38 is advantageously located in the line 17 from the block 11 to the heater. A clamp 39 may be located on or at that line for stopping liquid passing from connection 38 to the block, via line 17. A control valve 40 and a filter 41 are connected in series in line 37, the valve 40 being opened when return of coolant to the system is desired. The filter 41 removes any further contaminant.

An important feature of the invention is the provision, in association with the first means referred to above, of a pressurized gas (for example, air) source 43 connectible via a main valve 44 in a duct 45 to a control valve 46. The control valve 46 is connected via line 47 with the coolant system and forces coolant from that system to the tank 27 via the probe 21 and/or line 23. The line 47 may be

connected to duct 17, at 48, as shown. Air pressure drives coolant from the heater to the radiator, via line 18 and the pump 13. Coolant also flows from the block 11 to the radiator lower interior extent 12a, for removal by the probe 21.

The valve 46 is a three-way valve, and is controllable to alternatively supply air under pressure via line 52 to the holding tank interior for application to treated liquid in the tank, and for return under pressure to the engine cooling system, along the flow path described above.

Prior to initial operation of the system, the engine is operated to heat the coolant in the system, and as a result a thermostat controlled valve in that system, indicated at 60, is opened when the coolant reaches a predetermined temperature. Rust loosening or cleaning chemical additive (such as detergent solution) may be initially added to the coolant in the radiator to circulate during warm-up. The probe 21 is then inserted in the radiator, and operation of the apparatus is begun. Note that the apparatus is quickly connectible to the cooling system, via hoses or lines 23, 37 and 47.

Finally, a pressure gauge 63 is connected to air line 45 to indicate the pressure in that line. After air pressure has returned the treated coolant to the system, the radiator fill opening 23a is closed by returning the radiator cap to the neck 25, and tightening it to seal the opening 23a. Thereafter, air pressure from supply 43 pressurizes the entire coolant system, and the gauge 63 is observed to note the pressure. An air pressure regulator 45a in the line 45 regulates the pressure to a safe level. The valve 44 is then closed, and the gauge 63 is again observed to note any relatively rapid fall-off in pressure. If that does not occur, the pressure test indicates a non-leaking system. If the pressure falls-off, the test indicates that a leak has developed in the coolant system, and should be attended to. For example, a STOP-LEAK solution may be added to the contents of the radiator in an effort to arrest the pressure leak.

In Fig. 2, the modified cap 24a has a domed wall 90 with a central opening 91 to accommodate the tubular probe 21. A seal 92 carried by the cap seals off against the outer surface of the probe (which may be plastic) when a threaded fitting 150 is tightened in a threaded bore 151. The probe is axially shiftable, endwise, relative to the opening 91, when the fitting 150 is loosened. The cap has a lower lip 93 that tightens on the annular lip 94 of the radiator container, as shown, at which time an annular extension 152 fits in a radiator bore 153, sealing at 154. An off-set through a port 95 has a by-pass duct 96 connected therewith at 97, and a manually controllable by-pass valve 98 in the duct 96 controls escape of pressurized fluid from the radiator upper interior 12b, to an over-flow tank 100. A by-pass valve 98 is opened during air pressure induced return of treated coolant fluid to the system. Fluid is allowed to rise in the radiator, to level 101, above the indicator core 104. Any excess fluid (air, coolant or both) rising in the radiator exits via the by-pass duct and the valve 98, to the tank 100. Thus, hot fluid under pressure cannot discharge in direction 102, outside the probe 21, since the radiator fill port 23a is closed by a cap or closure 24a. The duct 96 is transparent so that any loss of coolant can be visually monitored. Coolant collected in the tank 100 can be returned to the tank 27 by siphoning, through a siphon 106. The radiator container or shell appears at 109.

In an alternative embodiment, as shown in Figures 4 and 5, the first means for forcing the liquid coolant from the coolant system may advantageously include a coolant discharge port 110 at the bottom of the radiator, in series with a valve 111, manually controlled at control 112. Air pressurized coolant is forced from the lower interior or extent of the radiator, through the duct 123, to the tank 27.

Means 24 is provided for maintaining the usual radiator fill opening 23a otherwise closed during removal of coolant from the radiator. Such means may comprise a screw-on cap 24a which is located above the upper interior 12b of the radiator and the finned tubes 104. A cap 24a is screwed onto the neck of the radiator fill-opening at screw connection 93, 94. A valve 111 at the bottom wall 109 of the radiator container communicates with the bottom interior 12a of the container so that substantially all pressurized coolant liquid may be removed, extracted or drained from the radiator, to the line 123. Liquid in the heater and engine block flows to the radiator for such removal.

A modified cap 24a for the fill port 23a has a domed wall 90 with a central opening 91 usable to induce a vacuum at the upper interior 12b of the radiator. See the siphon bulb 294 in series with the bypass valve 98 in Fig. 4. A seal 92 carried by the cap seals off when a threaded fitting 152 is tightened in a threaded bore 151, to close the cap 24a. The cap has a lower lip 93 that tightens on the annular lip 94 of the radiator container, as shown, at which time an annular extension 149 fits in the radiator bore 153, sealing at 154.

An offset through port 95 in the wall 90 has a by-pass duct 96 connected therewith, at 97, and a manually controllable by-pass valve 98 in the duct 96 controls the escape of pressurized fluid from the radiator upper interior 12b to an over-flow tank 100. The valve 98 is opened, during air pressurized and induced return of treated coolant fluid to the system, so that fluid is normally allowed to rise in the radiator to the level 101 above the radiator core 104. Any excess fluid (air, coolant or both) rising in

the radiator exits via the by-pass duct and valve 98 to the tank 100. Thus, hot fluid under pressure cannot freely discharge in direction 102 outside, since the radiator fill port 23a is closed by the cap 24a, with a fitting 152 installed in a bore 151. The by-pass valve 98 is also used with a siphon-vacuum bulb 294 to induce a vacuum at 12b, when original equipment is removed from the bottom of the radiator and a special coolant discharge port or duct 110 is installed into the bottom of the radiator at 109, in series with the valve 111.

Coolant collected in the tank 100 can be siphoned out and returned to the tank 27, by a siphon which includes a hose 107 and a bulb 106. The radiator shell or container 109 contains the core 104. Alternatively, the first means for forcing the liquid coolant from the coolant system may advantageously include an elongated tube or tubular probe 21 insertible endwise into the outer container or shell 22 incorporated by the radiator, and via the port 151 in the cap 24a, to extract coolant from the lower interior or extent of the radiator, for passage from the radiator as via return duct 23.

SUMMARY OF OPERATION

The following is a summary of steps that may be carried out during performance of the method of the invention.

(A) With reference to the embodiment shown in Figures 1 and 2:

1) Add cleaning or flushing chemicals to the engine coolant system after preliminarily testing the system for leaks;

2) Connect apparatus 20 to the cooling system as shown in Fig. 1, and as described above;

3) Operate the engine for about ten minutes to circulate the chemicals for loosening dirt, rust, sludge, etc., and also to warm up the coolant solution so that the thermostat controlled valve 60 opens, at about 190 - 205° F;

4) Insert the probe 21 into the radiator and tighten its cap means 24a to the lip 94;

5) Open the valve 44 and adjust the valve 46 to direct air pressure to the connection 48, which causes air pressure to drive coolant from the system to the holding tank 27, via the probe 21, filter 28, and valve 29, which is OPEN;

6) Close the valve 44;

7) Leave the probe 21 in the radiator, and leave the fill-opening 23a closed by the cap 24a. Open the by-pass valve 98;

8) Open the valve 44 and adjust the valve 46 to direct air pressure to the tank 27, via the line 52. The inlet 32 should be closed. This drives coolant from the tank, through the filter 41, and to the coolant system at line 17. Excess air or fluid vents via the valve 98;

9) When all coolant has been returned to the system (as can be viewed via line 37 which is transparent), the by-pass valve 98 is closed;

10) Pressurize the coolant system, and close the valve 44;

11) Observe the gauge 63 for any pressure leaks;

12) Relieve pressure in the system as by slowly opening the overflow valve attached to the cap at the radiator neck 25;

13) Disconnect the hoses or lines from the line 17 and replace the standard radiator cap to the neck 25, after withdrawing the probe 21.

(B) With reference to the embodiment shown in Figures 4 and 5:

1) Add cleaning or flushing chemicals to the engine coolant system after preliminarily testing the system for leaks;

2) Connect apparatus 20 and the cap 24a to the cooling system as described above;

3) Operate the engine for about 10 minutes to circulate the chemicals for loosening dirt, rust, sludge, etc., and also to warm up coolant solution so that the thermostat controlled valve 60 opens, at about 190-205° F;

4) Make sure that the cap means 24a is connected to the lip 94, and that the cap port 151 is plugged by plug 152;

5) Open the valve 44 and adjust the valve 46 to direct air pressure to the connection 48, which causes air pressure to drive coolant from the system to the holding tank 27, via the port 110, valve 111, filter 28, and valve 29, which is OPEN;

6) Close the valve 44.

7) Leave the fill-opening 23a closed by the cap 24a. Open the by-pass valve 98. Close the valve 111;

8) Open the valve 44 and adjust the valve 46 to direct air pressure to the tank 27, via line 52. the inlet 32 should be closed. This drives coolant from the tank, through the filter 41, and to the coolant system at line 17. Coolant rises to the level 101 in the radiator. Excess air or coolant fluid vents via the by-pass valve 98 to the tank 100.

9) When all coolant has been returned to the system, the by-pass valve 98 is closed.

10) Relieve pressure in the system as by slowly opening the valve 98 at the side of the cap 24a. Any flow via transparent line 96 can be viewed.

11) Remove the cap 24a from the radiator neck.

12) Disconnect the hoses or lines from the line 17;

13) Add treating chemical and anti-freeze (if necessary) to the radiator, via the open port 23a;

14) A standard radiator cap can then be attached to the radiator neck;

The connections to line 17 may take the form of those described in U.S. Patent 4,109,703, Fig. 12.

Fig. 3 shows valve controls on a console panel 105. along with the gauge 63. A flow indicator (spinner) connected into line 17, is shown at 106.

Claims

1. Apparatus for use with an internal combustion engine cooling system, the combination comprising:

a) first means for forcing coolant liquid from the cooling system to the exterior of that system,

b) second means in communication with said first means for receiving the coolant liquid at the exterior of the cooling system, for treatment thereof, and

c) third means in communication with said second means for returning treated coolant liquid to the cooling system,

d) the cooling system including a heat radiator including a container having a coolant liquid fill opening, the container having an associated discharge port to controllably pass coolant liquid from internal extent of the radiator, and means for maintaining the fill opening otherwise closed during said passage of coolant liquid from the radiator.

2. The apparatus of claim 1 wherein said discharge port is valve controlled and is proximate the bottom of the radiator, the apparatus further comprising a closure 24a for said fill opening, and a manually operable shut-off valve controlled by-pass opening associated with said closure, to pass pressurized fluid from the container interior to the exterior.

3. The apparatus of claim 2 comprising an overflow tank outside the container, and ducting extending from said by-pass opening to said overflow tank.

4. The apparatus of claim 2 comprising a duct communicating with the container via said closure and said fill opening to extract coolant liquid from the cooling system.

5. The apparatus of claim 4 wherein said closure is a metallic cap defining a through opening for said duct, the by-pass opening also located in the cap.

6. The apparatus of any one of the preceding claims wherein said third means includes a filter connected to pass coolant liquid being returned from a holding zone to the cooling system.

7. The apparatus of claim 5 including an elongated tube extending downwardly into the radiator interior via said through opening in the cap.

8. The apparatus of any of the preceding claims wherein the cooling system includes cooling passages in an engine block and in a heater, there being a coolant flow connection passage between said coolant passages in the block and heater, and wherein said third means includes a coolant return flow duct in communication with said flow connection passage.

9. The apparatus of any one of the preceding claims wherein said third means includes a valve and ducting in communication with a holding tank, and a pressurized gas source connectible via said valve and ducting with said tank for driving liquid from the tank to return the liquid to the cooling system.

10. The apparatus of claim 9 wherein the cooling system includes cooling passages in an engine block and in a heater, there being a coolant flow connection passage between said coolant passages in the block and heater, and wherein said third means includes a coolant return flow duct in communication with said flow connection passage.

11. The apparatus of any one of the preceding claims wherein the fill opening is maintained open during said return of treated coolant to the cooling system, and wherein said third means includes a source of pressurized gas connected to drive treated coolant back into the coolant system, at a location spaced from the radiator, spent gas leaving the system via said open fill opening.

12. The apparatus of any one of the preceding claims wherein:

said first means includes an elongated tube insertible into the container via said fill opening to extract coolant liquid from a lower extent of the radiator for passage from the radiator;

said means for maintaining the fill opening otherwise closed comprises a closure having a through opening in communication with said elongated tube, the closure attachable to the container proximate the fill opening.

13. The apparatus of claim 12 wherein said closure defines a valve controlled discharge port in the form of a by-pass opening to pass pressurized fluid from the container interior outside the tube and proximate the fill opening.

14. The apparatus of claim 13 including an overflow tank outside the container, and ducting extending from said by-pass opening to said overflow tank.

15. The apparatus of claim 13 wherein said closure is a metallic cap which has a dome shaped wall defining said through opening at the center of said wall, the by-pass opening located in said wall, in off-set relation to said through opening.

16. The apparatus of claim 12 wherein said elongated tube extends through said through opening, and said elongated tube is a plastic tube that

extends through said through opening and there being means carried by the cap for sealing off about the elongated plastic tube.

17. The apparatus of claim 13 wherein said second means includes a holding tank for collecting said coolant liquid in a holding zone.

18. The apparatus of claim 17 wherein said second means includes a filter connected to pass coolant liquid flowing to said holding zone.

19. The apparatus of claim 17 wherein said third means includes a filter connected to pass coolant liquid being returned from the holding zone to the cooling system.

20. The apparatus of claim 17 wherein the cooling system includes cooling passages in an engine block and in a heater, there being a coolant flow connection passage between said coolant passages in the block and heater, and wherein said third means includes a coolant return flow duct in communication with said flow connection passage.

21. A method of treating coolant liquid in an internal combustion engine cooling system, comprising:

a) forcing the coolant liquid from the cooling system to the exterior of that system,

b) treating the coolant liquid in a zone or zones outside the cooling system, said treating including removing contaminant from the coolant liquid, and

c) returning the treated coolant liquid to the cooling system,

d) said forcing step including supplying a pressurized gas to the cooling system to drive coolant liquid therefrom,

e) the cooling system including a heat radiator including a container having a coolant liquid fill opening, and said forcing step including employing said gas to drive coolant liquid from the radiator, and

f) controllably venting fluid including gas from said container via a closure at said fill opening, during said step of returning the treated coolant liquid to the cooling system.

22. The method of claim 21 including providing an elongated tube and inserting the tube into the radiator via said fill opening to extract said coolant liquid from the lower extent of the radiator for said passage from the radiator, and maintaining said fill opening otherwise closed during said passage of coolant liquid from the radiator.

23. The method of claims 21 or 22 wherein an overflow tank is provided in association with the radiator, and including discharging into said tank fluid vented via a by-pass valve associated with said closure, and controlling said valve to control said venting.

24. The method of claims 21 to 23 including a valve controlled discharge port proximate the bottom of the radiator, and said forcing step including employing said gas to drive coolant liquid from the radiator via said discharge port.

25. The method of claim 24 including the step of maintaining said fill opening closed during said forcing step.

26. The method of claim 24 including controllably venting fluid including gas from said container via said fill opening, during said step of returning the treated coolant to the cooling system.

27. The method of claim 26 including applying said closure to said fill opening, there being a by-pass valve connected with said closure, and carrying out said venting via said by-pass valve.

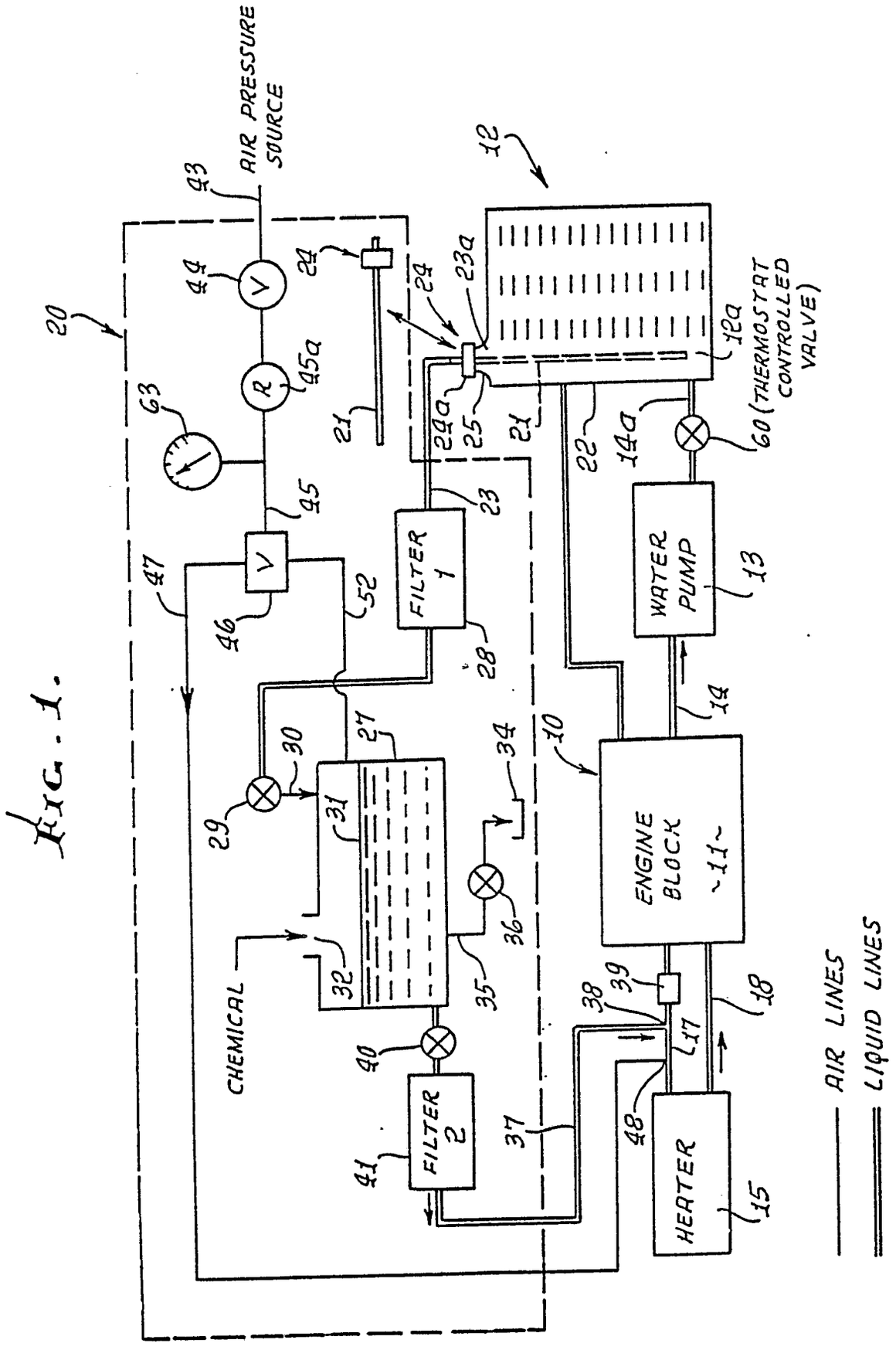
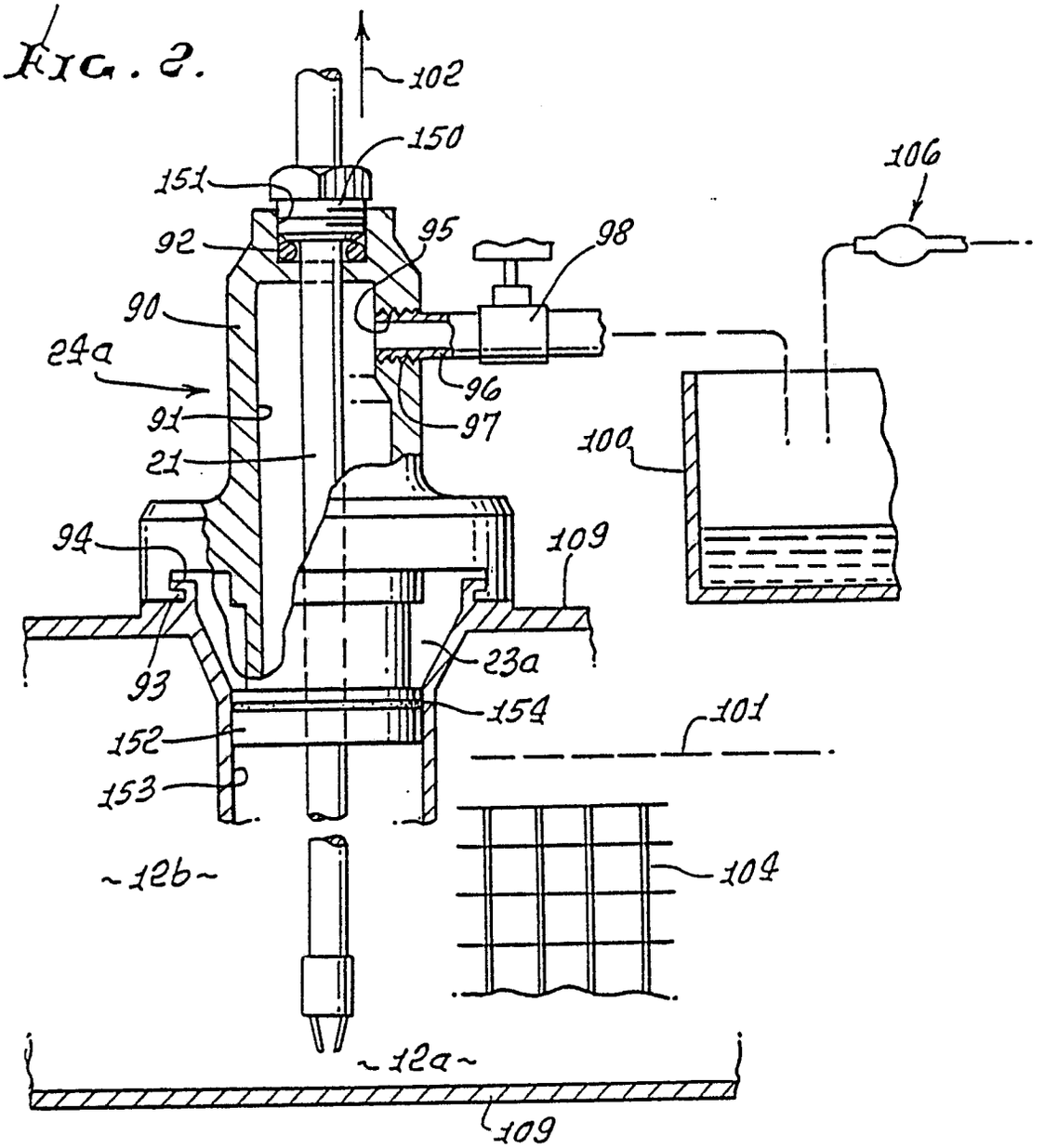

AIR PRESSURE SOURCE
43
44
45a
45
63
47
46
52
20
12
12a
23a
24
24a
25
21
22
14a
60 (THERMOSTAT CONTROLLED VALVE)
FILTER 1
23
28
WATER PUMP
13
14
10
ENGINE BLOCK 11
34
30
29
31
27
CHEMICAL
32
35
36
38
39
18
17
40
41
FILTER 2
37
48
HEATER
15
AIR LINES
LIQUID LINES

Fig. 1.

FIG. 2.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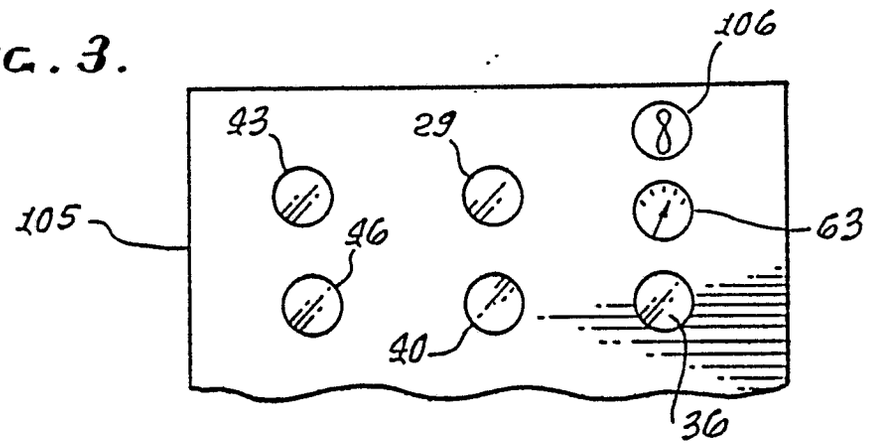
12b
12a
109

FIG. 3.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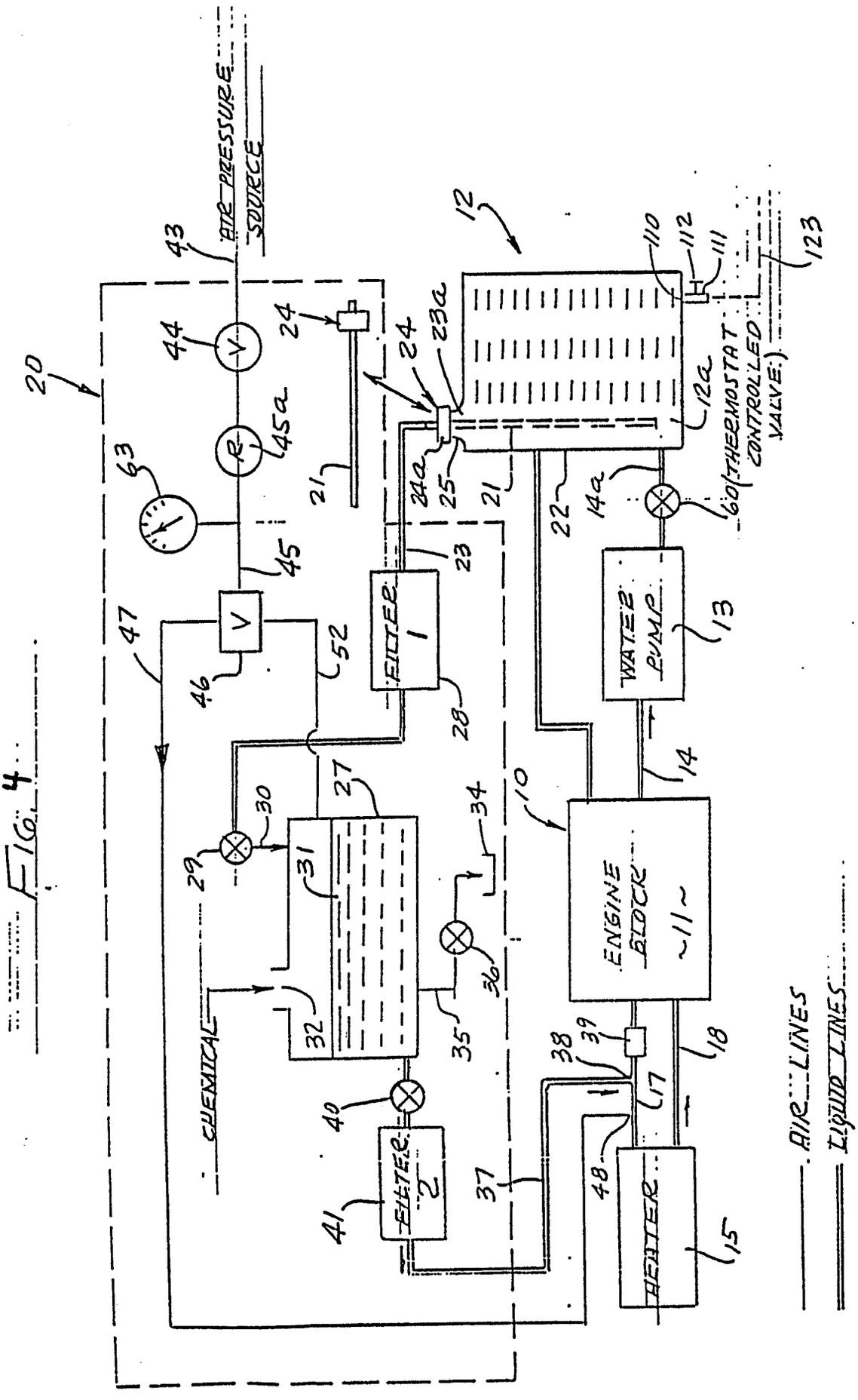
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47
46
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24
21
23
23a
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25
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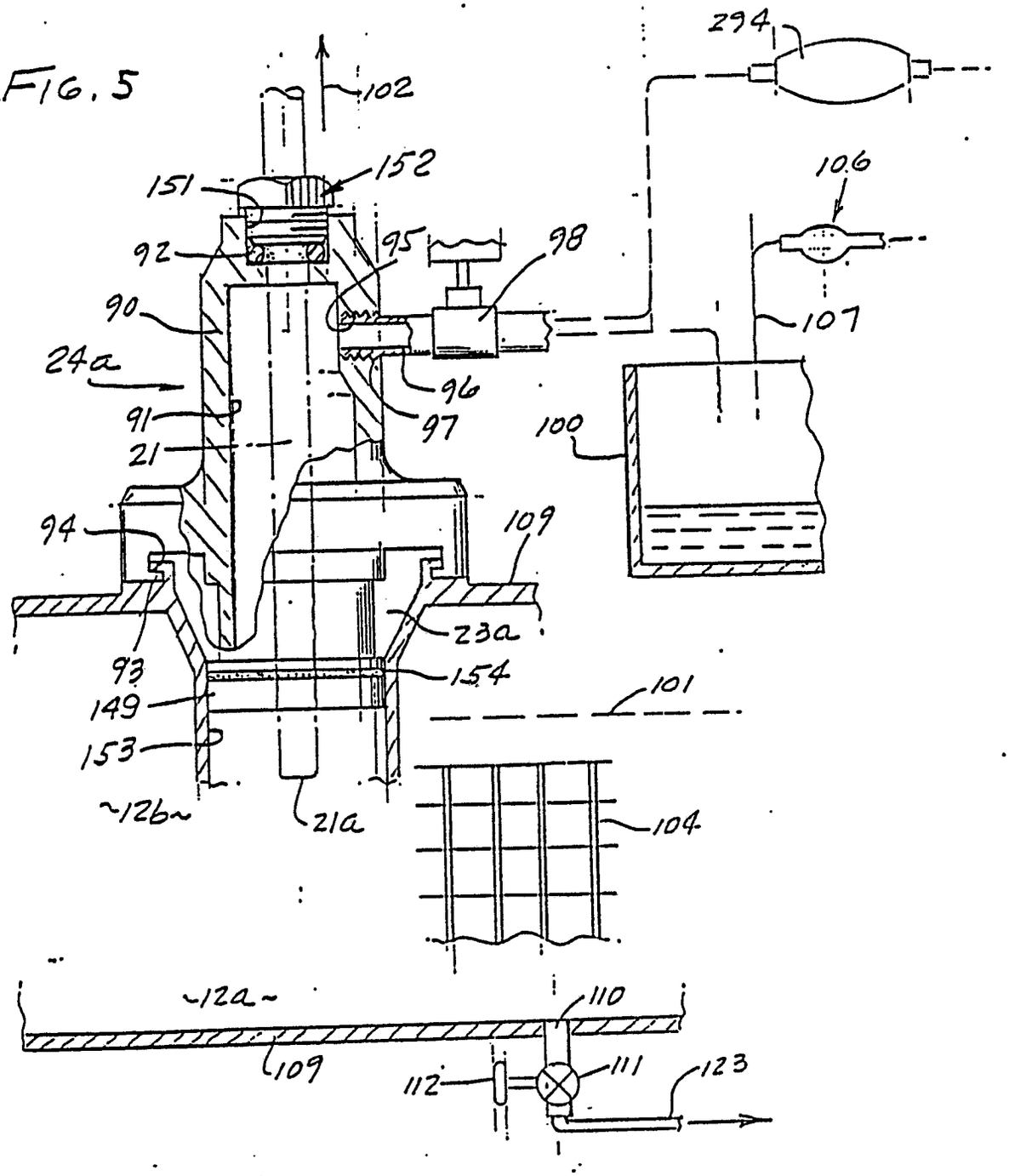
110
112
111
123
60 (THERMOSTAT CONTROLLED VALVE)
14a
22
WATER PUMP
13
HEATER 1
28
27
30
29
31
32
CHEMICAL
34
35
36
40
HEATER 2
41
37
10
ENGINE BLOCK
11
38
39
17
18
48
HEATER
15
AIR LINES
LIQUID LINES

FIG. 4

FIG. 5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