(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 July 2007 (19.07.2007)

PCT

(10) International Publication Number
WO 2007/082100 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/US2007/000998

(22) International Filing Date: 11 January 2007 (11.01.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/330,466 12 January 2006 (12.01.2006) US

(71) Applicant and
(72) Inventor: **RICHARDSON, James, M.** [US/US]; 26156 Balboa Court, Helendale, California 92342 (US).

(74) Agents: **GREEN, Kenneth** et al.; 8244 Painter Ave., Whittier, California 90602 (US).

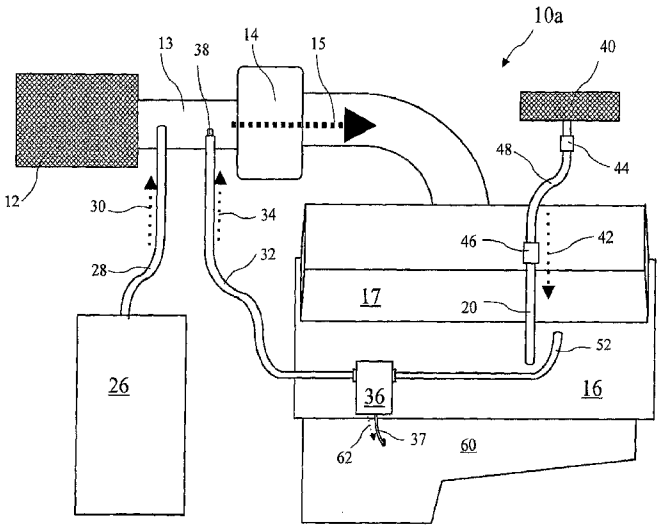
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: HYDROGEN AUGMENTED DIESEL CRANKCASE VENTILATION



(57) Abstract: A hydrogen augmented diesel crankcase ventilation system uses hydrogen to allow crankcase fumes, for example blow-by, to be burned by an engine 10. The system preferably includes a hydrogen generation system 26 as a hydrogen source connected to an engine air intake 13 by a first hose 28, a second hose 32, 52 connecting the crankcase 16 to the air intake 13, and a third hose 20, 48 connecting a fresh air source 40 to the crankcase 16. An orifice or a vacuum regulator 38 in cooperation with the second hose 32 may be included to regulate crankcase vacuum. A filter 36 may reside inline with the second hose 32, 52 to capture solids or liquids which enter the second hose 52 from the crankcase 16. A back flow preventor 44 may be included in cooperation with the third hose 20, 48 to prevent a back flow of crankcase fumes through the third hose 20, 48.

WO 2007/082100 A2

HYDROGEN AUGMENTED DIESEL CRANKCASE VENTILATION

TECHNICAL FIELD

[0001] The present invention relates to reducing emissions from diesel engines and in particular mixing hydrogen with crankcase fumes to facilitate combustion.

BACKGROUND OF THE INVENTION

[0002] Diesel engines are commonly used in commercial applications such as trucks and stationary engines. These engines typically have much higher compression ratios than gasoline engines, and as a result, a substantial amount of diesel blow-by escapes past the piston rings. Unlike gasoline engines which use a simple crankcase ventilation , the diesel blow-by is generally vented to the outside, and presents a source of unpleasant fumes. The diesel engines typically can not simply vent the crankcase to the engine intake, because the diesel blow-by includes components which will degrade the diesel engine operation.

DISCLOSURE OF THE INVENTION

[0003] The present invention addresses the above and other needs by providing a hydrogen augmented diesel crankcase ventilation system which uses hydrogen to allow crankcase fumes, for example blow-by and/or fumes resulting from the breakdown of engine oil, to be burned in the engine. The system preferably includes a hydrogen generation system as a hydrogen source connected to an engine air intake by a first hose, a second hose connecting the crankcase to the air intake, and a third hose connecting a fresh air source to the crankcase. An orifice or a vacuum regulator in cooperation with the second hose may be included to regulate crankcase vacuum. A filter may reside inline with the second hose to capture solids or liquids which enter the second hose from the crankcase. A back flow preventor may be included in cooperation with the third hose to prevent back flow of crankcase fumes through the third hose.

[0004] In accordance with one aspect of the invention, there is provided a hydrogen augmented diesel crankcase ventilation system. The system includes a hydrogen generator, a first hose connecting the hydrogen generator to an engine air intake, a second hose connecting an engine crankcase to the engine air intake, and a third hose connecting a fresh air source to the engine crankcase. The engine air intake preferably resides between an air cleaner and a supercharger, and more preferably a turbo charger. The first hose carries hydrogen gas and oxygen gas generated in the hydrogen generator to the air intake. A regulator or an orifice cooperates with the second hose to regulate a flow through the second hose and/or to regulate

crankcase vacuum. A back flow preventor cooperating with the third hose to prevent a back flow of crankcase fumes through the third hose.

BRIEF DESCRIPTION OF THE DRAWING

[0005] The above and other aspects, features and advantages of the present invention will be more apparent from the following more particular description thereof, presented in conjunction with the following drawings wherein:

[0006] FIG. 1 is a prior art diesel engine.

[0007] FIG. 2 is an improved diesel engine including a hydrogen augmented diesel crankcase ventilation system according to the present invention.

[0008] FIG. 3 is a second embodiment of an improved diesel engine including a hydrogen augmented diesel crankcase ventilation system according to the present invention.

[0009] Corresponding reference characters indicate corresponding components throughout the several views of the drawings.

BEST MODE FOR CARRYING OUT THE INVENTION

[0010] The following description is of the best mode presently contemplated for carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of describing one or more preferred embodiments of the invention. The scope of the invention should be determined with reference to the claims.

[0011] A typical known diesel cycle engine 10 is shown in FIG. 1. Diesel cycle engines generally use common diesel fuel, but may use other fuels, for example, bio diesel fuel, or the like. The diesel engine 10 includes an engine block 16 which encloses a crankcase. One or two cylinder heads 17 are attached to the block 16 and generally contain valves and intake and exhaust ports. An air flow 15 used in the combustion process enters the diesel cycle engine 10 through an air cleaner 10, passing through an air intake 13 and a super charger 14, which super charger 14 is preferably a turbo charger. The diesel cycle engine 10 further includes an oil fill cap 18 on an oil fill tube 20 for adding motor oil to the diesel cycle engine 10. The diesel cycle engine 10 also includes a crankcase breather 22 with an open end 24 for venting the crankcase and allowing diesel blow-by and the like to escape the crankcase.

[0012] An improved diesel cycle engine 10b with a hydrogen augmented diesel crankcase ventilation system is shown in FIG. 2. The diesel cycle engine 10a includes a hydrogen source 26 which is preferably a hydrogen generator. Examples of suitable hydrogen generators are well known and described in US Patent Application Publication No. 2005/0258049 for "Hydrogen Generator For Use in a Vehicle Fuel System," US Patent No. 4,573,435 for "Method and Apparatus for Generating Hydrogen Gas for Use As a Fuel Additive on a Diesel Engine," US Patent No. 6,155,212 for "Method and Apparatus for Operation of Combustion Engines," and US Patent No. 6,901,889 for "Fumigation System for a Diesel Engine". The '049 application and the '435, '212, and '889 patents are herein incorporated by reference.

[0013] The hydrogen source 26 is connected to the air intake 13 by a first hose 28. A first flow 30 including hydrogen gas is carried by the first hose 28 from the hydrogen source 26 to the air intake 13. Preferably, the first flow 30 includes both hydrogen gas and oxygen gas produced by a hydrogen generator from water. The breather 22 (see FIG. 1) is replaced by a breather hose 52, filter 36, and second hose 32 connecting the block 16 to the air intake 13. The air intake 13 may provide the air flow 15 to the diesel cycle engine through a supercharger 14, or directly to the diesel cycle engine. A supercharge generally provides greater vacuum in the second hose 32, but in many cases, the intake manifold vacuum in a normally aspirated (i.e., non-supercharged) engine is sufficient. The hoses 52, 32 carry a second flow 34 comprising blow-by and other crankcase fumes (e.g., fumes generated by the breakdown of engine oil) and material which previously were vented to the atmosphere through the breather 22. The hose 28 and hose 32 are preferably connected to the air intake 32 at spaced apart points.

[0014] A restriction 38 restricts the second flow 34, which restriction 38 preferably cooperates with the hose 32 or the hose 52, and more preferably resides proximal to the connection point of the hose 32 to the air intake 13. The restriction 38 regulates (or limits) the flow 34 into the air intake 13. The restriction 38 may be manually adjustable or may be self adjusting, for example, like a pressure or vacuum regulator, or may, for example, be a fixed size replaceable orifice, a variable orifice, or a clamp to squeeze the outside of the hose 32 or the hose 52 to restrict the second flow 34. The restriction 38 may be used to adjust crankcase vacuum and preferably results in between approximately one pound and approximately four pounds of crankcase vacuum, and more preferably results in approximately two

pounds of crankcase vacuum. In general, a larger engine will operate with a higher crankcase vacuum, and a small engine will operate with a lower crankcase vacuum. The restriction 38 may further cooperate with a vacuum regulator in the fresh air hose 48 to regulate crankcase vacuum.

[0015] The fourth hose 52 and a filter 36 preferably connect between the crankcase 16 and the hose 32. The hose 52 preferably connects to the block 16 where the breather 22 (see FIG. 1) would otherwise connect and the filter 36 catches any solids or liquids which enter the hose 52. The filter 36 may further include a clear body to allow observation of any solids or liquids collected by the filter 36, and may further include a back flow preventor.

[0016] A second air filter 40 is connected to the oil fill tube 20 by a third (or fresh air) hose 48 and a coupling 46. The air filter 40 allows a third flow 42 of fresh air to enter the crankcase to support a flow through the crank case and into the hose 32, and/or to help cool the crankcase. A back flow preventor 44 may reside inline in the hose 48 to prevent blow-by or other fumes, liquids, or solids from escaping the diesel cycle engine 10a through the air filter 40. The back flow preventor 44 may further include a vacuum regulator to regulate the crankcase vacuum. The crankcase vacuum is preferably regulated to be between approximately one and approximately four pounds.

[0017] In some instances, fluids may accumulate in the filter 36 at a high rate. Such high rate may fill the filter 36 during a single trip, and may reduce the performance of the present invention. In these applications, a filter drain line 37 may be included to carry fluids trapped by the filter 36 to the oil pan 60. The filter drain line 37 may attached at a dedicated attachment point, or connect to a filler tube, or

any tube running to the oil pan or to the crankcase. The filter drain line 37 may also connect directly to the crankcase.

[0018] While hoses 28, 32, 37, 48, and 52 are referenced above, metal or plastic tubing may be used as well, or any suitable conduit, may be used to carry the flows 30, 34, 37, and 42. Also, the hose 52 and the hose 48 may connect with the crankcase at any suitable point using any suitable connection, and are not limited to connecting through existing connection points.

[0019] A second embodiment of an improved diesel engine 10b including a hydrogen augmented diesel crankcase ventilation system according to the present invention is shown in FIG. 3. The improved diesel engine 10b includes a "T" 50 connecting the fresh air hose 48 to the breather hose 52. The improved diesel engine 10b is otherwise similar to the improved diesel engine 10a.

INDUSTRIAL APPLICABILITY

[0020] The present invention finds industrial applicability in the filed of reducing emissions from diesel engines and in particular mixing hydrogen with crankcase fumes to facilitate combustion in diesel engines to reduce emissions.

SCOPE OF THE INVENTION

[0021] While the invention herein disclosed has been described by means of specific embodiments and applications thereof, numerous modifications and

variations could be made thereto by those skilled in the art without departing from the scope of the invention set forth in the claims.

I CLAIM:

1. A hydrogen augmented crankcase ventilation system comprising:

a hydrogen source;

a first hose connecting the hydrogen source to an engine air intake, the first hose carrying a first flow including hydrogen from the hydrogen source to the air inlet;

a second hose connecting an engine crankcase to the engine air intake, the second hose carrying a second flow from the crankcase to the engine air intake; and

a third hose in fluid communication with the engine crankcase, the third hose carrying a third flow of fresh air.

2. The system of Claim 1, wherein the hydrogen source is a hydrogen generator and the first hose carries hydrogen gas to the air intake.

3. The system of Claim 2, wherein the first hose carries both hydrogen gas and oxygen gas to the air intake.

4. The system of Claim 1, wherein the engine air intake resides between an air cleaner and a super charger.

5. The system of Claim 4, wherein the engine air intake resides between an air cleaner and a turbo charger.

6. The system of Claim 1, wherein the third hose is connected between a second air cleaner and the crankcase.

7. The system of Claim 6, wherein the second air filter includes an in-line back flow preventor configured to prevent a flow from the crankcase to the second air cleaner.

8. The system of Claim 6, wherein the third hose includes an in-line back flow preventor configured to prevent a flow from the crankcase to the second air cleaner.

9. The system of Claim 1, wherein the third hose connects to the crankcase through an oil fill tube.

10. The system of Claim 1, wherein the second hose includes an inline filter for collecting liquids which enter the second hose.

11. The system of Claim 10 further including a filter drain line connecting the inline filter to the crankcase for allowing fluids trapped in the inline filter to drain into the crankcase.

12. The system of Claim 10, wherein the in-line filter includes a clear portion for viewing liquids collected by the in-line filter.

13. The system of Claim 1, wherein the second flow is restricted to limit the amount of flow.

14. The system of Claim 13, wherein the second flow is restricted to result in a crankcase vacuum between approximately one pound and approximately four pounds.

15. The system of Claim 1, further including an orifice for regulating the second flow through the second hose from the crankcase to the air intake.

16. The system of Claim 15, wherein the orifice resides proximal to a connection point of the second hose connects to the air intake.

17. The system of Claim 1, wherein the first hose and the second hose connect to the engine air intake at spaced apart points.

18. The system of Claim 1, wherein the third hose includes a vacuum regulator.

19. A diesel cycle engine including a hydrogen augmented crankcase ventilation system, the engine comprising:

a hydrogen generator which generates hydrogen gas and oxygen gas;

an engine air intake residing between an air cleaner and a supercharger;

a first hose connecting the hydrogen generator to the engine air intake which first hose carries a first flow from the hydrogen generator to the air intake;

a diesel cycle engine crankcase containing at least one of a set of crankcase fumes consisting of blow-by and fumes resulting from the breakdown of engine oil;

a second hose connecting the diesel cycle engine crankcase to the engine air intake, which second hose carries a second flow of crankcase fumes from the crankcase to the engine air intake;

a third hose connecting a second air cleaner to the engine crankcase to provide a third flow of fresh air to the crankcase; and

a restriction cooperating with the second flow.

20. A hydrogen augmented diesel cycle engine crankcase ventilation system comprising:

a hydrogen generator;

an engine air intake residing between an air cleaner and a turbocharger.

a first hose connecting the hydrogen generator to the engine air intake, which first hose carries hydrogen gas and oxygen gas generated in the hydrogen generator to the air intake;

a second hose connecting an engine crankcase to the engine air intake to carry a second flow of crankcase fumes from the engine crankcase to the engine air intake;

an inline filter cooperating with the second hose for collecting liquids which enter the second hose;

a filter drain line connected between the inline filter and the crankcase for allowing fluids trapped in the inline filter to drain into the crankcase;

a restriction cooperating with the second flow to restrict the second flow;

a third hose connecting a fresh air source to the engine crankcase to carry fresh air to the engine crankcase; and

a back flow preventor cooperating with the third hose to prevent a back flow through the third hose.

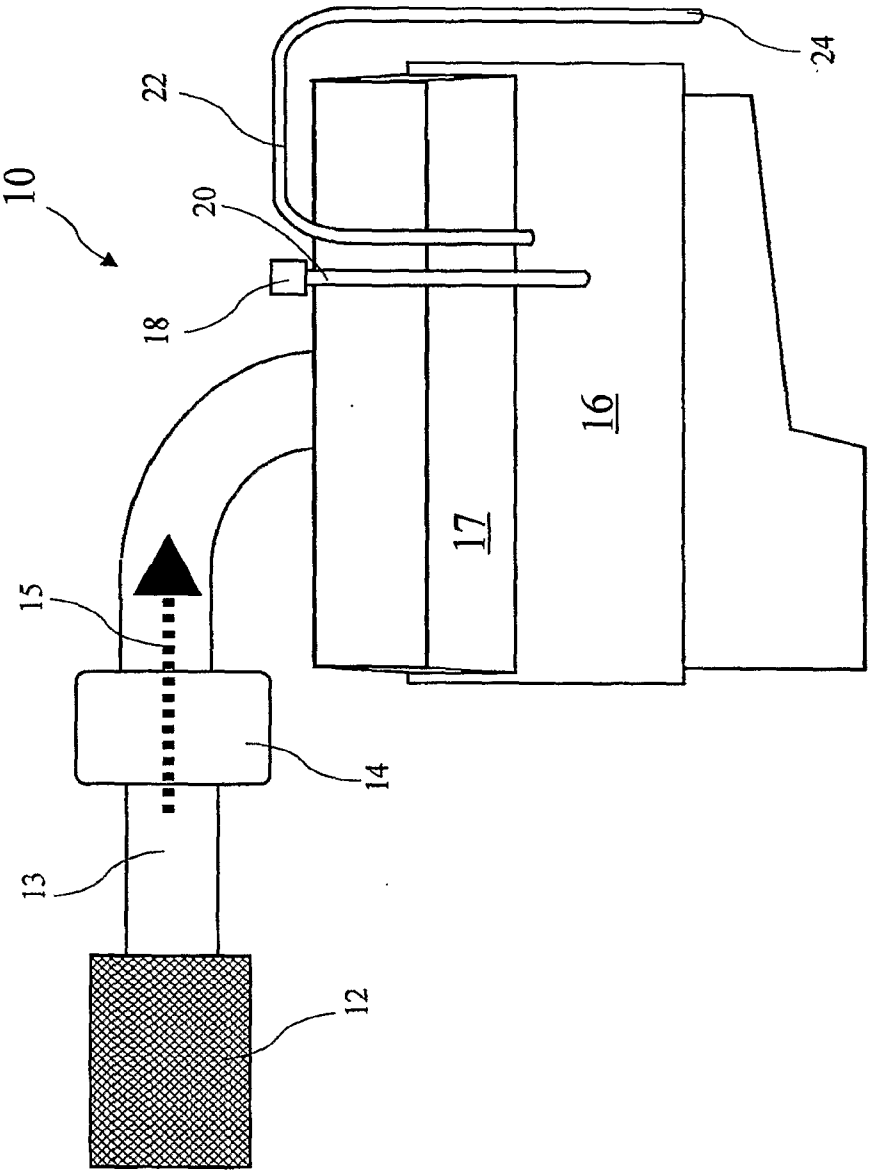


FIG. 1
(prior art)

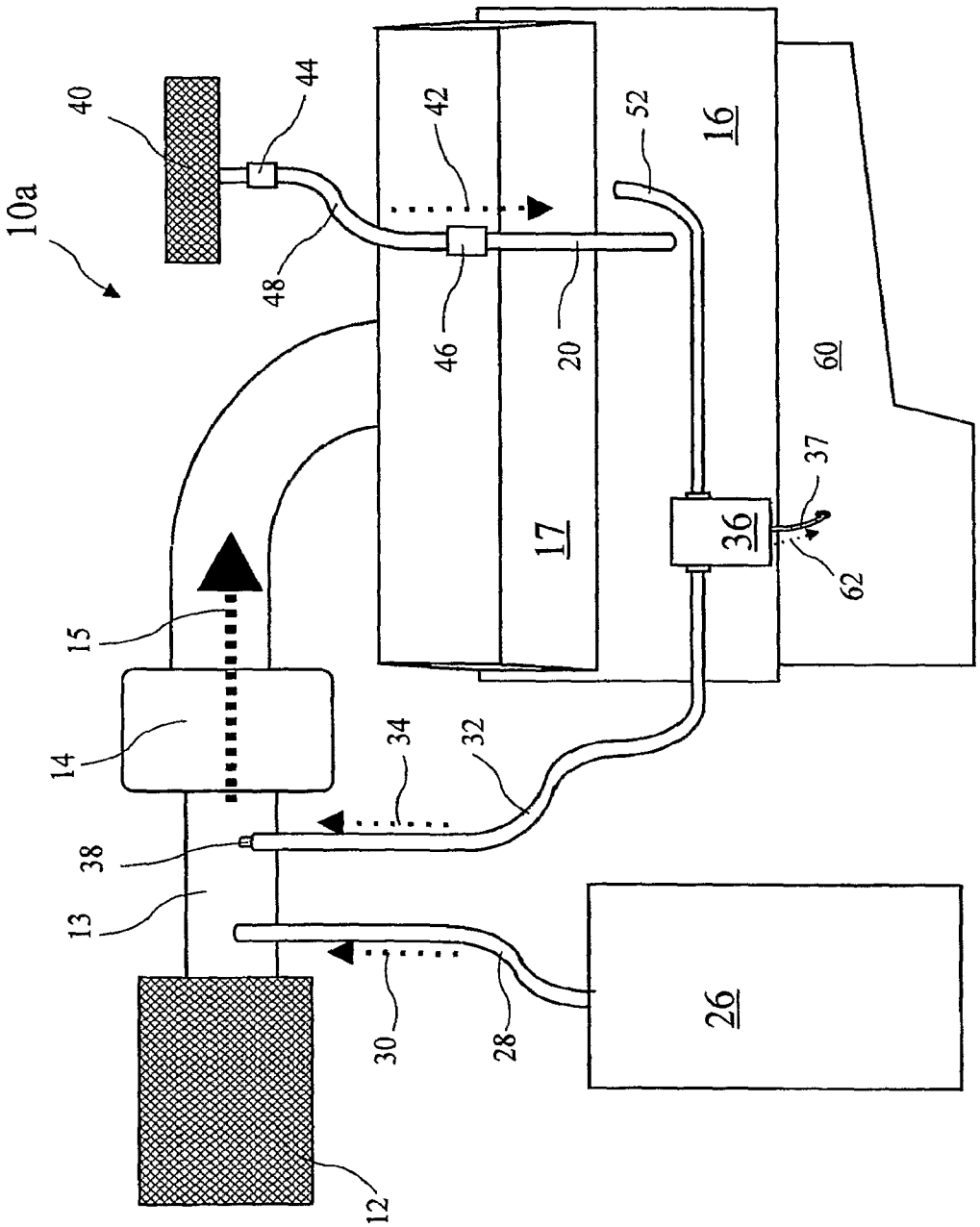


FIG. 2

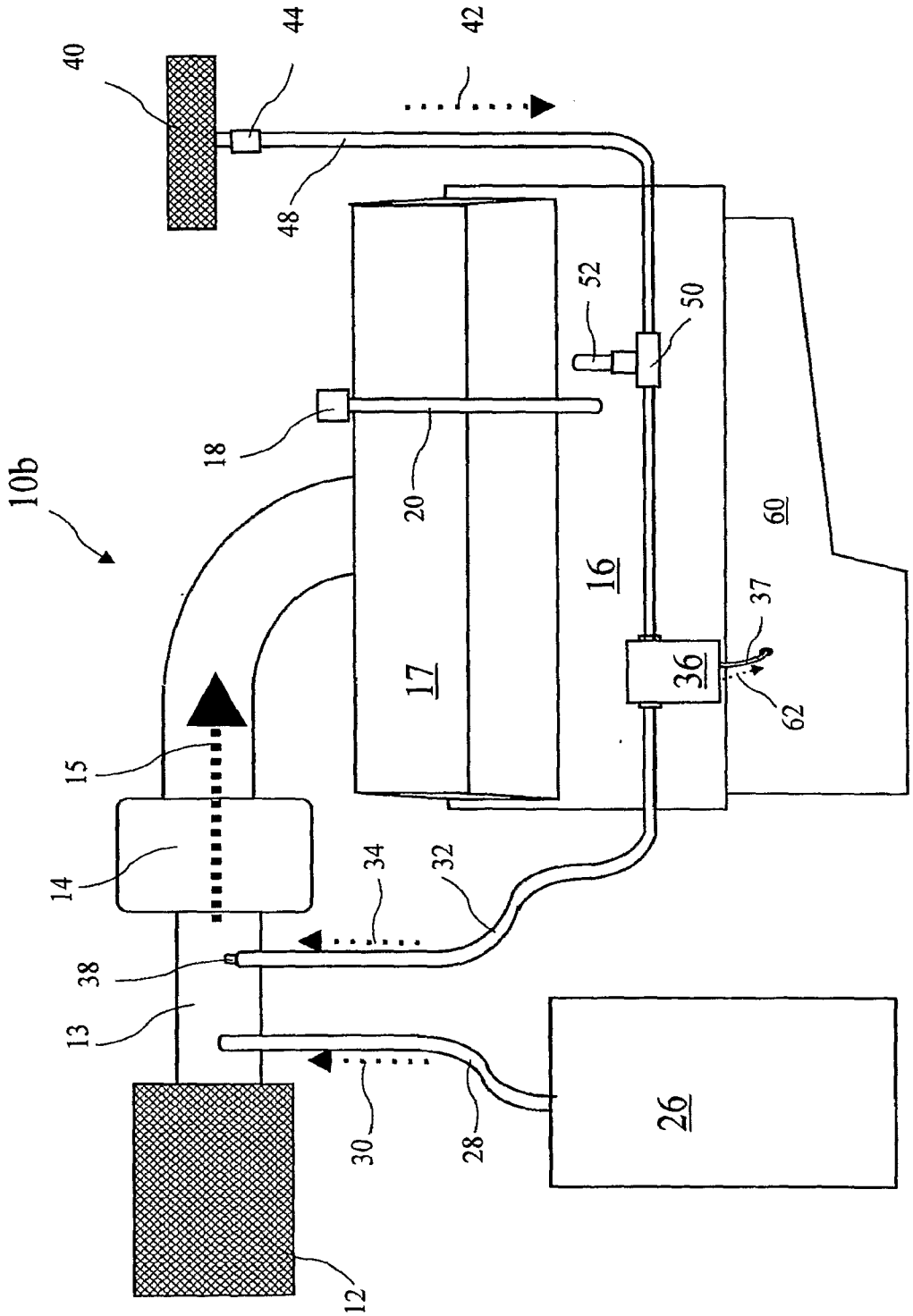

10b
12
13
14
15
16
17
18
20
26
28
30
32
34
36
37
38
40
42
44
48
50
52
60
62

FIG. 3