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(54) **DEVICE AND METHOD FOR CLEANING OF COMBUSTION ENGINES**

(57) A device for the performance of a method of cleaning of combustion engines contains a pneumatic-hydraulic, or a hydraulic circuit, which is from one side provided with an adapter for mechanical pressure-tight connection to a combustion space of a combustion engine through its solid casing, and from the other side, it

is connected to a source of a chemical-technical liquid, which is forced under the pressure within the range of from 0.1 to 2 MPa into the combustion space of the individual cylinder, in the space above the piston, and in the standstill condition of the engine.

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Description

Field of Art

[0001] The invention relates to a device for execution of a method of cleaning (decarbonization and demineralization) and to the actual method of cleaning of the working parts of the combustion engines.

Background Art

[0002] At present, the process of cleaning of combustion engines and of the parts thereof uses universal chemical-technical liquids that are intentionally introduced into the running engine being cleaned, to its individual working spaces, while the released contamination and mechanical particles are transported through the combustion and exhaust space outside this system.

Disclosure of Invention

[0003] The invention relates to a device for performing a method of cleaning, including the composition of chemical-technical liquids used for this purpose, and to the method of cleaning of the combustion engines. The method of cleaning of combustion engines is characterized in that a chemical-technical liquid is forced into the combustion compartment of the individual cylinder, in the closed space above the piston, in standstill state of the engine, under the pressure within the range of from 0.1 to 2 MPa, using the combustion engine cleaning device, while the said chemical-technical liquid dissolves carbon and mineral deposits, which originate during combustion of the greases and fuels, while some deposits have acid characteristic, and some deposits, especially the fuel ones, have alkaline characteristic. The process of cleaning thus consists of the minimum of two separate processes, while the alkaline and acid chemical-technical liquid is alternately used. When cleaning using an acid chemical-technical liquid (water solution of the individual acid - hydrochloric acid, trihydrogen phosphoric acid, boric acid, citric acid, acetic acid, formic acid, oxalic acid or lactic acid), the working time of contact with the metallic surfaces of the aluminum alloys is limited, this depending on its concentration, within the time range of from 1 to 200 minutes. When cleaning using an alkaline chemical-technical liquid (water solution of tensides and aliphatic alcohols with a content of potassium or sodium hydroxide), the working time of contact with metallic surfaces is also limited, this depending on its concentration, within the time range of from 1 to 200 minutes. The cleaning always takes place in an individual cylinder, this in the upper dead point of the piston, or partially under it, with the space above piston (i.e. the combustion space) closed so that during injection of the chemical-technical liquid into the cylinder above the piston under an increased pressure, the chemical-technical liquid flows mainly between the space between the piston, piston

rings, and the internal wall of the cylinder, which causes circumfluence around the piston, dissolving deposited contamination, and possibly also releasing of the dead piston rings. To secure the above-mentioned position of the piston under higher working pressures, the piston is mechanically secured against drop from the original position for example by blocking of the crank mechanism. Contaminated chemical-technical liquid with dissolved contamination is subsequently led from the cylinder compartment under the piston through the oil drainage hole, or, in case of two-stroke engines, through the channels in the casing, outside the engine. The above described method of cleaning (refer to Figure 1) reduces the risk of local or total seizure of susceptible parts of the combustion engine, as it is when using the methods of cleaning while the engine running. The increased effects of the chemical-technical liquid can be achieved by heating it up to the temperature within the range of from 50 to 100 °C, when the chemical dissolving of the deposits occurs with their subsequent conversion to gaseous state, the gaseous compounds of which by the effect of partial pressures increase the efficiency of the process of cleaning during heating up.

[0004] The device for executing the method of cleaning of the combustion engines contains pneumatic-hydraulic (refer to Figure 1), or hydraulic circuit (refer to Figure 2), which is provided on one side with an adapter for mechanical pressure-tight connection to the combustion compartment of the combustion engine through its firm casing, and from the other side, it is connected to the source of the chemical-technical liquid with the working pressure of from 0.1 to 2 MPa. The device for cleaning of the combustion engines uses as the chemical-technical liquid alternately a water solution of tensides and aliphatic alcohols with the contents of potassium hydroxide (or possibly sodium hydroxide), or a water solution of any of the above-mentioned acids. To increase the effect of the process of cleaning, it is possible to equip the device with a heating of the chemical-technical liquid up to the temperature of 100 °C (refer to Figure 3). To increase working comfort during the process of cleaning, it is possible to equip the device with up to three separate pneumatic-hydraulic or hydraulic circuits for the individual types of chemical-technical liquid with individual outputs, so that when changing the types of the chemical-technical liquids, the appropriate pneumatic-hydraulic (refer to Figure 4) or the hydraulic circuit with the corresponding output will be used.

Brief description of figures

[0005]

Figure 1 - Scheme of the device with one pneumatic-hydraulic circuit

Figure 2 - Scheme of the hydraulic circuit of the device

Figure 3 - Scheme of the second collection vessel

with heating up of the chemical-technical liquid

Figure 4 - Scheme of the device with three pneumatic-hydraulic circuits

Examples

[0006] Example 1: In the first example of the embodiment of the invention, the device for the performance of the method of cleaning of combustion engines is assembled from two parts of the pneumatic-hydraulic circuit. In the first part of the pneumatic-hydraulic circuit with pressure piping 12, which is mechanically seated in the box 1 made of resistant material, while inside of this box 1 there are in sequential order seated the following components: storage vessel 2 with the chemical-technical liquid (water solution of tensides and aliphatic alcohols with the content of potassium hydroxide (sodium hydroxide, or water solution of one of the acids mentioned), and the output closing valve 3, further an uni-directional valve 4, the first collection vessel 5 made of transparent material with a breather valve 6 and pressure gauge 7 of working pressure, further uni-directional valve 8, pressure gauge 9 of working pressure and further then a closing valve 10 with tubing link 11, that protrude from the casing of the box 1, while to the first collection vessel 5 there is at the same time connected a pressure vessel 24 with a source of compressed gas or air with the reduction valve 23 and pressure gauge 22. The storage vessel 2 for the chemical-technical liquid is in the box 1 of solid material located in the upper part so that the level of the chemical-technical liquid is higher than the level of the chemical-technical liquid in the first collecting vessel 5. The second outer portable part of the pneumatic-hydraulic circuit is connected through the second part of the tubing link 11 and it continuously links to the first part of the pneumatic-hydraulic circuit and there are in sequential order seated in it the following components - closing valve 14, flexible pressure tubing 13, the second collection vessel 15 with safety valve 17, breathing valve 18 and pressure gauge 16 of working pressure, further then the closing valve 19 and adapter 20 for mechanical pressure-tight connection to the solid casing of the cylinder 21 of the combustion engine (refer to Figure 1).

[0007] Example 2: In the second example of embodiment of the invention, the device for the performance of the method of cleaning of the combustion engines is assembled of two parts of the pneumatic-hydraulic circuit the same way, as it is in the first example of embodiment, however, with that the second collection vessel 15 on the external part of the device is provided with a heating element 29 for electrical heating up of the chemical-technical liquid with thermostat 30 for setting the required temperature (refer to Figure 3).

[0008] Example 3: In the third example of embodiment of the invention, the device for the performance of the method of cleaning of the combustion engines is assembled so that it consists of a hydraulic circuit with pressure tubing 26 with pressure gauge 31, where there are in a

sequential order seated the following components - storage vessel with chemical-technical liquid 28 (water solution of tensides and aliphatic alcohols with a content of potassium (sodium) hydroxide, or a water solution of any of the above mentioned acids), a pump 27 adapter 20 for mechanical pressure-tight connection to the solid casing of the cylinder 21 of the combustion engine (refer to Figure 2).

[0009] Example 3: Method of cleaning: Chemical-technical liquid (water solution of tensides and aliphatic alcohols with a content of potassium (sodium) hydroxide, or a water solution of any of the acids mentioned) is gravitationally transported from the storage vessel 2 through the output closing valve 3 and uni-directional valve 4 to the first collection vessel 5, which is thus filled while concurrent breathing of the compressed air space through the breathing valve 6. Subsequently the pressure vessel 24 is opened with the source of compressed gas or air, which creates the pressure in the first collection vessel 5, this with the value of from 0.1 to 2 MPa. Chemical-technical liquid travels to the closing valve 10 at the output from the box 1 through a uni-directional valve 8 down to the first part of the tubing link 11. Thereby, the first part of the device is in the standby mode and ready to be used. Upon inter-connection of the first and the second part of the tubing link 11 at the output from the box 1, the second outer portable part of the pneumatic-hydraulic circuit is connected, and through the closing valve 10 at the output from the box 1 approximately one half of the volume of the chemical-technical liquid is passed to the second collection vessel 15, and the closing valve 10 at the output from the box 1 closes. The adapter 20 at the end of the pressure tubing 13 shall be connected to the combustion compartment between the piston 25 and the cylinder 21, while the position of the piston 25 is at the upper dead point or slightly below that. In the engines with valves, these are closed during the process of cleaning. The second outer portable part of the pneumatic-hydraulic circuit is closed at its input side before disconnecting the tubing link 11 by the closing valve 14. Chemical-technical liquid is transported from the second collection vessel 15 through the closing valve 19 after this vessel and the adapter 20 to the combustion space in the cylinder 21, this either under increased working pressure, or gravitationally. Upon contact of the chemical-technical liquid with deposits, gasses originate that increase working pressure between the second collection vessel 15 and the combustion space in the cylinder 21, while the chemical-technical liquid flows around the piston 25 and further particular mechanical parts, and dissolves the deposited contamination. The contaminated chemical-technical liquid then flows away through the space under the piston 25.

[0010] Example 4: Method of cleaning: Chemical-technical liquid (water solution of tensides and aliphatic alcohols with the content of potassium (sodium) hydroxide, or a water solution of any of the mentioned acids) is sucked from the storage vessel 28 with the chemical-

technical liquid by the pump 27 and further transported through the pressure tubing 26 through the adapter 20 to the combustion space in the cylinder 21, while the chemical-technical liquid flows around the piston 25 and other particular mechanical parts and dissolves the deposits. The contaminated chemical-technical liquid then flows away through the space under the piston 25.

Industrial applicability

[0011] The invention can be used for cleaning of especially the inner parts of combustion engines without a necessity of complete dis-assembly of the engine, whereby it is possible, while spending low financial cost, to achieve a significant extension of the service life of the combustion engines and maintain their optimum operational characteristics, one of which being especially perfect functioning of sealing rings to ensure the necessary compression ratio in the combustion space.

List of reference numerals

[0012]

1 -	box	25
2 -	storage vessel	
3 -	closing valve	
4 -	uni-directional valve	
5 -	first collecting vessel	
6 -	breathing valve	30
7 -	pressure gauge	
8 -	uni-directional valve	
9 -	pressure gauge	
10 -	closing valve	
11 -	tubing link	35
12 -	pressure tubing	
13 -	flexible pressure tubing	
14 -	closing valve	
15 -	second collecting vessel	
16 -	pressure gauge	40
17 -	safety valve	
18 -	breathing valve	
19 -	closing valve	
20 -	adapter	
21 -	cylinder	45
22 -	pressure gauge	
23 -	reduction valve	
24 -	pressure vessel	
25 -	piston	
26 -	pressure tubing	50
27 -	pump	
28 -	storage vessel	
29 -	heating element	
30 -	thermostat	
31 -	pressure gauge	55

Claims

1. A method of cleaning of combustion engines, **characterized in that** it contains the following steps:

- a) a combustion engine is put in standstill condition;
- b) a piston (25) of a cylinder (21) of the combustion engine, which is intended for cleaning, is brought to the upper dead point position, in which position it is secured, preferably by blocking the crank mechanism, and in case that the engine contains valves, these are closed;
- c) acid or alkaline chemical-technical liquid is led under the pressure within the range of from 0.1 to 2 MPa from the device for performing the method of cleaning of combustion engines that contains: at least one pneumatic-hydraulic or hydraulic circuit with at least one source of chemical-technical liquid with the working pressure of from 0.1 to 2 MPa, which is mechanically pressure-tight connected through a pressure tubing (12, 13, 26) and an adapter (20) for mechanical pressure-tight connection to the combustion space of the combustion engine through a solid casing of the cylinder (21); through the pressure tubing (12, 13, 26) through the adapter (20) to the internal space of the cylinder (21) of the combustion engine, to the part above the piston (25) in the position of the upper dead point;
- d) chemical-technical liquid from the step c) flows around the piston (25) and piston rings through the spaces between the piston (25), piston rings and the internal wall of the cylinder (21), in the direction from the input of the chemical-technical liquid in the internal part of the cylinder (21) above the piston (25) in the position of the upper dead point, to the internal part of the cylinder (21) under the piston (25) in the position of the upper dead point, while possible contamination dissolves in the chemical-technical liquid;
- e) chemical-technical liquid from step d), which contains possible dissolved contamination, is led from the internal part of the cylinder (21) under the piston (25) in the position of the upper dead point through an engine oil drain opening or through channels in the casing of the cylinder (21) out of the cylinder (21) of the engine;

while the group of steps c), d), and e) is at least once repeated so that when repeating these steps, a chemical-technical liquid of opposite pH is used than the chemical-technical liquid used on the previous group of steps c), d), and e), and possibly, at the end of the method of cleaning of combustion engines, the group of steps c), d), and e) is repeated while

using water instead of the chemical-technical liquid.

2. The method according to claim 1, **characterized in that** when using the chemical-technical liquid, the entire time of the steps c), d), and e) is within the range of from 1 to 200 minutes.
3. The method of cleaning of combustion engines according to any one of the claims 1 and 2, **characterized in that** the alkaline chemical-technical liquid is a water solution of tensides and aliphatic alcohols with a content of potassium hydroxide and/or sodium hydroxide, with the resulting pH within the range of from 11 to 14.
4. The method of cleaning of combustion engines according to any one of the claims 1 and 2, **characterized in that** the acid chemical-technical liquid is a water solution of an acid with the pH value within the range of from 1 to 5, preferably the acid is selected from the group of inorganic acids comprising hydrochloric acid, trihydrogen phosphoric acid, boric acid, or organic acids including citric acid, acetic acid, formic acid, oxalic acid, and lactic acid.
5. The method of cleaning of combustion engines according to any one of the claims 1 to 4, **characterized in that** the temperature of the acid and/or alkaline chemical-technical liquid, which is in step c) led from the device for the performance of the method of cleaning of combustion engines through the pressure tubing (12, 13, 26) through the adapter (20) to the internal space of the cylinder (21) of the combustion engine, to the part above the piston (25) in the position of the upper dead point, is within the range of from 20 °C to 100 °C, preferably within the range of from 50 °C to 80 °C.
6. A device for the performance of the method of cleaning of the combustion engines according to any one of the claims 1 to 5, **characterized in that** it contains at least one pneumatic-hydraulic or hydraulic circuit with at least one source of the chemical-technical liquid with the working pressure of from 0.1 to 2 MPa, which is mechanically pressure-tight connected through a pressure tubing (12, 13, 26) and an adapter (20) for mechanical pressure-tight connection to the combustion space of the combustion engine through the solid casing of a cylinder (21).
7. The device according to the claim 6, **characterized in that** between the pneumatic-hydraulic or hydraulic circuit and the adapter (20), there is on the pressure tubing (13) placed in the sequential order: a second part of the tubing link (11); a closing valve (14); a second collection vessel (15) provided with a pressure gauge (16) of the working pressure, a safety valve (17) and a breathing valve (18); and

further a closing valve (19) at the output of the second collecting vessel (15).

8. The device according to the claim 7, **characterized in that** the second collecting vessel (15) contains a heating element (29) for heating up of the chemical-technical liquid, and a thermostat (30).
9. The device according to the claim 6, **characterized in that** the pneumatic-hydraulic or the hydraulic circuit provided with a pressure gauge (31) includes the source of the chemical-technical liquid in a form of a storage vessel (28) with the chemical-technical liquid, and a pump (27).
10. The device according to any one of the claims 6 to 8, **characterized in that** pneumatic-hydraulic or hydraulic circuit contains in the sequential order on the pressure tubing (12): a storage vessel (2) with the chemical-technical liquid and an output closing valve (3); further an uni-directional valve (4); a first collecting vessel (5) with a breathing valve (6) and a pressure gauge (7) of working pressure, to which there is connected as a source of compressed gas a pressure vessel (24) with a high-pressure pressure gauge (22) and a reduction valve (23), while the compressed gas is non-toxic, non-flammable, and non-explosive, preferably the compressed gas is air; further an uni-directional valve (8); a pressure gauge (9) of working pressure and a closing valve (10) with a first part of the tubing link (11).
11. The device according to the claim 10, **characterized in that** it contains two or more pneumatic-hydraulic or hydraulic circuits, while the pressure vessel (24) with the high-pressure pressure gauge (22) is common for all the pneumatic-hydraulic circuits present in the device, and while the pressure vessel (24) is connected to each individual pneumatic-hydraulic circuit using the reduction valve (23), which is included in each individual pneumatic-hydraulic circuit of the device and/or may be common for two or more pneumatic-hydraulic circuits.
12. The device according to any one of the claims 6 to 11, **characterized in that** the pneumatic-hydraulic or hydraulic circuit is mechanically seated inside the box (1) of a resistant material, preferably chosen from a group comprising metal, plastic, most preferably the material of the box (1) is metal.
13. The device according to the claim 12, **characterized in that** in one single box (1) there are mechanically seated two or more pneumatic-hydraulic or hydraulic circuits.
14. The device according to any one of the claims 6 to 13, **characterized in that** the alkaline chemical-

technical liquid is a water solution of tensides and aliphatic alcohols with a content of potassium hydroxide and/or sodium hydroxide, with the resulting pH within the range of from 11 to 14.

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15. The device according to any one of the claims 6 to 13, **characterized in that** the acid chemical-technical liquid is a water solution of acid with the value of pH within the range of from 1 to 5, preferably the acid is selected from a group of inorganic acids comprising hydrochloric acid, trihydrogen phosphoric acid, boric acid, or from a group of organic acids comprising citric acid, acetic acid, formic acid, oxalic acid, and lactic acid.

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Fig. 1

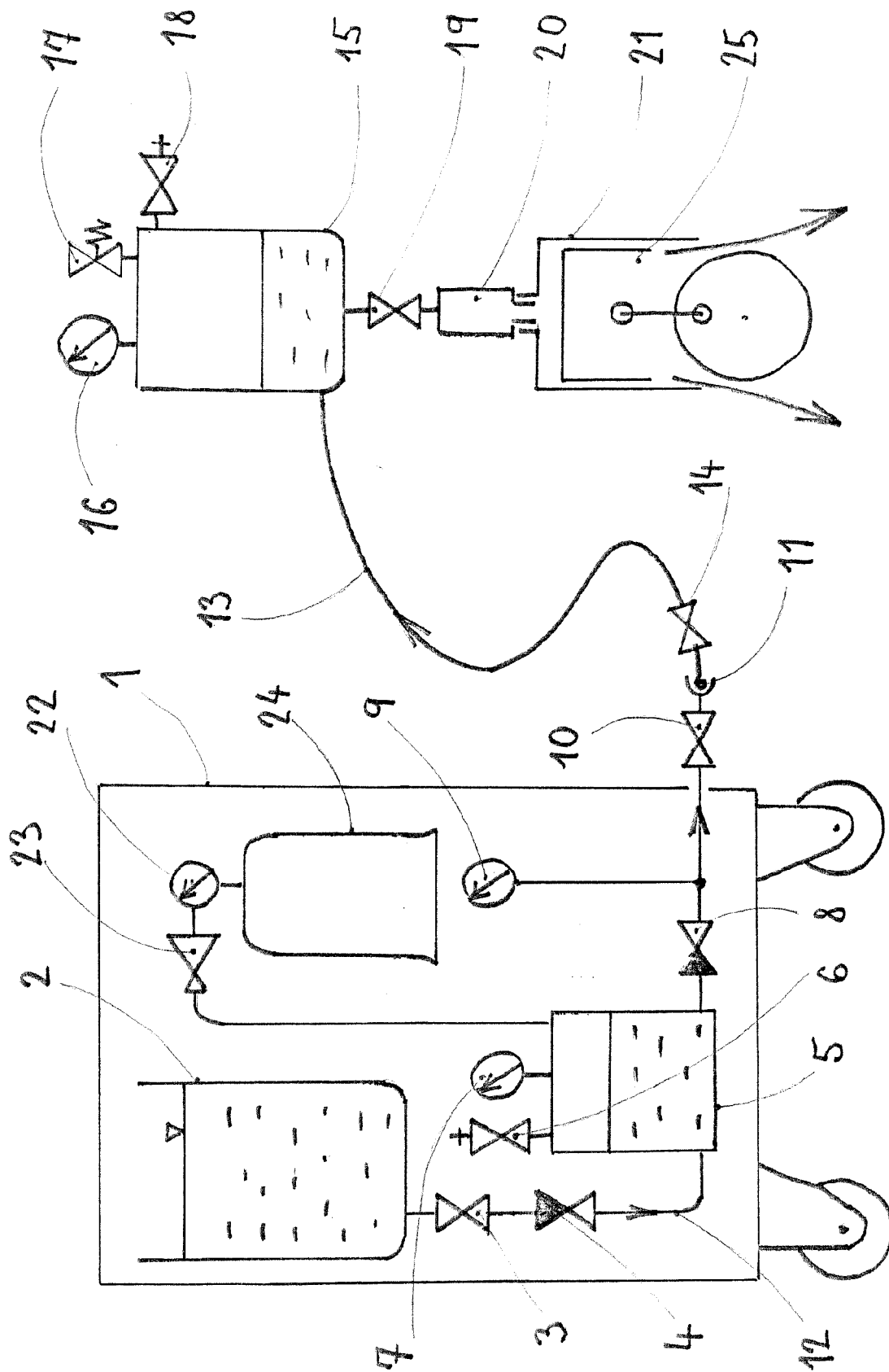


Fig. 2

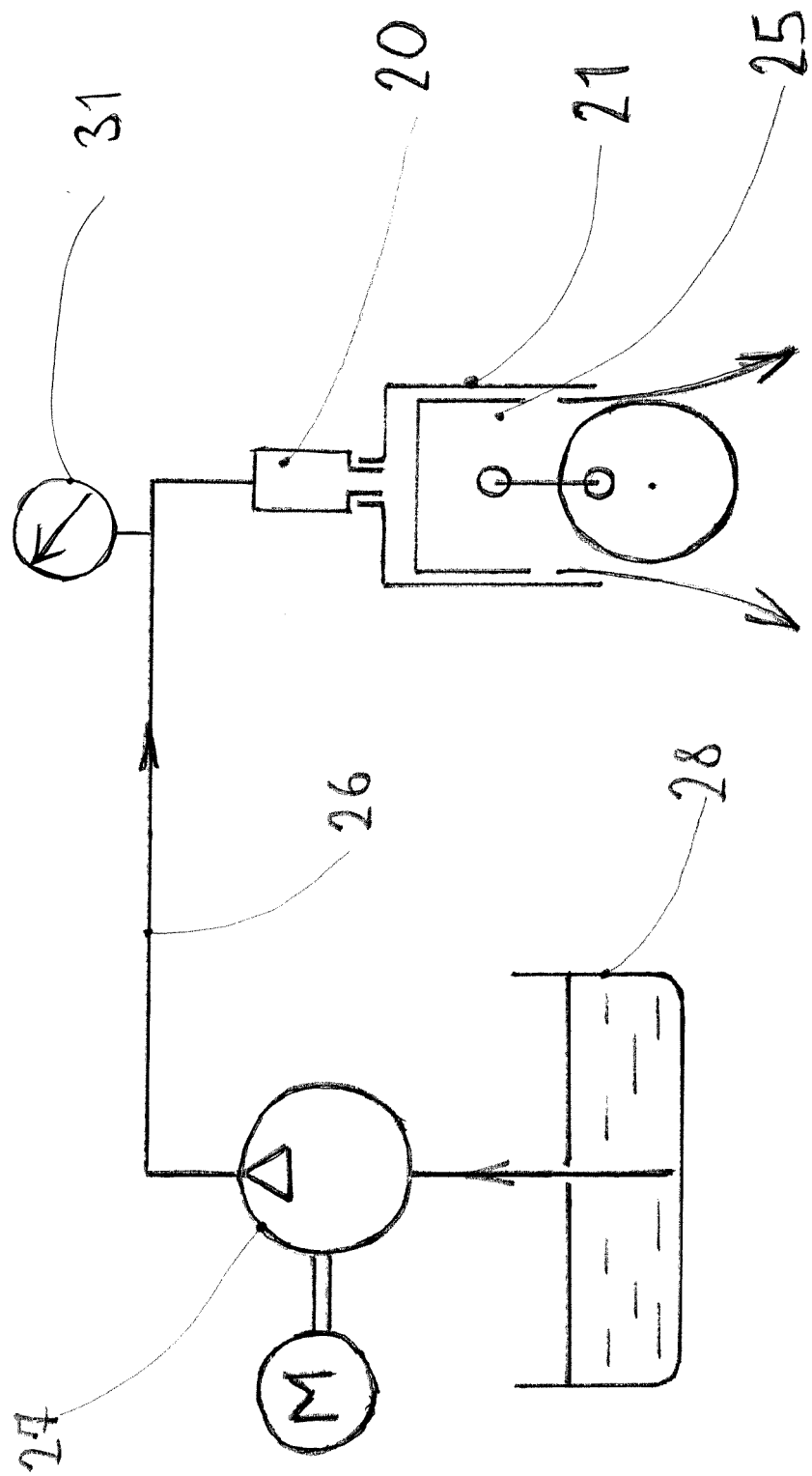


Fig. 3

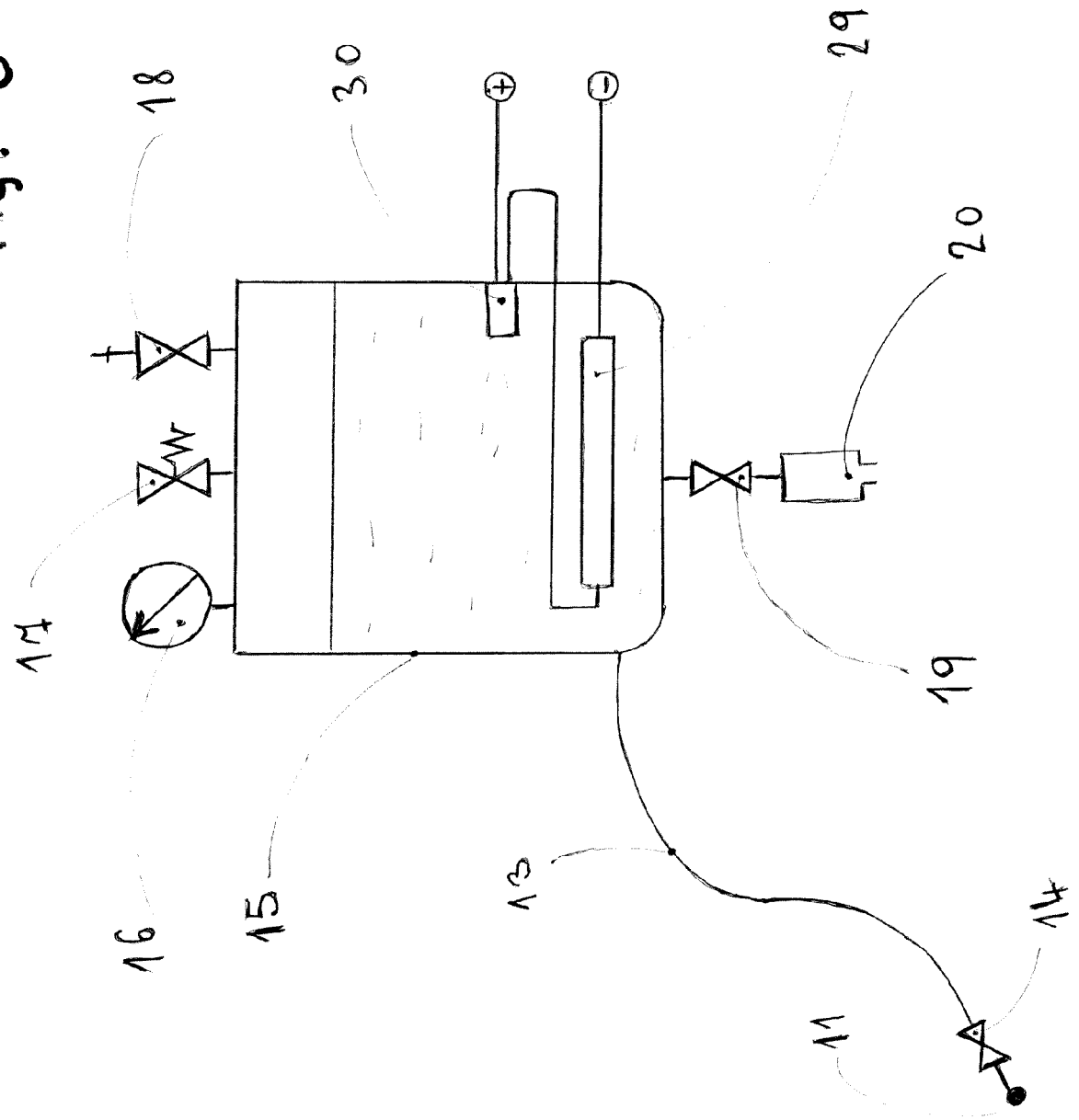
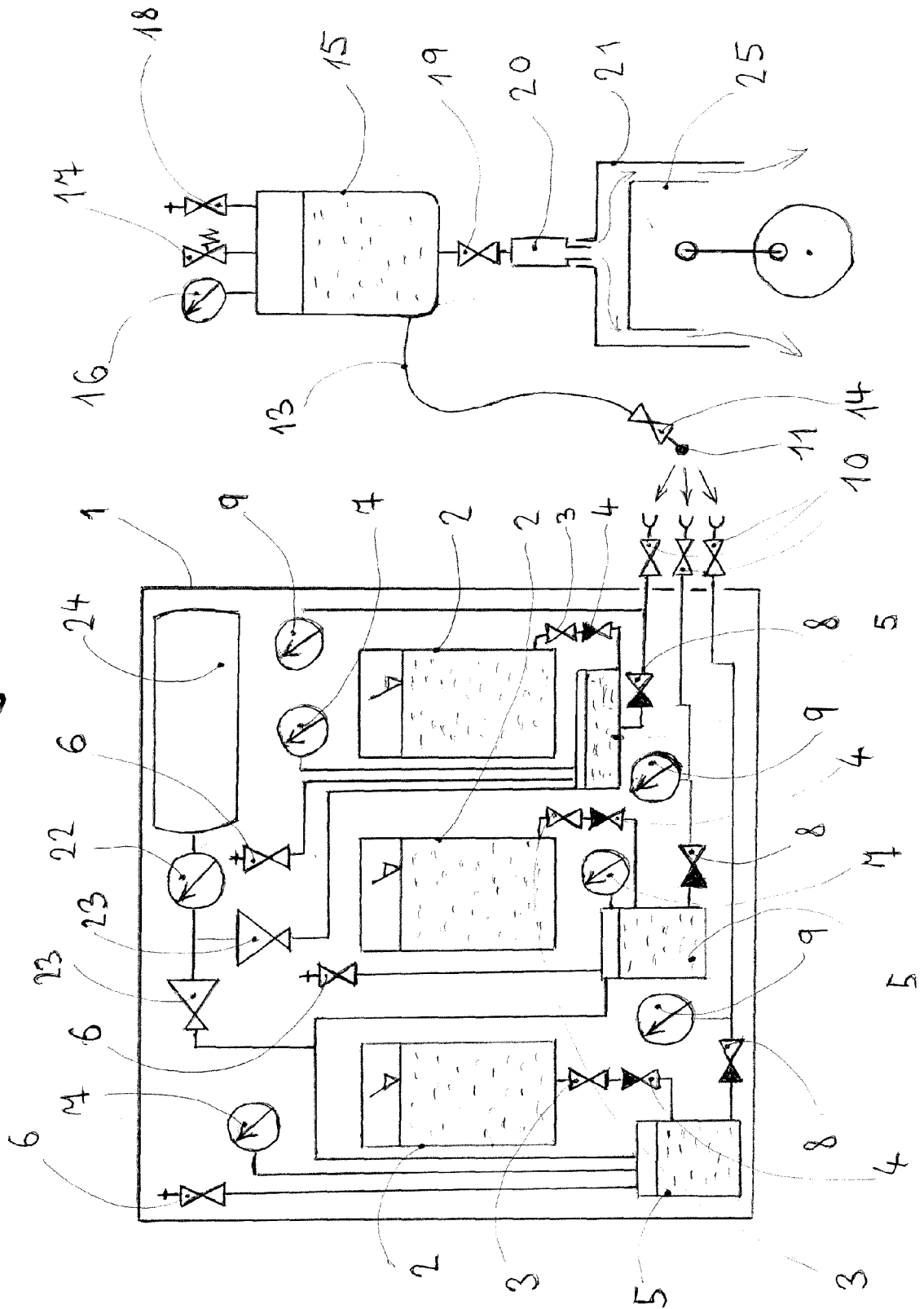


Fig. 4





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