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(54) Steam generator with automatic water loading system

(57) The present invention concerns an automatic system for loading water into a steam generating boiler normally used in appliances which use steam for carrying out their domestic or industrial functions, such as machines for domestic and industrial cleaning, ironing systems, pressure cleaners, extraction hydrojets, combined extractors etc. The components of the system comprise: cold water tank (1), level gauge for the water in the cold water tank (2), acoustic indicator (3), motor pump (4), priming and vacuum valve (5), boiler (6), main heating resistance (7), fuse (8), pressure switch (9), solenoid valve (10), safety valve (11), pilot resistance (12), motor pump control thermostat (13), remote control button (14), area for controlling the water level in the boiler (15). There may be a water level probe comprising a thermoconductive body, an electric heating resistance and a thermostat.

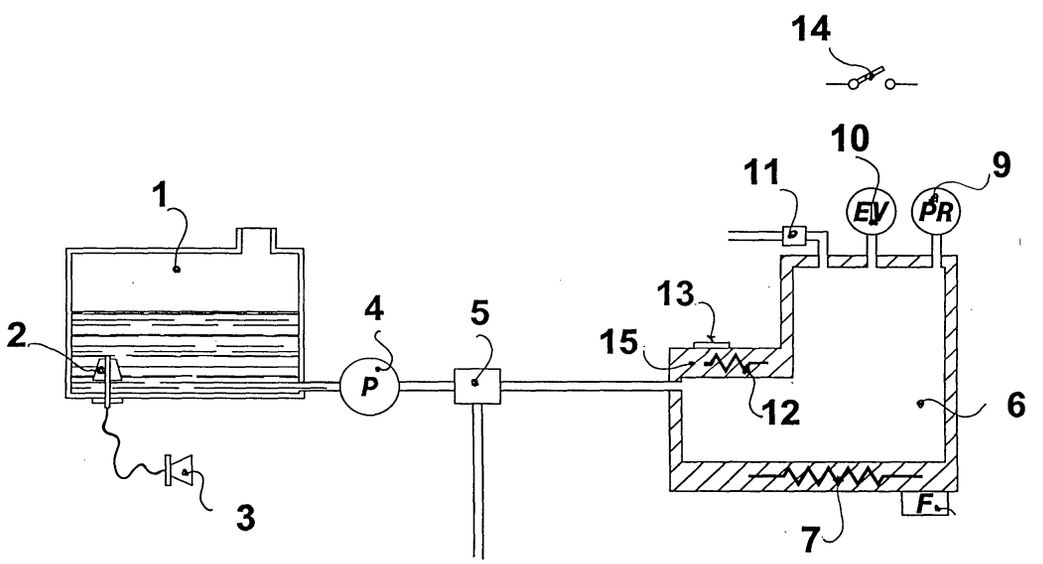

Fig. 1

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Description

DESCRIPTION OF THE INVENTION

[0001] The present invention concerns an automatic system for loading water into steam generating boilers. The innovation is used particularly, if not exclusively, in the sector of appliances which use steam for carrying out their domestic or industrial functions, such as ironing systems, cleaning machines, pressure cleaners, extraction hydrojets, combined extractors, etc.

[0002] **In the prior art** the following systems for automatically loading water into steam generating boilers are known:

a) Systems with a probe or internal float: systems with a floating probe contemplate the installation of these elements inside the boiler to check the water level. They present the serious problem of becoming insensitive (in the case of the probe) or of sticking (the float) due to the heat which gradually affects their surfaces when they are directly subjected to the action of the steam and heat inside the boiler. The second disadvantage is that, as they work with low voltage, for their operation they need sophisticated electronic cards and a current transformer, with considerable costs for components and installation labour.

b) Balance system: this system contemplates the control of water reloading by means of a microswitch placed on one side of the boiler. In this case the boiler is suspended with an equaliser system, in the sense that on one side it tilts with an articulated support and on the opposite side it is suspended with a spring. The weight of the water loaded into the boiler causes the boiler to be lowered, due to the effect of the weight, on the side of the spring, activating the microswitch which switches off the motor pump and interrupts the flow of the water; likewise, when the weight decreases as the steam is used, the spring lifts the boiler and opens the contact of the microswitch, which activates the motor pump that restores the water level.

This system has been almost completely abandoned because it presents the drawback that, with every slight movement of the apparatus, the boiler, with this suspended installation, moves and activates the reloading mechanism even if it is not necessary; moreover, the suspended spring loses its effectiveness over time and makes the appliance unusable.

c) System with an external control probe: this system contemplates the control of the water level with a probe outside the boiler, obtained by installing a small Teflon pipe directly connected to the bottom and top of the boiler compartment. This pipe is provided with a probe for the control of the water level, obtained through the principle of communicating vessels. Also this system, acting at low voltage, needs electronic control by means of a sophisticated card and a current transformer, with considerable costs for components and installation labour.

d) System with thermostat control. There is a system in which the temperature gauge is hermetically introduced into the boiler and positioned in direct contact with a collar that encircles the electric resistance. When the water level falls and uncovers the area surrounded by the collar, the resulting increase in temperature is detected on the outside by a thermostat resting on the temperature gauge. This system makes the operation of the resistance unstable, because it is forced to work sometimes in water and sometimes in air. This also leads to the formation of a lot of scale in the measuring area, with consequent gradual loss of sensitivity of the system.

[0003] Another device is composed of a boiler with a tilted bottom on which an external heating plate is applied, said plate being made of die-cast aluminium and containing a resistance and thermostats for measuring the temperature. The inconvenient aspects of this system are due to the fact that, as the water level falls, a part of the inclined bottom in contact with the heating plate is uncovered arid it becomes overheated due to the effect of the steam generating resistance, thus generating large quantities of scale in the wet-and-dry area with consequent loss of sensitivity of the system and rapid clogging due to scale.

[0004] One of the efficiency parameters for boilers or steam generators is the capacity to guarantee a constant amount of steam for as long a period as possible.

[0005] The efficiency of the steam production system also depends on the capacity of the loading system to keep the pressure level in the vaporisation chamber as constant as possible.

[0006] The various known mechanisms for controlling the water level in the vaporisation chamber are affected by the various mechanical and electrical problems, the depositing of scale, overheating and cooling.

[0007] **The aim of the present invention** is also to overcome the above-mentioned inconveniences.

[0008] This and other aims are achieved with the present invention according to the characteristics as in the annexed claims, solving the problems stated, by means of a suitably shaped boiler in which, at a suitable level, there is a flat part in which a pilot resistance and the respective control thermostat are housed. Said flat part is positioned in correspondence with the optimum water level and is subjected to a flushing action on the inside part in contact with the water at every reloading.

[0009] The formation of scale, already limited by the fact that the pilot resistance installed in that area does not have the function of generating steam, but of creating suitable temperatures for controlling the level, is further limited by the fact that the scale is deposited on the

bottom by gravity and not on the top of the boiler where the thermostat and the pilot resistance are positioned, thus allowing a precise and lasting control. The sensitivity thus obtained allows frequent brief loading operations, carried out by pouring small amounts of water into the boiler and in this way ensuring an excellent distribution of steam even during loading.

[0010] Alternatively, the vaporisation chamber has any shape, for example regular, parallelepiped, cylindrical or the shape requested and necessary for the appliance that uses the steam.

[0011] On one side of the vaporisation chamber there is a hole or through housing which allows the insertion and fixing of the new additional resistance in the shape of a water level probe.

[0012] The duct or hole for filling the vaporisation chamber is situated on the roof of the chamber itself, near or vertically above the probe so that the filling water strikes the probe itself, or affects it as quickly as possible.

[0013] The probe is composed of a thermoconductive body, generally in the shape of a parallelepiped or a cylinder, with an end flange for fixing it onto the wall of the vaporisation chamber.

[0014] Inside the probe body there is an electrical heating resistance, while a thermostat is fitted on the flange of the body itself, or in another suitable position.

[0015] The probe thus composed, once it has been inserted, applied and fixed onto the wall of the vaporisation chamber, is inside said vaporisation chamber. Substantially, the lower edge of the probe will identify the minimum water level at which the vaporisation chamber must be filled, while the upper edge of the probe will identify the maximum level at which filling of the vaporisation chamber must be interrupted.

[0016] As has been said, the probe thermostat is electrically connected to the pump that fills the vaporisation chamber.

[0017] In normal operating conditions the water in the vaporisation chamber submerges the probe body and the main heating resistance in the vaporisation chamber heats the water, producing steam.

[0018] The electric heating resistance of the probe heats the probe body itself, while the probe thermostat continuously controls the temperature of the probe itself.

[0019] The probe protrudes completely or partly from the water when the level of the water to be vaporised falls and consequently the heat generated by the heating resistance in the probe increases the temperature of the probe itself. This increase in the probe temperature is detected by the thermostat which activates the pump, taking water from the tank and sending it into the vaporisation chamber. The added water strikes the probe and cools it. The probe itself cools down when the water level has risen, reaching the lower limit temperature; at this point the thermostat commands the stopping of the filling pump.

[0020] The dimensions, the materials, and the thermal and thermoelectric characteristics of the various parts of the probe are studied and compared so as to have a high probe sensitivity. A very slight difference in level is obtained between the maximum level and the minimum level of the water in the vaporisation chamber.

[0021] The boiler composed as described above offers notable advantages:

- it maintains a substantially constant level of the water to be vaporised with consequent stability of the water-steam-pressure ratios,
- it sends in smaller quantities of cold water, drastically decreasing the extremes of temperature inside the vaporisation chamber,
- it has a more homogeneous production of steam and a less variable pressure value,
- high sensitivity to the variation of the water level,
- there are no malfunctions due to scale,
- continuous operation even in positions that are not perfectly horizontal, elimination of electric imbalance or other.

[0022] For the purpose of explanation, without limitation, of the characteristics of the present invention, an embodiment of the system according to the invention is now described, with reference to the enclosed schematic drawings, wherein:

- fig. 1 represents the system on the whole;
- fig. 2 and 3 represent the system highlighting the water levels inside the boiler at which the commands for loading water and for stopping loading are given.

[0023] When the appliance is connected to the mains and is switched on, in the hypothesis that there is no water in the cold water tank (1), the level gauge (2) by means of the acoustic indicator (or warning light) (3) notifies the user, who fills it with water; meanwhile the boiler will be heated by the main resistance (7). When the water in the boiler is at level (X) (see Fig. 2), after a few seconds the pilot resistance (12), located in the control area (15), overheats the area, causing the intervention of the thermostat (13) which commands the motor pump (4) connected to the cold water tank (1) and to the boiler (6) by means of a pipe. The entrance of cold water in the boiler (6) brings the water to the new level (Y). The contact of the cold water with the control area (15) lowers its temperature, causing the opening of the thermostat (13) and the consequent stopping of the pump (4).

[0024] As it heats the water, the main resistance (7) generates steam which puts the boiler under pressure. When the set pressure is reached the pressure switch (9) intervenes and interrupts the power supply to the resistances. The distribution of steam is accomplished by means of a solenoid valve (10) activated by a button (14) that controls the iron, floor washer or other machine, connected to it. The consequent pressure drop causes

intervention of the pressure switch (9) which again switches on the main resistance (7) to maintain the working pressure and the pilot resistance (12). The consequent fall in the water level due to the distribution of steam again triggers the cycle for feeding water into the boiler as described above.

[0025] Figure 4 shows an equivalent solution of the new boiler, while figures 5 and 6 show the two moments of low water level and high water level.

[0026] The cold water tank (1) is provided with a level gauge (2) which, by means of the acoustic indicator or warning light, notifies the user when there is no water.

[0027] The vaporisation chamber (6) heats the water that it contains by means of the main resistance (7). At the same time the resistance (12.2) of the probe (12) heats the body (12.1) of the probe (12) itself and the heat is absorbed by the water in the vaporisation chamber (6).

[0028] When the set pressure is reached the pressure switch (9) intervenes and interrupts the power supply to the resistances (7, 12.2). The distribution of steam is accomplished by means of a solenoid valve (10) activated by a button that controls the appliance that uses the steam. The consequent pressure drop causes intervention of the pressure switch (9) which again switches on the main resistance (7) to maintain the working pressure and the resistance (12.2) of the probe (12).

[0029] When the water in the vaporisation chamber (6) falls below the level (X, figure 5) of the probe body, the heat generated by the electric resistance (12.2) overheats the probe body (12.1) and the thermostat (13) of the probe itself intervenes, activating the pump (4) for topping up.

[0030] The pump (4) takes water from the tank (1) and sends it into the vaporisation chamber (6) through a filling nozzle or hole (8), in such a way that the water strikes or in some way washes against the probe (12).

[0031] As soon as the water level rises above the probe level (Y, figure 6), the greater heat of the body (12.1) of the probe (12) generated by its resistance (12.2) is absorbed by the water in the vaporisation chamber (6) and consequently the thermostat (13) intervenes again, interrupting operation of the pump (4).

[0032] This system allows frequent brief cold water loading operations so as not to jeopardise the pressure that has formed inside the boiler.

[0033] In this way the curve indicating the pressure values (p) of the new system (n) with relation to the time (t) is less wide than the one for the traditional systems (v) and the difference in pressure during the working phase and the filling phase is reduced, as illustrated in figure 7.

[0034] The traditional pressure switch detects the pressure (with a much smaller delta) and is then activated only in the cases where work is finished, thus avoiding interventions of the pressure switch which switches off the main water heating resistance during the loading phase and therefore allowing continuous and efficient work.

Claims

1. Boiler, equipped with an electric resistance for generating steam, **characterised in that** it is provided with a suitable cavity, niche or shelf on which a resistance is positioned, in addition to the one for generating steam, and wherein in the vicinity of said resistance there is a temperature gauge for activating loading and wherein said additional resistance and said temperature gauge have the function of controlling the water level inside the boiler.

2. Boiler, according to claim 1, **characterised in that** the vaporisation chamber is filled by a pump, which takes the water from an accessory tank.

3. Boiler, according to claim 2, **characterised in that** it is provided with a surface for controlling the water level with a pilot resistance and a control thermostat at the top, and wherein said surface is washed at the bottom by the water.

4. Boiler, according to claim 3, **characterised in that** it has a water level probe comprising a thermoconductive body, an electric heating resistance and a thermostat, and wherein the thermoconductive body has a generically linear shape with a flange at one end for connecting it to the wall of the steam generators, and wherein the heating resistance is completely or partly contained inside the thermoconductive body, and wherein the thermostat is applied to the thermoconductive body in a suitable position for detecting the heat variations of said probe.

5. Boiler, according to claims 3, 4, **characterised in that** said level probe is applied to the wall of the vaporisation chamber at a height between the maximum and minimum level of the water to be vaporised, and wherein the thermostat is connected to the pump for topping up the steam generator, activating and deactivating it according to the probe temperature.

6. Boiler, according to claim 5, **characterised in that** the probe is completely or partly inserted in the vaporisation chamber, provided with a main resistance, in an area where it may be both completely submerged in the loading water and completely emerged.

7. Boiler, according to claim 6, **characterised in that** the entry of the topping-up water is placed exactly above the probe or wherein the filling water strikes or washes against the probe.

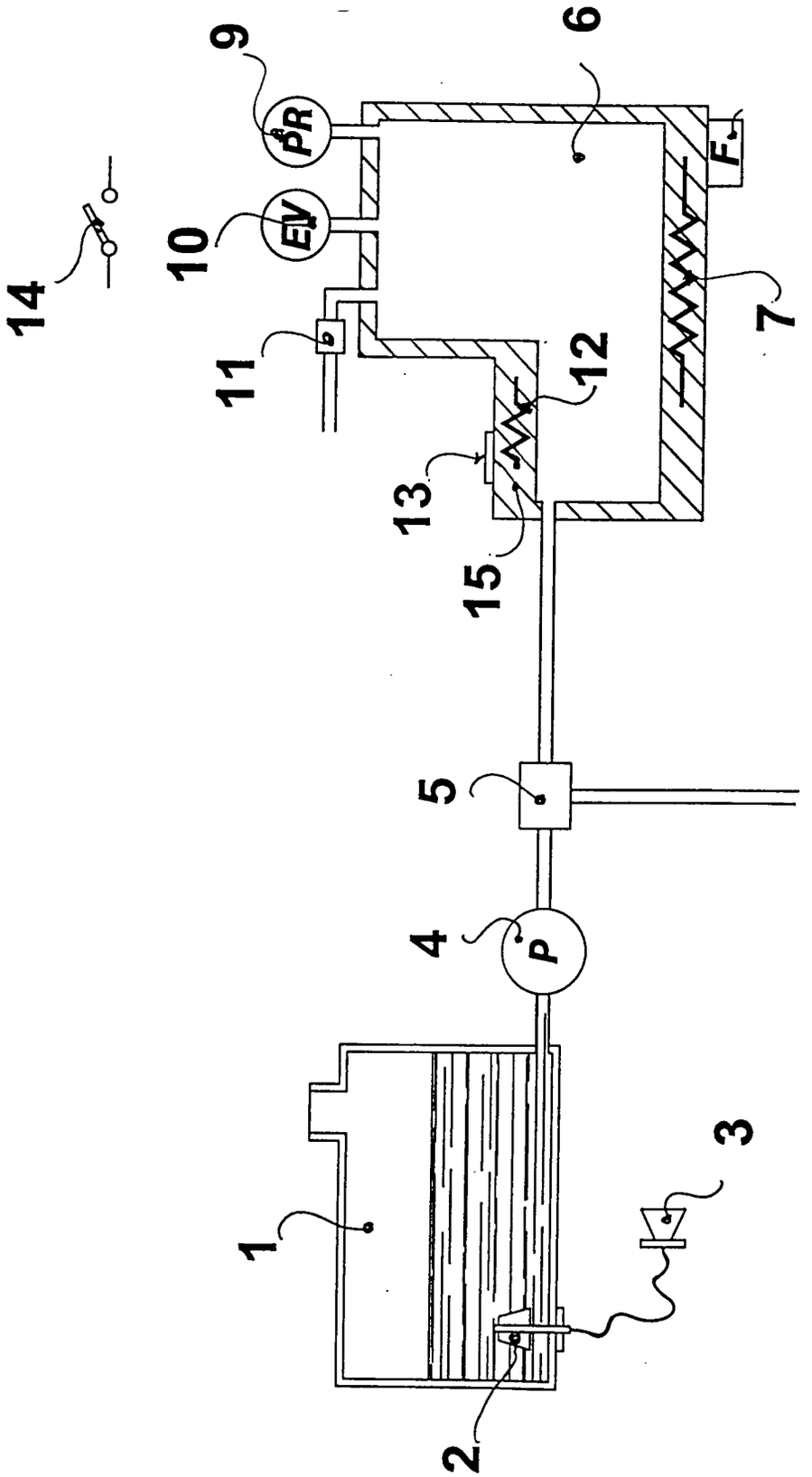

Fig. 1

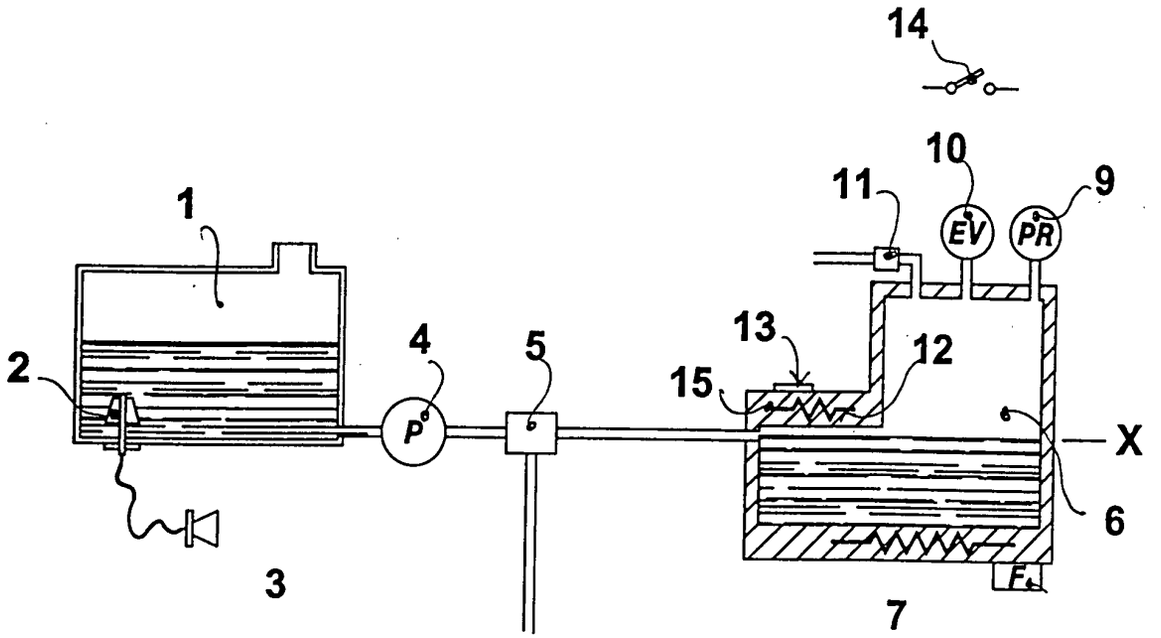
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Fig. 2

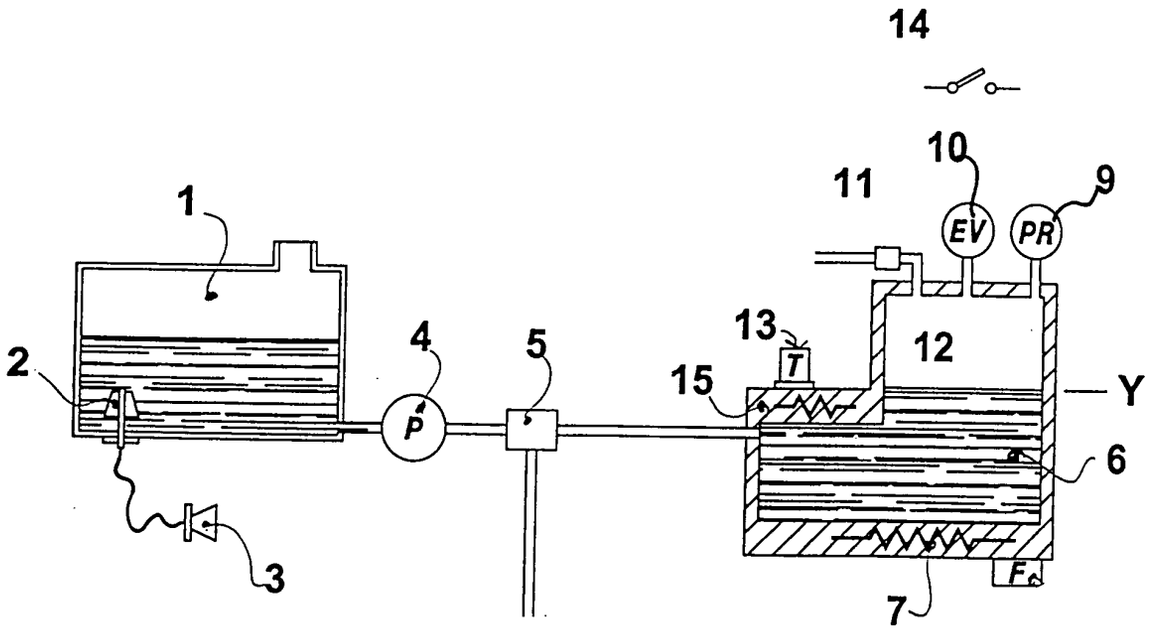
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Fig. 3

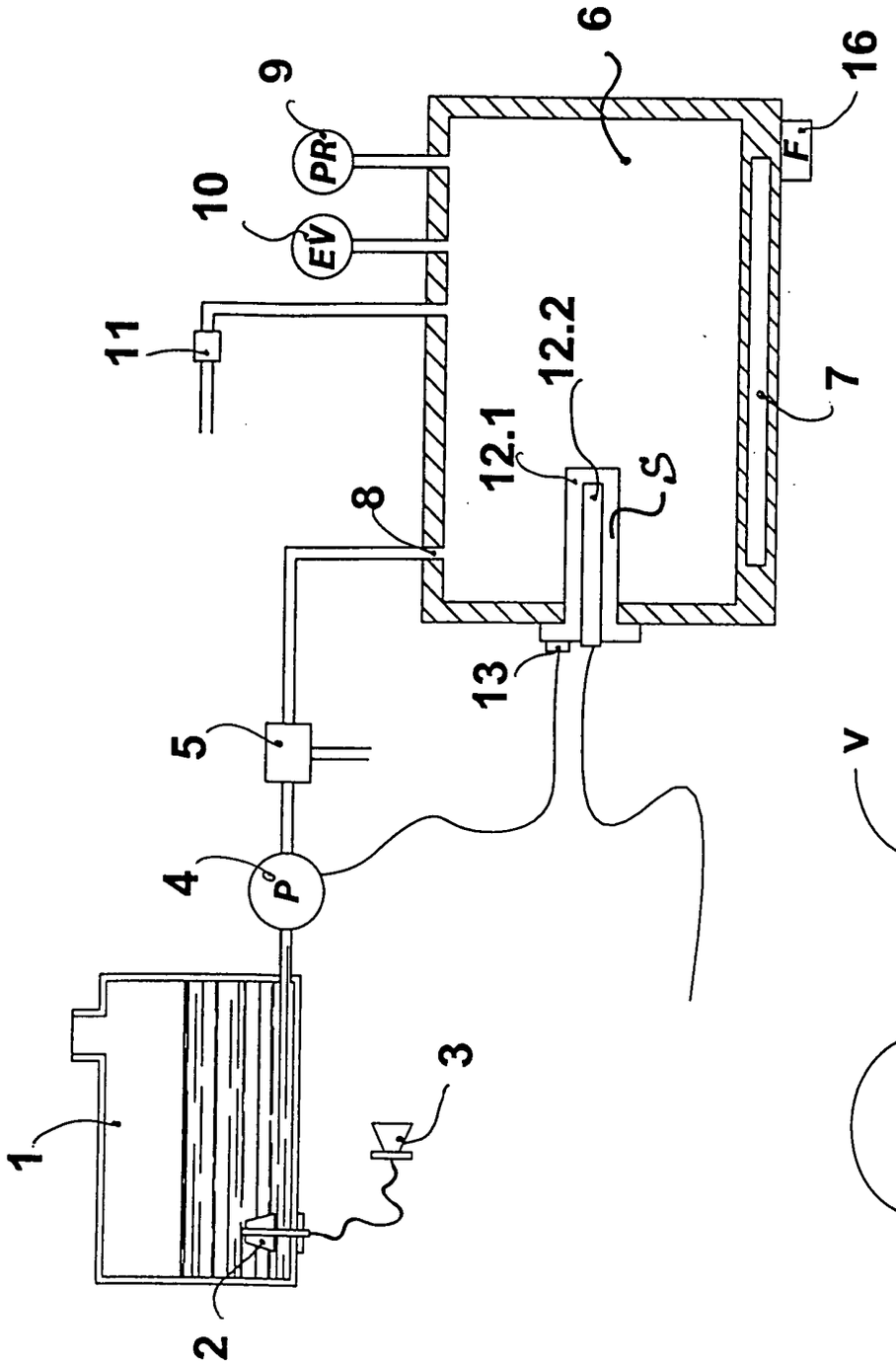

Fig. 4

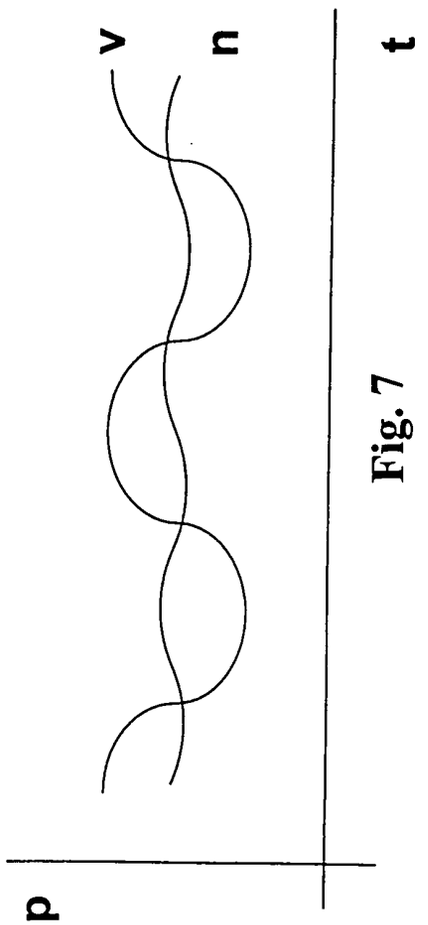

Fig. 7

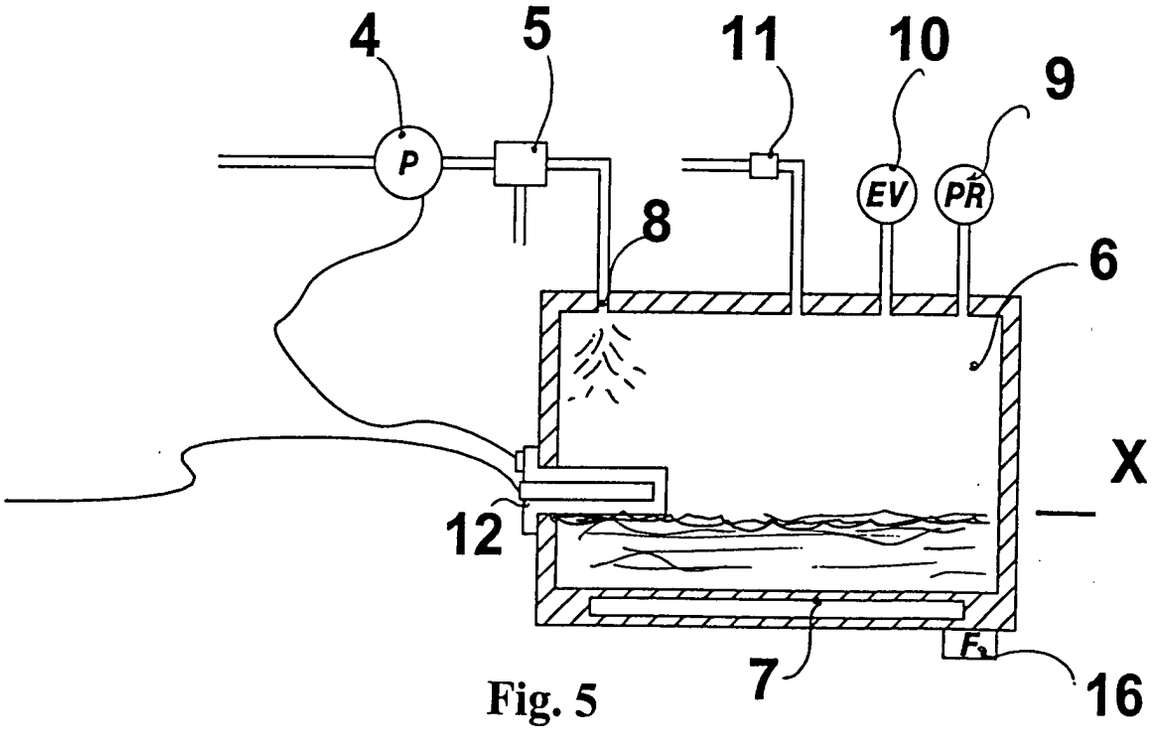

Fig. 5

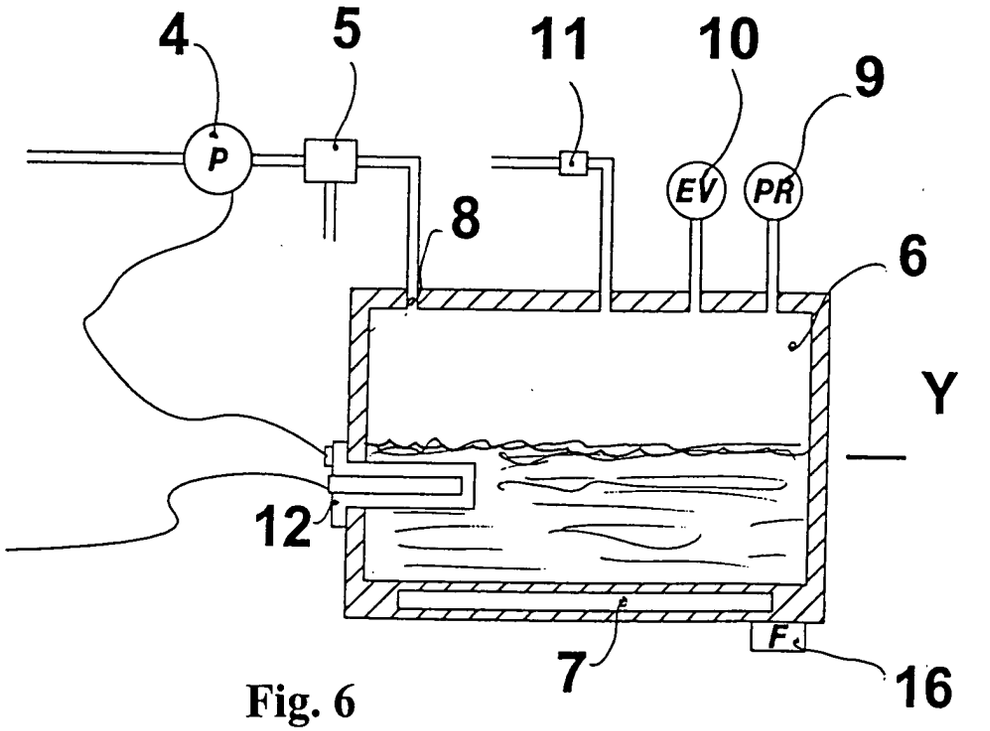

Fig. 6