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(71) Applicant: **HERMANN S.r.l.**  
**29010 Pontenure (PC) (IT)**

(72) Inventor: **Mazzoni, Paolo**  
**29100 Piacenza (IT)**

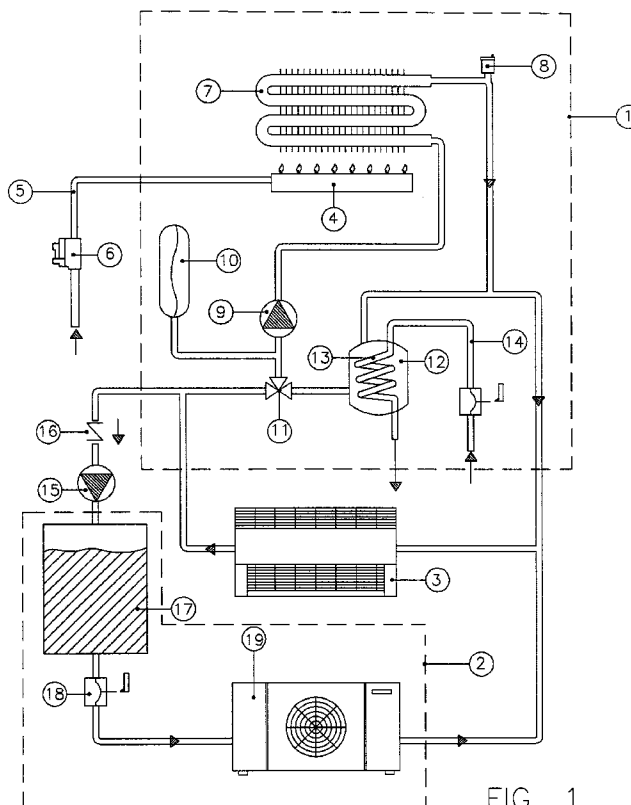
(74) Representative: **La Ciura, Salvatore**  
**Via Francesco Sforza 3**  
**20122 Milano (IT)**

(54) **Air-conditioning and heating system, especially for homes, shops, offices and the like**

(57) The invention relates to an air-conditioning and heating installation comprising in combination:

- a boiler connected to a heating circuit
- a heat exchanger for the production of hot tap water fitted to the said heating circuit
- an air-conditioning system connected to the said cooling circuit
- a by-pass valve which connects the said three circuits;

wherein only water circulates in the pipes connecting the air-conditioning circuit to the heating circuit.



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## Description

This invention relates to an air-conditioning and heating system, especially for residential premises, shops, offices and the like, comprising a boiler for space heating and the production of hot tap water, and a separate cooler connected to the boiler by pipes in which cooled water circulates, the cooler and system management devices all being located in the boiler.

The system allows hot tap water to be produced without interrupting the operation of the cooler, and offers the great advantage that it is very easy to instal, as the pipes leading from the boiler to the cooler and vice versa only contain water, not coolant gas like known plants; as a result, the system can be installed by any installer, with no need for the special know-how or equipment of a refrigerator technician.

An increasing number of homes contain an air-conditioning system for use in the summer season in addition to the heating system used in winter.

In present buildings a heating and air-conditioning system is installed, which comprises heating equipment, usually integrated with hot tap water production equipment, and air-conditioning equipment.

There are systems on the market in which the compressor is coupled to the boiler, but this method presents considerable drawbacks because the compressor is rather noisy during operation, and because of the resulting increase in size, which often makes it impractical.

More recently, systems have been introduced in which the air-conditioning unit is located outside the home, e.g. on a balcony or in a separate room, and is connected to the management devices located in the boiler and, via the said devices, to the installation in the home, to which it is connected by special pipes in which coolant fluid circulates.

This system also presents some drawbacks, mainly relating to the difficulty of installing this kind of equipment.

The coolant gas used in these systems, usually freon, requires a perfectly sealed system which can only be installed by skilled technicians with considerable experience.

As a result installers, usually plumbers, often have difficulty in installing this kind of system, as it involves problems with which they are unfamiliar.

The need is therefore felt in the industry for air-conditioning and heating systems which can be installed by the technicians who usually instal heating systems, without having to tackle new and unusual problems with which they are often unfamiliar.

This objective is achieved by the air-conditioning and heating installation in accordance with the invention, in which the cooler is connected to the management devices in the boiler via pipes in which only cooled water circulates.

Installation is thus highly simplified, and can be performed more rapidly and safely.

As the external cooler is an en bloc unit connected to the boiler only by hydraulic pipes, the installer faces no problems associated with the distance between the two units or differences in installation level, and there is no need to test the gas charge in the air-conditioning circuit.

This and other characteristics will become clearer from the detailed description which follows, provided by way of example but not of limitation, by reference to the annexed figures in which:

- figure 1 shows the general diagram of a system in accordance with the invention
- figure 2 shows the general diagram of a system in accordance with the invention during operation at the heating stage
- figure 3 shows the general diagram of the system during the hot tap water production stage in the heating period
- figure 4 shows the system during the air-conditioning stage
- figure 5 shows the same system during the hot tap water production stage in the air-conditioning period.

The various figures show the parts of the installation used for the various functions.

With reference to figure 1, the system in accordance with the invention comprises a heating and hot tap water production circuit, the said circuit being schematically illustrated and marked 1, and a cooling circuit marked 2, both included in the same supply circuit as a number of convectors, only one of which is shown in the figure, and marked 3.

The necessary heating is provided by a gas burner 4, supplied via a pipe 5 to which a throttle valve 6 is fitted.

A heat exchanger 7 absorbs the heat produced by the burner to heat the water circulating in the system.

No. 8 indicates an air relief valve commonly fitted on this type of installation.

Circulation of the space heating water is controlled by a pump 9, and the circuit also includes an expansion tank 10.

A by-pass valve 11, which connects the circuit to a second heat exchanger 12 containing a coil 13 of a tap water production circuit 14, is also fitted on this circuit.

The direction of circulation of the water in the various branches of the circuit is indicated by the arrows shown in the figures.

The air-conditioning circuit is also connected to the heating circuit. The air-conditioning circuit comprises a second pump 15 for the circulation of coolant water, a check valve 16, a cooled water accumulation tank 17 and a safety flow switch 18, together with the air-conditioning unit 19 of known type, comprising a compressor, an expansion vessel and a heat exchanger.

A characteristic of the invention is that only water, specifically cooled water, circulates in the section of the

circuit connecting air-conditioning unit 19 to the branches of the circuit leading to convectors 3 and to the control devices in the boiler.

In order to explain the operation of the system, the various operating modes will be briefly described; the parts of the installation activated at different times during heating, cooling, etc. are hatched in the various figures.

#### Heating stage (figure 2)

Pump 15 on the cooling circuit is inactive, while pump 9 on the heating circuit is activated, and by-pass valve 11 connects the pump to the branch of the circuit leading to convector 3.

The water then circulates from the pump to heat exchanger 7, from there to the convector, and at the exit from the convector back to pump 9 through valve 11.

At this stage the heating circuit remains separate from the air-conditioning circuit because pump 15 is shut down and check valve 16 is returned to the closed position by the suction generated by pump 9.

#### Production of hot tap water during heating stage (Figure 3)

Pump 15 is shut down and by-pass valve 11 connects pump 9 to the section of the circuit leading to heat exchanger 12.

The water then flows from pump 9 to heat exchanger 7 where it is heated, and is then conveyed to heat exchanger 12, where it yields heat to the tap water which flows through coil 13.

Here again, the circulation of water in the cooling circuit is prevented by the shut-down of pump 15 and the closing of check valve 16.

#### Air-conditioning stage (Figure 4)

Pump 9 is deactivated and pump 15 is activated, while by-pass valve 11 prevents flow towards pump 9 and connects convector 3 with the branch of the circuit leading to check valve 16 and from there to pump 15.

The water then flows freely in the cooling circuit, while circulation in the heating circuit is prevented by the shut-down of pump 9, the closing of by-pass valve 11, and the various pressure drops which take place along the circuit.

#### Production of hot tap water during air-conditioning stage (Figure 5)

During this stage, both air-conditioning and production of hot tap water can be performed simultaneously.

Pumps 9 and 15 are both activated, while by-pass valve 11 remains closed to prevent connection between the heating circuit, with pump 9, and the cooling circuit, with pump 15, which leads to air-conditioning unit 19 and from there to convector 3.

During this operating mode the upper part of the section of the circuit marked "T" will contain hot water, while the lower part will contain cold water; it is only in this zone that slight conduction between hot and cold water may take place, but in such minimal amounts that the efficient operation of the installation is unaffected.

During this stage, therefore, hot tap water can be produced without interrupting the operation of the air-conditioning circuit.

As will be clear from the description given, the system in accordance with the invention presents considerable advantages, as its installation does not require particularly expert technicians; it can be installed by any installer because, as mentioned, only water circulates in the pipes connecting the boiler to the air-conditioning unit, while the need for pipes in which coolant gas flows has been totally eliminated.

An expert in the field could devise numerous modifications and variations, all of which should be considered to fall within the scope of this invention.

#### **Claims**

1. Air-conditioning and heating installation of the type comprising a space heating boiler, a separate cooler (19) and a number of convectors(3), characterised by the fact that the said cooler is connected to the boiler by pipes in which only coolant liquid circulates.
2. Air-conditioning and heating installation in accordance with claim 1, characterised by the fact that it comprises a combination of:
  - a boiler connected to a heating circuit (1)
  - a heat exchanger (12) for the production of hot tap water fitted to the said heating circuit
  - an air-conditioning system (2) connected to the said heating circuit
  - a by-pass valve (11) which connects the said heating circuit (1), said conditioning system (19) and said heat exchanger (12),
 and that only cooling liquid circulates in the pipes connecting the air-conditioning circuit to the heating circuit.
3. Air-conditioning and heating installation in accordance with the preceding claims, in which the cooler control devices are incorporated in the boiler.
4. Air-conditioning and heating installation in accordance with claim 3, characterised by the fact that two water circulation pumps (9, 15) are fitted, one on the heating circuit (1) and one on the air-conditioning circuit (2).
5. Air-conditioning and heating installation characterised by the fact that it comprises:

- a boiler connected to one or more heat exchangers (3) for space heating via a circuit on which a water circulation pump (9) and a by-pass valve (11) are fitted in series
- a heat exchanger (12) for the production of hot tap water, connected on one side to the said by-pass valve (11) and on the other to the circuit leading from the boiler 5
- a cooler (19) connected to a circuit in which cooling liquid circulates, leading on one side to the said by-pass valve (11) and on the other to the said circuit supplying the space-heating heat exchangers (3); 10
- a second pump (15) fitted to the pipes connecting the said cooler (19) to the said by-pass valve (11). 15

6. Air-conditioning and heating installation in accordance with any of the preceeding claims, characterised by the fact that daid cooling liquid is water. 20

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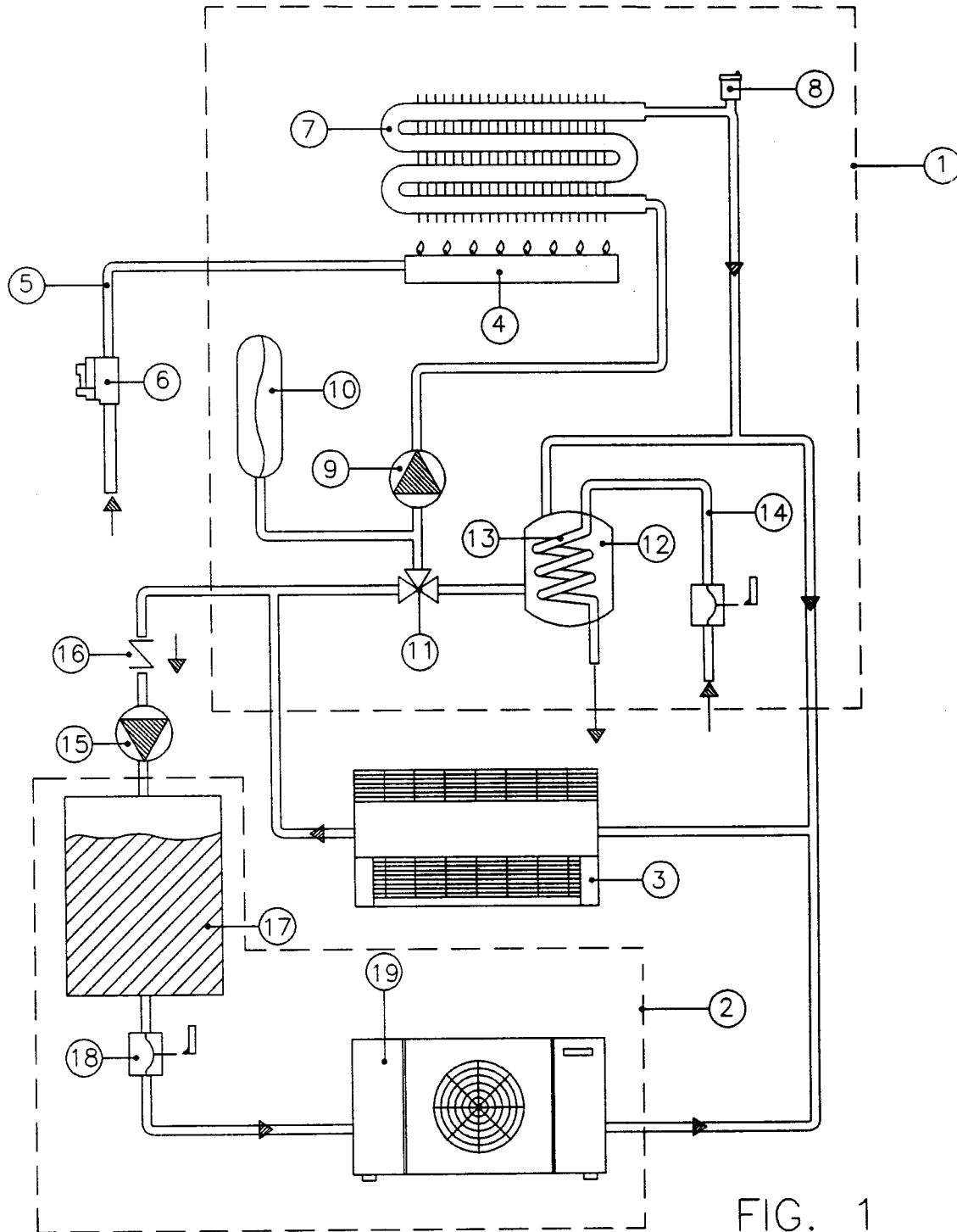


FIG. 1

HEATING STAGE

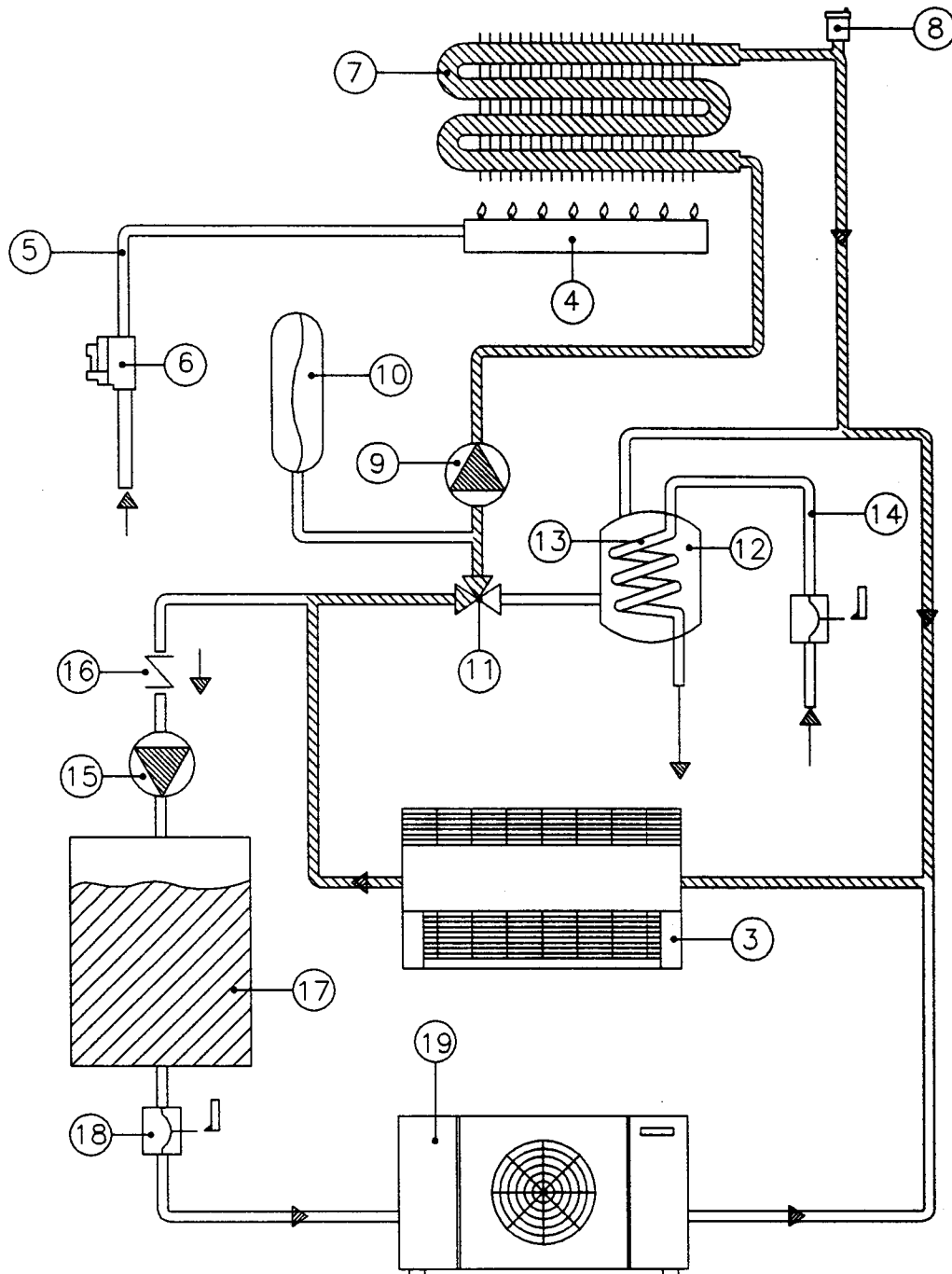


FIG. 2

PRODUCTION OF HOT TAP WATER DURING HEATING  
STAGE

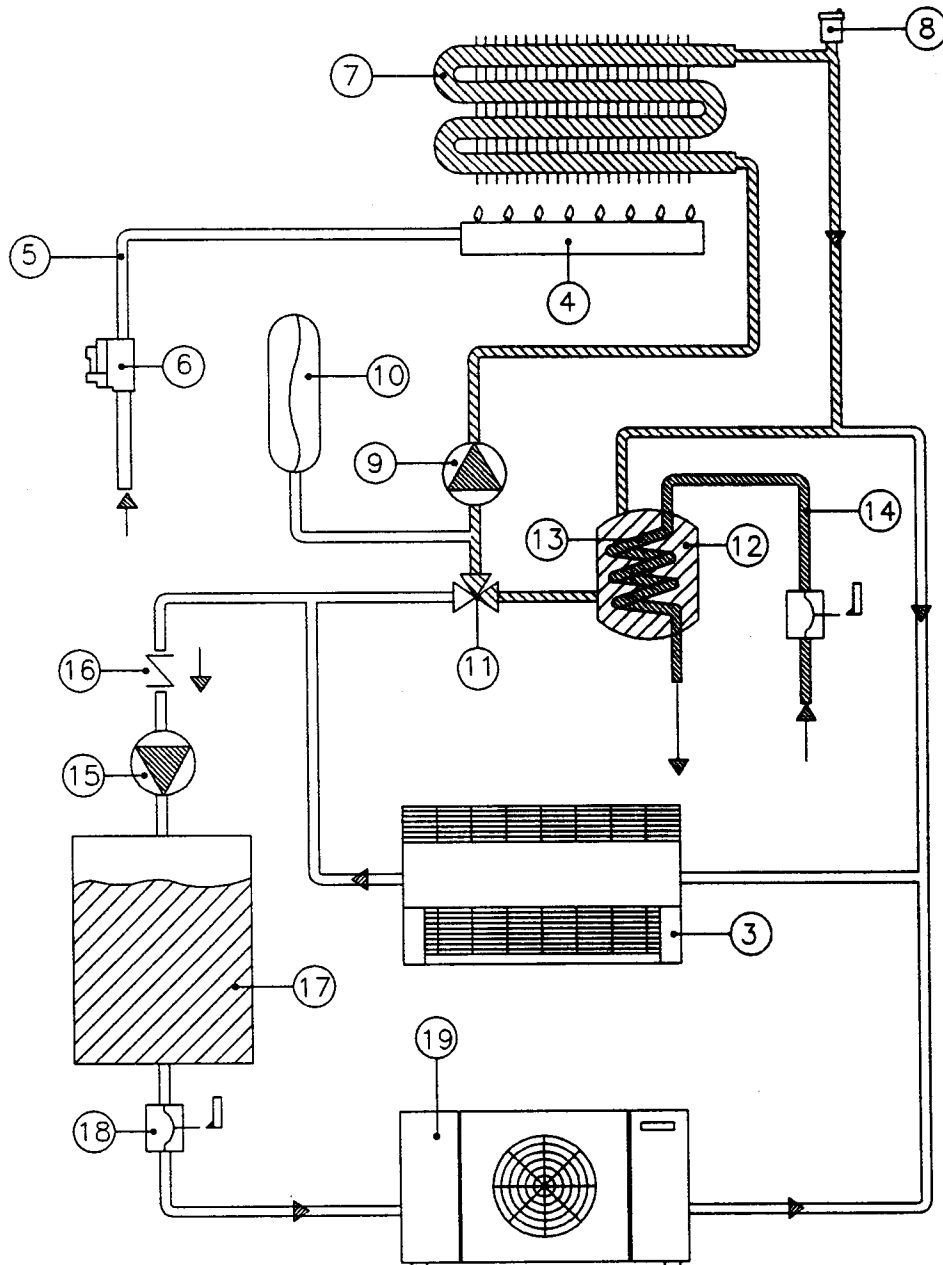


FIG. 3

AIR-CONDITIONING STAGE

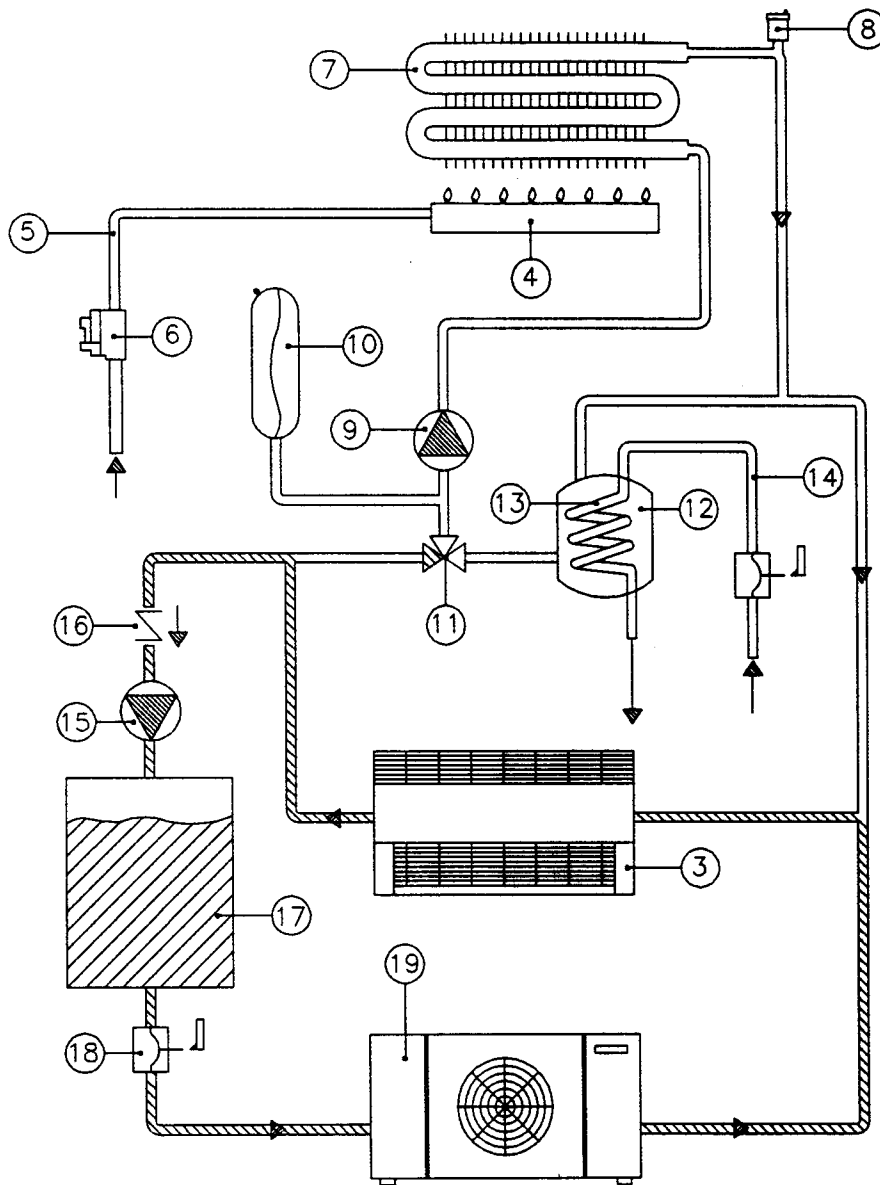


FIG. 4

## PRODUCTION OF HOT TAP WATER DURING AIR- CONDITIONING STAGE

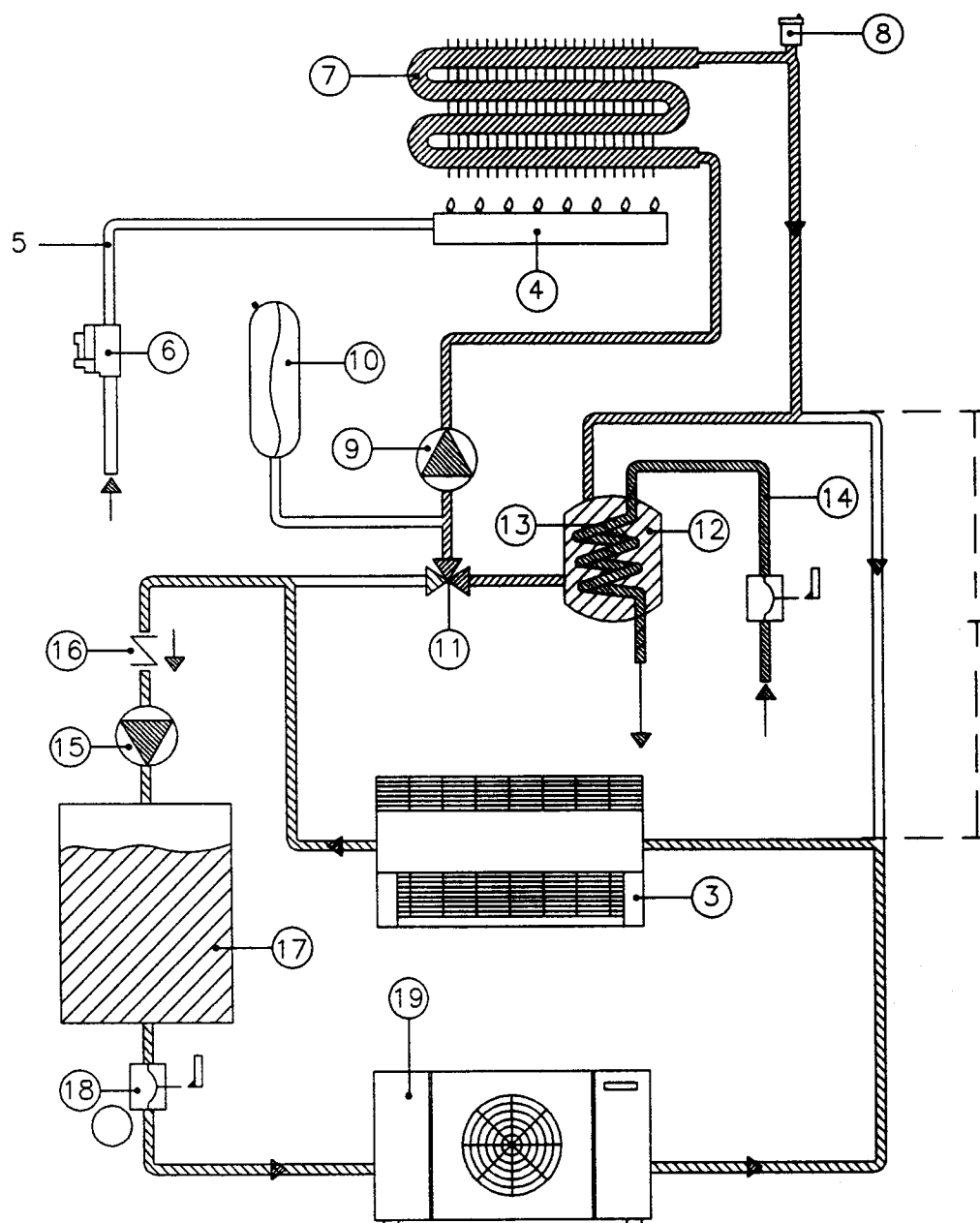


FIG. 5