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(54) SYSTEM FOR RECOVERY OF HEAT FROM SOLIDIFYING LARGE-SIZE METAL CASTINGS AND FOR USING IT TO HEAT CASTING MOULDS

(57) At the input of the system, a ventilator (1) is mounted which is connected to a circulating air conduit: system - atmosphere (17), an arm of which is connected to a heat exchanger (2) and constitutes an air outlet into the atmosphere. A second arm is connected through the heat exchanger (2) to a conduit of hot mixture: air - water vapour (16), connected with the other end to an outlet of a heater (12) of the casting mould (6). A water pump (3) is connected to a tank of working medium (4), and the heat exchanger (2) is connected, through a peak load boiler (5), to the tank of working medium (4) and to a conduit of hot air (14) in which a jet pump (8) is included. The other end of the conduit (14) is connected to a pouring tank (11) of the casting mould (6). In the air and water installations, control valves (7) and a metering valve (9) are included, which are electrically connected with a multi-strand cable (19) to an electronic control module (13).

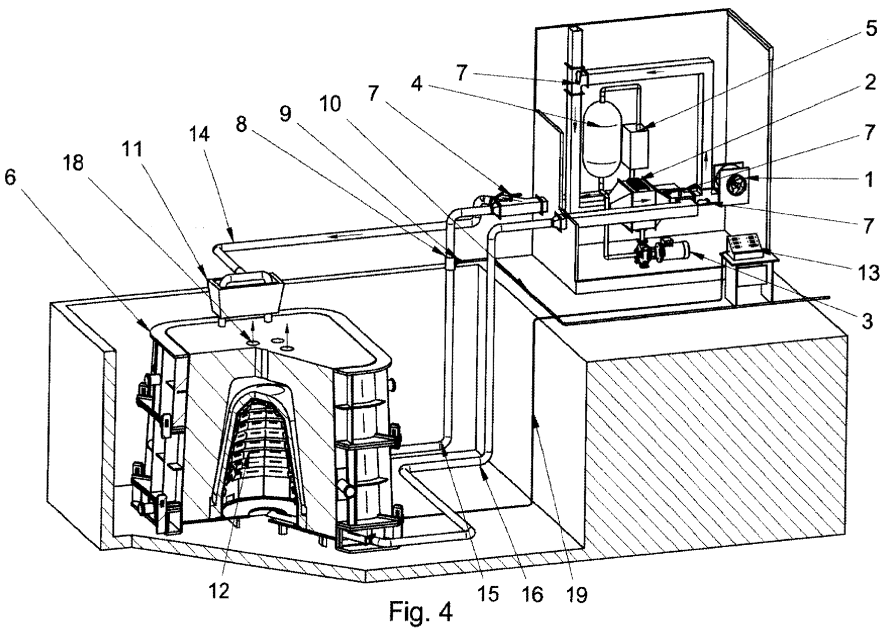

Fig. 4

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Description

[0001] The object of the invention is a system for recovery of heat from solidifying large-size metal castings and for using it to heat casting moulds.

[0002] Sand casting moulds made on the basis of certain resins, for example furan, are characterised by a high moisture of surfaces, which results from the presence of a large amount of hydrogen isolated as a result of chemical processes of binding a resin and a hardener, taking place in the mass. Presence of moisture in the mould negatively affects the casting process.

[0003] From patent specification PL177383, a system for recovery of heat from a refrigerating circuit, which can be used in refrigeration and food industries, in municipal and other installations, is known. This system consists of a refrigerating circuit with an exchanger assembly connected thereto which receives heat from overheated ammonia vapours, a receiving installation for water after heating, and an intermediate tank located therebetween. The exchanger assembly has, at the input of the refrigerant, a first pressure sensor and a second control valve, and at the output - a third control valve and a second pressure sensor, and a bypass conduit of the refrigerant and an installed first control valve. At its output, there is a condenser connected to a main tank for condensates. The refrigerating circuit is connected, at the output of the second pressure sensor, to a straight-through tank which is connected to an intermediate tank for refrigerant condensates and to the bypass conduit.

[0004] Between the exchanger assembly and the receiving installation for heated water, there is the intermediate tank. It has a gas space connected to the external atmosphere by means of a conduit on which a flow measuring element is located. Water part is determined by the maximum and minimum water levels for implementation of which two sensors are used. This tank is connected, with its gas space, to the exchanger assembly included in the refrigerating circuit, and at the output of the exchanger and at the input of the intermediate tank, there is a first temperature sensor and a first ammonia concentration sensor. Between the output of the intermediate tank and the receiving installation for heated water, there is a first pump assembly, bypassed with a sixth control valve. At its input, there is a second ammonia concentration sensor, and at the output of the first pump assembly, there is a fourth check valve. Between the output of the intermediate tank and the conduit of water before heating, there is a second pump assembly, bypassed with a seventh control valve. At the output of the pump assembly, a third check valve is located. On the conduit of water before heating, there is a fifth control valve at the output of which a first check valve is located. The receiving installation for water after heating includes a second exchanger assembly. The input of this assembly of the receiving installation for water after heating is connected, by means of a fourth control valve and a second check valve located at its output, to the conduit of water before heating. At the output of the second exchanger assembly 2, there is a mixing device and a second temperature sensor. At the input of the traditional heating medium, an eighth control valve is located. At the input of the mixing device, between the conduit of water before heating, there is a ninth control valve and a fifth check valve.

[0005] The entire system has a control device - processor. It is connected to two fault indicators: one based on sound and the other on light, as well as to the control valves, to the sensors and to the first and second pump assemblies.

[0006] Furthermore, patent specifications: CN203817349, WO2014105720, CN202639324, CN201988714, KR20030049961 show various devices for heat recovery in casting processes, but they do not disclose any devices for using the recovered heat. Structures of these devices contain a heat exchanger, a tank for the heated fluid, pipe conduits, valves, temperature sensors, but their structures significantly differ from the structure of the device disclosed by the present specification and drawings.

[0007] The essence of the invention consists in that at the input of the system, a ventilator is mounted, which is connected to a vertically circulating air conduit: system - atmosphere, an arm of which is connected to the heat exchanger and constitutes an air outlet into the atmosphere. A second arm of the air conduit is connected through the heat exchanger to a conduit of hot mixture: air - water vapour, connected with the other end to a heater outlet of the casting mould. A water pump, mounted in the system, is connected to a tank of working medium, and via its second pipe branching, it is connected to the heat exchanger which, through a peak load boiler, is also connected to a pipe conduit of hot air. In the conduit of hot air, a jet pump is included which is supplied from the water conduit the other end of which is connected to a pouring tank of the casting mould. In the air and water installations, control valves and a metering valve are included, which are electrically connected with a multistrand cable to an electronic control module.

[0008] Preferably, one control valve is mounted, at the connection of the air conduit: system -atmosphere, to the ventilator.

[0009] Preferably, the control valve is mounted at the separation place of the air conduit.

[0010] Preferably, the control valve is mounted at the connection of the conduit of hot air.

[0011] Preferably, the control valve is mounted at the connection of the conduit of hot mixture: air -water vapour.

[0012] Preferably, the metering valve is mounted on the water conduit before the jet pump.

[0013] Preferably, the pipe conduit of hot air is flexible.

[0014] Preferably, the pipe conduit of cold mixture: air-water mist is flexible.

[0015] Preferably, the pipe conduit of hot mixture: air - water vapour is flexible.

[0016] An advantage of the solution described above is its universality in use since one device performs two processes to a large extent technically opposed in relation to each other. The device itself is relatively simple, easy to use and practically failure-free.

[0017] The solution according to the invention is explained in an embodiment illustrated by the drawing in which Fig. 1 is a schematic diagram, and Fig. 3 - an isometric view with a partial cross-section of the casting mould of the system implementing the function of cooling the casting and recovering the heat, while Fig. 2 - a schematic diagram, and Fig. 4 - an isometric view with a partial cross-section of the casting mould of the system implementing the function of soaking the casting mould.

[0018] In the system, a ventilator 1 is mounted which is connected to a circulating air conduit: system-atmosphere, an arm of which is connected to a heat exchanger 2 and constitutes an air outlet into the atmosphere. A second arm of the air conduit: system - atmosphere is connected through the heat exchanger 2 to the conduit of hot mixture: air - water vapour 16, connected with an end to an outlet of a heater 12 of the casting mould 6. A mounted water pump 3 is connected to a tank 4, and via its second pipe branching, it is connected to the heat exchanger 2 which, through a peak load boiler 5, is connected to the tank 4 and is also connected to a pipe conduit of hot air 14 in which a jet pump 8 is included which is supplied with water from a water conduit 10. An end of the conduit of hot air 14 is connected to a pouring tank 11 of the casting mould 6, made of moulding sand the main component of which is silica sand. In the upper surface of the sand mould 6, there are outlet openings 18 of through channels of molten metal, through which also gases produced in chemical processes occurring in the moulding sand and a mixture: air - water vapour supplied to the interior of the mould 6 after heating and drying thereof flow out into the atmosphere.

[0019] In the air installation and the water installation, valves 7 controlling the flow of working media filling them are included. A control valve 7 is mounted, at the connection of the air conduit: system - atmosphere 17, to the ventilator 1. A second control valve 7 is mounted, at the separation place of the air conduit: system - atmosphere 17. A third control valve 7 is mounted on the conduit of hot air 14. A fourth control valve 7 is mounted at the connection of the conduit of hot mixture: air-water vapour 15.

[0020] A metering valve 9 is mounted on the water conduit 10 before the jet pump 8.

[0021] The control valves 7 and the metering valve 9 are electrically connected with a multi-strand cable to an electronic control module 13.

[0022] Preparation of the system for operation consists in heating the working medium, most often water, located in a peak load boiler 5 heated with gas or electric current, to a temperature of about 90°C. The peak load boiler 5 is also used to heat water in the winter period during downtime of the installation, thereby protecting it from freezing.

[0023] From the peak load boiler 5, hot water is pumped into the water tank 4, from where it is pumped with the pump 3 to the heat exchanger 2. At the same time, the ventilator 1 pumps the air form the atmosphere to a second circuit of the heat exchanger 2, from where the already heated air is pumped through a flexible conduit of hot air to the pouring tank 11 of the casting mould 6. The hot air is pumped further and is distributed by channels inside the casting mould 6, thereby heating and drying it, whereupon the already cooled air escapes through heads and outlet openings 19 of the mould 6 into the atmosphere. After completion of the operation of soaking the mould 6, the control valve 7 on the conduit 14 is closed and is demounted and, through the pouring tank 11, the mould 6 is poured with molten metal, whereupon the process of cooling and solidifying of the casting, associated with release of significant amounts of heat, is initiated and takes place.

[0024] After completion of pouring the mould 6, the soaking system is switched to the mode of heat recovery with cooling of the casting. This is achieved by means of a set of control valves 7 which, after resetting, direct cold air from the atmosphere, pumped by the ventilator 1, through the conduit 15, in which the jet pump 8 is mounted. To increase the efficiency of heat extraction from the ingot, water mist is introduced through the jet pump 8 to the air flowing through the conduit 15, thereby forming a mixture: air - water mist. An end of the conduit 15 is connected to an inlet of the heater 12, through which a cold mixture: air - water mist is pumped to the interior of the coil 12. The water contained in the mixture in contact with the hot coil 12 turns into water vapour with a temperature reaching up to 300°C.

[0025] The mixture: air-water vapour, heated in the coil 12, is pumped to a flexible conduit of hot mixture 16, connected to the outlet of the coil 12, and is delivered to the heat exchanger 2, where it gives off the heat and, when cooled, is expelled through the air conduit 17 to the atmosphere. In the exchanger 2, the heat is absorbed by water circulating therein and is collected in the tank of working medium 4. The water circulates in the exchanger system 2 in a closed circuit forced by the pump 3.

[0026] After reaching the maximum temperature of the water located in the tank 4, the system is switched off, and the supply conduit 15 and the exhaust conduit 16 are disengaged from the mould.

[0027] The process of heating the mould 6 and recovering the heat is checked and controlled by the electronic control system 13 to which measurement data are delivered from sensors, in particular of temperature and pressure, (not shown in the drawings) and position of the control valves 7 and the metering valve 9, and based on the said data, the control system 13 manages the entire process.

List of designations

[0028]

1 - ventilator,
2 - heat exchanger,
3 - water pump,
4 - tank of working medium,
5 - peak load boiler,
6 - casting mould,
7 - control valve,
8 - jet pump,
9 - metering valve,
10 - water conduit,
11 - pouring tank,
12 - pipe coil,
13 - electronic control module,
14 - pipe conduit of hot air,
15 - conduit of cold mixture: air - water mist,
16 - conduit of hot mixture: air-water vapour,
17 - air conduit: system - atmosphere,
18 - overflow and outlet openings of cooled air,
19 - multi-strand cable connecting temperature sensors - control assembly.

Claims

1. A system for recovery of heat from solidifying large-size metal castings and for using it to heat casting moulds, consisting of a casting mould, a heat exchanger, a tank of heated working medium, pipe conduits, control valves, **characterised in that**, at the input of the system, a ventilator (1) is mounted which is connected to a circulating air conduit: system - atmosphere (17), an arm of which is connected to a heat exchanger (2) and constitutes an air outlet into the atmosphere, and a second arm is connected through the heat exchanger (2) to a conduit of hot mixture: air - water vapour (16), connected with the other end to an outlet of a heater (12) of the casting mould (6), furthermore, a mounted water pump (3) is connected to a tank of working medium (4), and via its second pipe branching, it is connected to the heat exchanger (2) which, through a peak load boiler (5), is connected to the tank of working medium (4) and is also connected to a pipe conduit of hot air (14) in which a jet pump (8) is included which is supplied from a water conduit (10), and the other end of the said conduit (14) is connected to the pouring tank (11) of the casting mould (6), moreover, in the air and water installations, control valves (7) and a metering valve (9) are included, which are electrically connected with a multi-strand cable (19) to an electronic control module (13).

2. The system according to claim 1, **characterised in that** a control valve (7) is mounted, at the connection of the air conduit: system - atmosphere (17), to the ventilator (1).

3. The system according to claim 1, **characterised in that** the control valve (7) is mounted at the separation of the air conduit: system - atmosphere (17).

4. The system according to claim 1, **characterised in that** the control valve (7) is mounted on the conduit of hot air (14).

5. The system according to claim 1, **characterised in that** the control valve (7) is mounted at the connection of the conduit of hot mixture: air - water vapour (15).

6. The system according to claim 1, **characterised in that** the metering valve (9) is mounted on the water conduit (10) before the jet pump (8).

7. The system according to claim 1, **characterised in that** the pipe conduit of hot air (14) is flexible.

8. The system according to claim 1, **characterised in that** the pipe conduit of cold mixture: air-water mist (15) is flexible.

9. The system according to claim 1, **characterised in that** the pipe conduit of hot mixture: air - water vapour (16) is flexible.

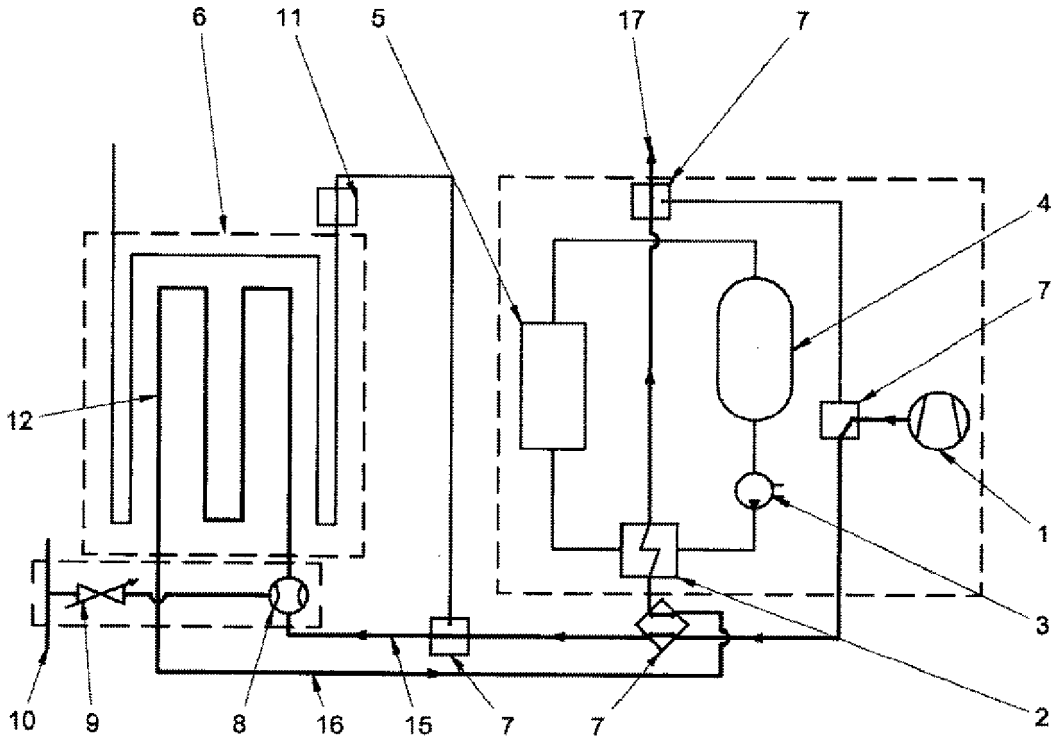

Fig. 1

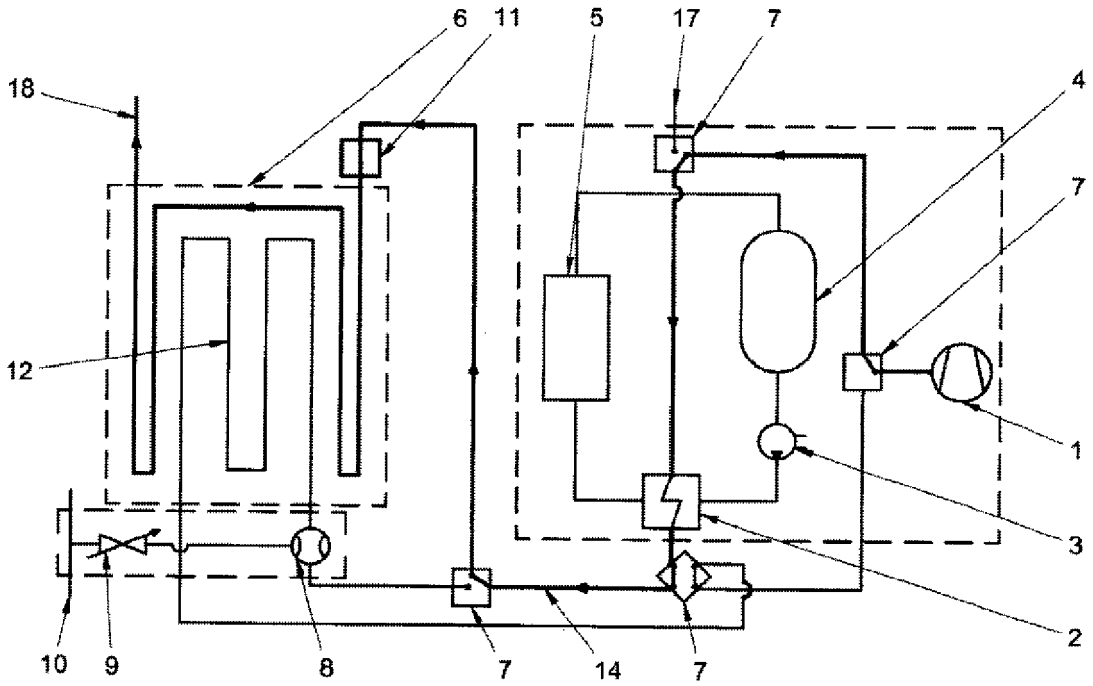

Fig.2

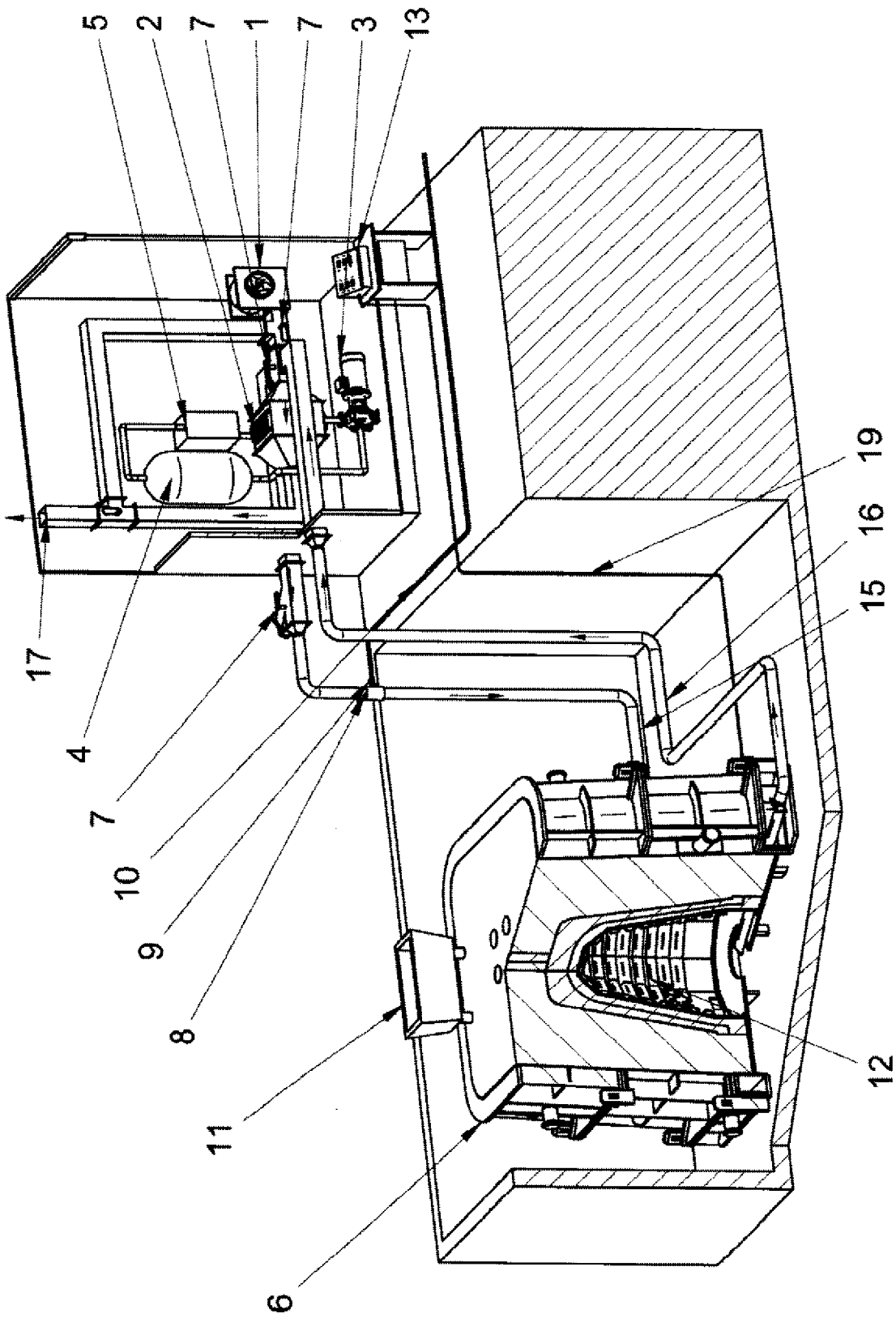

Fig. 3

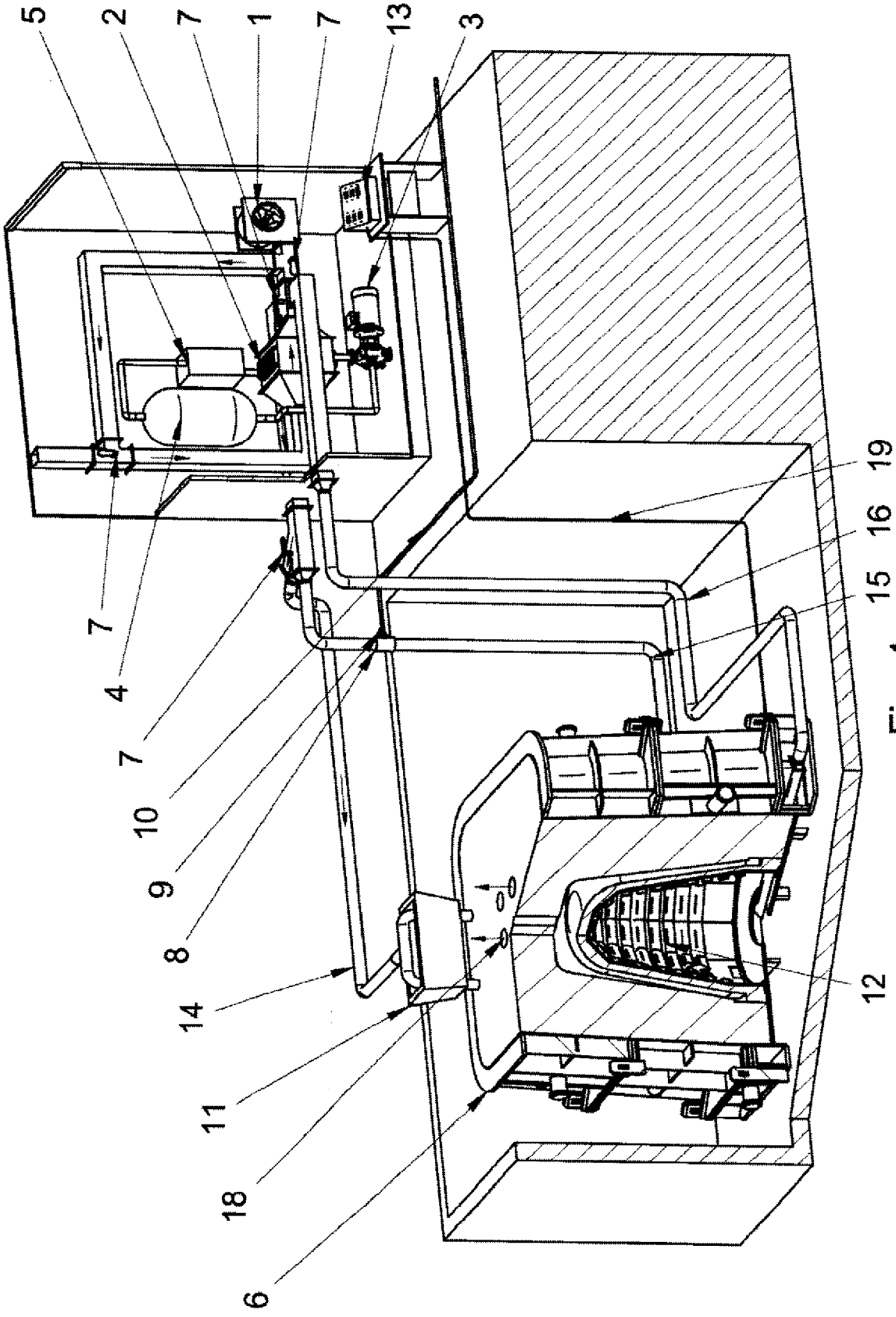

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 15 46 0117

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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