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(54) Scale reducing device for gas-fired boilers

(57) The gas-fired boiler comprises a primary circuit (11) for the heating water, a secondary circuit (12) for the sanitary water, a primary heat exchanger (13), a secondary heat exchanger (14), a pump (17) for circulating the heating water, a three-way valve (19) for diverting the flow of the heating water from the primary circuit (11) into the secondary heat exchanger (14) and for returning the heating water into the primary circuit (11), and a heating water storage vessel (20). According to the invention a device (30) is arranged so as to bypass the secondary heat exchanger (14) in order to prevent the heating water from flowing and remaining therein when there is no demand of hot sanitary water, said device (30) being disposed in the primary circuit (11) and comprising a pipe (30') and a valve (30") for controlling the heating water flow through said pipe (30').

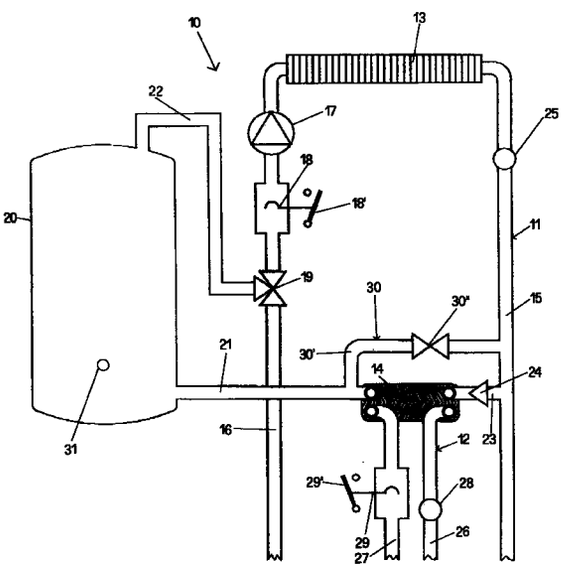

FIG. 2

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Description

[0001] The invention generally relates to gas-fired boilers intended to be used for supplying hot water for heating and sanitary purposes. More particularly, the present invention relates to a device permitting the scale formation in said gas-fired boilers to be reduced.

[0002] Generally, the gas-fired boilers comprise a circuit for the heating water (primary circuit) and a circuit for the sanitary water (secondary circuit) . Each circuit is provided with an own heat exchanger (primary heat exchanger and secondary heat exchanger). In the primary heat exchanger heat provided by the burner flame is transferred to the heating water. In the secondary heat exchanger heat is transferred from the hot heating water circulating in the primary circuit to the cold sanitary water circulating in the secondary circuit.

[0003] It is known that the high temperature to which the heating water is brought in a gas-fired boiler promotes the precipitation of salts, mainly calcium sulphate, from the water. The salts deposit on the inside surface of boilers, pipes, plates and heat exchangers in contact with the heating water forming thereon a non-conducting hard coating known as scale. The formation of scale on the inside surface of boilers, pipes, plates and heat exchangers is a major problem which hinders the operation of the gas-fired boilers. The reason of this can be easily understood by considering for example the operation of heat exchangers. If the scale formed on the inside of the heat exchanger is excessively thick, it can adversely affect the heat transfer from the hot fluid to the cold fluid and lead to overheating of the metal and ultimate failure. Furthermore, the buildup of scale can also increase the surface friction resistance to water flow in the pipes, plates and heat exchangers and eventually cause their obstruction.

[0004] In the specific case of gas-fired boilers for domestic purposes the formation of scale is more likely to occur in the secondary heat exchanger. As a matter of fact, the conventional gas-fired boilers do not prevent a certain amount of the heating water utilized as a medium for heating the sanitary water from remaining in the secondary heat exchanger when there is no demand of sanitary water. The amount of hot heating water that remains at rest in the secondary heat exchanger provides an optimal condition for the development of scale on the inside of the secondary heat exchanger.

[0005] The object of the present invention is to provide a device for reducing the scale formation in the secondary heat exchanger of gas-fired boilers for domestic purposes by preventing the heating water from flowing and remaining in the secondary heat exchanger when there is no demand of sanitary water, while permitting the heating water to be heated during a water preheating period.

[0006] More particularly, the scale reducing device for gas-fired boilers according to the present invention is characterized in that it comprises a pipe arranged so as to by-pass the heating water inlet and outlet pipes of the secondary heat exchanger and a valve for controlling the flow of the heating water through said pipe, said device being disposed in the primary circuit and arranged to by-pass the secondary heat exchanger so as to prevent the heating water from flowing and remaining therein when there is no demand of hot sanitary water.

[0007] According to a feature of the present invention, the valve controlling the flow through the pipe is an electrically operated by-pass valve under control of a manostat provided in the secondary circuit and a temperature sensor provided in the heating water storage vessel, so that said by-pass valve will be closed when there is demand of hot sanitary water and opened when said demand of sanitary water is terminated or when the temperature of the heating water is below a predetermined value.

[0008] The invention will be better understood in connection with the accompanying drawings, wherein:

Figure 1 is a diagrammatic view of a conventional gas-fired boiler for domestic purposes,

Figure 2 is a diagrammatic view of the gas-fired boiler provided of the device according to the invention,

Figures 3, 4 and 5 show the heating water flow in the gas-fired boiler of Fig. 2 during the three different operation modes.

[0009] Referring to Figure 1, there is diagrammatically shown a typical gas-fired boiler for domestic purposes, generally identified by numeral 10. As already said at the beginning, the gas-fired boiler 10 comprises a primary circuit 11 and a secondary circuit 12, both intended to heat the water through a corresponding heat exchanger, i.e. a primary heat exchanger 13 for the heating water and a secondary heat exchanger 14 for the sanitary water.

[0010] The primary circuit 11 is formed of a heating water supply pipe 15 departing from the primary heat exchanger 13 where the heating water is subjected to the hot combustion fumes, and a heating water return pipe 16 which leads to the primary heat exchanger 13. The heating water return pipe 16 embodies a circulation pump 17 for the heating water in the primary circuit 11, a safety device 18 connected to an emergency switch 18' and intended to cut off the heating water flow in the case of a malfunctioning and a three-way valve 19 for controlling the flow direction of the heating water. The gas-fired boiler 10 also includes a heating water storage vessel 20 which is intended to store the heating water when the latter is not to be supplied to the heating units (not shown). The storage vessel 20 is connected to the heating water outlet of the secondary heat exchanger 14 via an outlet pipe 21 and to the primary circuit 11 via a return pipe 22 leading to the three-way valve 19. The

heating water inlet of secondary heat exchanger 14 is connected to the primary circuit 11 via an inlet pipe 23 which is branched off from the heating water supply pipe 15 and in which a check valve 24 is provided. By means of the three-way valve 19, the heating water flow can be diverted from the heating water supply pipe 15 into the secondary heat exchanger 14 via the inlet pipe 23 and therefrom into the storage vessel 20, and then returned to the heating water return pipe 16 through the return pipe 22. Further, a temperature sensor 25 is included in the heating water supply pipe for sensing the temperature of the heating water from the primary heat exchanger 13.

[0011] The secondary circuit 12 includes a sanitary hot water delivery pipe 26 departing from the sanitary water outlet of the secondary heat exchanger 14 and a sanitary cold water supply pipe 27 leading to the sanitary water inlet of said secondary heat exchanger. A temperature sensor 28 is located in the sanitary hot water delivery pipe 26 for monitoring the temperature of the sanitary water. The sanitary cold water supply pipe 27 includes a flow control device 29, typically a manostat, connected to a switch 29' and intended to control the flow of the sanitary water.

[0012] Referring now to Figure 2, there is shown a gas-fired boiler for domestic purposes provided with the scale reducing device in the primary circuit 11 according to the invention. For the sake of semplicity, all parts corresponding to those shown in Figure 1 are identified by the same numeral characters.

[0013] According to the invention, the scale reducing device, generally indicated by 30, comprises a by-pass pipe 30' establishing a parallel flow path for the heating water around the secondary heat exchanger 14 and a by-pass valve 30" controlling the flow of the heating water through said by-pass pipe 30'. The by-pass pipe 30' is arranged so as to by-pass the heating water inlet and outlet pipes 23, 21 of the secondary heat exchanger 14. Further, the heating water storage vessel 20 is provided with a temperature sensor 31 the purpose of which will be explained in the following.

[0014] With such a provision the flow of the heating water can be bypassed around the secondary heat exchanger 14 and therefore be directed through the scale reducing device 30. The by-pass valve 30" of this device 30 is electrically operated in response to signals transmitted by the flow control device 29 located in the secondary circuit 12 and the temperature sensor 31 located in the heating water storage vessel 20.

OPERATION

[0015] A gas-fired boiler comprising the scale reducing device 30 of the invention has three operation modes during which the heating water and the sanitary water flows are indicated by the arrows in Figures 3, 4 and 5, respectively.

[0016] Referring to Figure 3, there is shown the first operation mode in which there is no demand of hot water for heating or sanitary purposes. During this operation mode, the by-pass valve 30" is open, whereas the three-way valve 19 is switched to disconnect the primary circuit 11 from the heating units (not shown) by closing the heating water return pipe 16. The heating water flow is so diverted from the heating water supply pipe 15 into the water storage vessel 20 via the by-pass pipe 30' and returned to the three-way valve 19 via the return pipe 22. In so doing, the heating water is heated in the primary heat exchanger 13 during the water preheating period, but does not flow through the secondary heat exchanger 14 as occurs in the conventional gas-fired boilers.

[0017] Referring now to Figure 4, there is shown the second operation mode in which there is demand of hot water for heating purposes only. During this operation mode, the three-way valve 19 is switched to disconnect the secondary heat exchanger 14 from the primary circuit 11 by closing the return pipe 22. Thus, the heating water is supplied to the heating units (not shown) via the heating water supply pipe 15 and returns back to the primary heat exchanger 13 via the heating water return pipe 16.

[0018] Finally, Figure 5 shows the third operation mode in which there is also demand of hot water for sanitary purposes. During this operation mode, the by-pass valve 30" of the scale reducing device 30 is closed and the three-way valve 19 is switched to disconnect the heating units from the primary circuit 11 by closing the heating water return pipe 16. The flow of the heating water is diverted from the heating water supply pipe 15 into the secondary heat exchanger 14 and the storage vessel 20, and then returned to the three-way valve 19 via the return pipe 22. Since the by-pass valve 30" is closed, the hot heating water is forced by the circulation pump 17 to flow through the secondary heat exchanger 14 where it transfers heat to the cold sanitary water entering therein. When demand of sanitary water ceases, the by-pass valve 30" opens and the secondary heat exchanger 14 empties so that no heating water will remain at rest therein. Then, the three-way valve 19 is switched to disconnect the secondary heat exchanger 14 from the primary circuit 11 and to connect the heating units to primary circuit 11 back again.

[0019] From the foregoing, it can be understood that the provision in the primary circuit 11 of the scale reducing device 30 connected across the secondary heat exchanger 14, will prevent the heating water from flowing through the secondary heat exchanger 14 and thus from remaining therein when there is no demand of hot sanitary water, while permitting the heating water to be heated during the water preheating period. Accordingly, the scale reducing device 30 of the present invention substantially reduces the possibility of scale formation inside the secondary heat exchanger 14 without involving expensive modifications in the conventional gas-fired boilers for domestic purposes.

Claims

1. In a gas-fired boiler for supplying hot water for domestic heating and sanitary purposes of the type including:

   - a primary circuit (11) for the heating water,
   - a secondary circuit (12) for the sanitary water,
   - a primary heat exchanger (13) for heating the heating water,
   - a secondary heat exchanger (14) in which the sanitary water is to be heated by the heating water,
   - pump means (17) for circulating the heating water,
   - a three-way valve (19) for diverting the flow of the heating water from the primary circuit (11) into the secondary heat exchanger (14) and for returning the heating water into the primary circuit (11), and
   - a heating water storage vessel (20) connected to the secondary heat exchanger (14) and to the three-way valve (19),

   the improvement consisting in a device (30) comprising a pipe (30') arranged so as to by-pass the heating water inlet and outlet pipes (21, 23) of the secondary heat exchanger (14) and a valve (30") for controlling the flow of the heating water through said pipe (30'), said device (30) being disposed in the primary circuit (11) and arranged to by-pass the secondary heat exchanger (14) so as to prevent the heating water from flowing and remaining therein when there is no demand of hot sanitary water.

2. Scale reducing device according to claim 1, characterized in that said valve (30") is an electrically operated by-pass valve under control of a manostat (29) provided in the secondary circuit (12) and a temperature sensor (31) provided in the heating water storage vessel (20), so that said by-pass valve (30") will be closed when there is demand of hot sanitary water and opened when said demand of sanitary water is terminated or when the temperature of the heating water is below a predetermined value.

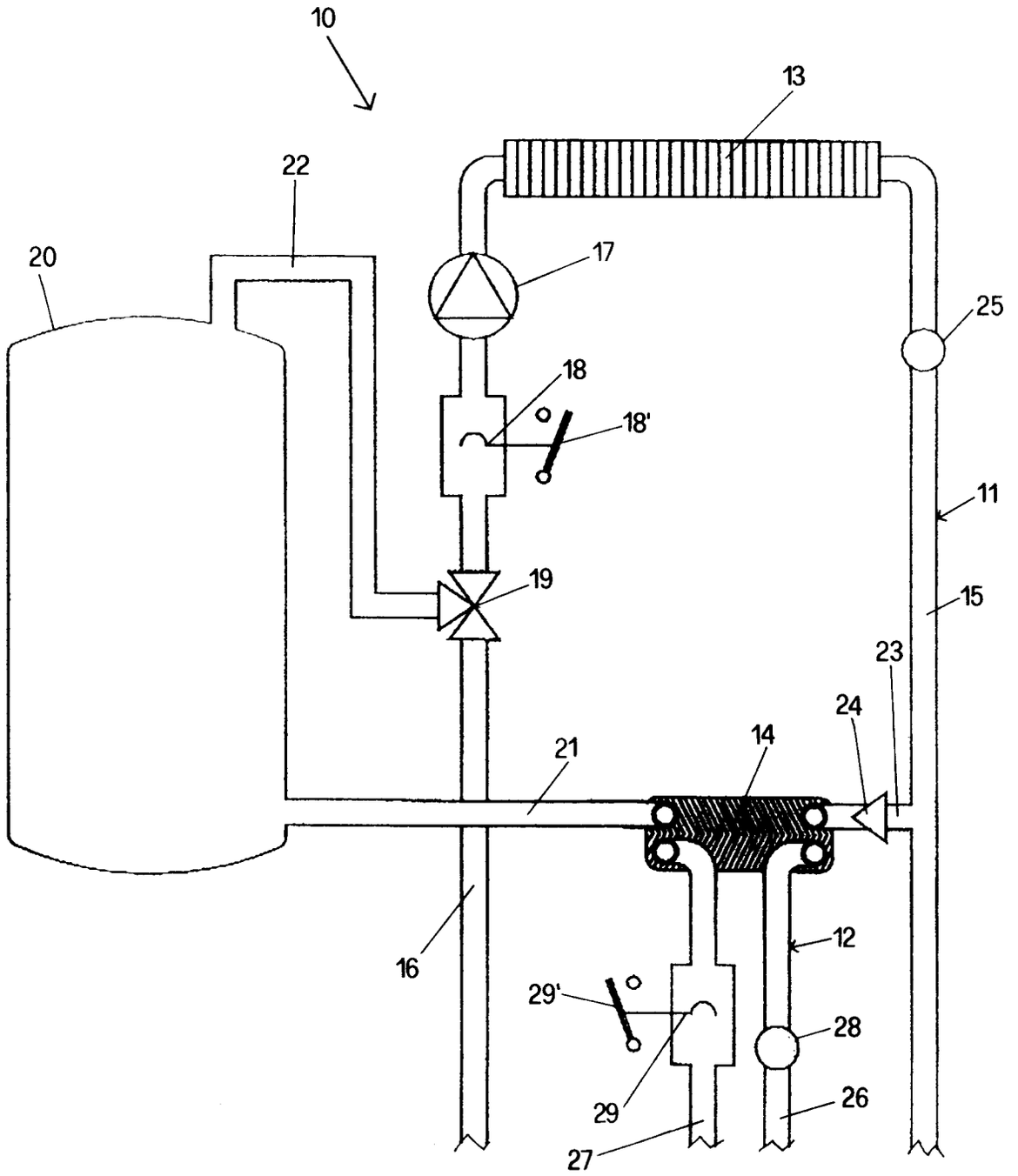

FIG. 1

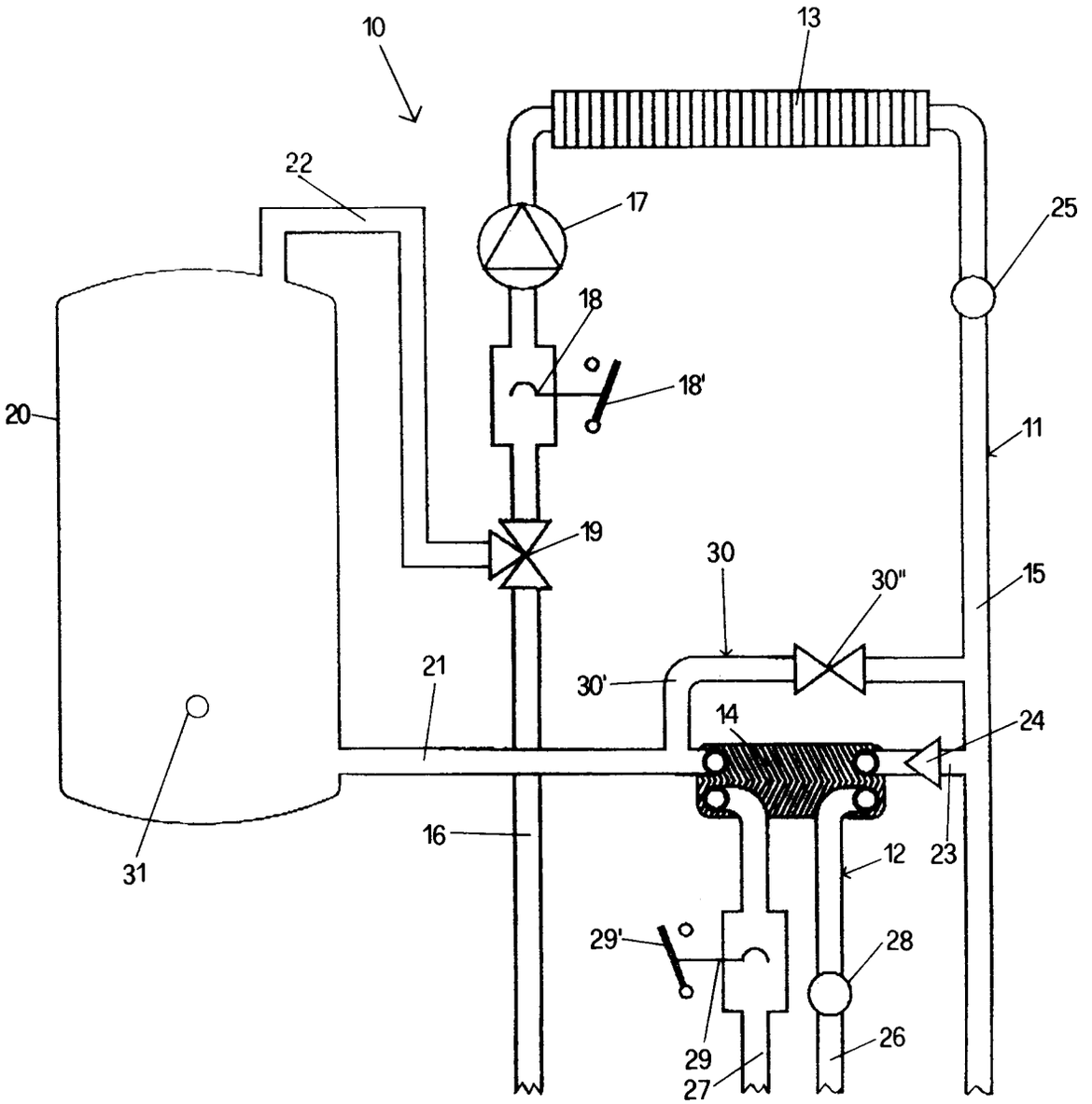
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FIG. 2

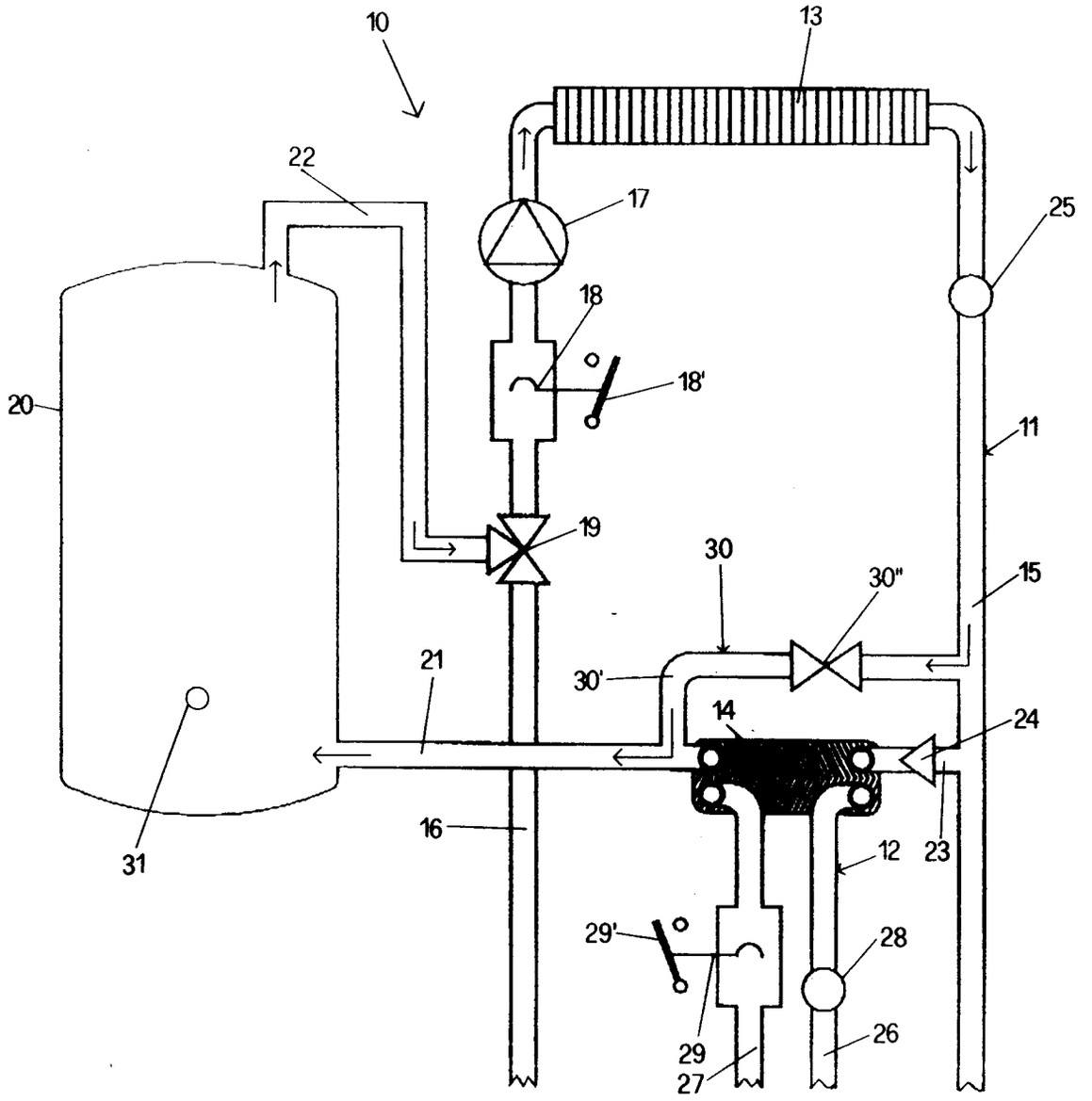
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FIG. 3

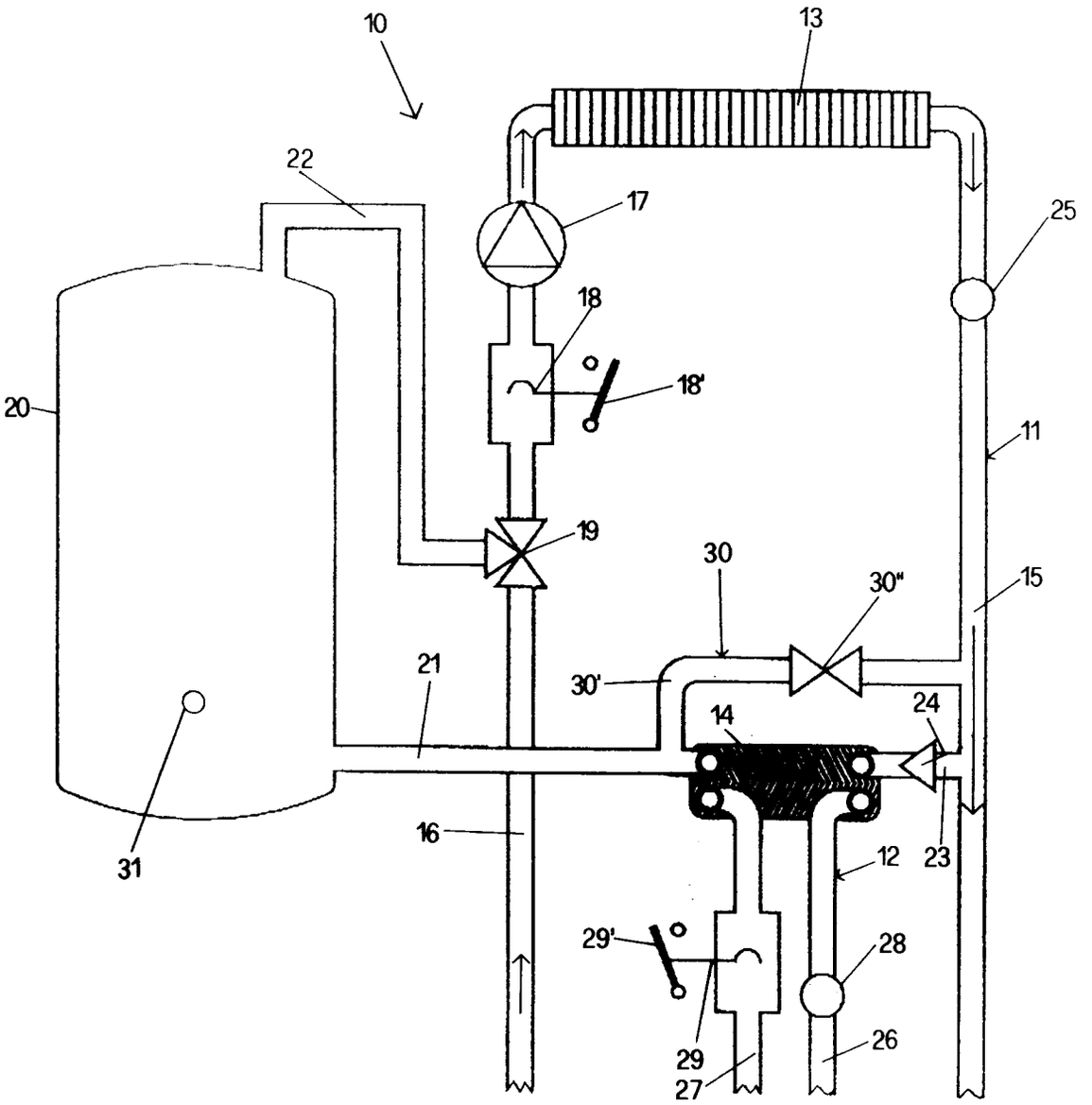
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FIG. 4

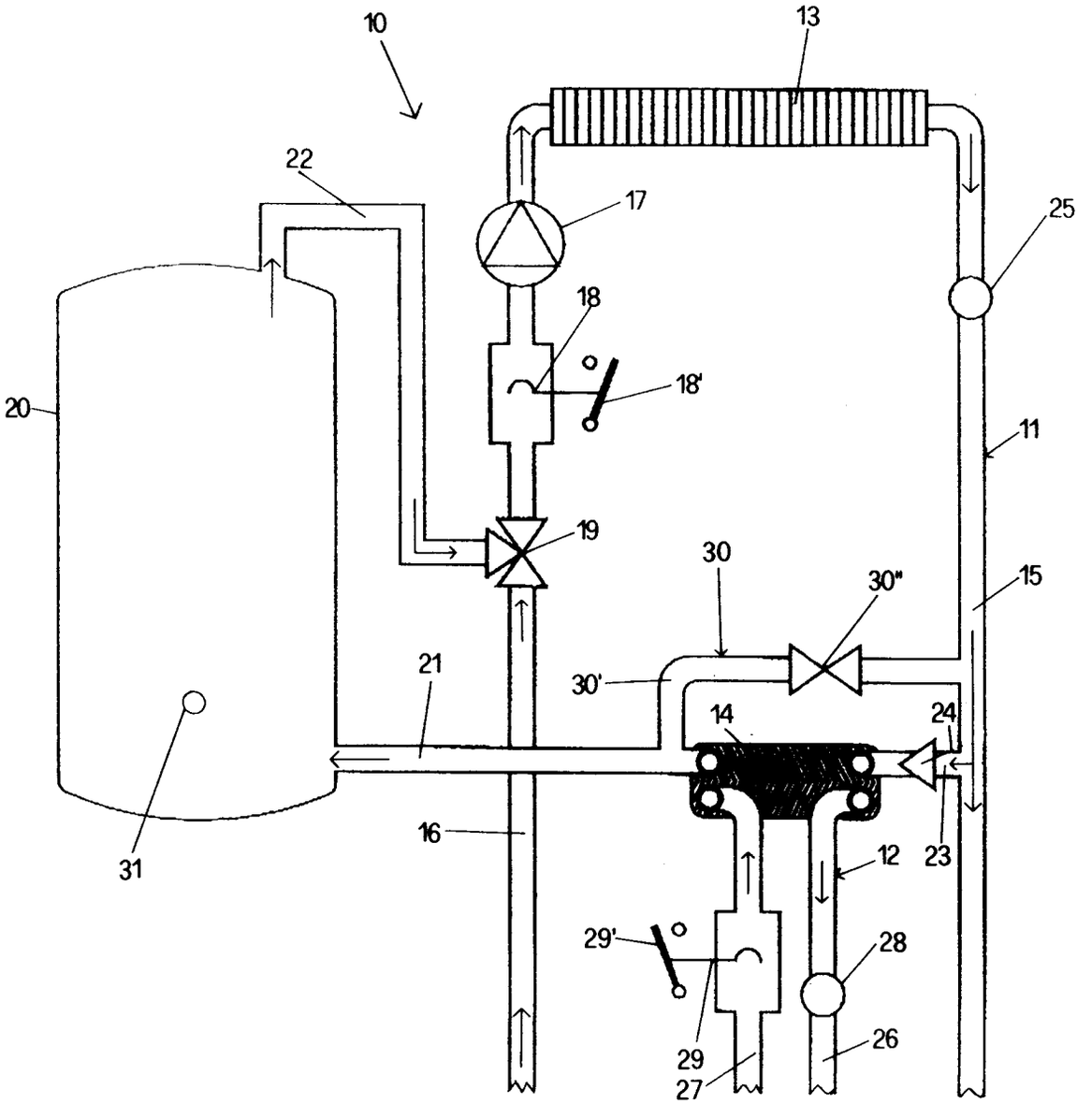
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FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 83 0588

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB 2 262 593 A (INTER ALBION LTD) * abstract *	1	F24D3/08
A	EP 0 635 682 A (NEOVIA S R L) * abstract *	1	
A	US 4 347 972 A (HILLERSTROEM BJOERN ET AL) * abstract *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	6 April 1998	Van Gestel, H

CATEGORY OF CITED DOCUMENTS

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