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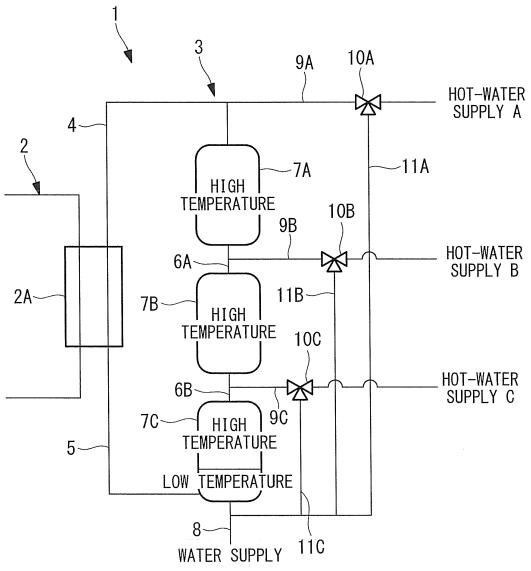
(54) Storage-type hot-water supplying system

(57) A storage-type hot-water supplying system (1) comprising hot-water storage tanks (7A, 7B, 7C) connected in series between a hot-water outlet pipe for high-temperature water (4), extending from a heat source unit (2), and a water supplying pipe for low-temperature water (5), leading to the heat source unit (2); wherein a most-upstream hot-water storage tank (7A) closest to the hot-water outlet pipe (4) serves as a hot-water-supplying hot-water storage tank for high-temperature water, and a most-downstream hot-water storage tank (7C) serves as a water-supplying hot-water storage tank for the heat source unit (2); and a hot-water supplying system (9A) for high-temperature water is connected to the most-upstream tank (7A), and at least one hot-water supplying system (9B, 9C) that allows hot water of different temperatures to be supplied via a mixing valve (10B, 10C) is connected to a top portion of a tank (7B, 7C) at the downstream side thereof.

FIG. 1



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Description

{Technical Field}

[0001] The present invention relates to a storage-type hot-water supplying system that stores high-temperature water generated at a heat source unit in a hot-water storage tank and that supplies this high-temperature water to a load.

{Background Art}

[0002] Among storage-type hot-water supplying systems in the related art, there are known storage-type hot-water supplying systems that are configured such that a heat pump is employed as a heat source unit, a plurality of hot-water storage tanks are connected in series (including a case in which a plurality of additional tanks are connected in series) between a hot-water outlet pipe for high-temperature water, extending from a water/refrigerant heat exchanger thereof, and a water supplying pipe for low-temperature water, leading to the water/refrigerant heat exchanger, and hot water is sequentially stored starting from a most-upstream hot-water storage tank positioned close to the hot-water outlet pipe for high-temperature water; and that are configured such that a most-downstream hot-water storage tank serves as a water-supplying hot-water storage tank, and a water supply pipe, extending from a water supply source, and the water supplying pipe for low-temperature water, leading to the above-described water/refrigerant heat exchanger, are connected to the water-supplying hot-water storage tank (see Patent Literatures 1 and 2).

[0003] On the other hand, as described above, even in systems in which a plurality of hot-water storage tanks are connected in series, in many cases, hot water to be supplied to a load is output from a top portion of a most-upstream hot-water storage tank and is supplied in the form of hot water of a predetermined temperature via a mixing valve, and, in the case in which hot water of two different temperatures can be supplied, as disclosed in Patent Literature 1, this hot-water supply is achieved by employing a system in which high-temperature water taken out from the top portion of the most-upstream hot-water storage tank is split, and one of the split water flows is supplied in the form of high-temperature water without applying any change thereto, and the other of the split water flows is supplied in the form of intermediate-temperature water or low-temperature water by mixing it with low-temperature water via a mixing valve to decrease the temperature thereof, or by employing a system in which a hot-water storage tank having a special structure that allows hot water of two different temperatures to be taken out is used.

{Citation List}

{Patent Literature}

[0004]

{PTL 1} Japanese Unexamined Patent Application, Publication No. 2005-127640
{PTL 2} Japanese Unexamined Patent Application, Publication No. 2011-169584

{Summary of Invention}

{Technical Problem}

[0005] However, when using a tank having a special structure for taking out hot water of two different temperatures, there is a problem in that the cost is increased, making it difficult to install additional tanks, etc., as compared with a system employing a simple, special hot-water storage tank. On the other hand, as in Patent Literature 1, when employing a system in which high-temperature water taken out from a top portion of a most-upstream hot-water storage tank is split, and hot water of at least two different temperatures is taken out by separately adjusting the temperatures thereof, although it is possible to take out hot water of at least two different temperatures in a simple manner by using a simple, special hot-water storage tank, because high-temperature water is always output from the most-upstream hot-water storage tank in this case, there is a problem in that, among others, it is difficult to sequentially supply hot water for other usages while reliably securing a required amount of high-temperature water whose usage is already decided.

[0006] Specifically, with the above-described system, when the high-temperature water is output to the load from the top portion of the most-upstream hot-water storage tank, the low-temperature water is supplied from the water supply source to a bottom portion of a most-downstream hot-water storage tank in an amount equivalent to the amount of the output high-temperature water, and a temperature boundary layer between the low-temperature water and the high-temperature water sequentially moves to hot-water storage tanks on the upstream side, during which the high-temperature water and the low-temperature water are mixed, inevitably resulting in a gradual decrease in the temperature of the high-temperature water. Because of this, for example, when applied to usages in which a required amount of high-temperature water must be secured for performing heat sterilization, as in the case of storage-type hot-water supplying systems used at school-meal supply centers, food-processing plants, etc., there is a risk of falling into a situation in which high-temperature water required for performing heat sterilization cannot be taken out.

[0007] The present invention has been conceived in light of the above-described circumstances, and an ob-

ject thereof is to provide an inexpensive storage-type hot-water supplying system having a simple configuration that allows hot water of at least two different temperatures to be taken out simultaneously or separately in accordance with differences in usage by using a plurality of simple, special hot-water storage tanks and that is also capable of supplying hot water while reliably securing a required amount of high-temperature water for a specified use.

{Solution to Problem}

[0008] In order to solve the above-described problems, a storage-type hot-water supplying system of the present invention employs the following solutions.

[0009] Specifically, a storage-type hot-water supplying system according to the present invention is a storage-type hot-water supplying system that stores high-temperature water generated by a heat source unit in a hot-water storage tank and that allows the high-temperature water to be sequentially supplied to a load, wherein a plurality of the hot-water storage tanks connected in series are provided between a hot-water outlet pipe for high-temperature water, extending from the heat source unit, and a water supplying pipe for low-temperature water, leading to the heat source unit, of the plurality of hot-water storage tanks, a most-upstream hot-water storage tank that is closest to the hot-water outlet pipe, extending from the heat source unit, serves as a hot-water-supplying hot-water storage tank for high-temperature water, and a most-downstream hot-water storage tank serves as a water-supplying hot-water storage tank for the heat source unit, and a hot-water supplying system for high-temperature water is connected to the most-upstream hot-water-supplying hot-water storage tank, and at least one hot-water supplying system that allows hot water of different temperatures to be supplied via a mixing valve is connected to a top portion of at least one of the hot-water storage tanks at a downstream side thereof.

[0010] With the present invention, in the storage-type hot-water supplying system provided with the hot-water storage tanks, the plurality of hot-water storage tanks connected in series are provided between the hot-water outlet pipe for high-temperature water, extending from the heat source unit, and the water supplying pipe for low-temperature water, leading to the heat source unit; of the plurality of hot-water storage tanks, the most-upstream hot-water storage tank that is closest to the hot-water outlet pipe, extending from the heat source unit, serves as the hot-water-supplying hot-water storage tank for high-temperature water, and the most-downstream hot-water storage tank serves as the water-supplying hot-water storage tank for the heat source unit; and the hot-water supplying system for high-temperature water is connected to the most-upstream hot-water-supplying hot-water storage tank, and at least one hot-water supplying system that allows hot water of different temperatures to be supplied via the mixing valve is connected to the top portion of at least one of the hot-water storage tanks at the downstream side thereof; therefore, of the plurality of hot-water storage tanks that are connected in series, by supplying high-temperature water from the most-upstream hot-water-supplying hot-water storage tank and by supplying hot water of different temperatures from at least one of the hot-water storage tanks at the downstream side thereof via the mixing valve, it is possible to simultaneously or separately take out hot water of at least two different temperatures and to supply it to the load from a single storage-type hot-water supplying system without employing special hot-water storage tanks for taking out hot water of two different temperatures. Moreover, by taking out intermediate-temperature water or low-temperature water from at least one of the hot-water storage tanks at the downstream side thereof via the mixing valve, it is possible to sequentially supply and consume high-temperature water stored in the downstream-side hot-water storage tanks while keeping a required amount of high-temperature water stored in the most-upstream hot-water-supplying hot-water storage tank. Therefore, it is possible to provide an inexpensive storage-type hot-water supplying system that is capable of supplying hot water by simultaneously or separately taking out hot water of at least two different temperatures in accordance with differences in usage without employing a tank having a special configuration, but by employing the plurality of tanks having a simple configuration designed specially for storing hot water, and it is also possible to provide a storage-type hot-water supplying system with which it is possible to reliably secure a required amount of high-temperature water for a specified use.

[0011] Furthermore, with the storage-type hot-water supplying system of the present invention, in the storage-type hot-water supplying system described above, a water supplying pipe that is branched off from a water supply pipe connected to a bottom portion of the water-supplying hot-water storage tank may be connected to the mixing valve.

[0012] By employing such a configuration, because the water supplying pipe that is branched off from the water supply pipe, which is connected to the bottom portion of the water-supplying hot-water storage tank, is connected to the mixing valve, when supplying hot water from the downstream-side hot-water storage tank to the load, hot water can be supplied while adjusting the temperature thereof to form intermediate-temperature water or low-temperature water of a set temperature by supplying low-temperature water to the mixing valve via the water supplying pipe that is branched off from the water supply pipe. Therefore, it is possible to simultaneously or separately take out hot water of different temperatures and to supply it to the load, independently from the hot-water supply from the most-upstream hot-water-supplying hot-water storage tank, while securing a required amount of high-temperature water in the most-upstream hot-water-supplying hot-water storage tank.

[0013] Furthermore, with the storage-type hot-water supplying system of the present invention, in any one of the storage-type hot-water supplying systems described above, the configuration thereof may be such that high-temperature water can be supplied from the most-upstream hot-water-supplying hot-water storage tank, and hot water of different temperatures can also be supplied from at least one of the hot-water storage tanks at the downstream side thereof, thus, making it possible to simultaneously or separately supply hot water of at least two different temperatures.

[0014] By employing such a configuration, it is possible to supply high-temperature water from the most-upstream hot-water-supplying hot-water storage tank, it is also possible to supply hot water of different temperatures from at least one of the hot-water storage tanks at the downstream side thereof, and thus, it is possible to simultaneously or separately supply hot water of at least two different temperatures; therefore, merely by connecting, in series, the plurality of hot-water storage tanks having a simple configuration designed specially for storing hot water, it is possible to simultaneously or separately supply hot water of at least two different temperatures by using the supply of high-temperature water from the most-upstream hot-water-supplying hot-water storage tank and the supply of hot water of different temperatures from at least one of the hot-water storage tanks at the downstream side thereof. Therefore, it is possible to provide, at low cost, a storage-type hot-water supplying system that allows hot water of at least two different temperatures to be taken out simultaneously or separately in accordance with differences in usage, without employing an expensive hot-water storage tank having a special structure for taking out hot water of two different temperatures.

[0015] Furthermore, with the storage-type hot-water supplying system of the present invention, in any one of the storage-type hot-water supplying systems described above, the plurality of hot-water storage tanks may be special hot-water storage tanks having the same structure as each other.

[0016] By employing such a configuration, because the plurality of hot-water storage tanks are special hot-water storage tanks having the same structure as each other, the plurality of hot-water storage tanks to be connected in series can be constituted of existing special hot-water storage tanks having a simple configuration and the same structure. Therefore, it is possible to provide, at low cost, a storage-type hot-water supplying system that allows hot water of at least two different temperatures to be taken out simultaneously or separately in accordance with differences in usage by employing the plurality of inexpensive, special hot-water storage tanks having the same structure.

{Advantageous Effects of Invention}

[0017] With the present invention, of the plurality of hot-water storage tanks that are connected in series, by supplying high-temperature water from a most-upstream hot-water-supplying hot-water storage tank and by supplying hot water of different temperatures from at least one of the hot-water storage tanks at the downstream side thereof via a mixing valve, it is possible to simultaneously or separately take out hot water of at least two different temperatures and to supply it to a load from a single storage-type hot-water supplying system without employing a special hot-water storage tank for taking out hot water of two different temperatures, and, moreover, by taking out intermediate-temperature water or low-temperature water from at least one of the hot-water storage tanks at the downstream side thereof via the mixing valve, it is possible to sequentially supply and consume high-temperature water stored in the downstream-side hot-water storage tanks while keeping a required amount of high-temperature water stored in the most-upstream hot-water-supplying hot-water storage tank; therefore, it is possible to provide an inexpensive storage-type hot-water supplying system that is capable of simultaneously or separately taking out and supplying hot water of at least two different temperatures in accordance with differences in usage without employing a tank having a special configuration, but by employing the plurality of tanks having a simple configuration designed specially for storing hot water, and it is also possible to provide a storage-type hot-water supplying system with which it is possible to reliably secure a required amount of high-temperature water for a specified use.

{Brief Description of Drawings}

[0018]

{Fig. 1} Fig. 1 is a diagram showing the configuration of a storage-type hot-water supplying system according to an embodiment of the present invention.

{Fig. 2} Fig. 2 is a diagram for explaining the operation of the above-described storage-type hot-water supplying system during hot-water storing operation.

{Fig. 3} Fig. 3 is a diagram for explaining the operation of the above-described storage-type hot-water supplying system when supplying high-temperature water.

{Fig. 4} Fig. 4 is a diagram for explaining the operation of the above-described storage-type hot-water supplying system when supplying intermediate-temperature water or low-temperature water.

{Fig. 5} Fig. 5 is a diagram for explaining the operation of the above-described storage-type hot-water supplying system when supplying hot water having two temperatures, namely, high-temperature water and intermediate-temperature water or low-temperature water.

{Description of Embodiment}

[0019] An embodiment of the present invention will be described below with reference to Figs. 1 to 5.

[0020] Fig. 1 is a diagram showing the configuration of a storage-type hot-water supplying system according to an embodiment of the present invention.

[0021] A storage-type hot-water supplying system 1 is provided with a heat source unit 2 constituted of a heat pump, an electric water heater, a boiler, or the like that generates high-temperature water by heating low-temperature water. This heat source unit 2 has a configuration in which low-temperature water supplied from a hot-water storage unit 3 via a water supplying pump is heated by using a heat exchanger, a heater 2A, or the like, and is circulated back to the hot-water storage unit 3 in the form of high-temperature water, and a known heat source unit 2 can be employed.

[0022] The hot-water storage unit 3 is provided with a plurality of hot-water storage tanks 7A, 7B, and 7C that are connected in series by using connecting pipes 6A and 6B and that are provided between a hot-water outlet pipe 4 for high-temperature water, extending from the heat source unit 2, and a water supplying pipe 5 for low-temperature water, leading to the heat source unit 2. Although an example in which three hot-water storage tanks 7A, 7B, and 7C are connected in series will be described here, with these hot-water storage tanks, it suffices to have at least two tanks that are connected in series.

[0023] Note that, in the following descriptions, among the above-described plurality of hot-water storage tanks 7A, 7B, and 7C, the hot-water storage tank 7A, which is connected at the closest position to the hot-water outlet pipe 4 for high-temperature water, extending from the heat source unit 2, is referred to as the most-upstream hot-water-supplying hot-water storage tank 7A, at least one hot-water storage tank 7B connected at the downstream side thereof is referred to as the downstream-side hot-water storage tank 7B, and the hot-water storage tank 7C to which the water supplying pipe 5 is connected is referred to as the most-downstream water-supplying hot-water storage tank 7C.

[0024] A water supply pipe 8 is connected to a bottom portion of the most-downstream water-supplying hot-water storage tank 7C, and it is possible to supply city water (tap water) from a tap, etc., which is a water supply source, via the water supply pipe 8. Low-temperature water supplied to the most-downstream water-supplying hot-water storage tank 7C via the water supply pipe 8 can be supplied to the heat source unit 2 from the bottom portion of the most-downstream water-supplying hot-water storage tank 7C via the water supplying pipe 5 and a water supplying pump (not shown). Note that the water supply source is not necessarily limited to city water from a tap, etc., and other water supply sources, such as well water, etc. may be used.

[0025] On the other hand, a hot-water supplying pipe (hot-water supplying system) 9A, which is for supplying high-temperature water (hot-water supply A) to a load, is connected to a top portion of the most-upstream hot-water-supplying hot-water storage tank 7A, and high-temperature water stored in the most-upstream hot-water-supplying hot-water storage tank 7A can be supplied for a required high-temperature water load usage. Note that it is naturally permissible to install a mixing valve 10A in this hot-water supplying pipe 9A, as needed, so as to allow the high-temperature water to be supplied after the temperature thereof is adjusted to a predetermined temperature. In this case, a water supplying pipe 11A that is split off from the water supply pipe 8 should be connected to the mixing valve 10A so as to supply hot water whose temperature is adjusted to form high-temperature water of the predetermined temperature by mixing the high-temperature water with low-temperature water.

[0026] Furthermore, in this embodiment, hot-water supplying pipes (hot-water supplying systems) 9B and 9C, which are for supplying intermediate-temperature water or low-temperature water (hot-water supply B or hot-water supply C) to the load, are connected to the downstream-side hot-water storage tank 7B and the most-downstream water-supplying hot-water storage tank 7C also, via the connecting pipes 6A and 6B at the top portions thereof. Then, by employing a configuration in which these hot-water supplying pipes 9B and 9C are also provided with mixing valves 10B and 10C, respectively, and in which water supplying pipes 11B and 11C branched off from the water supply pipe 8 are connected to the hot-water supplying pipes 9B and 9C, it is possible to supply high-temperature water stored in the hot-water storage tanks 7B and 7C for the required load usage while adjusting the temperature thereof to form intermediate-temperature water or low-temperature water.

[0027] In the above-described storage-type hot-water supplying system 1, the hot-water storing operation is performed as described below.

[0028] First, with a water supply from the water supply pipe 8, a state in which the hot-water storage tanks 7A, 7B, and 7C are filled with low-temperature water is achieved. From this state, as indicated by solid-line arrows in Fig. 2, the low-temperature water is sequentially supplied to the heat source unit 2 from the bottom portion of the water-supplying hot-water storage tank 7C via the water supplying pipe 5 and the water supplying pump (not shown) and is heated by using the heat exchanger, the heater 2A, etc. to generate high-temperature water, thus starting the hot-water storing operation. This high-temperature water is supplied to the top portion of the most-upstream hot-water-supplying hot-water storage tank 7A via the hot-water outlet pipe 4 extending from the heat source unit 2, and is stored while forming a temperature boundary layer that moves sequentially toward the downstream-side hot-water storage tanks 7B and 7C starting from the most-upstream hot-water-supplying hot-water storage tank 7A, as shown in Fig. 2.

[0029] When it is detected that a predetermined

amount of high-temperature water of a set temperature is stored in the plurality of hot-water storage tanks 7A, 7B, and 7C, it is assumed that water heating is completed and the hot-water storing operation is terminated. This hot-water storing operation is normally performed late at night by using inexpensive nighttime power. Fig. 1 shows a state in which water heating has been completed, that is, a state in which the predetermined amount of high-temperature water of the set temperature is individually stored in the plurality of hot-water storage tanks 7A, 7B, and 7C.

[0030] On the other hand, the hot-water supplying operation in which the high-temperature water stored in the hot-water storage tanks 7A, 7B, and 7C is consumed is performed during a consumption period as described below. Fig. 3 shows an operation diagram for the case in which the high-temperature water is supplied from the most-upstream hot-water-supplying hot-water storage tank 7A via the hot-water supplying pipe 9A.

[0031] In this case, the high-temperature water is sequentially output from the top portion of the most-upstream hot-water-supplying hot-water storage tank 7A via the hot-water supplying pipe 9A, and is supplied (hot-water supply A) to the load after the temperature thereof is adjusted, as needed, to a necessary temperature by being mixed with low-temperature water from a water supplying pipe 11A by using the mixing valve 10A provided in the hot-water supplying pipe 9A.

[0032] When the high-temperature water is sequentially output from the most-upstream hot-water-supplying hot-water storage tank 7A, low-temperature water is supplied to the most-downstream water-supplying hot-water storage tank 7C via the water supply pipe 8 in an appropriate amount relative to the amount of output hot water, thus pushing out the high-temperature water in the water-supplying hot-water storage tank 7C toward the hot-water storage tanks 7B and 7A on the upstream side thereof. By doing so, the high-temperature water in the hot-water storage tanks 7B and 7C is sequentially moved to the most-upstream hot-water-supplying hot-water storage tank 7A, as indicated by solid-line arrows in Fig. 3. Because of this, the most-upstream hot-water-supplying hot-water storage tank 7A is always maintained in a state in which a required amount of the high-temperature water is secured.

[0033] In addition, Fig. 4 shows an operation diagram for the case in which intermediate-temperature water or low-temperature water is supplied from the most-downstream water-supplying hot-water storage tank 7C via the hot-water supplying pipe 9C.

[0034] In this case, the high-temperature water is sequentially output from the top portion of the most-downstream water-supplying hot-water storage tank 7C and is supplied (hot-water supply C) to the load after the temperature thereof is adjusted to form intermediate-temperature water or low-temperature water by being mixed in the hot-water supplying pipe 9C with low-temperature water from the water supplying pipe 11C by using the mixing valve 10C. At this time also, low-temperature water is supplied to the hot-water storage tank 7C via the water supply pipe 8 in an appropriate amount relative to the amount of output hot water from the hot-water storage tank 7C; however, if all of the high-temperature water stored in the hot-water storage tank 7C is consumed, the low-temperature water supplied from the water supply pipe 8 would be output via the hot-water supplying pipe 9C without applying any change thereto.

[0035] Therefore, the amount of high-temperature water that can be supplied from the most-downstream water-supplying hot-water storage tank 7C via the hot-water supplying pipe 9C in the form of intermediate-temperature water or low-temperature water is limited to the high-temperature water stored in the most-downstream water-supplying hot-water storage tank 7C, and thus, it is not possible to supply, via the hot-water supplying pipe 9C, the high-temperature water stored in the hot-water storage tank 7B or 7A located on the upstream side.

[0036] Note that it is clear that hot water can separately be supplied (hot-water supply B) from the hot-water storage tank 7B based on the separate hot-water supply (hot-water supply A or hot-water supply C) from the hot-water storage tank 7A or 7C, and thus, it is not necessary to provide a detailed description thereof. However, when separately supplying hot water from the hot-water storage tank 7B, even if all of the high-temperature water stored in the hot-water storage tank 7B is used up, because it is possible to additionally use even the high-temperature water stored in the downstream-side hot-water storage tank 7C to supply hot water, the amount thereof is not limited merely by the high-temperature water in the hot-water storage tank 7B; nonetheless, it is not possible to supply, via the hot-water supplying pipe 9B, high-temperature water stored in the most-upstream hot-water-supplying hot-water storage tank 7A. Therefore, a predetermined amount of high-temperature water can be reliably secured in the most-upstream hot-water-supplying hot-water storage tank 7A.

[0037] As has been described above, with this embodiment, it is possible to separately supply hot water of different temperatures or hot water of the same temperature from the three hot-water storage tanks 7A, 7B, and 7C in accordance with a plurality of usages.

[0038] Furthermore, with this embodiment, it is possible to simultaneously or separately supply hot water of at least two different temperatures from at least two of the hot-water storage tanks 7A, 7B, and 7C. For example, it is possible to simultaneously or separately supply hot water of at least two different temperatures from the hot-water storage tanks 7A and 7B, the hot-water storage tanks 7A and 7C, the hot-water storage tanks 7B and 7C, or the hot-water storage tanks 7A, 7B, and 7C, in accordance with a plurality of usages.

[0039] As an example of this, Fig. 5 shows an operation diagram for the case in which hot water of two different temperatures is simultaneously supplied from the hot-water storage tank 7A and the hot-water storage tank

7C. The hot-water supplying operation in this case will be described in detail below based on Fig. 5.

[0040] In this case, it is possible to sequentially supply the high-temperature water from the top portion of the most-upstream hot-water-supplying hot-water storage tank 7A to the load via the hot-water supplying pipe 9A. At this time, it is possible to supply hot water (hot-water supply A) while adjusting the temperature thereof, as needed, by using the mixing valve 10A provided in the hot-water supplying pipe 9A. With the hot-water supply from the most-upstream hot-water-supplying hot-water storage tank 7A, low-temperature water is supplied to the most-downstream water-supplying hot-water storage tank 7C via the water supply pipe 8, and, as has been described above, the high-temperature water in the hot-water storage tanks 7B and 7C is sequentially pushed out toward the most-upstream hot-water-supplying hot-water storage tank 7A, as indicated by the solid-line arrows in Fig. 5.

[0041] At the same time, it is possible to supply (hot-water supply C) intermediate-temperature water or low-temperature water to the load also from the top portion of the most-downstream water-supplying hot-water storage tank 7C via the hot-water supplying pipe 9C. The high-temperature water output to the hot-water supplying pipe 9C from the most-downstream water-supplying hot-water storage tank 7C is supplied to the load after the temperature thereof is adjusted to form intermediate-temperature water or low-temperature water by being mixed with low-temperature water from the water supplying pipe 11C by using the mixing valve 10C provided in the hot-water supplying pipe 9C. At this time also, low-temperature water is supplied to the hot-water storage tank 7C via the water supply pipe 8 in an appropriate amount relative to the amount of output hot water from the hot-water storage tank 7C, and, if all of the high-temperature water stored in the hot-water storage tank 7C is consumed, it would not be possible to supply hot water from the hot-water storage tank 7C via the hot-water supplying pipe 9C.

[0042] Similarly, it is also possible to simultaneously or separately supply hot water of at least two different temperatures from the hot-water storage tanks 7A and 7B, the hot-water storage tanks 7B and 7C, or the hot-water storage tanks 7A, 7B, and 7C in accordance with a plurality of usages, and, moreover, by supplying hot water from the downstream-side hot-water storage tanks 7B and 7C, it is possible to secure a required amount of high-temperature water in the most-upstream hot-water-supplying hot-water storage tank 7A and to supply this high-temperature water for a specific usage, even if all of the high-temperature water stored in these hot-water storage tanks 7B and 7C is used up.

[0043] In this way, with this embodiment, of the plurality of hot-water storage tanks 7A, 7B, and 7C that are connected in series, by supplying high-temperature water from the most-upstream hot-water-supplying hot-water storage tank 7A and by supplying hot water of different temperatures from at least one of the hot-water storage tanks 7B and 7C at the downstream side thereof via the mixing valves 10B and 10C, it is possible to simultaneously or separately take out hot water of at least two different temperatures and to supply it to the load from a single unit of the storage-type hot-water supplying system 1 without employing special hot-water storage tanks for taking out hot water of two different temperatures.

[0044] Moreover, by taking out intermediate-temperature water or low-temperature water from at least one of the hot-water storage tanks 7B and 7C at the downstream side via the mixing valves 10B and 10C, it is possible to sequentially supply and consume the high-temperature water stored in the downstream-side hot-water storage tanks 7B and 7C while keeping the required amount of high-temperature water stored in the most-upstream hot-water-supplying hot-water storage tank 7A.

[0045] Because of this, it is possible to provide an inexpensive storage-type hot-water supplying system 1 that is capable of supplying hot water by simultaneously or separately taking out hot water of at least two different temperatures in accordance with differences in usage without employing a tank having a special configuration, but by employing the plurality of tanks 7A, 7B, and 7C having a simple configuration designed specially for storing hot water, and it is also possible to provide a storage-type hot-water supplying system 1 with which it is possible to reliably secure a required amount of high-temperature water for a specified use.

[0046] In addition, with this embodiment, the water supplying pipes 11B and 11C that are branched off from the water supply pipe 8, which is connected to the bottom portion of the water-supplying hot-water storage tank 7C, are connected to the mixing valves 10B and 10C; and, when supplying hot water from the downstream-side hot-water storage tanks 7B and 7C to the load, because hot water can be supplied while adjusting the temperature thereof to form intermediate-temperature water or low-temperature water of a set temperature by supplying low-temperature water to the mixing valves 10B and 10C via the water supplying pipes 11B and 11C that are branched off from the water supply pipe 8, it is possible to simultaneously or separately take out hot water of different temperatures from the downstream-side hot-water storage tanks 7B and 7C and to supply it to the load, independently from the hot-water supply from the most-upstream hot-water-supplying hot-water storage tank 7A, while securing the required amount of high-temperature water in the most-upstream hot-water-supplying hot-water storage tank 7A.

[0047] Furthermore, it is possible to supply the high-temperature water from the most-upstream hot-water-supplying hot-water storage tank 7A, it is also possible to supply hot water of different temperatures from at least one of the hot-water storage tanks 7B and 7C at the downstream side thereof, and thus, it is possible to simultaneously or separately supply hot water of at least two different temperatures; therefore, merely by connecting, in

series, the plurality of simple, special hot-water storage tanks 7A, 7B, and 7C, it is possible to simultaneously or separately supply hot water of at least two different temperatures by using the supply of the high-temperature water from the most-upstream hot-water-supplying hot-water storage tank 7A and the supply of the hot water of different temperatures from at least one of the hot-water storage tanks 7B and 7C at the downstream side thereof.

[0048] By doing so, it is possible to provide, at low cost, a storage-type hot-water supplying system 1 that allows hot water of at least two different temperatures to be taken out simultaneously or separately in accordance with differences in usage without employing hot-water storage tanks for taking out hot water of two different temperatures, which are expensive due to the special structures thereof, but by employing inexpensive existing hot-water storage tanks 7A, 7B, and 7C having simple configurations designed specially for storing hot water.

[0049] In addition, the plurality of hot-water storage tanks 7A, 7B, and 7C are special hot-water storage tanks having the same structure as each other. Because of this, the plurality of hot-water storage tanks 7A, 7B, and 7C to be connected in series can be constituted of existing special hot-water storage tanks 7A, 7B, and 7C having a simple configuration and the same structure, and, by doing so, it is possible to provide, at lower cost, a storage-type hot-water supplying system 1 that allows hot water of at least two different temperatures to be taken out simultaneously or separately in accordance with differences in usage by employing a plurality of inexpensive special hot-water storage tanks having the same structure.

[0050] Note that the present invention is not limited to the invention according to the above-described embodiment, and appropriate modifications are possible within a range that does not depart from the scope thereof. For example, although an example in which temperature adjustment is made possible by providing the mixing valve 10A in the hot-water supplying pipe 9A connected to the most-upstream hot-water storage tank 7A has been described in the above-described embodiment, there is no particular need to provide the mixing valve 10A, and it may be omitted in the case in which the usage of hot water is specified and the high-temperature water of the set temperature stored in the hot-water storage tanks 7A, 7B, and 7C is used without applying any change thereto. It is needless to say that such a system is also encompassed by the present invention.

{Reference Signs List}

[0051]

1 storage-type hot-water supplying system
2 heat source unit
3 hot-water storage unit
4 hot-water outlet pipe for high-temperature water
5 water supplying pipe for low-temperature water
6A, 6B connecting pipe
7A, 7B, 7C hot-water storage tank
8 water supply pipe
9A 9B, 9C hot-water supplying pipe (hot-water supplying system)
10A, 10B, 10C mixing valve
11A, 11B, 11C water supplying pipe

Claims

1. A storage-type hot-water supplying system (1) that stores high-temperature water generated by a heat source unit (2) in a hot-water storage tank (7A, 7B, 7C) and that allows the high-temperature water to be sequentially supplied to a load,
characterized in that a plurality of the hot-water storage tanks (7A, 7B, 7C) connected in series are provided between a hot-water outlet pipe for high-temperature water (4), extending from the heat source unit (2), and a water supplying pipe for low-temperature water (5), leading to the heat source unit (2),
of the plurality of hot-water storage tanks (7A, 7B, 7C), a most-upstream hot-water storage tank (7A) that is closest to the hot-water outlet pipe (4), extending from the heat source unit (2), serves as a hot-water-supplying hot-water storage tank for high-temperature water, and a most-downstream hot-water storage tank (7C) serves as a water-supplying hot-water storage tank for the heat source unit (2), and
a hot-water supplying system (9A) for high-temperature water is connected to the most-upstream hot-water-supplying hot-water storage tank (7A), and at least one hot-water supplying system (9B, 9C) that allows hot water of different temperatures to be supplied via a mixing valve is connected to a top portion of at least one of the hot-water storage tanks (7B, 7C) at a downstream side thereof.

2. A storage-type hot-water supplying system (1) according to Claim 1, wherein a water supplying pipe (11B, 11C) that is branched off from a water supply pipe (8) connected to a bottom portion of the water-supplying hot-water storage tank (7B, 7C) is connected to the mixing valve.

3. A storage-type hot-water supplying system (1) according to Claim 1 or 2, wherein high-temperature water can be supplied from the most-upstream hot-water-supplying hot-water storage tank (7A), and hot water of different temperatures can also be supplied from at least one of the hot-water storage tanks (7B, 7C) at the downstream side thereof, thus, making it possible to simultaneously or separately supply hot water of at least two different temperatures.

4. A storage-type hot-water supplying system (1) according to any one of Claims 1 to 3, wherein the plurality of hot-water storage tanks (7A, 7B, 7C) are special hot-water storage tanks having the same structure as each other.

FIG. 1

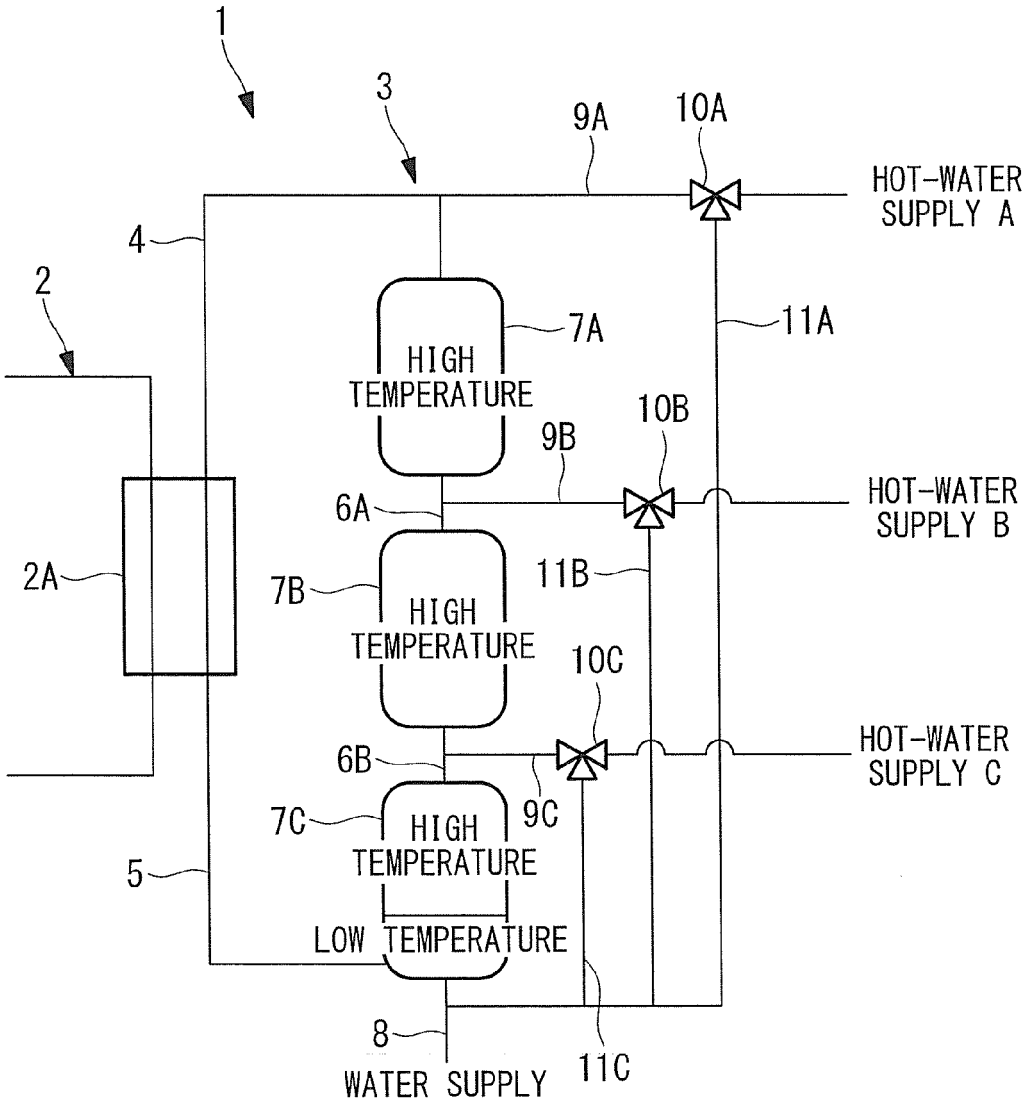
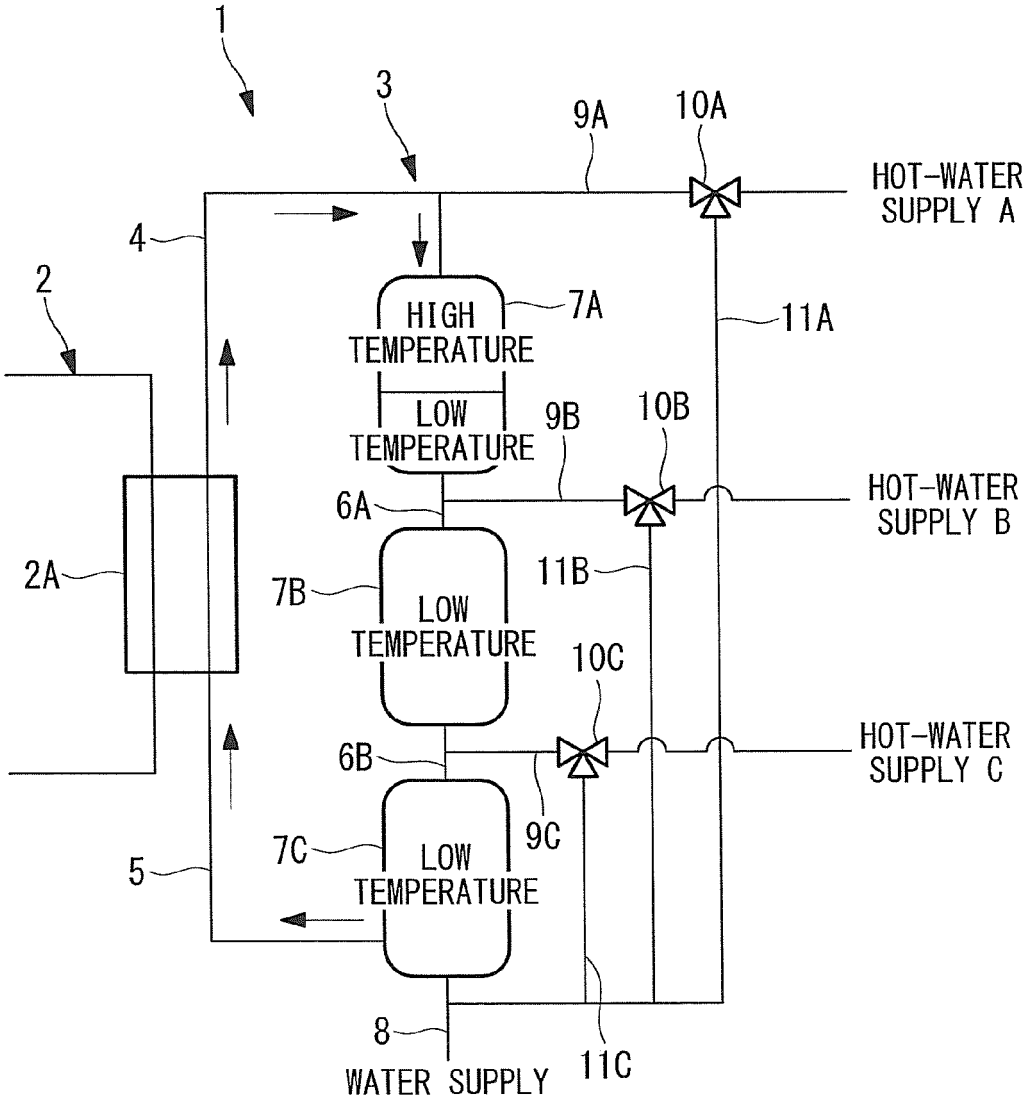

1
3
9A
10A
HOT-WATER SUPPLY A
4
2
7A
HIGH TEMPERATURE
11A
10B
9B
HOT-WATER SUPPLY B
6A
2A
7B
HIGH TEMPERATURE
11B
10C
HOT-WATER SUPPLY C
6B
9C
7C
HIGH TEMPERATURE
5
LOW TEMPERATURE
8
WATER SUPPLY
11C

FIG. 2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4
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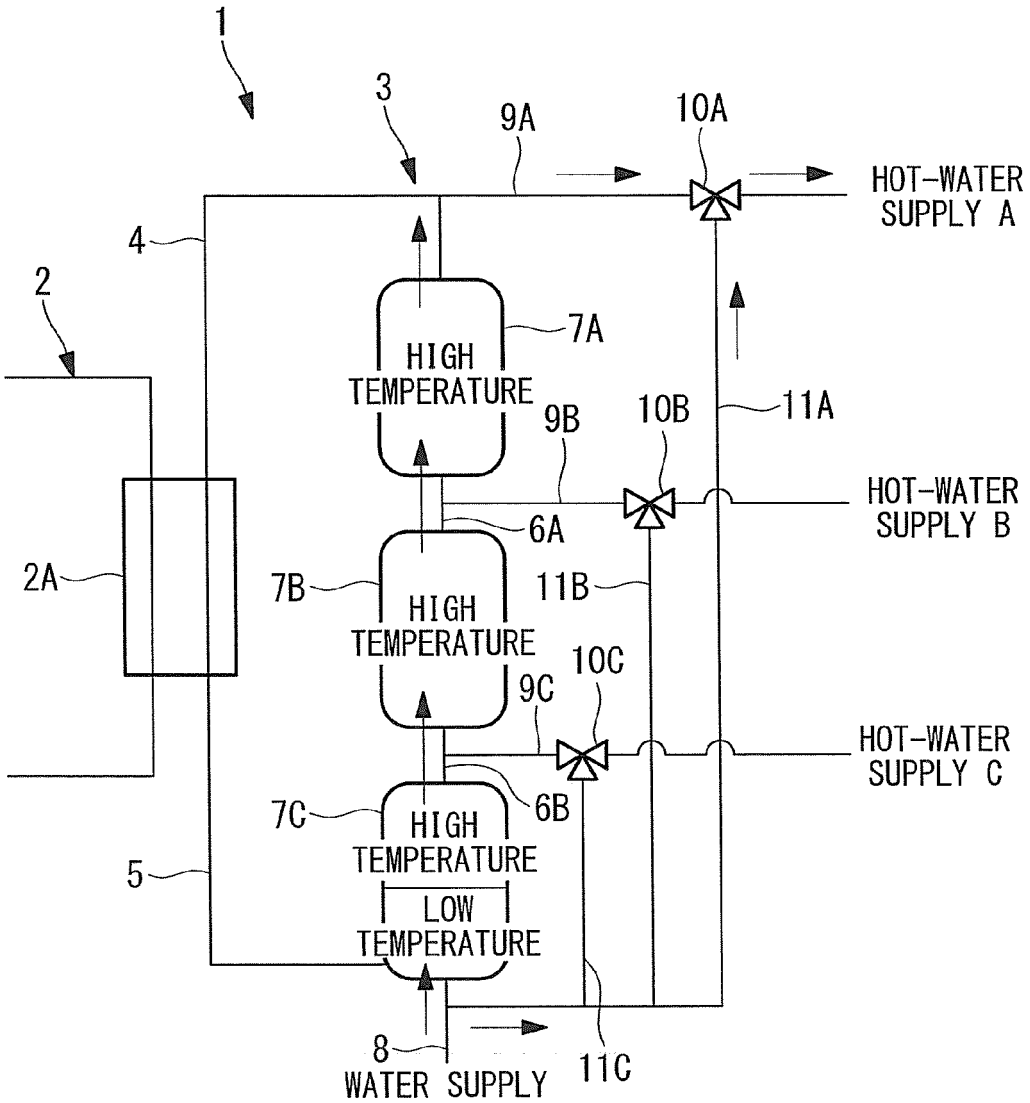
9B
10B
6A
HOT-WATER SUPPLY B
2A
7B
LOW TEMPERATURE
11B
10C
6B
HOT-WATER SUPPLY C
9C
7C
LOW TEMPERATURE
5
8
WATER SUPPLY
11C

FIG. 3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10A
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6A
2A
7B
HIGH TEMPERATURE
11B
10C
9C
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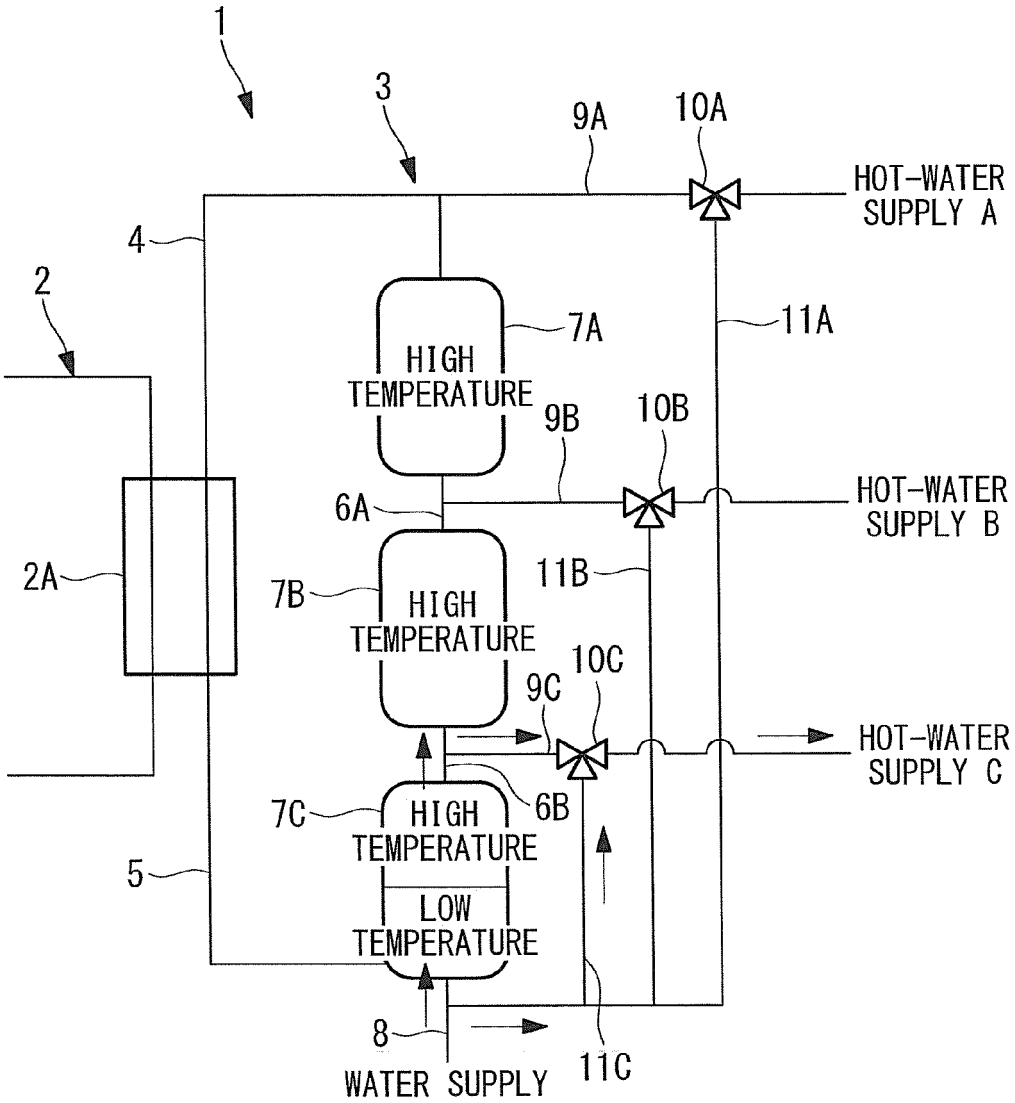
LOW TEMPERATURE
8
WATER SUPPLY
11C

FIG. 4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11A
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HOT-WATER SUPPLY B
6A
2A
7B
11B
HIGH TEMPERATURE
10C
9C
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HIGH TEMPERATURE
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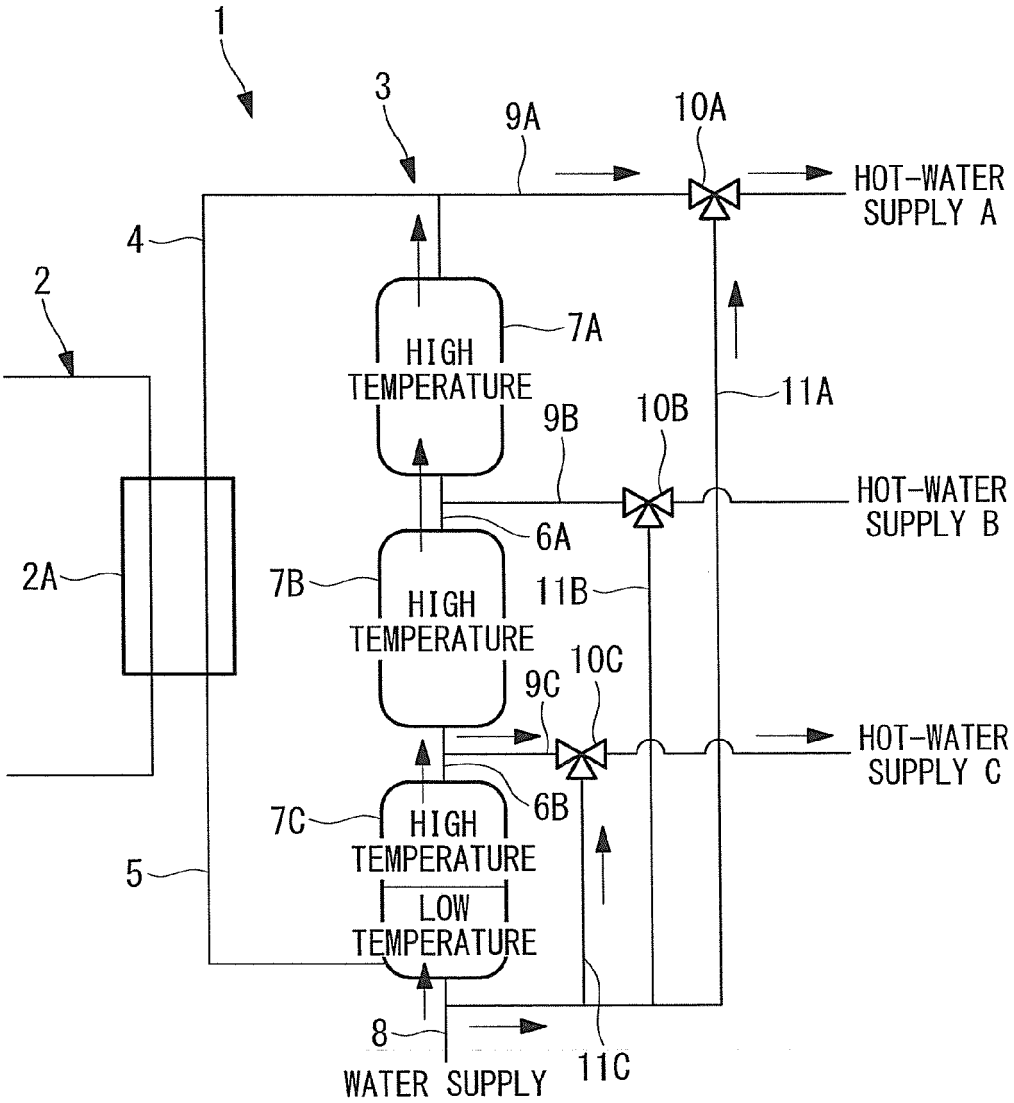
LOW TEMPERATURE
8
WATER SUPPLY
11C

FIG. 5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HOT-WATER SUPPLY B
6A
2A
7B
HIGH TEMPERATURE
11B
10C
9C
HOT-WATER SUPPLY C
6B
7C
HIGH TEMPERATURE
5
LOW TEMPERATURE
8
WATER SUPPLY
11C

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 5982

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2011/133987 A1 (BRUWER FREDERICK JOHANNES [ZA]; BRUWER FREDERICK JOHANNES JR [ZA]) 27 October 2011 (2011-10-27) * paragraphs [0045] - [0062]; figures 8a-8c *	1-4	INV. F24D17/00 F24D17/02
Y	US 4 601 263 A (SHIEH TZYY D [TW]) 22 July 1986 (1986-07-22) * columns 2-4; figure 1 *	1-4	

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F24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 March 2015	Blot, Pierre-Edouard

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25-03-2015

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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