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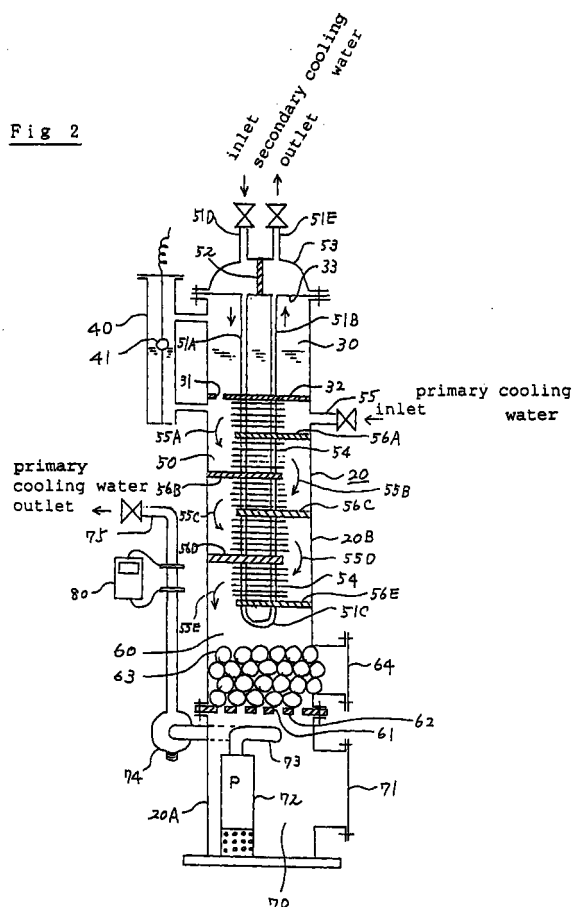
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(54) **Heat exchange apparatus for cooling water**

(57) The components forming a heat exchange apparatus are integrally combined to omit piping, and the heat exchange apparatus becomes compact. The heat exchange apparatus comprises the following components: A heat exchanger section (50) in which an equipment cooling water for cooling a water cooling type equipment is heat exchanged with other cooling water to keep the equipment cooling water within a predetermined temperature range; a surge tank section (30) connected to a passage (55A-55E) of the equipment cooling water to absorb volume changes of the equipment cooling water; an ion exchanger section (60) disposed at least on a part of the passage (55A-55E) of the equipment cooling water to perform ion exchange of the equipment cooling water; and a pump (72) for circulating the equipment cooling water between the pump (72) and the water cooling type equipment. The components are accommodated in a container (20) consisting of a single vessel or a plurality of vessels (20A, 20B) integrally combined.

Fig 2



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Description

BACKGROUND OF THE INVENTION

Technical Field

[0001] The present invention relates to a heat exchange apparatus and, more particularly, to a heat exchange apparatus in which a cooling water for cooling a water cooling type equipment (hereinafter referred to as primary cooling water) is heat exchanged with other cooling water (hereinafter referred to as secondary cooling water) to keep the primary cooling water is kept within a predetermined temperature range.

Prior Art

[0002] Construction of a conventional heat exchange apparatus of this type is hereinafter described with reference to the accompanying drawing.

[0003] Fig. 4 is a perspective view showing schematically a construction of the conventional heat exchange apparatus. In the drawing, reference numeral 1 is a bed on which equipment forming the heat exchange apparatus is installed. Numeral 2 is a panel type heat exchanger in which pipes each introducing the primary cooling water and the secondary cooling water are respectively connected to a panel so that heat exchange is performed through the panel. Numeral 3 is an inflow pipe for introducing the primary cooling water into the heat exchanger, and numeral 4 is a circulation pump for circulating the primary cooling water connected to the inflow pipe. Numeral 5 is a pipe for connecting the circulation pump 4 to an inlet 6 of the primary cooling water, and numeral 7 is a pipe for connecting the heat exchanger 2 to an outlet 8 of the primary cooling water. Numeral 9 is a flow meter connected to the pipe 7 for measuring a flow rate of the primary cooling water.

[0004] In addition, the inlet 7 and the outlet 8 of the primary cooling water are respectively connected to a passage of the cooling water (pure water) for cooling a water cooling type equipment (i.e., an equipment to be cooled with water) not illustrated such as thyristor converter, thereby forming a circulation passage of the primary cooling water including the mentioned heat exchanger.

[0005] Numeral 10 is an inflow pipe for connecting the heat exchanger 2 to an inlet 11 of the secondary cooling water, and numeral 12 is an outflow pipe for connecting the heat exchanger 2 to an outlet 13 of the secondary cooling water. Numeral 14 is an ion exchanger for increasing purity of the pure water, which is connected to the inflow pipe 3 and the pipe 7 of the primary cooling water through a pipe 14A and a pipe 14B so that a part of the primary cooling water passes there-through. Numeral 15 is a surge tank for absorbing volume change of the primary cooling water, which is

connected to the pipe 5 on the inlet side of the primary cooling water through a pipe 15A.

[0006] Numeral 16 is a control panel for performing the entire control including pumping control on the basis of water level, etc. of the surge tank.

[0007] In the conventional heat exchange apparatus of above construction, each equipment and pipe forming the heat exchange apparatus are arranged and installed on one common bed 1 for the convenience of local work.

[0008] In such an apparatus, however, since the primary and secondary cooling waters are introduced or guided to each component equipment through pipe connection to perform a heat exchange by exhibiting their respective functions, it is necessary to secure spaces for installation of each component equipment. Hence, a problem exists in that size of the entire heat exchange apparatus becomes large, and that there are a lot of pipes for connection among the component equipment resulting in a complicated apparatus as a whole.

SUMMARY OF THE INVENTION

[0009] The present invention was made to solve the above-discussed problems and has an object of providing an heat exchange apparatus in which each of the mentioned component equipment is almost integrally formed into one unit, omitting the piping, so that the entire apparatus becomes compact.

[0010] To accomplish the foregoing object, a heat exchange apparatus for cooling water according to the invention comprises: a heat exchanger section in which an equipment cooling water for cooling a water cooling type equipment is heat exchanged with other cooling water to keep the equipment cooling water within a predetermined temperature range; a surge tank section connected to a passage of the equipment cooling water to absorb volume change of the equipment cooling water; an ion exchanger section disposed at least on a part of the passage of the equipment cooling water to perform ion exchange of the equipment cooling water; and a pump for circulating the equipment cooling water between the pump and the water cooling type equipment; said heat exchanger section, said surge tank section, said ion exchanger section, and said pump being accommodated in a container consisting of a single vessel or plural vessels integrally combined.

[0011] In the heat exchange apparatus for cooling water of above construction, volume of the entire apparatus becomes small and compact, and installation area of the apparatus can be reduced.

[0012] Since the piping is largely reduced and the construction is simplified, assembly thereof is simple and easy.

[0013] A heat exchange apparatus for cooling water according to the invention comprises: a container formed by disposing almost vertically a single cylinder or a combination of plural cylinders; a surge tank sec-

tion formed on upper end of the container by providing a seal member having a communication hole on upper part of the container; a heat exchanger section having a large number of plate fins disposed under the surge tank section, an inflow pipe connected to the plate fins to guide a cooling water from outside of the container, an outflow pipe connected integrally to the inflow pipe to guide the cooling water of the inflow pipe to outside of the container, and a passage of the equipment cooling water to guide the equipment cooling water for cooling a water cooling type equipment installed outside of the container downward from the surge tank section, perform heat exchange with the cooling water of the inflow pipe and the outflow pipe, and guide the cooling water downward from the container; an ion exchanger section formed under the heat exchanger section and having a partition plate through which the equipment cooling water can pass and ion exchange resins disposed on the partition plate; a storage section provided under the ion exchanger section to store the equipment cooling water from the ion exchanger section; and a pump provided in the storage section to circulate the stored equipment cooling water through the water cooling type equipment.

[0014] In the heat exchange apparatus for cooling water of above construction, maintenance of the apparatus becomes easy and it is possible to transport the entire apparatus, and therefore the apparatus can be installed in any optional place.

[0015] It is preferable that, in the heat exchange apparatus for cooling water according to the invention, a control panel for controlling the apparatus corresponding to water level, etc. in the surge tank section is provided on outside surface of the container.

[0016] It is preferable that, in the heat exchange apparatus for cooling water according to the invention, a flow meter for measuring flow rate of the equipment cooling water is provided on outside surface of the container.

[0017] It is preferable that, in the heat exchange apparatus for cooling water according to the invention, the inflow pipe and the outflow pipe are provided with an inlet and an outlet on upper end of the container and are disposed almost vertically up to the heat exchanger section passing through the surge tank section and the seal member, and the passage of the equipment cooling water is provided with an inlet on the side face of the container.

[0018] A heat exchange apparatus for cooling water according to the invention comprises: a container formed by disposing almost horizontally a single cylinder or a combination of plural cylinders; a heat exchanger section provided at a predetermined portion in the container and having a large number of plate fins, an inflow pipe connected to the plate fins to guide a cooling water from outside of the container, an outflow pipe connected integrally to the inflow pipe to guide the cooling water of the inflow pipe to outside of the con-

tainer, and a passage of the equipment cooling water to guide the equipment cooling water for cooling a water cooling type equipment installed outside of the container into the container and perform heat exchange with the cooling water of the inflow pipe and the outflow pipe; an ion exchanger section formed in the vicinity of the heat exchanger section so as to communicate to the passage of the equipment cooling water and performing ion exchange of the equipment cooling water; a storage section provided on the side of the ion exchanger section or the heat exchanger section to store the equipment cooling water from the ion exchanger section, thereby forming a surge-tank for the equipment cooling water; and a pump provided in the storage section to circulate the stored equipment cooling water through the water cooling type equipment.

[0019] In the heat exchange apparatus for cooling water of above construction, it is possible to utilize the upper space of the storage section for storing the equipment cooling water as a surge tank, which results in formation of a compact apparatus.

[0020] It is preferable that, in the heat exchange apparatus for cooling water, the pump is a submerged pump.

[0021] It is preferable that, in the heat exchange apparatus for cooling water, the container is formed to be transportable.

[0022] Other objects, features and advantages of the invention will become apparent in the course of the following description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is a perspective view showing an external construction of embodiment 1 according to the present invention.

Fig. 2 is a schematic sectional view showing an internal construction of embodiment 1 according to the invention.

Fig. 3 is a schematic sectional view showing an internal construction of embodiment 2 according to the invention.

Fig. 4 is a perspective view showing a schematic construction of a heat exchange apparatus according to the prior art.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment 1

[0024] Embodiment 1 according to the invention is hereinafter described with reference to the drawings. Fig. 1 is a perspective view showing an external construction of embodiment 1 according to the present

invention and Fig. 2 is a schematic sectional view showing an internal construction of embodiment 1.

[0025] In the drawings, reference numeral 20 is a container comprising a single cylinder or a combination of plural cylinders. The container 20 is almost vertically set. As described later, the container 20 illustrated comprises a cylinder 20A forming a storage section, and a cylinder 20B forming the remaining sections. Numeral 30 is a surge tank section formed between an upper end wall 33 and a seal member 32 by providing the seal member 32 having a communication hole 31 on the upper part of the container.

[0026] Numeral 40 is a water level gauge provided on the side of the surge tank section, and numeral 41 is a float forming a level switch for control.

[0027] Numeral 50 is a heat exchanger section formed under the surge tank section, and comprises following elements. That is, numeral 51A is an inflow pipe of the secondary cooling water extending vertically from the upper end wall 33 of the container 20 through the surge tank section 30. Numeral 51B is an outflow pipe integrally combined with the inflow pipe 51A and extending to the upper end wall 33 of the container 20 in the same manner as the inflow pipe through a U-shaped part 51C. Numeral 52 is a partition plate for partitioning the passage of the secondary cooling water dividing the space part of an upper cap 53, and numerals 51D and 51E are an inlet and an outlet of the secondary cooling water respectively connected to the upper cap 53. Numeral 54 is a large number of plate fins associated with the inflow pipe 51A and the outflow pipe 51B, and numeral 55 is an inlet of the primary cooling water (pure water) provided on the side face of the container. Numerals 56A, 56B, 56C, 56D and 56E are guide plates respectively protruding alternately from wall surfaces opposite to each other in the container and forming a passage of the primary cooling water indicated by the arrows 55A, 55B, 55C, 55D and 55E to guide the primary cooling water downward.

[0028] Numeral 60 is an ion exchanger section formed under the heat exchanger section. The ion exchanger section 60 comprises a partition plate 62 formed with a number of through holes 61, ion exchange resins (each in a pack) 63 disposed on the partition plate, and a port 64 for putting in and out through which ion exchange resin are charged and replaced.

[0029] In this regard, the partition plate 62 is formed, for example, in combination of a punching metal and a metal gauze. Numeral 70 is a storage section provided under the ion exchanger section, numeral 71 is an inspection port provided in the storage section, and numeral 72 is a submerged pump set in the storage section. Numeral 73 is a pipe for guiding the primary cooling water discharged from the submerged pump and the pipe is returned to the water cooling type equipment not illustrated through a strainer 74 and an outlet 75.

[0030] Numeral 80 is a flow meter for the primary cooling water provided on the pipe 73. Numeral 90 is a control panel for controlling the entire apparatus including the control of the submerged pump using a level switch, etc. of the water level gauge 40. This control panel 90 is fixed to outside of the container 20.

[0031] Note that the container 20 is of one integrated construction capable of being transported as it is upon disconnecting the pipes for the primary cooling water and the secondary cooling water. As a result, the container 20 can be transported to any place to be installed and operated there.

[0032] Operation of the apparatus according to this embodiment is hereinafter described.

[0033] Circulating the secondary cooling water in the form of supplying from the inlet 51D and returning to the outlet 51E through the inflow pipe 51A and the outflow pipe 51B, the submerged pump 72 is driven. Thus, the primary cooling water (pure water) for cooling a water cooling type equipment not illustrated is introduced from the inlet 55 to the heat exchanger section 50. When volume of the primary cooling water is increased due to change in temperature, pressure, etc., the water flows from the communication port 31 of the seal member 32 into the surge tank section 30 to raise water level, thereby absorbing the increase in volume. The primary cooling water is cooled by heat exchange with the secondary cooling water through the plate fins 54, flows downward as indicated by the arrows 55A, 55B, 55C, 55D and 55E, then flows in the ion exchanger section 60.

[0034] Purity of the primary cooling water is increased by flowing through the ion exchange resins 63, and the water flows through the holes 61 of the partition plate 52 and is stored in the storage section 70. The stored primary cooling water is pumped up by the submerged pump 72 and returned to the water cooling type equipment to be cooled through the pipe 73.

Embodiment 2

[0035] Embodiment 2 according to the invention is hereinafter described with reference to the drawings.

[0036] Fig. 3 is a schematic sectional view showing an internal construction of embodiment 2 according to the invention, and in which the vertical type construction shown in Fig. 2 is formed into a horizontal type. In Fig. 3, the same reference numerals are designated to the same or like parts shown in Fig. 2, and further description is omitted herein.

[0037] As shown in Fig. 3, the container 20 is comprised of a single tank long sideways arranged almost horizontally. It is also preferable that the container 20 is formed in combination of plural boxes.

[0038] As a result of forming the container 20 into a horizontal type construction, the surge tank section 30 is provided at a location different from that in Fig. 2. That is, in Fig. 3, the surge tank section 30 is combined to the

storage section 70 provided at the left end of the container 20, and an upper space thereof operates as a surge tank.

[0039] The heat exchanger section 50 is arranged at the right end of the container 20 by forming the vertical type heat exchanger section shown in Fig. 2 into a horizontal type. The ion exchanger section 60 is arranged in the center of the container 20 between the heat exchanger section 50 and the storage section 70. Accordingly, the primary cooling water guided along the passage indicated by the arrows 55A to 55E flows from the bottom part of the ion exchanger section 60 upward, and is ion exchanged through the ion exchange resins not illustrated in the ion exchanger section 60. The ion exchanged primary cooling water then flows from upper part of the ion exchanger section 60 into the storage section 70 as indicated by the arrow. In the storage section 70, three submerged pumps 72A to 72C are disposed to guide the primary cooling water to outside of the container through the pipes 73A to 73C and return it to the water cooling type equipment not illustrated. Number of submerged pumps is decided depending upon the quantity of the primary cooling water, and therefore it is a matter of course that the mentioned advantage can be performed by only one submerged pump.

Claims

1. A heat exchange apparatus for cooling water, comprising:
 - a heat exchanger section (50) in which an equipment cooling water for cooling a water cooling type equipment is heat exchanged with other cooling water to keep the equipment cooling water within a predetermined temperature range;
 - a surge tank section (30) connected to a passage (31, 55A-55E) of the equipment cooling water to absorb volume changes of the equipment cooling water;
 - an ion exchanger section (60) disposed at least on a part of the passage (55A-55E) of the equipment cooling water to perform ion exchange of the equipment cooling water; and
 - a pump (72) for circulating the equipment cooling water between the pump (72) and the water cooling type equipment;
 - wherein the heat exchanger section (50), the surge tank section (30), the ion exchanger section (60), and the pump (72) are accommodated in a container (20) consisting of a single vessel or a plurality of vessels (20A, 20B) and are integrally combined.
2. A heat exchange apparatus for cooling water, comprising:
 - a container (20) formed by disposing almost vertically a single cylinder or a combination of a plurality of cylinders (20A, 20B);
 - a surge tank section (30) formed on the upper end of the container (20) by providing a seal member (32) having a communication hole (31) on the upper part of the container (20);
 - a heat exchanger section (50) having a large number of plate fins (54) disposed under the surge tank section (30), an inflow pipe (51A) connected to the plate fins (54) to guide cooling water from outside of the container (20), an outflow pipe (51B) connected integrally to the inflow pipe (51A) to guide the cooling water of the inflow pipe (51A) to outside of the container (20), and a passage (55A-55E) of the equipment cooling water to guide the equipment cooling water for cooling a water cooling type equipment installed outside of the container (20) downward from the surge tank section (30), perform heat exchange with the cooling water of the inflow pipe (51A) and the outflow pipe (51B), and guide the cooling water downward from the container (20);
 - an ion exchanger section (60) formed under the heat exchanger section (50) and having a partition plate (62) through which the equipment cooling water can pass (61) and ion exchange resins (63) disposed on the partition plate (62);
 - a storage section (70) provided under the ion exchanger section (60) to store the equipment cooling water from the ion exchanger section (60); and
 - a pump (72) provided in the storage section (70) to circulate the stored equipment cooling water through the water cooling type equipment.
3. The apparatus according to claim 1 or 2, wherein a control panel (90) for controlling the apparatus corresponding to water level etc. in the surge tank section (30) is provided outside of the container (20).
4. The apparatus according to any of claims 1 to 3, wherein a flow meter (80) for measuring the flow rate of the equipment cooling water is provided outside of the container (20).
5. The apparatus according to any of claims 1 to 4, wherein the inflow pipe (51A) and the outflow pipe (51B) are provided with an inlet (51D) and an outlet (51E) on the upper end (53) of the container (20) and are disposed almost vertically up to the heat exchanger section (50) passing through the surge tank section (30) and the seal member (32), and the passage (55A-55E) of the equipment cooling water

is provided with an inlet on the side face of the container (20).

6. A heat exchange apparatus for cooling water, comprising: 5
- a container (20) formed by disposing almost horizontally a single cylinder or a combination of a plurality of cylinders (20A, 20B);
 - a heat exchanger section (50) provided at a predetermined portion in the container (20) and having a large number of plate fins (54), an inflow pipe (51A) to guide cooling water from outside of the container (20), an outflow pipe (51B) connected integrally to the inflow pipe (51A) to guide the cooling water of the inflow pipe (51A) to outside of the container (20), and a passage (55A-55E) of the equipment cooling water to guide the equipment cooling water for cooling a water cooling type equipment installed outside of the container (20) into the container (20) and perform heat exchange with the cooling water of the inflow pipe (51A) and the outflow pipe (51B); 10 15 20
 - an ion exchanger section (60) disposed in the vicinity of the heat exchanger section (50) so as to communicate with the passage (55A-55E) of the equipment cooling water and performing ion exchange of the equipment cooling water; 25 30
 - a storage section (70) provided on the side of the ion exchanger section (60) or the heat exchanger section (50) to store the equipment cooling water from the ion exchanger section (60), thereby forming a surge tank (30) for the equipment cooling water; and 35
 - a pump (72) provided in the storage section (70) to circulate the stored equipment cooling water through the water cooling type equipment. 40
7. The apparatus according to any of claims 1 to 6, wherein the pump (72) is a submerged pump.
8. The apparatus according to any of claims 1 to 7, wherein the container (20) is formed and adapted to be transportable. 45

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Fig 1

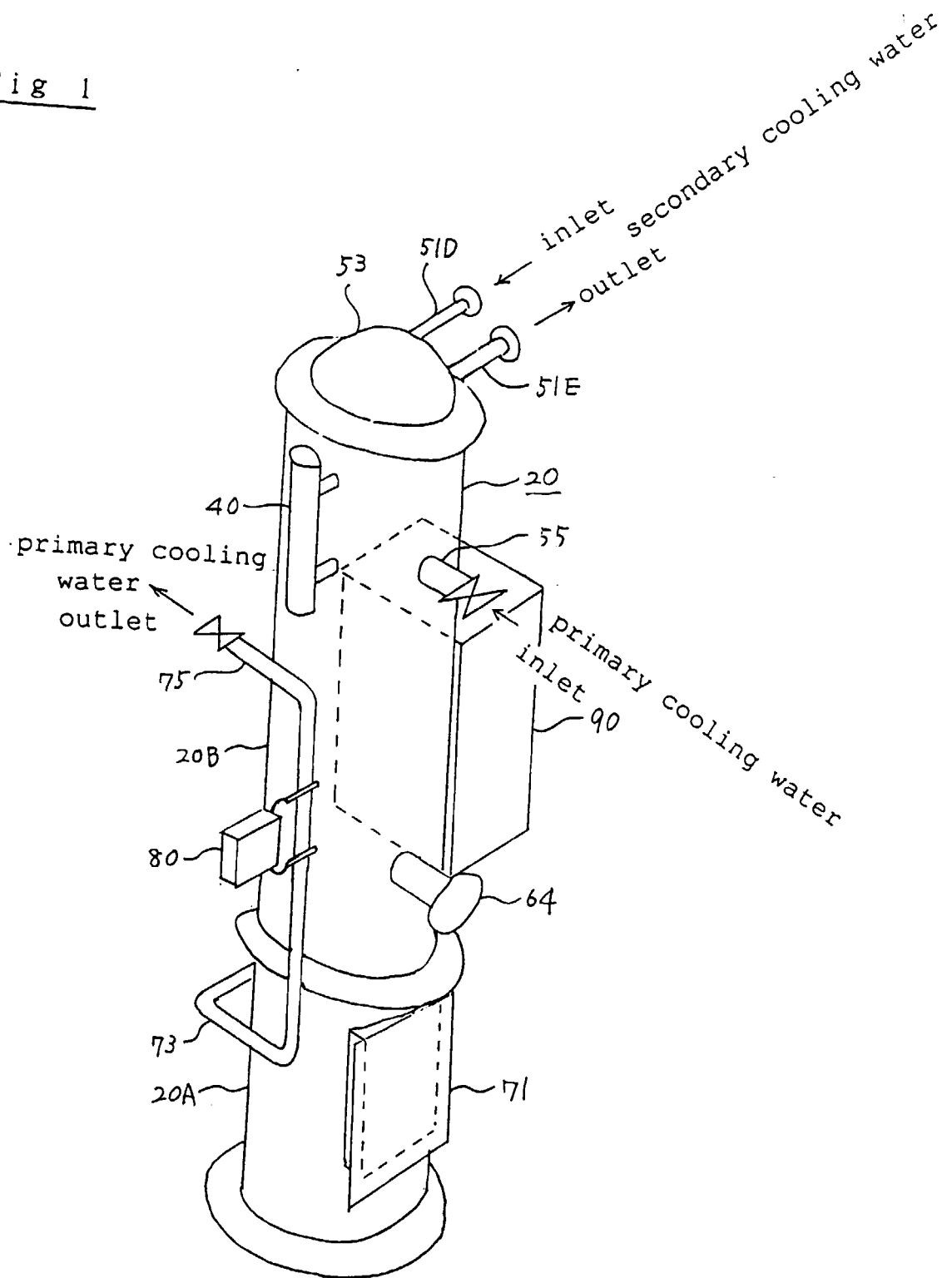


Fig 2

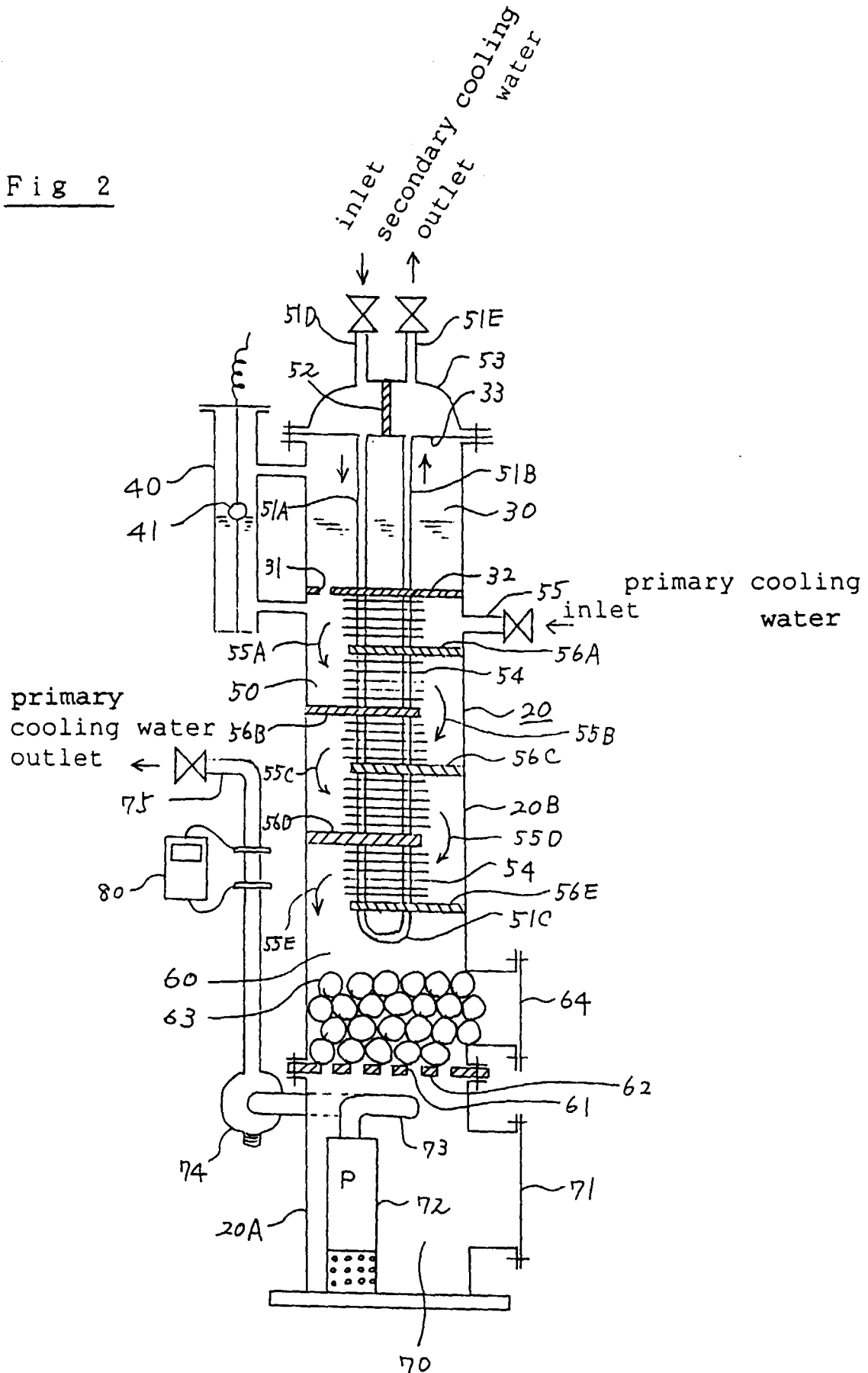


Fig 3

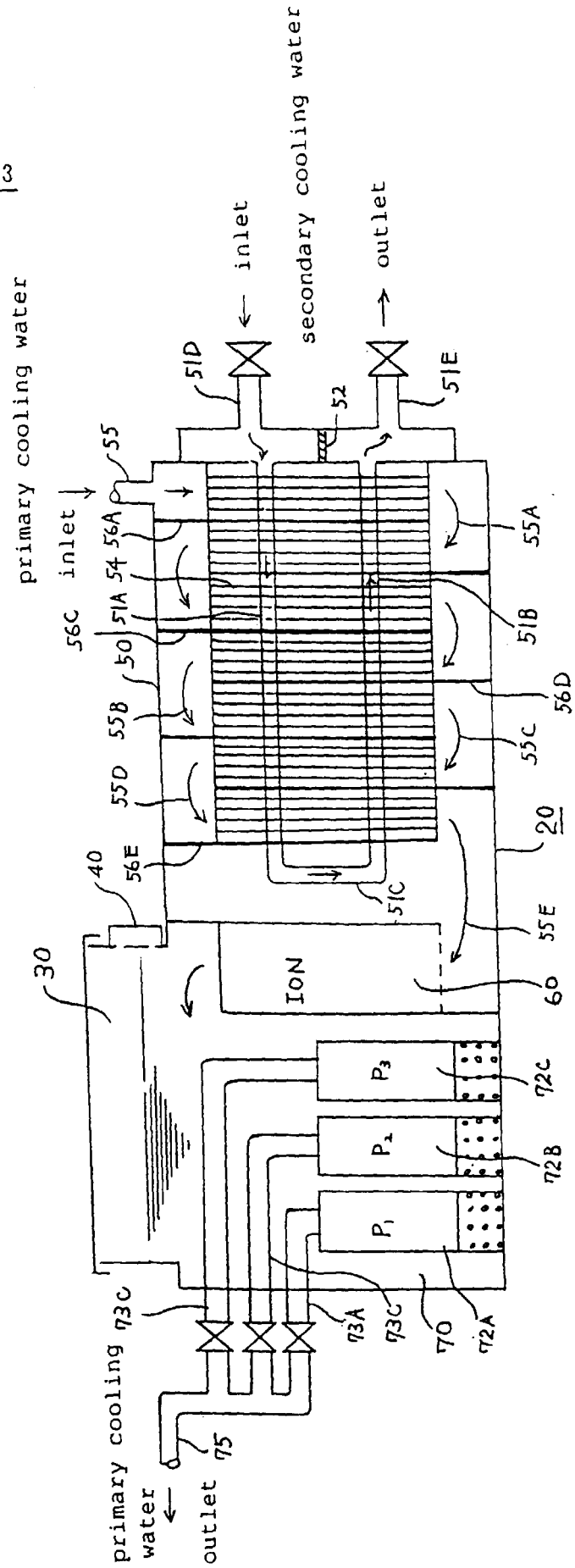
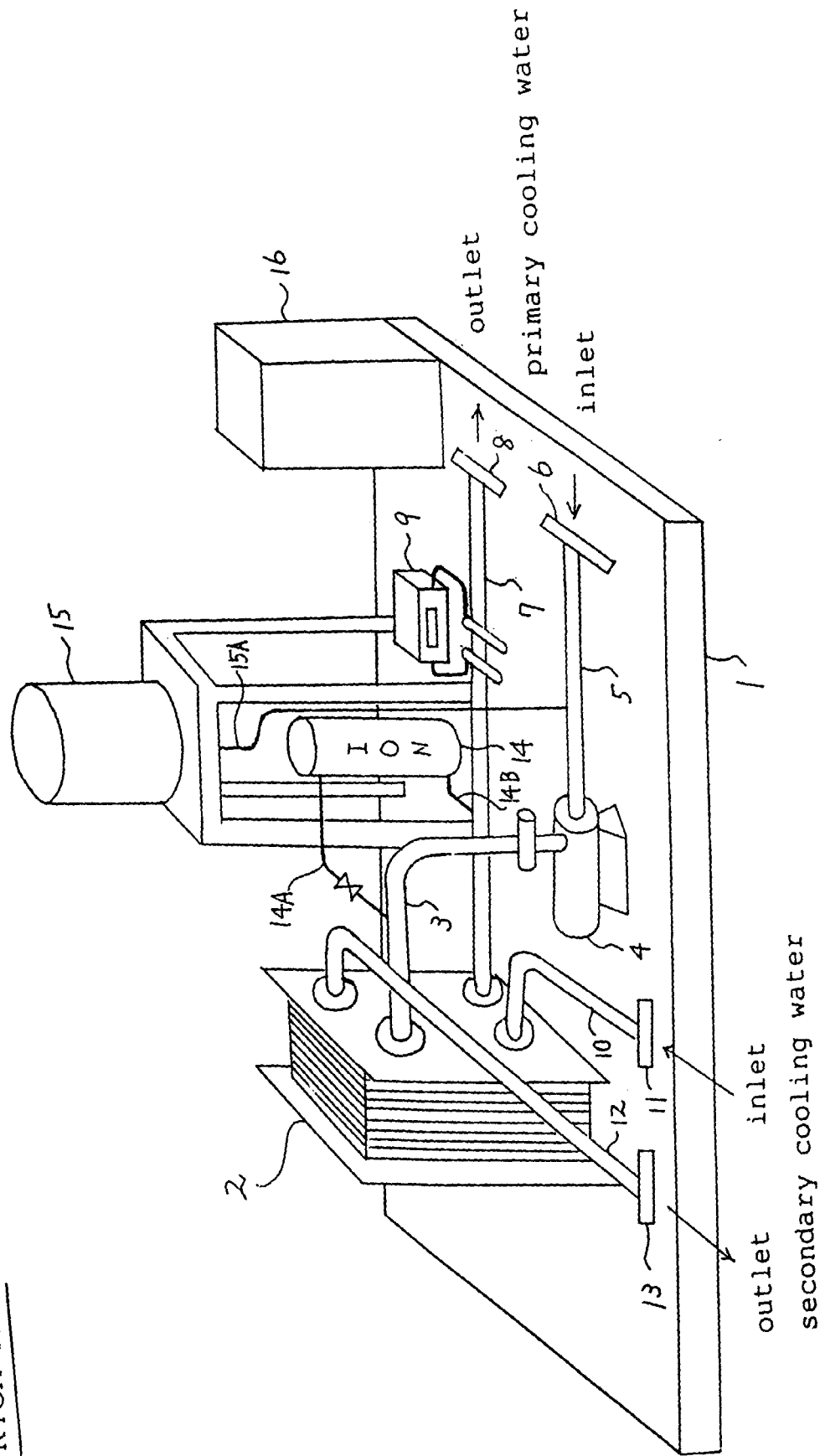


Fig 4

PRIOR ART





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 4287

DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 31 October 2000	Examiner Mootz, F
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 00 10 4287

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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