



(22) Date de dépôt/Filing Date: 2009/01/28

(41) Mise à la disp. pub./Open to Public Insp.: 2009/07/28

(45) Date de délivrance/Issue Date: 2013/07/30

(30) Priorité/Priority: 2008/01/28 (JP2008-016508)

(51) Cl.Int./Int.Cl. *F28F 27/00* (2006.01),
F25B 41/00 (2006.01)

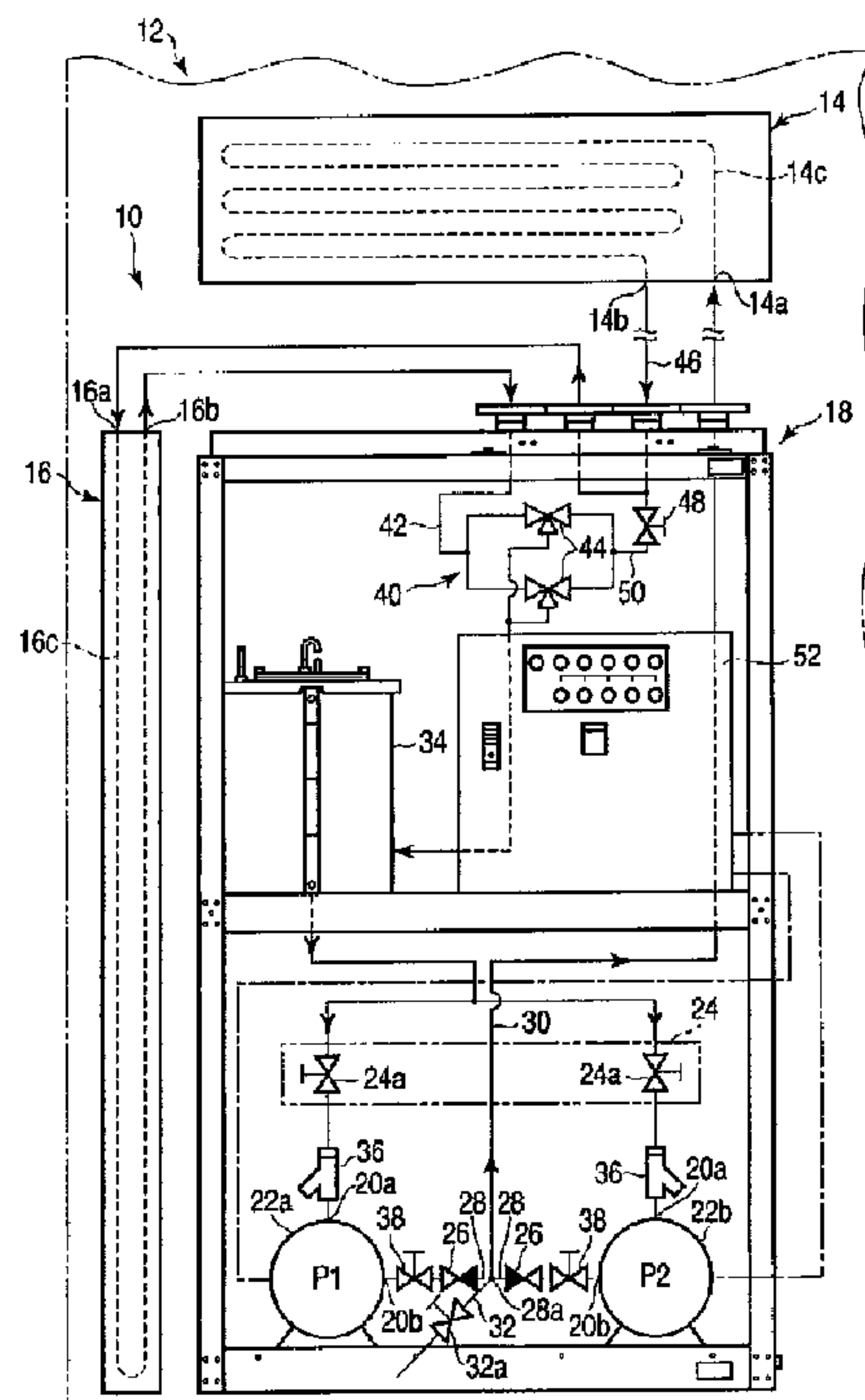
(72) Inventeur/Inventor:
AOKI, KENSUKE, JP

(73) Propriétaire/Owner:
KABUSHIKI KAISHA TOSHIBA, JP

(74) Agent: MARKS & CLERK

(54) Titre : APPAREILLAGE DE CIRCULATION DE LIQUIDE DE REFROIDISSEMENT, ET DISPOSITIF DE REFROIDISSEMENT COMPRENANT LE MEME APPAREILLAGE DE CIRCULATION POUR DISPOSITIF ELECTRIQUE ET/OU ELECTRONIQUE GENERANT DE LA CHALEUR

(54) Title: COOLANT CIRCULATING APPARATUS, AND COOLING APPARATUS INCLUDING THE SAME COOLANT CIRCULATING APPARATUS FOR ELECTRIC AND/OR ELECTRONIC DEVICE WHICH GENERATES HEAT



(57) Abrégé/Abstract:

A coolant circulating apparatus includes circulating pumps disposed in parallel to each other and each having inlet and discharge ports and discharging coolant flowing into the inlet port from the discharge port, a coolant selectively introducing unit connected to the inlet ports of the pumps and selectively introducing the coolant into the inlet ports of the pumps, check valves connected to the discharge ports of the pumps. Branched coolant supply pipes extend horizontally or downwardly from the check valves and have extending ends at which the branched pipes are integrated with each other. An integrated coolant supply pipe extends upward from the integrated extending ends of the branched pipes. And, a coolant discharge pipe with an on-off valve extends horizontally or downwardly from the integrated extending ends of the branched pipes.



ABSTRACT OF THE DISCLOSURE

A coolant circulating apparatus includes circulating pumps disposed in parallel to each other and each having inlet and discharge ports and
5 discharging coolant flowing into the inlet port from the discharge port, a coolant selectively introducing unit connected to the inlet ports of the pumps and selectively introducing the coolant into the inlet ports of the pumps, check valves connected to the
10 discharge ports of the pumps. Branched coolant supply pipes extend horizontally or downwardly from the check valves and have extending ends at which the branched pipes are integrated with each other. An integrated coolant supply pipe extends upward from the integrated
15 extending ends of the branched pipes. And, a coolant discharge pipe with an on-off valve extends horizontally or downwardly from the integrated extending ends of the branched pipes.

- 1 -

TITLE OF THE INVENTION

COOLANT CIRCULATING APPARATUS, AND COOLING APPARATUS
INCLUDING THE SAME COOLANT CIRCULATING APPARATUS FOR
ELECTRIC AND/OR ELECTRONIC DEVICE WHICH GENERATES HEAT

5

BACKGROUND OF THE INVENTION

The present invention relates to a coolant
circulating apparatus, and a cooling apparatus
including the same coolant circulating apparatus for an
electric and/or electronic device which generates heat.

10

As an electric and/or electronic device which
generates heat, a transmitter for broadcasting has been
well known. The broadcasting transmitter uses, for
example, a number of power amplifiers as its heat
generating elements. The broadcasting transmitter
cannot display its original performance unless heat
generated by the heat generating elements is removed.

15

A conventional cooling apparatus for the
broadcasting transmitter includes: a cooling plate
which is disposed adjacent to a heat generating element
and in which a coolant circulating passage having an
inlet and an outlet is provided; a radiator which is
disposed apart from the heat generating element and in
which a coolant circulating passage having an inlet and
an outlet is provided, the inlet being connected to the
outlet of the coolant circulating passage of the
cooling plate; and a coolant circulating apparatus
which is interposed between the cooling plate and the

25

- 2 -

5 radiator and which supplies a heat-radiated coolant from the outlet of the coolant circulating passage of the radiator to the inlet of the coolant circulating passage of the cooling plate and moves the coolant passed through the coolant circulating passage of the cooling plate toward the inlet of the coolant circulating passage of the radiator.

10 In such a conventional cooling apparatus, the heat-radiated coolant supplied from the coolant circulating apparatus to the inlet of the coolant circulating passage of the cooling plate absorbs heat from the heat generating element adjacent to the cooling plate while the coolant passes through the coolant circulating passage of the cooling plate. The
15 heat-absorbing coolant moved from the outlet of the coolant circulating passage of the cooling plate to the inlet of the coolant circulating passage of the radiator is radiated its heat while the heat-absorbing coolant passes through the coolant circulating passage
20 of the radiator. After heat is radiated in the coolant circulating passage of the radiator, the coolant is supplied again to the coolant circulating apparatus from the outlet of the coolant circulating passage of the radiator as described previously.

25 The coolant circulating apparatus includes first and second circulating pumps disposed in parallel to each other. The first and second circulating pumps are

- 3 -

used alternately at a predetermined interval in order to prolong their durability. An inlet port of each of the first and second circulating pumps is provided with an on-off valve, and a discharge port of each of the first and second circulating pumps is provided with a check valve. Because the first and second circulating pumps of the coolant circulating apparatus are heavy and bulky, they are disposed at the bottommost section of the broadcasting transmitter. Therefore, they are disposed below the cooling plate disposed adjacent to a number of power amplifiers as the heat generating elements in the broadcasting transmitter.

Two branched coolant supply pipes extend from the outlet sides of the check valves of the first and second circulating pumps toward the inlet of the coolant circulating passage of the cooling plate disposed above, and the two branched coolant supply pipes are integrated to a single integrated coolant supply pipe. The extending end of the single integrated coolant supply pipe is connected to the inlet of the coolant circulating passage of the cooling plate.

A coolant discharge pipe with an on-off valve is branched downward from the proximal end of the single integrated coolant supply pipe. By opening the on-off valve of the coolant discharge pipe, the coolant can be discharged from the coolant circulating passage of the

- 4 -

cooling plate through the integrated coolant supply pipe. However, in this case, the coolant is left in the two branched coolant supply pipes extending between the proximal end of the integrated coolant supply pipe and the outlet sides of the check valves of the first and second circulating pumps. A work for removing the coolant left in the two branched coolant supply pipes from those two branched coolant supply pipes is troublesome.

The present invention has been derived from the above-described circumstances, and an object of the present invention is to provide a coolant circulating apparatus which is configured to remove a coolant surely and easily from coolant supply pipes extending from outlet sides of check valves of plural circulating pumps to a coolant circulating passage of a cooler like a cooling plate, and to provide a cooling apparatus including such a coolant circulating apparatus as described above for an electric and/or electronic device which generate heat.

BRIEF SUMMARY OF THE INVENTION

According to an aspect of the present invention there is provided a coolant circulating apparatus comprising:

circulating pumps which are disposed in parallel to each other, and each of which has an inlet port and a discharge port and discharges coolant flowing into the inlet port from the discharge port;

- 5 -

a coolant selectively introducing unit which is connected to the inlet ports of the circulating pumps and which selectively introduces the coolant into the inlet ports of the circulating pumps;

5 check valves which are connected to the discharge ports of the circulating pumps;

branched coolant supply pipes each of which extends in one of a horizontal direction or a downward direction from each of the check valves and which have extending
10 ends at which the branched coolant supply pipes are integrated with each other;

an integrated coolant supply pipe which extends upward from the integrated extending ends of the branched coolant supply pipes; and

15 a coolant discharge pipe with an on-off valve, which extends downwardly from the integrated extending ends of the branched coolant supply pipes, the coolant discharge pipe being configured to discharge coolant from the coolant circulating apparatus.

20 According to another aspect of the present invention there is provided a cooling apparatus for an electric and/or electronic device having a heat generating element, comprising:

a cooler which is disposed adjacent to the heat
25 generating element and in which a coolant circulating passage having an inlet and an outlet is provided;

a radiator which is disposed apart from the heat generating element and in which a coolant circulating

- 6 -

passage having an inlet and an outlet is provided, the inlet being connected to the outlet of the coolant circulating passage of the cooler; and

5 a coolant circulating apparatus which is interposed between the cooler and the radiator and which supplies a heat-radiated coolant from the outlet of the coolant circulating passage of the radiator to the inlet of the coolant circulating passage of the cooler and moves the coolant passed through the coolant circulating passage
10 of the cooler toward the inlet of the coolant circulating passage of the radiator,

wherein the coolant circulating apparatus comprises:

circulating pumps which are disposed in
15 parallel to each other, and each of which has an inlet port and a discharge port and discharges coolant flowing into the inlet port from the discharge port;

a coolant selectively introducing unit which
20 is connected to the inlet ports of the circulating pumps and which selectively introduces the coolant into the inlet ports of the circulating pumps;

check valves which are connected to the discharge ports of the circulating pumps;

25 branched coolant supply pipes each of which extends in one of a horizontal direction or a downward direction from each of the check valves and which have extending ends at which the branched

- 6a -

coolant supply pipes are integrated with each other;

an integrated coolant supply pipe which extends upward from the integrated extending ends of the branched coolant supply pipes; and

a coolant discharge pipe with an on-off valve, which extends downwardly from the integrated extending ends of the branched coolant supply pipes, the coolant discharge pipe being configured to discharge coolant from the coolant circulating apparatus.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The single figure is a view showing schematically

- 7 -

a structure of a cooling apparatus, including a coolant circulating apparatus according to an embodiment of the present invention, for a broadcasting transmitter which is a kind of an electric and/or electronic device which
5 generates a heat.

DETAILED DESCRIPTION OF THE INVENTION

A cooling apparatus 10 according to an embodiment of the present invention is used to cool heat generating elements of an electric and/or electronic
10 device, such as a transmitter for broadcasting 12 which uses a plurality of power amplifiers as the heat generating elements.

The cooling apparatus 10 includes: a cooler 14 which is disposed adjacent to the power amplifiers of
15 the broadcasting transmitter 12 and in which a coolant circulating passage 14c having an inlet 14a and an outlet 14b is provided; and a radiator 16 which is disposed apart from the heat generating elements and in which a coolant circulating passage 16c having an inlet
20 16a and an outlet 16b is provided, the inlet 16a being connected to the outlet 14b of the coolant circulating passage 14c of the cooler 14.

In this embodiment, the cooler 14 has a known structure which is called as a cooling panel.

25 In this embodiment, the radiator 16 has a known structure in which a plurality of heat radiating fins are provided along the coolant circulating passage 16c

- 8 -

and wind caused by a fan is blown against the plurality of heat radiating fins so that heat is radiated from a coolant flowing through the coolant circulating passage 16.

5 The cooling apparatus 10 further includes a coolant circulating apparatus 18 which is interposed between the cooler 14 and the heat radiator 16. The coolant circulating apparatus 18 is supplied with the heat-radiated coolant from the outlet 16b of the
10 coolant circulating passage 16c of the radiator 16, and feeds the heat-radiated coolant to the inlet 14a of the coolant circulating passage 14c of the cooler 14 so that the heat-radiated coolant is passed through the coolant circulating passage 14c of the cooler 14 and
15 then is directed to the inlet 16a of the coolant circulating passage 16c of the radiator 16.

 The coolant circulating apparatus 18 includes: a plurality of circulating pumps 22a, 22b each of which has an inlet port 20a and a discharge port 20b, which
20 are disposed in parallel to each other, and which discharge the coolant flowing into the respective inlet ports 20a from the respective discharge ports 20b; a coolant selectively introducing unit 24 which is connected to the inlet ports 20a of the plural
25 circulating pumps 22a, 22b, which is supplied with the heat-radiated coolant from the outlet 16b of the coolant circulating passage 16c of the radiator 16, and

- 9 -

which selectively introduces the heat-radiated coolant into the inlet ports 20a of the plural circulating pumps 22a, 22b; and a plurality of check valves 26 which are connected to the discharge ports 20b of the plural circulating pumps 22a, 22b.

Since the plural circulating pumps 22a, 22b of the coolant circulating apparatus 18 are heavy and bulky, the plural circulating pumps 22a, 22b are disposed at the lowest part of the broadcasting transmitter 12. Thus, the plural circulating pumps 22a, 22b are disposed below the cooler 14 disposed adjacent to the plural power amplifiers serving as the heat generating elements in the broadcasting transmitter 12.

In this embodiment, the coolant is water or water mixed with anti-freeze liquid.

The coolant circulating apparatus 18 further includes: a plurality of branched coolant supply pipes 28 which extend from the check valves 26 horizontally or downwardly and which have extending ends 28a integrated with each other; an integrated coolant supply pipe 30 which extends upward from the integrated extending ends 28a of the branched coolant supply pipes 28 and which supplies the heat-radiated coolant to the inlet 14a of the coolant passage 14c of the cooler 14; and a coolant discharge pipe 32 which extends horizontally or downwardly from the integrated extending ends 28a of the plural branched coolant

- 10 -

supply pipes 28 and which is provided with an on-off valve 32a.

In this embodiment, the coolant selectively introducing unit 24 includes a plurality of on-off valves 24a connected to the inlet ports 20a of the plural circulating pumps 22a, 22b.

The coolant circulating apparatus 18 of this embodiment further includes a coolant reservoir 34 between the outlet 16b of the coolant circulating passage 16c of the heat radiator 16 and the coolant selectively introducing unit 24 of the coolant circulating apparatus 18. The coolant reservoir 34 temporarily reserves the heat-radiated coolant from the outlet 16b of the coolant circulating passage 16c of the radiator 16.

Further in this embodiment, a known dust remover 36 for removing dust mixed in the coolant is interposed between the coolant selectively introducing unit 24 and the inlet port 20a of each of the plural circulating pumps 22a, 22b, and a flow control valve 38 is interposed between the discharge port 20b of each of the plural circulating pumps 22a, 22b and the check valve 26 corresponding thereto.

More further in this embodiment, a coolant temperature adjusting unit 40 is interposed between the outlet 16b of the coolant circulating passage 16c of the heat radiator 16 and the coolant selectively

- 11 -

introducing unit 24 of the coolant circulating
apparatus 18. The coolant temperature adjusting unit
40 mixes the heat-radiated coolant from the outlet 16b
of the coolant circulating passage 16c of the radiator
16 with the heat-absorbed coolant from the outlet 14b
of the coolant circulating passage 14c of the cooler 14
at a desired ratio, and supplies the mixture of the
heat-radiated coolant and the heat-absorbed coolant at
the desired ratio to the coolant selectively
introducing unit 24 of the coolant circulating
apparatus 18.

Particularly, the coolant temperature adjusting
unit 40 is interposed between the outlet 16b of the
coolant circulating passage 16c of the radiator 16 and
the coolant reservoir 34. A pipe 42 extending from the
outlet 16b of the coolant circulating passage 16c of
the radiator 16 toward the coolant reservoir 34 is
branched to two ways before it reaches the coolant
reservoir 34, and reaches the coolant reservoir 34
through thermostat valves 44 connected to the two
branched ends of the pipe 42.

A two-way branched pipe 50 with an on-off valve 48
is branched from a pipe 46 extending from the outlet
14b of the coolant circulating passage 14c of the
cooler 14 toward the inlet 16a of the coolant
circulating passage 16c of the radiator 16, and two
extending ends of the two-way branched pipe 50 are

- 12 -

connected to the thermostat valves 44.

Drive sources (which are usually electric motors and do not shown in the attached figure) for the plural circulating pumps 22a, 22b are connected to a control unit 52 for controlling these operations. The control unit 52 monitors the temperature and pressure of the coolant flown in the cooling apparatus including those of the coolant flown out from the discharge ports 20b of the plural circulating pumps 22a, 22b, and further monitors the temperature of the heat generating element of the electric and/or electronic device to be cooled by the cooler 14, that is for example the temperature of the electric power amplifier as the heat generating element in the broadcasting transmitter 12 in this embodiment. And, the control unit 52 controls the operations of the drive sources (which are usually electric motors and do not shown in the attached figure) for the plural circulating pumps 22a, 22b so that the temperature of the heat generating element stays below a predetermined value.

The on-off valve 48 of the coolant temperature adjusting unit 40, the on-off valves 24a of the coolant selectively introducing unit 24, and the flow control valves 38 of the discharge ports 20b of the plural circulating pumps 22a, 22b may be opened or closed suitably on a basis of the monitoring result of the control unit 52.

- 13 -

Next, an operation of the cooling apparatus 10 according to this embodiment and structured as described above will be described.

When the broadcasting transmitter 12 using the
5 plurality of power amplifiers as the heat generating elements starts its operation while one of the plural on-off valves 24a of the coolant selectively introducing unit 24 is opened and the other is closed, the control unit 52 of the cooling apparatus 10 makes
10 one driving source (not shown) of the plural circulating pumps 22a, 22b corresponding to the opened on-off valve 24a operates and makes the remaining driving source (not shown) of the plural circulating pumps 22a, 22b corresponding to the remaining closed
15 on-off valve 24a being inoperative.

As a result, the heat-radiated coolant supplied from the outlet 16b of the coolant circulating passage 16c of the radiator 16 to the coolant reservoir 34 through the coolant temperature adjusting unit 40 and
20 reserved in the coolant reservoir 34, is discharged from the coolant reservoir 34 into the one of the plural circulating pumps 22a, 22b (for example, the circulating pump 22a in this embodiment) corresponding to the opened on-off valve 24a. The one plural
25 circulating pump 22a or 22b discharges the heat-radiated coolant from its discharge port 20b into the branched coolant supply pipe 28 corresponding to the

- 14 -

one circulating pump 22a or 22b through the flow control valve 38 and check valve 26 corresponding thereto.

Usually, the on-off valve 32a of the coolant
5 discharge pipe extending horizontally or downwardly from the integrated extending ends 28a of the branched coolant supply pipes 28 extending from the discharge ports 20b of the plural circulating pumps 22a, 22b is closed. Therefore, the heat-radiated coolant in the
10 branched coolant supply pipe 28 flows into the integrated coolant supply pipe 30 extending upward from the integrated extending ends 28a of the branched coolant supply pipes 28 to the inlet 14a of the coolant circulating passage 14c of the cooler 14 located above
15 the plural circulating pumps 22a, 22b, and then flows into the inlet 14a of the coolant circulating passage 14c of the cooler 14 to move in the coolant circulating passage 14c.

The heat-radiated coolant moving in the coolant
20 circulating passage 14c from the inlet 14a to the outlet 14b in the cooler 14 absorbs the heat generated by the plural power amplifiers (not shown) as the heat generating elements (not shown) located adjacent to the cooler 14 in the broadcasting transmitter 12.

25 When the temperature of the air surrounding the broadcasting transmitter 12 is over a predetermined value, for example over a normal temperature, the

- 15 -

on-off valve 48 of the coolant temperature adjusting unit 40 is closed.

5 In this case, the coolant which absorbs heat in the coolant circulating passage 14c of the cooler 14 is sent from the outlet 14b of the coolant circulating passage 14c of the cooler 14 into the inlet 16a of the coolant circulating passage 16c of the radiator 16 without passing through the coolant temperature adjusting unit 40. The heat absorbed in the coolant is
10 radiated by blowing air from the fan against the plural heat radiating fins (not shown) of the heat radiator 16 while the heat-absorbed coolant passes through the coolant circulating passage 16c of the heat radiator 16.

15 The coolant radiated heat in the coolant circulating passage 16c of the radiator 16 is returned to the coolant reservoir 34 through the thermostat valves 44 of the coolant temperature adjusting unit 40.

20 When the temperature of the air surrounding the broadcasting transmitter 12 is lower than the predetermined value, for example lower than the normal temperature, the on-off valve 48 of the coolant temperature adjusting unit 40 is opened. As a result, the heat-absorbed coolant supplied from the cooler 14
25 is mixed with the heat-radiated coolant supplied from the heat radiator 16 at a desired ratio by the thermostat valves 44 of the coolant temperature

- 16 -

adjusting unit 40, and the mixture of the heat-absorbed coolant supplied from the cooler 14 with the heat-radiated coolant supplied from the heat radiator 16 at the desired ratio is supplied to the coolant reservoir 34 of the coolant circulating apparatus 18 and then to the coolant selectively introducing unit 24.

When the on-off valve 32a of the coolant discharge pipe 32 extending horizontally or downwardly from the proximal end of the integrated coolant supply pipe 30, that is the integrated extending ends 28a of the branched coolant supply pipes 28, is opened while the operation of the broadcasting transmitter 12 is stopped, that is while the operation of the cooling apparatus 10 is stopped, the coolant can be discharged from the coolant circulating passage 14c of the cooler 14 through the integrated coolant supply pipe 30 and the coolant discharge pipe 32.

The plural branched coolant supply pipes 28 connected to the discharge ports 20b of the plural circulating pumps 22a, 22b and having the extending ends 28a integrated with each other at the proximal end of the integrated coolant supply pipe 28a extends from the flow out sides of the check valves 26 toward the extending ends 28a horizontally or downwardly. Therefore, the coolant in the part of the plural branched coolant supply pipes 28 located between the extending ends 28a at the proximal end of the

- 17 -

integrated coolant supply pipe 30 and the flow out sides of the check valves 28 of the plural circulating pumps 22a, 22b can be discharged through the coolant discharge pipe 32 surely and easily.

- 18 -

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A coolant circulating apparatus comprising:

circulating pumps which are disposed in parallel to each other, and each of which has an inlet port and a discharge port and discharges coolant flowing into the inlet port from the discharge port;

a coolant selectively introducing unit which is connected to the inlet ports of the circulating pumps and which selectively introduces the coolant into the inlet ports of the circulating pumps;

check valves which are connected to the discharge ports of the circulating pumps;

branched coolant supply pipes each of which extends in one of a horizontal direction or a downward direction from each of the check valves and which have extending ends at which the branched coolant supply pipes are integrated with each other;

an integrated coolant supply pipe which extends upward from the integrated extending ends of the branched coolant supply pipes; and

a coolant discharge pipe with an on-off valve, which extends downwardly from the integrated extending ends of the branched coolant supply pipes, the coolant discharge pipe being configured to discharge coolant from the coolant circulating apparatus.

2. The coolant circulating apparatus according to claim 1, wherein the coolant selectively introducing unit includes on-off valves connected to the inlet ports of the circulating pumps.

- 19 -

3. A cooling apparatus for an electric and/or electronic device having a heat generating element, comprising:

a cooler which is disposed adjacent to the heat generating element and in which a coolant circulating passage having an inlet and an outlet is provided;

a radiator which is disposed apart from the heat generating element and in which a coolant circulating passage having an inlet and an outlet is provided, the inlet being connected to the outlet of the coolant circulating passage of the cooler; and

a coolant circulating apparatus which is interposed between the cooler and the radiator and which supplies a heat-radiated coolant from the outlet of the coolant circulating passage of the radiator to the inlet of the coolant circulating passage of the cooler and moves the coolant passed through the coolant circulating passage of the cooler toward the inlet of the coolant circulating passage of the radiator,

wherein the coolant circulating apparatus comprises:

circulating pumps which are disposed in parallel to each other, and each of which has an inlet port and a discharge port and discharges coolant flowing into the inlet port from the discharge port;

a coolant selectively introducing unit which is connected to the inlet ports of the circulating pumps and which selectively introduces the coolant into the inlet ports of the circulating pumps;

check valves which are connected to the discharge ports of the circulating pumps;

branched coolant supply pipes each of which extends in one of a horizontal direction or a downward direction from each of the check valves and which have

- 20 -

extending ends at which the branched coolant supply pipes are integrated with each other;

an integrated coolant supply pipe which extends upward from the integrated extending ends of the branched coolant supply pipes; and

a coolant discharge pipe with an on-off valve, which extends downwardly from the integrated extending ends of the branched coolant supply pipes, the coolant discharge pipe being configured to discharge coolant from the coolant circulating apparatus.

4. The cooling apparatus according to claim 3, wherein the coolant selectively introducing unit of the coolant circulating apparatus includes on-off valves connected to the inlet ports of the circulating pumps.

5. The cooling apparatus according to claim 3, further comprising a coolant reservoir which is provided between the outlet of the coolant circulating passage of the radiator and the coolant selectively introducing unit of the coolant circulating apparatus and which temporally reserves the heat-radiated coolant from the outlet of the coolant circulating passage of the radiator.

6. The cooling apparatus according to claim 3, further comprising a coolant temperature adjusting unit which is interposed between the outlet of the coolant circulating passage of the radiator and the coolant selectively introducing unit of the coolant circulating apparatus, which mixes the heat-radiated coolant from the outlet of the coolant circulating passage of the radiator with the heat-absorbed coolant from the outlet of the coolant circulating passage of the cooler at a desired ratio, and

- 21 -

which supplies the mixture of the heat-radiated coolant and the heat-absorbed coolant at the desired ratio to the coolant selectively introducing unit of the coolant circulating apparatus.

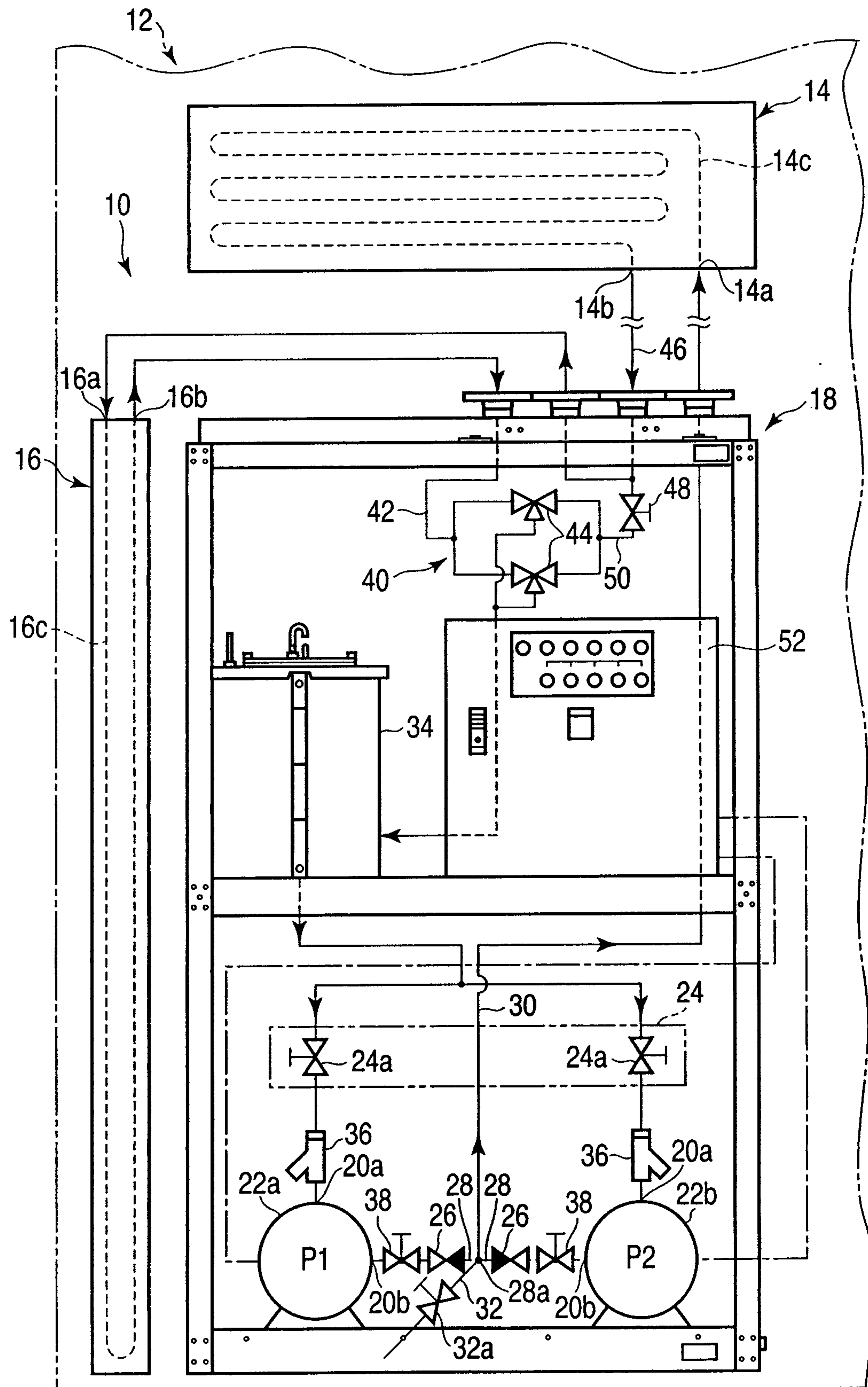


FIGURE 1

