Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2570122 A1 2008/06/06

(21) 2 570 122

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2006/12/06

(41) Mise à la disp. pub./Open to Public Insp.: 2008/06/06

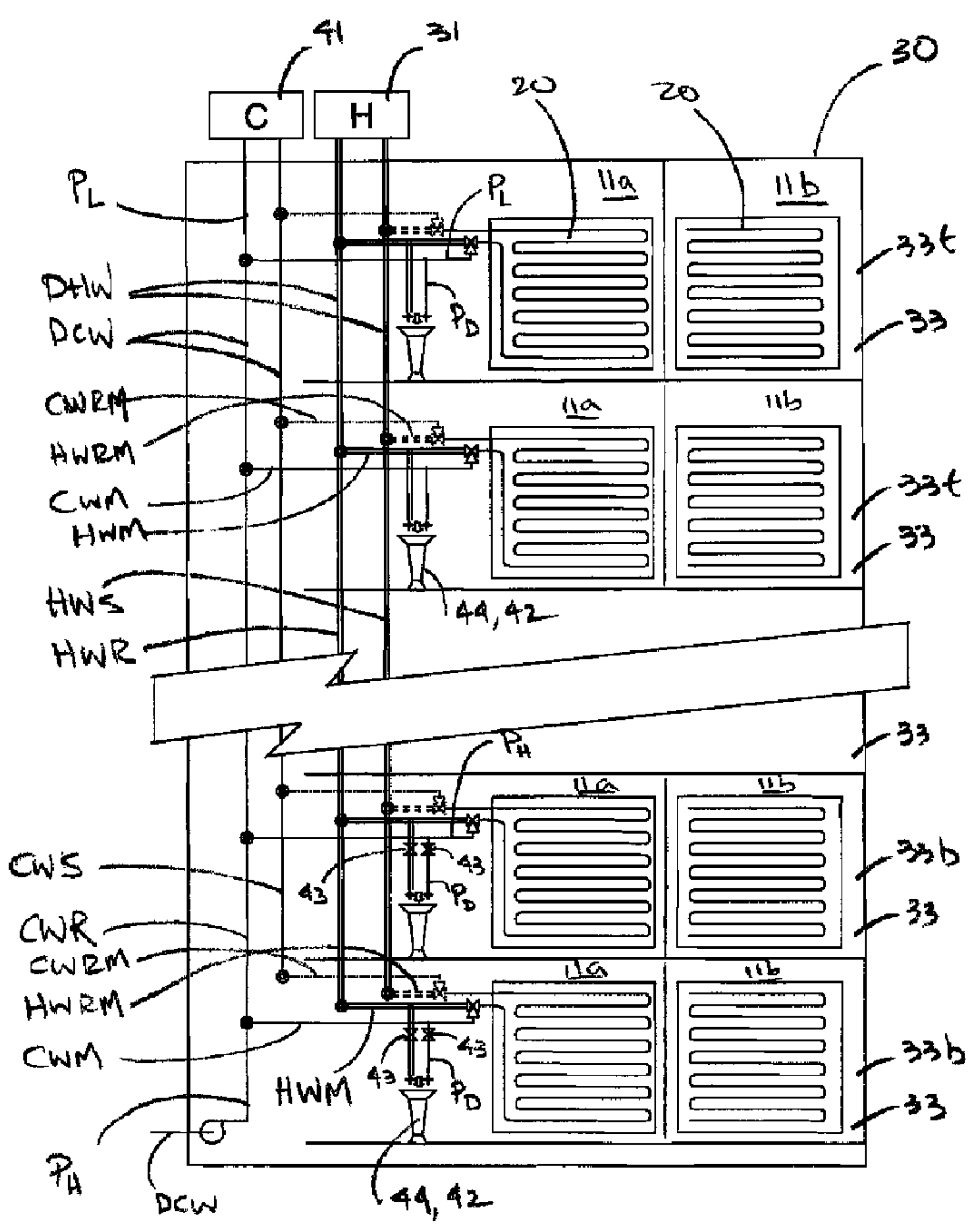
(51) Cl.Int./Int.Cl. *F24D 3/08* (2006.01), *F24D 3/12* (2006.01)

(71) Demandeur/Applicant:
SINCLAIRE, ROSS, CA

(72) Inventeur/Inventor:
SINCLAIRE, ROSS, CA

(74) Agent: GOODWIN MCKAY

(54) Titre : SYSTEME MURAL RAYONNANT DE CONDITIONNEMENT POUR IMMEUBLES DE GRANDE HAUTEUR
(54) Title: TEMPERATURE CONDITIONING RADIANT WALL SYSTEM FOR BUILDINGS



(57) Abrégé/Abstract:
A temperature conditioning system for a plurality of suites of a high rise building is provided utilizing at least domestic hot water circulated through tubing fit to a radiant wall in a suite for heating the suite. A hot water heating system in communication with a

(57) Abrégé(suite)/Abstract(continued):

supply riser and return riser provides hot water at variable pressure to each of the multiple serviced floors. Hot water is cirulated through distribution mains to radiant walls in the suites at full riser pressure, while pressure reducing valves off of the distribution mains lower the hot water pressure to domestic service pressures at plumbing fixtures. Similarly, domestic cold water can be chilled and circulated through the radiant walls for cooling. Three-way valves at the radiant wall can alternately circulate hot water or cold water under thermostatic control.

ABSTRACT OF THE INVENTION

A temperature conditioning system for a plurality of suites of a high rise building is provided utilizing at least domestic hot water circulated through tubing fit to a radiant wall in a suite for heating the suite. A hot water heating system in communication with a supply riser and return riser provides hot water at variable pressure to each of the multiple serviced floors. Hot water is cirulated through distribution mains to radiant walls in the suites at full riser pressure, while pressure reducing valves off of the distribution mains lower the hot water pressure to domestic service pressures at plumbing fixtures. Similarly, domestic cold water can be chilled and circulated through the radiant walls for cooling. Three-way valves at the radiant wall can alternately circulate hot water or cold water under thermostatic control.

TEMPERATURE CONDITIONING RADIANT WALL SYSTEM FOR BUILDINGS

FIELD OF THE INVENTION

The present invention relates to systems for the heating and cooling of buildings, reduction in capital expense, and the distribution of water for minimizing the number of piping risers and avoiding over-pressure supplies through the strategic placement of pressure reducing valves.

BACKGROUND OF THE INVENTION

Heating and cooling systems for multi-story buildings typically use specifically supplied and circulated hot and cold water for delivery to heat exchangers. Traditionally, room-by-room heating, and air conditioning systems in large buildings have been, what are known in the art, as four-pipe fan-coil systems; two pipes for chilled water flow, and two pipes for heated water flow. Individual fan-coil units placed at various locations throughout the building provide for zonal temperature control. Heating or cooling is provided by having the fan circulate air over a coil that is accessing either the hot or the chilled-water piping system, respectively. Water distribution systems for multi-story buildings also typically comprise various arrangements of water supply and returns.

Conventional 8 floor zones extend risers up through all suites with the associated water noise for the lower suites and the large number of risers. Each riser is associated with fire blocking and challenges at bulkheads and cross-over floors.

To date, choices for heating and cooling commercial or multi-suite buildings have been limited and equipment such as fan coils are an expensive, but known, solution.

Multi-story buildings further introduce challenges including problems related to hydrostatic pressure variation from floor to floor. In a 24 storey building the pressure at the lowest floor may be about 130 psig so as to maintain 40 psig at the highest of the upper floors or roof where the hydraulic head is at its minimum. To supply a 72 storey building from a single water supply riser would result in pressures at the lowest floor at about 250 psi. However, it is unacceptable to apply 250 psi or even 130 psig water for domestic use. Higher pressure in a domestic hot water system will ensure return flow to the hot water boilers but such pressures are too high for domestic purposes.

There is a need for a reduction in redundant piping, elimination of noise in suites, lower capital cost and more efficient systems in the heating, cooling and distribution of domestic water in high rise buildings. Applicant addresses these shortcomings and incorporates further improvements to heating and cooling systems, some of which can be incorporated with domestic water distribution.

SUMMARY OF THE INVENTION

Applicant has provided a system which significantly reduces the piping needed to supply domestic hot and cold water to one or more units, residences or suites in high rise buildings, solves issues associated with the supply of water at pressures above desired domestic use pressures, and incorporates novel heating concepts for multi-residence buildings. The number of risers throughout can be reduced in number by more than an order of magnitude. Noise issues associated with flow in risers extending through each suite is eliminated.

Applicant has recognizes that use of domestic water system for heating and cooling using partitioning walls as radiant walls, enables heating and cooling of adjacent rooms and better utilizes existing domestic water systems for minimizing capital expenditures such as through the reduction or elimination of fan-coil or hydronic radiant panel devices.

The partitioning walls condition room temperatures by acting as a cold or hot radiant wall either using hot domestic water for heating, or using chilled domestic water for cooling, or alternating therebetween using thermostatic valves for circulating either the heated domestic water or chilled domestic water.

Applicant further recognized that several aspects of pressure control at lower floors provides significant advantages. Use of full pressure, variable over elevation, domestic cold and hot water systems and pressure reducing valves as required for domestic service only, eliminates floor to floor risers and remarkably reduces the numbers of piping runs. Pressure and flow control is maintained despite the number of floors in the building. No longer do domestic water pressure and plumbing fixture requirements limit the use of common risers at full pump pressure at full hydrostatic head. Further, the system has several solutions for ensuring hot water availability and avoiding stagnation which can occur in some domestic lines, contrary to public safety and contrary to plumbing regulations in some jurisdictions.

In one embodiment, the system has a domestic hot water supply riser and a hot water return riser. At each serviced floor, a domestic hot water distribution main extends from the hot water supply riser to each of one or more suites and returns to the hot water return riser. On each floor, typically lower floors, at which a riser pressure is higher than preferred service pressure for domestic plumbing fixtures, a pressure reducing valve is situated at least between the distribution main and domestic use fixtures in the suites for reducing the pressure of the cold and the hot water as required. Coupling of the heating systems directly off of the supply riser at full water pressure and to the hot water distribution main provides an effective piping system for circulation of hot water through heating systems and allows for return of hot water circulation to the heating system without a need for further pumping. Further, implementation of a substantially constant circulation of hot water through the hot water distribution main ensures hot water is available on demand. Additionally, when heating is not required, regular and periodic circulation through the hot water distribution main avoids stagnation of the domestic hot water supply.

As a result, applicant has determined that up to 70% can be saved on the fluid piping in a building and 20% on the cost of the entire mechanical system. Supply risers no longer run through suites, eliminating noise. Bulkheads and cross-over floors are no longer a concern for domestic water distribution. Water circulation is simplified without a need for auxiliary pumps to return spent water to heating and cooling systems. With reduced numbers of risers comes less wasted floor area for accommodating piping. Use of domestic hot water for heating, and as desired domestic cold water for cooling reduced capital cost by reducing or eliminating fan coils and other equipment.

In one broad aspect, a system for temperature conditioning multiple serviced floors of a high rise building is provided, each floor having one or more suites having interior and exterior walls and having plumbing fixtures being serviced with at least domestic hot water. Such a system comprises: providing at least a domestic hot water distribution main at a supply pressure at each serviced floor for servicing the suites. The domestic hot water distribution main provides domestic hot water to one or more suites on the floor. The domestic hot water is thermostatically controlled through radiant tubing installed in one or more radiant walls in a suite, of one or more suites, for heating the suite. For each floor at which the supply pressure of the domestic hot water is above a first pressure threshold, typically a suitable domestic service pressure, the water pressure of the hot water to the domestic use fixtures is reduced to about the first threshold pressure using one or more pressure reducing valves situated between the distribution main and the domestic use fixtures of each suite.

Preferably, the system further comprises a domestic cold water distribution main for each serviced floor at a supply pressure. In embodiments where cooling is not required, such as in moderate climates, and for each floor at which the supply pressure of the domestic cold water supply at each floor is above a second pressure threshold, typically the suitable domestic service pressure, the water pressure of the cold water is simply reduced at the before the distribution main. Where cooling using domestic cold water is employed as well for the radiant walls, one can maintain the domestic cold water distribution main at full pressure for radiant wall circulation and, as applied to the domestic hot water, reduce the water pressure of the cold water to the domestic use fixtures to the second threshold pressure using one or more pressure reducing valves situate between the full pressure cold water distribution main and the domestic use fixtures of each suite.

Preferably, a heating system or heater provides heated hot water to each domestic hot water distribution main, and a hot water return riser returns hot water from the distribution mains to the heater. Similarly, a cold water riser provides chilled cold water from a cooling system or chiller to each floor's distribution main, and a cold water return riser returns cold water from each distribution main to the chiller.

For heating and cooling using radiant walls, a pair of three-way valves are employed, a first three-way valve controls whether chilled or heated domestic water is circulated into the tubing in the radiant wall, and a second three-way valve controls whether the thermally spent water returning from the radiant wall is returned to the cold water return riser or the hot water return riser respectively.

Preferably the domestic hot water main is fit with a flow control valve to flow back to the return riser so as to provide a controlled, yet substantially constant flow of hot water for ensuring a substantially on-demand hot water response at the domestic use fixtures. Preferably the flow control valve is positioned between the distribution main after the last serviced suite, and a return main to the return riser. The radiant walls and other heating loops can be provided with thermostatically controlled valves having periodic dump features to avoid stagnation.

Typically radiant wall are provided on interior walls of a suite for bi-directional heating. More preferably, suites adjacent an exterior wall, and similarly adjacent utility or common areas such as stairwells, can be provided with additional radiant tubing installed in the floor such as adjacent the exterior wall. As necessary, walls between adjacent suites can be fit with radiant walls, but are arranged for uni-directional heating to the suite having the thermostatic control.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic plan view of an arrangement of a hot wall heating system arranged in an intervening partition wall dividing two rooms of a suite;

Figure 2 is a schematic elevation view of radiant tubing arranged in a radiant wall and operating at full hot water supply pressures;

Figure 3A is a schematic elevation of a high rise building implementing some of the heating and cooling features of the present invention;

Figure 3B is a schematic elevation of a high rise building implementing only heating features of the present invention;

Figure 3C is a schematic of adjacent suites of a lower floor according to Fig. 3A and illustrating the hot and cold water distribution mains and pressure reducing valves to fixtures;

Figure 4 is a schematic plan view of an arrangement of a hot wall heating system arranged on the facing wall of a single suite to avoid heat transfer or loss through the facing wall, such as to an adjacent suite or non-suite;

Figure 5 is a schematic plan view of an arrangement of a hot wall heating system arranged in an intervening partition wall dividing two suites where one of the two suites is adjacent an exterior wall and the radiant tubing is expanded to include auxiliary floor heating; and

Figures 6A and 6B illustrate the domestic hot water and domestic cold water piping to typical plumbing fixtures in a suite.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Generally, as shown in Fig. 1, adjacent rooms 10a,10b within a suite 11 are separated by a walls 12, such as an interior partitioning wall 13. During seasons where the rooms 10a,10b require heating, one or more of the walls 12 can be operated as hot radiant walls 20. In the case of an interior partitioning wall 13 operated as a radiant wall 20, heat radiates bi-directionally into the suite 11 in both directions to adjacent rooms 10a,10b. An interior partitioning wall 13 within a suite 11 is a convenient embodiment for a bi-directional radiant wall 20 wherein a suite occupant can control the radiant output solely for their suite 11. One is less inclined to operate a party wall 14, located between adjacent suites 11a,11b, as a bi-directional radiant wall 20 because thermostatic control by an occupant in one suite 11a can also affect the comfort of an occupant of the adjacent suite 11b. Options include either avoiding the implementation of radiant walls 20 in a party wall between suites 11a,11b or instead to configure such radiant walls 20 for uni-directional radiant thermal control.

While referred to as a "radiant" wall, which suggests radiant heat transfer, other aspects of the principles of heat transfer are also inherent and contemplated, such as conduction to the wall surface and convection therefrom. Further, radiant walls 20 can provide thermal control including either heating and cooling. While examples are provided in terms of a hot radiant wall 20, heated using domestic hot water DHW, temperature conditioning or thermal control using a radiant wall 20 can equally include cooling using a circulation of domestic cold water DCW. Temperature adjusted water, which is circulated through radiant walls 20 for temperature control, is generally termed herein as thermal water and more specifically as domestic cold water DCW or domestic hot water DHW.

With reference also to Fig. 2, the radiant wall 20 comprises thermal tubing 21, such as cross-linked polyethylene tubing (PEX), for example AQUAPEX® available from Wirsbo Company of 4925 W 148th Street, Apple Valley MN, 55124, USA, located within the cavity of the partition wall 13. The tubing 21 is arranged in a serpentine manner to distribute the tubing in the wall. The tubing 21 can be overlapped as necessary and without concern. Tubing 21 can be arranged in up-and-down orientation (not shown) or a side-to-side orientation (shown) which can have advantages if the system needs to be drained at come point. Thermal water is circulated through the tubing 21 as necessary to meet the thermal loads, typically heating and can alternately include cooling. Heating loads for each suite 11a,11b ... are provided from the domestic hot water DHW provided at each floor. Where necessary, cooling loads are provided from the domestic cold water DCW, preferably chilled, provided at each floor. The length of thermal tubing 21 fit to the radiant wall 20 provides sufficient surface area to meet the design thermal loads as is known to those of skill in the art.

Within a radiant wall 20, the thermal tubing 21 is positioned sufficiently offset within the wall 20 from either wall surface to avoid accidental punctures from screws and other fasteners.

An implementation of various embodiments in the context of a high rise building 30 is set forth in Figs. 3A – 3C and discussed later below.

With respect to the radiant walls 20, and in Fig. 4, where heating is desired only to one side of the radiant wall 20, such as at a party wall 14, the wall

20 is configured for directing the heat H into the room 10 only which is to be heated. Again, the thermal tubing 21 is also positioned sufficiently offset within the wall 11 from the wall surface to avoid accidental punctures from screws and the like, however, heat transmission is emphasized from one side of the wall 20, either through heat reflective surfaces, offsetting the radiant tubing 21 more towards the wall surface adjacent the room to be heated, or through selective insulation 15 or a combination thereof.

In Fig. 5, end suites are subject to greater heat loss through windows and an additional exterior wall and can be fit with additional thermal tubing 21, such as in an auxiliary radiant heating loop 22. The loops 22 are embedded in the floor and provide heat H adjacent the areas most susceptible to the additional heat loss or gain due to exterior influences. The loop 22 can be in plumbed to circulate in series with radiant wall 20, such as after the thermal tubing 21 has passed through the radiant wall and resulting in lesser thermal gradient. Depending on the plumbing arrangement, alternatively the loop 22 can be plumbed in parallel with the radiant wall for maximal output of heat H.

Domestic hot water DHW and domestic cold water DCW are also typically provided at each floor of a multi-story building and are circulated to each suite 11.

Fig. 3A is a schematic illustration of a typical arrangement of piping for radiant walls 20 for a high rise, multi-story building 30. At least a heating system 31 such as a boiler or heat pump is provided for the heating and circulation of heated domestic hot water DHW through a hot water supply riser HWS to each floor 33. Domestic hot water returns to the heating system 31 through a hot water return riser HWR. The heating system can be located at a convenient location. Hot water heaters and boilers with heat exchangers for heating domestic hot water are often at roof level. Heat pumps, which can heat or cool domestic water are typically located in the basement levels adjacent ground loops.

The hot water supply riser HWS and hot water return riser HWR extend to each of the multiple services floors 33 and are fluidly connected to the hot water heating system 31. Water pressure of the domestic hot water DHW in the risers HWS,HWR varies with elevation due to the variation in hydrostatic head.

The heating system 31 is illustrated at the top floor but could be located at any elevation in fluid communication with the supply and return risers HWS,HWR.

Further, on very tall buildings, vertical zones of multiple floors can be provided with their own heater, hot water supply and return risers (not shown). The multiple serviced floors can be arranged in vertical zones, further comprising for each zone a booster pump which supplies water to the zonal hot and cold water risers to ensure a pressure exists therein which, at a highest floor of the zone is at least domestic service pressure, and at the lowest floor of the zone, is at or below a maximum booster system pressure.

Where cooling functions are desired, a cooling system 41 such as a heat pump or chiller is also provided for circulation of chilled domestic cold water DCW through a chilled water supply riser CWS to each floor 33. Domestic cold water returns to the cooling system 41 through a chiller water return riser CWR. The cooling system 41 is illustrated at the top floor but could be located at any elevation along the supply and return risers CWS,CWR. Water pressure of the domestic cold water in the risers CWS,CWR varies with elevation. The temperature of the chilled water is pre-determined to avoid condensation issues as is known to those skilled in the art.

With reference to Figs. 3A and 3C, each serviced floor 33 comprises a plurality of suites 11a,11b ... serviced with domestic cold water DCW and domestic hot water DHW, supplied by the hot water distribution main HWM and cold water distribution main CWM respectively. For illustrative purposes only, one suite 11a is shown plumbed to the mains HWM,CWM. Further, for illustrative purposes only, a pedestal sink 44 is provided in suite 11a as an example of a domestic use fixture 42.

Characteristic of multi-story buildings 30, each successive higher floor 33 experiences a corresponding loss of hydrostatic head and water pressure. In order to provide water under sufficient domestic service pressure P_D to more than one vertically arranged floor in the building, the hot water supply riser HWS is pressurized, at lowest of the lower floors 33b, to a pressure threshold P_H, which is often greater than the desired domestic use pressure P_D, so that a minimum domestic pressure P_L can be maintained at a highest of the upper floors 33t. The pressure threshold P_H at the lowest of the lower floors 33b, is typically at a pump pressure for delivering at least the minimum domestic pressure P_L to the upper floors 33t.

Similarly, the cold water supply riser CWS also extends either up or down the building 30, and is subject to the same variation in hydrostatic head and will operate at substantially the same variable pressures. Accordingly, the lowest floors 33b are supplied at the greatest pressure with water pressure diminishing at higher elevations to the upper floors 33t which are supplied at the lowest pressure P_L.

Domestic facilities or fixtures 42, such as toilets, sinks and laundry hook-ups have a maximum service pressure and preferably operate at domestic service pressures P_D. The fixtures plumbed with domestic water will a preferred hot water threshold pressure and a cold water threshold pressure. Usually the threshold pressures for the DCW and DHC at the fixtures 42 is the same domestic service pressure P_D. As shown in Figs. 6A and 6B typical plumbing fixtures in a suite include a water closet or toilet WC (DWC only), laundry L (DHW and DCW), shower SH (DHW and DCW) and a sink SK (DHW and DCW).

The pressure of the domestic hot water DHW and domestic cold water DCW in the risers HWS,CWS at lower floors 33b can be higher that acceptable domestic service pressures P_D. Accordingly, the cold water DCW and the hot water DHW for these lower floors 33b are pressure reduced at the fixtures 42. One or more hot water pressure reducing valve 43 are at least provided at each suite 11 for reducing the pressure of the hot water DHW directed to plumbing fixtures 42. The valve 43 is located between the hot water distribution main HWM, which circulates heating water at full riser pressure through radiant walls 20, and the fixtures 42, which are fed at reduced domestic service pressures P_D.

Upper floors 33t do not require pressure reduction as the water pressure is already between the minimum pressure P_L and a preferred domestic service pressure P_D. Accordingly, the domestic plumbing fixtures 42 for upper floors 33t are directly plumbed to the distribution main HWM at the full pressure of the hot water supply riser HWS.

Further, in Fig. 6B, before the water returns from a serviced floor 33, a thermal tubing 21 from the hot water distribution main HWM can also be directed to ancillary, non-suite areas such as stairwells 50. In this arrangement shown in Figs. 6A and 6B, and according to Fig. 3B in which cooling is not required, the domestic cold water DCW is not circulated. Therefore, a pressure reducing valve 43 need only be provided (not shown) between the cold water supply riser CWS and the cold water distribution main CWM as domestic cold water is only used for domestic use fixtures 42. Accordingly, pressure reducing valves are not needed, nor illustrated, between the cold water distribution main CWM and a return riser, as there is no need for a cold water return main or riser.

As discussed in Applicant's co-pending application 10/851,349, filed May 21, 2004 to Applicant and published as US-2005-0183773-A1 on August 25, 2005, and discussed in the context of the use of fan coils as the preferred heating and cooling equipment, improved efficiencies and comfort are achieved using an improved piping system by implementing hot water supply risers HWS and hot water return risers HWR extending vertically up the building with pressure reduction applied on a floor-by-floor basis as necessary to accommodate domestic plumbing fixtures 42. Each floor is supplied with a domestic hot water distribution main HWM for providing domestic hot water service throughout the floor to each suite 11. Even at the lower floors 33b, hot water recirculates at full hydrostatic pressures between the hot water heating system 31 or boiler, the supply risers HWS, and each distribution main HWM, so as to enable recirculation of return domestic hot water DHW through the hot water return riser HWR to the hot water heating system 31, the recirculation being performed without pumping. Therefore, on each lower floor 33b, a plurality of hot water pressure reducing valves 43 are provided, one at each suite 11 or for one or more of the plumbing fixtures 42. Each pressure reducing valve 43 reduces the pressure between the full pressure of the hot water main HWM and the actual domestic use fixtures 42 at domestic service pressures P_D. At upper floors 33t, once the hydrostatic pressure in the hot and cold water supply risers HWS, CWS reduces to approximately 80 – 85 psig or less, pressure reducing valves 43 on both hot and cold water respectively are no longer required.

As shown in Fig. 3B, in instances where cooling is not required, the cooling system 41 for the domestic cold water DCW is generally not required at all, and the domestic cold water DCW can be pressure reduced with valves 43 at each lower floor 33b and a cold water distribution main CWM for each lower floor 33b can operate at domestic service pressures P_D.

Returning to Fig. 3A, where cooling through radiant walls 20 is also an option, the cold water supply riser CWS supplies cold water to a cold water distribution main CWM for circulation of cold water to each suite on the floor 33. Again, for lower floors 33b, pressure reducing valves 43 are provided between the cold water distribution main CWM and the domestic use fixtures 42.

With reference also to Fig. 3C, domestic hot water and domestic cold water is provided to radiant walls 20 in two adjacent suites 11a,11b through the hot water distribution main HWM and cold water distribution main CWM respectively. The two suites 11 shown are located adjacent an end of a run of the distribution mains HWM,CWM. In order to implement alternative heating or cooling through the radiant walls 20, a first three way valve 45 is provided for alternately connecting an inlet end of the thermal tubing to the hot water distribution main HWM for heating the radiant wall 20 and the cold water distribution main CWM for cooling the radiant wall. Under thermostatic control, either hot water DHW flows through the thermal tubing 21, or chilled water flows through the thermal tubing 21. The thermally spent water flows out a discharge end of the thermal tubing 21 for return to one of the risers HWR,CWR. Preferably a second three way valve 46 alternately connects the discharge end of the thermal tubing to the hot water return main HWRM while heating, and the cold water return main CWRM while cooling. Both the first and second three-way valves 45,46 can be controlled by a conventional thermostatic controller (not shown).

Circulation of hot water through the radiant walls 20 is effective by directing hot water DHW to each radiant wall 20 from the hot water distribution main HWM, and back to a collector main or hot water return main HWRM. Generally the hot water return main is arranged in a run parallel to the distribution main HWM and is in fluid communication with the hot water return riser. The hot water return main HWRM collects all the spent hot water collected from the radiant walls 20 for return to the hot water return riser HWR and the hot water heating system 31.

After having distributed hot water to all suites 11 on a floor 33, it is also preferable to install a flow control valve 47 between the hot water distribution main HWM and the return riser HWR. Preferably the flow control valve 47 is positioned between the hot water distribution main HWM, at about a last suite of the one or more suites in series, and the hot water return main HWRM. The valve 47 can be set at about ½ USgpm to assure that there is a continual flow and supply of domestic hot water in the distribution main HWM on each floor and adjacent each suite 11. This is important, especially in the summer months when no hot water is being used for circulation through the radiant walls 20, so as to provide hot water on demand to the fixtures 42. More preferably (not shown), in the case of very large residential suites, a flow control valve can be located (not shown) in each suite to assure that the hot water reaches the suite's faucets in less time.

As shown in Fig. 3C, radiant walls 20 are both heated and cooled. Pressure reducing valves 43 are positioned, in each suite 11a,11b, between the mains HWM,CWM and the fixtures 42 for the particular suite 11. Accordingly, pressures need not be reduced for use with the radiant wall 20.

Circulation of cold water through the radiant walls 20 is effective by directing cold water to each radiant wall 20 from the cold water distribution main CWM, and back to a collector main or cold water return main CWRM. Generally the cold water return main CWRM is arranged in a run parallel to the distribution main CWM and is in fluid communication with the cold water return riser CWR. The cold water return main HWRM collects all the spent cold water collected from the radiant walls 20 for return to the cold water return riser HWR and the cooling system 41.

The thermostatic control for the suite 11 can be fit with a dump valve (not shown) to periodically permit flow therethrough to minimize stagnation in low demand situations or, for simplicity, can operate periodically even during usual demand situations.

In testing conducted in Calgary, Alberta, Canada, a system was tested which utilized domestic hot water DHW for both domestic use and heating of student residences using a radiant wall 20. Heating of adjacent rooms 10a,10b was simulated using a radiant wall 20 such as that arranged shown in

Fig. 1. The radiant wall 20 was formed by threading plastic pipe as the thermal tubing 21 through the metal studs in the partition wall 13, with local thermostatic control of the flow of hot water DHW to each occupant's room. The testing investigated the adequacy of thermal performance (including comfort and thermal output), durability of building systems (include pipe, drywall, and paint lifetime), and the significance of energy savings. The assessment determined that the system met the above criteria.

More specifically test measurements show that a single radiant wall 20, as tested, had a heating capacity of about 1500 W (4500 Btu/hr), which is sufficient to offset losses from typical residence rooms. It was recognized that end units and top floor units would require additional heating. The heat capacity was determined by calculating the heat transfer from the hot water supply and return temperature differential, the water flow rate, and the heat capacity of the water per unit volume. The industry guide for comfort assessment is ASHRAE's Standard 55-2004, Thermal Environmental Conditions for Human Occupancy. At Calgary, Alberta's 99% winter design temperature of -27°C or 17°F, the proposed system, including window losses, maintained an interior room temperature of 11°C (52°F), which compared favorably to the minimum acceptable vertical surface temperature of 10°C in terms of radiant asymmetry (ASHRAE 2004, p. 7).

The wall operating conditions were within conditions deemed acceptable by drywall and paint manufacturers. Prior art piping arrangements that have worn prematurely, having small hot water return water legs, are not used in this system. Further, it was found that it is easy to service radiant wall tubing relative to prior art piping systems such as in-slab radiant piping, because the tubing is enclosed within dry-walled areas.

The simulated system was tested with a hot water temperature of 150°F (10°F or 5.5°C higher than the design temperature) and the maximum interior wall temperature temperatures observed was 118°F (48°C), which was 4°C (7°F) below the warranty limit. Drywall warranties typically allow temperatures up to 125°F (or 51.5°C) on a regular basis. Applicant understands that latex paints can be exposed to temperatures of up to 175°F (80°C) without degradation.

The whole building simulation model was used to estimate annual pump energy use with a conventional dual-piped domestic hot water and building heating system. Pump energy was estimated to be about 5% of total annual energy use. The annual cost saving was estimated to be about 33%, worth about $7,000 CAD at current energy prices. For a building with a local boiler plant, the 60°C supply water temperature for the system allows a return water temperature suitable to permit condensing boilers to operate in condensing mode and attain efficiencies above 88%.

In the testing, the heated wall, at steady-state heat output, had a surface temperature of about 26°C, compared with a known normal range of 18-29°C (65-85°F). The supply-return temperature differential was a minimum of about 5.5°C . The flow rate of the water through the wall was 1 USgpm or 0.063 L/s. At a density of 1,000 g/L, this is a mass flow of 63 g/s. With the specific heat of water at 4.2 J/gC, the heat transferred was 245 J/s per °C or 245 W/°C. For a 6°C temperature differential (the approximate difference at maximum heating), the heat transfer was then 1470 W (5000 Btu/hr). The heat loss was calculated for the double room, as its wall area is greater. The heat loss was estimated at about 1320 W at the design outdoor temperature with a temperature differential inside to outside of -49°C. The heat loss comprised 140W from a spandrel area of 2.4 m^2, 709 W from 5.4 m^2 of windows, 237W from 8.1 m^2 of exterior wall, and lastly an estimated loss from infiltration of 233W.

The wall heat supply was therefore greater than the wall heat loss. The calculation neglected heat gains from occupants (about 70W per person) and any heat-generating equipment, which would provide an additional "cushion" against heat loss. A window thermal gradient calculation showed that the interior temperature at the -27°C design temperature is 11°C.

While a preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention. Consequently, within the scope of the appended claims, it is to be understood that the invention can be practiced otherwise than as specifically described herein.

THE EMBODIMENTS OF THE INVENTION FOR WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A system for temperature control in one or more suites of a high rise building having multiple serviced floors, each serviced floor having the one or more suites serviced with at least domestic hot water, the one or more suites having domestic use fixture therein, the system comprising:

a hot water heating system for heating the domestic hot water;

a hot water supply riser extending to each of the multiple serviced floors, fluidly connected to the hot water heating system, and in which a pressure of the domestic hot water therein varies with elevation;

a hot water return riser extending to each of the multiple serviced floors and fluidly connected to the hot water heating system;

a hot water distribution main extending from the hot water supply riser at each serviced floor for servicing the one or more suites for the serviced floor;

a hot water return main, extending from the hot water return riser at each serviced floor, for returning the domestic hot water from the hot water distribution main for the serviced floor to the hot water heating system and establishing circulation therethrough; and

at each of the one or more suites, further comprising at least one radiant wall fit with thermal tubing for circulation of hot water between the hot water distribution main and the hot water return main; and

at each serviced floor at which the pressure of the domestic hot water in the hot water distribution main is above a hot water pressure threshold, further comprising one or more hot water pressure reducing valves located between the hot water distribution main and the domestic use fixtures of each of the one or more suites for providing domestic hot water to the domestic use fixtures at a domestic service pressure.

2. The system of claim 1 wherein the hot water pressure threshold is above the domestic service pressure.

3. The system of claim 1 or 2 wherein each hot water distribution main further comprises a flow control valve between the hot water distribution main, at about a last suite of the one or more suites in series, and the hot water return main.

4. The system of claim 1, 2 or 3 further comprising a thermostatic control for controlling the circulation of domestic hot water through the radiant tubing.

5. The system of any one of claims 1 to 4 further comprising at least one auxiliary heating loop positioned at a location experiencing additional heat loss than can be accommodated by the radiant wall alone, the auxiliary heating loop being fit with the thermal tubing for circulation of hot water between the hot water distribution main and the hot water return main.

6. The system of claim 5 wherein

the one or more suites comprise interior suite and end suites, the end suites experiencing higher heat loss than can be accommodated by the radiant wall alone, and wherein

the auxiliary heating loop is embedded in the floor of the suite adjacent the higher heat loss.

7. The system of any one of claims 1 to 6 wherein the radiant wall is a partitioning wall dividing two rooms of the suite for heating both rooms.

8. The system of any one of claims 1 to 6 wherein the radiant wall is a party wall dividing a heated room of a first suite and a second suite, further comprising insulation between the radiant wall and the second suite for directing heat to the first suite.

9. The system of any one of claims 1 to 8 wherein the heating system is a boiler.

10. The system of any one of claims 1 to 8 wherein the heating system is a heat pump.

11. The system of any one of claims 1 to 10 wherein each serviced floor is serviced with domestic cold water, further comprising:

a cold water supply riser extending to each of the multiple serviced floors and in which the pressure of the domestic cold water therein varies with elevation;

a cold water distribution main extending from the cold water supply riser at each serviced floor for servicing the one or more suites for the serviced floor; and

at each serviced floor at which the pressure of the domestic cold water in the cold water riser is above a cold water pressure threshold, further comprising at least one cold hot water pressure reducing valve located between the hot water distribution main and the domestic use fixtures of each of the one or more suites for providing domestic cold water to the domestic use fixtures at a domestic service pressure for domestic use fixtures.

12. The system of claim 11 further comprising:

a cooling system for cooling the domestic cold water and wherein the cold water riser is fluidly connected to the cooling system ;

a cold water return riser extending to each of the multiple serviced floors and fluidly connected to the cooling system ;

a cold water distribution main extending from the cold water supply riser at each serviced floor for servicing the one or more suites for the serviced floor;

a cold water return main extending from the cold water return riser at each serviced floor for returning the domestic cold water from the cold water distribution main for the serviced floor to the cooling system and establishing circulation therethrough.

13. The system of claim 11 or 12 wherein at each of the radiant walls of the one or more suites, further comprising a first three way valve for alternately connecting an inlet end of the thermal tubing to the hot water distribution main for heating the radiant wall and the cold water distribution main for cooling the radiant wall.

14. The system of claim 13 wherein, at each of the radiant walls of the one or more suites, further comprising a second three way valve for alternately connecting a discharge end of the thermal tubing to the hot water return main while heating and the cold water return main while cooling.

15. The system of claim 14 further comprising a thermostatic control for controlling the first and second three way valves.

16. The system of any one of claims 11 - 15 wherein the cooling system is a chiller.

17. The system of any one of claims 11 - 15 wherein the cooling system is a heat pump.

18. A method of controlling the temperature of one or more suites of a high rise building having multiple serviced floors, each serviced floor having the one or more suites serviced with at least domestic hot water, the one or more suites having domestic use fixtures therein, the system comprising:

supplying domestic hot water to each serviced floor at full water pressure which varies with elevation, the water pressure at an uppermost floor being at or above domestic service pressures; and

at each serviced floor,

controlling the circulation of the domestic hot water through one or more radiant walls in the one or more suites; and

at each serviced floor having full water pressures above a domestic service pressure suitable for the domestic use fixtures,

reducing the water pressure of the domestic hot water before the domestic use fixtures to the domestic service pressure.

19. The method of claim 18 wherein the supplying of domestic hot water to each serviced floor comprises:

supplying hot water to each serviced floor in a hot water riser extending to each serviced floor, further comprising at each serviced floor:

distributing the domestic hot water from the hot water riser through a hot water distribution main for circulating the domestic hot water through one or more radiant walls; and reducing the water pressure of the domestic hot water between the hot water distribution main and the domestic use fixtures where full water pressure is above the domestic service pressure.

20. The method of claim 18 or 19 wherein heating and cooling of the one or more suites is desired, further comprising:

supplying domestic cold water to each serviced floor at full water pressure which varies with elevation, the water pressure at an uppermost floor being at or above domestic service pressures; and

at each serviced floor,

controlling circulation of the domestic cold water through the one or more radiant walls in the one or more suites; and

at each serviced floor having full water pressures above a domestic service pressure suitable for the domestic use fixtures,

reducing the water pressure of the domestic cold water before the domestic use fixtures to the domestic service pressure.

21. The method of claim 18 or 19 wherein only heating of the one or more suites is desired, further comprising:

supplying domestic cold water to each serviced floor at full water pressure which varies with elevation, the water pressure at an uppermost floor being at or above domestic service pressures; and

reducing the water pressure of the domestic cold water to the domestic service pressure before distribution of the domestic cold water at each serviced floor having full water pressures above the domestic service pressure.

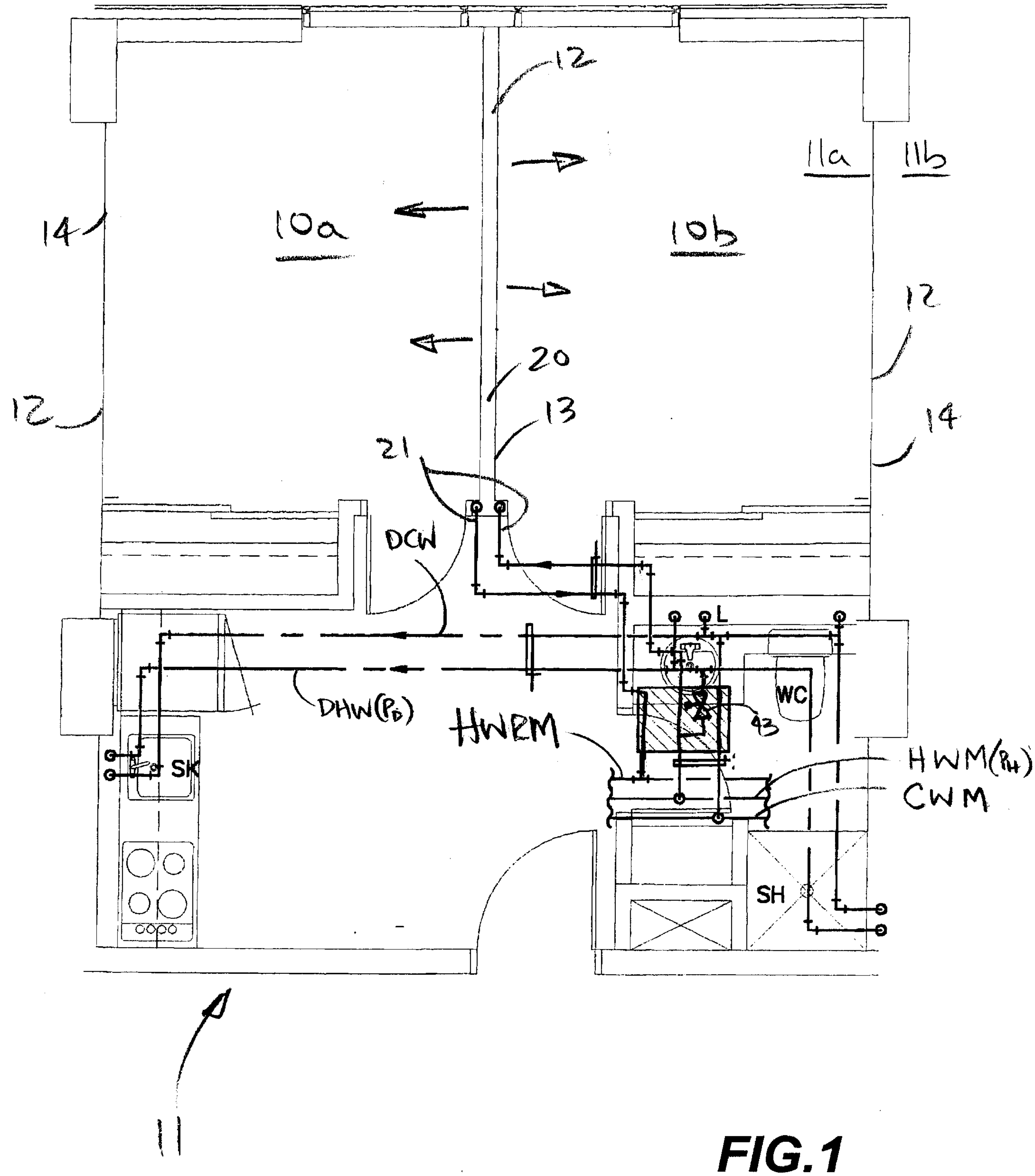

12
11a
11b
14
10a
10b
12
20
12
13
14
21
DCW
L
WC
DHW(PD)
HWRM
43
SK
HWM(PH)
CWM
SH
11

FIG.1

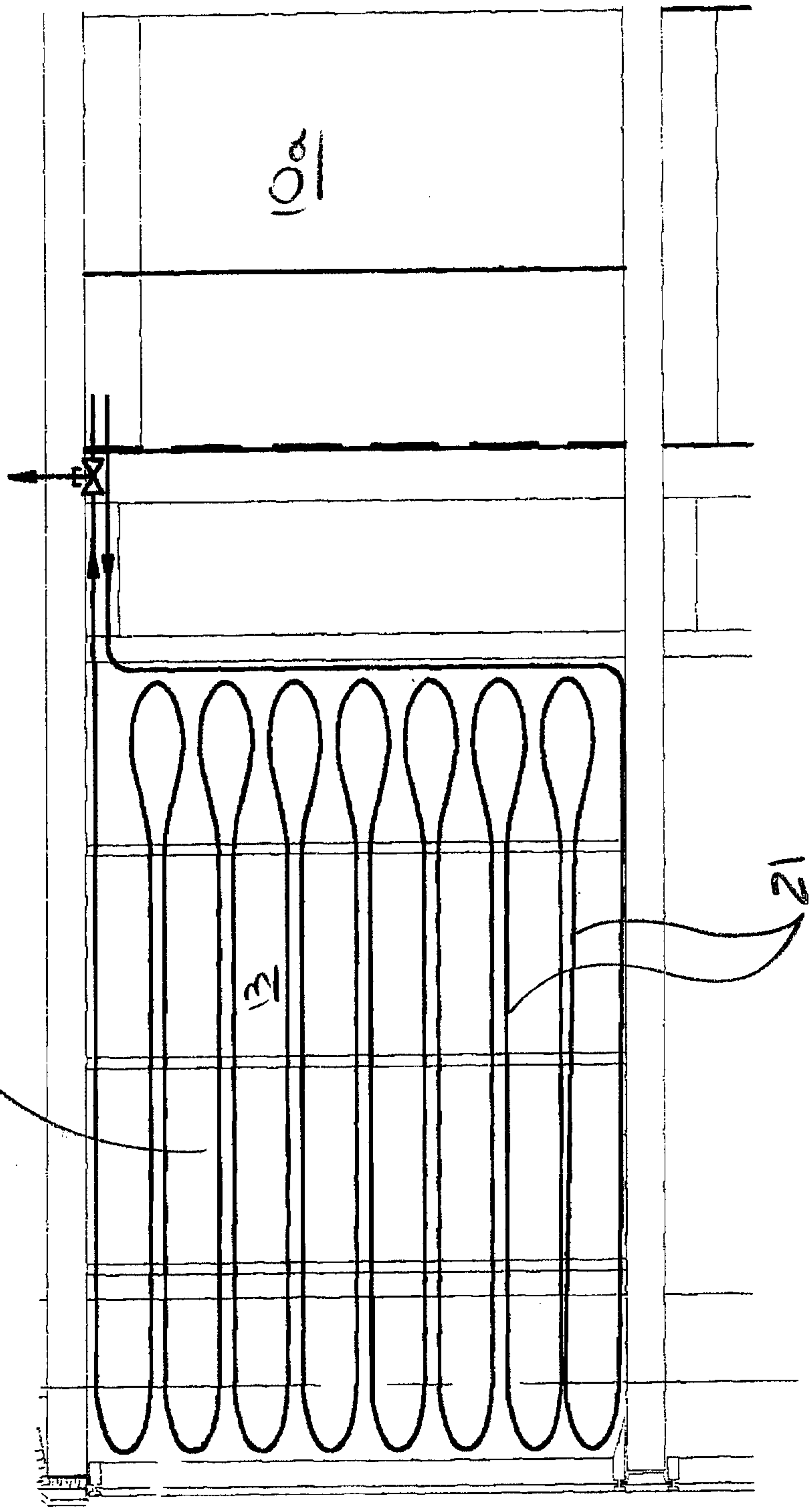


FIG. 2

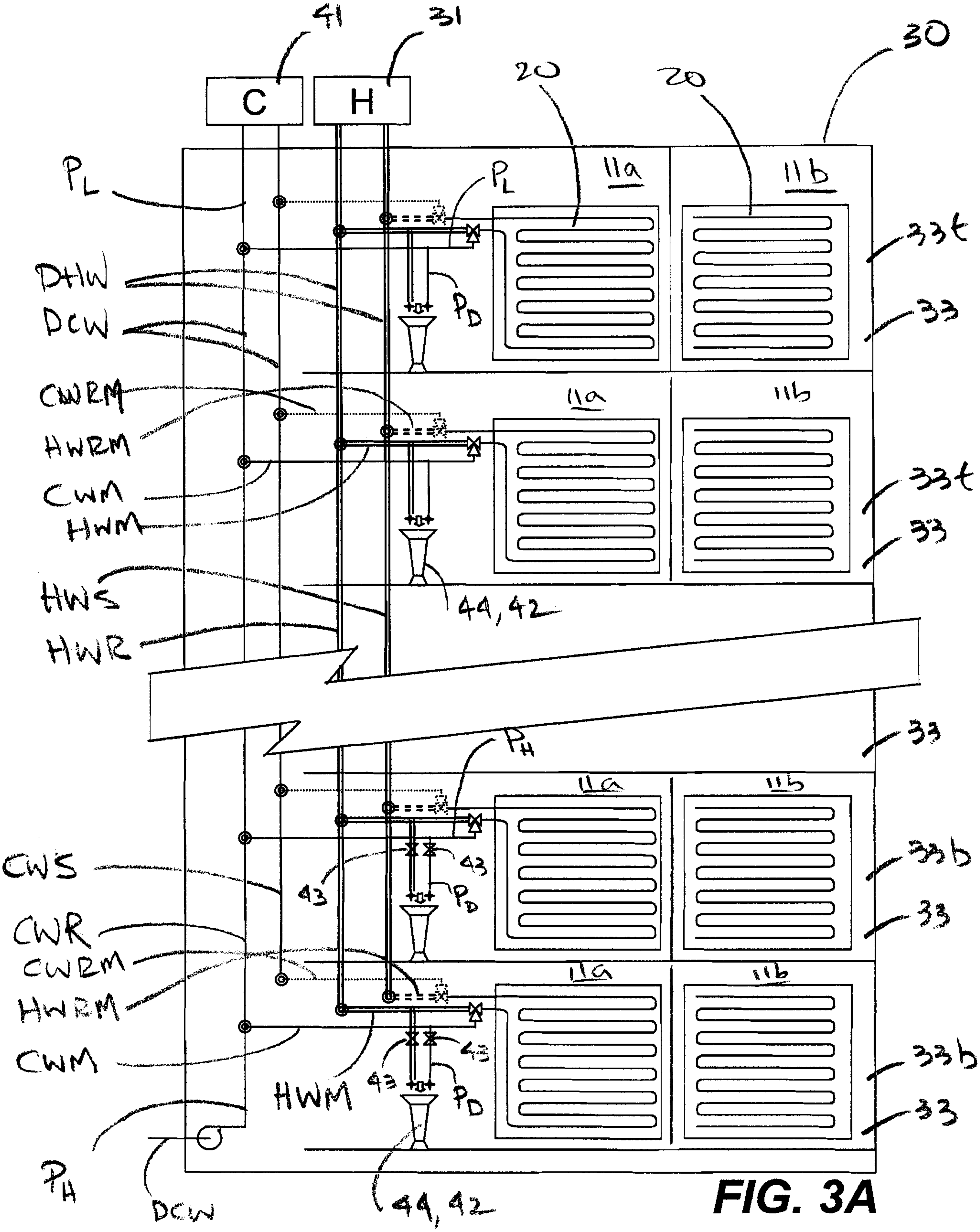

41
31
30
C
H
20
20
11a
11b
P_L
P_L
DHW
DCW
33t
33
P_D
CWRM
HWRM
CWM
HWM
11a
11b
33t
33
HWS
HWR
44, 42
33
P_H
11a
11b
CWS
43
43
P_D
33b
33
CWR
CWRM
HWRM
CWM
HWM
11a
11b
43
43
P_D
33b
33
P_H
DCW
44, 42

FIG. 3A

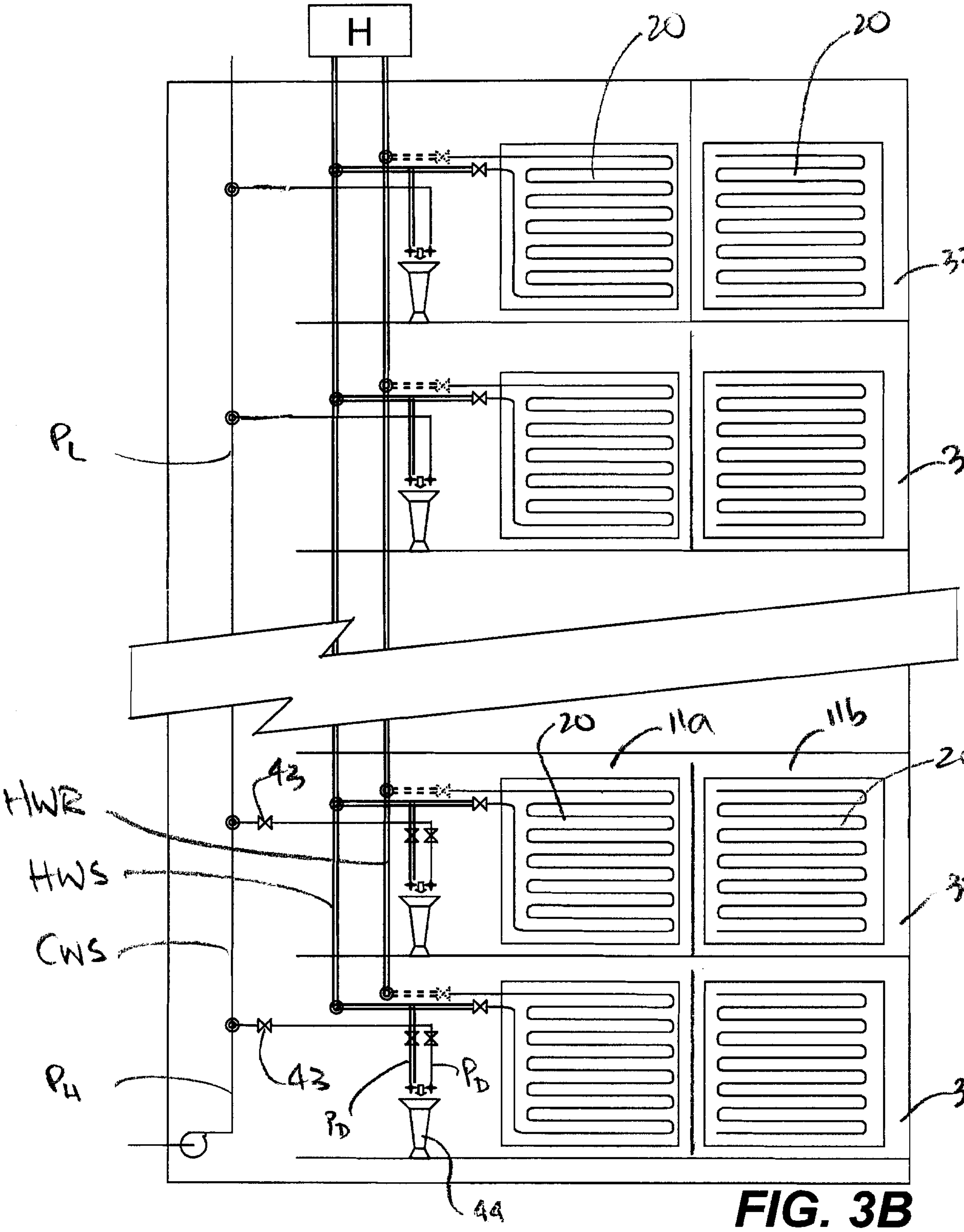

H
20
20
33t
33t
PL
HWR
HWS
CWS
PH
43
43
20
11a
11b
20
33b
33b
PD
PD
44

FIG. 3B

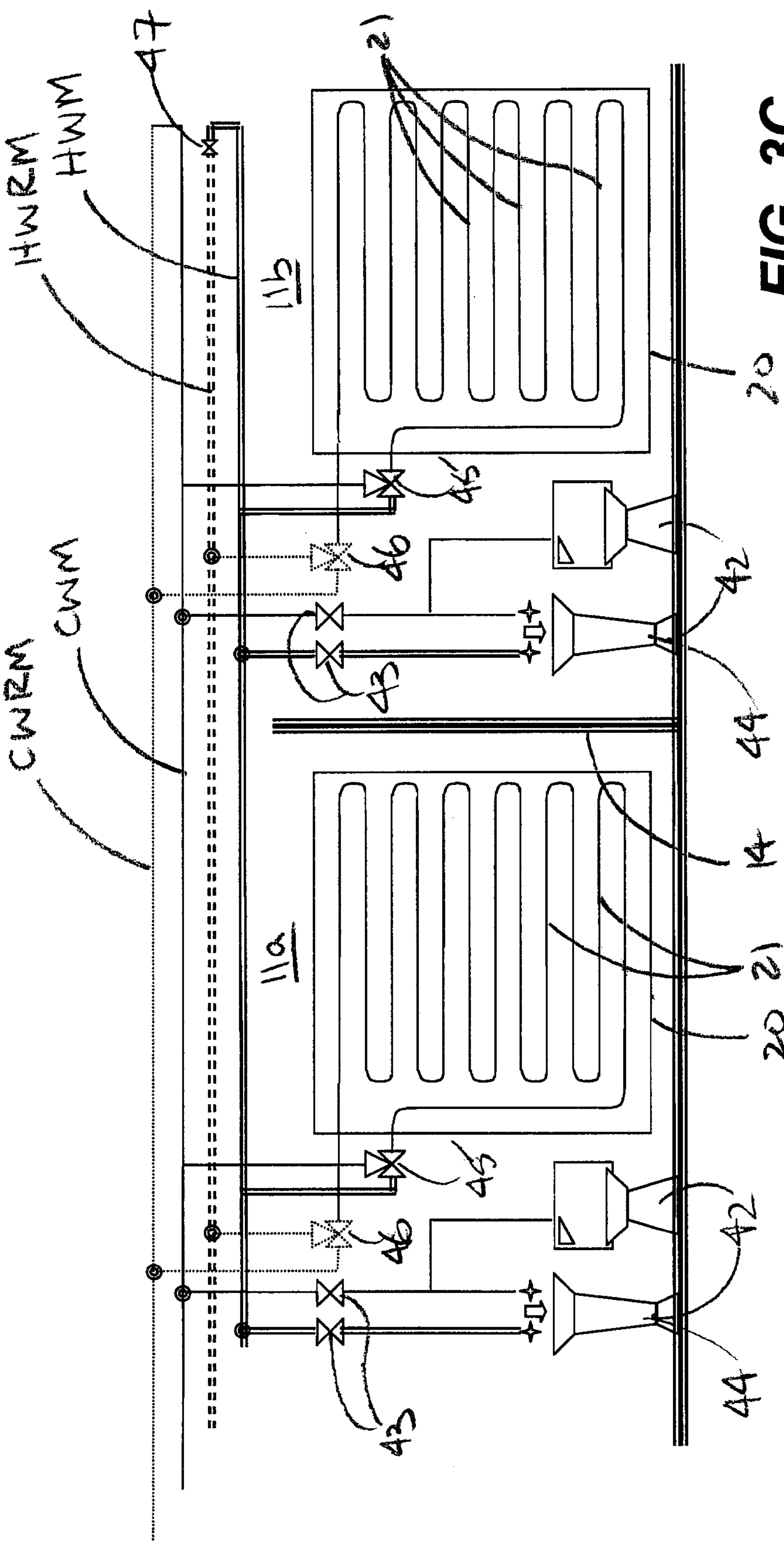


FIG. 3C

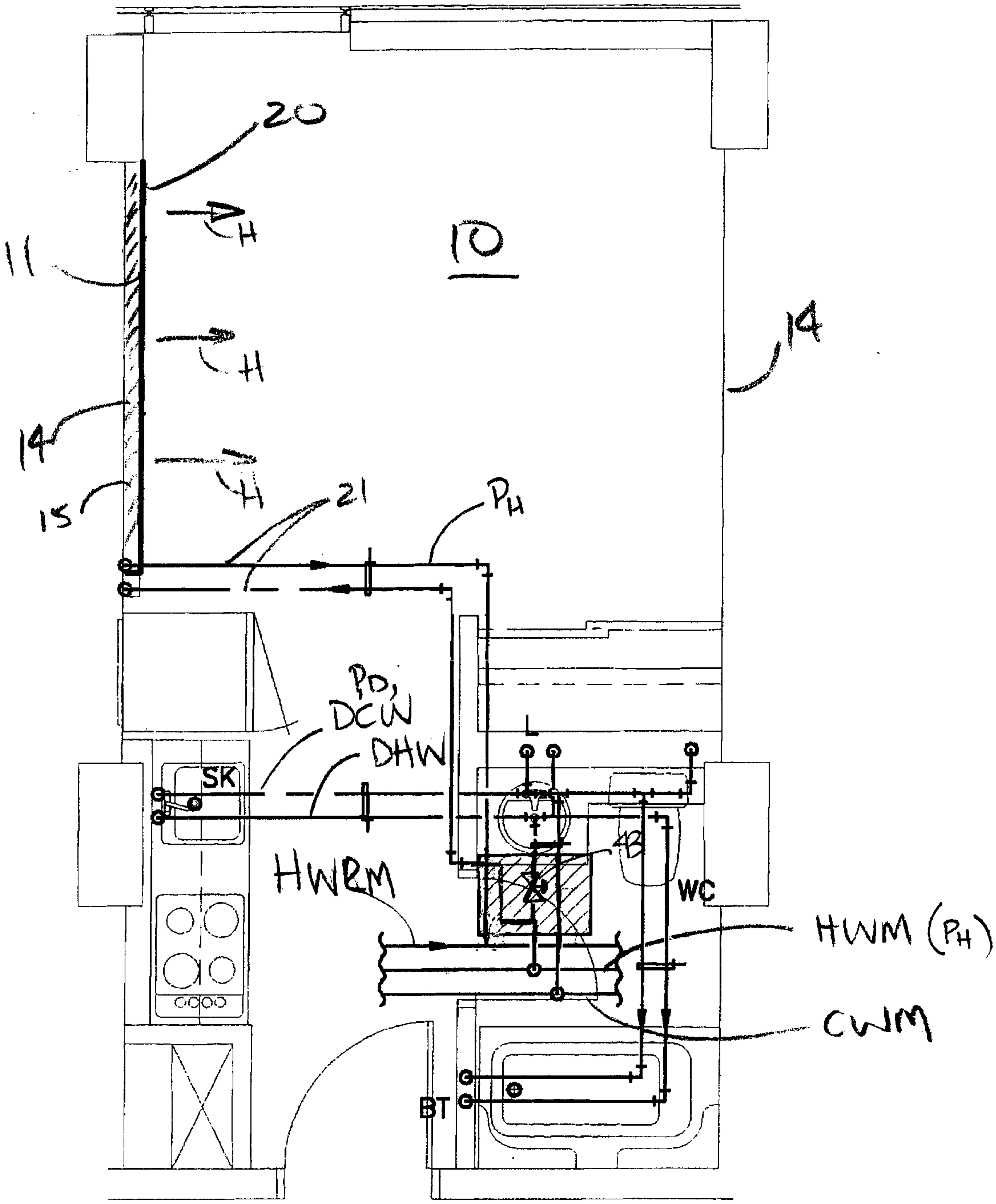


FIG. 4

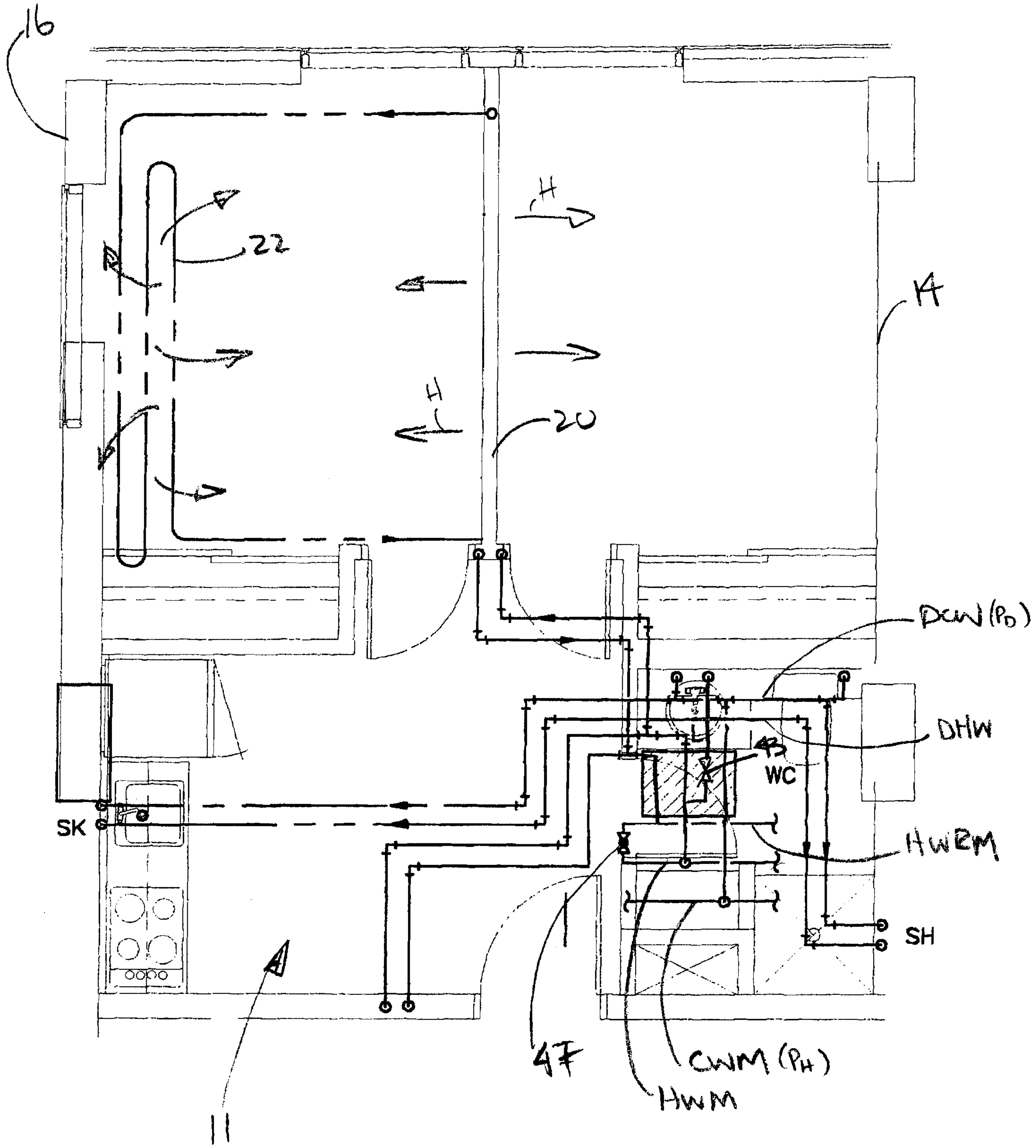


FIG. 5

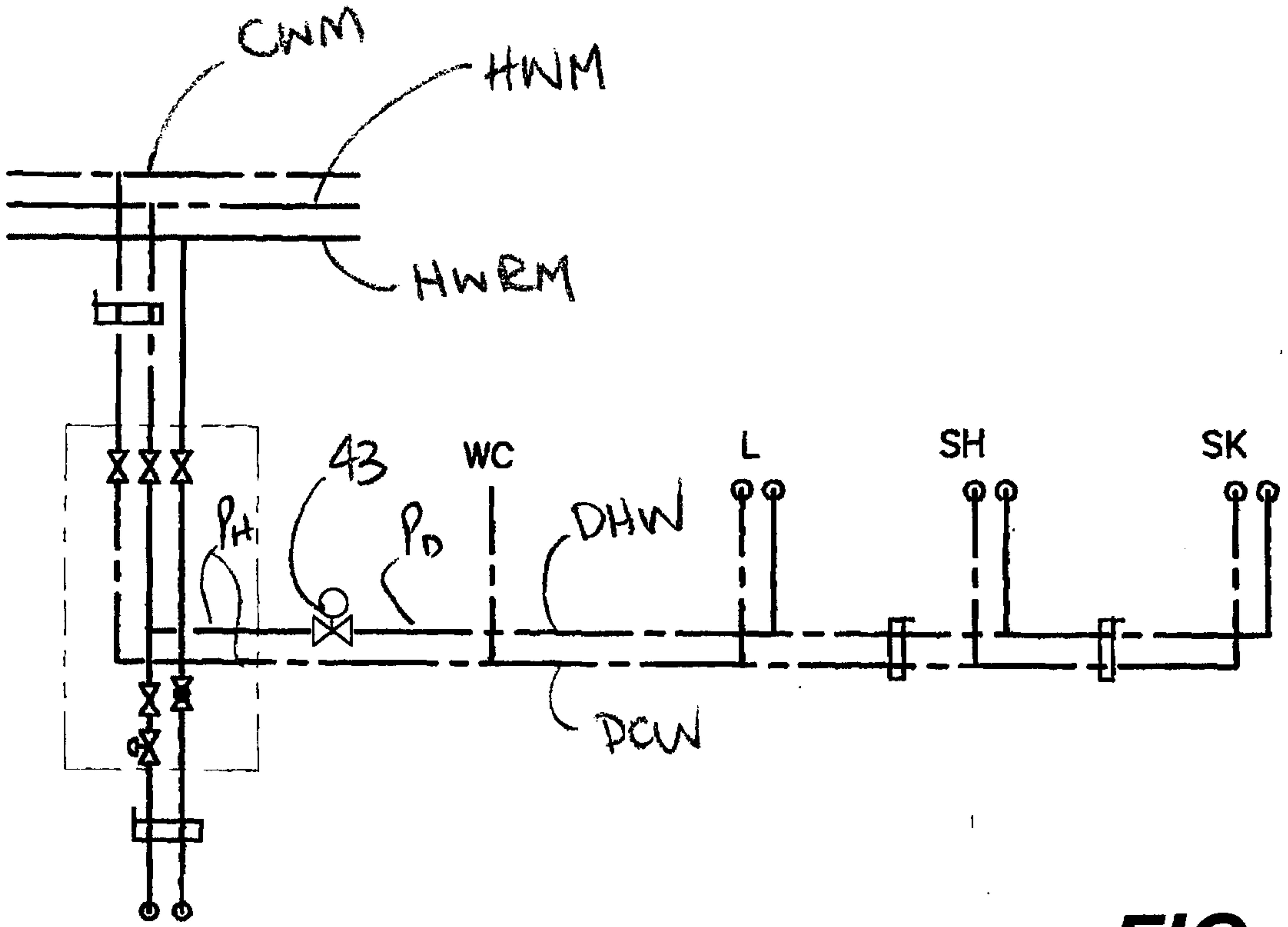

CWM
HWM
HWRM
43
WC
L
SH
SK
P_H
P_D
DHW
DCW

FIG. 6A

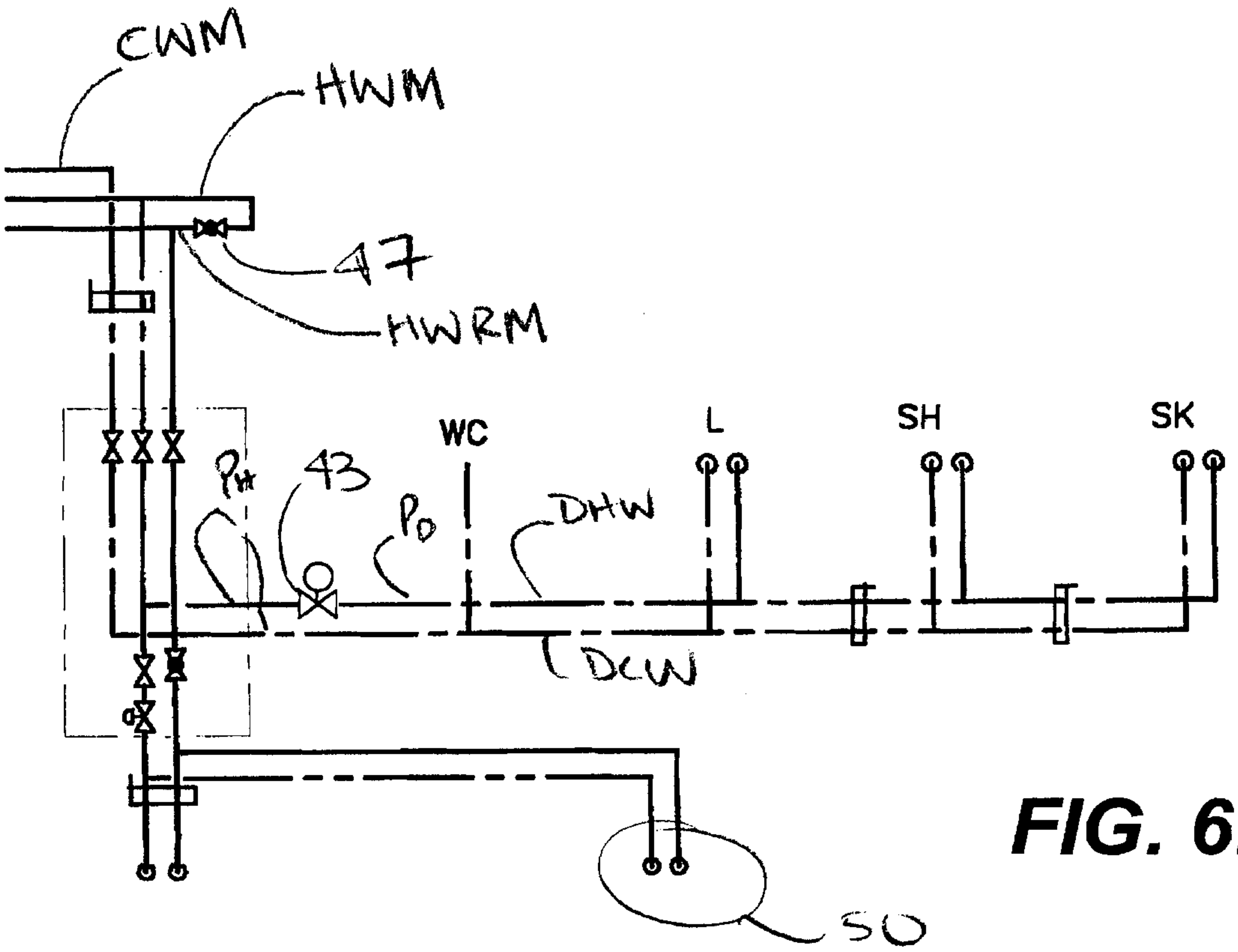
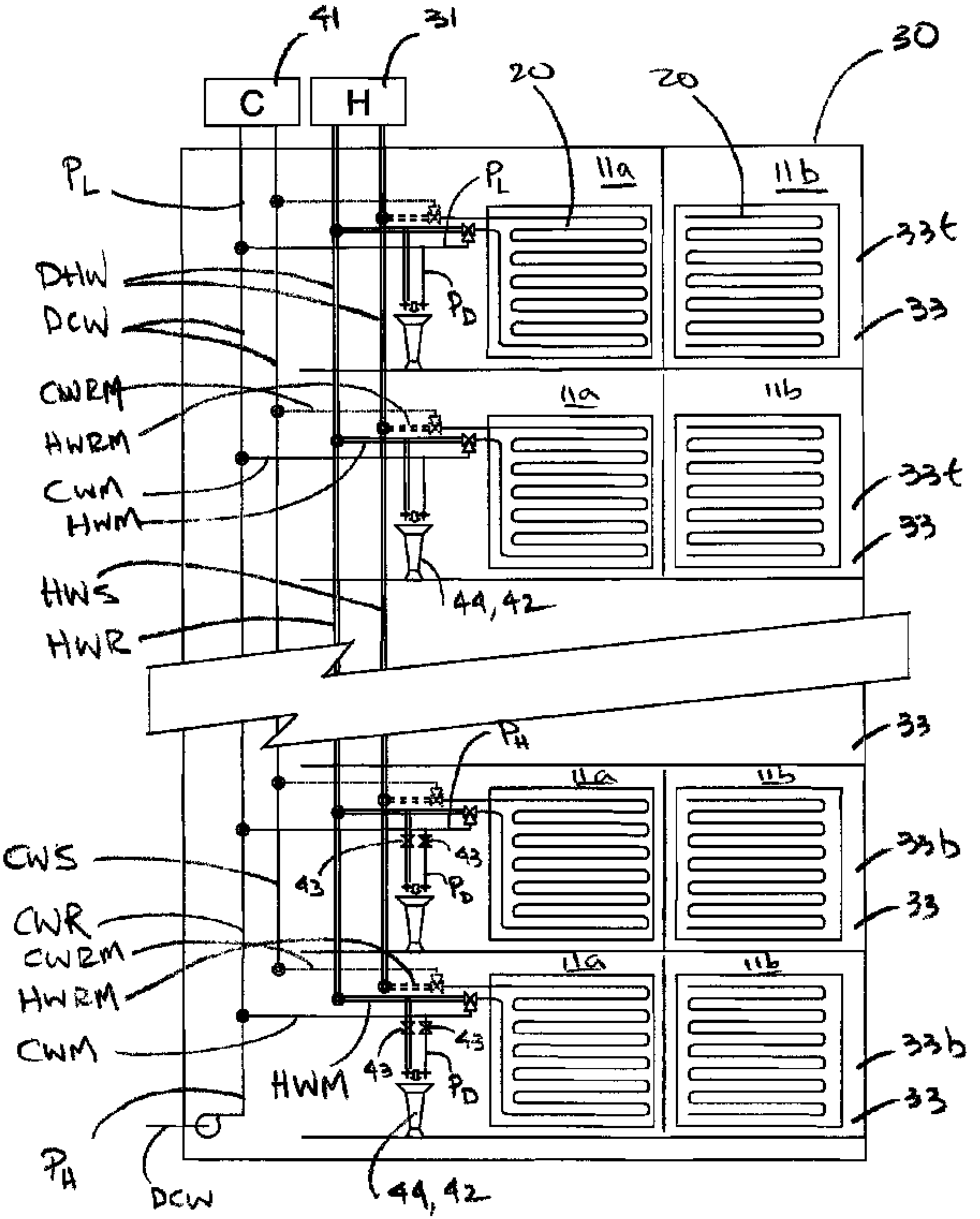

CWM
HWM
47
HWRM
WC
L
SH
SK
P_H
43
P_D
DHW
DCW
50

FIG. 6B



41
31
C
H
30
20
20
11a
11b
PL
PL
33t
33
DHW
DCW
PD
CWRM
HWRM
CWM
HWM
11a
11b
33t
33
HWS
HWR
44, 42
33
PH
11a
11b
CWS
43
43
43
PD
33b
33
CWR
CWRM
HWRM
CWM
11a
11b
43
43
PD
33b
HWM
33
PH
DCW
44, 42