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C. L. RINGQUIST

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SUMMER-WINTER AIR CONDITIONING SYSTEM

Filed May 29, 1961

2 Sheets-Sheet 1

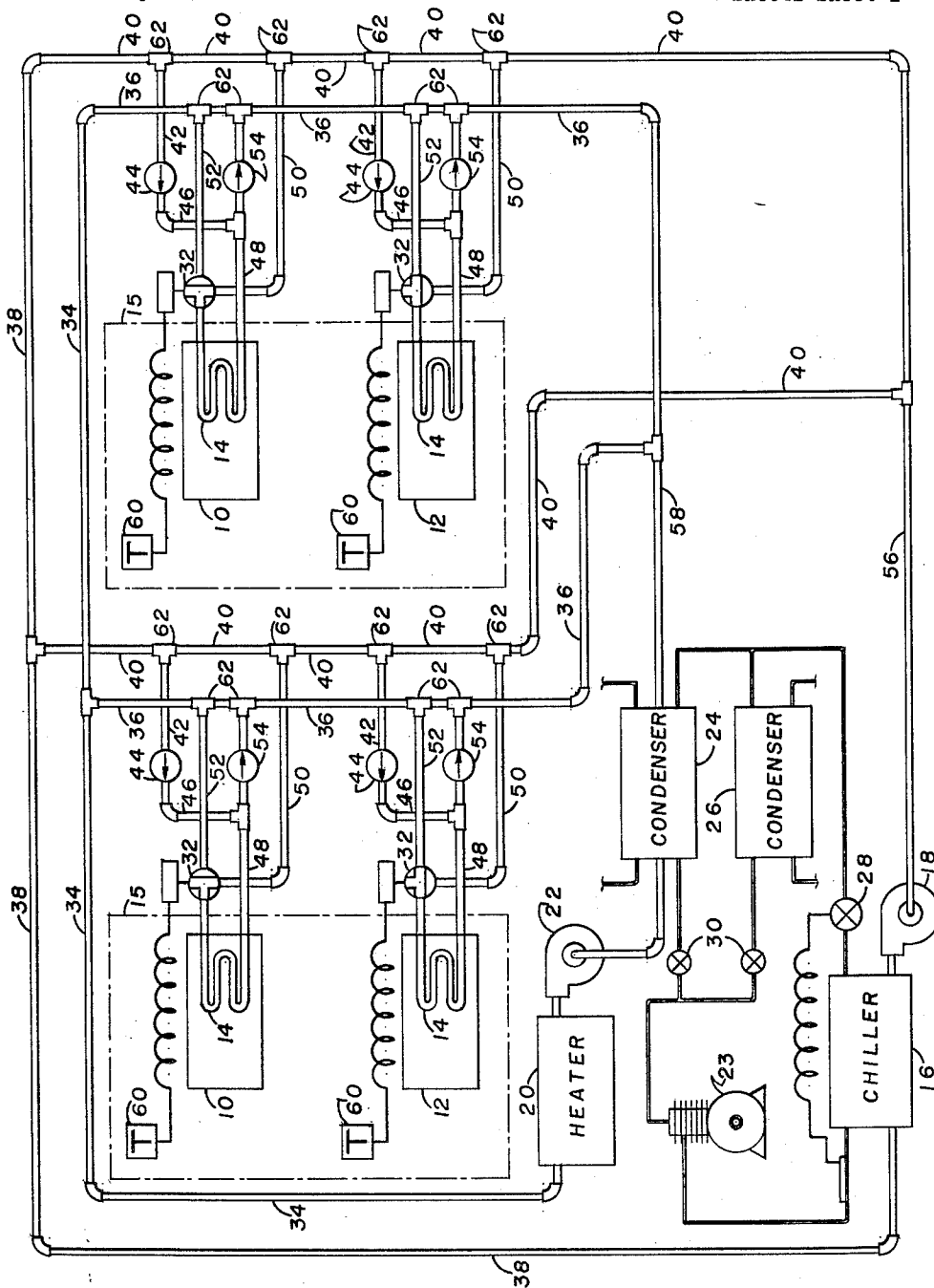


FIG. 1

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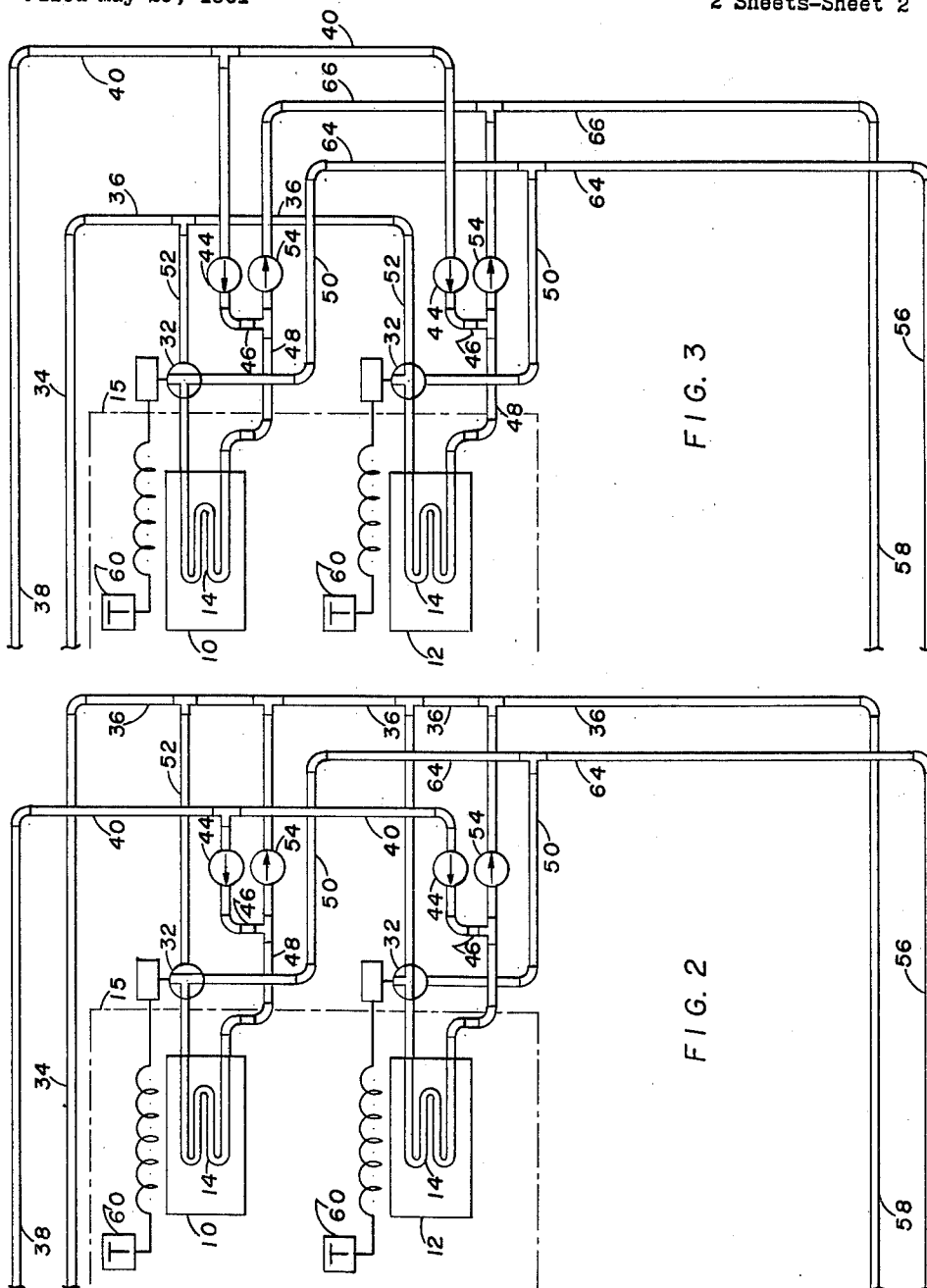
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SUMMER-WINTER AIR CONDITIONING SYSTEM
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16 Claims. (Cl. 62-159)

This invention relates generally to a combination heating and cooling air conditioning system and more specifically to an air conditioning system in which heated and chilled water is available to the heat exchange members at all times, if desired.

In recent years the air conditioning industry has tended to provide air conditioning systems in which a supply of hot and cold water is provided simultaneously to the heat exchange members in the system. Prior to this invention a separate heat exchange coil for each source of water was provided in each heat exchange unit. In other words, each heat exchange unit normally would have two heat exchange coils, one for the hot fluid and one for the cold fluid.

It is therefore an object of this invention to provide an air conditioning system in which both hot and cold heat exchange fluid may be supplied simultaneously to a heat exchange unit and the heat exchange unit requires only a single heat exchange coil.

Another object of the invention is to provide an air conditioning system in which both hot and cold heat exchange fluid may be supplied simultaneously to a heat exchange unit and the flow of hot heat exchange fluid through the heat exchange coil is opposite to the flow of the cold heat exchange fluid through the heat exchange coil.

A third object of the invention is to provide an air conditioning system in which hot and cold heat exchange fluid may be supplied simultaneously to a heat exchange unit and in which the cold fluid is conditioned by a refrigeration system and the hot fluid may partially or wholly be heated by the condenser of the refrigeration system.

A fourth object of the invention is to provide an air conditioning system in which hot and cold heat exchange fluid may be supplied simultaneously to a heat exchange unit and in which the hot and cold fluid is supplied to the units each in a one-pipe circulation system. To elucidate, a single cold supply pipe and a single hot pipe are supplied to each zone and the desired heat exchange fluid is taken from one of these pipes and fed through the heat exchange coil. The fluid passing through the heat exchange coil is then returned back to the supply from whence it came and is mixed with the heat exchange fluid being supplied to the other units on this pipe.

A still further object of the invention is to provide an air conditioning system in which hot and cold heat exchange fluid may be supplied simultaneously to a heat exchange unit and in which the cold or chilled water system is a two-pipe or separate supply and return system while the hot water system is one-pipe.

A sixth object of the invention is to provide an air conditioning system in which hot and cold heat exchange fluid may be supplied simultaneously to a heat exchange unit and in which both the hot and cold heat exchange fluid is supplied to the units through a two-pipe heating and a two-pipe cooling system. In other words, a separate supply and return line is provided for both the heating and cooling systems.

Other objects and advantages of the invention will be clearly apparent as the specification proceeds to describe the invention with reference to the accompanying drawings in which:

FIGURE 1 is a schematic view of the preferred form

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of an air conditioning system incorporating the principles of my invention;

FIGURE 2 is a modification of the system shown in FIGURE 1; and

FIGURE 3 is a still further modification of the system shown in FIGURE 1.

Looking now to FIGURE 1, there is shown the preferred form of my invention. For the basis of a disclosure, a plurality of heat exchange units 10 and 12 with a single heat exchange coil 14 are located in a plurality of zones 15 (shown in dotted lines). The number of units and the number of zones depending upon the particular requirements of the enclosure to be conditioned. Heat exchange units 10 are shown in the position to receive cold heat exchange fluid and heat exchange units 12 are shown receiving hot heat exchange fluid.

Chilled water is supplied to each heat exchange unit from chiller 16 by chilled water pump 18. Hot water is supplied to each heat exchange unit from heater 20 by hot water pump 22.

A refrigeration system consisting of compressor 23, condensers 24 and 26, expansion means 28, and chiller 16 is employed to cool the returning chilled water and to heat the returning hot water. As is usual in refrigeration systems, hot gas is supplied to either or both of condensers 24 and 26 from compressor 23. The liquified condensed refrigerant from the condensers 24 and 26 is then expanded through expansion means 28 into chiller 16 to cool the returning chilled water. Vaporized refrigerant is returned from chiller 16 to compressor 23 for compression and is re-cycled through the system. Valves 30 are provided so that all or part of the hot gas may be condensed in condenser 24 to heat the warm return water in order to utilize the heat normally rejected. Heater 20 is necessary under conditions when the amount of heat rejected by condenser 24 is not sufficient to heat the warm water to a temperature high enough to handle the heating requirements of the area to be conditioned.

Operation

The operation of only two units 10 and 12 in only one zone will be discussed keeping in mind that the other units in the zone and in other zones operate in the same manner. As pointed out previously, unit 10 is shown in the cold water receiving position and unit 12 is shown in the hot water receiving position. It being understood that in extreme weather conditions when either all heating or all cooling is required in the conditioned areas that either the refrigeration system or the heating system may be shut down in order to save operating expense. It should also be kept in mind that the pressure in the hot water system is kept above the pressure in the cold water system in order to prevent the hot water from crossing over into the cold system and vice versa.

Each heat exchange unit 10 or 12 is provided with a single heat exchange coil 14 with a temperature responsive three-way valve 32 connected to one end thereof. Hot water from conduit 34 is supplied to conduit 36 and cold water from conduit 38 is supplied to conduit 40.

Three-way valves 32 are shown as responsive to the temperature of the space to be conditioned and operate in response to the temperature sensed by thermostat 60 to supply either hot or cold heat exchange fluid to the heat exchange units. The construction and the operation of three-way valves 32 is not considered a part of my invention other than to supply hot exchange fluid to coils 14 when heat is required and to supply cold heat exchange fluid when cooling is required.

Looking at heat exchange unit 10, cold water from conduit 40 flows through conduit 42, check valve 44, conduits 46 and 48, heat exchange coil 14, three-way valve 32, and through conduit 50 back into conduit 40 where

it mixes with the water flowing to the units further down the line. This type of cooling system will herein be referred to as a one-pipe cooling system.

Conversely heat exchange unit 12 is being supplied hot water from conduit 36. Hot water flows through conduit 52, three-way valve 32, heat exchange coil 14, conduit 48, check valve 54, and back into conduit 36 where it mixes with the hot water being supplied to other heat exchange units further down the line.

The cold and hot fluid in conduits 40 and 36 is returned to the chiller 16 and the heater 26 by way of conduits 56 and 58 respectively.

It should be noted that check valves 44 allow the cold water to pass therethrough when thermostat 60 has positioned valve 32 to allow the flow of cooling water but prevent the passage of hot water into the chilled water line 40 when the heat exchange units are on the heating cycle.

Check valves 54 allow the hot water to pass therethrough when the heat exchange unit is on the heating cycle but prevents hot water from passing into the chilled water line when the heat exchange unit is on the cooling cycle.

Cold water from the chilled water line 40 is prevented from passing through check valves 44 and 54 since, as hereinabove described, the pressure in the hot water conduit is maintained above the pressure of the chilled water conduit.

Obviously the arrangement of the thermostatic three-way valve 32 and the check valves 44 and 54 provides a heat exchange member through which the cooling fluid flows in a direction opposite to the flow of the heating fluid. This reversal of flow of heat exchange fluid allows the use of a heat exchange unit which has only a single heat exchange coil.

Pipe T's 62 are shown at the junctions of the conduits 36 and 40 with the conduits supplying heat exchange fluid to the heat exchange units. Such T's are only exemplary and it is within the scope of the invention to use any other suitable connections such as commercially available flow-fittings.

Looking now to the modifications shown in FIGURES 2 and 3, like elements will be denoted like the same element of FIGURE 1.

The modification of FIGURE 2 is basically the same as the preferred form shown in FIGURE 1 except the chilled water returned from each unit is directed into a separate chilled water return line 64.

The modification of FIGURE 3 is also basically the same as FIGURE 1 except that the chilled water returned from the heat exchange units is directed into a separate chilled water return line 64 and the warm water returned from the heat exchange units is also directed into a separate warm water return line 66.

My new and novel air conditioning system provides efficient and economical operation. I have provided a system which allows the use of a heat exchange member which employs only a single heat exchange coil for both heating and cooling. My new and novel valve arrangement allows the heating fluid to flow through the coil in a direction opposite to the flow of cooling fluid through the coil thereby alleviating the necessity of having an additional heat exchange coil and thereby eliminating the expense of such additional coil. Further, since only one heat exchange coil is necessary, I can eliminate the need of providing an additional three-way valve on the leaving side of the heat exchange unit and substituting two economical check valves therefor.

Although I have described in detail the preferred embodiments of my invention, it is contemplated that many changes may be made without departing from the scope or spirit of my invention and I desire to be limited only by the claims.

I claim:

1. An air conditioning system for a space having a

plurality of areas with similar heating and cooling requirements, a compressor, an evaporator, and a condenser interconnected to provide a refrigeration system, a first conduit for conducting hot fluid from said condenser to said areas, a second conduit for conducting cold fluid from said evaporator to said areas, a third conduit for conducting hot fluid from said areas back to said condenser, a fourth conduit for conducting cold fluid from said areas back to said evaporator, at least one heat exchange unit in each of said areas, said heat exchange unit having a heat exchange coil therein, and means connected to said heat exchange coil and to said first, second, third, and fourth conduits to selectively circulate cold fluid or hot fluid through said heat exchange coil, said cold fluid flowing through said heat exchange coil in a direction opposite to the flow of hot fluid through said coil.

2. An air conditioning system for a space having a plurality of areas with similar heating and cooling requirements, a source of hot fluid, a source of cold fluid, a first conduit for conducting hot fluid from said source of hot fluid to said areas, a second conduit for conducting cold fluid from said source of cold fluid to said areas, a third conduit for conducting hot fluid from said areas back to said source of hot fluid, a fourth conduit for conducting cold fluid from said areas back to said source of cold fluid, at least one heat exchange unit in each of said areas, said heat exchange unit having a heat exchange coil therein, and means connected to said heat exchange coil and to said first, second, third, and fourth conduits to selectively circulate cold fluid or hot fluid through said heat exchange coil, said cold fluid flowing through said heat exchange coil in a direction opposite to the flow of hot fluid through said coil.

3. An air conditioning system for a space having a plurality of zones with each zone having a plurality of areas with similar heating and cooling requirements, a source of hot fluid, a source of cold fluid, a first conduit for conducting hot fluid from said source of hot fluid to said zones, a second conduit for conducting cold fluid from said source of cold fluid to said zones, a third conduit for conducting hot fluid from said zones back to said source of hot fluid, a fourth conduit for conducting cold fluid from said zones back to said source of cold fluid, at least one heat exchange unit in each of said zones, said heat exchange unit having a heat exchange coil therein, and means connected to said heat exchange coil and to said first, second, third, and fourth conduits to selectively circulate cold fluid or hot fluid through said heat exchange coil, said cold fluid flowing through said heat exchange coil in a direction opposite to the flow of hot fluid through said coil.

4. The structure of claim 3 wherein said connecting means includes thermostatically operated valve means responsive to the load condition of the area conditioned by said heat exchange unit.

5. The structure of claim 4 wherein said valve means is a three-way valve.

6. The structure of claim 5 wherein said thermostatic three-way valve has a first port connected to said heat exchange coil, a second port connected to first conduit, and a third port connected to said second conduit.

7. The structure of claim 5 wherein said thermostatic three-way valve has a first port connected to said heat exchange coil, a second port connected to said first conduit, and a third port connected to said fourth conduit.

8. An air conditioning system for a space having a plurality of areas with similar heating and cooling requirements, a source of hot fluid, a source of cold fluid, a first conduit for conducting hot fluid from said source of hot fluid to said areas, a second conduit for conducting cold fluid from said source of cold fluid to said areas, a third conduit for conducting hot fluid from said areas back to said source of hot fluid, a fourth conduit for conducting cold fluid from said areas back to said source of cold fluid, a fifth conduit connected to said first conduit

and said third conduit, a sixth conduit connected to said second and fourth conduits, at least one heat exchange unit in each of said areas to be heated or cooled, said heat exchange unit having a heat exchange coil therein, first conduit means connected to said fifth conduit to conduct hot fluid from said fifth conduit through said heat exchange coil and back into said fifth conduit, second conduit means connected to said sixth conduit to conduct cold fluid from said sixth conduit through said heat exchange coil and back into said sixth conduit, and valve means connected to said first conduit means and said second conduit means to selectively pass hot or cold fluid through said coil in response to the load conditions of said area, said valve means reversing the flow of cold fluid through said coil opposite to the flow of hot fluid through said coil.

9. The structure of claim 8 wherein said valve means includes check means in said first and second conduit means respectively to prevent passage of the fluid from the fifth conduit into the sixth conduit.

10. The structure of claim 9 wherein said valve means also includes a thermostatically operated three-way valve with one port connected to said heat exchange coil, a second port connected to first conduit means, and a third port connected to said second conduit means.

11. An air conditioning system for a space having a plurality of areas with similar heating and cooling requirements, a source of hot fluid, a source of cold fluid, a first conduit for conducting hot fluid from said source of hot fluid to said areas, a second conduit for conducting cold fluid from said source of cold fluid to said areas, a third conduit for conducting hot fluid from said areas back to said source of hot fluid, a fourth conduit for conducting cold fluid from said areas back to said source of cold fluid, a fifth conduit connected to said first conduit and said third conduit, a sixth conduit connected to said second conduit, a seventh conduit connected to said fourth conduit, at least one heat exchange unit in each of said areas to be heated or cooled, said heat exchange unit having a heat exchange coil therein, first conduit means connected to said fifth conduit to conduct hot fluid from said fifth conduit through said heat exchange coil and back into said fifth conduit, second conduit means connected to said sixth and seventh conduits to conduct cold fluid from said sixth conduit through said heat exchange coil and into said seventh conduit, and valve means connected to said first conduit means and said second conduit means to selectively pass hot or cold fluid through said coil in response to the load condition of said area, said valve means reversing the flow of cold fluid through said coil opposite to the flow of hot fluid through said coil.

12. The structure of claim 11 wherein said valve means includes check means in said first and second conduit means respectively to prevent passage of the fluid from the fifth conduit into the sixth conduit.

13. The structure of claim 12 wherein said valve means also includes a thermostatically operated three-way valve with one port connected to said heat exchange coil, a second port connected to said first conduit means, and a third port connected to said second conduit means.

14. An air conditioning system for a space having a plurality of areas with similar heating and cooling requirements, a source of hot fluid, a source of cold fluid, a first conduit for conducting hot fluid from said source of hot fluid to said areas, a second conduit for conducting a cold fluid from said source of cold fluid to said areas, a third conduit for conducting hot fluid from said areas back to said source of hot fluid, a fourth conduit for conducting cold fluid from said areas back to said source of cold fluid, a fifth conduit connected to said first conduit, a sixth conduit connected to said second conduit, a seventh conduit connected to said third conduit, an eighth conduit connected to said fourth conduit, at least one heat exchange unit in each of said areas to be heated or cooled, said heat exchange unit having a heat exchange coil therein, first conduit means connected to said fifth conduit and said seventh conduit to conduct hot fluid from said fifth conduit through said heat exchange coil and into said seventh conduit, second conduit means connected to said sixth and eighth conduits to conduct cold fluid from said sixth conduit through said heat exchange coil and into said eighth conduit, and valve means connected to said first means and said second conduit means to selectively pass hot or cold fluid through said coil in response to the load conditions of said area, said valve means reversing the flow of cold fluid through said coil opposite to the flow of hot fluid through said coil.

15. The structure of claim 14 wherein said valve means includes check means in said first and second conduit means respectively to prevent passage of the fluid from the fifth conduit into the sixth conduit.

16. The structure of claim 15 wherein said valve means also includes a thermostatically operated three-way valve with one port connected to said heat exchange coil, a second port connected to first conduit means, and a third port connected to said second conduit means.

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