Nov. 2, 1954 G. LABOLLE 2,693,092

AIR-CONDITIONING PLANT

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FIG. 1

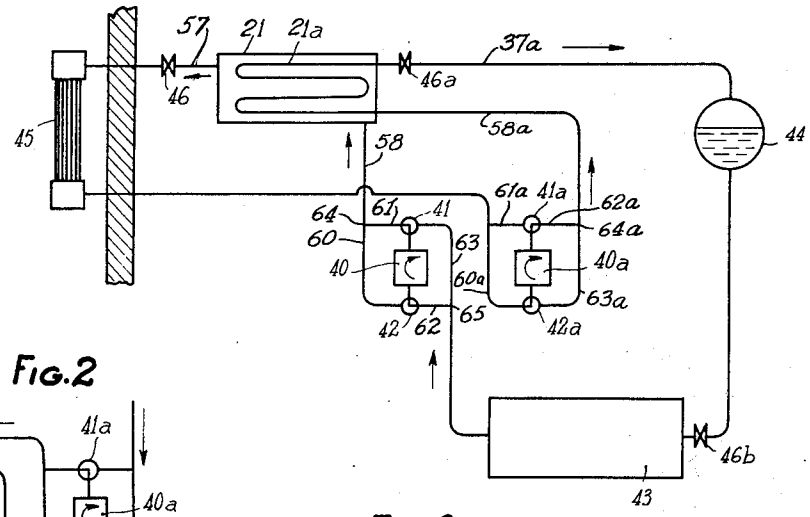


FIG. 2

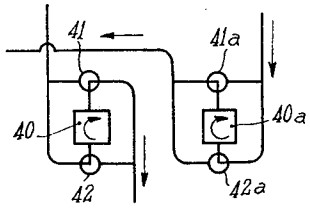


FIG. 3

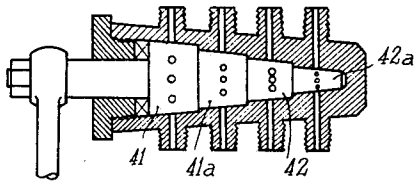


FIG. 4

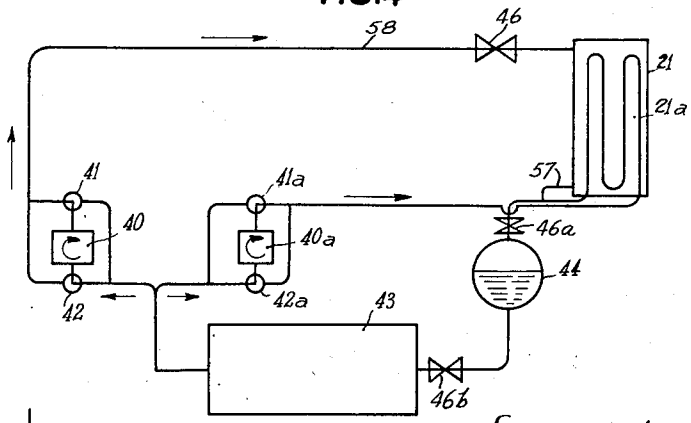
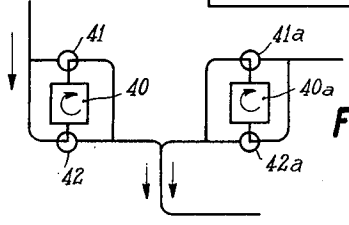


FIG. 5



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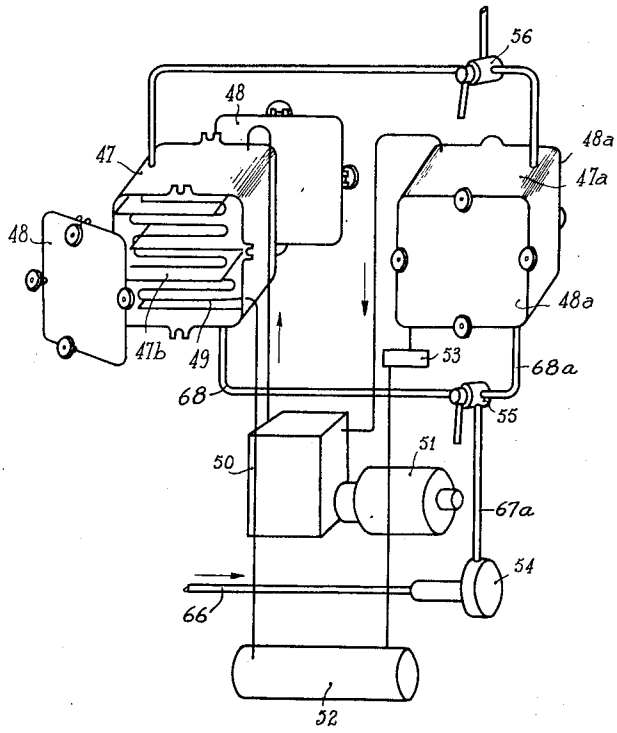


FIG. 6

FIG. 8

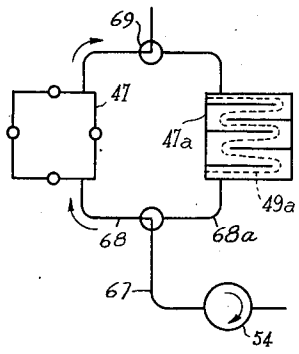
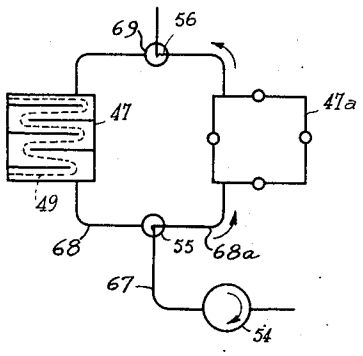


FIG. 7



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FIG. 9

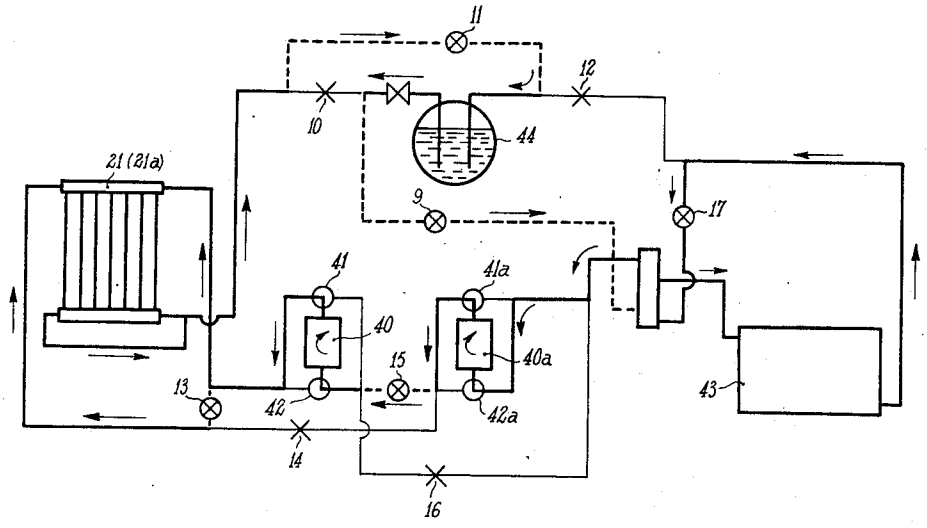
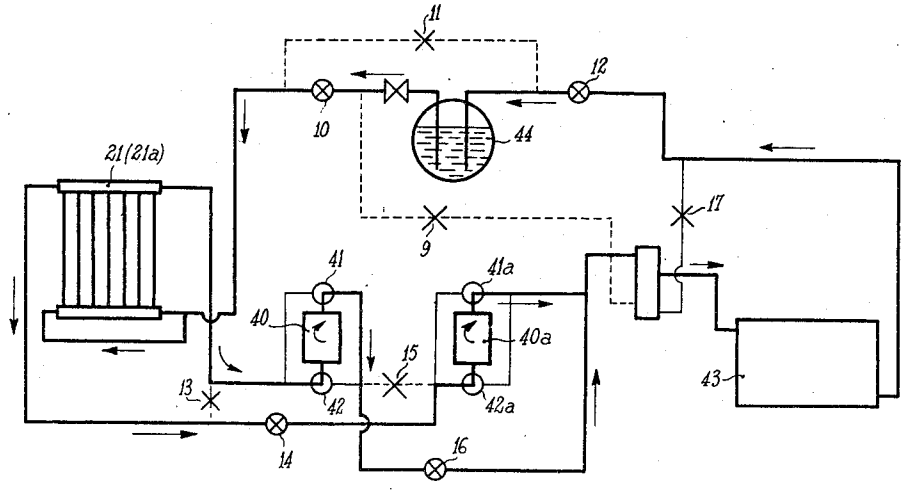


FIG. 10



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Fig. 11

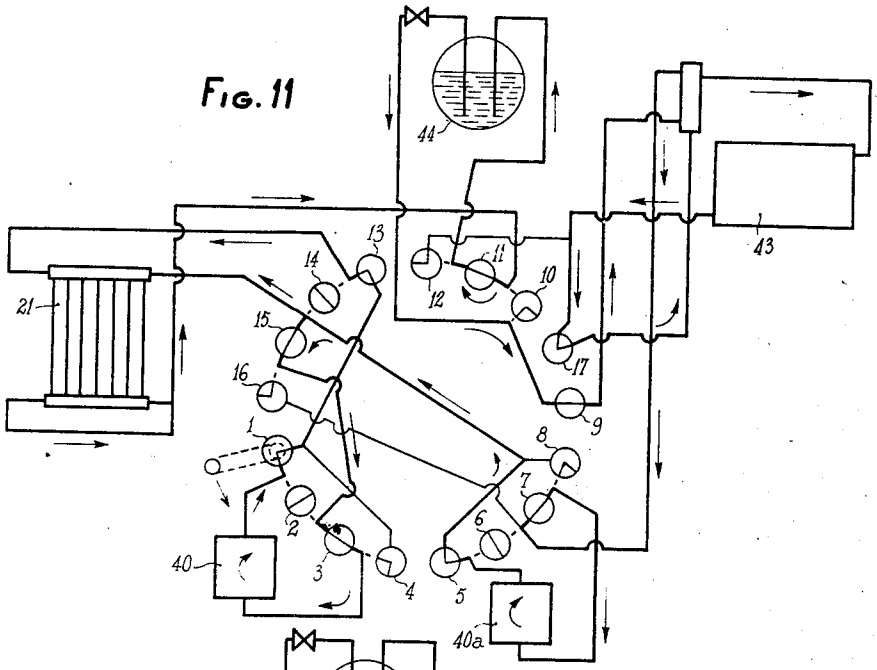
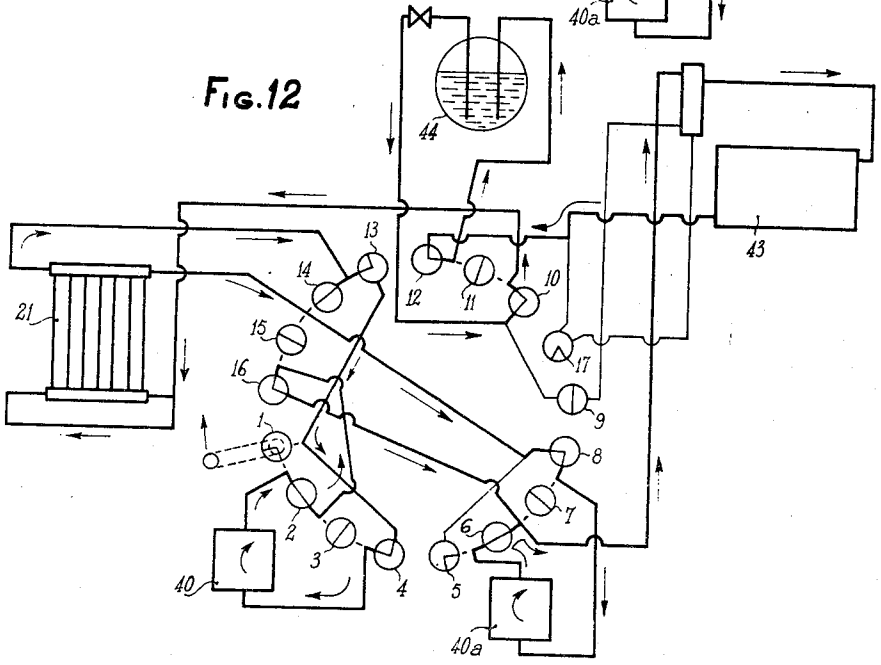


Fig. 12



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AIR-CONDITIONING PLANT

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Application June 18, 1951, Serial No. 232,085

Claims priority, application France June 27, 1950

3 Claims. (Cl. 62—129)

This invention relates to air-conditioning plant of the type including radiator means adapted, during the cold weather period, to be supplied with a heated fluid and, during the summer or hot weather season, to be supplied with a cooled fluid.

One object of the invention is to provide such a plant comprising at least one compressor for a cold-generating liquid, and adapted to be switched from summer-type operation to winter-type operation and vice versa merely by the operation of valve means.

Another object of the invention is so operatively to interconnect the control valves as to make possible their joint operation by action on a single control member.

A further object is to provide an air-conditioning plant of the kind described wherein the radiator means are adapted to serve either as evaporator or as condenser means for the cooling fluid depending on whether the premises in which the plant is installed are to be cooled or heated.

Yet a further object is to provide such a plant wherein the radiator means are supplied with an intermediate fluid adapted, in winter, to be heated by virtue of the fact that said liquid is used for condensing the cooling fluid, and to be cooled in summer by heat exchange with the evaporator.

The above and further objects of this invention will appear in the course of the ensuing description relating to several exemplary forms of embodiment of air-conditioning plant constructed in accordance therewith. In the accompanying diagrammatic drawings:

Figs. 1 to 3 illustrate a first embodiment involving direct expansion of the cooling fluid; therein

Fig. 1 shows the plant in its condition for winter operation.

Fig. 2 shows the plant in summer operation; and

Fig. 3 is an axial section of a multiple valve used in the installation according to Fig. 1 and 2.

Figs. 4 and 5 illustrate a modified embodiment, in winter and summer operation respectively.

Figs. 6 to 8 relate to a third embodiment, involving the use of an intermediate liquid as the heat transfer medium; therein

Fig. 6 is an isometric view of the principal section of the plant;

Figs. 7 and 8 are diagrammatic views of the same section, in summer and winter condition respectively.

Figs. 9 and 10 relate to a modification of Figs. 1 and 2; and

Figs. 11 and 12 diagrammatically illustrate the grouped arrangement of the control valves in the embodiment of the Figures 1 to 10.

In the forms of embodiment of the invention respectively illustrated in Figs. 1, 4 and 9, the radiators are directly supplied with the cooling fluid. According to a known arrangement, they comprise a central tube nest **21** having associated therewith a complementary tube nest **21***a* adapted to operate under higher pressure. Since these radiators in the double group arrangement are well known, these elements have been only schematically shown in the drawing. They may moreover be provided, if desired, with fans, as well-known per se.

While only a single radiator unit has been shown in the figures for greater clearness, the plant may obviously include as many radiators as desired.

As shown in Figs. 1 and 2, the radiator tube nests **21**—**21***a* are each connected to a circuit **57**, **58** and **57***a*, **58***a* which includes compressors **40**—**40***a* actuated in a

constant direction by a motor (not shown). Each compressor **40**, **40***a* is surrounded by a quadrilateral arrangement of conduits **60**, **61**, **62**, **63** and **60***a*, **61***a*, **62***a*, **63***a*. Its intake and delivery are respectively connected to opposite sides **60**, **63** and **60***a*, **63***a* of this quadrilateral, and are controlled by three-way valves **41**, **41***a*, **42**, **42***a*. One apex **64** of the quadrilateral of conduits **60**, **61**, **62**, **63** for compressor **40***a* is connected with a tube nest **21** of the radiator. The opposite apex **65** is connected to a cooler **43** which communicates at its other side with a container **44** containing a body of liquefied cooling fluid.

One apex **64***a* of the quadrilateral of conduits **60***a*, **61***a*, **63***a* associated with compressor **40***a* connects with one end of the radiator tube nest **21***a*. The latter communicates at its other side with the container **44**. The opposite apex of this quadrilateral connects with an auxiliary evaporator **45** which further communicates with the radiator tube nest **21**.

Expanders or pressure-relief means **46**, **46***a*, **46***b* are provided in the conduits which respectively serve the tube nests **21**—**21***a* and the cooler **43**.

For "winter' operation, the valves **41**, **41***a*, **42**, **42***a* are actuated to the position shown in Fig. 1. Both compressors **40** and **40***a* then deliver in series into the radiator tube nests **21**—**21***a*, which then act as a condenser.

For "summer" operation, the valves **41**—**41***a*, **42**—**42***a* are switched to the position shown in Fig. 2. The compressors then exert suction in series on the radiator tube nests **21**—**21***a*, which then serve as evaporator means.

The operating levers or handles of all four valves **41**, **41***a*, **42**, **42***a* may be mechanically connected for simultaneous actuation. Alternatively the four said valves may also be grouped into a unit, and for actuation by means of a common multiple key or the like (Fig. 3).

Rather than being mounted in series as indicated in Figs. 1 and 2, the two compressors **40**—**40***a* may be connected in parallel, as indicated in Fig. 4, in which the arrangement is shown in condition for summer operation, while Fig. 5 illustrates the same in winter operation.

The radiators may be supplied with a liquid serving as a medium for conveying cold in summer, and heat in winter. To heat and cool this liquid, a cooling machine is also used operated as heat pump, that is a cooling machine whose condenser is used as a source of heat and the evaporator as a source of cold.

Figs. 6 to 8 illustrate the essential components of such a plant. This comprises a pair of boxes or casings, **47**, **47***a* containing baffle members **47***b*. The opposite walls **48**—**48**, **48***a*—**48***a* of each box are removable. With these walls in position, the boxes are tightly sealed from the exterior.

Box **47** contains a cooling coil **49** or the like, which at one end connects with the delivery of a compressor **50** for a coolant liquid, said compressor being driven by a motor **51**. The other end of the coil connects with a container **52** for a supply of liquefied cold-producing substance. The container **52** is further connected, through an interposed pressure-relief or expander means **53**, with another coil **49***a* placed in box **47***a* and the other end of which communicates with the intake of the compressor **50**.

The plant further includes a conduit **66**, **67** for the circulation of the intermediate liquid between the heat pump and the radiators. Interposed on this conduit is a pump **54** the delivery pipe **67** of which divides into two branches **68**, **68***a* respectively leading to the box **47** and the box **47***a*, said branches again merging into a common pipe beyond the boxes. Three-way valves **55**—**56** are respectively interposed at the branching-off point on the delivery pipe of pump **54**, and at the merging point of the branches.

The coil **49** serves as a condenser for the cold-producing fluid, while coil **49***a* serves as the evaporator.

For summer operation, the walls **48**—**48** of box **47** containing coil **49** are removed and valves **55**—**56** are actuated to the position shown in Fig. 7, in which the intermediate-liquid pump **54** delivers into the box **47***a*, said liquid being cooled therein before it is conveyed to the radiators.

For winter operation, on the other hand, the walls

48*a*—48*a* of box 47*a* are removed, and valves 55—56 are brought to their other position shown in Fig. 8. The intermediate liquid then flows through box 47 in which it is heated prior to flowing into the radiators.

As already stated, the actuating levers of valves 55—56 may be interconnected, or both valves may be combined into a unit provided with a common actuating lever.

As shown in Figs. 9 and 10, the radiator or radiators are directly supplied with the cold-producing fluid as in the embodiments illustrated in Figs. 4 and 5. The plant also includes two compressors 40, 40*a* which are grouped in parallel.

In Figures 11 and 12, the three way valves are replaced by 8 ordinary valves, 1–8 grouped together with valves 9–17.

In the summer operation of the installation, according to Figures 8 and 9, the valves 1–9 carrying the odd number designations are open and the valves carrying the even number designations are closed. In another connection, the three way valves 41—42, 41*a*—42*a* are in the respective positions as shown in Figure 10. The radiators thus function as evaporators to cool the ambient air.

In the apparatus for winter operation, the odd numbered valves are closed while the even numbered valves are opened, and the three way valves 41—42 and 41*a*—42*a* are in the positions as shown in Fig. 9.

The compressors compress the fluid in the radiators, which serve as condensers and consequently as heating elements.

Figs. 11 and 12 show in what manner the valves may be grouped with the purpose of common control thereof through actuation of a common control member, such as a crank connected with a gear meshing with an endless sprocket chain trained over sprocket pinions respectively rotatable with the plug of each valve. Matters are so arranged that the valves designated by odd reference numerals will be closed when the even-referenced valves are open. This is the condition for winter operation (Fig. 11). In summer operation on the other hand, the odd valves are open and the even ones closed.

To change over from winter to summer operation and vice versa, it is only necessary to actuate the common operating member in one or the other direction.

The general function of the apparatus whether it be for summer or for winter operation is altogether the same, in view of the foregoing description of the embodiments shown in Figs. 8 and 9.

What I claim is:

1. In an air conditioning plant comprising radiators and means for evaporating and then compressing and condensing a cooling fluid, at least one radiator comprising a central tube nest and a complementary tube nest, a cooling fluid compressor for each of said tube nests, and valve controlled means for selectively connecting each of said tube nests with the inlet and outlet of the corresponding compressors.

2. In a plant according to claim 1, at least one radiator comprising a central tube nest and a complementary tube nest, a compressor for each of said nests, and valve controlled means for selectively connecting each of said tube nests with the inlet and the outlet of the corresponding compressors each in series with respect to the other.

3. In a plant according to claim 1, at least one radiator comprising a central tube nest and a complementary tube nest, a compressor for each of said nests, and valve controlled means for selectively connecting each of said tube nests with the inlet and outlet of the corresponding compressors each in parallel with respect to the other.

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