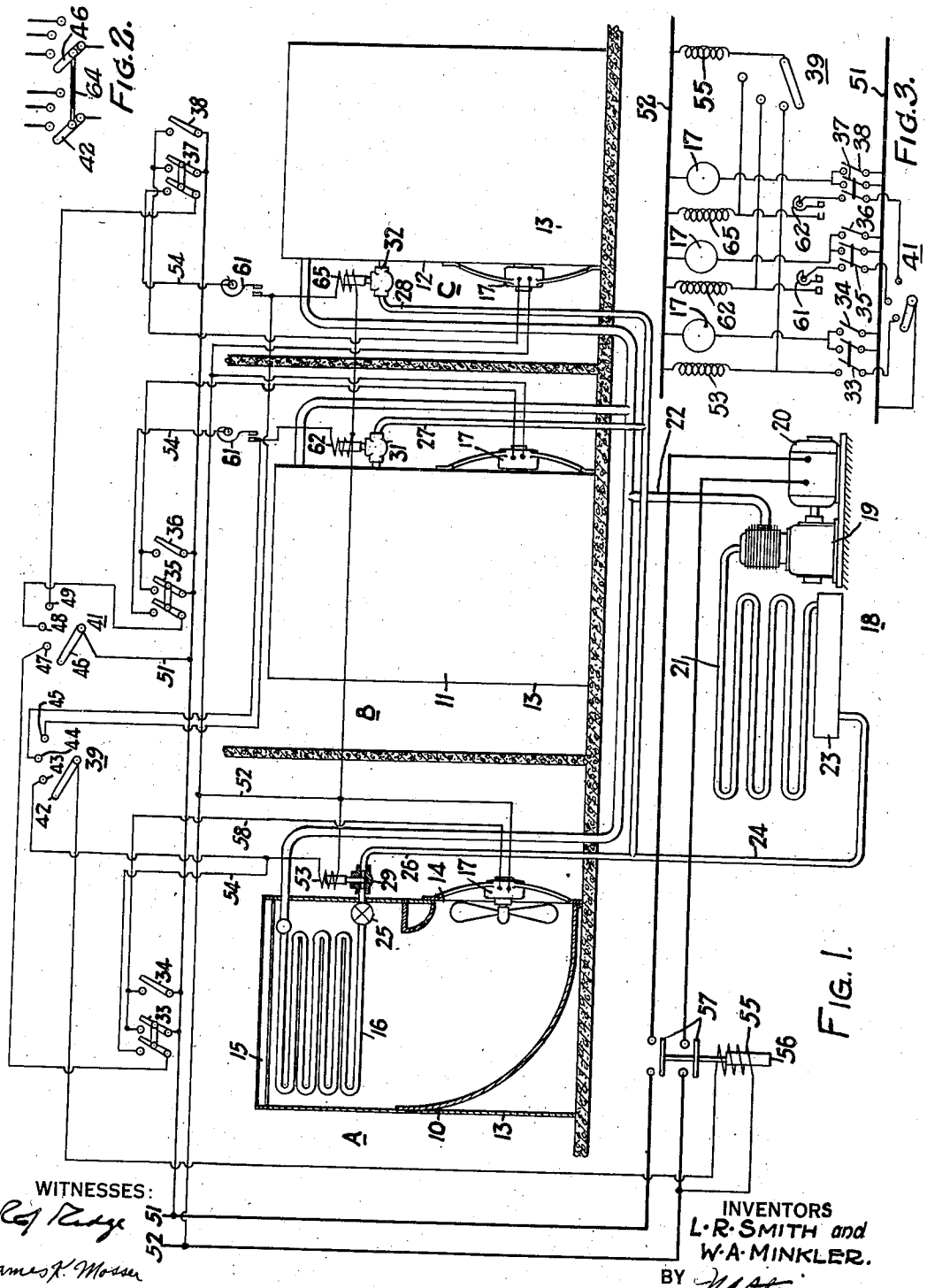
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CONTROL MECHANISM

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CONTROL MECHANISM

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Our invention relates to a control system for air cooling apparatus and it has for an object to provide an improved system therefor.

It is a further object of our invention to provide an improved control system for a plurality of air cooling devices which are supplied with a cooling medium from a common source of limited capacity.

A still further object of this invention is to provide a control system, for a plurality of air cooling devices receiving refrigerant from a common source, which limits the refrigerating load applied to said source to the capacity thereof.

While not necessarily limited thereto, our invention is more applicable to relatively small air cooling devices, such as are used for cooling air in the home and small storerooms, and which are commonly referred to as room coolers. These devices usually include a cabinet structure, within which a cooling coil or evaporator is disposed and a fan for circulating air in heat exchanging relation with the cooling coil and delivering it to the room in a cooled condition. The cooling coil or evaporator is supplied with refrigerant from a refrigerating machine which may be of any well known type.

It is often desired to operate two or more cooling devices from a single refrigerant source, the capacity of which is limited to the requirements of a single device. For example, an air cooling device may be installed in the lower floor of a home and one on the upper or bedroom floor. During the day, the cooler on the lower floor is operated, and, in the evening, the upper floor cooler is placed in operation and operation of the cooler on the lower floor terminated. An efficient system is provided by an arrangement of this kind where a refrigerating machine having a capacity capable of operating one device at a time constitutes the refrigerant source. The machine while in operation is running under optimum conditions at full load. It is to arrangements of this kind that our novel control system applies.

In practicing our invention, we provide a selector switch, movable to a plurality of selective positions, each position of which renders a different air cooling device operable. The selected operable device may be further controlled by a manually-operated disconnecting switch adjacent to the cooler cabinet and/or a temperature responsive instrument disposed within the space being cooled.

The fan associated with each device is preferably so connected to the electrical source that it may be operated independently of any of the switches mentioned in the foregoing in order that it may be operated at any time for ventilation. However, operation of the fan is desirable at all times that its associated cooling device is operative and provision is made in our novel system to assure this operation.

These and other objects are effected by our invention, as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a diagrammatic view of air cooling apparatus having our novel control system applied thereto;

Fig. 2 is a diagrammatic view of a modification of the selector switch employed; and,

Fig. 3 is a straight line wiring diagram of the control system shown in Figure 1.

Reference will now be had to Fig. 1 in which we have disclosed a plurality of air cooling devices 10, 11, and 12, respectively, disposed within spaces or enclosures A, B, and C, to be air-conditioned. As the air cooling devices are of similar construction, we have shown but one of them in section and a description of but one will be given; it being understood that all have corresponding elements. Each of the devices includes a cabinet 13 having an inlet opening 14 and an outlet opening 15 in communication with the enclosure in which it is located. A cooling coil or evaporator 16 is disposed within the cabinet 13 intermediate between said inlet and outlet openings. A motor driven fan 17 is arranged adjacent the inlet opening 14 for drawing in air therethrough and for translating it through the cabinet 13 and the outlet opening 15 to the enclosure. Suitable provision for fresh air may be made.

The evaporators 16 receive refrigerant from a common refrigerating machine 18, preferably of the compressor-expander type. The latter machine includes a compressor 19, driven by a motor 20, for withdrawing vaporized or spent refrigerant from the evaporator 16 and for compressing it, and a condenser 21 for condensing the same. The refrigerating machine 18 has a capacity sufficient to meet the requirement of any one of the air cooling devices 10 11, and 12 when operated singly, but insufficient for multiple operation. The system operates on the well known compression-expansion cycle in which refrigerant vapor is withdrawn from one of the evaporators 16, depending upon which is selected for operation, through a branched conduit 22, compressed by the compressor 19 and conveyed to the condenser 21. The compressor vapor is cooled and liquefied in

the condenser 21 and may be stored in a reservoir 23. Liquid refrigerant from the reservoir 23 is conveyed by a branched conduit 24 to an expansion device 25, through which it is admitted under reduced pressure to the evaporator 16. Due to the low pressure produced by the suction of the compressor 19, refrigerant is vaporized in the evaporator 16, absorbing heat therefrom in a well known manner. Branches 26, 27, and 28 of the conduit 24 have electrically-operated valves 29, 31, and 32 connected therein, the operation of which will be described hereinafter.

As the capacity of the refrigerating machine 18 is a fraction of the total refrigeration requirements of the air cooling devices, we have provided a novel control system to limit the number of devices which may be connected to the refrigerating machine at any one time to a number whose total refrigeration requirements do not exceed the capacity of the refrigerating machine 18. In the present case, the refrigerating machine 18 is assumed to have sufficient capacity to supply refrigerant to only one of the cooling devices 10, 11, and 12, so that the control system permits refrigerant to be supplied to only one of said cooling devices at a time.

The air cooling device 10 has a two-pole switch 33 and a single pole switch 34 associated therewith, which switches are disposed adjacent to the device and are preferably carried by the cabinet thereof. Similarly, the device 11 has switches 35 and 36 associated therewith and the device 12 includes switches 37 and 38. The control system also includes selector switches 39 and 41 which are preferably located centrally with respect to the devices 10, 11, and 12 where they may be conveniently reached from any one of the three. It will be obvious that the location of these switches will vary with different installations. The selector switch 39 includes a movable contact arm 42 and stationary contacts 43, 44, and 45 and the switch 41 has a movable contact arm 46 and stationary contacts 47, 48, and 49.

The electrically operated valves 29, 31 and 32 are of well known construction, and are preferably opened and closed by the energization and deenergization of solenoids associated therewith. The solenoids for operating the valves 29, 31 and 32 are shown at 53, 62, and 65, respectively, and are so arranged that, when energized, their respective valves are opened, and, when deenergized, their valves are closed. As these valves are well known in the art, no further description of them is deemed necessary.

The motor 20 for driving the compressor 19 may be connected directly to the power source when the proper switches, mentioned in the foregoing description, are adjusted to their closed positions, but we prefer to effect this connection by means of a relay shown at 56. This relay includes switches 57 connected in the circuit of the motor 20 and a solenoid 55 which, when energized, closes the switches 57 and, when deenergized, opens the same.

Automatic control of the air cooling device 10, 11, or 12 in accordance with a condition of the air in the spaces served thereby may be effected if desired. We have shown thermostats 61 for automatically controlling the devices 11 and 12 in accordance with the temperature in the spaces B and C, respectively. The thermostats 61 are electrically connected in the circuits of the devices 11 and 12; the specific connections being described hereinafter. As the electrical connections between the various elements are clearly shown in the drawing, no detailed description of them will be necessary, and the reference to them in the mode of operation which follows, clearly outlines their function.

Operation

Assuming it is desired to cool the air in the enclosure A, the switch 33 will be closed and, the arms 42 and 46 of the selector switches moved into engagement with the contacts 43 and 47, respectively. A circuit is thereby closed which extends through the coil 53 of the refrigerant valve 29. This circuit may be traced from a line conductor 51, arm 46, contact 47, switch 33, conductor 54, coil 53 to the other line conductor 52. A parallel circuit is also formed from the energized conductor 54 to the coil 55 of the relay 56, which controls the energization of the compressor motor 20. This circuit may be traced from conductor 54, contact 43, arm 42, coil 55 to the line conductor 52. Refrigerant is now permitted to flow to the evaporator 16 from the supply pipe 24 as the energization of the coil 53 has opened the valve 29. Operation of the refrigerating machine 18 is initiated as the motor 20 is electrically connected to the line conductors 51 and 52 by the closing of the contacts 57 of the relay 56. The fan 17 operates due to the closing of the switch 33, the circuit through the fan motor extending from conductor 51, the second pole of the switch 33, conductor 58, the motor of fan 17 to the line conductor 52. Air from the enclosure A is withdrawn by the fan 17, conveyed in heat exchanging relation with the evaporator 16 where its temperature is reduced, and discharged upwardly into the enclosure A.

Operation of the air cooling devices 11 and 12 is initiated in the same manner as previously described in connection with the device 10, the selector switches 39 and 41 being moved to their proper positions. For example, if the air cooling device 12 is to be operated, the arms 42 and 46 of the selector switches are moved into engagement with contacts 45 and 49, and the switch 37 is closed. When the arms 42 and 46 are moved to the off position shown on the drawing, the circuits of the several coils 53, 62, 65 and 55 are opened, thereby rendering all of the air cooling devices and the refrigerating machine inoperable.

If it is desired to automatically control the operation of the air cooling device in accordance with the temperature of the air in the enclosure which it serves, the thermostat 61 may be placed in the conductor 54. Such an arrangement is shown in connection with the air cooling devices 11 and 12 serving the enclosures B and C. Assuming the device 11 to be in operation, the switch 35 is closed, the arm 42 engaged with contact 44, and the arm 46 engaged with contact 48. The contacts of the thermostats 61 are shown open, which indicates that the temperature of the enclosure B is at the desired degree. Accordingly, the coil 62 of the refrigerant valve 31 and the coil 55 of the relay 56 are deenergized. The refrigerant machine 18 is therefore inactive, due to the open position of the switch 57, and flow of refrigerant from the supply pipe 24 to the evaporator 16 of the air cooling device 11 is prevented by the closed valve 31. When the temperature of the air in the enclosure B rises above a predetermined degree, the contacts of the thermostat 61 close to complete the circuit from the line conductor 51, arm 46 of the selector switch 41, contact 48, switch 35, conductor 54, thermostat 61, the coil 62 of the valve 31, to the other

line conductor 52. A parallel circuit is also completed from the energized thermostat 61, contact 44, arm 42, relay coil 55 to the line conductor 52. Opening of the valve 31 by its energized coil 62 permits refrigerant to flow to the evaporator 16 of the air cooling device 11 and the energization of the coil 55 closes the relay contacts 57 to initiate operation of the refrigerating machine.

It will be seen from the foregoing that, when an air cooling device is rendered operable by the closing of its associated control switch 33, 35, or 37, operation of the fan 17 associated with that particular device is initiated and is continuous as long as its respective switch 33, 35, or 37 is closed. Where thermostatic control is employed, such as shown in connection with the air cooling device 11, the circuit is such that only the refrigerant valve and the refrigerating machine are under control of the thermostat; operation of the fan 17 being independent thereof. Therefore, when any of the air cooling devices are rendered operable, uninterrupted operation of the fan associated therewith results. The fan is further controlled by switches 34, 36, or 38 which are connected in parallel with the second pole of switches 33, 35, and 37, respectively, so that the fan may be operated for ventilation even if cooling is not desired.

We have shown the selector switches 39 and 41 as separate devices in Fig. 1 as they are of standard construction and of a type generally used by the electrical trade. However, a selector switch similar to that shown in Fig. 2 may be used in which the arms 42 and 46 are mechanically tied together so that both arms are set with one operation. One form of accomplishing this is shown as comprising an insulated bar 64 mechanically connected to the arms 42 and 46.

With the above control mechanism, it is possible, if desired, to initiate and control operation of the various room coolers from the selector switches. To do this, the switches 33, 35, and 37 are closed, which, in the present embodiment, effects continuous operation of the air circulating fans. Then by moving the arms 42 and 46 to the contacts of the selected room cooler, operation thereof is effected, subject to the action of the thermostat if the room cooler is provided therewith. To discontinue operation of all room coolers, the arms 42 and 46 are moved to the off position shown in Fig. 1.

From the above description, it will be seen that we have provided a control system whereby the number of cooling devices in operation at one time is limited to the capacity of the refrigerant supply means. It will also be noted that the control system cannot effect operation of the refrigerating machine 18 without being connected to one of the cooling devices, since the coil 55, to be energized through one of the contacts of the switch 42, is necessarily connected in parallel with one of the coils controlling the refrigerant valves.

While we have shown our invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and we desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What we claim is:

1. In a control system for air conditioning apparatus, the combination of a plurality of air cooling devices, a refrigerating machine, common to said devices, for providing a supply of refrigerant therefor, a plurality of electrically operated valves for controlling the supply of refrigerant to said devices, and a selector switch for controlling the operation of the refrigerating machine and said valves and movable to a plurality of selective positions, in each of which the refrigerating machine and one of said valves are rendered operable, and to an off position in which the refrigerating machine and all of said valves are rendered inoperable.

2. In a control system for air conditioning apparatus, the combination of a plurality of air cooling devices, a refrigerating machine, the capacity of which is a fraction of the total refrigeration requirements of the air cooling devices, for providing a supply of refrigerant therefor, a plurality of conduits for conveying refrigerant from the refrigerating machine to the air cooling devices, a plurality of electrically operated valves connected in said conduits, respectively, and a selector switch for controlling the operation of the refrigerating machine and said valves and movable to a plurality of selective positions, in each of which said refrigerating machine is rendered operable and flow of refrigerant through one of said conduits may be effected, and to an off position in which the refrigerating machine is rendered inoperable and all of said valves are closed.

3. In a control system for air conditioning apparatus, the combination of a plurality of air cooling devices, a refrigerating machine, common to said devices, for providing a supply of refrigerant therefor, electrically operated valves for controlling the supply of refrigerant to said devices, respectively, an electrical circuit for each valve, a disconnecting switch in each of the last-named circuits, and a selector switch, movable to a plurality of selective positions, for energizing both said refrigerating machine and one of said valve circuits through the respective disconnecting switch.

4. In a control system for air conditioning apparatus, the combination of a plurality of devices for cooling the air in a plurality of spaces, a refrigerating machine, common to said devices, for producing a supply of refrigerant therefor, electrically operated valves for controlling the supply of refrigerant to said devices, respectively, electrical circuits for said valves, switches operated in response to the temperature of the air in their associated spaces for controlling the energization of said circuits, respectively, and switching means movable to a plurality of selective positions for energizing both said refrigerating machine and one of said valve circuits through the respective temperature responsive switch.

5. In a control system for air conditioning apparatus, the combination of a plurality of cooling devices, a fan associated with each device for translating air therethrough, a refrigerating machine common to said devices for providing a supply of refrigerant therefor, electrically operated valves for controlling the supply of refrigerant to said devices, respectively, an electrical circuit for each valve, a disconnecting switch in each of the last-named circuits, a selector switch, movable to a plurality of selective positions, for energizing both the refrigerating machine and one of said valve circuits through the respective disconnecting switch, and switching means associated with each disconnecting switch for con-

trolling the operation of the fan independently of the selector switch.

6. In a control system for air conditioning apparatus, the combination of a plurality of air cooling devices, a refrigerating machine, common to said devices, for providing a supply of refrigerant therefor, electrically operated valves for controlling the supply of refrigerant to said devices, respectively, electrical circuits for said valves, a selector switch for selectively energizing one of said circuits, an electrical circuit for effecting operation of said refrigerating machine, and a second selector switch for connecting said last-mentioned circuit to the selected valve circuit to be energized thereby.

7. In a control system for air conditioning apparatus, the combination of a plurality of air cooling devices, each having a fan for translating air therethrough, a refrigerating machine, common to said devices, for providing a supply of refrigerant therefor, electrically operated valves for controlling the supply of refrigerant to said devices, respectively, an electrical circuit for each valve, a disconnecting switch in each circuit, a selector switch movable to a plurality of selective positions for energizing one of said valve circuits through its respective disconnecting switch, a second selector switch electrically connected to the first-mentioned selector switch and to said refrigerating machine for energizing the latter when moved to a position corresponding to the selected position of the first-mentioned selector switch and switching means associated with each disconnect switch and opened and closed therewith for controlling the operation of the fans.

8. In a control system for air conditioning apparatus, the combination of a plurality of air cooling devices for a plurality of spaces to be cooled, each device having a fan associated therewith for conveying air in heat exchanging relation with the air cooling device and to the associated space, a refrigerating machine for providing a supply of refrigerant for the air cooling devices and common thereto, electrically operated valves for controlling the supply of refrigerant to each air cooling device, electrical circuits for each valve, a disconnecting switch in each valve circuit, an automatic switch connected in series relation with each disconnecting switch and operated in response to the temperature of the space associated therewith, a selector switch movable to a plurality of selective positions for energizing one of said valve circuits, a second selector switch connected to the first-mentioned selector switch through the disconnecting and automatic switches and to the refrigerating machine for energizing the latter when moved to a position corresponding to the selected position of the first selector switch, and switching means associated with each disconnecting switch and opened and closed therewith for controlling the operation of the fans independently of the temperature responsive switches and of the selector switches.

9. In air conditioning apparatus, the combination of a plurality of air coolers, electrical circuits for the respective air coolers for effecting operation thereof, a separate switch in each of said circuits adjacent the associated air cooler, a second switch connected in each of said circuits and operable in response to the temperature of the air in the space served by the associated air cooler, and other switch means for selectively connecting any one of said circuits to a source of electrical energy and for limiting the number of circuits that may be so connected at one time.

10. In a control system for air conditioning apparatus, the combination of a plurality of air cooling devices, a refrigerating machine for providing a supply of refrigerant for said devices, an electrically operated valve and an electrical circuit therefor associated with each air cooling device for controlling the supply of refrigerant thereto, a separate switch associated with each circuit for controlling the associated air cooling device individually and for simultaneously controlling the refrigerating machine, and switch means for selectively connecting any one of said circuits to a source of electrical energy and for limiting the number of circuits that may be so connected at one time.

11. In air cooling apparatus, the combination of a plurality of air cooling devices, refrigerating apparatus for supplying refrigerant for said air cooling devices, a selector switch having a plurality of selective positions corresponding to various air cooling devices and an off position, and means responsive to the adjustment of the selector switch to a selected position for supplying cooling medium to the air cooling device corresponding to said selected position and for effecting operation of said refrigerating apparatus and responsive to the adjustment of the selector switch to the off position for terminating supply of cooling medium to all the air cooling devices and for terminating operation of said refrigerating apparatus.

12. In a control system for air conditioning apparatus, the combination of a plurality of air cooling devices, a refrigerating machine, common to said devices, for providing a supply of refrigerant therefor, electrically operated valves for controlling the supply of refrigerant to said devices, respectively, an electrical circuit for each valve, a selector switch for selectively rendering one of said circuits operable and for rendering one or more other circuits inoperable, separate switch means connected in the respective circuits, each switch means controlling its associated circuit when the latter is rendered operable by the selector switch, and means for effecting operation of the refrigerating machine under control of the switch means whose circuit is rendered operable by the selector switch.

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