May 29, 1945. S. J. BENN 2,376,859

REVERSE CYCLE HEATING AND COOLING SYSTEM

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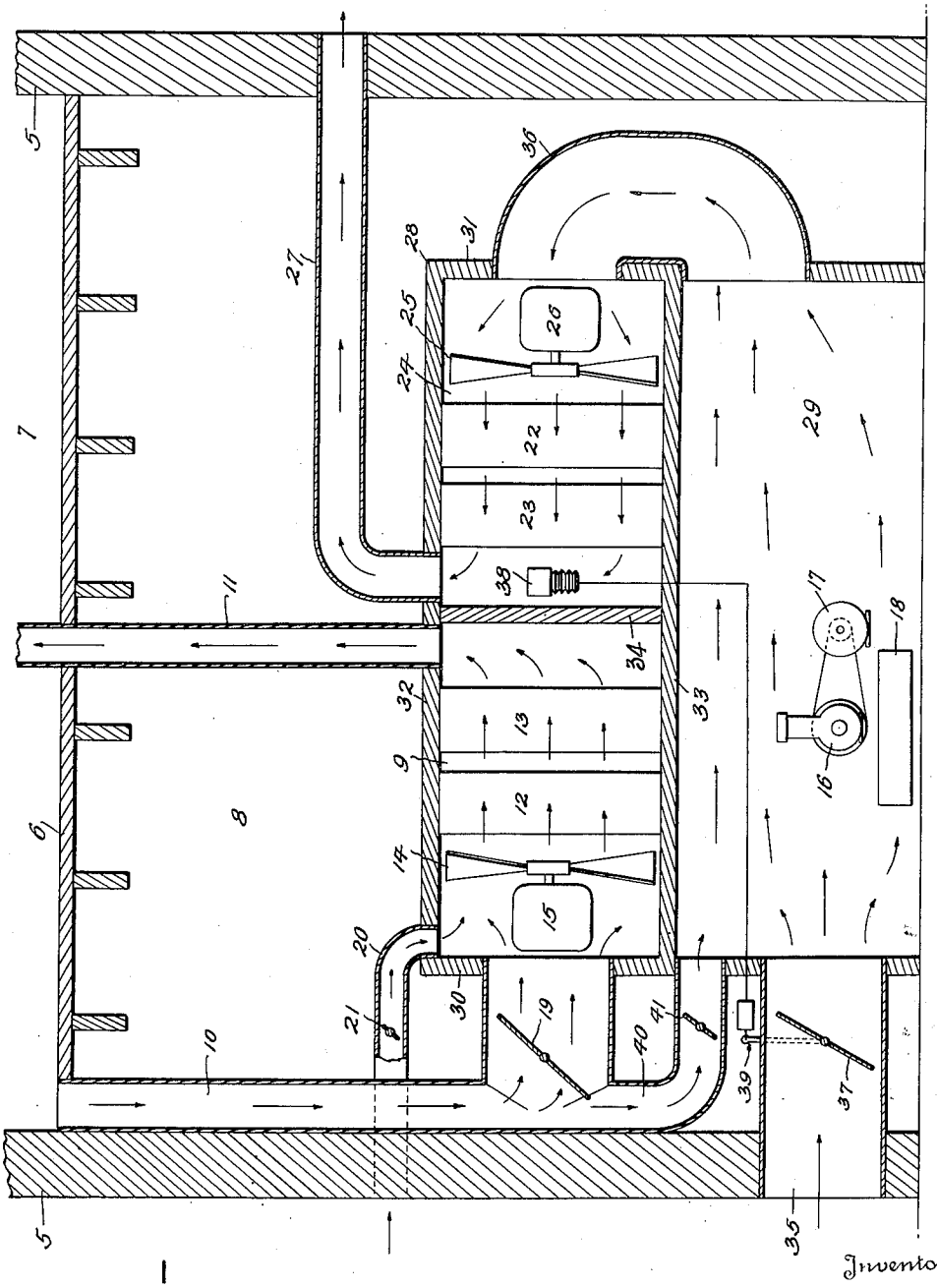


FIG. 1

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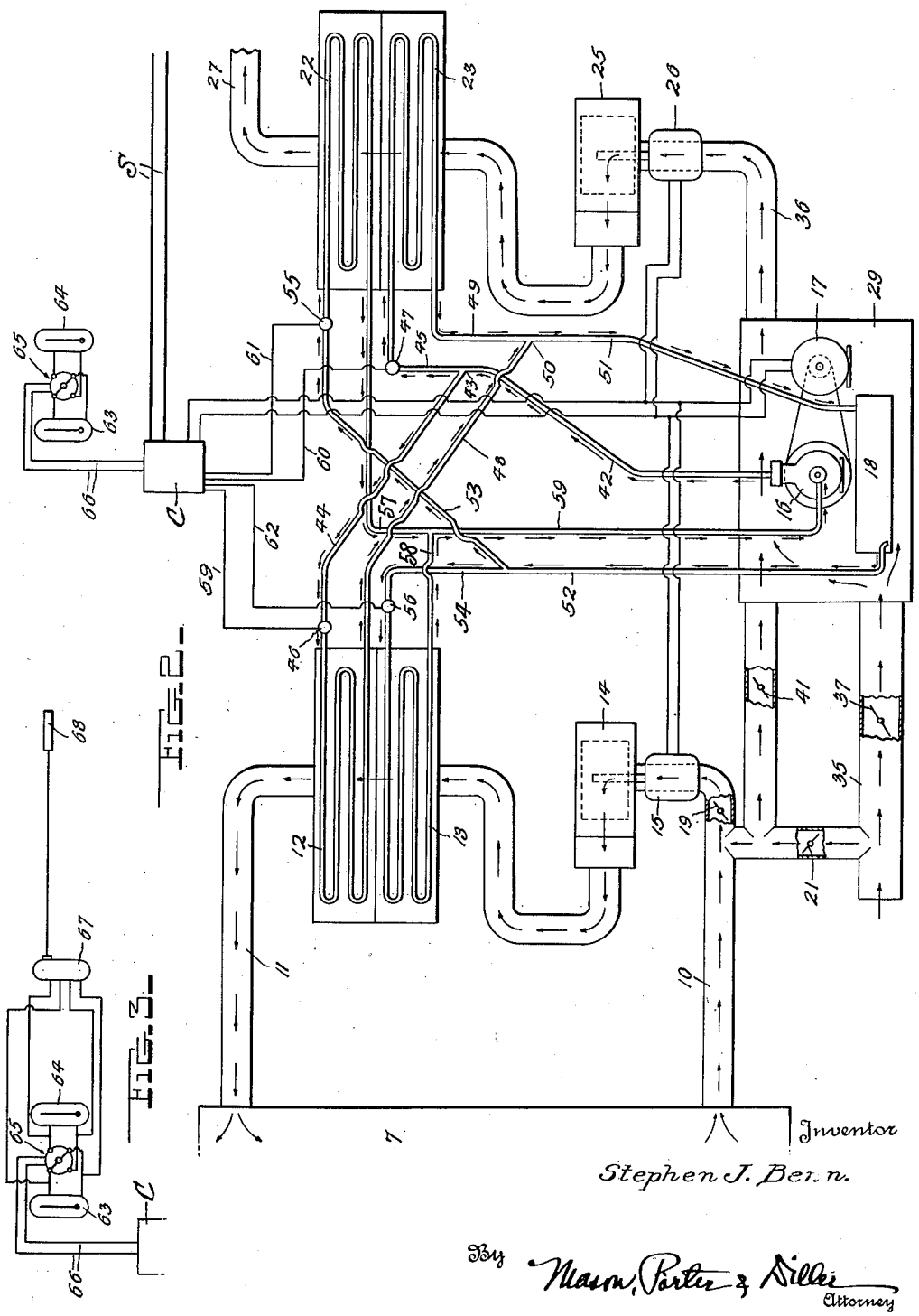


Fig. 2.

Fig. 3.

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REVERSE CYCLE HEATING AND COOLING SYSTEM

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8 Claims. (Cl. 62—6)

This invention relates to reverse cycle heating and cooling systems such as employ the compression refrigeration principle, for heating buildings or auditoriums in winter and for cooling the same during the hotter seasons of the year.

Systems of the class mentioned comprise generally an air conditioning chamber, air ducts connecting said chamber with the auditorium, a fan or blower for withdrawing air from the auditorium through one of said ducts and returning the same through the other duct; together with heating and cooling units in said conditioning chamber, and means for selectively utilizing said units as needed.

The object of this invention is to provide a comparatively simple system of the class stated, whereby a substantially uniform temperature may be maintained irrespective of variations in the outside temperature.

A further object is to provide means in a system of the character under consideration whereby the heating and cooling units may be selectively controlled by the variations in the outside temperature.

A further and particular object of this invention is to provide means increasing the efficiency of the system and thereby reducing the operating costs to a minimum.

The invention will be more readily understood by references to the accompanying drawings forming a part of this specification and in which:

Figure 1 is a diagrammatic sectional view of a portion of a building equipped with an air conditioning system embodying the invention, the connecting pipes and the electric controls being omitted to avoid undue confusion.

Figure 2 is a schematic diagram of the general layout including a manual summer-winter selective control switch, and

Figure 3 is a detail diagram of the selective control portion arranged for automatic actuation.

Referring now to Figure 1 of the drawings, 5—5 indicate outer walls of a building and 6 a floor of the rooms or auditorium 7 to be serviced by the system. In another room of the building, such a basement 8, is located the main operative parts of the device. These comprise the condensers and evaporators, the compressor and motor for operating the same, and means for maintaining a circulation of air about the condensers and evaporators and to and from the auditorium. As systems of the kind under consideration are usually employed for heating and cooling rooms for public assembly, I have herein designated such room as an "auditorium," although it is to be understood that the system may be used for heating and cooling the rooms of private dwellings, hotels, offices or any other rooms or compartments. Also, I have designated the "basement" as to locus of the main operative elements of the system, as the basement is where they will usually be located, but it is obvious that any convenient room or space may be utilized for the purpose. Hence, the word "auditorium" as used herein should be construed to mean the place to be heated or cooled; and "basement" as the room or space wherein the operative parts are located.

Arranged in the basement is an air-conditioning chamber 9 connected at one end to a duct 10 leading from the auditorium 7, and at the opposite end to a duct 11 for returning the air to the auditorium. Located within the chamber 9 is a condenser 12, an evaporator 13, and a fan or blower 14 driven by a motor 15. Connected to the condenser and evaporator in a manner hereinafter described, is a compressor 16 operated by a motor 17, and having the usual receiver 18. When it is desired to heat the auditorium the compressor is connected to the condenser 12. The fan 14 will create a circulation of air from the auditorium, through the chamber 9 in contact with the heated condenser, and then return the reconditioned air to the auditorium through the return duct 11. To cool the auditorium, the communication between the compressor and condenser is shut off and communication between the compressor and evaporator 13 established, thereby cooling the air as it passes through the ducts 10 and 11 and chamber 9. Arranged in the duct 10 is a damper 19 for controlling the passage of air through the conditioning chamber as will be described more fully hereinafter.

To supply fresh air to the air passing to the auditorium, a duct 20 is provided which extends from a point in communication with the outside atmosphere to the chamber 9, discharging therein at the inlet end of said chamber to mingle with the air of the general circulating current and to pass therewith through the condenser 12 and evaporator 13. The amount of fresh air admitted may be controlled by a damper 21.

In refrigerating systems of the type herein employed, each condenser must be in operative communication with an evaporator, and each evaporator communicate with a condenser. To this end an evaporator 22 is in communication

with the condenser 12; and a condenser 23 with the evaporator 13. The connections between the compressors and cooperating evaporators are not shown in Figure 1 as it would tend to confuse the figure; but these connections are fully illustrated in the diagrammatic Figure 2. This condenser 23 and evaporator 22 are arranged in an auxiliary chamber 24 through which a circulation of air is maintained by a fan or blower 25 driven by a motor 26 the air being drawn in from outside the building and after passing through the chamber 24, discharged whenever desired, usually to the outside atmosphere, as by a discharge duct 27.

The portions of the device so far described are preferably arranged in a unitary housing 28, insulated for both heat and noise and divided into the chambers 9 and 24, and a third chamber 29 for the compressor, motor, and other portions of the assembly. As shown in Figure 1, the housing comprises the insulating end walls 30 and 31, a top wall 32 and a horizontal partition 33 dividing the housing into the upper chambers 9 and 24, which are preferably in alignment and separated by a wall or partition 34, and the lower chamber 29 for the compressor, etc. Although this arrangement is preferable, it will be obvious that it may be varied without departing from the invention.

As stated above, the air for the auxiliary chamber 24 is drawn in from the outside atmosphere, and to this end an inlet duct 35 is provided, leading into the compressor chamber 29, preferably at the end of the housing opposite to the chamber 24, so that the air will be heated by the compressor and motor on its passage to the chamber 24, and also serve to cool the compressor and motor. A duct 36 connects the chamber 24 with the adjacent end of the chamber 28. Located in the inlet duct 35 is a damper 37 to control the amount of outside air passing to the chamber 24; and it is preferable that this damper be automatically controlled by the temperature of the air being discharged from said chamber. To this end a thermostat 38 is arranged in the chamber 24 at the discharge end thereof, that is, between the condenser 23 and evaporator 22, and the receiving end of the discharge duct 27. This thermostatic control is connected to the damper 37 as diagrammatically indicated at 39. Extending from the return air duct 10 to the end of the chamber adjacent the duct 35 is a bypass 40 which is provided with a damper 41.

The efficiency of the device depends largely upon the temperature of the air in the chamber 24, as will be understood. In hot weather sufficient air will usually be admitted through the duct 35; but in cold weather the temperature of the chamber 24 should be higher, and under such conditions the thermostat 38 will operate to more or less close the damper 37, causing the blower or fan 25 to draw air through the by-pass 40. This air being already warm is further heated by the compressor and motor, and by mingling with the now comparatively small amount of air entering through duct 35, assists in heating the same before entering the chamber 24.

In Figure 2 is illustrated the complete general layout including the cross connections between the condensers and evaporators, and with the connections between the same and the compressor, together with the selective valves arranged for changing from winter to summer operation and vice versa. As shown therein a conductor pipe 42 for the compressed refrigerant extends from the compressor 16 and is forked as at 43 forming branches 44 and 45 connected to the condensers 12 and 23 respectively. In the branch 44 is an electrically actuated valve 46, and a similar valve 47 is in the branch 45. Return pipes 48 and 49 from the condensers merge at 50 into a single pipe 51 discharging into the receiver 18.

Extending from the receiver is a pipe 52 having branches 53 and 54 extending to the evaporators 22 and 13 respectively, said branches having electrically actuated valves 55 and 56 respectively. Return pipes 57 and 58 lead from the evaporators and merge into a single return 59 to the compressor.

For summer use to cool the auditorium, the valves 47 and 56 are opened, and the valves 46 and 55 closed. The refrigerant is then forced by the compressor through 42 and 45 into the condenser 23, then returned through 49 and 51 to the receiver 18. From the receiver it is conducted through 52 and 56 to the evaporator 13, and returned through 58 and 59 to the compressor. The air current through the air conditioning chamber 9 is thus cooled by the evaporator before being returned to the auditorium, and the rate of flow of the cooled air is controlled or regulated by the damper 19. By closing or partly closing the damper 19, and more or less opening the damper 21, the desired quantity of fresh air may be injected into the circulating current.

In winter, the valves 56 and 47 are closed and the valves 46 and 55 opened. The refrigerant is then forced from the compressor through 42 and 44 to the condenser 12 and returned through 48 and 51 to the receiver 18; thence through 52 and 53 to the evaporator 22 and returned through 57 and 59 to the compressor. The air current passing through the chamber 9 is then heated by the condenser 12, and the rate of flow of the heated air is controlled by the damper 19; fresh air being admitted through the dampered duct 20 as hereinbefore described. The efficiency of the heating by the condenser 12 depends upon the efficient operation of the evaporator 22, and this is accomplished by sufficiently heating the air passing through the chamber 24. Part of the heat for this purpose is supplied by the otherwise waste heat from the compressor 16 and motor 17 which are located in the passageway of the fresh air entering through the inlet duct 35. To regulate the entry of the cold outer air and maintain the desired temperature in the chamber 24 for greater efficiency, the damper 37 is provided, and this is operated by the thermostat 38 in the discharge end of the chamber 24. Should the air entering 35 be too cold to be sufficiently tempered by the waste heat of the compressor and motor, the damper 37 is accordingly closed and the necessary air for proper circulation through the chamber is drawn from the bypass 40. As this is warm air from the auditorium, it is evident that the thermostat 38 will maintain the temperature in the chamber 24 at the most efficient degree.

The valves 46, 47, 55 and 56 are electrically operated through an automatic control C supplied from the power lines S. From this control C lines 59, 60, 61 and 62 lead to the valves 56, 47, 55 and 56 respectively. In Figure 2 the control C is shown as governed by a pair of thermostatic switches 63 and 64 for winter and summer use respectively. These switches are each set to operate through a specified range of temperatures and are selectively connected to the automatic control C by a manually actuated switch 65 and

lines 66. This form of control is but semi-automatic, as the switch 65 must be manually operated to connect the seasonal thermostatic switch 63 or 64 to the control C. In order to render the system completely automatic, the summer and winter controls are selectively connected to actuate the switches by thermostatic means 67 having an outside bulb 68. It is believed that the operation of the system will be clear from the foregoing description.

I claim:

1. In a system of the class described, an air conditioning chamber, a heating condenser and a cooling evaporator in said chamber, means for circulating air from a room through said conditioner and return, a second chamber, an evaporator and a condenser in said chamber cooperatively connected to the first said condeneser and evaporator respectively, a compressor, means for selectively connecting either of said condensers and its respective evaporator to said compressor, means for directing a stream of air over said compressor and through said second chamber, a damper controlling said stream of air, and thermostatic means in said second chamber for actuating said damper.

2. In a system of the class described, an air conditioning chamber, a heating condenser and a cooling evaporator in said chamber, means for circulating air from a room through said conditioning chamber comprising a duct from said room to one end of said chamber and a duct from the opposite end of said chamber to said room and a blower in said chamber, a second chamber, an evaporator and a condenser in said second chamber cooperatively connected to the first said condenser and evaporator respectively, a compressor, means for selectively connecting either of said condensers and its respective evaporator to said compressor, means for directing a stream of air adjacent said compressor to receive heat therefrom and then through said second chamber, a damper controlling said stream of air, thermostatic means in said second chamber for actuating said damper, a bypass from the first said duct to discharge with said stream of air adjacent the compressor, and a damper in said bypass.

3. In a system of the class described, an air conditioning chamber, a heating condenser and a cooling evaporator in said chamber, means for circulating air from a room through said conditioning chamber comprising a duct from said room to one end of said chamber and a duct from the opposite end of said chamber to said room and a blower in said chamber, a second chamber, an evaporator and a condenser in said second chamber cooperatively connected to the first said condenser and evaporator respectively, a compressor, thermostatic means for selectively and automatically connecting either of said condensers and its respective evaporator to said compressor, means for directing a stream of air adjacent said compressor to receive heat therefrom and then through said second chamber, a damper controlling said stream of air, thermostatic means in said second chamber for actuating said damper, a bypass from the first said duct to discharge with said stream of air adjacent the compressor, and a damper in said bypass.

4. In a system of the class described, an air conditioning chamber having a receiving end and a discharge end, a heating condenser and a cooling evaporator in said chamber, means for circulating air from a room through said conditioning chamber comprising a duct from said room to the receiving end of said chamber, and a duct from the discharge end of said chamber to said room and a blower in said chamber, a second chamber, an evaporator and a condenser in said second chamber cooperatively connected to the first said condenser and evaporator respectively, a compressor, thermostatic means for selectively and automatically connecting either of said condensers and its respective evaporator to said compressor, means for directing a stream of air adjacent said compressor to receive heat therefrom and then through said second chamber, a damper controlling said stream of air, thermostatic means in said second chamber for actuating said damper, a bypass from the first said duct to discharge into said stream of air adjacent the compressor, a damper in said bypass, and a valve controlled fresh air duct opening into the receiving end of the conditioning chamber.

5. In a system of the class described an air conditioning unit comprising an insulating housing divided into a conditioning chamber having a receiving end and a discharge end, a second chamber and a compressor chamber, a heating condenser and a cooling evaporator in said conditioning chamber, an evaporator and a condenser in the second chamber, cross connected to the first said condenser and evaporator, an inlet air duct leading into the receiving end of the conditioning chamber and a discharge duct leading from the discharge end thereof, a damper on said inlet duct, a fresh air duct leading into the receiving end of the conditioning chamber, an air duct discharging into one end of the compressor chamber, a damper in the last said duct, a duct connecting the opposite end of the compressor chamber and one end of the said second chamber, a discharge duct at the opposite end of the said second chamber, a thermostat in said second chamber adjacent the discharge duct, and operatively connected to the damper in the inlet duct to the compressor chamber, a valved bypass from the inlet duct of the conditioning chamber, and a receiver in said compressor chamber.

6. In a system of the class described, a heating condenser and a cooling evaporator, means for circulating the air from a room to be conditioned adjacent said condenser and evaporator and back to said room, a second evaporator and condenser, a compressor and a cooperating receiver, a pipe leading from said compressor, branches from said pipe to the first and second mentioned condensers respectively, an electrically controlled valve in each of said branches, return pipes from the condensers to the receiver, a pipe leading from said receiver, branches from the last said pipe to the first and second mentioned evaporators respectively, return pipes from the evaporators to said compressor, an electrically controlled valve in each of said last mentioned branches, and an automatic control for opening the valves to one of said condensers and to the cooperating evaporator and closing the valves to the other condenser and evaporator.

7. In a system of the class described, a heating condenser and a cooling evaporator, means for circulating the air from a room to be conditioned adjacent said condenser and evaporator and back to said room, a second evaporator and condenser, a compressor and a cooperating receiver, a pipe leading from said compressor, branches from said pipe to the first and second

mentioned condensers respectively, an electrically controlled valve in each of said branches, return pipes from the condensers to the receiver, a pipe leading from said receiver, branches from the last said pipe to the first and second mentioned evaporators respectively, return pipes from the evaporators to said compressor, an electrically controlled valve in each of said branches, an automatic control for opening the valves to one of said condensers and to the cooperating evaporator and closing the valves to the other condenser and evaporator, and a selector switch for reversing the operation of the automatic valve control for winter or summer use.

8. In a system of the class described, a heating condenser and a cooling evaporator, means for circulating the air from a room to be conditioned adjacent said condenser and evaporator and back to said room, a second evaporator and condenser, a compressor and a cooperating receiver, a pipe leading from said compressor, branches from said pipe to the first and second mentioned condensers respectively, an electrically controlled valve in each of said branches, return pipes from the condensers to the receiver, a pipe leading from said receiver, branches from the last said pipe to the first and second mentioned evaporators respectively, return pipes from the evaporators to said compressor, an electrically controlled valve in each of said branches, an automatic control for opening the valves to one of said condensers and to the cooperating evaporator and closing the valves to the other condenser and evaporator, means for reversing the operation of the automatic valve control for winter or summer use, and a thermostat exposed to the outside temperature for actuating said reversing means.

STEPHEN J. BENN.