Dec. 26, 1939. S. J. LEVINE 2,184,354

AIR CONDITIONING APPARATUS

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Fig. 1.

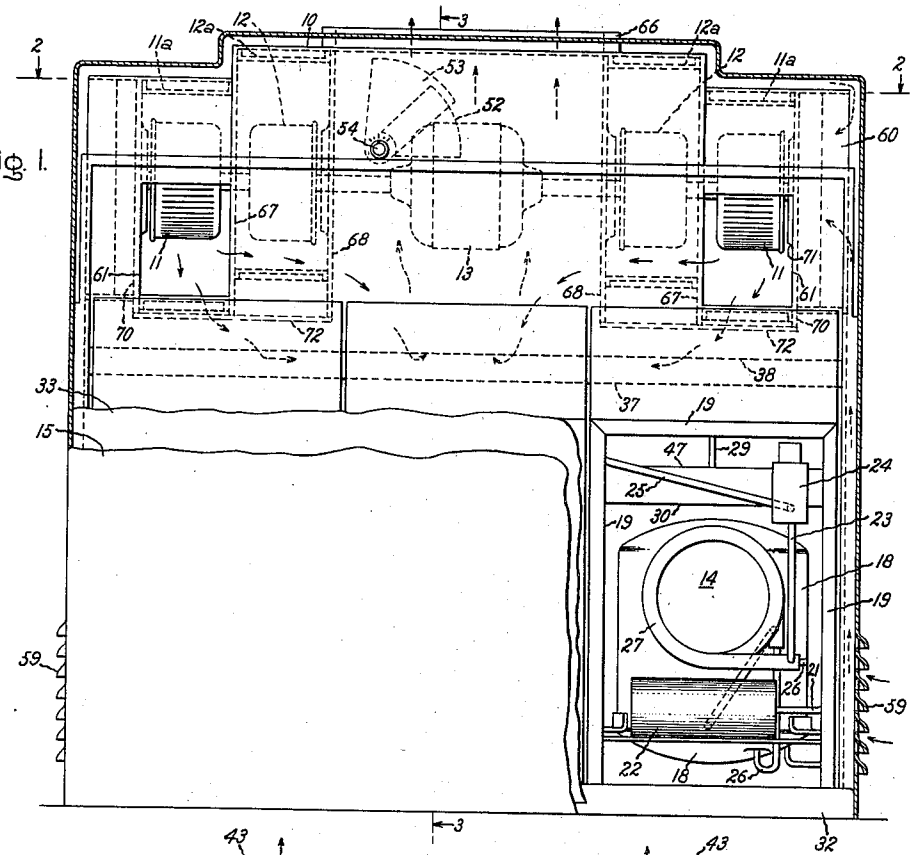
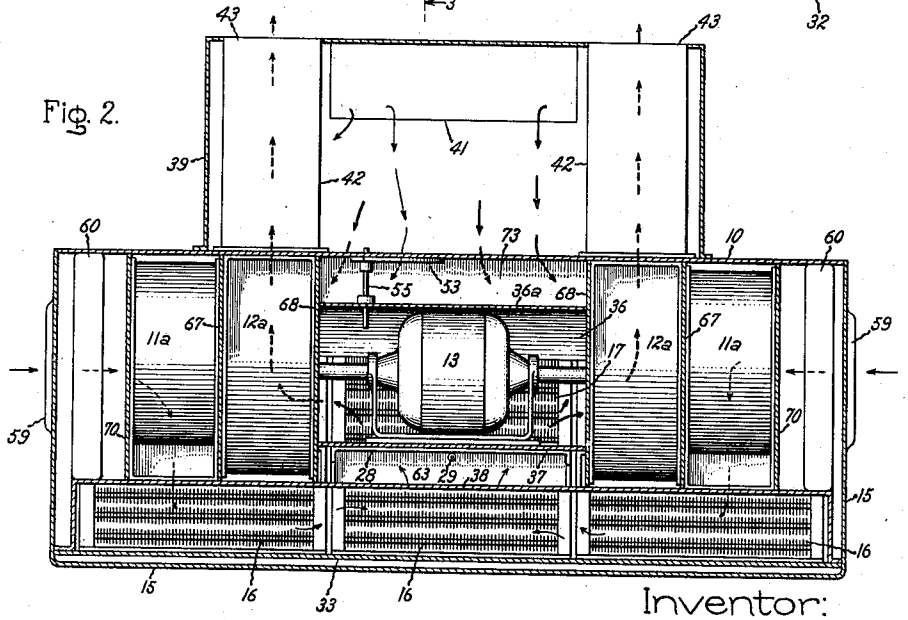


Fig. 2.



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Fig. 3.

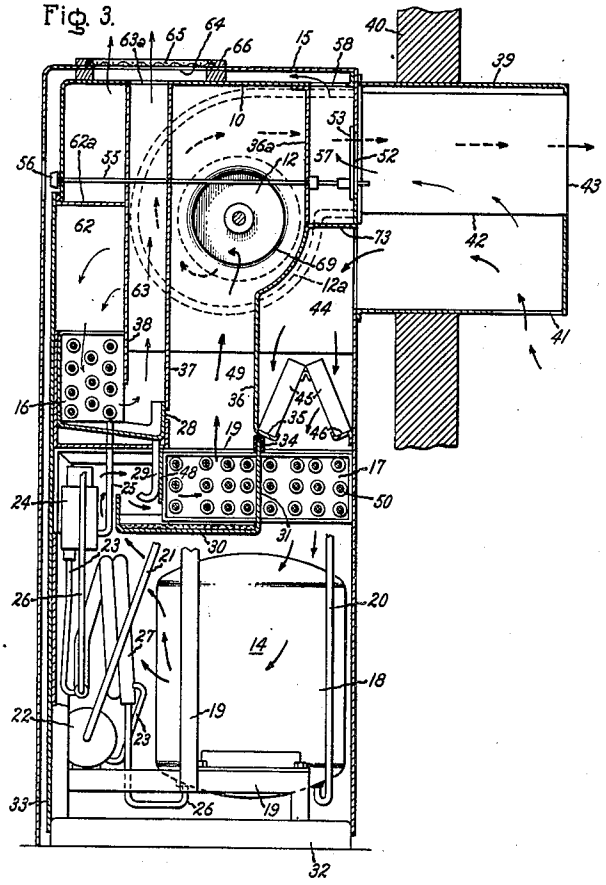


Fig. 4.

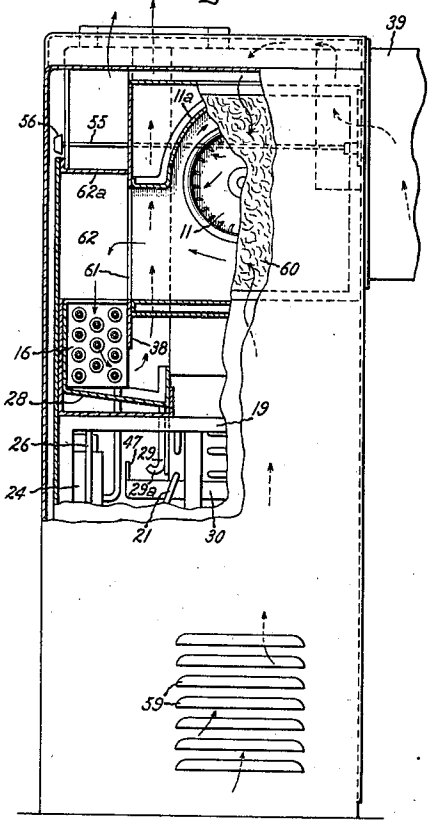


Fig. 6.

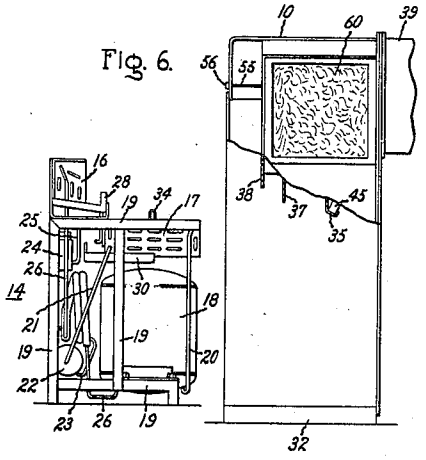
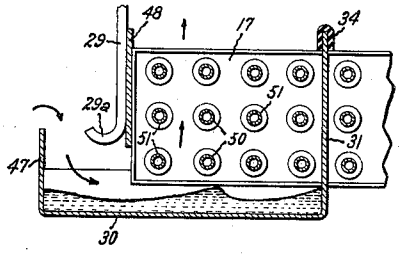


Fig. 5.



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Fig. 7.

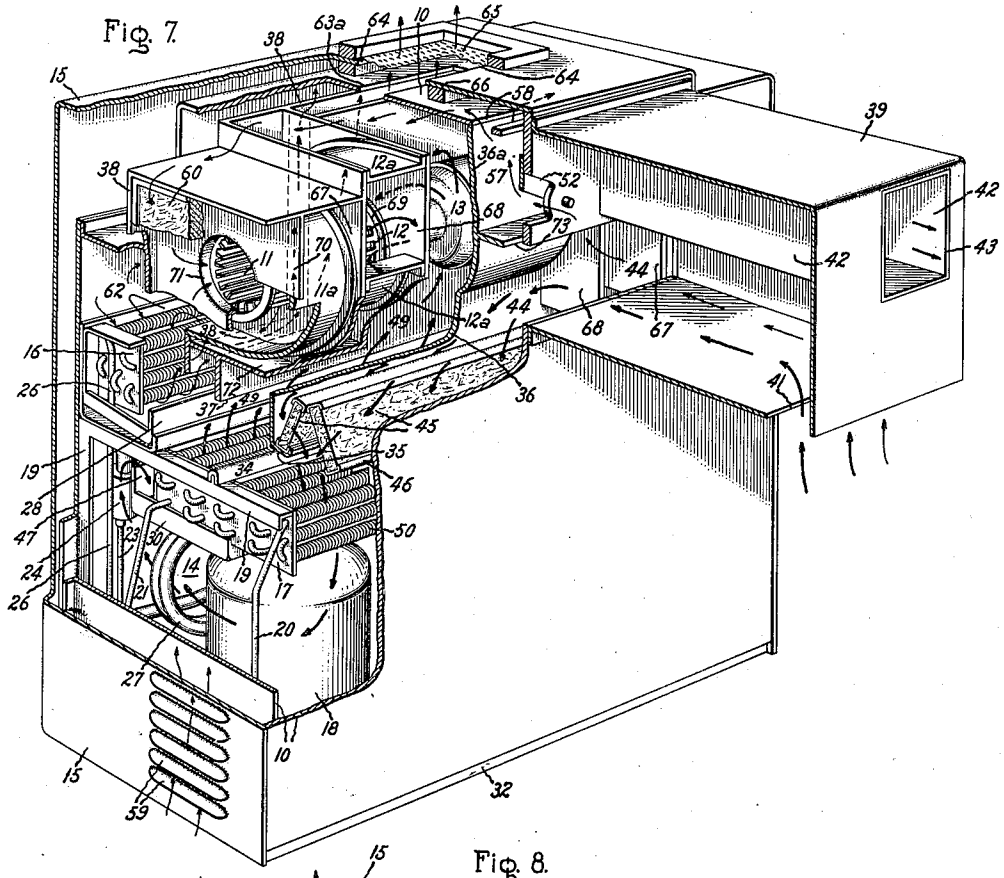
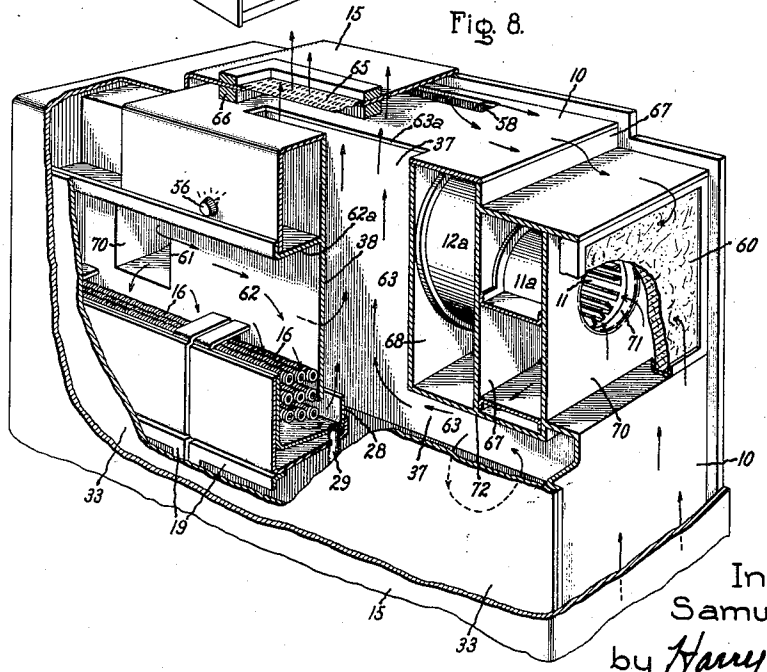


Fig. 8.



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2,184,354

UNITED STATES PATENT OFFICE

2,184,354

AIR CONDITIONING APPARATUS

Samuel J. Levine, East Orange, N. J., assignor to General Electric Company, a corporation of New York

Application May 13, 1936, Serial No. 79,511

6 Claims. (Cl. 62—140)

My invention relates to air conditioning apparatus.

It is an object of my invention to provide an apparatus including a refrigerating machine for cooling and dehumidifying the air within an enclosure and an improved arrangement of ducts for circulating through the apparatus the air to be conditioned and for expelling from the enclosure moisture removed from the air in the enclosure.

Another object of my invention is to provide a unitary apparatus for conditioning the air within an enclosure, including a removable refrigerating machine having an evaporator and a condenser and cooperating with the duct structure of the apparatus to complete a plurality of air circulating paths therethrough.

Further objects and advantages of my invention will become apparent as the following description proceeds, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawings in which Fig. 1 is a front elevation view, partly in section, of an air conditioning unit embodying my invention; Fig. 2 is a sectional plan view on the line 2—2 of Fig. 1; Fig. 3 is a sectional side view along the line 3—3 of the unit shown in Fig. 1; Fig. 4 is a side elevation view, partly in section, of the unit shown in Fig. 1; Fig. 5 is an enlarged sectional view of the condensate disposal arrangement shown in Fig. 3; Fig. 6 is a reduced side elevation view, partly in section, of the inner casing of the unit shown in Fig. 1 with the refrigerating machines removed therefrom, one of the machines being shown in front of the casing; Fig. 7 is a sectional perspective rear view of the unit shown in Fig. 1, and Fig. 8 is a sectional perspective front view of the upper portion of the unit.

Referring now to the drawings, in Figs. 1 and 2 I have shown an air conditioning unit for cooling and dehumidifying the air within an enclosure. The air conditioning unit comprises an inner casing 10 having a plurality of fans or blowers 11 and 12 arranged in scrolls or casings 11*a* and 12*a*, respectively, in the upper or air duct portion of the inner casing. The fans 11 and 12 are arranged on a common shaft and driven by a motor 13 at the center thereof. In the lower or machinery portion of the casing 10 are arranged three removable refrigerating machines 14, one being shown in the cut away portion of Figs. 1, 3, and 7. A removable casing 15 surrounds the casing 10 on the front, top and sides and provides an air space about the casing 10. Each of the refrigerating machines 14 is provided with an evaporator or air cooling element 16 for absorbing heat and a condenser 17 for rejecting heat, both removable with the machine as a unit. The upper portion of the inner casing 10 is provided with a plurality of partitions so arranged that when the machines 14 are in place in the lower portion of the casing, the fans 11 circulate air received from the enclosure to be conditioned and also fresh air over the evaporators and thence into the room, thereby cooling and dehumidifying the air. The arrangement of the partitions also provides an air circulating duct through which the fans 12 circulate fresh air as a cooling medium from outside the enclosure over the condensers and other warm portions of the refrigerating machines 14 and thence out of the enclosure. The fans 11 thus serve to circulate air over the evaporators and through the enclosure while the fans 12 circulate cooling air over the condensers and the refrigerating machines. In the drawings, the completed path of the air circulated over the condensers and the completed refrigerating machines is indicated by heavy solid and dotted arrows, and the path of the air circulated over the evaporators and into the room or other enclosure to be conditioned is indicated by light solid and dotted arrows.

Each of the refrigerating machines 14 comprises a closed casing 18 within which is arranged a motor and a compressor and which is mounted on a frame 19, together with one of the evaporators 16 and one of the condensers 17. Gaseous refrigerant is compressed by operation of the compressor within the casing 18 and is discharged through a conduit 20 to the condenser 17. The compressed refrigerant in the condenser 17 is cooled and thereby liquefied and then flows through a connection 21 to a liquid receiver 22 mounted on the frame 19 near the bottom thereof. The liquid refrigerant is withdrawn from receiver 22 through a liquid line 23 upon operation of a flow controlling device 24, which may be of any desirable type, such as a thermostatically operated valve responsive to the temperature of the refrigerant withdrawn from the evaporator 16. From the valve 24 the refrigerant flows through a connection 25 to the evaporator 16. The liquid refrigerant within the evaporator 16 is vaporized by the absorption of heat from the air passing over the evaporator and the vaporized refrigerant is withdrawn from the evapo-

rator through a suction line 26 having an enlarged portion 27 through which passes the liquid line 23. This arrangement of the liquid and suction lines provides a heat exchanger for absorbing heat from the liquid refrigerant before it passes to the valve 24, thereby utilizing the heat absorbing capacity of the vaporized refrigerant withdrawn from the evaporator to increase the economy of operation of the refrigerating machine. The gaseous refrigerant after passing through the heat exchanger is returned to the casing 18.

An inclined pan or plate 28 is provided below the evaporator 16 in order to complete the evaporator air path and to catch moisture condensed on the coils of the evaporator. The moisture collected flows through a tube 29 having a bend or trap 29a at the lower end thereof and falls into a pan or plate 30 extending the width of the refrigerating machine assembly. The front half or portion of the condenser 17 is directly above the pan 30 and is divided from the rear portion by a vertical partition 31 extending the length of the condenser. The condensed moisture which collects in the pan 30 is absorbed in the air stream passing over the condenser and thereby removed from the apparatus and discharged to the atmosphere outside of the enclosure to be conditioned. The manner in which this arrangement operates to remove the condensed moisture will be hereinafter more fully described.

When the refrigerating machines 14 are placed within the cabinet 10 they rest upon a base 32 of the cabinet, and a front plate 33 is secured over the front opening of the cabinet through which the refrigerating machines have been inserted. When the machines are in place a sealing gasket of rubber or other suitable material 34 secured to the top of partition 31 engages a flange 35 at the bottom of a vertical partition 36 in the upper portion of the cabinet, and the pan 28 rests against the lower edge of a vertical partition 37 in the upper portion of the casing. The evaporator 16 lies closely adjacent the lower end of a vertical partition 38 in the upper portion of the casing, the partition covering the upper half of the side of the evaporator. When the pan 28 is in engagement with the lower end of the partition 37 it seals the air space surrounding the evaporator 16 from the air space surrounding the condenser 17, the only communication between the evaporator and condenser compartments being through the tube 29. The bend 29a at the bottom of the tube 29 acts as a liquid trap and prevents the passage of air through the tube 29 between the condenser and evaporator compartments.

A vertical wall 67 is arranged between the scrolls 11a and 12a of each set of fans and separates the fans 11 and 12. Vertical walls 68 close each of the fan scrolls 12a and are provided with openings 69 through which air is admitted to the fans 12. Vertical walls 70 close the outer sides of the scroll 11a and are provided with openings 71 through which air is admitted to the fans 11. The vertical walls 67, 68 and 70 extend between the rear wall of the casing 10 and the partition 38; the upper ends of the blower compartments thus formed are closed by the top of the casing 10 and the lower ends between partitions 36 and 38 are closed by plates 72. The fan scrolls 11a and 12a are thus enclosed in box-like compartments in the upper portion of the casing, the compartments being provided with the inlet and outlet openings of the fans.

In order to provide communication between the casing 10 and the exterior of the building, an air duct 39 is provided passing through the wall 40 of the building as shown in Fig. 3. The duct 39 is provided with a fresh air intake opening at its outer end at the bottom thereof and two horizontal air discharge ducts 42, arranged one at each side of the duct in the upper portion thereof. The ducts 42 have discharge openings 43 and direct the expelled air horizontally away from the downwardly opening fresh air intake 41 as shown clearly in Fig. 7.

Outside air is drawn in through the opening 41 and the duct 39 and enters a duct or passage 44 extending the width of the casing 10 above the rear or right-hand portion of the condensers 17, and passes down through inclined filters 45 arranged in the lower end of passage 44. The front filter 45 is supported on the flange 35 and the rear filter on a flange 46 secured to the outer wall of the casing 10. Dust and other impurities are removed by the filters and the air passes down over the right-hand or rear portions of the condenser 17 between the wall of the casing 10 and the partitions 31. This path of the condenser cooling air is indicated by heavy arrows and can be followed clearly in Figs. 3 and 7. The air flows downwardly over the casings 18 and cools the casings and then circulates about the liquid receivers 22, the heat exchangers 27 and the valves 24 moving upwardly and then being directed downwardly over the pans 30. A baffle plate 47 is provided on the front edge of each of the pans 30 to produce a swirling action of the air, and a baffle 48 is provided above each of the pans 30 and extending downwardly from the pans 28 to force the air downwardly against the water in the pans 30 and upwardly through the left-hand or front portions of the condensers 17. From the condensers the air flows up through a duct or passage 49 between the partitions 36 and 37 and around the motor 13 and into the fans 12 which discharge the air from the casing through the ducts 42. The lower portion of the passage 49 extends entirely across the casing 10 below the bottom wall 72 of the blower compartments above the left-hand portions of the condensers 17 as shown in Figs. 3 and 7, and the portion of the passage 49 above the middle condenser 17 extends upwardly between the walls 68 to conduct the air around the motor 13 and thence through the openings 69 into the fans 12. This construction can be seen clearly in Fig. 7. The condenser cooling air is thus circulated in such a manner as to cool the warm portions of the refrigerating machines and the fan motor as well as the condensers.

The air passing over the pans 30 vaporizes some of the water and also throws particles of the water over the extended surface of the condensers 17, thereby cooling the condensers and vaporizing the water thereon which is absorbed in the air stream and discharged with the air to the outside. This arrangement avoids the necessity of providing a drain for the water condensed on the evaporators 16 and thereby makes plumbing fixtures unnecessary. The operation of the moisture disposal arrangement can be better understood by reference to Fig. 5, which shows an enlarged sectional view of the pan 30 and the left-hand side of the condenser 17 of one of the refrigerating machines 14. During the operation of the fans 12 the air passes at a high velocity be-

tween the baffles 47 and 48 downwardly onto the surface of the water in the pan 30. This violently agitates the water in the pan and throws particles of water upwardly with the air stream onto coil 50 of the condenser 17. The coil 50 is provided with fins 51 which form an extended heat radiating surface. The water thrown onto the condenser cools the coil by absorbing heat therefrom as it is vaporized. The vaporization of water produced by the passing of the air over the water in the pan 30 and over the water blown onto the coil 50 is accomplished at a sufficient rate to remove all of the water condensed on the evaporator 16 without overflow from the pan 30.

The air which is to be conditioned and discharged into the room is a mixture of fresh air and air withdrawn from the room for recirculation. When the outer casing 15 is in place an air space is formed between the outer cover and the casing 10. Fresh air is admitted to this space through an opening 52 in the rear wall of the casing 10 providing communication with the duct 39. The size of the opening 52 may be varied by moving a segmental damper 53 pivoted at 54 on an operating rod 55 having a knob 56 accessible from the front of the casing. Fresh air enters from the duct 39 passes through the opening 52 into a passage 57 formed between the casing 10 an extension 36*a* of wall 36 and a horizontal wall 73 and extending between the two walls 68. The air passes out of passage 57 through an opening 58 into the space between the cover 15 and the casing 10. The casing 15 is provided with a plurality of louvers 59 at the ends of the casing in the lower portion thereof, and through these louvers air from the room enters the space between the cover 15 and the casing 10. The path of the fresh and recirculated air to be conditioned is indicated by light arrows. As shown in Fig. 8 the mixture of fresh and recirculated air in the space between the inner casing 10 and the outer casing 15 passes through filters 60 at either end of the casing 10 into the fans 11 through openings 71 and is forced by operation of the fans through fan outlets 61 and thence into a duct or passage 62 extending entirely across the casing 10 above the evaporators 16 and below a horizontal wall 62*a*, which forms a part of the top wall of casing 10. The air then passes downwardly over the evaporators 16 where it is cooled and dehumidified, the condensed moisture flowing from the surface of the evaporators into the pans 28 and thence through the tubes 29 to the pans 30. The air is discharged from the evaporators into a duct or passage 63 formed between the vertical partitions 37 and 38; the lower portion of the passage 63 extends entirely across the casing 10 below the walls 72 of the fan compartments. The air then passes upwardly through the passage 63 above the middle one of the refrigerating machines 14 and between the walls 68 and thence into the room through an opening 63*a* in casing 10 and an opening 64 in the casing 15, the opening being provided with a grill 65. The air space between the casing 15 and the inner casing 10 is sealed from the air discharged from the passage 63 by a gasket 66 extending around the openings 63*a* and 64 between the cover and the casing.

From the foregoing it will be noted that the condenser cooling fan is located at the outlet of the condenser air path while the air conditioning fan is located at the inlet of the evaporator air path. It is evident then that when the indoor and outdoor pressures are substantially the same, the air flowing through the condenser path must be at a lower pressure than the air flowing through the evaporator path, the condenser air being on the suction side of the condenser fans while the evaporator air is on the discharge side of the evaporator fans. Therefore, if there are any air leaks between the evaporator and the condenser chambers there will tend to be a flow of air from the evaporator path to the condenser path and a minimum tendency for the warm condenser air to leak into the cooling compartment and thereby reduce the cooling capacity of the conditioning unit.

The louvers 59 through which the recirculated or room air is admitted are arranged in the lower portion of the casing 15 in order to minimize the transmission of sound from the apparatus within the casing 10 to the room, it being evident that there is an extended and tortuous path for the air between the louvers 59 and the fan inlet opening covered by the filters 60. This extended path muffles the sound produced by the fans and the fan motor and minimizes the transmission of sound through the louvers 59 into the room. Furthermore, it is evident that the air path between the fans 11 and the discharge opening covered by the grill 65 is also an extended tortuous path and minimizes the transmission to the room of the sound produced by the fans.

In Fig. 6 I have shown the refrigerating machines 14 removed from the casing 10 to show clearly the removable and stationary portions. The arrangement of the removable refrigerating machines and the baffle plates including the pans 28 and 30 thereon is such that when the machines are in place in the lower portion of the casing 10 they utilize the duct work in the upper portion of the casing to complete two separate circulating paths, the one path circulating air over the condenser and warm parts of the refrigerating machine and the other over the evaporator. This arrangement makes it possible to provide an air conditioning unit having refrigerating machine units which may be removed completely without disconnecting any of the parts of the refrigerant circuits of the machine, and it is, therefore, possible to place a substitute machine in the casing while one of the machines is being repaired and thereby avoid interruption of service.

During the operation of the air conditioning unit illustrated, a mixture of recirculated and fresh air is cooled and dehumidified and discharged into the room and at the same time the refrigerating machine is cooled by outside air, and all of the moisture condensed from the air within the room is discharged to the outside with the condenser cooling air. It is unnecessary to provide any plumbing connections or any refrigerant circuit connections outside of the conditioner. The unit may readily be moved when desired, the duct 39 being adapted to be placed in the window opening of a room.

While I have described my invention in connection with an air conditioning unit for conditioning individual rooms, it will be understood that it is applicable to other types of air conditioners. I do not, therefore, desire my invention to be limited to the particular construction shown and described and I intend in the appended claims to cover all modifications thereof which do not depart from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Apparatus for conditioning the air within

an enclosure, including a casing having an air duct portion and a machinery portion and an air inlet and an air outlet opening for said air duct portion, means including a partition in said air duct portion for providing two ducts one extending from each of said openings and opening into said machinery portion of said casing, a frame having mounted thereon a refrigerating machine having a heat absorbing element and a heat rejecting element, said frame and said machine being arranged within said machinery portion of said casing and being removable therefrom as a unit, means including a baffle mounted on said frame and adapted to engage walls of said ducts when said frame is in position in said casing for connecting said ducts and completing an air circulating path from said inlet opening to said outlet opening and for enclosing said heat absorbing element in said path, means for circulating air through said path from said inlet opening to said outlet opening to cool said air, and means for circulating a cooling medium over said heat rejecting element to cool said heat rejecting element.

2. Apparatus for conditioning the air within an enclosure including a casing having an air duct portion and a machinery portion and a plurality of air inlet and outlet openings for said air duct portion, means including partitions in said air duct portion for providing a plurality of ducts extending from said openings and opening into said machinery portion of said casing, a removable frame arranged in said machinery portion of said casing and having mounted thereon a refrigerating machine provided with an air cooling element, means including a baffle arranged on said frame and adapted to engage at least one of said partitions when said frame is in place in said casing for completing two air circulating paths through said casing and for sealing the space surrounding said cooling element from the space surrounding the remainder of said refrigerating machine, each of said paths having one of said inlet openings at one end thereof and one of said outlet openings at the other end thereof, a portion of said refrigerating machine being arranged in one of said paths and said air cooling element being arranged in the other of said paths, means for circulating air through said one of said paths to cool said portion of said refrigerating machine, and means for circulating air through said other of said paths over said air cooling element to cool the air in said enclosure.

3. Apparatus for conditioning the air within an enclosure including a casing having an air duct portion and a machinery portion and a plurality of air inlet and outlet openings for said air duct portion thereof, means including partitions in said air duct portion for providing a plurality of ducts extending from said openings and opening into said machinery portion of said casing, a removable frame arranged in said machinery portion of said casing and having a refrigerating machine including an evaporator and a condenser mounted thereon, means including a baffle arranged on said frame and adapted to engage at least one of said partitions when said frame is in place in said casing for completing two air circulating paths through said casing and for sealing the space surrounding said evaporator from the space surrounding said condenser, each of said paths having one of said inlet openings at one end thereof and one of said outlet openings at the other end thereof, said evaporator being arranged in one of said paths and said condenser being arranged in the other of said paths, means for circulating air through said one of said paths over said evaporator for cooling the air in said enclosure, and means for circulating air through said other of said paths to cool said condenser.

4. Apparatus for conditioning the air within an enclosure including a casing having an air duct portion and a machinery portion and a plurality of air inlet and outlet openings for said air duct portion, means including partitions in said casing for providing a plurality of ducts extending from said openings and opening into said machinery portion of said casing, a removable frame arranged in said machinery portion of said casing and having a refrigerating machine including an evaporator and a condenser mounted thereon, means including a plurality of baffles arranged on said frame and adapted to cooperate with said partitions when said frame is in place in said casing for completing two air circulating paths through said casing, one of said baffles being adapted to engage at least one of said partitions and being arranged to seal the space surrounding said evaporator from the space surrounding said condenser, each of said paths having one of said inlet openings at one end thereof and one of said outlet openings at the other end thereof, said evaporator being arranged in one of said paths and said condenser being arranged in the other of said paths, means circulating air through said one of said paths over said evaporator for cooling the air in said enclosure, means for circulating air through said other of said paths to cool said condenser, and means arranged in the path of the air circulating over said condenser for collecting water condensed on said evaporator and for absorbing said water in the air circulated over said condenser to discharge said water from said casing.

5. Apparatus for conditioning the air within an enclosure including a casing having an air duct portion and a machinery portion and a plurality of air inlet and outlet openings for said air duct portion, means including partitions in said air duct portion of said casing for providing a plurality of ducts extending from said openings, all of said ducts opening into said machinery portion of said casing, a removable frame arranged in said machinery portion of said casing and having mounted thereon a refrigerating machine and an air cooling element therefor, means including a baffle arranged on said frame and adapted to engage at least one of said partitions when said frame is in place in said casing for completing two air circulating paths through said casing and for sealing the space surrounding said cooling element from the space surrounding the remainder of said refrigerating machine, each of said paths having one of said inlet openings at one end thereof and one of said outlet openings at the other end thereof, a portion of said refrigerating machine being arranged in one of said paths and said air cooling element being arranged in the other of said paths, means including a fan arranged in the outlet portion of said one of said paths for circulating air through said one of said paths to cool said portion of said refrigerating machine, and means including a second fan arranged in the inlet portion of said other of said paths for circulating air through said other of said paths over said air cooling element for cooling the air in said enclosure.

6. Apparatus for conditioning the air within

an enclosure including a casing having an air duct portion and a machinery portion and a plurality of air inlet and outlet openings for said air duct portion, means including partitions in said air duct portion of said casing for providing a plurality of ducts extending from said openings and opening into said machinery portion of said casing, a removable frame arranged in said machinery portion of said casing and having mounted thereon a refrigerating machine and an air cooling element therefor, means including a baffle arranged on said frame and adapted to engage at least one of said partitions when said frame is in place in said casing for completing two air circulating paths through said casing and for sealing the space surrounding said cooling element from the space surrounding the remainder of said refrigerating machine, each of said paths having one of said inlet openings at one end thereof and one of said outlet openings at the other end thereof, a portion of said refrigerating machine being arranged in one of said paths and said air cooling element being arranged in the other of said paths, means including a fan arranged in the outlet portion of said one of said paths to cool said portion of said refrigerating machine, means including a second fan arranged in the inlet portion of said other of said paths for circulating air through said other of said paths over said air cooling element for cooling the air in said enclosure, and a motor for driving said fans, said motor being arranged in said one of said paths.

SAMUEL J. LEVINE.