

Jan. 25, 1955

G. A. KELLEY ET AL

2,700,536

AIR CONDITIONER

Filed Nov. 2, 1951

2 Sheets-Sheet 1

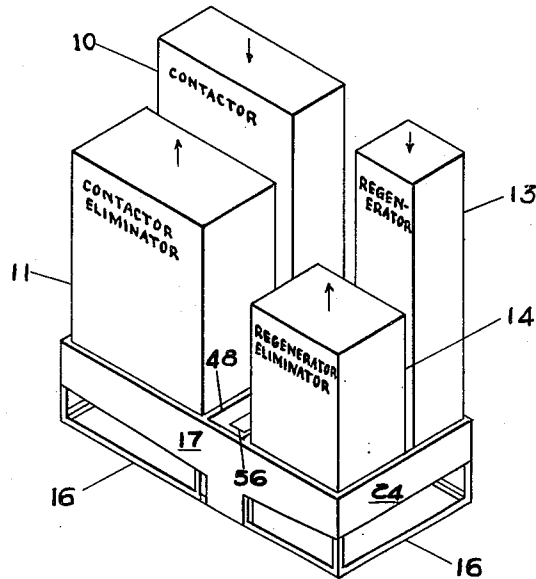


FIG-1-

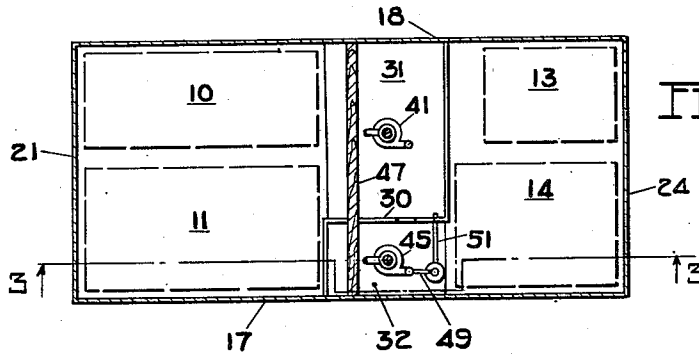


FIG-2-

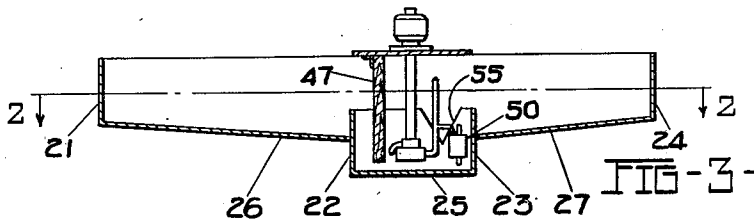


FIG-3-

INVENTORS:
G. A. KELLEY,
BY H. E. RAHM.
Charles H. Hughes
AGENT.

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2 Sheets-Sheet 2

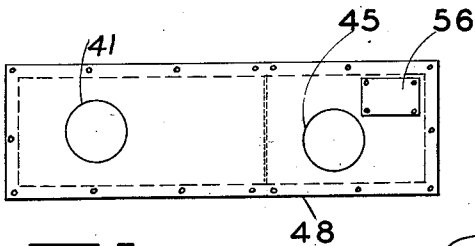


FIG-7-

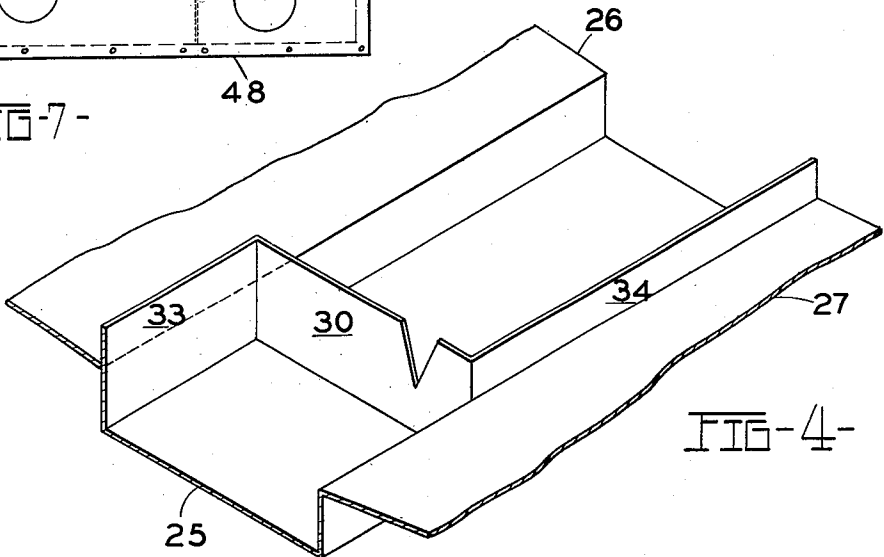


FIG-4-

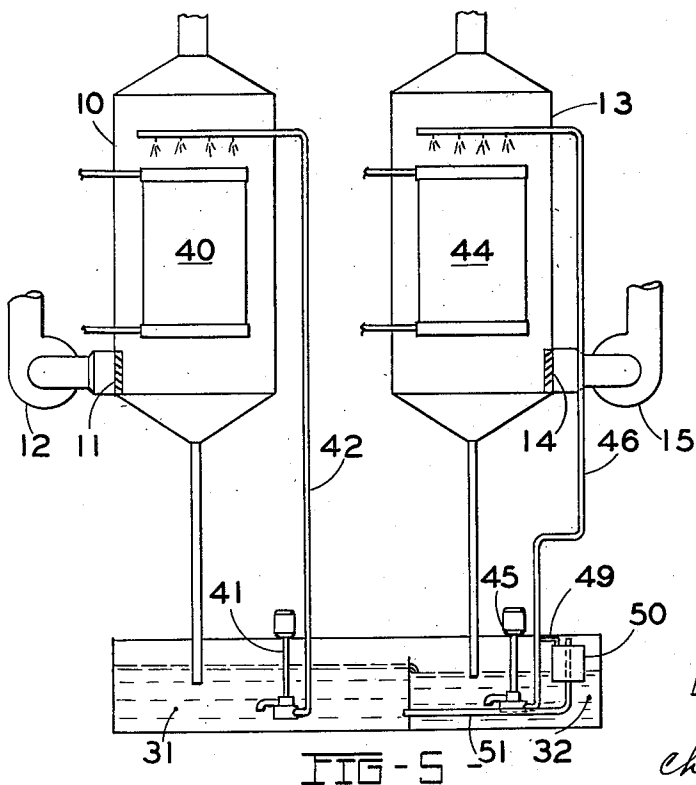


FIG-5

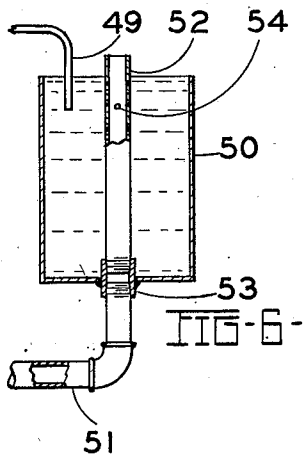


FIG-6-

INVENTORS:
G. A. KELLEY,
BY H. E. RAHM.
Charles H. Haughey
AGENT.

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2,700,536

AIR CONDITIONER

Gilbert A. Kelley and Howard E. Rahm, Toledo, Ohio, assignors to Surface Combustion Corporation, Toledo, Ohio, a corporation of Ohio

Application November 2, 1951, Serial No. 254,618

4 Claims. (Cl. 261—3)

This invention relates to air conditioners which utilize a liquid for treating the air to be conditioned. More particularly, the invention relates to a sump system for an air conditioner and controls therefor, and is designed to provide for collection and circulation of a hygroscopic solution such as a water solution of lithium chloride or other salts or solutions of the glycol type.

In a two sump air conditioner utilizing, for example, a water solution of lithium chloride as a hygroscopic agent for removal of moisture from air to be treated it is desirable to maintain a first sump for the contactor, a second sump for the regenerator, and to provide but a small flow of solution therebetween for removal of water from the contactor sump and return of the hygroscopic salt to that sump in solution form. The present invention provides a novel means for controlling such flow of solution between the sumps without the usual attendant difficulties of plugging small orifices with foreign material, and the like.

For a consideration of what we believe to be novel and our invention, attention is directed to the following specification and the drawing and concluding claims thereof.

In the drawing:

Figure 1 is a diagrammatic view of an air conditioner according to this invention.

Figure 2 is a sectional view in plan of the sump of the air conditioner of Figure 1 showing the relative position of the elements thereabove by dashed lines.

Figure 3 is a vertical sectional view of the sump on line 3—3 of Figure 2.

Figure 4 is a partial view of the sump structure in perspective.

Figure 5 is a schematic diagram of the apparatus of Figure 1 showing the flow of solution therethrough.

Figure 6 is a detail view of a flow control device.

Figure 7 is a plan view of the pump section of the air conditioner of Figure 1.

The physical arrangement of the contactor 10, contactor eliminator 11, regenerator 13, regenerator eliminator 14 and sump structure and framework 16 is shown in Figure 1, and the operational relationship of the various elements is best understood by reference to Figure 5. The contactor 10 houses a water cooled heat exchanger 40 over which solution is circulated by a contactor sump pump 41 from a contactor sump 31 through pipe 42. A blower or fan 12 draws air to be treated through the contactor wherein it is contacted by the solution flowing through the contactor, and the solution, and consequently the air, is maintained cool by the cooling effect of cooling water circulated through the heat exchanger 40. Excess water in the incoming air to be treated is removed by absorption by the hygroscopic solution, and the heat of absorption, as well as sensible heat in the incoming air, is transferred to the cooling water in the heat exchanger 40. Unless means are provided for removing the water so absorbed by the solution, the solution will become excessively dilute and ineffective, as is well known.

The regenerator 13 houses a steam heated heat exchanger 44 over which solution is circulated from a regenerator sump 32 by a regenerator sump pump 45 through pipe 46. Atmospheric air from without the space to be conditioned is drawn through the regenerator 13 and its eliminator 14 and discharged through the blower or fan 15 back to the atmosphere. Such air, in its passage over the heated solution in the regenerator will pick up moisture due to the high vapor pressure thereof at elevated temperatures,

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and will discharge the moisture through fan 15, thus removing water from the solution circulated therethrough.

In the apparatus as shown the sump structure comprises endwalls 17 and 18 which form with bottom wall 25 and side walls 22 and 23, a liquid holder which is divided into two sumps proper by dividing wall 30, the larger sump 31 being the contactor sump and the smaller sump 32 being the regenerator sump. A drain pan 26, end wall 21 and wall portion 33 which extends from wall 22 over the regenerator sump form a collecting trough for solution from the contactor and the contactor eliminator. A drain pan 27, end wall 24 and wall portion 34 above the contactor sump 31 form a collecting trough for the regenerator and regenerator eliminator. Intermingling of hot, wet air on the regenerator side of the sump structure with cold, dry air on the contactor side is prevented by a depending wall 47 supported from a pump support plate 48 above the two sumps and extending into both sumps. The wall 47 is slotted to straddle the wall 30 between the sumps, and is made of an insulating, corrosion resistant material, preferably wood. The wall 47 is placed nearest the contactor side of the sumps to prevent substantial contact of the cool, dry air treated with the hot solution in the regenerator sump. It is made of wood to prevent condensation on the hot side of the wall due to its heat transfer and the cooling effect of cool air on its other side. This structure provides the necessary sump elements with a minimum of materials and in a most compact manner.

The flows of solution from the respective sumps to the contactor and the regenerator are relatively large, and are determined largely by the volume of solution flow necessary to completely wet the respective heat exchangers. Excessively large flows there will not substantially affect the efficiency of the unit. A critical flow, however, is the flow from one sump to the other, and the complementary return flow, as is more thoroughly explained in application Serial No. 76,079, filed February 12, 1949, of G. A. Kelley, this being, in brief, because solution flowing from sump 31 to sump 32 is cold and dilute whereas solution flowing from sump 32 to sump 31 is hot and concentrated. If these flows are too small, over-concentration of the solution in the regenerator sump will occur, and if too large, loss of economy of operation due to heat exchange will result; hence it is of great importance to control these flows accurately and reliably. Toward this end an overflow cup 50 is provided in the regenerator sump 32 above the level of solution in the sump. A drain pipe 51 leads therefrom through the dividing wall 30 and discharges into the contactor sump 31. A control pipe 52 is connected to the drain pipe through a coupling 53, the control pipe 52 having one or several holes 54 which are below the top of the cup when the pipe 52 is inserted into the coupling 53. A cup feed pipe 49 of relatively small size, but having no valves or trouble-making restrictions therein leads from pipe 46 to the cup 50 and delivers a constant stream of solution thereto. A portion of this stream overflows the cup 50 and returns to the regenerator sump whence it came, and a portion flows through the hole or holes 54, through pipe 51 and into the contactor sump 31. A corresponding stream of solution from the contactor sump 31 flows over a weir 55 in dividing wall 30 and returns to the regenerator sump. The flow of solution through the pipe is held constant by the constant pressure differential provided between the liquid level in the cup at overflow and the fixed position of the submerged hole or holes 54. It will be appreciated that the cup must be sufficiently elevated with respect to the contactor sump to enable the drain pipe 51 to carry away solution flowing therein fast enough to avoid affecting flow of solution into the said pipe. To adjust the flows of solution through the drain pipe 51, and consequently the complementary flow over the weir 55, the effective height or size of the holes in the control pipe 52 may be varied, preferably by replacing one pipe 52 with a second pipe 52 calibrated for a different rate of flow of solution. Utilizing replaceable control pipes 52 for adjustment provides a most simple adjustment with a minimum of tampering or accidental mis-adjustment of such flows.

To visually check the volume of solution flowing over the weir 55 or into the pipe 52 a cover plate 56 secured

to the pump support plate 48 may be removed, and access to the pipe 52 for changing is had therethrough.

We claim:

1. In an air conditioning apparatus having a contactor, adapted to provide contact between air passed therethrough and solution supplied thereto, and a regenerator, adapted to heat solution supplied thereto and to evaporate moisture from such solution, an improved sump structure comprising wall means forming a first drain trough arranged to receive solution draining from said contactor, wall means forming a second drain trough arranged to receive solution draining from said regenerator, wall means forming an elongate liquid holder between said drain troughs and comprising a dividing wall for separating said liquid holder into two sumps, the first of said sumps being the source of the solution supplied to said contactor and being arranged to receive solution draining from said first drain trough, and the second of said sumps being the source of the solution supplied to said regenerator and being arranged to receive solution draining from said second drain trough, means comprising a pump for withdrawing regenerated solution from the second sump and delivering it to the first sump, and means for delivering from the first sump to the second sump solution that has become diluted by moisture absorbed from the air in said contactor.

2. Apparatus according to claim 1 wherein one of said means for delivering solution is a weir formed by said dividing wall, and comprising, in combination with said sump structure, a pump support plate that is secured to said sump structure and is adapted to support said pump.

3. Apparatus according to claim 1 wherein one of said means for delivering solution is a V notch type weir formed by said dividing wall over which flow of solution may be observed as it flows from one sump to the other.

4. Air conditioning apparatus comprising a contactor wherein air to be conditioned may be contacted by a solution, a regenerator wherein said solution may be contacted by a second air stream to recondition the solution, first wall means forming a first drain trough whereinto solution from the contactor may drain, second wall means forming a second drain trough whereinto solution from the regenerator may drain, third wall means forming an elongate liquid holder between said first and second drain troughs, a liquid separation wall for dividing the liquid holder into two adjacent sections, extending upwardly and transversely of the liquid holder from the bottom of the liquid holder to above the solution level in either adjacent

section of said holder, a first extension of the separation wall extending therefrom between the holder and the first drain trough whereby to channel solution from the first drain trough into the holder on one side of the separation wall and to constitute the section of the holder on that side of the separation wall a contactor sump from which solution may be supplied to the contactor, a second extension of the separation wall extending therefrom between the holder and the second drain trough on the side of the separation wall adjacent to the contactor sump whereby to drain solution from the second drain trough into the holder on the opposite side thereof from the contactor sump and to constitute the section of the holder on said opposite side a regenerator sump from which solution may be supplied to the regenerator, said separation wall forming a weir over which solution may flow from one sump to the other, a removable plate extending over said holder and comprising a depending wall which straddles said separation wall and extends below the liquid levels of said sumps but does not extend to the bottom of either sump, whereby to divide only the air chamber above said troughs into a contactor chamber and a regenerator chamber sealed from said contactor chamber and to maintain said weir operable, and means comprising a pump for causing a substantially constant solution flow from one of said sumps to the other and thereby causing an overflow in the reverse direction past said weir, whereby the resulting interchange between the sumps counteracts the diluting effect of moisture absorbed by the solution in the contactor.

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