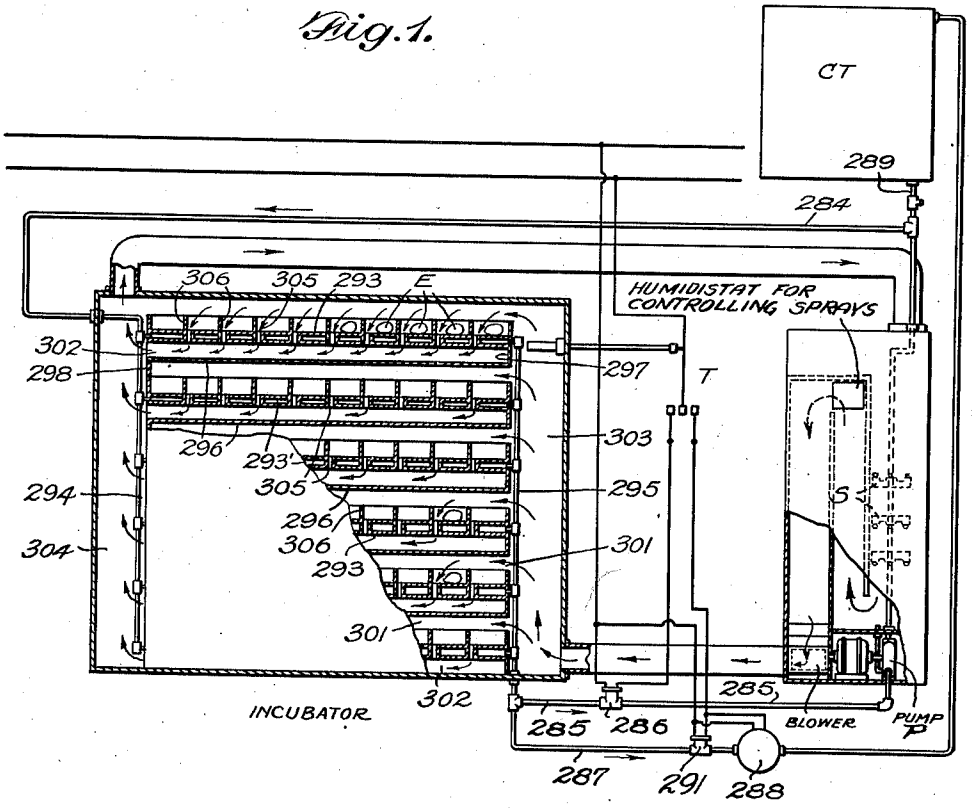
Nov. 22, 1938. R. B. P. CRAWFORD 2,137,769

AIR CONDITIONING SYSTEM

Original Filed July 5, 1929 2 Sheets-Sheet 1

Fig. 1.



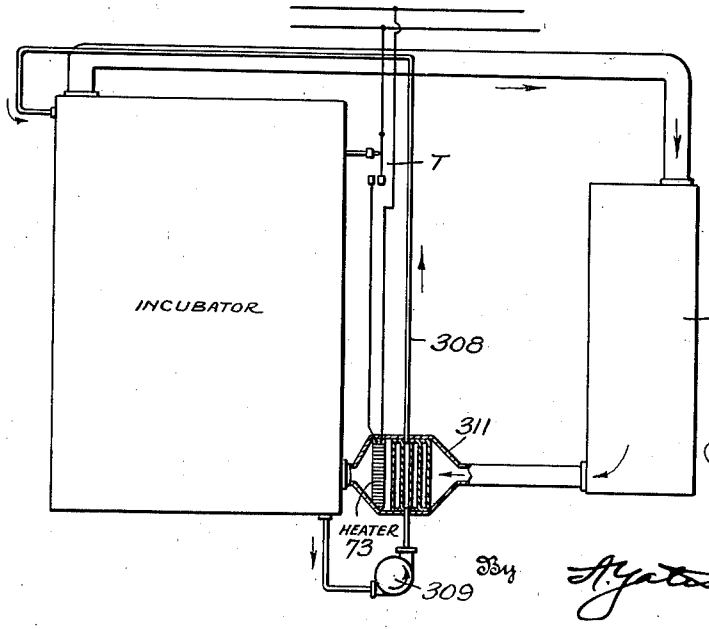


Fig. 2.

Inventor
R. B. P. Crawford

By Ayatt & Dowell.
Attorneys

Nov. 22, 1938. R. B. P. CRAWFORD 2,137,769

AIR CONDITIONING SYSTEM

Original Filed July 5, 1929 2 Sheets-Sheet 2

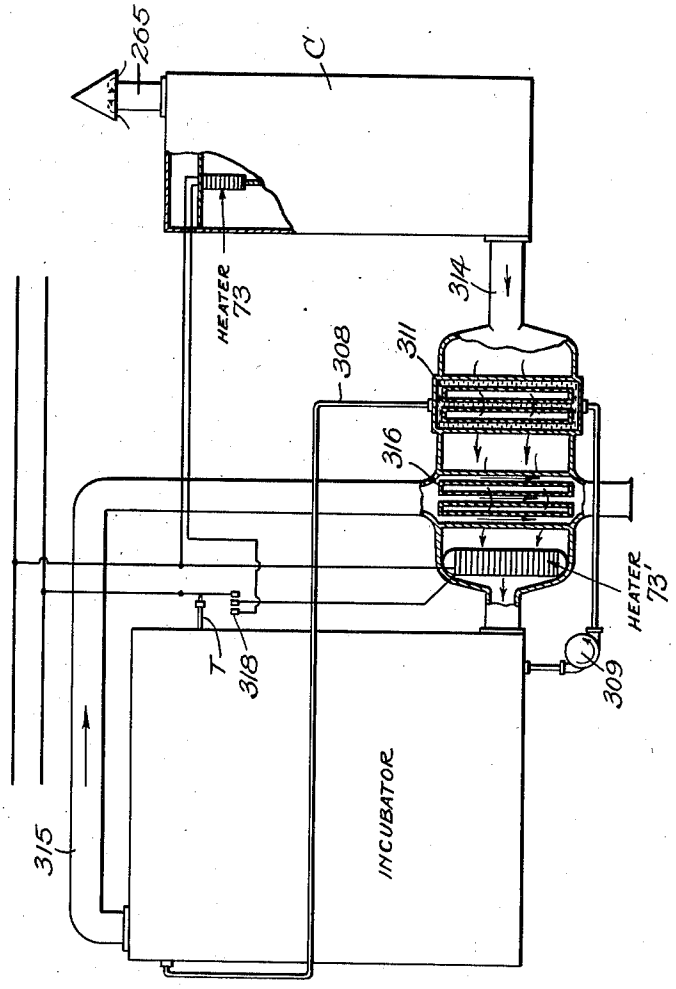


Fig. 3.

Inventor

R. B. P. Crawford.

By Macdonell

Attorneys

Patented Nov. 22, 1938 2,137,769

UNITED STATES PATENT OFFICE

2,137,769

AIR CONDITIONING SYSTEM

Robert B. P. Crawford, Washington, D. C., assignor to Frick Company, Waynesboro, Pa., a corporation of Pennsylvania

Original application July 5, 1929, Serial No. 375,952. Divided and this application July 17, 1937, Serial No. 154,316

10 Claims. (Cl. 257—1)

This application is a division of my copending application Ser. No. 375,952, filed July 5, 1929, and relates to systems for incubating, hatching and brooding, and more particularly to such systems including apparatus for maintaining satisfactory psychrometric conditions therein.

The invention contemplates generally the maintaining of proper, predetermined psychrometric (temperature and/or humidity) conditions within enclosures by the employment of heat exchange means and humidity changing apparatus; for example, the heat exchange means may be located within one of said enclosures and humidity changing apparatus may be associated with the one enclosure, but located exteriorly thereof.

It is an object of the invention to provide the construction of improved arrangement wherein the air within the enclosures of incubating, hatching and brooding systems may be satisfactorily, efficiently, and economically maintained at the proper psychrometric conditions.

It is another object of this invention to provide an enclosure, the air within which, is to be maintained at both the proper temperature and humidity conditions, by the utilization of air temperature changing means and air humidity changing means.

Other objects and the nature and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a diagrammatic view partly broken away and partly shown in section of an embodiment of the invention wherein water is circulated directly through an enclosure for changing the temperature of the air therein.

Figure 2 is a similar view wherein means is shown to maintain the water (which is circulated through the enclosure to temper the air therein) at a higher temperature level.

Figure 3 is a modified form of the invention similar to Figure 2.

In Figure 1, I have illustrated an arrangement of control system wherein a thermal transfer occurs within an enclosure, between water, air, or objects within the enclosure. The enclosure may be either an incubating, hatching or brooding chamber. For convenience of illustration, the air conditioned unit is shown in spaced relation to the conditioned enclosure, such air conditioning unit being of any suitable construction and in a preferred form includes a spray apparatus. Preferably the spray apparatus of the air conditioning unit is arranged so that it can be connected in circuit with water passageways in the enclosure, and to this end the discharge from the pump P is conducted up through spray apparatus S and that portion of the water not projected from the spray nozzles is conducted to a pipe 284 extending to the enclosure. Here the water is circulated in contact with heat exchanging surfaces within the enclosure, and this water is thence conveyed back through pipe 285 to the spray water tank or to the inlet of the pump P. An automatic valve 286 is interposed in the pipe 285 and is controlled by a temperature control device T. Preferably this temperature control comprises a thermostat located within the enclosure or at a point to sense the temperature therein, and connected to actuate a switch in such manner that when the temperature within the enclosure falls below a predetermined point the valve 286 is energized and moved to open position. Thus, for winter or other relatively cool climatic conditions, the circuit for the water will be through the air conditioning unit to the heat transfer surfaces in the enclosure and thence back to the air conditioning unit.

For summer or relatively warm weather operation, the water circuit is arranged to include a cooling tower CT. At such time the valve 286 will be closed and the water returning from the enclosure will pass through pipe 287 to a separate motor driven pump 288 and thence through a continuation of the pipe 287 up to the spray nozzles in the cooling tower CT. The cooled water is conducted through pipe 289 to the pipe 284, in which it is conveyed back to the heat exchange surfaces in the enclosure. Interposed in the pipe 287, preferably on the inlet side of the pump 288, is an automatic valve 291 which is responsive to the other side of the temperature control device T. That is to say, when the temperature within the enclosure rises above a predetermined point, the control switch T completes a circuit to energize the valve 291, thereby resulting in the water circulation being conducted up through the cooling tower CT for lowering the temperature thereof. The spray water tank of the conditioning unit preferably has a float controlled inlet valve for replenishing the supply of water as described in my copending application, Serial No. 375,952, filed July 5, 1929. It will be understood that the pump P also draws from this spray water tank.

As previously stated, the enclosure may be an incubating or hatching chamber, in which case the water circulated therethrough absorbs the

radiant heat from the eggs, or such enclosure may be a brooding chamber, in which case this water absorbs the heat emitted from the bodies of the chicks.

The heat thus absorbed by the water will, under most conditions, avoid the necessity of heating the spray water in the air conditioning unit when the water circulation is through pipe line 285. This absorbed heat may be utilized in a dry air heater of the simplest and most elementary type such as an ordinary closed coil over which air to be heated and conducted to the enclosure may be passed or in a heater of the open type wherein relatively hot water may directly contact the air to be heated and conducted to the enclosure in the spray water tank, if desired. The dry air heater and the open contact heater, not shown, are of the ordinary type common in the art and for which, per se, no novelty is claimed. In passing through the enclosure, the water may be circulated through hollow walls lining the enclosure or through coils or other heat absorbing surfaces. As illustrative of one method of circulating the water through an incubating or hatching enclosure, I have illustrated a series of superposed hollow shelves or trays 293 on which the eggs E are supported. Each shelf 293 comprises upper and lower spaced walls defining a chamber 293' therebetween, through which the water is circulated. The water entering through pipe 284 is conducted through a header 294 communicating with each of the chamber areas 293'. Connecting with the other ends of these chamber areas is a header 295 which conducts the heated water to the two pipe lines 285 and 287. The construction shown also comprises a novel method of circulating the air through the enclosure. Extending horizontally between adjacent shelves 293 are partitions or baffles 296. Each partition is joined at one end with the shelf directly above it through a vertical end wall 297, and at the opposite end is joined with the shelf directly below it by an end wall 298. Such arrangement defines an air admission passageway 301 extending over each shelf, and an air discharge passageway 302 extending under each shelf. All of the air admission passageways communicate with a manifold space or riser 303 into which air is supplied from the conditioning unit, and all of the discharge passageways 302 communicate with a similar manifold space 304 at the opposite end of the enclosure, such latter manifold space connected to return the air to the conditioning unit.

Extending through each tray 293 are a plurality of air passages 305 for circulating the air from each admission passageway 301 down through the shelf to the discharge passageway 302. Each of the passages 305 may be constructed in the form of a sleeve or thimble or properly proportioned bore so that the air circulation will be uniformly distributed over the entire upper surface of the shelf, and these sleeves or thimbles may be thermally insulated from the metallic construction of the shelf or may be composed of heat insulating material. The eggs E may each be placed in a separate compartment defined by the longitudinal and transverse partitions 306 so as to prevent lateral flow of air from egg to egg. One of the passageways 305 leads down from each of the separate egg compartments. The eggs may be placed directly on the shelves 293, or may be supported in insulated plates or baskets resting on such shelves.

It will be observed that the foregoing method of circulating the air results in the air flowing straight down through the eggs with no transverse flow, such being advantageous because it prevents the air from carrying bacteria or contamination from one egg laterally to another. Moreover, it will be noted that any given portion of the air stream only passes through one layer or quantity of eggs, rather than down or up through successive layers, such also avoiding contamination from egg to egg.

In Figure 2 I have illustrated a modified arrangement utilizing this water circulation through the enclosure. The water is circulated through hollow shelves, hollow walls or other heat absorbing surfaces in the enclosure, the circuit for this flow being completed outside of the enclosure by a pipe 308 in which a circulating pump 309 is interposed.

A heat exchanger or economizer 311 is interposed in the water and air circuits for bringing the water and air into heat transferring relation. Preferably this heat exchanging device is disposed in the duct returning the conditioned air from the conditioning unit to the enclosure. Such device comprises any suitable arrangement of passages or coils with the water contacting one side of the heat transferring surface and the air the other. The heat picked up by the water from the eggs or chicks is transferred to the air stream at the economizing device 311 so that the temperature of the air is raised with a consequent saving in the heating of the air. The electric heater 73, or such other heater as may be employed, is disposed in the return air duct between the economizing device 311 and the enclosure, such heater only supplying such additional heat as may be required to raise the air to the desired dry bulb temperature in the enclosure. This heater is automatically controlled by a temperature control apparatus T, as described of the preceding embodiment. The conditioning unit, designated C, may be constructed in accordance with the disclosure of my copending application Ser. No. 375,952 filed July 5, 1929. The water passing through pipe 308 may circulate through hollow shelves, such as shelves 293 within the incubator shown in Figure 1, if desired.

Figure 3 illustrates another modification of the arrangements shown in Figures 1 and 2. In this embodiment the conditioning unit C draws its air from a fresh air intake 265, and after this air is properly conditioned and tempered in the unit it is impelled through duct 314 to the enclosure, which may be either an incubating, hatching or brooding enclosure.

The exhaust air is discharged from the enclosure through a discharge duct 315 which conveys such air to an interchanger 316 in the inlet duct 314. This interchanger may be of any suitable construction comprising a series of passageways with the exhaust air contacting with one side of a surface or surfaces and transferring its accumulated heat to the entering air contacting with the other side of said surface or surfaces. This exhaust air may be discharged to the atmosphere after passing through the interchanger 316. The water circulated through pipe 308 by the pump 309 may also be arranged to pass through an interchanger 311 in the entering air duct 314, as previously described of Figure 2. The water circulated through the pipe 308 may be caused to pass through hollow partitions, walls, or through hollow shelves 293, as described in Figure 1. It will be seen that by the provision of the two heat interchanging devices 311 and 316, substantially

all of the heat picked up from the eggs or chicks by the air circulated through the enclosure and by the water circulated therethrough can be returned to the air entering the enclosure so that a decided thermal economy is obtained. This point of heat return or heat interchange is not necessarily limited to the duct 314, as either, or both, of the interchangers 311 and 316 may be arranged to transfer heat to the air entering the conditioning unit through the fresh air intake 265 if desired. In the arrangement illustrated the interchangers 311 and 316 may be transposed for placing the unit 316 on the air inflow side of the unit 311.

Such additional heat as it may be necessary to supply to the entering air may be obtained from one or more heating units 73, 73'. In the arrangement illustrated, the heater 73' is interposed in the duct 314 at a point beyond the two interchangers 311 and 316 so that this heater will be in position to boost the air temperature beyond the temperature control apparatus T, whereby with a lowering of the temperature within the enclosure beyond a predetermined point the heater 73' will be energized. When the heater 73 is employed in the conditioning unit C, it is electrically connected with contact 318 of this temperature control apparatus. Preferably these contacts are arranged so that the heater 73' will be first energized with a falling temperature, and thereafter the heater 73 will be energized if the temperature continues to fall, but this arrangement may be reversed if desired.

It will be obvious to those skilled in the art that various changes may be made in this device without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

I claim:

1. An air conditioning system comprising an enclosure adapted to house bodies emitting some heat, a dehumidifier in said system in which air is conditioned with respect to its humidity and temperature, cooling means in said enclosure by which air is cooled, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of such air, temperature responsive regulating means for controlling the cooling means, means for supplying said cooling means with a cooling fluid at a temperature not less than the temperature of the air about said cooling means, whereby no condensation can occur on the cooling means, and said cooling means becomes effective to absorb heat which may leak into or be emitted by bodies within the enclosure.

2. An air conditioning system comprising an enclosure adapted to house bodies emitting some heat, a dehumidifier in said system in which air is conditioned with respect to its humidity, fluid spray means associated with said dehumidifier, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of said air, cooling means within said enclosure by which air is cooled, means for supplying said fluid spray means and said cooling means with cool fluid from a single source, temperature responsive means for controlling said cooling means, means for passing air from said dehumidifier to said enclosure, said cooling means being so associated with said system as to have its surface temperature above the saturation temperature of the entering air, whereby no condensation can occur on the cooling means, and said cooling means becomes effective to absorb heat which may leak into or be emitted by bodies within the enclosure.

3. An air conditioning system comprising an enclosure adapted to house bodies emitting some heat, a dehumidifier in said system in which air is conditioned with respect to its humidity, cooling means associated with said dehumidifier, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of said air, a second cooling means in said enclosure by which air is cooled, means for supplying said first cooling means and said second cooling means with cooling fluid from a single source, temperature responsive regulating means for controlling the second cooling means, means for passing air from said dehumidifier to said enclosure, said second cooling means being so associated with said system as to have its surface temperature above the saturation temperature of the entering air.

4. An air conditioning system comprising an enclosure adapted to house bodies emitting some heat, a dehumidifier in said system in which air is conditioned with respect to its humidity and temperature, fluid means associated with said dehumidifier, cooling means in said enclosure by which air is cooled, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of such air, temperature responsive regulating means for controlling the cooling means, means for supplying said cooling means with a cooling fluid at a temperature not less than the temperature of the air about said cooling means, means for supplying cooling fluid to the fluid means associated with the dehumidifier and the cooling means in said enclosure from a single source, whereby no condensation can occur on the cooling means, and said cooling means becomes effective to absorb heat which may leak into or be emitted by bodies within the enclosure.

5. An air conditioning system comprising an enclosure adapted to house bodies emitting some heat, a dehumidifier in said system in which air is conditioned with respect to its humidity and temperature, fluid means associated with said dehumidifier, cooling means in said enclosure by which air is cooled, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of such air, temperature responsive regulating means for controlling the cooling means, means for supplying said cooling means with a cooling fluid at a temperature not less than the temperature of the air about said cooling means, means including a pump for supplying cooling fluid to the fluid means associated with the dehumidifier and the cooling means in said enclosure from a single source, whereby no condensation can occur on the cooling means, and said cooling means becomes effective to absorb heat which may leak into or be emitted by bodies within the enclosure.

6. An air conditioning system comprising an enclosure adapted to house bodies emitting some heat, a dehumidifier in said system in which air is conditioned with respect to its humidity, cooling means associated with said dehumidifier, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of said air, a second cooling means having a cooling element in said enclosure by which air is cooled, means for supplying said first cooling means and said second cooling means with cooling fluid from a single source, temperature responsive regulating means for controlling the second cooling

means, means for passing air from said dehumidifier to said enclosure, said second cooling means being so associated with said system as to have its surface temperature above the saturation temperature of the entering air.

7. An air conditioning system comprising an enclosure adapted to house bodies emitting some heat, a dehumidifier in said system in which air is conditioned with respect to its humidity, cooling means associated with said dehumidifier, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of said air, a second cooling means having a cooling element in said enclosure by which air is cooled, means for supplying said first cooling means and said second cooling means with cooling from a single source, temperature responsive regulating means for controlling the second cooling means, means for passing air from said dehumidifier to said enclosure, said second cooling means being so associated with said system as to have its surface temperature above the saturation temperature of the entering air.

8. An air conditioning system comprising an enclosure adapted to house bodies emitting some heat, a dehumidifier in said system in which air is conditioned with respect to its humidity, cooling means in said enclosure by which air is cooled, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of such air, temperature responsive regulating means for controlling the cooling means, means for supplying said cooling means with a cooling fluid at a temperature above the saturation temperature of the air about said cooling means, whereby no condensation can occur on the cooling means, and said cooling means becomes effective to absorb heat which may leak into or be emitted by bodies within the enclosure.

9. An air conditioning system comprising an enclosure adapted to house bodies emitting some heat, a dehumidifier in said system in which air is conditioned with respect to its humidity, fluid spray means associated with said dehumidifier, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of said air, cooling means within said enclosure by which air is cooled, conduit means and pump means for supplying said fluid spray means and said cooling means with cool fluid from a single source, a valve in said conduit means, temperature responsive means for controlling said valve, means for passing air from said dehumidifier to said enclosure, said cooling means being so associated with said system as to have its surface temperature above the saturation temperature of the entering air, whereby no condensation can occur on the cooling means, and said cooling means becomes effective to absorb heat which may leak into or be emitted by bodies within the enclosure.

10. An air conditioning system comprising an enclosure, a dehumidifier in said system in which air is conditioned with respect to its humidity, cooling means in said enclosure by which air is cooled, regulating means operable on the dehumidifier to effect a predetermined absolute humidity value of such air, temperature responsive regulating means for controlling the cooling means, means for supplying said cooling means with a cooling fluid at a temperature above the saturation temperature of the air about said cooling means, whereby no condensation can occur on the cooling means, and said cooling means becomes effective to absorb heat which may leak into the enclosure, and unitary means for rejecting heat absorbed by said dehumidifier and said cooling means.

ROBERT B. P. CRAWFORD.