July 31, 1934. C. A. SCHAEFER, JR 1,968,355

INCUBATOR

Filed April 13, 1932 5 Sheets-Sheet 1

FIG 1

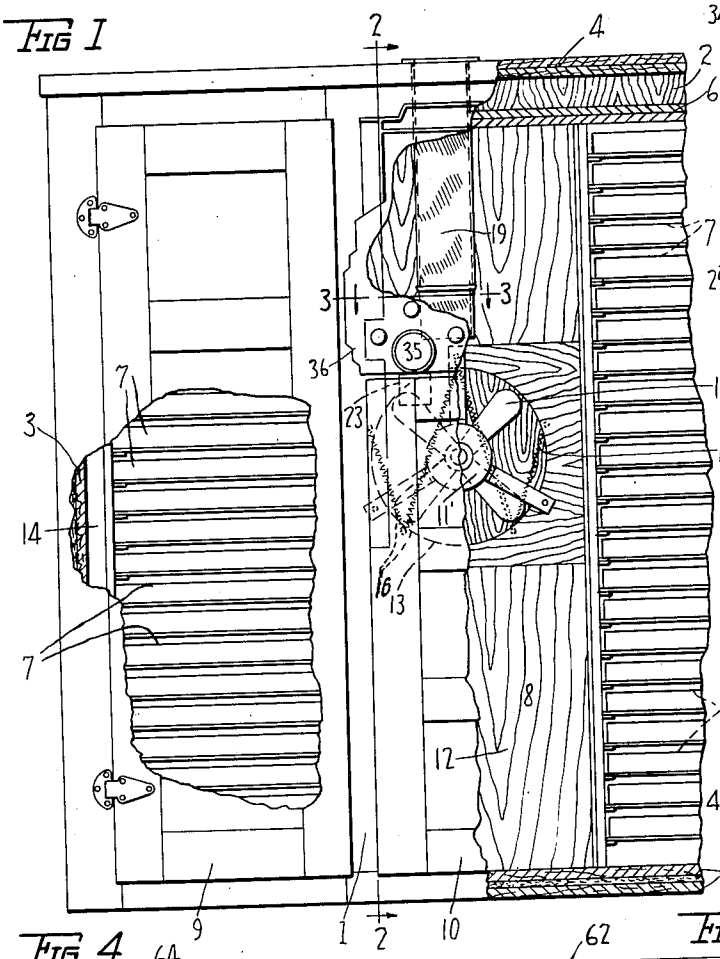


FIG 3

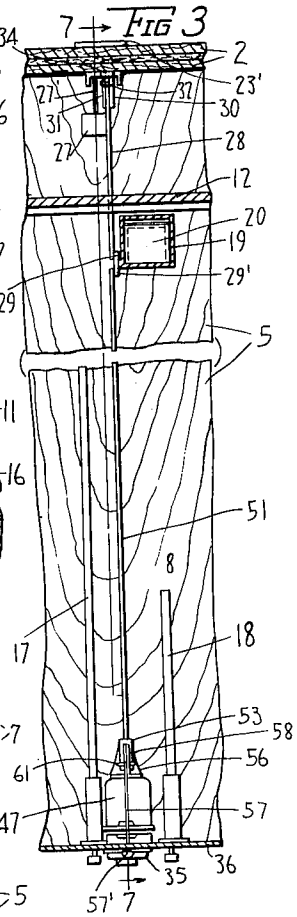


FIG 4

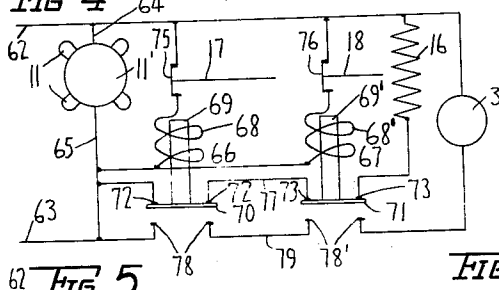


FIG 6

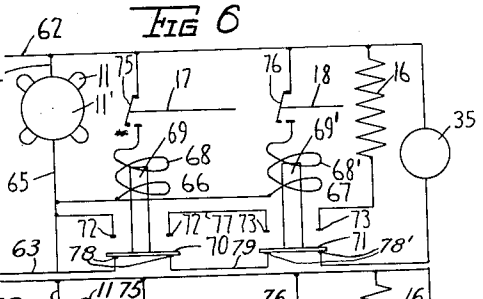


FIG 5

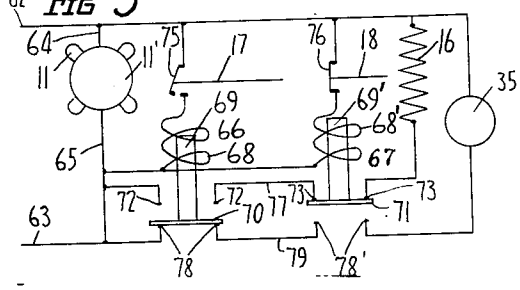
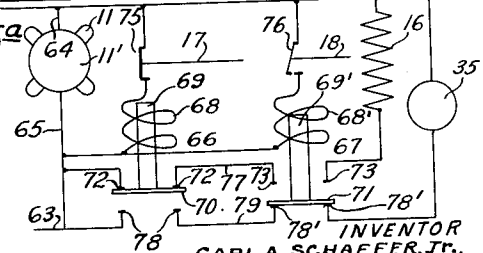


FIG 6a



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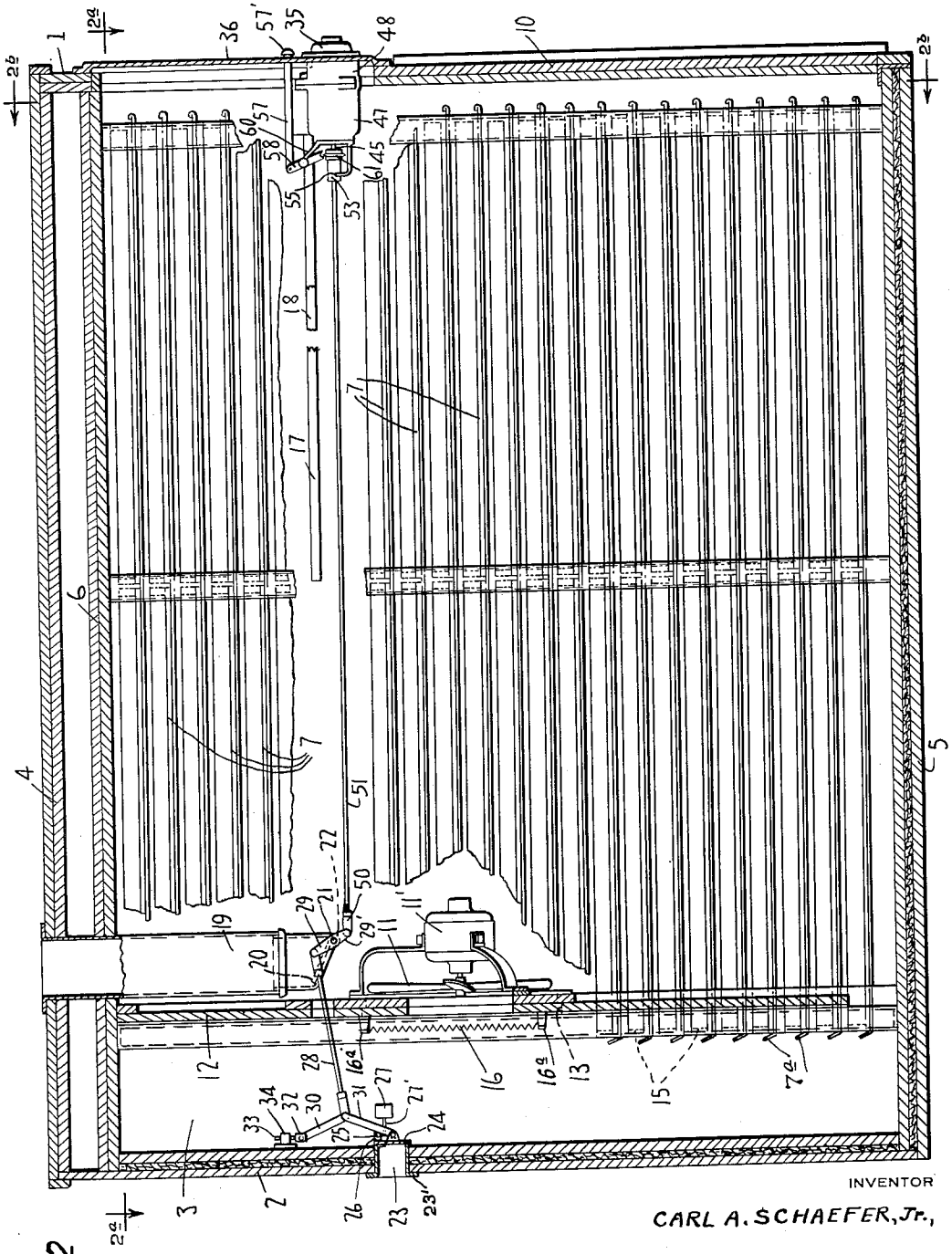


FIG 2

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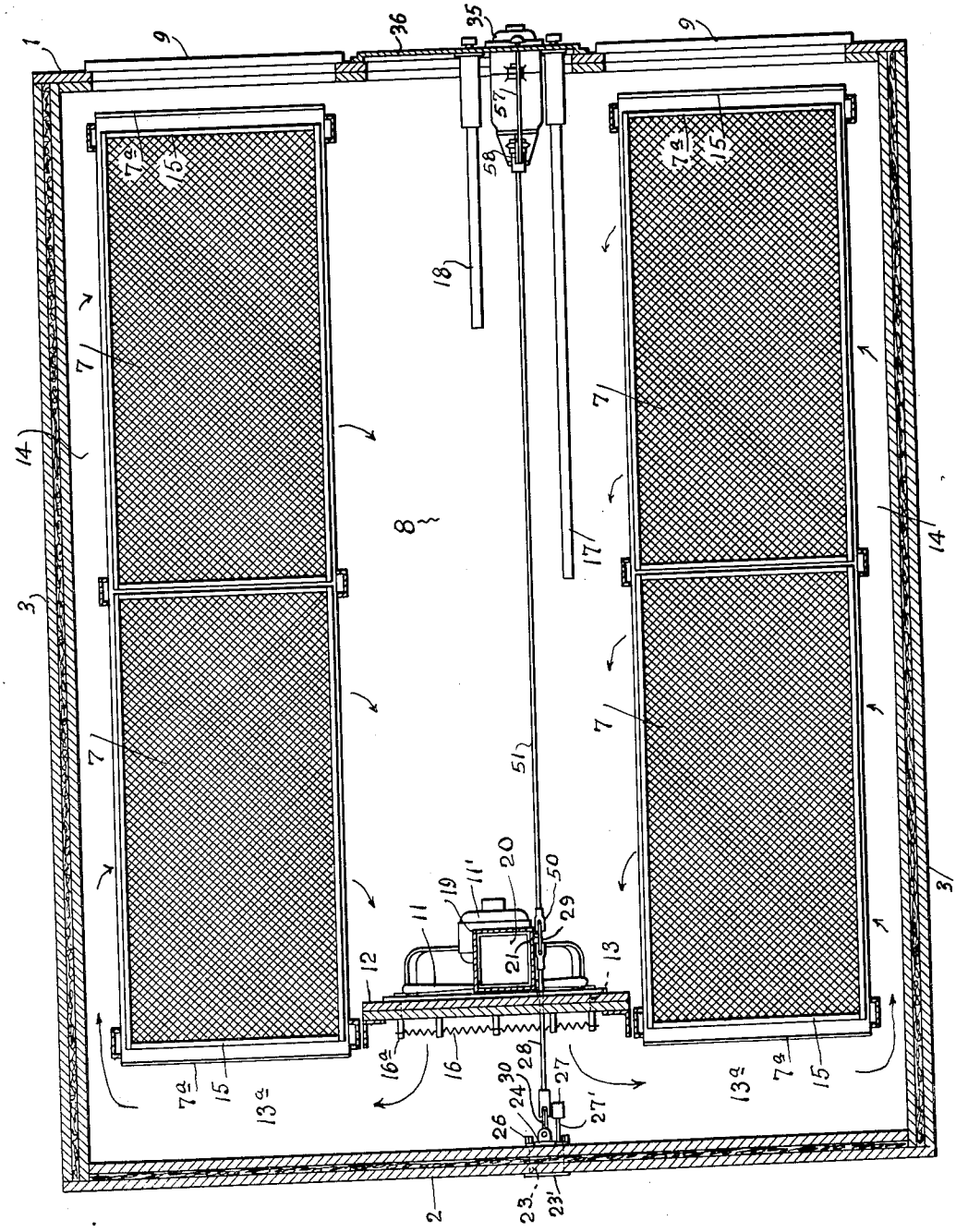


FIG. 2a.

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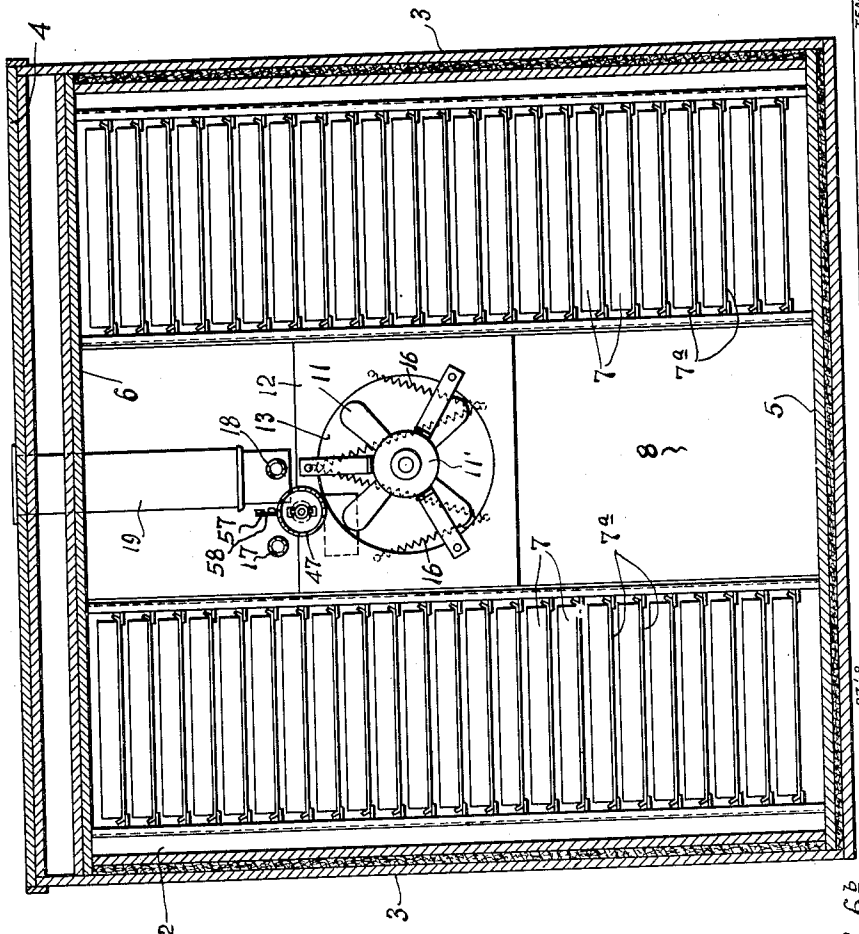


FIG. 2b.

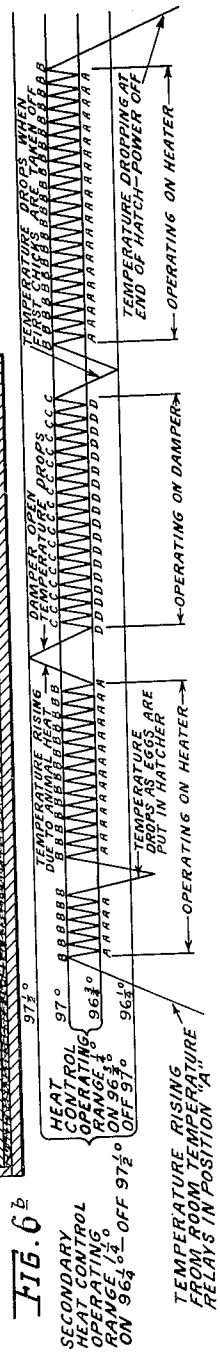


FIG. 6b.

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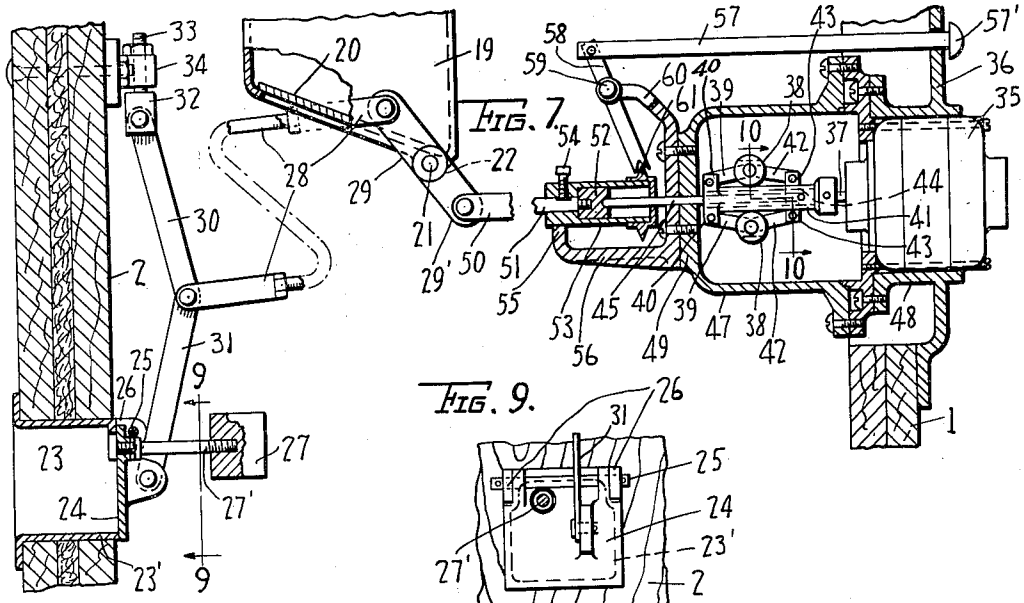


FIG. 7.

FIG. 9.

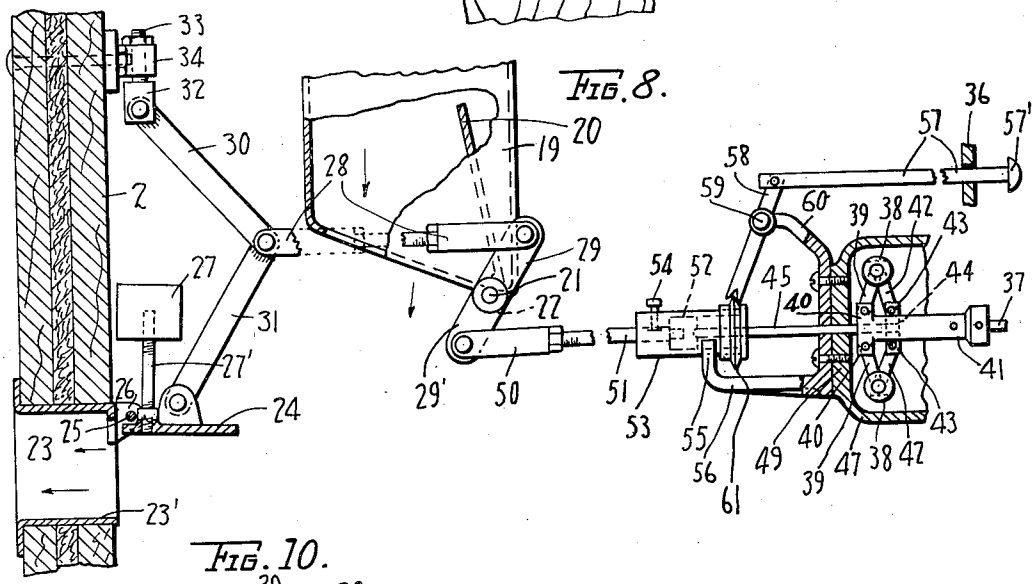


FIG. 8.

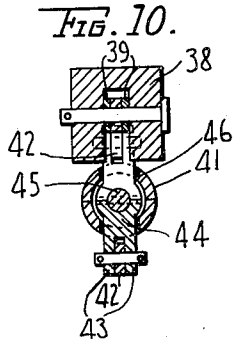


FIG. 10.

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UNITED STATES PATENT OFFICE

1,968,355

INCUBATOR

Carl A. Schaefer, Jr., Springfield, Ohio, assignor to The Buckeye Incubator Manufacturing Company, Springfield, Ohio, a corporation of Ohio

Application April 13, 1932, Serial No. 605,008

24 Claims. (Cl. 236—3)

This invention relates to a method of and means for maintaining a uniform temperature in an enclosed structure. The drawings in the present case illustrate a hatcher for eggs, but the improvements may be used with incubators and setters for eggs, with brooders for chicks and with any kind of a structure in which it is desired to maintain a uniform or substantially uniform temperature therein.

One of the objects of the invention is to provide means for maintaining the temperature in the structure within a given range, whether the air in the structure is being supplied with artificial heat or with heat from the contents of the structure.

Another object of the invention is to provide means for producing artificial heat, when necessary, to maintain the air in the structure at the desired temperature.

Another object of the invention is to provide means for admitting outside air into the structure when necessary to reduce the temperature therein in order to maintain the temperature within the desired range.

Another object of the invention is to provide means for the escape of air from the structure while air is being admitted thereto.

Another object of the invention is to open and close the air inlet and air outlet simultaneously, so that some air will be exhausted during the time that air is being taken into the structure.

Another object of the invention is to provide means for supplying artificial heat when the temperature in the structure falls to a predetermined degree, to admit outside air when the temperature rises to a predetermined degree, to cut off the supply of heat before air is admitted, to cut off the admission of air before the supply of heat is turned on, and to operate without artificial heat or admission of outside air when the air in the structure is within a predetermined range of temperature.

Another object of the invention is to provide means for producing air currents in the structure and to locate such means adjacent to the air inlet and air outlet so that such means will cause air to enter the structure and to be exhausted therefrom when the inlet and outlet are open.

Another object of the invention is to provide a plurality of thermostats to operate in conjunction with each other so that they will control the heater and the air inlet and outlet to provide heat or admit outside air when needed, and cut off the heat and air when not needed.

Another object of the invention is to provide a plurality of thermostats capable of operating switches for making and breaking of the heater circuit and the damper motor circuit.

Another object of the invention is to provide a pair of thermostats which cooperate to control both the artificial heater and the air supply.

Another object of the invention is to provide one or more tiers of egg trays with a division plate between each egg tray and the egg tray above or below it and to provide a space between each division plate and an adjacent tray so that the air currents can move horizontally through the tier of egg trays, but not vertically through the same.

An object of the method is to supply heat until the temperature rises to a certain degree, then cut off the heat until the temperature drops to a certain degree, when the heat is again turned on, and continuing this method of temperature control until the temperature reaches a certain higher degree, when air is admitted to the structure and exhausted therefrom to reduce the temperature until it falls to a certain degree, when the air supply and exhaust are cut off until a certain higher temperature is reached, when the outside air is again admitted and some of the inside air is exhausted to reduce the temperature, and continuing this method until a certain lower temperature is reached, when the temperature is again controlled by alternately turning on and cutting off the artificial heat.

Another object of the method is to control the temperature in the structure by admitting outside air and exhausting some of the air from the structure under certain conditions, by supplying artificial heat under certain conditions, and cutting off the artificial heat supply and the air supply and exhaust under certain conditions.

Another object of the method is to control the temperature by alternately supplying heat and cutting it off until the temperature rises to a predetermined degree, when the temperature is controlled by alternately admitting outside air and cutting off this supply of outside air.

Another object of the invention is to keep a uniform temperature in the structure by producing horizontal air currents.

Another object of the method is to admit outside air and exhaust inside air at adjacent points and to circulate the air horizontally through the tier of egg trays.

Another object of the method is to circulate the air horizontally through the tier of egg trays and to prevent its circulation vertically through the tier of egg trays.

In the accompanying drawings:

Fig. 1 is a partial front elevation, partly in transverse section, of a hatcher in which the improved features are incorporated.

Fig. 2 is an enlarged longitudinal section on the line 2—2 of Fig. 1.

Fig. 2*a* is a horizontal section on the line 2*a*—2*a* of Fig. 2.

Fig. 2*b* is a vertical section on the line 2*b*—2*b* of Fig. 2.

Fig. 3 is a fragmentary horizontal section on the line 3—3 of Fig. 1.

Figs. 4, 5, 6 and 6*a* are electrical circuit diagrams in different stages of operation, showing the manner of controlling the temperature conditions by electrically operated means.

Fig. 6*b* is a diagrammatic view showing the operating ranges of the thermostats for controlling the heater and the air supply.

Fig. 7 is an enlarged fragmentary longitudinal section of some of the details of the mechanism as seen on the line 7—7 of Fig. 3.

Fig. 8 is a view similar to Fig. 7, but with the parts in a different working position.

Fig. 9 is a fragmentary transverse section on the line 9—9 of Fig. 7.

Fig. 10 is an enlarged fragmentary transverse section on the line 10—10 of Fig. 7.

Referring to the drawings, the casing of the hatcher is constructed in a well known manner, 1 being the front wall, 2 the rear wall, 3 the side walls, 4 the top and 5 the bottom or floor. An inside ceiling 6 is also employed over the entire interior of the casing to provide for heat insulation at this point, while in the side and rear walls and floor, a central sheet of insulating fiber is used for the same purpose.

As seen in Figs. 1, 2 and 2*b*, egg trays 7 of the usual mesh bottom type are arranged in two vertical tiers, one tier on either side of the interior of the casing, leaving a corridor 8 between them. Access to the space in which the trays are stacked is obtained by doors one of which is shown at 9, while the corridor may be entered through a smaller door 10.

Air is circulated over and through the egg trays preferably by an electrically driven fan 11 which is supported in a vertical partition 12 at the rear of the corridor 8. The partition 12 is spaced a short distance forwardly from the rear wall 2 and is provided with a comparatively large circular opening 13 through which the air from the fan is forced, the fan being so mounted on the corridor side of the partition 12 that the direction of circulation of air is toward the rear wall 2 from the corridor 8. The air currents from the fan divide and spread in all directions, first entering the passages 13*a*, and then the passages 14, as seen in Fig. 2*a*. The flow of air is then toward the forward ends of these passages, returning to the corridor 8 and fan 11 over and between the egg trays 7. The movement of the air between the egg trays is always horizontal. The horizontal division plates 7*a* support the egg trays 7 and prevent vertical movement of the air through the tiers of egg trays. The arrows in Fig. 2*a* indicate the horizontal path of the air.

When the stacks of trays are in place, the end portions 15 of the trays effect a continuation of the baffle formed by the partition 12 at the end of the corridor, although this partition need be no more in width than the width of the corridor.

For the purpose of circulating heated air, the air from the fan is caused to pass an electrical heating element 16 arranged on insulating studs 16*a* attached to the rear side of the partition 12, the element 16 passing several times across the opening 13, as shown in Fig. 1.

Electric current is supplied to the fan 11 and heating element 16 from a common source; the supply of current to the heating element, however, being under the control of the thermostats 17 and 18, which actuate switches in the line leading to the heater 16. The thermostat 17 and the switch it controls are of the type described in my pending application Serial No. 432,693, filed March 3d, 1930, and in the present drawings, the thermostatic element 17 corresponds to the element 6 of the above-mentioned application. The thermostatic element 17, which is in the nature of a long, thin-walled tube, extends into the corridor in a horizontal direction to a comparatively great depth, this thermostat being a type in which the sensitivity increases with the length of the tubular element 17. In this position the element 17 is readily affected by the air flowing from the trays into the corridor 8 and increases or decreases in length according to the temperature of the air, and opens or closes the switch connected therewith for controlling one of the switches in the heater circuit as needed.

During the operation of a hatcher or other structure of the kind referred to, in certain weather conditions or in certain climates, however, it is necessary at times to provide for cooling the air within the structure, rather than heating it, due to the large amount of heat which is liberated therein. In the case of a hatcher a large amount of animal heat is given off by the eggs in the advanced stage of hatching. In the present case, cooling is effected by the admission into the hatcher of air from the outside and the discharge of a proportionately equal amount from the inside.

The admission and discharge of air and the heater 16 are under the control of the thermostat 17, which is known as the primary heat control thermostat, and the thermostat 18, which is known as the secondary heat control thermostat.

Air from the outside is admitted to the interior of the hatcher or structure when necessary through a vertical duct 19 which extends downwardly from the top to the proximity of the fan 11 and is, therefore, affected by the suction of the fan. The duct 19 is provided with a closing damper 20 (Figs. 7 and 8) pivotally mounted on a shaft 21 rotatably supported in bosses 22 attached to the lower end of the duct 19.

Air from the hatcher is discharged through an opening 23 in a damper frame fixed in the rear wall 2, so positioned as to be in the direct path of the air flow from the fan and in close proximity thereto. This opening is provided with a closing damper 24 which is pivotally mounted on a shaft 25 secured in bosses 26 attached to a damper frame 23′ and which is maintained in a normally closed position by means of a weight 27, which is secured to the damper by a stem 27′.

The damper 20 and the damper 24 are interconnected by an adjustable connection 28, so that they will open and close simultaneously. This connection is pivotally secured to the upper end of a double armed lever 29 secured to the shaft 21 of the damper 20, while the opposite end of the connection is pivotally secured to the central portion of a toggle lever arrangement consisting of the members 30 and 31. The member 30 is

pivotally secured at its upper end to an adjustable anchor block 32 having an upwardly extending screw-threaded stem 33 threaded into a member 34 attached to the inner side of the rear wall 2 above the damper opening 23. The lower end of the member 31 is pivotally attached to an ear on the damper 24 whereby as the damper 20 is opened as is seen in Fig. 8, the damper 24 is also opened. By this arrangement, when the fan is in operation, the simultaneous opening of the dampers 20 and 24 allows air to enter through the duct 19, due to the fan suction, and causes a quantity of air to be discharged at the same time through the opening 23, due to the force of the fan, without interfering with the normal circulation of the major portion of the air within the hatcher or structure. The dampers are closed by a simultaneous movement of the dampers when there is no necessity of admitting air in any quantity whatever.

The dampers are opened by an electric motor 35 mounted in a plate-like casting 36 which forms a portion of the front wall 1, at the forward end of the corridor 8, the operation of the damper motor being under the joint control of the previously mentioned thermostats to open the dampers, which are closed by the effect of the weight 27. The mechanism by which the dampers are opened and maintained in open position is attached to the shaft 37, Figs. 7 and 8, of the motor 35, and is a fly-ball centrifugally affected device, power being derived from the action of a pair of oppositely positioned fly-balls 38. Each fly-ball 38 is pivotally connected at the central portion of a toggle lever arrangement consisting of the links 39 and 42. Each link 39 is pivotally secured in a pair of slotted, radially-extending ears 40 integrally attached at the outer end of a sleeve-like member 41 secured to the shaft 37 of the damper motor 35. The links 42 are each pivotally connected at their outer ends to their respective fly-balls 38, and at their inner ends to the oppositely positioned, radially-extending slotted ears 43 of a cross-head member 44 (Fig. 10).

The cross-head 44 is secured by a pin to the inner end of a short rod 45 extending rearwardly through a central bore in the outer end of the sleeve member 41 in longitudinal alignment with the shaft 37 of the damper motor, and is mounted for reciprocal movement with respect to the sleeve 41 in a longitudinally-extending slot 46 in the sleeve 41. Therefore, as the damper motor 35 is put into operation, the fly-balls swing outwardly and exert a force on the toggle link lever arrangement just described which results in drawing the cross-head 44 toward the outer end of the sleeve 41 and thus causes a movement to the rear of the short shaft 45. The fly-ball mechanism is preferably enclosed in a bell-shaped housing 47 which is attached to a rearwardly extending hollow boss 48 of the plate 36, in which boss 48 the damper motor 35 is mounted. The short shaft 45 is loosely supported for reciprocal movement in a central opening in the end portion 49 of the housing 47.

The mechanism just described is connected with the dampers 20 and 24 in the following manner, whereby operation of the damper motor 35 serves to open and retain in opened position these dampers. An adjustable rod-end connection, consisting of a rod-end 50 and a rod 51, is pivotally secured at its rearward end to the lower end 29' of the double armed lever 29 connected with the air inflow damper 20. On the forward end of the rod 51 is secured a thrust block 52 and in the center of its forward surface is a spherical depression in which is seated the rearward end of the short shaft 45. Therefore, as the shaft 45 is moved rearwardly, it presses on the thrust block 52 and on the rod 51 and causes the dampers to assume the open position as seen in Fig. 8, retaining them in this position as long as current is supplied to the damper motor 35, since the fly-balls are being continuously rotated by the motor. The block 52 is enclosed in a tubular grease-retaining member 53 which is secured to the rod 51 by a set-screw 54; the member 53 is lightly supported for reciprocal movement in the semi-circular seat of an upturned saddle 55 at the rearward end of a bracket 56 attached to the housing 47. A means of indicating whether the dampers are in an open or closed position is afforded by the button 57' mounted on the outer end of a bar 57 which projects forwardly through the front wall plate 36. The bar 57 is pivotally secured to the upper end of a lever 58 pivoted on a pin 59 supported in a bracket 60 attached to the rear end of the housing 47, the lever 48 being notched at its lower end to coact with an annularly-extending rib 61 on the outer surface of the grease-retaining member 53, whereby when the dampers are in the closed position as seen in Fig. 7, the button 56 lies closely adjacent the outer surface of the front wall plate 36. Likewise, when the dampers are in the opened position the bar 57 is projected forwardly, and the button 56 assumes a position spaced apart forwardly from the forward wall 36.

Referring to Figs. 4, 5, 6 and 6a, there is illustrated diagrammatically the devices for controlling the temperature. Two thermostats 17 and 18 are employed for controlling the circuit for the heater 16 and the circuit for the motor 35 for operating the dampers 20 and 24. These thermostats control the temperature within predetermined limits whether the air is subjected to artificial heat or to cooling air. These thermostats act through different ranges of temperature whose midway or average point is the same. The thermostat indicated at 17 is the primary one and is responsive to the shortest range of temperature and in the present case is regulated to respond to open a switch controlled thereby at a maximum temperature of 97 degrees F. and to close the switch at a minimum temperature of 96¾ degrees F. The thermostat indicated at 18, known as a secondary one, operates through the widest range of temperature and in the present case is regulated to open the switch controlled thereby at a maximum temperature of 97½ degrees F. and to close the switch at a minimum temperature of 96¼ degrees F. The preferable temperature to maintain the hatcher is 96⅞ degrees F. which is the midway or average point between the temperature range of each thermostat.

The operation of these thermostats is such that under certain conditions the temperature is maintained by the artificial heater within the desired range, while under certain other conditions the temperature is maintained by the admission of cooling air to maintain the temperature within the same range.

Before explaining the operation of the thermostats, a brief description of the devices will be given. The power lines are indicated at 62 and 63, and incidentally it will be stated here that the motor 11' of the fan 11 is placed in a circuit 64 and 65 which is bridged across the power lines so that this fan will continuously operate to pro-

duce a circulation of air. The thermostat 17 controls a switch 75 and the thermostat 18 controls a switch 76. These switches control the circuits of the windings 68 and 68' of solenoids 66 and 67, the cores of which are represented by 69 and 69' and carry switch members 70 and 71. The switch members 70 and 71 act to alternately make and break the circuit 77 for the heater 16 and the circuit 79 of the damper motor 35.

Figs. 4, 5, 6 and 6*a* show the various positions of the switches 70, 71, 75 and 76. Fig. 4 shows the switches 75 and 76 closed, at which time the heater circuit 77 is closed because the thermostats 17 and 18 have closed the switches 75 and 76, resulting in the switch 70 bridging the gap between the contacts 72 and the switch 71 bridging the gap between the contacts 73. In this position of the switches, the heater circuit 77 is closed and artificial heat is supplied by the heater 16. The damper motor circuit is open at this time and consequently the dampers are closed.

The heater 16 will continue to supply artificial heat until the temperature reaches a predetermined degree, when the thermostat 17 will open the switch 75 and break the circuit to the winding 68 of the solenoid 66, whereupon the switch 70 will move to the position shown in Fig. 5, which also shows the switch 75 open. In this position the switch 70 will bridge the gap between the contacts 78 in circuit 79. At this time the heater circuit 77 is open and likewise the damper motor circuit 79. Consequently, no artificial heat is being supplied and no air is being admitted into the structure or discharged therefrom.

The switches will remain in the positions indicated in Fig. 5 until the temperature rises to a predetermined degree or drops to a predetermined degree. If the temperature drops to a predetermined degree, 96¾ degrees in this case, the thermostat 17 will act and close the switch 75, which will result in the solenoid 66 being energized and the switch 70 will return to the position shown in Fig. 4, where it bridges the gap between the contacts 72 in circuit 77. Then artificial heat will again be supplied as before described until the temperature rises sufficiently to cause the thermostat 17 to open the switch 75.

With the switches in the positions indicated in Fig. 5, if the temperature rises sufficiently to cause the thermostat 18 to open the switch 76, which would occur at 97½ degrees as this thermostat is regulated for purposes of illustration, then the solenoid 67 will be de-energized and the switch 71 will move to the position indicated in Fig. 6, where it bridges the gap between the contacts 78' in circuit 79. At this time the damper motor circuit is closed and the damper motor rotates and opens the inlet damper 20 and the outlet damper 24, so as to admit outside air and discharge some of the inside air.

It will be observed that during this time the heater circuit 77 is open. After the damper motor circuit is closed, and so long as the switch 76 is open, the temperature in the structure is controlled wholly by admitting and discharging air, the thermostat 17 at this time controlling the switches 75 and 70 to make and break the damper motor circuit. While the switch 76 is open, the thermostat 17 opens and closes the switch 75, which causes the switch 70 to shift alternately from the contacts 72 to the contacts 78. Fig. 6*a* shows switch 75 closed and switch 70 bridging the gap between contacts 72, while switch 76 is shown open and switch 71 bridging the gap between contacts 78'.

In this position of the switches, both the heater circuit and the damper motor circuit are open, when no artificial heat is supplied and no air admitted or discharged.

With the switches in the positions indicated in Fig. 6*a*, either the heater circuit can be closed or the damper motor circuit can be opened according to the temperature in the structure. If the temperature drops to 96¼ degrees, the thermostat 18 will close switch 76, whereupon switch 71 will be shifted to engage the contacts 73 and close the heater circuit. If, however, the temperature rises to 97 degrees, the thermostat 17 will open the switch 75, which will cause the switch 70 to engage the contacts 78 and close the damper motor circuit and open the dampers 20 and 24 to admit and discharge air.

It will be observed that when either switch 75 or 76 is open, both the heater circuit 77 and the damper motor circuit are open. When both switches 75 and 76 are closed, the heater circuit 77 is closed and when both switches 75 and 76 are open, the damper motor circuit 79 is open.

Fig. 6*b* is a diagram showing the operation of the temperature control. The letter A indicates that the switches are in the positions indicated in Fig. 4, when the heater circuit is closed and the damper motor circuit open, at which time artificial heat is supplied. The letter B indicates that the switches are in the positions indicated in Fig. 5, when the heater and damper motor circuits are both open, at which time no artificial heat is supplied and no air is being admitted or discharged. The letter C indicates that the switches are in the positions indicated in Fig. 6, when the damper motor circuit is closed and the heater circuit is open, at which time no artificial heat is being supplied, but the dampers 20 and 24 are open so that cooling air can be admitted and some of the inside air discharged. The letter D indicates that the switches are in the positions indicated in Fig. 6*a*, when both the heater circuit and the damper motor circuit are open and no artificial heat is being supplied and no air admitted or discharged.

Diagrammatic Fig. 6*b* also shows that the primary thermostat 17 is adjusted to open the switch 75 at 97 degrees and to close it at 96¾ degrees, while the secondary thermostat 18 is adjusted to open the switch 76 at 97½ degrees and close it at 96¼ degrees. This difference of range is provided so that there is sufficient leeway between the two thermostats to prevent operation of the thermostat 18 unless there is a change of temperature of a somewhat permanent nature.

Diagrammatic Fig. 6*b* also shows that after the temperature drops to 96¼ degrees, the temperature is controlled by turning on and cutting off the artificial heat. This operation then continues until the temperature reaches 97½ degrees, when the temperature is controlled by admitting cooling air and discharging some of the inside air. From this time on the temperature is controlled by admitting cooling air and discharging some of the inside air and by cutting off this admission and discharge of air. This operation then continues until the temperature drops to 96¼ degrees, when the temperature is again controlled by supplying artificial heat and cutting it off.

When eggs are put in the structure, the temperature drops and artificial heat is supplied until the temperature reaches 97 degrees, when it is cut off. When the temperature drops to 96¾ degrees, the artificial heat is again supplied. During this interval, the structure is closed and no outside

air is admitted. During the hatching stage the temperature rises due to the animal heat liberated by the eggs, and when the temperature reaches 97½ degrees, the dampers are opened and cooling air admitted. From that time the temperature is controlled by admitting and cutting off the admission of cooling air, without supplying any artificial heat. But when some of the chicks are removed, the temperature drops to 96¼ degrees, when the heater circuit is again closed and then the temperature is controlled by turning on and off the heat.

This is a dual system of temperature control, in which the thermostats control the temperature through the heater under certain conditions and through the dampers under certain conditions. The temperature is maintained between 96¾ degrees F. and 97 degrees F. by both systems of control, except momentarily when it rises to 97½ degrees F. or drops to 96¼ degrees F. Such rise changes the control to the dampers and such drop changes the control to the heater.

The improved method of controlling the temperature, one means of practicing which is illustrated in the drawings forming a part hereof and which will be understood from the foregoing description, consists of supporting eggs in an enclosed structure in a tier of superimposed egg trays, causing a circulation of air in the enclosure and directing it horizontally between the egg trays, while preventing it from passing vertically through the tier of egg trays, and back to the circulating means. The method also embodies locating between tiers of egg supporting trays means for causing a circulation of air, and directing the air currents so that they will pass to the rear of the egg trays, then divide and pass back of the egg trays to the outer sides thereof, thence along the outer sides of the egg trays and horizontally between the egg trays and back to the circulating means.

The method of controlling the temperature also includes supplying artificial heat when the temperature drops to a predetermined degree, continuing the artificial heat until the temperature rises to a predetermined degree, then cutting off the heat and continuing these operations until an excessive degree is reached, when cooling air is admitted and some inside air is discharged to control the temperature, cutting off the admission and discharge of air when the temperature has been reduced to the desired degree, continuing the control of the temperature by the admission and discharge of air until a predetermined lower degree is reached and then supplying artificial heat. In other words, the temperature is controlled under certain conditions by supplying artificial heat and cutting it off and under certain conditions by admitting cooling air and discharging some of the inside air and discontinuing the admission and discharge of air.

While the invention has been primarily described in connection with controlling the temperature in a hatcher, it is to be understood that the same can be used for controlling the temperature in any enclosure in which eggs or chickens are placed or for controlling the temperature in buildings occupied by persons or enclosures of any kind.

It will be understood that it is desired to comprehend within the invention all the modifications necessary to adapt it to varying conditions and uses.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The method of regulating the temperature of an incubator, consisting in circulating air therein, maintaining the temperature within a predetermined range by supplying artificial heat when the temperature drops to a predetermined degree, cutting off the heat at one predetermined degree of temperature, admitting cooling air and discharging some of the air in the structure when the temperature rises to another predetermined degree, and thermostatically controlling the supply of artificial heat and the admission and discharge of air, and maintaining at all times the continuous circuit of air within the incubator and causing the air to follow the same circuit within the incubator when supplying artificial heat and when admitting cooling air.

2. The method of regulating the temperature of an enclosed structure consisting in circulating air therein, maintaining the temperature within a predetermined range by supplying artificial heat when the temperature drops to a predetermined degree, admitting cooling air when the temperature rises to a predetermined degree, and thermostatically controlling the supply of artificial heat and the admission of cooling air so that after the artificial heat is supplied the temperature will be regulated by supplying and cutting off the supply of artificial heat and after the cooling air is admitted the temperature will be regulated by opening and closing the air supply.

3. A method of regulating the temperature of an incubator consisting in using artificial heat when the temperature in the structure is within a predetermined range, using the heat of the contents of the structure and cooling air to maintain temperature within a second predetermined range after the temperature has exceeded the predetermined range first defined, the source of artificial heat and air being thermostatically controlled, and maintaining at all times a continuous circuit of air within the incubator and causing the air to follow the same circuit within the incubator when supplying artificial heat and when admitting cooling air.

4. The method of regulating the temperature of an enclosed structure containing animal heat, a source of artificial heat and a source of cooling air, consisting in controlling the temperature which is produced solely by animal heat and the cooling air within predetermined limits by thermostatically controlling the air, and thermostatically controlling the artificial heat.

5. In a temperature regulator for an enclosed structure, a source of artificial heat, a source of cooling air therefor, and thermostatic devices for controlling the source of heat and the source of cooling air said thermostatic devices including means to cut off the air when the artificial heat is produced and for maintaining the temperature between the same ranges by either the artificial heat or the cooling air.

6. In a temperature regulator for an enclosed structure, a source of artificial heat, a source of cooling air therefor, and thermostatic devices responsive to different ranges of temperature for controlling the source of artificial heat and the source of cooling air said thermostatic devices including means to cut off the artificial heat at a certain temperature, and means to cut off the admission of cooling air at a certain temperature, said last two means operating to permit the operation of the structure at a certain temperature and during certain stages of operation with-

out the production of artificial heat, and without the admission of cooling air.

7. In a temperature regulator for an enclosed structure, a heater, a source of cooling air, and thermostatic devices for controlling the heater and the source of cooling air said thermostatic devices including means to maintain the same range of temperature when the heater is functioning, as when the cooling air is being admitted.

8. In a temperature regulator for an enclosed structure, a heater, a source of air supply, means for rendering the heater operative and inoperative, means for admitting and preventing the admission of cooling air, and thermostatic means for controlling said means for the heater and air supply said thermostatic devices including means to maintain the same range of temperature when the heater is functioning as when the cooling air is being admitted.

9. In a temperature regulator for an enclosed structure, a heater, a damper for admitting cooling air, a motor for opening the damper, an electrical circuit for the heater, an electrical circuit for the damper motor, said circuits each having two gaps therein, two thermostatically controlled switches capable of bridging two of said gaps at a time, whereby the heater circuit is closed when said switches bridge the two gaps in said circuit, the damper motor circuit is closed when the two switches bridge the two gaps in the motor circuit, and both circuits are open when only one gap is bridged in each circuit.

10. In a temperature regulator for an enclosed structure having an air inlet, a damper for controlling said inlet, a motor for opening the damper, a heater, an electrical circuit for the heater, an electrical circuit for the damper motor, said circuits each having two gaps therein, and two thermostatically controlled switches capable of simultaneously bridging two of said gaps, whereby the heater circuit is closed when said switches bridge the two gaps in said circuit, the damper motor circuit is closed when the two switches bridge the two gaps in the motor circuit, and both circuits are open when only one gap is bridged in each circuit.

11. In a temperature regulator for an enclosed structure having an air inlet and outlet, means for controlling the inlet and outlet including a motor and an electrical circuit having a plurality of gaps therein, a heater, an electrical circuit for the heater having a plurality of gaps therein, and a plurality of thermostatically controlled switches capable of simultaneously bridging the gaps in one circuit and capable of bridging a gap in one circuit and a gap in another circuit, whereby the heater circuit is closed when the switches close the gaps therein, the motor circuit is closed when the switches bridge the gaps therein, and neither circuit is closed when a gap in the heater circuit and a gap in the motor circuit is bridged.

12. In a temperature regulator for an enclosed structure, a source of artificial heat, a source of cooling air, and thermostatic devices responsive to different ranges of temperature for controlling the source of heat and the source of cooling air, whereby the temperature will be maintained within a predetermined range by turning on and off the heat until the temperature reaches a predetermined higher degree, after the temperature will be maintained within a predetermined range until a predetermined lower degree is reached, when the temperature will again be maintained within a predetermined range by turning on and off the heat, and means for maintaining at all times a recirculation of air within the enclosed structure, and causing the air to follow the same circuit within the enclosed structure when supplying artificial heat and when admitting cooling air.

13. In a temperature regulator for an enclosed structure containing animal heat such as produced by eggs or chicks, a source of artificial heat therein, a source of cooling air therefor, and thermostatic devices including means operable to maintain a given range of temperature by the artificial heat and the same range of temperature produced merely by the combined effect of the animal heat and cooling air.

14. In a temperature regulator for an enclosed structure, a source of artificial heat, a source of cooling air, automatic devices operable within a given range of temperature to independently control either the artificial heat or the air, and means operable at given temperatures to transfer the control of said automatic devices from the heat to the air or vice versa.

15. In a temperature regulator for an enclosed structure, a source of artificial heat, a source of cooling air, thermostatic means to independently control either the artificial heat or the air, and a thermostat operable at given temperatures to transfer the control of said first mentioned thermostatic means from the heat to the air or vice versa.

16. In a temperature regulator for an enclosed structure, a source of artificial heat, a source of cooling air, a thermostat operable within a given range of temperature to independently control either the artificial heat or the air, and a second thermostat operable over a greater range of temperature to transfer the control of the first mentioned thermostat from the heat to the air or vice versa.

17. In a temperature regulator for an enclosed structure, a source of artificial heat, a source of fresh air, a thermostat operable within a given range of temperature to independently control either the artificial heat or the air, and a second thermostat operable at a higher temperature to transfer the control of said first thermostat from the heat to the air and operable at a lower temperature to transfer the control of said first thermostat from the air to the heat.

18. In a temperature regulator for an enclosed structure, a source of artificial heat, an electric heater, a source of cooling air including a damper, an electric motor for operating said damper, two electrical circuits, one for the heater and one for the motor, a thermostatically controlled switch operable within a predetermined range of temperature to break one of said circuits and partially close the other, and a second thermostat operable within a greater range of temperature to close the circuit which has been partially closed by the first thermostat.

19. In a temperature regulator for an enclosed structure, a source of artificial heat, an electrical circuit to control the same, a source of air having a damper, an electric motor to operate said damper, a circuit to control said motor, a thermostat to control independently either one of said circuits within a predetermined range of temperature, and a second thermostat operable over a greater range of temperature to place either one of said circuits in condition to be controlled by said first thermostat.

20. In a temperature regulator for an enclosed structure, a source of artificial heat, an electrical

circuit to control the same, a source of air having a damper, an electric motor to operate said damper, a circuit to control said motor, a thermostatically controlled switch to control independently either one of said circuits within a given range of temperature, and a second thermostatically controlled switch operable over a greater range of temperature to place either one of said circuits in condition to be controlled by said first switch.

21. In a temperature regulator for an enclosed structure, a source of artificial heat, an electrical circuit to control the same, a source of air having a damper, an electric motor to operate said damper, a circuit to control said motor, an electrically operated thermostatically controlled switch operable within a given range of temperature to control independently either one of said circuits, and a second electrically operated thermostatically controlled switch operable over a greater range of temperature to place either one of said circuits in condition to be controlled by said first switch.

22. In a temperature regulator for an enclosed structure, a source of artificial heat, an electrical circuit to control the same, a source of air having a damper, an electric motor to operate said damper, a circuit to control said motor, a thermostatically controlled switch operable over a given range of temperature to partially open or close either one of said circuits, and a second thermostatically controlled switch operable over a less range of temperature to control the circuit which has been partially closed by said first thermostat.

23. In a temperature regulator for an enclosed structure, a source of artificial heat, an electrical circuit to control the same, a source of air having a damper, an electric motor to operate said damper, a circuit to control said motor, an electro-magnet, a thermostat for controlling said electro-magnet operable over a given range of temperature, a switch operated by said electro-magnet to independently control either one of said circuits, a second electro-magnet, a second thermostat operable over a greater range of temperature to control same, and a second switch operated by said second electro-magnet and operable to partially close either one of said circuits.

24. In combination, an incubator artificial heating means, means to cut in and cut out the artificial heating means to maintain a given range of temperature in the incubator, and means for admitting outside cold air to reduce the animal heat in the incubator when that heat passes above the point at which the artificial heating means is cut out and maintain the temperature within said range, and means continuously operating for causing continuous circuit of air within said incubator when said artificial heating means is in operation or when said means for admitting the outside cool air is in operation, and means for causing the air to follow the same circuit within said incubator when admitting cooled air and when artificial heat is supplied.

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