Oct. 17, 1944. J. I. TAGGART 2,360,527

INCUBATOR

Filed April 20, 1942 3 Sheets-Sheet 1

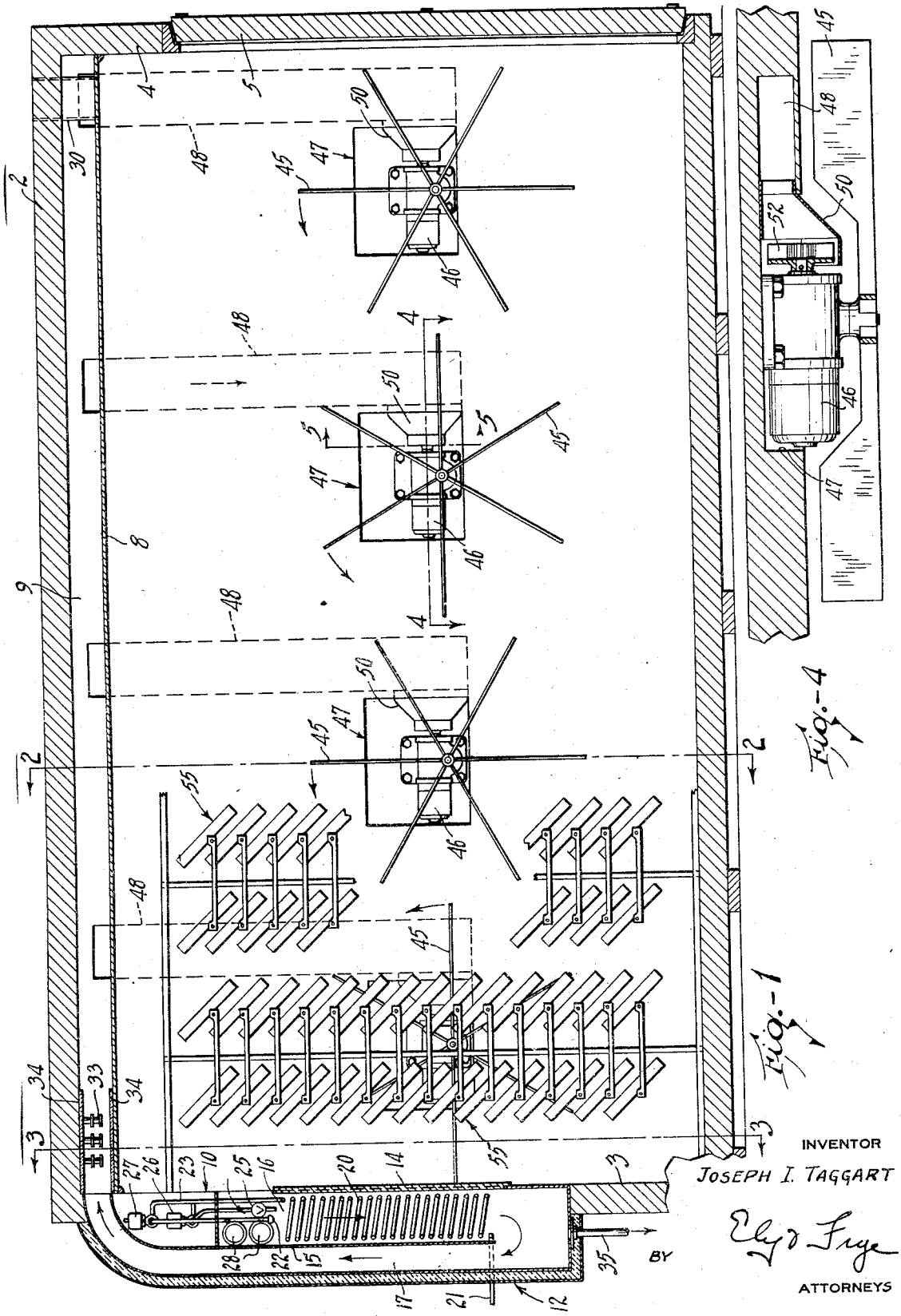


Fig.-4

Fig.-1

INVENTOR
JOSEPH I. TAGGART

BY Elyd Frye
ATTORNEYS

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INCUBATOR

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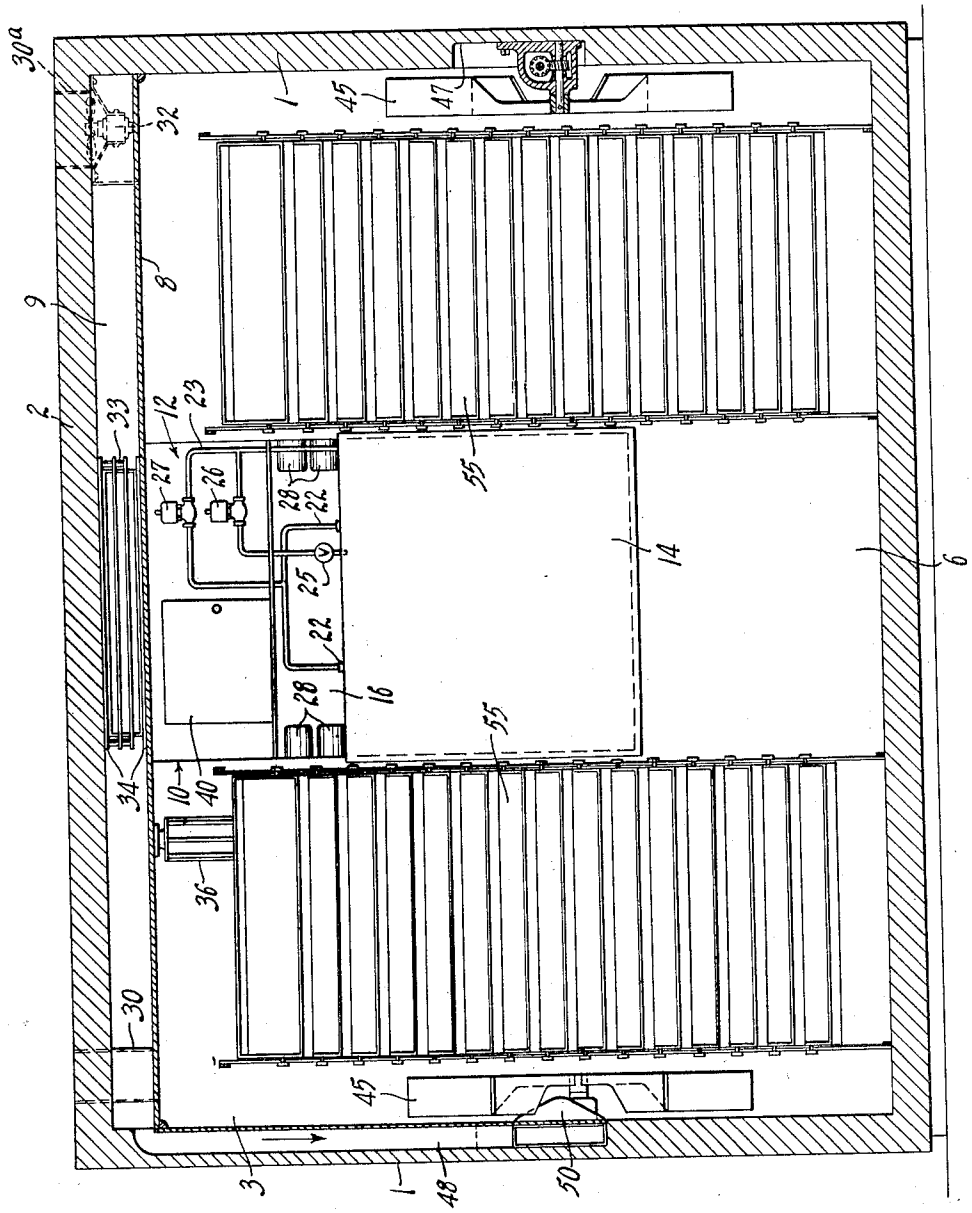



Fig.-2

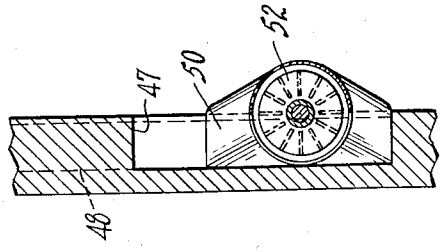



Fig.-5

INVENTOR
JOSEPH I. TAGGART

BY Ely & Frye

ATTORNEYS

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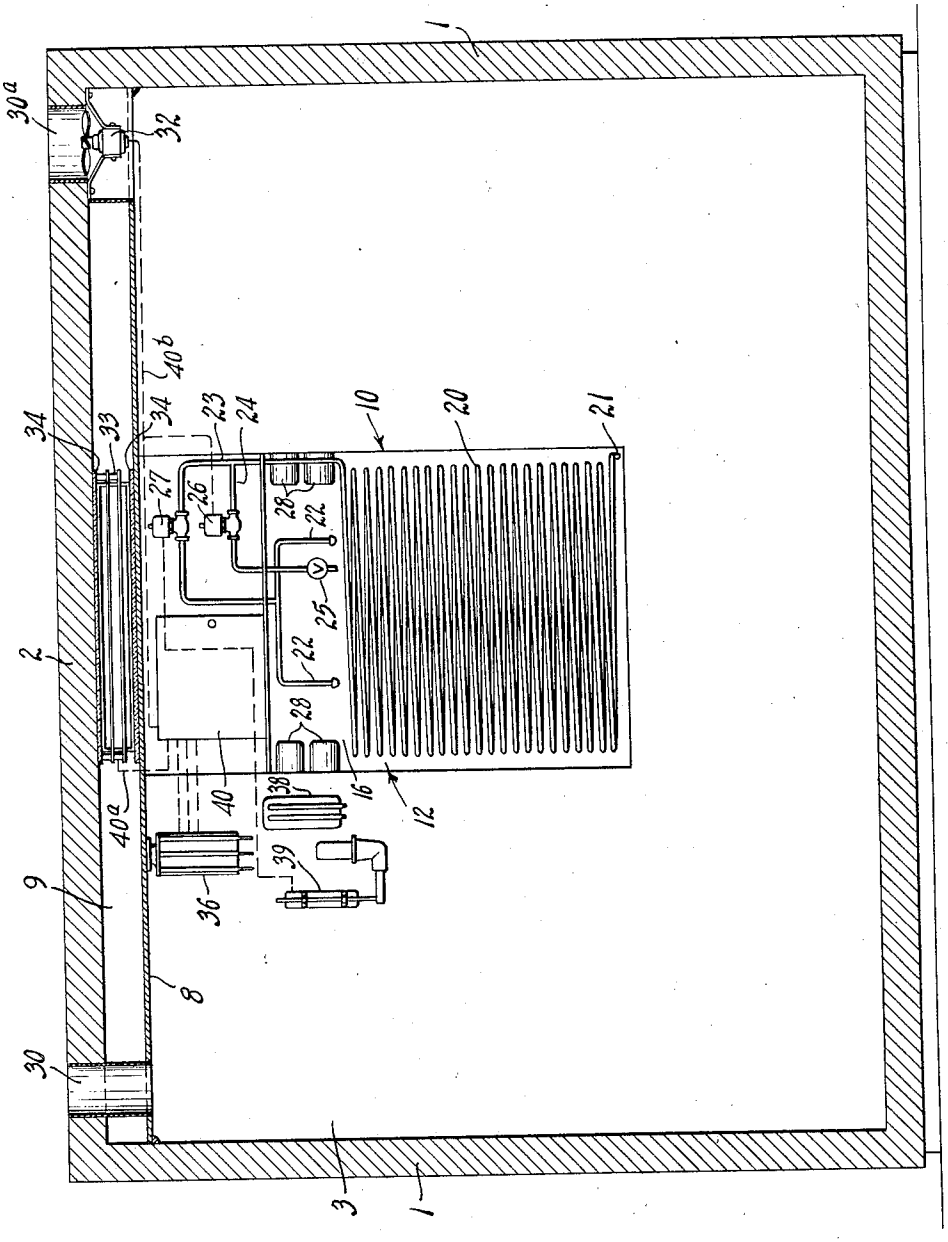



Fig. -3

INVENTOR
JOSEPH I. TAGGART

BY

ATTORNEYS

Patented Oct. 17, 1944 2,360,527

# UNITED STATES PATENT OFFICE

2,360,527

## INCUBATOR

Joseph I. Taggart, Cleveland, Ohio, assignor to The Bundy Incubator Company, Springfield, Ohio, a corporation of Ohio

Application April 20, 1942, Serial No. 439,795

12 Claims. (Cl. 119—35)

The present invention relates to incubators and particularly to large incubators of the forced draft type in which many tiers of egg trays are housed in a single cabinet or chamber. This general form of incubator is old and well known in the art and the present invention is specifically directed to new and improved means of providing thorough and adequate circulation of air through the incubator and the maintenance of the proper temperature and humidity in the body of air which is kept in circulation through the egg chamber.

The maintenance of proper and exact humidity during incubation is one of the objects of the invention, and the incubator is designed particularly and especially to secure this result. It is also an object of the invention to provide means which will insure a constant correct temperature. The apparatus is designed particularly to prevent rise in temperature beyond the closely controlled limits which are deemed to be the optimum requirements for successful incubation. The apparatus, therefore, comprises in combination with a large chamber to hold the eggs, a control unit by which the exact degrees of humidity and temperature are maintained. For this purpose, in the preferred form of the invention there is a single cabinet or air conditioning unit which is designed to distribute air at the requisite temperature and humidity so that uniform conditions are found in all parts of the egg chamber. The machine is particularly designed so that it may be successfully operated during all ranges of outside temperature. This makes it possible to carry on commercially profitable operations in very warm climates and during the entire year. Year-round hatching has, in recent years, been found to be profitable and the incubator disclosed and claimed here is peculiarly adapted for this type of operation.

The principles and mode of operation are illustrated and described in connection with an incubating chamber or unit, that is to say, one in which hen eggs are incubated for a period of eighteen days or thereabouts, at which time they are to be removed to a separate hatching chamber where the humidity is raised in accordance with the process of the Stover Patent No. 1,911,-250. For this reason the invention is shown and described in conjunction with means for supporting and tilting incubating trays only, no hatching trays being shown, but principles of the invention may be incorporated in a unitary incubator and hatcher if the differential humidities of the Stover process are not to be employed. Therefore, when the terms "incubator" or "incubating chamber" are employed, it will be understood that the expression is intended to cover either type so far as may be practicable. The incubator is shown as the large or corridor type in which the operator goes inside the cabinet for setting or turning the eggs or for other necessary operations. This is not essential, however.

It will be understood that strict following of the detailed construction is not essential and may be altered or modified within the scope of the invention as set forth in the appended claims.

In the drawings, which illustrate the best known or preferred form of the invention:

Fig. 1 is a longitudinal section through a large incubator of the corridor type, showing the arrangement and location of the air conditioning unit and the air circulating fans along one side wall. Only a part of the complement of tilting egg trays is shown.

Fig. 2 is a transverse section on the line 2—2 of Fig. 1.

Fig. 3 is another transverse section on the line 3—3 of Fig. 1, taken immediately in front of the air conditioning unit on the back wall of the chamber.

Figs. 4 and 5 are enlarged sections on the lines 4—4 and 5—5 of Fig. 1, showing a fan and the means for feeding to the fan the increment of humidified and treated air which maintains the correct conditions within the chamber.

In the form of incubator shown herein, the side walls of the egg chamber or housing are indicated at 1, the main or true ceiling at 2, the rear wall at 3 and the front wall at 4 in which there is a door 5 through which access is had to the central corridor 6. These elements are of any usual or standard construction to give the necessary insulation from outside temperatures. Across the entire top of the chamber is located the false ceiling 8 which is spaced from the true ceiling to provide a large area or secondary chamber 9 which houses the body of properly heated and humidified air that is distributed to the various fans and thus added to the main body of air circulating in the incubating chamber. By adding increments of pretreated and conditioned air, the humidity and temperature in the main chamber are accurately controlled.

The rear wall is provided with an enlarged opening 10 at the end of the corridor and in this opening is positioned the air conditioning unit indicated generally by the numeral 12. The front of this unit opens into the corridor

where there is provided a removable panel 14 which permits access to the interior of the unit for cleaning or repair of instrumentalities within the air conditioning unit or box. Fig. 3 shows the device with the panel removed. Through the center of this unit 12 is a dividing wall 15 which extends up to the false ceiling, as shown in Fig. 1. There are thus provided a down passage 16 which leads from the large opening above the top of the panel 14 to the bottom of the unit and an up passage 17 which delivers the air which has passed through the unit to the space 9 between the true and false ceilings.

Air entering the passage 16 from the main body within the chamber passes downward over a coil 20 which is filled with water from a main supply line 21 at the lower end of the coil. This arrangement provides a normal supply of water for the humidifying system which is warmed by the air from the egg chamber. The water is circulated in a greater volume so that the coil becomes a cooling means for the incubator in the event the temperature in the incubator rises beyond the limits imposed by the automatic controls to be described. In the passage are located one or more water sprays, two being indicated at 22, which are fed from the branch line 23 supplied from the coil. The main water pipe 24 is led over the top of the conditioning unit and turns downwardly to discharge into the unit, a manually operated valve 25 being provided near the discharge point so as to regulate the stream which will flow through the coil when the coil is used for cooling purposes. In the line 24 is the control valve 26 which is opened when the temperature rises above the desired level by a thermostat in the egg chamber. In the line 23 is a similar valve 27 to control the spray, which valve is controlled by a humidostat located in the egg chamber. As the spray requires only a limited amount of water, a sufficient reservoir of preheated water will normally be retained in the coil.

At each side of the conditioning unit are valve-controlled openings 28, through which regulated amounts of fresh air are admitted to the air stream to freshen the air in the chamber. Sufficient foul air is permitted to pass out of the chamber through passages 30 located at the four corners of the chamber. These passages are flues leading to the outside, but one of the passages, indicated at 30a, is provided with a small bladed exhaust fan 32 of the common desk type. It will be found, depending on the direction of rotation of the main fans, that the pressure in two diagonally opposite corners of the chamber will be greater than in the other corners. The fan 32 is preferably placed in one of the high pressure corners and is designed to be operated when the temperature in the egg chamber rises abnormally, whereupon the fan 32 starts in rotation, drawing air out of the chamber. At the same time it will be found that the direction of the air will reverse in the low pressure outlets and they will then become air inlets which, in conjunction with the air entering through the inlets 28, serve to maintain the equilibrium between the pressure within and outside of the chamber.

In the main distributing chamber 9 and at the discharge point of the upward passage 17 are heating coils 33 located between insulating pads 34. By locating the heater at a point in the travel of the air beyond the sprays, better results are achieved than by locating the heater in the spray. As the heaters are removed from any metal part of the incubator, there are no elements to store residual heat and the whole system responds quickly to the cooling agents when the heat is shut off. As the air passes downward through the passage 16, it is humidified by the water sprays, the excess water being discharged through the drain 35. If the temperature in the chamber has risen above the desired point, the valve 26 is opened so that the water circulates in greater volume through the coil 20 and the temperature of the air is reduced to the desired point. The humidified (and at times cooled) air now turns upwardly through the passage 17, the upward movement of the air permitting any entrained droplets of water to fall to the bottom of the unit. The air now passes into the large chamber 9 which extends over the whole of the egg chamber, passing over the heating coils which will bring the air freed of any droplets of water up to the requisite temperature.

The operation of the cooling coil 20, fan 32 and the heater 33 is controlled by a group of three thermostats 36 of any standard electrical control type. One of these thermostats controls the heating elements 33, and another controls the valve 26 for the cooling coil and the exhaust fan 32. The third thermostat is used in the customary manner for the purpose of an alarm and for safety. From the thermostats, lines lead to a relay box 40 of standard construction, the details of which need not be described. From this box a line 40a leads to the heaters 33 and a second line 40b leads to the valve 26 and the exhaust fan 32. If the temperature in the egg chamber drops slightly, the appropriate thermostat automatically turns on the heaters 33 until the correct temperature is restored in the egg chamber. If the temperature in the egg chamber rises above the desired limit, due perhaps to too high outside temperature or to the fact that many eggs may be approaching the eighteenth day and thus giving off an excess of heat, the appropriate thermostat turns on the valve 26 and at the same time starts up the exhaust fan. If the excess heat is not immediately controlled for some accidental cause, the third thermostat then comes into play.

At a convenient point, here shown as the back wall, is located the usual visual wet and dry bulb thermometer unit, indicated at 38, and also a humidostat in the form of a wet bulb thermometer with electrical controls, indicated at 39. This humidostat is connected to the valve 27 which controls the spray. Any other well known type of humidity responsive element may be employed. Normally the spray will be turned on, but should the humidity rise to too high a degree, the humidostat will close the valve 27 and shut off the sprays until the humidity falls to the desired point.

It will thus be seen that the desired humidity and temperature within the egg chamber are maintained by the addition to the main body of air of freshened air from the chamber 9 at the requisite humidity and temperature to keep those factors of humidity and temperature at the proper point in the egg chamber.

The body of humidified air at the requisite temperature occupies the space 9 above the egg chamber from which it is supplied to all of the main fans, as will now be described. In the form of the invention shown, there are located

on each side wall, four large fans, indicated at **45**, which are placed as closely together as necessary clearances will permit. Each main fan consists of a number of long flat blades and is driven by a motor **46** through a reducing worm gear so that in normal operation they rotate at approximately 90 R. P. M. Each motor is set in an embrasure **47** in the side wall. As the fans are about 40 inches in diameter, they exert a powerful action on the air and effectively maintain the whole body of the air in the chamber in violent agitation. Fans of this type when set closely to a wall, as these are, will draw air into the center or eye of the fan and discharge at the periphery of the fan. Most of the air which is drawn into the fans comes from the main chamber, but a portion of the air will also be drawn from the chamber **9**, so that the conditioned air will be commingled with the main body of air in the egg chamber and thus serve to maintain the air in the egg chamber at the proper humidity and temperature.

From the chamber **9** extends to each fan a vertical flue **48** which leads to the embrasure **47** and discharges the air through a funnel or housing **50**. The shaft of the motor is extended into the mouth of the housing where it carries a fan of the impeller type, indicated at **52**. As the impeller fan **52** is mounted directly on the motor shaft, it rotates at high speed (approximately 1700 R. P. M.) and draws the air from the chamber **9** through the flue. The housing **50** partially surrounds the fan **52**, but opens to the rear so that the fresh conditioned air is discharged into the embrasure from which it is drawn into the center of the main circulating fan **45**.

As each of the eight circulating fans **45**, which constitute the equipment for the incubator shown herein, is connected to a flue **48** and to a fan **52**, it will be seen that the body of correctly conditioned air in the chamber **9** is distributed to all of the fans. The distribution of the conditioned air is approximately equal to all of the fans, and the violent agitation of the whole body of air in the chamber, replenished at many points from a single body of conditioned air, will give uniform conditions of temperature and humidity throughout the whole chamber. Accurate tests conducted in an incubator of the type shown have shown a remarkable absence of hot or cold spots in the chamber and the humidity has been found to be uniform throughout.

The tilting egg racks are indicated at **55**, ranged in tiers along the side walls of the egg chamber in front of the fans. They may be of any preferred type and provided with any standard turning mechanism. As shown, the trays are all tilting, which indicates that incubation only is performed. If the incubator is to be used for both incubating and hatching, a portion of the tilting trays should be replaced by stationary hatching trays.

It is desirable, in operating this incubator, to set the eggs in the customary staged incubation so that more or less of a balance between endothermic and exothermic eggs will be maintained. In the incubator shown herein, however, care need not be exercised to set the eggs in exact ratios of old and new eggs or to distribute the eggs through the chamber as to ages as the automatic controls in combination with the distribution of the conditioned air will prevent the formation of hot or cold spots around eggs of the same ages.

It has been found that incubators made in accordance with this invention give universally satisfactory results and the loss of fertile eggs through improper conditions in the egg chamber is substantially eliminated. This highly beneficial result is obtained because of the uniform distribution of streams of conditioned air at the proper humidity and temperature from a single body of air to the individual fans, by which the increments of freshened, properly humidified air at the correct temperature are added to the main body of air at numerous points and thoroughly admixed therein. It is also due to the accurate and automatic control of humidity and temperature which prevents either too high or too low temperatures or excess or deficiency of humidity.

What is claimed is:

1. In an incubator having an egg chamber, fans on the walls of the egg chamber, a secondary chamber to house a body of humidified air at the desired temperature, ducts leading from the secondary chamber to the intake areas of the several fans, and impellers to draw the air from the secondary chamber through the ducts and deliver it directly to the several fans.

2. In an incubator having an egg chamber, fans on the walls of the egg chamber, fan driving means, a secondary chamber to house a body of humidified air at the desired temperature, ducts leading from the secondary chamber to the intake areas of the several fans, and impellers driven by the fan driving means and located at the discharge end of the ducts to draw the air from the secondary chamber through the ducts and deliver it directly to the several fans.

3. An incubator comprising an egg chamber, a false ceiling over the egg chamber to form a secondary chamber, means to conduct air from the main chamber to the secondary chamber, means to humidify the air and raise or lower its temperature while it is passing to the secondary chamber, fans located on the side walls of the egg chamber, and conduits leading from the secondary chamber to the several fans.

4. An incubator comprising an egg chamber, a false ceiling over the egg chamber to form a secondary chamber, means to conduct air from the main chamber to the secondary chamber, means controlled by the air conditions in the egg chamber to humidify the air and raise or lower its temperature while it is passing to the secondary chamber, fans located on the side walls of the egg chamber, and conduits leading from the secondary chamber to the several fans.

5. An incubator comprising an egg chamber, a false ceiling over the egg chamber to form a secondary chamber, means to conduit air from the main chamber to the secondary chamber, means controlled by the air conditions in the egg chamber to humidify the air and raise or lower its temperature while it is passing to the secondary chamber, fans located on the side walls of the egg chamber, conduits leading from the secondary chamber to the several fans, and air impellers located in the conduits.

6. An incubator comprising an egg chamber, fans within the egg chamber to maintain the whole body of air therein in constant agitation, an air conditioning unit comprising a cooler, means to create a spray located in the unit, means to withdraw a portion of the body of air from the egg chamber and conduct it over the cooler and through the spray, a heater in the path of the air after it passes the spray and has been freed of droplets of water, means to control

the operation of the spray automatically controlled by the humidity of the air in the egg chamber, means to return the treated air to the main body of air in the egg chamber, and means to control the heater and the cooler automatically controlled by the temperature in the egg chamber.

7. An incubator comprising an egg chamber, an air conditioning unit comprising a cooler, means to create a spray located in the unit, means to conduct a portion of the air in the egg chamber over the cooler and through the spray, a heater in the path of the air after it passes the spray and has been freed of droplets of water, means to control the operation of the spray controlled by the humidity of the air in the egg chamber, means to control the heater and the cooler controlled by the temperature in the egg chamber, fans in the egg chamber, and means to conduct the treated air from the unit to the several fans.

8. An incubator comprising an egg chamber, fans in the egg chamber, an air conditioning unit communicating with the egg chamber, said unit being provided with means controlled by the temperature and humidity of the air in the egg chamber to humidify the air in the unit and to heat or cool it dependent upon the temperature in the chamber, a plurality of air outlets in the egg chamber, an exhaust fan in one of said outlets, means responsive to the temperature within the egg chamber to operate the exhaust fan when the temperature in the egg chamber rises above a predetermined point, and means to return the air from the unit to the fans in the egg chamber.

9. An incubator comprising an egg chamber, fans in the egg chamber, an air conditioning unit in communication with the egg chamber, said unit being provided with means to heat or cool the air, means to operate the heater or cooler in accordance with the temperature in the egg chamber, an exhaust fan in the egg chamber, said exhaust fan and cooler operating simultaneously, means to humidify the air in the unit, and conduits to return the air from the unit to the fans in the egg chamber.

10. An incubator comprising an egg chamber, an air conditioning unit in communication with the egg chamber, said unit being provided with means to heat or cool and humidify the air, means to operate the heater or cooler in accordance with the temperature in the egg chamber, an exhaust fan in the egg chamber, said exhaust fan and cooler operating simultaneously, means to humidify the air in the unit, fans in the egg chamber, and conduits to return the air from the unit to the intake areas of the several fans.

11. An incubator comprising an egg chamber, a plurality of fans in the egg chamber, a secondary chamber, means to conduct a portion of the air from the egg chamber to the secondary chamber, means to condition the air which is withdrawn from the egg chamber by humidification and cooling or heating controlled by the humidity and temperature of the main body of air in the egg chamber, separate return conduits leading from the secondary chamber to the intake areas of the several fans, a foul air outlet from the egg chamber, and means to accelerate the outward passage of air through the outlet actuated by the rise of temperature in the egg chamber.

12. An incubator comprising an egg chamber, a plurality of fans in the egg chamber, a secondary chamber, means to conduct a portion of the air from the egg chamber to the secondary chamber, means to condition the air which is withdrawn from the egg chamber by humidification and cooling or heating controlled by the humidity and temperature of the main body of air in the egg chamber, separate return conduits leading from the secondary chamber to the intake areas of the several fans, a foul air outlet from the egg chamber, and means operative concurrently with the cooling means to accelerate the outward passage of air through the outlet actuated by the rise of temperature in the egg chamber.

JOSEPH I. TAGGART.