June 7, 1932. J. F. MacKAY 1,861,746

INCUBATOR

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FIG. I.

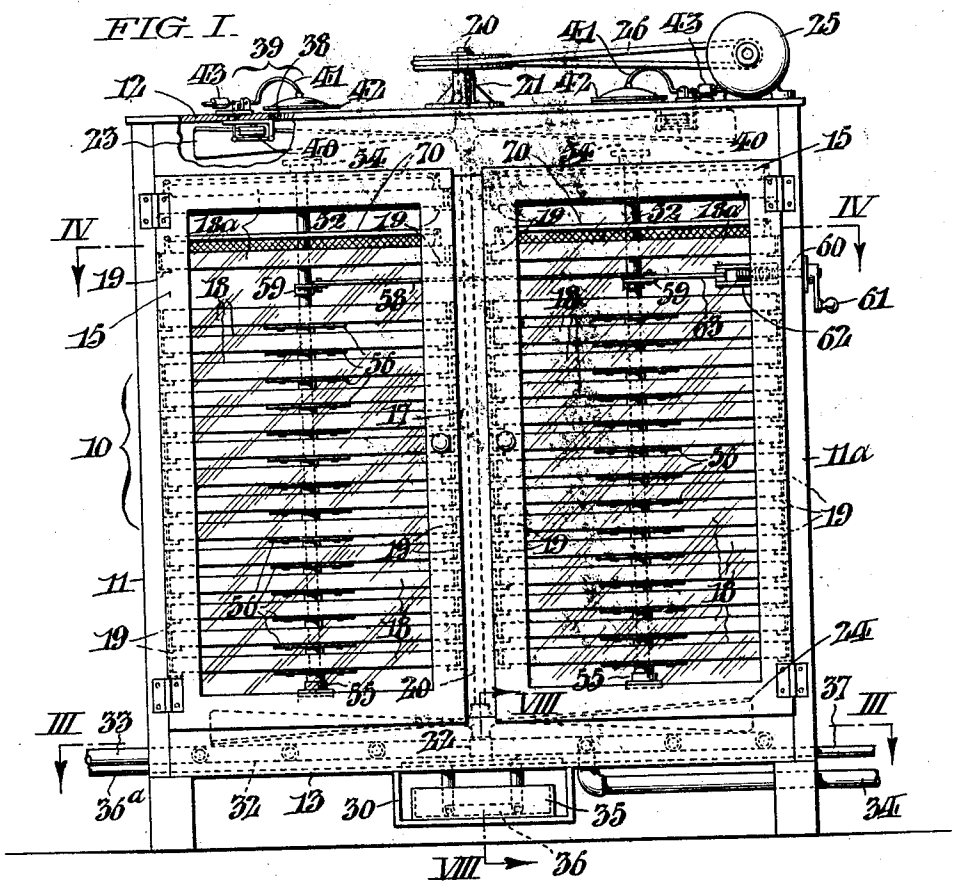
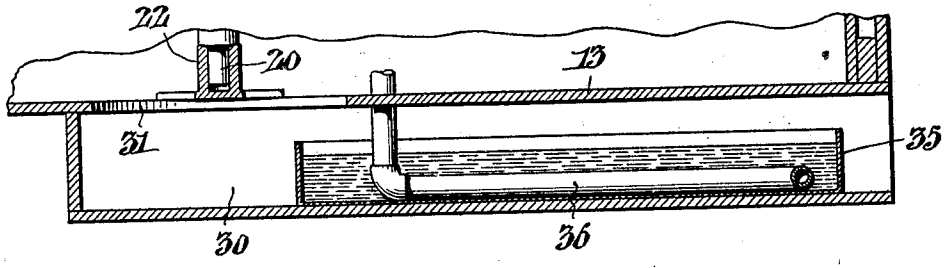



FIG. VIII.




WITNESSES

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INCUBATOR

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FIG. II.

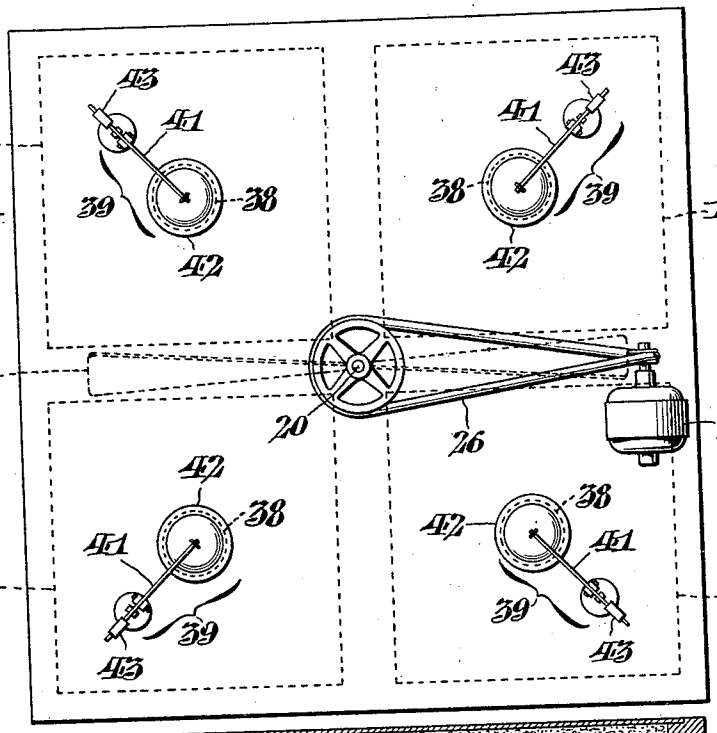
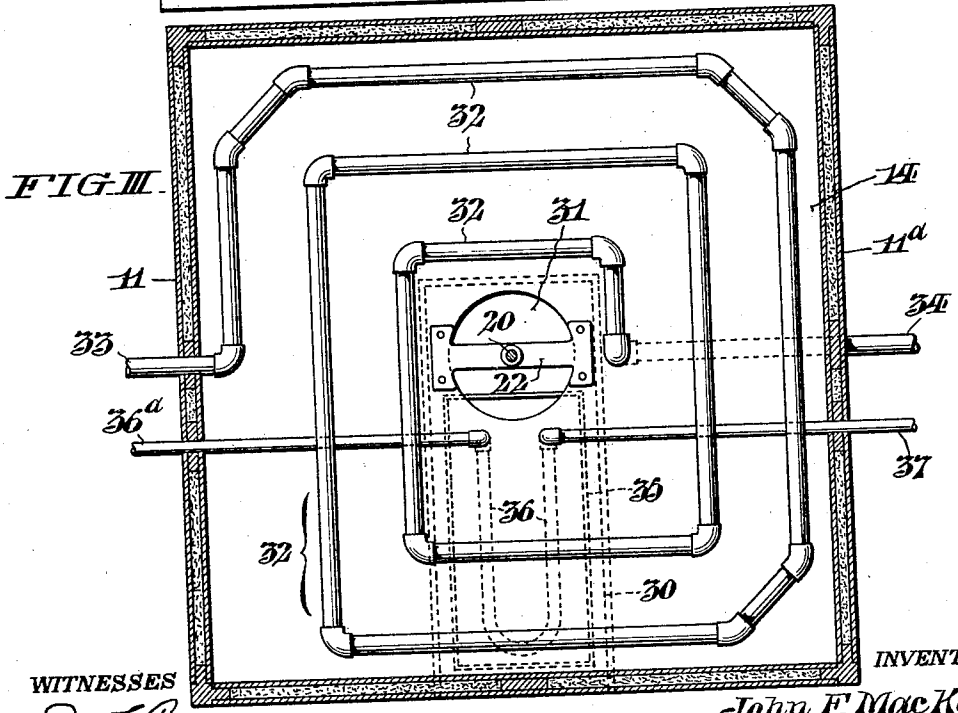



FIG. III.




WITNESSES

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INCUBATOR

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FIG. IV.

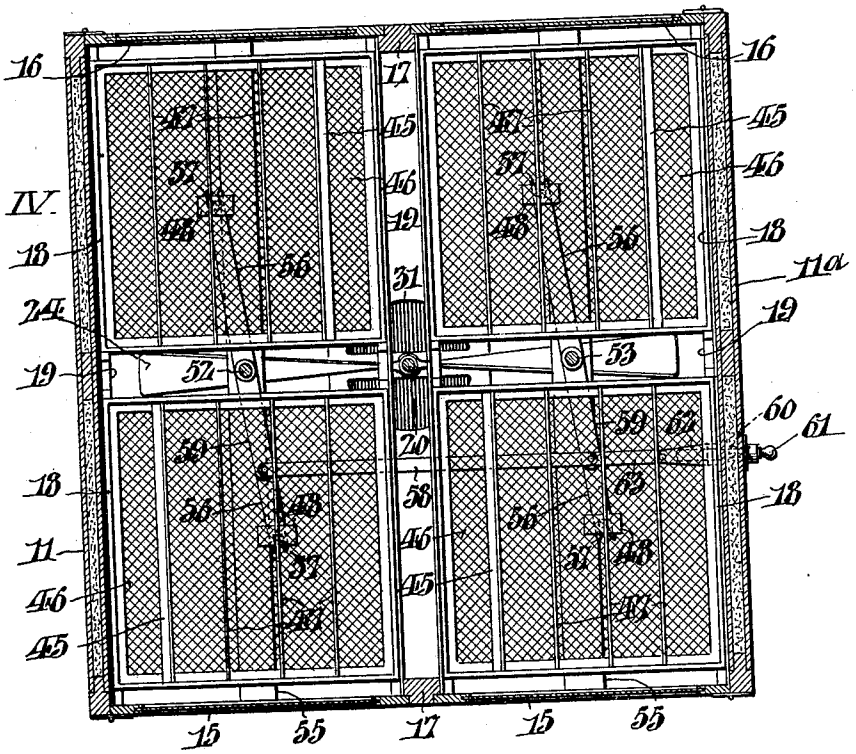



FIG. V.

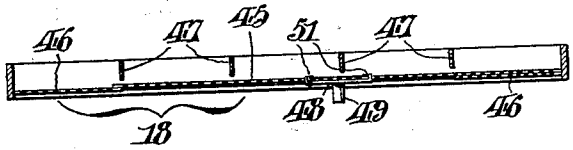



FIG. VI.

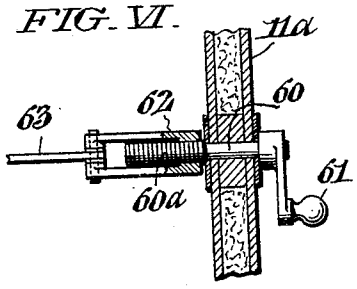
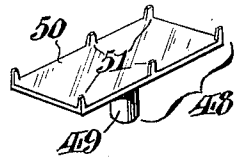



FIG. VII.




WITNESSES

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Patented June 7, 1932

1,861,746

# UNITED STATES PATENT OFFICE

JOHN F. MacKAY, OF LANCASTER, PENNSYLVANIA

## INCUBATOR

Application filed January 7, 1928. Serial No. 245,077.

This invention relates to incubators, more particularly to upright or "cabinet" incubators wherein a multiplicity of egg trays are arranged in superposed relation, as distinguished from the type of incubators in which individual chambers for the egg trays are disposed in horizontal sequence.

In connection with an incubator of the specific type referred to I aim to provide for continuous turbulence of the air, within the incubating chamber, to the avoidance of forced circulation over any definite or prescribed course past the eggs in the several trays, and with preclusion of dead air spaces or "pockets" at the corners of said incubating chamber. In other words, I aim to maintain the air within the incubator in a state of gentle agitation for impingement upon the eggs from different directions so that they are all accorded exactly the same treatment during the entire incubating period with pre-assurance of timely hatching and of the maximum yield from the batch.

Another object of my invention is to provide for uniform and efficient heating and humidification of the air, agitated in the manner described within the incubator; as well as for compensative replacement of the carbonized or foul air, under automatic regulation, by fresh air from the exterior.

How the foregoing and other objects and advantages may be readily realized in practice will be manifest from the detailed description which follows of the typical embodiment of my invention illustrated in the drawings, whereof Fig. I is a front elevation of the incubator with a portion broken out and in section to show certain details at the interior.

Fig. II is a top plan view of the structure.

Fig. III is a plan-sectional view through the lower part of the incubator, taken as indicated by the arrows III—III in Fig. I, and showing the location of the heating means.

Fig. IV is a plan-section at a higher plane than the preceding illustration, or as indicated by the arrows IV—IV in Fig. I, showing more particularly the means whereby the eggs are turned in the trays.

Fig. V is a sectional view of one of the egg trays on a somewhat larger scale.

Fig. VI is a fragmentary sectional view featuring some of the details associated with the egg-turning mechanism.

Fig. VII is a perspective view of one of the actuating lug members, which I provide for use in connection with the trays to effect turning of the eggs in them; and

Fig. VIII is a detail sectional view taken as indicated by the arrows VIII—VIII in Fig. I, and drawn to a larger scale.

With reference first more especially to Figs. I, II, III and IV, it will be observed that my improved incubator comprises an enclosure 10 of the upright or cabinet type with insulated side walls 11, 11*a*, a top 12, and a bottom 13, jointly affording a chamber 14 within for the purposes of incubation. This chamber 14 is closed at the front and back of the structure by double doors indicated at 15, 16, in Figs. I and IV, said doors closing against upright jambs or posts 17 extending from the top 12 to the bottom 13. As shown in Figs. II, III and IV, the cabinet 10 is square in plan and of ample area to accommodate a multiplicity of vertically-spaced egg trays 18 grouped, in the present instance, into four symmetrically-arranged stacks with pairs of such stacks accessible from opposite sides of the enclosure through the doors 15, 16. The trays 18 are slidingly supported upon transversely-extending angle guides 19, whereof the outer ones are secured to the side walls 11 of the enclosure, while the inner ones are secured at opposite ends to the jamb posts 17. The upper two trays 18*a* of each stack are reserved for hatching and are therefore spaced further apart vertically than the others.

Extending down through the incubator in the midst of the four tray stacks, is a shaft 20 having journal support at the top of the structure in a bearing 21, and, at the bottom, in a bearing 22. Within the chamber 14 the shaft 20 carries a pair of rotary fans 23, 24, the first of these being disposed immediately below the top 12, and the latter directly above the bottom 13. As shown, the fans 23, 24 are reversely pitched so as to oppose each other and thereby agitate the air for passage through and about the trays without setting up any definite course of circulation. The fans 23, 24 are constantly driven by an electric motor 25, mounted on the top 12 of an incubator structure, through a belt 26. In practice the speed of the fans 23, 24 is so regulated that the agitation induced by them is very gentle with impingement of the air lightly upon the eggs from all directions to the advantage of insuring uniform treatment throughout the period of incubation. The opposing action of the fans 23, 24 is further advantageous in that dead air spaces or pockets at the corners of the chamber 14, and round the corresponding portions of the egg trays 18 in the several stacks are effectively avoided.

Fresh air enters the incubator at the bottom through a duct 30 which is open at the front of the structure and extends rearward for communication with a circular opening 31 in the bottom 13. The fresh air is thus conducted to the middle of the lower fan 24 for distribution upward centrally of the tray stack group in the chamber 14, as well as radially outward toward the sides of said chamber. Incidental to agitation by the fan 24, the air is heated through contact with heating means in the form of a pipe coil 32 (Fig. III) in the bottom of the chamber 14, said pipe coil having its convolutions in a common horizontal plane and its terminals 33, 34 extending to a suitable heater (not shown) for steam or hot water.

In order to insure provision of the requisite amount of moisture for successful incubation, I place within the fresh air inlet duct 30, a water tray 35 which is heated by an auxiliary pipe coil 36 which may be connected through the leads 36*a*, 37 to the same heater which serves the coil 32.

Exhaust of the carbonized or foul air from the chamber 14 takes place through outlets 38 located in the top 12 of the cabinet 10, one directly over the center of each of the four tray stacks. Such exhaust is automatically controlled, after common practice in this art, by thermostatic regulators of a conventional type, such as comprehensively designated by the numeral 39 in Figs. I and II. As shown, each of these regulators 39 comprises a wafer thermostat 40 (Fig. I) located within the chamber 14, and effective upon a lever 41, which, at one end carries a damper 42 over the opening 38, and at the other end, a counter balance-weight 43 so as to be responsive immediately to very light changes of temperature within the incubator.

As shown in Figs. IV and V, the trays 18 are of the type embodying a shiftable egg-turning bottom section 45 constructed of wire mesh with reinforced edges, said section moving over similarly-constructed fixed end-filler pieces 46. Each tray 18 is also equipped at intervals with removable cross bars 47 to prevent bodily movement of the eggs incidental to being turned through shifting of the bottom section 45—all as well understood in the art. For the purpose of actuating the sliding bottom sections 45 of the trays 18, I provide lug members 48, one of said members being illustrated in perspective in Fig. VII. Each lug member 48 has a projection 49 depending from an anchorage plate 50 with a number of upstanding tongues 51 adapted to penetrate the wire mesh of the sliding bottom section 45 of the tray 18 and to be bent over in opposite directions to secure the lug member 48 in place, as shown in Fig. V.

The mechanism for turning all the eggs in the trays 18 at one time includes a pair of vertical shafts 52, 53 which are located in the intervals between the two tray stacks at each side of the structure, said shafts having journal bearing top and bottom in beams 54, 55 extending transversely of the chamber 14 respectively beneath and above the fans 23, 24. From Figs. I and IV it will be observed that the shafts 52, 53 are equipped with double arms 56 whose extremities reach horizontally outward in opposite directions through the interspaces between the egg trays 18 of contiguous (with regard to front and rear of the structure) stacks. These arms 56 have their outer ends bifurcated as at 57 (Fig. IV) to engage the depending projections 49 of the lug members 48 on the movable bottom sections 45, of the trays 18. Referring again to Figs. I and IV, it will be noted that the shafts 52, 53 are co-ordinated for concurrent actuation by a coupling bar 58, which connects a pair of auxiliary arms 59 secured to them. Journaled for rotation in the right hand wall 11*a*, of the cabinet 10, is a shaft 60 to the outer or protruding end of which is secured a crank handle 61. The inner end of this shaft 60 is threaded as at 60*a* to engage a follower 62 having a link connection 63 with the bar 58. By rotating the crank handle 61 in one direction or the other, it will be obvious that, through the various interposed connections just described, the sliding bottom sections 45 of the trays 18 will be correspondingly shifted with resultant simultaneous turning of all the eggs in the incubator; those in the hatching trays 18 being, of course, excepted.

In order to convert the ordinary egg trays 18 into the nursery trays 18*a*, I employ fenc-

ing inserts, such as shown at 70 in Fig. I. The insert 70 is so proportioned as to fit within the frame of a tray 18, so as to be retained in position upon removal of the cross bars 47 previously referred to. As shown, the insert 70 is sufficiently high to act as a barrier and prevent the newly hatched chicks from falling out of the tray 18.

In the operation of my invention, the fresh air, as it traverses the duct 30, absorbs moisture given off from the water in the pan 35 under the action of the heating coil 36. Thus humidified, the air enters the chamber 14 by way of the central inlet opening 31 through the bottom 13, and encounters the medial portion of the lower fan 24, being thereby urged in part horizontally outward in all directions in the interval occupied by the fan 24 between the heating coil 32 and the lowermost trays 18 of the several stacks. As a consequence of commingling with the warm atmosphere within the chamber 14 and through contact with the several convolutions of the coil 32 around the opening 31, the incoming air is quickly heated. Under the opposing action of the fans 23, 24 the air is agitated gently so as to pass through and around the trays 18, 18*a* to the avoidance of air pockets at the corners of the chamber 14. By the consequent vari-directional impingement of the conditioned heated air, upon the eggs, it will be seen that treatment throughout the incubation period is attended by absolute uniformity with preassurance of a timely hatch and a maximum yield from the batch under treatment. There is, of course, a circulation of air induced in the incubator upward from the inlet opening 31, the flow being obliged to divide and traverse the several tray stacks enroute to the exhaust outlets 38 in the top 12 of the structure; but such circulation is obviously ineffective as regards influence upon the turbulence set up by the fans 23, 24. As a matter of fact, the characteristic action of the fans 23, 24 will, in a regulatory manner, check the circulation of the air upward through the chamber 14, this being particularly true of the upper fan 23 revolving in the horizontal interval between the uppermost trays 18*a* in the stacks and the top 12 of the incubator. Such regulation is, however, subordinate to that afforded by thermostatic control of the flow through the outlets 38 by the devices 39 in accordance with temperature conditions prevailing within the chamber 14, and as influenced to varying extents by the increasing amount of animal heat contributed by the eggs as incubation progresses. Throughout the incubation period the eggs are periodically turned at regular intervals, after established practice, by turning the crank handle 61 first in one direction and then in the other, as already explained.

Having thus described my invention, I claim:

1. An incubator embodying an enclosure to house a multiplicity of egg trays in symmetrically-arranged stationary columns, and reversely-pitched fans operative in planes above and below said columns to gently agitate the air within the enclosure for passage through and about the egg trays to the avoidance of forming air-pockets at the corners of the enclosure.

2. An incubator embodying an enclosure to house a multiplicity of egg trays in symmetrically-arranged relatively-spaced stationary columns, and reversely-pitched horizontally-rotating fans respectively above and below the columns of trays operative to gently agitate the air outwardly in all directions within the enclosure for passage through and about said trays to the avoidance of setting up air-pockets at the corners of the enclosure.

3. An incubator embodying an enclosure to house a multiplicity of egg trays in stationary columns symmetrically-arranged relative to a vertical axis centrally of said columns, reversely-pitched propeller fans concentric with said axis and operative in planes above and below the columns to gently agitate the air in all directions within the enclosure for passage through and about the egg trays without setting up any air-pockets at the corners of said enclosure.

4. An incubator embodying an enclosure to house a multiplicity of egg trays in stationary columns symmetrically-arranged about a vertical axis centrally of said columns, and reversely-pitched horizontally-rotative fans concentric with said axis above and below said trays operating to gently agitate the air within the enclosure for vari-directional passage through and about the egg trays without setting up any air-pockets at the corners of the enclosure.

5. An incubator embodying an enclosure to house a multiplicity of egg trays in stationary columns symmetrically-arranged around a vertical axis centrally of said columns, a number of reversely-pitched rotary fans respectively located above and below the stacks and operating in opposition to one another to gently agitate the air in all directions within the enclosure for vari-directional passage through and about the egg trays without setting up any air-pockets at the corners of the enclosure, and means to rotate said fans.

6. An incubator embodying an enclosure to house a multiplicity of vertically-spaced egg trays in symmetrically-arranged stationary stacks, a shaft extending down through the midst of the tray stacks, and horizontally-rotative fans secured to the shaft above and below the trays to agitate the air within the enclosure.

7. An incubator embodying an enclosure to

house a multiplicity of vertically-spaced egg trays in symmetrically-arranged stationary stacks, a shaft extending down through the midst of the tray stacks, and reversely-pitched horizontally-rotative fans secured to the shaft above and below the trays for operation in opposition to agitate the air within the enclosure.

8. An incubator embodying an enclosure to house a multiplicity of vertically-spaced egg trays in perpendicular stacks, said enclosure having an inlet in its bottom admitting fresh air centrally of the tray stack group, and exhaust outlets in its top, one centrally over each tray stack, means for heating the air within the enclosure, reversely-pitched fans on a common shaft for agitating the air within the enclosure, and thermostatic control means to govern flow through the exhaust outlets aforesaid.

9. An incubator embodying an enclosure to house a multiplicity of egg trays in symmetrically-arranged stationary stacks, heating means within the enclosure below said stacks, and reversely-pitched fans rotative above and below the trays to agitate the air heated by the heating means horizontally outward in all directions to the avoidance of forming air-pockets at the corners of the enclosure.

10. An incubator embodying an enclosure to house a multiplicity of vertically-spaced stationary stacks of egg trays symmetrically-arranged relative to a vertical axis centrally of such stacks, said enclosure having a subjacent fresh air duct open at the front of the structure with an inlet centrally of the incubator bottom, and a heating coil with its convolutions around the central air-inlet opening from said subjacent duct and lying in a horizontal plane at the bottom of the enclosure beneath the egg trays.

11. An incubator embodying an enclosure to house a multiplicity of trays vertically-spaced in symmetrically-arranged stacks, said enclosure having a subjacent fresh air conduit with an inlet opening centrally of the incubator bottom, a heating coil with its convolutions around the fresh air inlet opening and lying in a horizontal plane at the bottom of the enclosure, and reversely-pitched rotary fans on a vertical axis coincident with that of the opening aforesaid adapted to propel the heated air outward in all directions and one of said fans occupying a horizontal interval between the heating coil and the trays and the other fan being located above the latter.

12. An incubator embodying an enclosure to house a multiplicity of vertically-spaced egg trays in symmetrically-arranged stacks, said enclosure having a subjacent conduit leading to an inlet opening in the incubator bottom to admit fresh air centrally of the tray stack group, a heating coil with its convolutions around the fresh air inlet opening and lying in a horizontal plane at the bottom of the enclosure, and reversely-pitched propeller fans on a common rotary shaft coincident with that of the opening aforesaid adapted to propel the heated air outward in all directions and one of said fans occupying a horizontal interval between the heating coil and the nethermost trays of the several stacks with the other fan located above the latter.

13. An incubator embodying an enclosure to house a multiplicity of vertically-spaced egg trays in symmetrically-arranged stacks, said enclosure having an inlet opening in its bottom admitting fresh air centrally of the tray stack group, and exhaust outlet openings in the top centrally over each stack, a heating coil with its its convolutions around the fresh air inlet and lying in a horizontal plane at the bottom of the enclosure, a rotary fan revolving on a vertical axis coincident with that of the opening aforesaid occupying a horizontal interval between the heating coil and the nethermoost trays of the several stacks, and an opposing rotary fan in line with the first and occupying a horizontal interval between the uppermost trays of the stacks and the top of the enclosure.

14. An incubator embodying an enclosure to house a multiplicity of vertically-spaced egg trays in symmetrically-arranged stationary stacks, said enclosure having an inlet in its bottom admitting fresh air centrally of the tray stack group, reversing-pitched fans respectively above and below the stacks and rotative on a common axis for agitating the air in all directing to the avoidance of forming dead-air pockets in the enclosure, a horizontal fresh air duct open at one side of the incubator and communicating with the inlet aforesaid, a moisture pan in said inlet, and means in said pan whereby the entering fresh air is humidified.

15. An incubator embodying an enclosure to house a multiplicity of vertically-spaced egg trays in symmetrically-arranged stationary stacks, said enclosure having an inlet in its bottom admitting fresh air centrally of the tray stack group, a horizontal fresh air duct open to one side of the incubator and communicating with the inlet aforesaid, reversely-pitched fans respectively above and below the stacks and rotative on a common axis for agitating the air in all directions to the avoidance of forming dead-air pockets in the enclosure, a moisture pan in the fresh air duct, and a pipe coil in said pan for heating water therein to effect humidification of the entering fresh air.

16. An incubator embodying an enclosure to house a multiplicity of vertically-spaced egg trays in symmetrically-arranged stationary stacks, said enclosure having an inlet in its bottom admitting fresh air centrally of the tray stack group, reversely-pitched fans respectively above and below the stacks and

rotative on a common axis for agitating the air in all directions to the avoidance of forming dead air pockets in the enclosure, a horizontal pipe coil within the enclosure having its convolutions around the fresh air inlet and proximate the incubator bottom, a fresh air duct open at one side of the incubator and communicating with the inlet, a moisture pan in said fresh air inlet, and an auxiliary pipe coil in said pan to heat the water therein to effect humidification of the entering fresh air.

In testimony whereof, I have hereunto signed my name at Philadelphia, Pennsylvania, this 3rd day of January, 1928.

JOHN F. MacKAY.