Sept. 12, 1933. P. S. MARTIN 1,926,295

VENTILATION

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FIG. I.

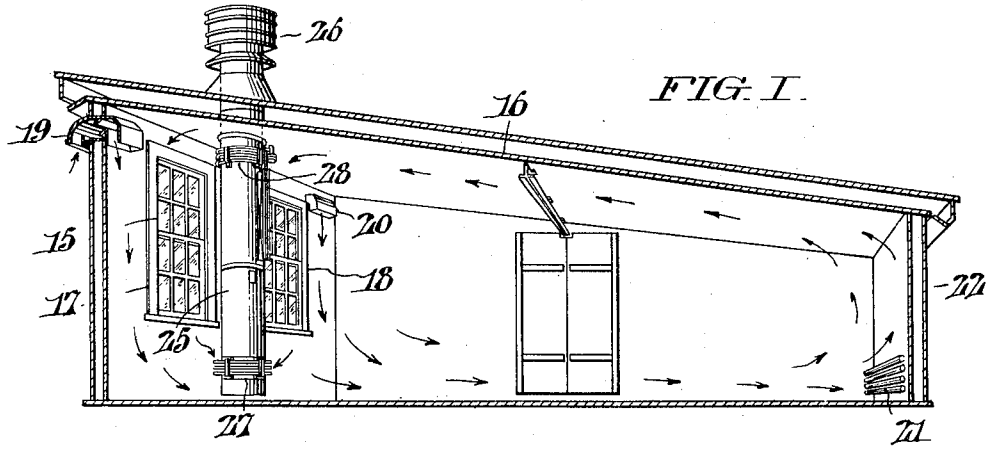


FIG. VII.

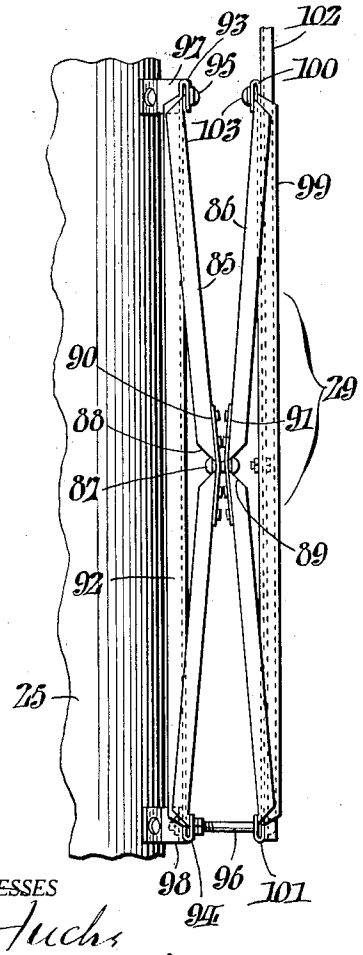
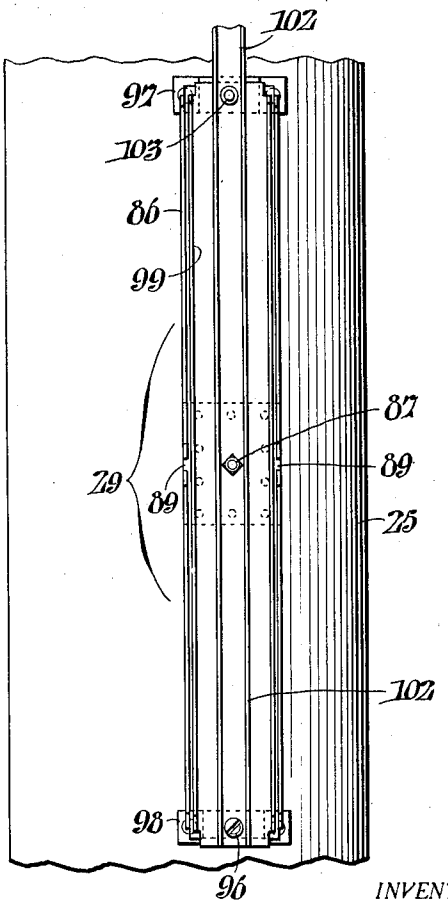


FIG. VIII.



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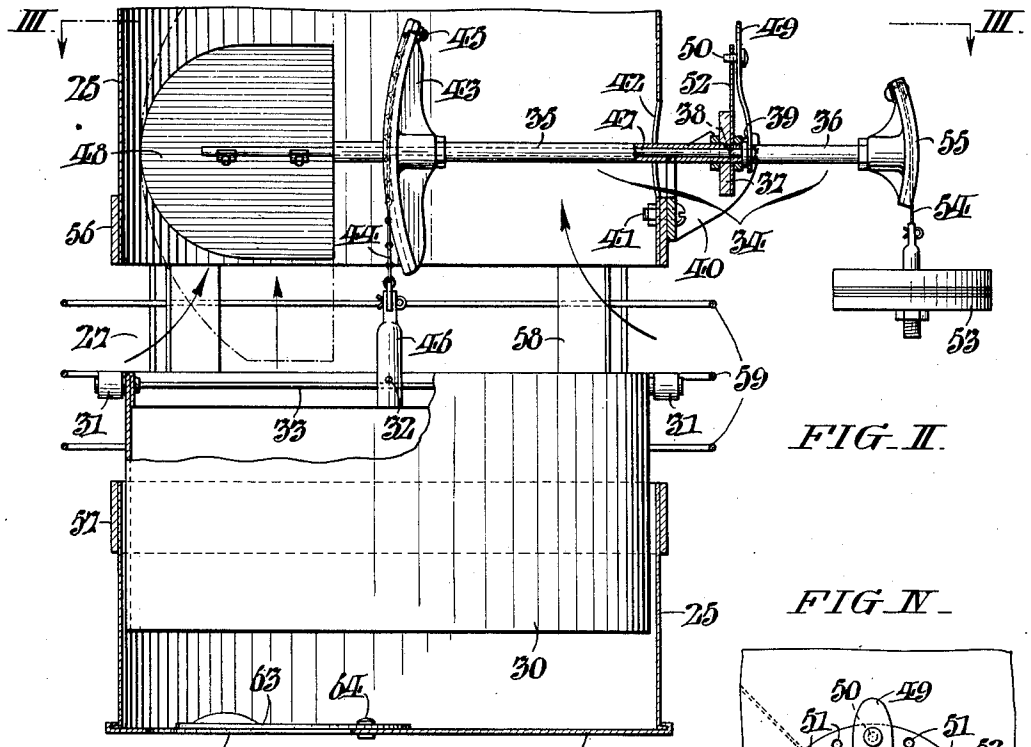


FIG. II.

FIG. IV.

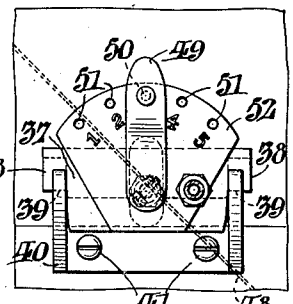


FIG. III.

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VENTILATION

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FIG. V.

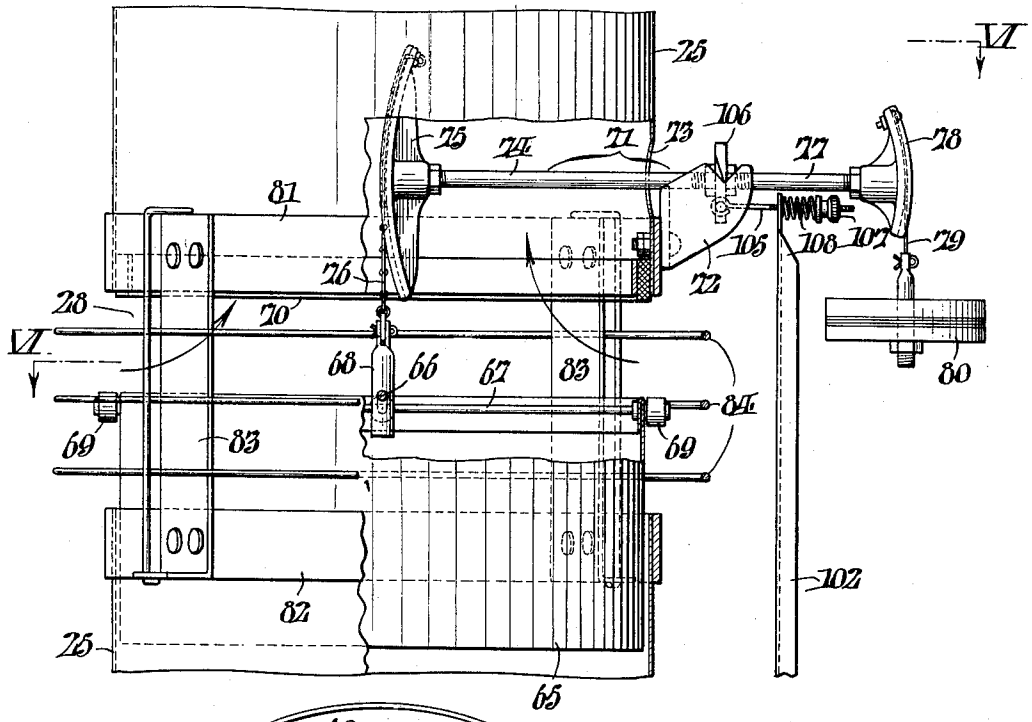
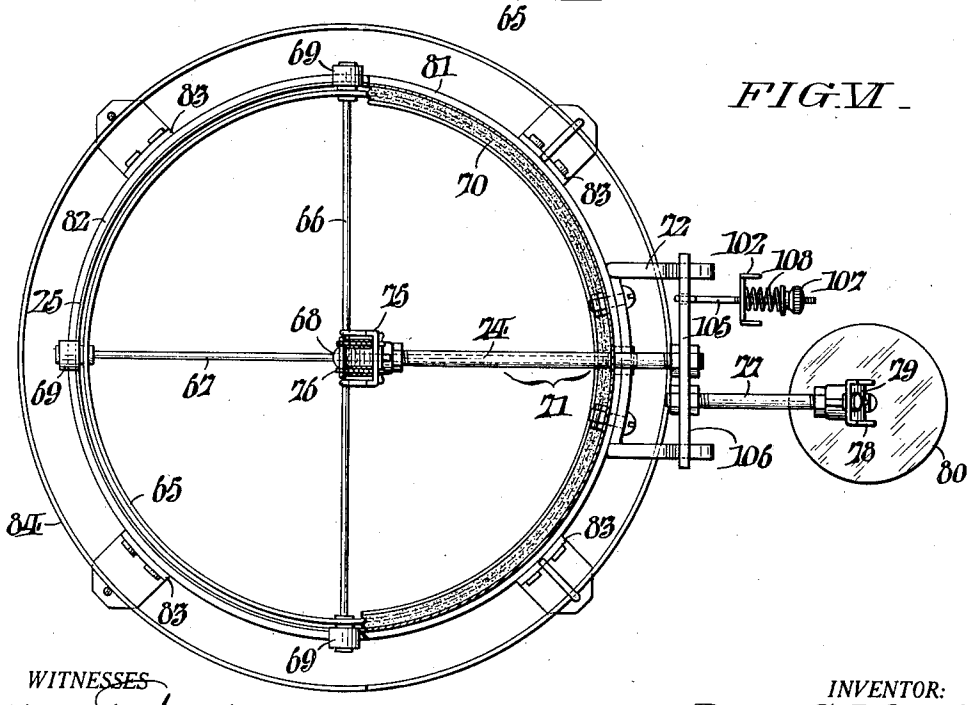


FIG. VI.



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VENTILATION

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FIG. IX.

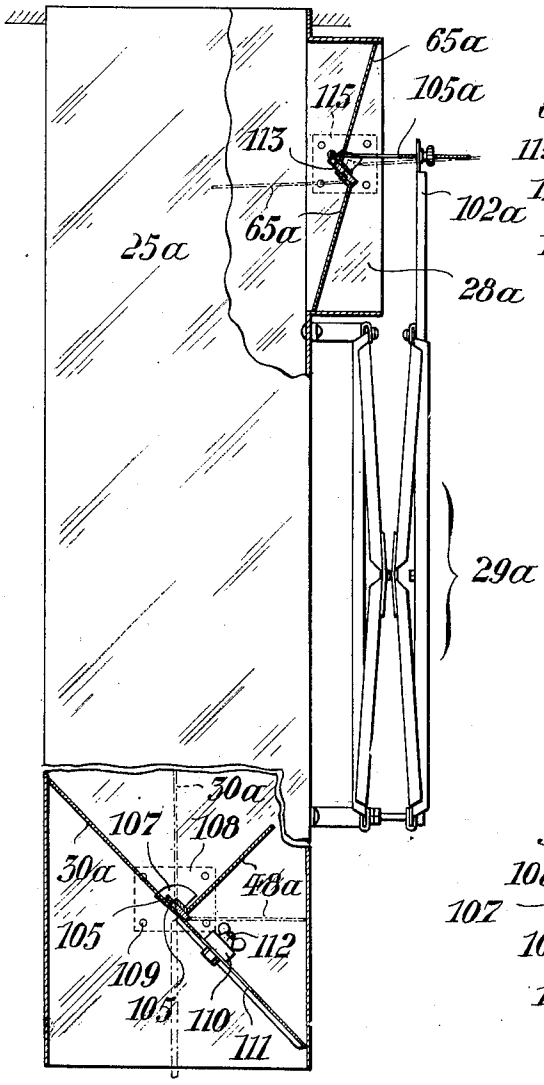


FIG. X.

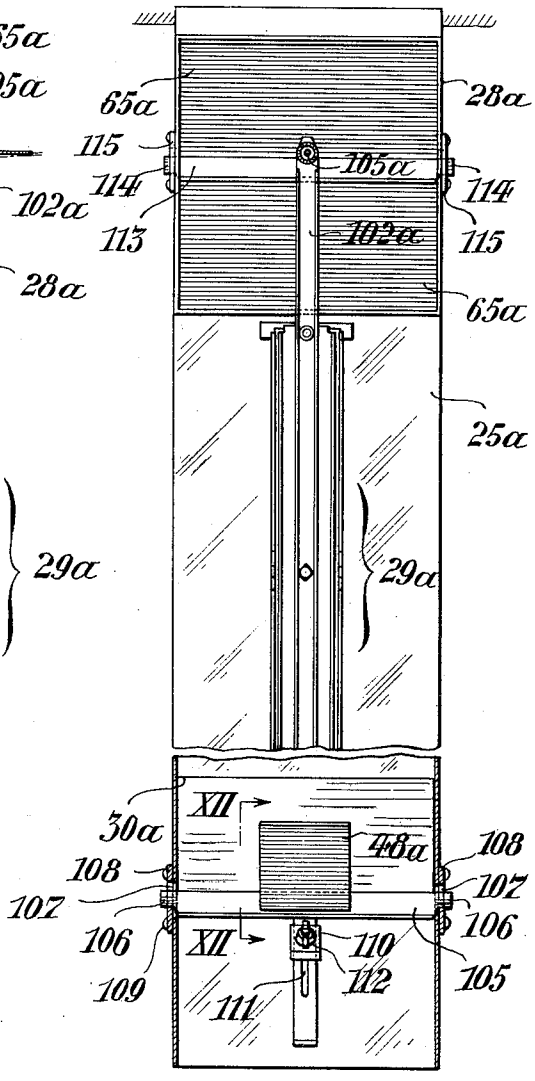


FIG. XI.

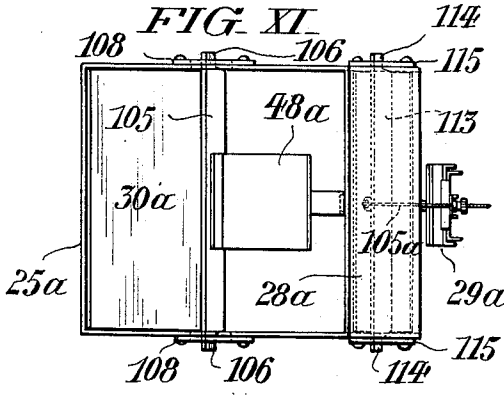
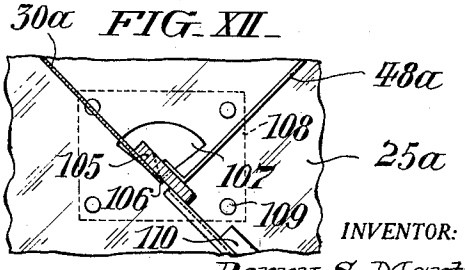


FIG. XII.



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FIG. XIV

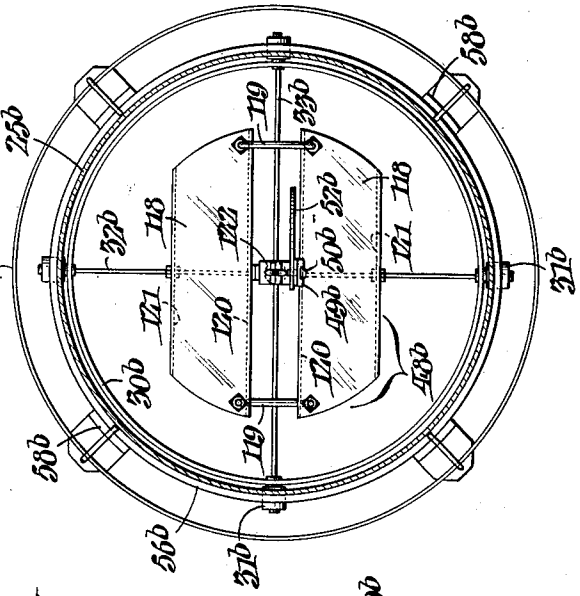


FIG. XIII

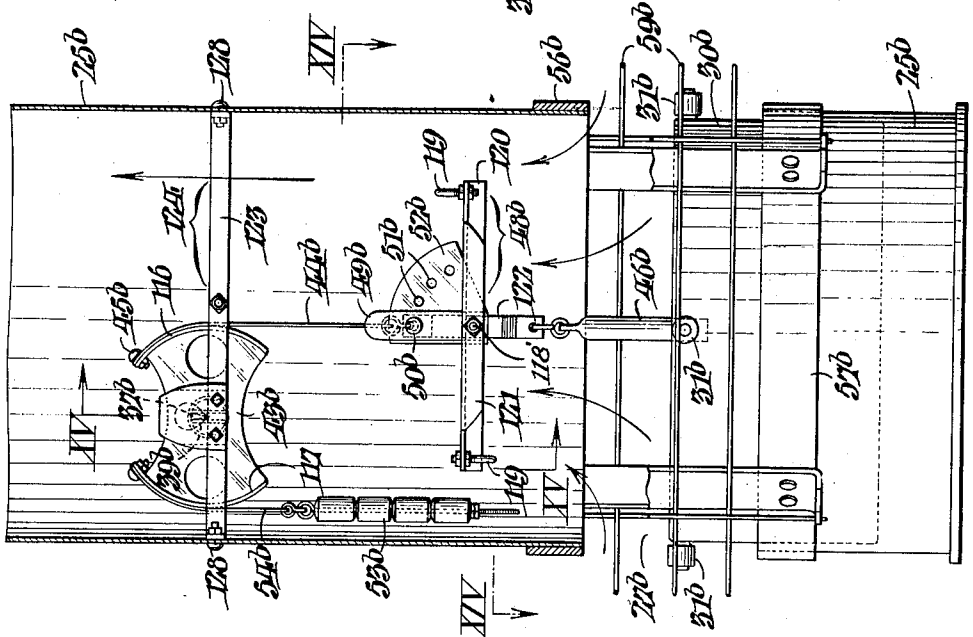
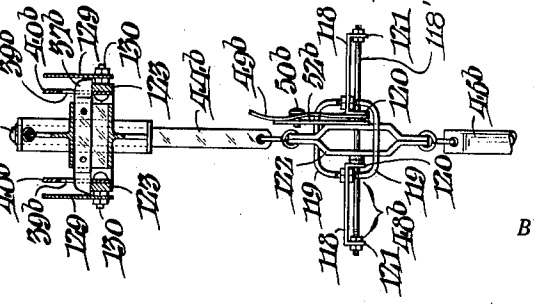


FIG. XV



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Patented Sept. 12, 1933 1,926,295

UNITED STATES PATENT OFFICE

1,926,295

VENTILATION

Perry S. Martin, Harrisonburg, Va.

Application June 24, 1930. Serial No. 463,401

8 Claims. (Cl. 98—32)

This invention relates to ventilation, and is concerned with methods of ventilation as well as with apparatus for the purpose.

Considered from the broadest standpoint, my invention is directed toward automatically maintaining, in individual chambers of a building, a continuous effective movement or circulation of air to bring about thorough diffusion with attendant proportionate replacement by fresh outside air, so that the humidity, air purity and temperature is kept substantially uniform at all levels in all portions of the chambers regardless of fluctuations in external wind pressure or temperature.

The foregoing desideratum I aim to attain without the aid of mechanical means to induce forced circulation, by admitting fresh outside air through one of the walls of the chamber which is to be ventilated, preferably the front wall or that wall containing the greatest number of windows, at several points near the ceiling of the chamber; drawing off or exhausting a proportionate amount of the air by draft action at the floor level for discharge at the exterior above the ceiling level; and setting up circulation through convection with the aid of heating means placed at or near the opposite or rear wall of the chamber, with determination of movement of the incoming air downwardly of the front wall, then rearwardly in the lower portion of the chamber, then upward of the rear wall, and finally forward in the upper part of the chamber.

Further objects of my invention are to provide in connection with ventilating apparatus, designed for the attainment of the above indicated ends, simple and reliable means whereby the rate of air displacement in the chamber, as well as the temperature, may be very accurately controlled and regulated.

Still further objects and attendant advantages of this invention will be manifest from the detailed description following considered in conjunction with the attached drawings, whereof Fig. I shows a sectional view of a single chambered building equipped with novel apparatus suitable to the practice of my improved method of ventilation.

Fig. II is an axial sectional view of the lower end of a vertical exhaust conduit constituting a part of the equipment, drawn to a larger scale than in Fig. I, and showing the main or lower air influx port with the valve means for governing it.

Fig. III is a cross sectional view of the exhaust conduit taken as indicated by the arrows III—III in Fig. II.

Fig. IV is a detail view taken as indicated by the arrows IV—IV in Fig. III.

Fig. V is an elevation of the upper portion of the exhaust conduit, with a portion thereof broken out to expose important details, and showing the supplemental relief port as well as a thermostatically actuated valve means associated with it, whereby the temperature within the chamber is automatically controlled.

Fig. VI is a staggered cross sectional view of the conduit taken as indicated by the arrows VI—VI in Fig. V.

Fig. VII is a side view of a thermostat for automatically actuating the valve means shown in Fig. V.

Fig. VIII is a front elevation of the parts shown in Fig. VII.

Fig. IX is a side elevation of an alternative embodiment of my invention with certain portions broken out and others in section.

Fig. X is an elevation of the modified embodiment viewed from the right of Fig. IX.

Fig. XI is a plan view.

Fig. XII is a fragmentary detail view taken as indicated by the arrows XII—XII in Fig. X and drawn to a larger scale.

Fig. XIII is a view corresponding to Fig. II showing an alternative form of valve means for governing the lower or main air influx port of the exhaust conduit.

Fig. XIV is a staggered plan section taken as indicated by the arrows XIV—XIV in Fig. XIII; and,

Fig. XV is a detail illustration viewed as indicated by the arrows XV—XV in Fig. XIII.

The pictorial representation in Fig. I is that of a poultry brooder or laying house which has been arbitrarily chosen for convenience in illustrating one practical embodiment of my invention. As shown, the front wall 15 of the single chamber of the building is provided adjacent the ceiling 16, to opposite sides of the windows 17, 18, with fresh air intakes 19, 20; while a heating means 21 having in the present instance the form of a pipe radiator, is placed at or near the rear wall 22 of said chamber. At a suitable point centrally of the width of the chamber a cylindric air exhaust conduit 25 extends vertically from a level above the floor, for a purpose later on again referred to, up through the rearwardly sloping roof of the building at the highest end to the exterior where it is fitted with a ventilator head 26, which may be of any approved design and construction. This conduit 25 is closed at the bottom, but at a slightly higher level, it has a lateral circumferentially-ex-

tending main induction port 27 with a governing valve means automatically actuated by the velocity of the upward exhaust flow in said conduit, as hereinafter fully explained. Immediately below the ceiling 16 of the chamber, the conduit 25 has a second or supplemental lateral circumferentially-extending port 28 with governing valve means adapted to be automatically actuated by a thermostat 29 attached to that side of the conduit 25 away from the front wall 15 of the chamber, to permit at times, escape of just a sufficient quantity of heated air from the upper part of the chamber for the purpose of temperature control, also as hereinafter fully set forth. Normally, the upper or supplemental port 28 is closed so that the exhaust of the air from the chamber takes place chiefly through the lower or main port 27 which is normally open.

As detailed in Figs. II, III and IV, the valve means governing flow into the lower circumferentially extending influx port 27 of the exhaust conduit 25 has the form of a valve sleeve 30 which is somewhat smaller in diameter than said conduit so as to be freely movable up and down therein. Buffers 31 of rubber or the like on the ends of diametral rods 32, 33 extending at right angles crosswise of the top of the valve sleeve 30, limit vertical movement of the latter by contact with the upper and lower edges of the port 27. The means for actuating the valve sleeve 30 includes a counterbalanced compositely formed lever 34 with separately attached extremities 35, 36 projecting to opposite sides of a cross piece 37. The ends of this cross piece 37 are fashioned to knife edge configuration as at 38, Figs. II and IV, and rest in V-notches 39 of a fulcrum bracket 40 secured by screws 41 to the outside of the exhaust conduit 25, the lever 34 being thereby pivotally supported with freedom from frictional restraint. The longer extremity 35 of the lever 34 passes inward through a vertical slot 42 in the tube 25, and has secured to its free end a vertically disposed sector head 43. The arcuate face of this sector head 43 is tangential to the axis of the exhaust tube 25 and concentric with the fulcrum axis of the lever 34. A chain 44, with its upper end attached at 45 to the top of the sector head 43, serves to support the valve sleeve 30 in free suspension from the extremity 35 of the lever 34, the lower end of said chain being connected to a juncture piece 46 which is pierced for passage of both of the diametral rods 32, 33 of the valve sleeve 30, as shown in Fig. II. Obviously, through confinement of the chain 44 to the curvature of the sector head 43, a constant effective length is determined for the extremity 35 of the lever 34 regardless of the different positions which the latter may take in action. Affixed to the inner end of a rod 47 extending axially through the extremity 35, of the lever 34 is a vane 48. This vane 48 is adapted to be influenced by the velocity of the upward flow of exhaust air admitted into the conduit 25 by way of the port 27, thereby to effect automatic actuation of the valve sleeve 30. The vane 48 is angularly adjustable by means of a spring finger 49 rigidly secured to the outer end of the rod 47, and provided, adjacent its free end, with a stud 50 capable of selective registry with a number of apertures 51 in a vernier plate 52 fast on the cross piece 37 of the lever 34, see Figs. II and IV more particularly. A weight 53, whereby the extremity 35 of the lever 34 and the parts supported by it are balanced, is suspended by means of a flexible metallic strip 54 from a sector head 55 at the outer end of the shorter extremity 36 of said lever. The effective length of the extremity 36 is thus maintained constant throughout the range of movement of the lever 34 in the same manner as described in connection with the extremity 35, said lever being thereby always in perfect balance. The edges of the port 27 in the tube 25 are reinforced by externally applied metallic bands 56, 57 of heavy gage, and said bands are joined at circumferential intervals by vertical straps 58 of like material. A vertically movable guard 59 made from stout wire and surrounding the port 27 serves to protect the valve sleeve 30 against injury. In order to enable, from time to time, removal of dirt and litter collecting in the conduit 25, below the port 27, the bottom or closure diaphragm 62 is provided with an opening 61 which, as hereinbefore referred to, is located above the floor level. This opening 61 is normally closed by a cover disk 63 which is pivoted to swing on a fulcrum rivet 64 and accessible by sliding the guard 59 downward on the tube 25 temporarily out of the way.

Except for the means by which it is controlled, the valve mechanism for the upper or supplemental port 28 in the exhaust tube 25 is generally similar to the means governing the port 27 in that it comprises, as shown in Figs. V and VI, a valve sleeve 65 with diametral cross rods 66, 67 which are jointed at the center by a juncture piece 68 and fitted at their outer ends with rubber buffers 69. These buffers 69, however, act as stops only by contact with the lower edge of the port 28, with assurance of silient operation and of an air tight juncture when the valve sleeve 65 is in its normal or closed position. The lever 71 for actuating the valve sleeve 65, like the lever 34 aforedescribed, is of composite construction and fulcrumed with a knife edge pivot bearing on a bracket 72 secured to the outside of the exhaust conduit 25 adjacent a vertical slot 73 through which the longer extremity 74 of said lever passes into said conduit. The lever extremity 74 has attached to it a sector head 75 wherefrom depends the suspension chain 76 for the valve sleeve 65. The shorter extremity 77 of the lever 71 is likewise fitted with a sector head which is indicated by the numeral 78, and from which depends a flexible band 79 for suspension of the counter-balancing weight 80. Reinforcing bands 81, 82 around the upper and lower edges of the port 28 are connected, at circumferential intervals, by vertical straps 83 in the same manner as described in connection with the port 27; while provisions are here also made in the form of a guard 84 of wire for protection of the valve sleeve 65. The thermostat 29 which automatically controls operation of the valve sleeve 65 is detailed in Figs. VII and VIII and comprises, as shown, a pair of thermally-sensitive bar elements 85, 86. These elements 85, 86 are fashioned to channel section from suitable sheet material such as zinc plate, and joined together medially of their lengths by a screw bolt 87. At the region of the juncture the side flanges of the elements 85, 86 are cut away as at 88, 89 to facilitate individual bending for the purposes of lateral expansion and contraction of the couple in the plane of Fig. VII. Also, to assist contraction, the main webs of the elements 85, 86 are reinforced crosswise of the cutouts 88, 89 by flexure plates 90, 91 of comparatively stiff sheet iron. A bar 92, likewise fashioned to channel cross-section but from sheet metal with a low co-efficient of expansion; preferably iron, has its ends lapping over the ends of the bar element 85 as shown at 93, 94, and secured by screws 95, 96 to brackets

97, 98 which are in turn permanently fastened by screws or rivets to the side of the exhaust conduit 25. A bar 99 of sheet iron similar to the bar 92 has its ends folded over the ends of the companion thermo-element 86 as at 100, 101. To the back of the bar 99 is attached a motion-multiplying arm 102 which is pierced to receive a screw 103 connecting the element 86 and the bar 99 at their upper ends, and also at the bottom where it and the connected ends of said element and bar are engaged on the screw 96 previously mentioned. At its extreme upper end, the motion multiplying arm 102 (Figs. V and VI) is pierced for passage of the shank of a link member 105 providing connection with the cross piece 106 of the actuating lever 71 for the valve sleeve 65 governing the upper port 28 in the conduit 25. As shown, the shank of the link member 105 is threaded to take an adjusting thumb nut 107 ahead of which a coiled spring 108 is placed to compensate for excess movement of the thermostat 29, when the valve sleeve 65 is in the normal or closed position over the port 28. In practice, the thermostat 29 is liberally proportioned so as to be highly sensitive and therefore capable of responding to very slight variations of temperature.

Through allocation of the various component parts of the system as explained in connection with Fig. I, and by continuously exhausting a proportionate amount of air from a level near the floor of the chamber by way of the lower port 27 of the conduit 25 under draft action, circulation is induced within the chamber by convection in said direction generally indicated by the arrows in the illustration. In other words, air heated by the pipe coil 21 rises at the rear of the chamber, then passes forwardly in the upper part of said chamber to commingle with the fresh displacement air admitted through the intakes 19, 20 at the top of the frontal wall 15. The fresh incoming air, being cold, has a natural tendency to gravitate, and, in flowing downward, carries with it the heated air from the upper part of the chamber, this action being promoted in part through chilling of the heated air to a certain extent incident to flow past the windows 17, 18. A proportionate amount of the recirculated air so carried downward in the chamber is drawn, by draft action, through the lower or main port 27 (which port is normally open as hereinbefore stated) into the exhaust conduit 25. However, the greater volume of the flow moves rearward in the lower part of the chamber to be reheated by the pipe coils 21, with completion of the cycle. Under this novel method of constant circulation, it is evident that substantially uniform conditions of temperature and humidity are maintained at all levels within the chamber to the avoidance of stagnation in any part thereof. By angularly adjusting the vane 48 on the lever 34 (Figs. II and III) functioning of the valve sleeve 30 may be so regulated that any desired rate of air replacement may be predetermined under the draft action of the upward flow in the conduit 25. In the event that the temperature within the chamber rises beyond the point for which the thermostat 29 is adjusted, the upper port 28 in the conduit 25 is gradually opened automatically to permit escape of a certain amount of heated air from the highest point in the chamber until the desired degree of temperature is restored. The extreme sensitivity of the valve actuating mechanisms for the ports 27, 28 of the conduit 25 due to accuracy of balance of the constituent parts, obviously insures dependable operation regardless of changes in external wind pressure or climatic conditions.

In the modified embodiment of my invention illustrated in Figs. IX–XII, the vertical conduit 25*a* is square in cross section and open at the bottom. The valve means for governing influx into the conduit 25*a* through its open bottom, has here the form of a damper 30*a* with a diametral cross bar 105 whereof the ends 106 project through openings at opposite sides of said conduit. The ends of the bar 105, it will be observed, are of knife edge configuration and rest in V-bearings afforded by triangular openings 107 in fulcrum plates 108 which are secured to the conduit 25*a* by means of screws or rivets 109, see Fig. XII. A weight 110 tends to maintain the damper 30*a* normally in the vertical or open position indicated in dotted lines in Fig. IX against the influence of the upward exhaust flow in the conduit 25*a*, which, in acting upon a perpendicular projecting vane 43*a* on the damper 30*a*, tends to move said damper to the full line or closed position diagonally of the conduit 25*a*. In order that the weight 110 may be positionally adjusted to modify the automatic action of the damper 30*a*, the latter is provided with a radial slot 111 for traverse of a clamp screw 112 whereby said weight is securable in different adjusted positions. The valve means for governing the supplemental or relief port 28*a* at the upper end of the conduit 25*a* for the purposes of temperature control, is likewise in the form of a damper 65*a* with a diametral cross bar 113 whereof the knife edge ends 114 are supported by fulcrum plates 115 at opposite sides of the conduit 25*a*. The thermostat shown at 29*a* is exactly like the thermostat 29 of the first described embodiment, and its upward arm 102*a* is connected to the damper 65*a*, with provision of adjustment, by means of a link member 105*a* similar to the link member 105 shown in Figs. V and VI.

In Figs. XIII–XV which show an alternative form of valve mechanism capable of substitution for the type of lower or main port valve mechanism illustrated in Figs. II and III, the valve sleeve 30*b* is attached to a flexible strip 44*b* that contacts tangentially with the sector arm 116 of a walking beam 43*b* whereto its upper end is secured at 45*b*. To the opposite sector arm 117 of the walking beam 43*b* is secured a flexible strip 54*b* with attached weights 53*b* for balancing the valve sleeve 30*b* and an associated vane 48*b*. This vane 48*b* corresponds to the vane 48 of the previously described embodiment, and is adapted to be influenced by the velocity of the exhaust air entering through the port 27*b* and passing upward in the conduit 25*b*. The vane 48*b* in the present instance, consists of two counterpart substantially sem-circular half components 118 which are separated by a diametral interval and connected at opposite ends by bridging U-bolts 119 as shown. The downturned inner and outer flanges 120 and 121 of the vane components 118 are pierced for passage of a transverse pivot bolt 118′ supported by a link member 122 which is interposed between the end of the strap 44*b* and the juncture piece 46*b* coupling the diametral rods 32*b*, 33*b* of the valve sleeve 30*b*. The vane 48*b* is angularly adjustable about the pivot bolt 118′ through shifting of a finger 49*b* carrying a pin 50*b* which is registrable with perforations 51*b* in a sector 52*b*, the latter being rigidly secured to the link member 122 aforementioned. The adjustment here is thus substantially similar

to that set forth in connection with the adjustment of the vane 48 in the first described embodiment. The walking beam 43*b*, it will be noted, has a transverse fulcrum bar 37*b* whereof the knife edge ends rest in V-notch openings 39*b* of lugs 40*b* projecting upwardly from the spaced side members 123 of a composite supporting bar 124 that extends diametrically of the conduit 25*b*, the ends of said side members being bent at right angles and secured to the wall of the conduit 25*b* by means of screw bolts 128. The walking beam 43*b* is held against lateral displacement by keeper pieces 129 that engage the ends of the fulcrum bar 37*b*, as shown in Fig. XV. These keeper pieces 129 are secured to the supporting bar 124 by screws 130 which also serve the lugs 40*b*. It will at once be apparent from the foregoing that the alternative form of valve mechanism just described operates in precisely the same manner as the first described type of Figs. II and III, the advantage gained here being that the valve governing parts are entirely within the conduit 25*b* so as to be effectively protected against injury and against disturbance through accidental contacts as might otherwise be the case. This advantage is also present in connection with the lower valve control in the modification illustrated in Figs. IX and X.

My invention is, of course, not to be considered as limited in its application to poultry houses, since it is obviously adaptable to dwellings or other buildings for the automatic ventilation of individual chambers. In such cases, the exhaust conduits may be concealed in the walls wthout change in the characteristic operation of my novel apparatus as hereinbefore disclosed.

Having thus described my invention, I claim:

1. In ventilating apparatus, an exhaust conduit with a circumferential port near the lower end thereof, said conduit extending vertically from the floor and up through the ceiling of the chamber being ventilated, to the exterior; a co-axial valve sleeve for governing the circumferential port aforesaid; and means subject to the velocity of the exhaust flow in the conduit to automatically actuate the valve sleeve for the purposes of volume control.

2. In ventilating apparatus, an exhaust conduit with a circumferential influx port proximate the lower end thereof, said conduit extending vertically from the floor and up through the ceiling of the chamber being ventilated, to the exterior; a valve for governing the influx port at the lower end of the conduit; and means to automatically actuate the valve for the purposes of volume control including a counter-balanced supporting lever with a vane thereon subject to the velocity of upward exhaust flow in the conduit.

3. In ventilating apparatus, an exhaust conduit with a circumferential influx port proximate the lower end thereof, said conduit extending vertically from the floor and up through the ceiling of the chamber being ventilated to the exterior; a co-axial sleeve valve for governing the circumferential influx port at the lower end of the conduit; and means to automatically actuate the sleeve valve for the purposes of volume control including a counter-balanced lever wherefrom said sleeve valve is freely suspended, and a vane on said lever subject to the velocity of upward exhaust flow in the conduit.

4. In ventilating apparatus, an exhaust conduit with a circumferential influx port near the lower end thereof, said conduit extending vertically from the floor up through the ceiling of the chamber being ventilated to the exterior; a sleeve valve for governing the influx port at the lower end of the conduit; and means to automatically actuate the sleeve valve for the purposes of volume control including a counter-balanced lever wherefrom said sleeve valve is freely suspended, and a vane on said lever subject to the influence of upward exhaust flow in the conduit, said vane being angularly adjustable to regulate the action of the valve.

5. In ventilating apparatus, an exhaust conduit with a lateral influx port near the lower end thereof, said conduit extending vertically from a level adjacently above the floor of the chamber being ventilated, and up through the ceiling to the exterior; a valve for governing the lateral influx port near the lower end of the conduit; means to automatically actuate the valve for the purposes of volume control including a counter-balanced supporting lever with a vane thereon adapted to respond to the velocity of exhaust flow admitted through the lateral influx port, and an apertured diaphragm with a pivoted cover disk normally closing the conduit at the bottom but movable for cleaning out the bottom of said conduit.

6. In ventilating apparatus, an exhaust conduit extending vertically of the chamber being ventilated and up through the ceiling to the exterior, said conduit having a normally open influx port near the floor of the chamber, and a normally closed relief port near the ceiling of the chamber; valve means actuated by the velocity of upward exhaust flow in the conduit to automatically govern the lower port for the purposes of volume control; and thermostatically actuated valve means to govern relief through the upper port for the purposes of automatic temperature control.

7. In ventilating apparatus, a tubular exhaust conduit extending vertically of the chamber being ventilated and up through the ceiling to the exterior, said conduit having a normally open circumferential influx port adjacent the floor level of the chamber and a normally closed circumferential relief port adjacent the ceiling of the chamber; an axial valve sleeve actuated by the velocity of upward exhaust flow in the conduit to automatically govern the lower port for the purposes of volume control; and a thermostatically actuated valve sleeve to automatically govern relief through the upper port of the conduit for the purposes of temperature control.

8. In ventilating apparatus, an exhaust conduit extending vertically from the floor and up through the ceiling of a chamber being ventilated to the exterior; said conduit having a normally open circumferential port adjacent the lower end thereof, an internal co-axial sleeve valve for governing said circumferential influx port; and means wholly within the conduit and subject to the velocity of the exhaust flow in said conduit to automatically actuate the valve sleeve for the purposes of volume control.

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