Oct. 8, 1963 E. H. HARRIS 3,106,386

CURING OVEN FOR ENAMELED WIRE

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FIG. 1

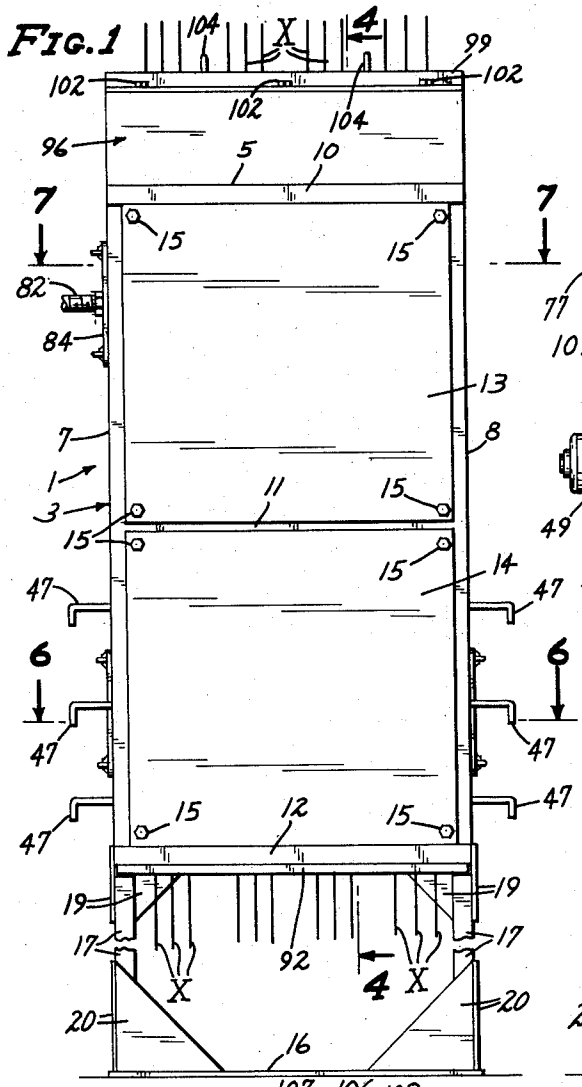
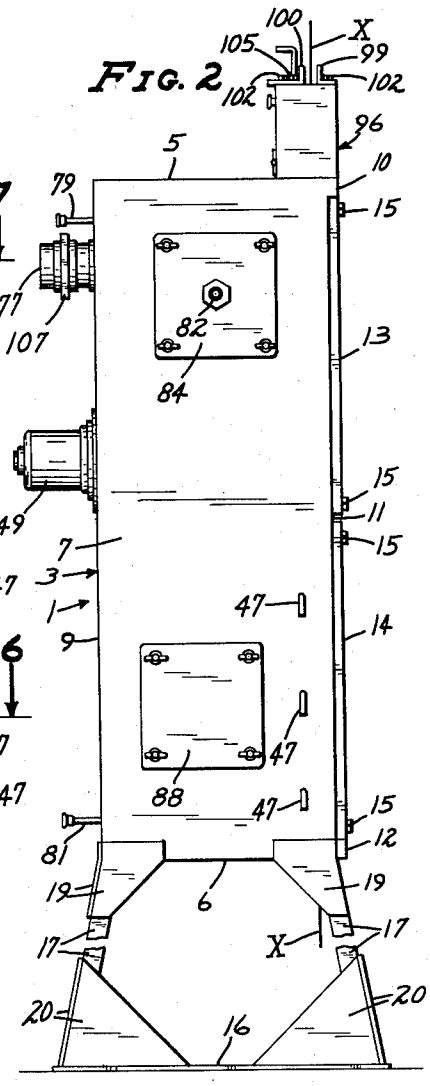


FIG. 2



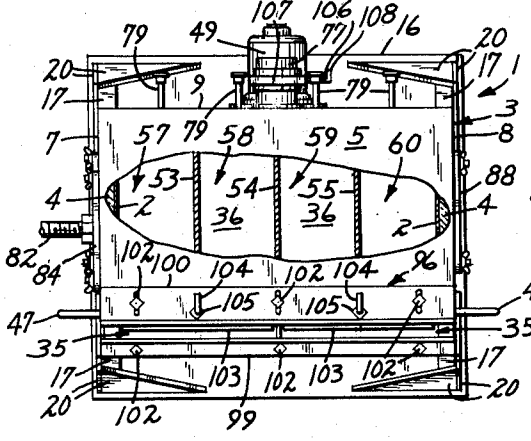


FIG. 3

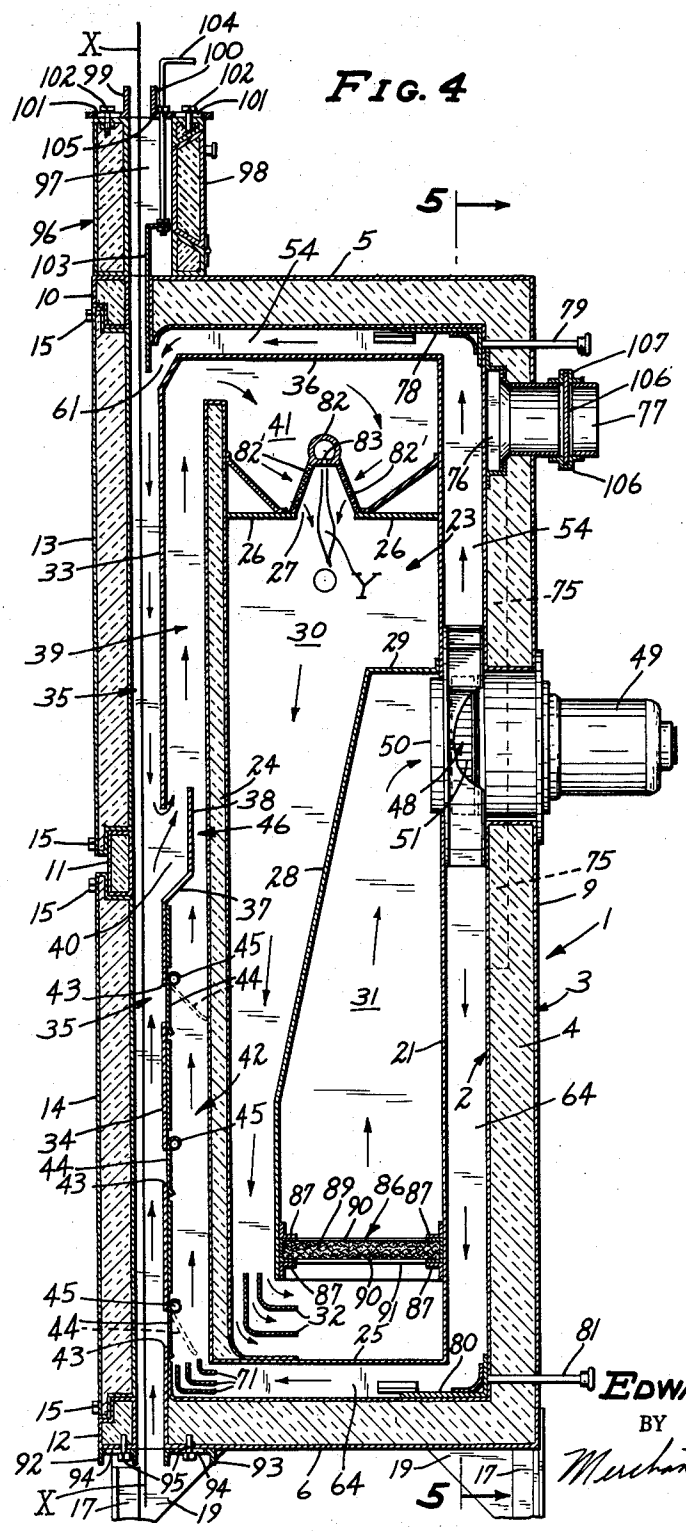
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FIG. 4



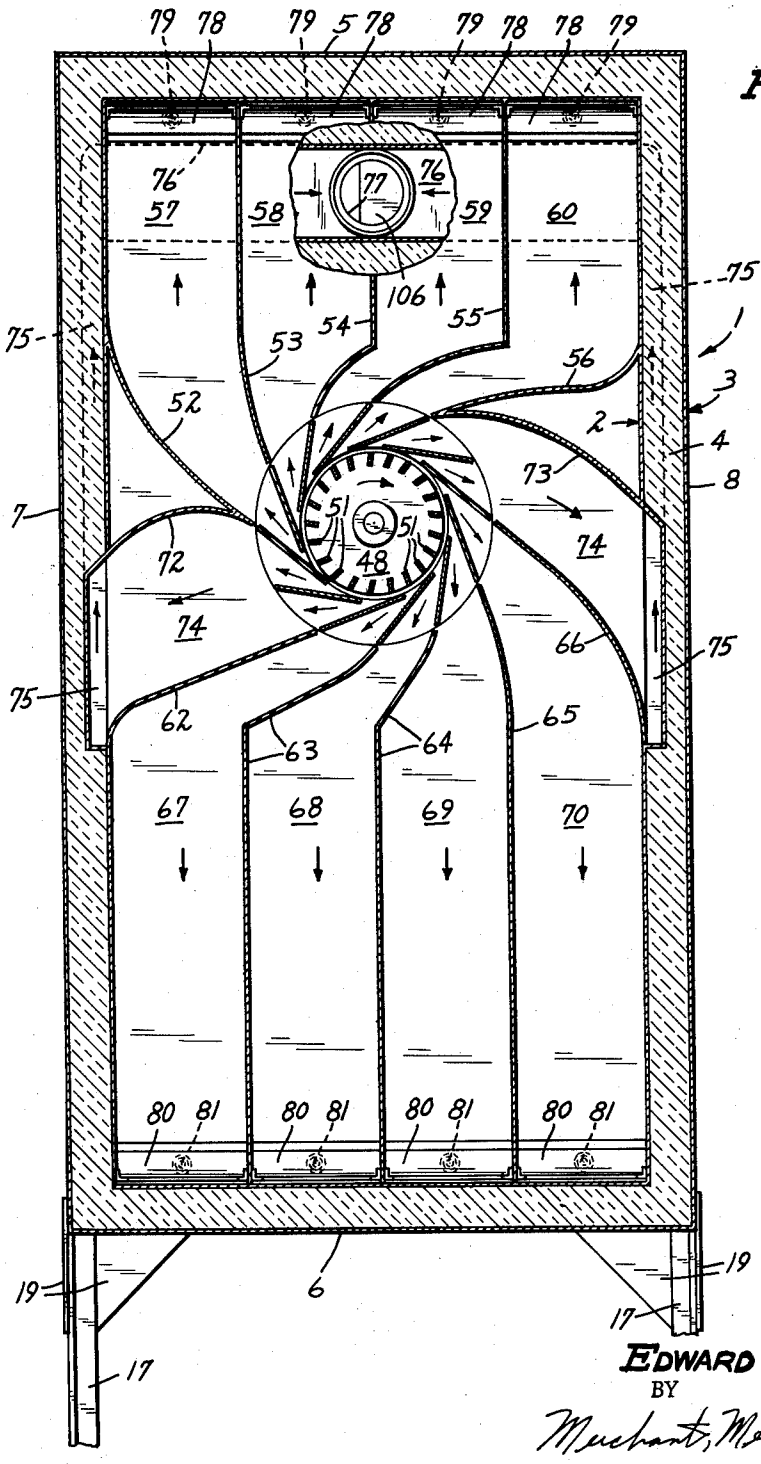
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FIG. 5



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CURING OVEN FOR ENAMELED WIRE

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FIG. 6

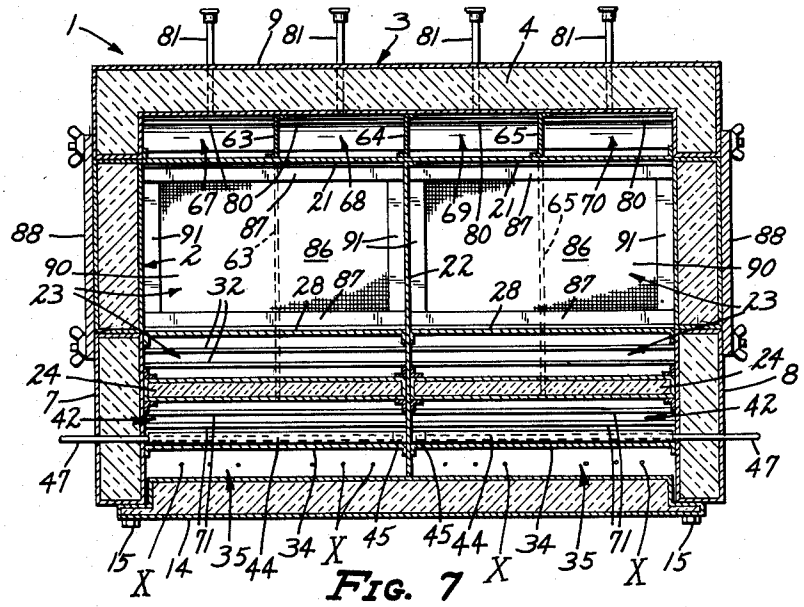
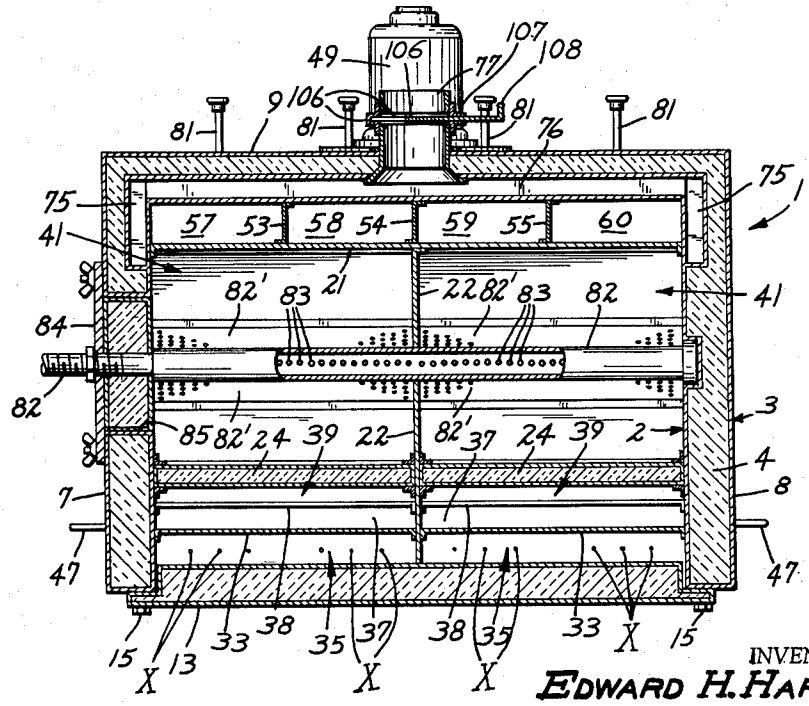


FIG. 7



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United States Patent Office 3,106,386 Patented Oct. 8, 1963

3,106,386

CURING OVEN FOR ENAMELED WIRE

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Filed Jan. 3, 1962, Ser. No. 164,663
8 Claims. (Cl. 263—3)

My invention relates generally to apparatus used in enameling of wire, such as magnet wire, to provide an insulating coating thereon, and more specifically, to curing ovens for drying or curing coats of enamel or similar material after the same has been applied to the wire.

In the enameling or coating of wire, it is common practice to apply a thin coat or layer of enamel to the wire, run the coated wire through an oven to dry the same, apply a second coat over the first and again conduct the wire through the oven, repeating the process as many times as is necessary to obtain the desired thickness of enamel on the wire. This process is disclosed broadly in my prior United States Letters Patent No. 2,087,145, issued July 13, 1937.

Curing ovens for drying or baking the enameled coatings are usually provided with heating means, the heating means in some ovens being employed merely to generate drying heat, the means in others comprising a flame, not only for heating the oven chamber, but also for consuming or oxidizing the volatile fumes driven from the enamel by the oven heat. However, it has been found that, in many instances where this is done, not all of the fumes are completely consumed; and when the same are discharged to the surrounding atmosphere, the odor thereof is objectionable, and often a substantial quantity of unconsumed fumes condenses and forms a coating on the interior of the oven structure, necessitating frequent cleaning thereof to prevent undue buildup of the condensed material.

An important object of my invention is the provision of a curing oven of the type set forth, having novel means for effecting complete consumption or oxidation of the fumes given off by drying enamel as the enameled wire is passed through the oven. To this end, I provide a highly porous catalytic element through which the gaseous material flows. This gaseous material includes air drawn into the work or oven chamber through the open ends thereof, gas recirculated from the heating means through the work chamber, and the volatile fumes given off by the drying enamel. The fumes flowing through the combustion chamber may be partially consumed by the heating means, if such means is in the nature of a flame. Whether or not any oxidation of the fumes occurs by action of the heating means, the fumes are heated thereby to a temperature at which catalytic oxidation will take place as the fumes flow through the catalytic element; resulting in complete oxidation of the gaseous material and an increase in the heat thereof as the same is recirculated to the work chamber.

Another object of my invention is the provision of a curing oven having a novel valve arrangement for controlling the velocity of hot gaseous material flowing to different portions or zones of the work or oven chamber through which the enameled wire is conducted, whereby to vary the heat conditions in such different zones as required by different varieties of enamel, thickness of enamel coating, and the like.

Still another object of my invention is to provision of a curing oven wherein the coated wire being cured is subject to heat, not only by convection, but also by radiation from a heated wall of the work chamber; and of novel means for varying the amount by which the wire is subject to each of these methods of heat transfer.

Another object of my invention is the provision of a curing oven involving a work or oven chamber, a combustion chamber, a burner in the combustion chamber, gas passage means for conducting hot gaseous material from the combustion chamber to the work chamber and from the work chamber to the combustion chamber, a catalytic element for catalytic oxidation of fumes not thoroughly consumed or oxidized by the burner, and valve means for controlling the flow of gaseous material through the oven, the arrangement being such as to require the use of but a single fan or blower to effect the necessary flow of gaseous material through the oven and outwardly thereof.

The above, and still further highly important objects and advantages of my invention will become apparent from the following detailed specification, appended claims and attached drawings.

Referring to the drawings, which illustrate the invention, and in which like reference characters indicate like parts throughout the several views:

FIG. 1 is a view in front elevation of a curing oven produced in accordance with my invention, some parts being broken away;

FIG. 2 is a view in side elevation as seen from the left with respect to FIG. 1, some parts being broken away;

FIG. 3 is a view in top plan;

FIG. 4 is an enlarged vertical section taken substantially on the line 4—4 of FIG. 1, some parts being broken away;

FIG. 5 is an enlarged vertical section taken substantially on the line 5—5 of FIG. 4, some parts being broken away;

FIG. 6 is an enlarged horizontal section taken substantially on the line 6—6 of FIG. 1; and

FIG. 7 is an enlarged horizontal section taken substantially on the line 7—7 of FIG. 1.

In the preferred embodiment of my invention illustrated, a generally rectangular casing structure 1 is shown as comprising spaced inner and outer shells 2 and 3 respectively, the space therebetween being filled with suitable heat insulating material 4. The casing 1 is preferably elongated in a vertical direction, and comprises top and bottom walls 5 and 6 respectively, laterally spaced side walls 7 and 8, a rear wall 9, and horizontally disposed upper, intermediate and lower front cross members 10, 11 and 12 respectively. The otherwise open front of the casing structure 1 is normally closed by insulated upper and lower doors 13 and 14 respectively that are removably held in place by suitable means such as bolts or the like 15, screw threaded into the front edge portions of the side walls 7 and 8 and cross members 10—12. The casing structure 1 is supported from a plate-like base member 16 by legs 17, reinforced at their upper and lower ends by gussets or the like 19 and 20 respectively.

The interior of the casing 1 is provided with various partitions and wall elements which cooperate to divide said interior into a plurality of chambers and passages interconnecting the chambers. A vertically elongated partition wall 21, preferably made from sheet metal or the like, is welded or otherwise rigidly secured at its opposite side edges to the inner surfaces of the side walls 7 and 8 in forwardly spaced relation to the rear casing wall 9, the opposite upper and lower ends of the wall element 21 terminating in inwardly spaced relation to the top and bottom casing walls 5 and 6 respectively. A vertically extended divider wall 22 is welded or otherwise rigidly secured at its rear longitudinal edge to the wall element 21 and projects forwardly therefrom, the front edge of the divider wall 22 abutting the inner surfaces of the cross members 10, 11 and 12, and the inner surfaces of the doors 13 and 14, opposite ends of the

divider wall 22 being suitably anchored to the inner surfaces of the top and bottom casing walls 5 and 6 respectively. The divider wall 22 is centrally located between the casing side walls 7 and 8 and divides the interior of the casing 1, forwardly of the partition wall 21, into substantially identical halves. The partition wall 21 forms the rear wall of a pair of combustion chambers 23, the front walls of which are defined by vertically elongated insulated partition members 24, the opposite upper and lower ends of which are spaced from their adjacent top and bottom casing walls 5 and 6 respectively. The bottoms of the combustion chambers 23 are defined by horizontal partitions 25, and the top or upper ends thereof are defined by horizontally disposed partitions 26, see FIG. 4, the partitions 26 defining laterally extending openings 27, the purpose of which will hereinafter be described. Generally vertically extended wall elements 28 disposed intermediate the partition wall 21 and wall 24 have rearwardly directed upper end portions 29 that are secured to the partition wall 21, and divide the combustion chambers 23 into primary and secondary chamber sections 30 and 31 respectively. The lower ends of the wall elements 28 terminate in upwardly spaced relation to the bottoms 25, and horizontally extended guide baffles 32 are interposed between the lower ends of the wall elements 28 and the adjacent bottoms 25 and walls 24.

Pairs of vertically disposed partition elements 33 and 34 are disposed intermediate the wall 23 and the doors 13 and 14 and parallel thereto, the partition elements 33 and 34 cooperating with the doors 13 and 14 to define opposite side walls of a pair of work or oven chambers 35 that are open at their opposite ends to receive therein one or more lengths of enameled wire, indicated by the reference character X. Means for supporting the wire X for longitudinal movement through the work or oven chambers 35 comprises various pulleys or like supporting means, not shown, such means being well known in the art. The upper ends of the partition elements 33 are connected with the front ends of horizontally disposed partition elements 36 that are connected at their rear ends to the upper end of the partition wall 21, the partition elements 36 being disposed in downwardly spaced parallel relation to the top wall 5 of the casing 1. With reference particularly to FIG. 4, it will be seen that the horizontally disposed partition elements 36, one of which is shown therein, are disposed in upwardly spaced relation to the upper end of the front wall 24. With further reference to FIG. 4, it will be seen that the upper ends of the partition elements 34 are bent angularly rearwardly and upwardly, as indicated at 37, and have vertically disposed upper ends 38 disposed intermediate the lower ends of their respective partition elements 33 and their adjacent walls 24. The upper partition elements 33 cooperate with their adjacent front walls 24 to define return passages 39 that communicate at their lower ends with the work chamber 35 substantially centrally thereof between the open opposite ends thereof, as indicated at 40. The enlarged opposite or delivery ends 41 of the return passages 39 communicate with the upper ends of their respective primary combustion chamber sections 30 through the openings 27 in their respective combustion chamber top walls 26.

The lower partition elements 34 cooperate with their respective front walls 24 to define vertically elongated distribution chambers 42, the partition elements 34 being provided with vertically spaced openings 43 through which communication is had between the distribution chambers 42 and their respective work chambers 35. Each of the openings 43 is provided with valve means in the nature of a plate-like valve element 44 that is pivotally mounted to its respective partition element 34 as indicated at 45 for swinging movements between open and closed positions, see FIG. 4. As further shown in FIG. 4, the upper end partition portions 38 cooperate with their respective walls 24 to define passages 46 affording communication between the distribution chambers 42 and their respective return passages 39. The plate-like valve elements 44 are moved between their fully opened and closed positions by means of individual control handles 47 which extend outwardly through their respective casing sidewalls 7 and 8.

A fan or blower 48 is powered by a conventional motor 49, rigidly mounted on the rear wall 9 of the casing 1, the blower 48 having its inlet portion 50 in communication with the upper ends of the secondary combustion chamber sections 31, the blower 48 being disposed between the partition wall 21 and the rear casing wall 9, see particularly FIG. 4. The blower 48 is preferably of the centrifugal type, discharging gaseous material generally radially outwardly of the circumferentially spaced blades 51 thereof, into the space between the rear casing wall 9 and partition wall 21. With reference to FIG. 5, it will be seen that a plurality of partition elements 52—56 divide the space between the casing rear wall 9 and partition wall 21 above the blower 48 into generally vertically extending delivery passages 57, 58, 59 and 60, which passages extend forwardly between the top casing wall 5 and the underlying horizontally disposed partition elements 36, communicating with the oven or work chamber 35 adjacent the outlet end thereof, as indicated at 61 in FIG 4. Other partition elements 62, 63, 64, 65 and 66 divide the space between the rear casing wall 9 and the partition wall 21 into generally vertically extending passages 67, 68, 69 and 70, generally below the blower 48, the passages 67—70 extending forwardly between the bottom casing wall 6 and the bottom wall 25 of the combustion chamber 23, the passages 67—70 communicating with the lower end of the distribution chamber 42. With further reference to FIG. 4, it will be seen that a plurality of guide baffles 71 are mounted at the lower end of the distribution chambers 42 and at the delivery ends of the delivery passages 67—70 for the purpose of reducing turbulence in the gaseous material delivered from the blower 48 to the distribution chambers 42. Partition elements 72 and 73 cooperate with the partition elements 62 and 66 respectively to define outlet passages 74 which extend laterally toward the oppsite casing sidewalls 7 and 8, and connect with passages 75 in the side walls 7 and 8 that extend upwardly and communicate with a transverse passage 76 in the rear casing wall 9, the passage 76 communicating with atmosphere externally of the casing 1 by means of an outlet duct 77. Movement of gaseous material through the upper delivery passages 57—60 is controlled by a plurality of sliding valves 78, each individually controlled by suitable means such as a handle-equipped control rod 79. In like manner, movement of gaseous material through the several passages 67—70 is controlled by a plurality of slide valves 80, one each disposed in a different one of the passages 67—70, and each individually controlled by a handle-equipped control rod or bar 81.

It will be noted that the upper and lower ends of the divider 22 above the partition element 36 and below the bottom partitions 25 respectively, comprise forwardly extending portions of the partition elements 54 and 64 respectively.

An elongated horizontally disposed tubular burner 82 extends transversely through the enlarged delivery end portions 41 of the return passages 39, and is provided with a plurality of closely spaced burner orifices 83 that are disposed to direct flames downwardly through the openings 27 in the combustion top walls or partitions 26, said flames being indicated at Y in FIG. 4. The burner 82 is mounted at one end in the casing side wall 8, and at its other end extends through a mounting plate or the like 84 releasably mounted in an opening 85 therefor in the casing side wall 7. It will be appreciated that the burner 82 may be of any desired one of a number of commercially available types, and for the purpose of the present example, may be assumed to utilize pre-

mixed gas and combustion air to produce the flame or flames Y. Preferably, the orifices **83** are spaced sufficiently close together to produce the flames Y in a substantially continuous sheet across the upper ends of the primary combustion chambers **30**. At each side of the divider wall **22**, a pair of downwardly diverging perforate guide plates **82'** extend from the burner **82** toward their respective partition walls **26** at opposite sides of the openings **27** therein, to direct gaseous material flowing toward the primary combustion chambers **30** from the return passages **39**, directly toward the flame or flames Y.

The lower or outlet end portions of the primary combustion chambers **30** communicate with the lower inlet end portions of their respective secondary combustion chamber sections **31** through highly porous catalytic elements **86** which permit relatively free passage of gaseous material therethrough. The catalytic elements **86** are removably mounted in the lower inlet end portions of their respective secondary combustion chamber sections **31** by suitable supporting brackets or the like **87**, and access is had thereto by means of closure elements **88** in the opposite casing side walls **7** and **8** for the purpose of removal of the catalytic elements **86** for service, and easy replacement thereof. The elements **86** are of a commercially available variety, usually formed from crimped ribbons of high nickel alloy or the like coated with a platinum alloy and suitably treated for catalytic activity. The ribbons are preferably interlaced or intertwined to produce a mat-like element held in shape by opposed screens and a peripheral frame. In FIG. 4, the catalytic material is indicated at **89**, the screens at **90**, and the peripheral frame at **91**, see FIG. 4. Preferably, the screens **90** are of the same material as the catalytic fill **89**, and coated as is the film material **89** to form a working part of the catalytic element.

A pair of valve members **92** and **93**, in the nature of elongated channel irons or the like, are bolted to the bottom surfaces of the lower cross member **12** and bottom casing wall **6** respectively, to provide valve means which effectively enlarge or reduce the lower inlet end of the work or oven chambers **35**, see FIG. 4. As shown, the valve members **92** and **93** are provided with transverse slots **94** to which extend locking screws **95** that are screw threaded into the cross member **12** and bottom casing wall **6** to adjustably mount the valve members **92** and **93** in desired positions.

A generally rectangular insulated frame **96** is suitably mounted on the upper cross member **10** and top casing wall **5** and defines an open-ended cooling chamber **97** that forms an extension of the work or oven chambers **35** at the upper or outlet end thereof. The frame **96** is provided with an access door or the like **98** at its rear side, for cleaning purposes and the like. At its upper end, the frame **96** is provided with a pair of cooperating valve members **99** and **100** that are mounted thereto in the same manner as the valve members **92** and **93** are mounted to the bottom of the casing **1**, and for the purpose of effectively enlarging or reducing the size of the work passage at the upper or outlet end of the cooling chamber **97**. As shown in FIGS. 3 and 4, the members **99** and **100** are provided with slots **101** and mounting screws **102** extending through the slots **101** and screw threaded into the frame **96**. A pair of vertical baffle elements **103** are mounted in the chamber **97** by vertically adjustable mounting rods or the like **104** for vertical movements into and out of the upper outlet ends of the work chambers **35**, the lower end portions of the baffle elements **103** being adapted to extend downwardly in front of the discharge ends **61** of the delivery passages **57**, **58**, **59** and **60**, whereby to extend the length of the cooling chamber **97** downwardly into the upper end of the work chambers **35**, see FIG. 4. The mounting rods **104** extend through the valve member **100**, and are adjustably supported thereon by adjustable means, such as nuts **105** screw threaded on the mounting rods **104**.

In operation, a suitable number of wires X are fed upwardly through the work or oven chambers **35** from an enameling or coating device, not shown, and by suitable means, not shown, the enamel coating being cured or dried in the oven chambers **35**, and the wire X being drawn outwardly from the upper end of the cooling chamber **97** and from thence to the enabling machine and again through the work chambers **35** and cooling chamber **97**, the process being repeated until the wire X has received a desired number of coats of enamel, after which the wire is delivered to a spool, drum, or the like, for storage or shipment. It will be appreciated that movement of the wire X through the curing oven is continuous and uninterrupted for the entire length of wire to be coated.

Prior to initiation of wire travel through the work chambers **35**, the burner **82** is ignited, and the motor **49** energized to operate the blower **48**, the flame or flames Y heating the gaseous material, such as air in the primary combustion chamber section **30**, the heated gaseous material being drawn into the secondary combustion chamber **31** by the blower **48** and discharged generally upwardly and forwardly through the passages **57—60** to the upper discharge end portion of the work chambers **35**; and downwardly and forwardly through the delivery passages **67—70** to the distribution chamber **42** and outwardly through any openings **43** having open valve elements **44**, into the lower end portion of the work chambers **35**. The work chambers **35** are thus heated by the hot gaseous material flowing therethrough, as are the partition elements **33** and **34**, the gases returning to the combustion chamber through the inlets **40** and passages **46** and **39**. Assuming that all of the valve elements **44** are closed, as shown by full lines in FIG. 4, the heated gases delivered to the distribution chambers **42** will flow entirely through the passages **46** to the return passages **39**, heating the partition elements **34** which in turn radiate heat to the lower half of the one-half of the work chambers **35**. It will be appreciated that, by swinging the lowermost valve elements **44** away from their respective openings **43** in the partition element **34** until said lowermost valve elements **44** engage the front surfaces of the front walls **24**, substantially all of the gaseous material delivered to the distribution chambers **42** will flow forwardly into the lower inlet portions of the work chambers **35**. Thus, by adjusting the several valve elements **44** to desired positions, the lower portions of the work chambers **35** may be heated partly by convection and partly by radiation from the partition element **34**.

Inasmuch as the blower **48** communicates with the outlet duct **77** through the passages **74**, **75** and **76**, some of the gaseous material drawn from the secondary combustion chamber section **31** is delivered to atmosphere exterior of the curing oven. To replace this discharged gaseous material, air is drawn into the work chambers **35** at its open lower inlet end as well as through the cooling chamber **97**, this fresh air being heated as it is drawn into the work chambers **35** and combining with the recirculated gaseous material to draw off fumes from the enamel as the wire X passes through the work chambers **35**. The temperature within the work chambers **35** accelerates the evaporation of the volatiles from the enamel, and the fumes are carried with the air and recirculated gases through the return passages **39** and directed against the flames Y by the perforate guide plates **82**, where the mixture becomes heated, and at least some of the fumes oxidized by combustion. In the event that combustion of the fumes does not occur or is not complete within the primary combustion chamber section **30**, they are at least preheated to the extent that, when they flow through the catalytic element **86**, they will become completely oxidized due to the catalytic action of the element **86**. In view of the fact that heat is generated during catalysis, the gaseous material leaving the secondary combustion chamber sections **31** is of

higher temperature than that entering the secondary combustion chamber sections, thus adding to the overall heating of the oven, particularly the work chambers **35**.

For the purpose of controlling the volume of cool air entering the work chambers **35** through the upper and lower ends thereof, I provide a valve member **106** in the outlet duct **77**, see FIGS. 4, 5 and 7. The valve member **106** is mounted in a pair of opposed guide channels **107**, and is movable transversely of the duct **77** to control the amount of gases discharged therethrough to atmosphere. As shown in FIG. 7, the valve member **106** is formed to provide an angularly disposed handle portion **108** by means of which the valve member **106** may be moved in the guide channels **107** between fully opened and fully closed positions. The valve member **106** controls the volume of cooling air being drawn into the work or oven chambers **35** to the opposite ends thereof, while the valve members **92, 93, 99** and **100** control the velocity of the incoming cool air.

As above indicated, as the wire X moves upwardly through the cooling chamber **97**, it is quickly cooled by incoming air from the open upper end of the chamber **97**, whereby to reduce any residual evaporation of volatiles and to carry whatever fumes are given off by the wire passing through the chamber **97**, into the work chambers **35**, wherein the downward movement of heated gaseous material carries the same to the inlets **40** and from tthence to the combustion chambers.

With the use of my improved oven structure, and the valve arrangements therein, I have been enabled to more thoroughly bake or cure the enameled coating on wires, and at greater speed, than has been heretofore done. The valve elements **44** are highly useful in achieving different gas velocities at different portions of the lower halves of the work chambers **35** so that the heat conditions within the oven chambers **35** may be accurately controlled. Further, with the above arrangement, it is only necessary that a single blower be used to move all of the gaseous material through the oven system in a highly efficient manner, and by dividing the oven into identical halves, the single oven may be utilized to cure enamels of different compositions and of various coat thicknesses.

The curing oven of this invention has been thoroughly tested and found to be completely satisfactory for the accomplishment of the objectives set forth; and while I have shown a commercial embodiment thereof, it will be understood that the same is capable of modification without departure from the spirit and scope of the invention, as defined in the claims.

What is claim is:

1. In a curing oven for enameled wire:

(*a*) casing means having partition means dividing the interior of said casing means into an elongated work chamber having opposed open inlet and outlet ends for passage of enameled wire therethrough, a distribution chamber adjacent a portion of said work chamber, a combustion chamber, and gas passage means;

(*b*) said gas passage means including a pair of delivery passageways extending from said combustion chamber to said distribution chamber and to said work chamber for delivery of heated gaseous material thereto longitudinally inwardly of the opposite ends thereof, a return gas passageway for delivery of gaseous material from said work chamber intermediate the delivery ends of said delivery passageways to said combustion chamber, and an outlet passageway for directing a portion of said gaseous material to the exterior of said casing means;

(*c*) a burner for gaseous material delivered to said combustion chamber;

(*d*) a blower in said passage means;

(*e*) a catalytic element interposed between said combustion chamber and said delivery passageways and outlet pasageway for catalytic oxidation of gaseous material delivered from said combustion chamber;

(*f*) and valve means in said pair of delivery passageways for controlling the flow of gaseous material from said catalytic element to said work chamber;

(*g*) said partition means including a heat conducting wall element between said work chamber and said distribution chamber for radiating heat toward wire passing through the adjacent portion of said work chamber.

2. The structure defined in claim 1:

(*a*) in which said partition means defines a gas passageway between said distribution chamber and said return passage independently of said work chamber;

(*b*) said wall element having an opening therethrough for passage of gaseous material from said distribution chamber to said work chamber intermediate said return passageway and one end portion of said work chamber,

(*c*) and in further combination with a damper valve movable between a closed position closing said opening in the wall element and an open position directing said gaseous material through said opening into said work chamber.

3. The structure defined in claim 1 in further combination with means defining an open ended cooling chamber disposed longitudinally outwardly of said work chamber and in communication with the outlet end of said work chamber for passage of said wire longitudinally outwardly therethrough and for passage of cooling air from the exterior of said oven longitudinally inwardly therethrough to said work chamber, and valve means mounted on said cooling chamber defining means for controlling the flowing of cooling air through said cooling chamber.

4. In a curing oven for enameled wire:

(*a*) casing means having partition means dividing the interior of said casing means into an elongated work chamber having opposed open inlet and outlet ends for passage of enameled wire therethrough, a distribution chamber adjacent the inlet end portion of said work chamber, a combustion chamber, and gas passage means;

(*b*) said gas passage means including, a delivery passageway extending from said combustion chamber and communicating with said work chamber adjacent the outlet end thereof, a second delivery passageway extending from said combustion chamber to said distribution chamber adjacent the inlet end of said work chamber, a return passageway communicating with said work chamber substantially centrally between the opposite ends thereof for delivery of gaseous material from said work chamber to said combustion chamber, and an outlet passageway for directing a portion of said gaseous material to the exterior of said casing means;

(*c*) a burner for gaseous material delivered to said combustion chamber;

(*d*) a blower in said passage means;

(*e*) a catalytic element interposed between said combustion chamber and said delivery passageways and outlet passageway for catalytic oxidation of gaseous material delivered from said combustion chamber;

(*f*) and valve means in said delivery passageways for controlling the flow of gaseous material from said catalytic element to said work chamber;

(*g*) said partition means including a heat conducting wall element between said work chamber and said distribution chamber for radiating heat toward wire passing through the adjacent portion of said work chamber.

5. The structure defined in claim 4:

(*a*) in which said wall element defines a plurality of openings spaced in a direction longitudinally of said

work chamber for passage of gaseous material from said distribution chamber to said work chamber;

(*b*) and in further combination with a plurality of damper valves each movable between a closed position closing a different one of said openings and an open position directing said gaseous material through its respective opening into said work chamber;

(*c*) and means for independently moving said damper valves between their open and closed positions.

6. The structure defined in claim 4:

(*a*) in which said valve means comprises a valve element in said first mentioned delivery passageway and a second valve element in said second delivery passageway;

(*b*) and in further combination with means for independently operating said valves to independently control the flow of gaseous material to the outlet end portion of said work chamber and to said distribution chamber.

7. The structure defined in claim 4:

(*a*) in which the end of said first mentioned delivery passageway adjacent said work chamber extends at an oblique angle to a plane extending longitudinally of said work chamber to direct hot gaseous material angularly toward the longitudinally intermediate portion of said work chamber;

(*b*) and in further combination with means defining an open ended cooling chamber disposed in end to end relationship with the outlet end of said work chamber and providing an extension thereof;

(*c*) and a baffle element mounted for movements longitudinally of said cooling and work chambers forwardly of the opening between the delivery end of said first mentioned delivery passage and said work chamber, whereby to vary the effective length of said cooling chamber.

8. In a curing oven for enameled wire:

(*a*) casing means having partition means dividing the interior of said casing means into an elongated open ended work chamber for passage of enameled wire

longitudinally therethrough, a combustion chamber, and gas passage means;

(*b*) said gas passage means including a pair of delivery passageways extending from said combustion chamber to the work chamber for delivery of heated gaseous material thereto adjacent the opposite open ends thereof, a return passageway having an inlet end communicating with said work chamber intermediate said delivery passages and an outlet end communicating with said combustion chamber for delivery of gaseous material from said work chamber to said combustion chamber, and an outlet passageway for directing a portion of said gaseous material to the exterior of said casing means;

(*c*) said partition means including a wall element dividing said combustion chamber into primary and secondary chamber portions;

(*d*) a burner adjacent the outlet end of said return passageway for initial combustion of gaseous material delivered to said combustion chamber from said work chamber;

(*e*) a porous catalytic element interposed between said primary and secondary chamber portions for catalytic oxidation of gaseous material from said primary chamber portion;

(*f*) a blower having an inlet communicating with said secondary chamber portion and an outlet communicating with said delivery passageways and said outlet passageway;

(*g*) and valve means for controlling the flow of gaseous material through said delivery passageways to said work chamber, whereby to vary the flow of gaseous material therethrough and through said outlet passageway.

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