Feb. 9, 1965 E. H. HARRIS 3,169,157

ANNEALING OVEN FOR CONTINUOUSLY MOVING WIRE

Filed July 17, 1962 3 Sheets-Sheet 1

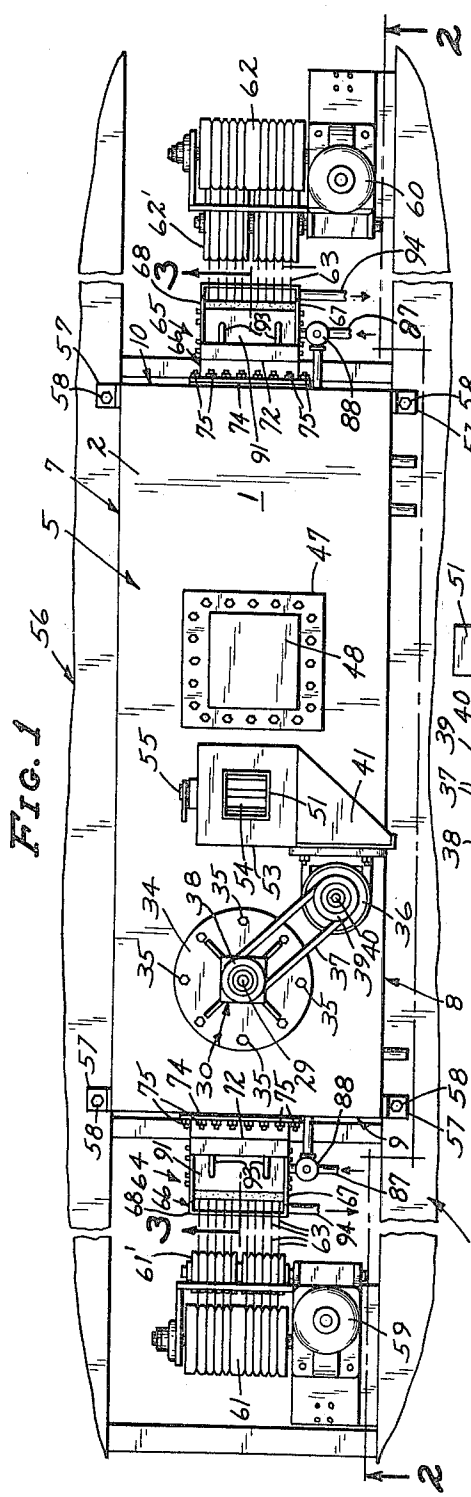


FIG. 1

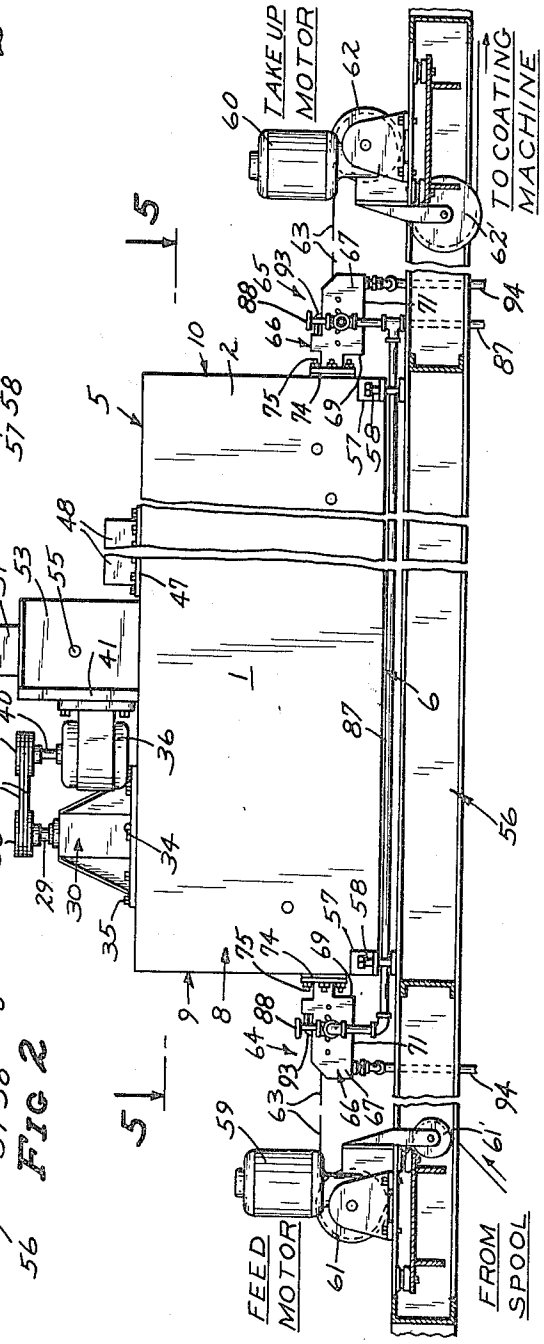


FIG 2

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FIG. 3

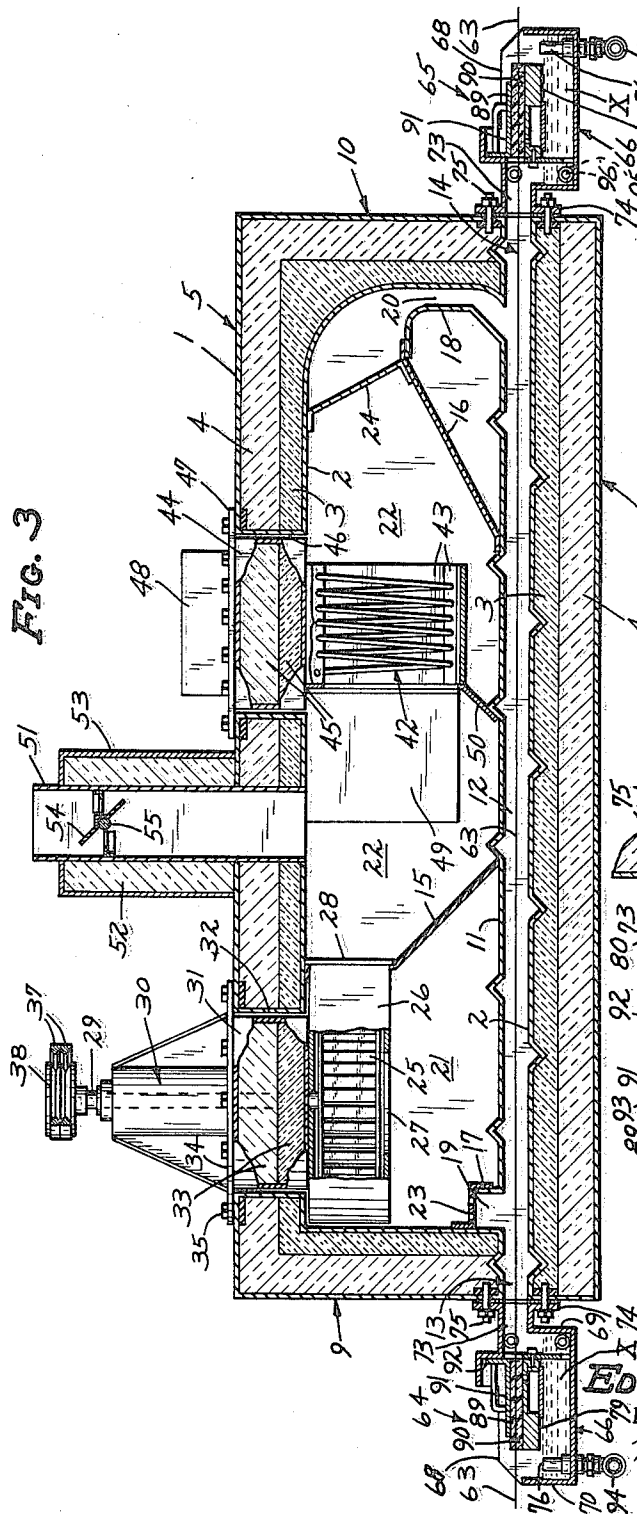
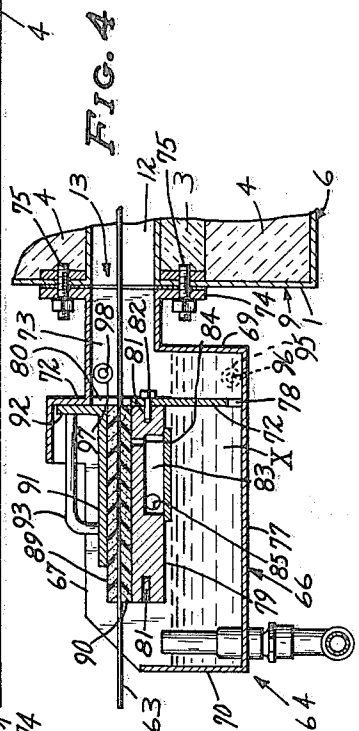


FIG. 4



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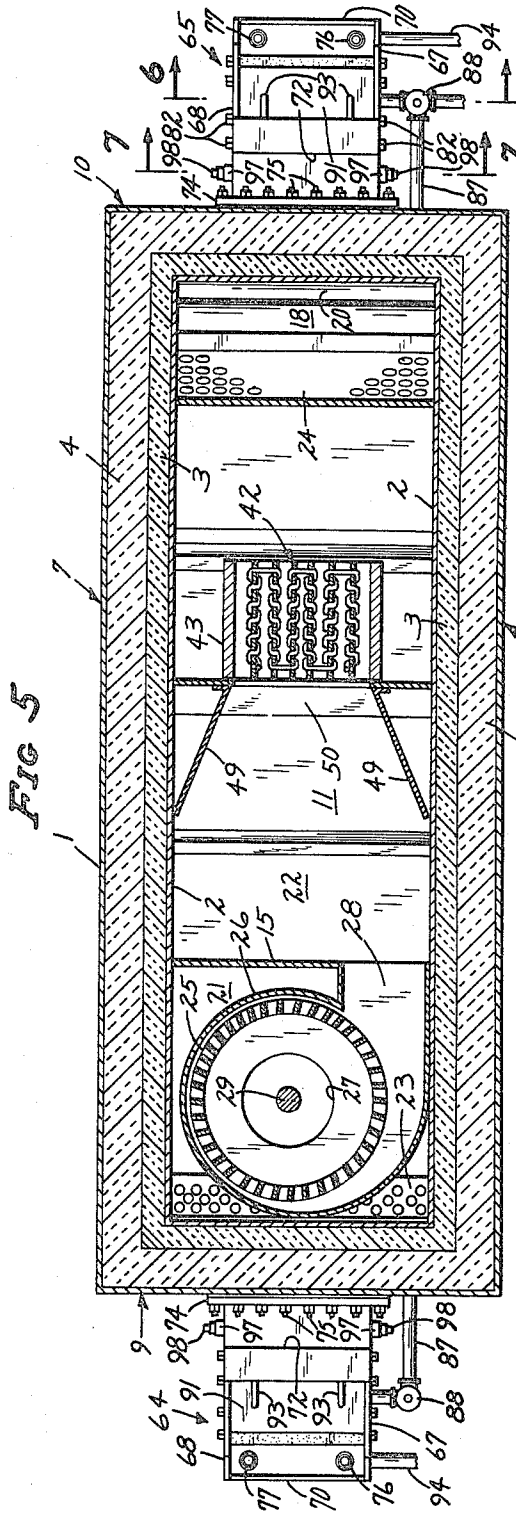


FIG 5

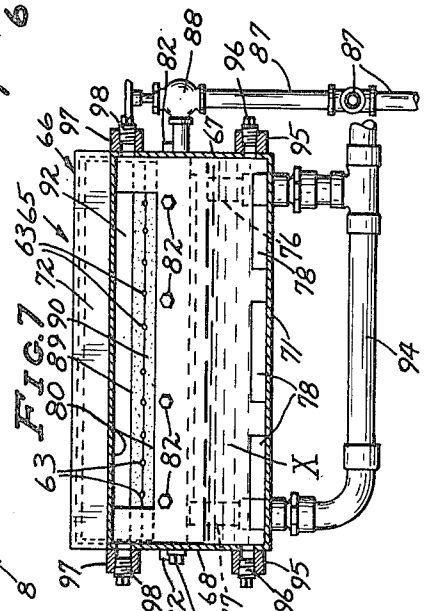


FIG. 7

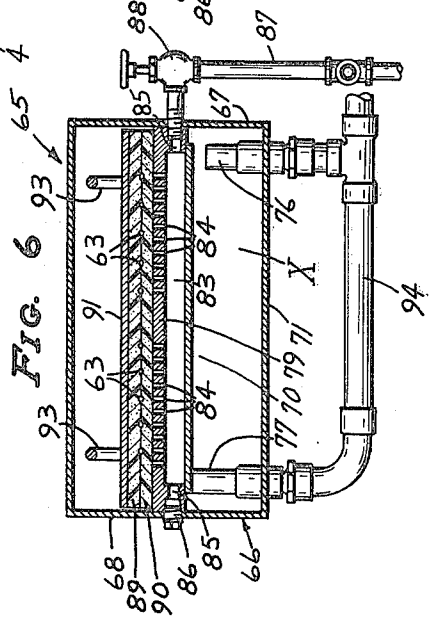


FIG. 6

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3,169,157

ANNEALING OVEN FOR CONTINUOUSLY MOVING WIRE

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Filed July 17, 1962, Ser. No. 210,348
6 Claims. (Cl. 266—3)

My invention relates generally to oven structures and more particularly to high temperature ovens for annealing non-ferrous metallic wire and the like.

More specifically, my invention relates to improvements in such ovens wherein strands of wire, such as copper wire, are continuously moved through an oven chamber for annealing preparatory to enameling of the wire or other treatment thereof.

An important object of my invention is the provision of a wire annealing oven wherein exterior air is excluded from the interior of the oven chamber without hindering the movement of wire through the oven chamber.

Another object of my invention is the provision of an oven wherein gas is circulated in a continuous stream between a heating means and the oven or annealing chamber, whereby heat loss from the oven is held to a minimum.

Another object of my invention is the provision of liquid sealing means for the inlet and outlet portions of said oven, and having a novel arrangement for applying liquid to wire strands as the strands enter and leave the oven, and wherein said liquid provides gaseous medium utilized to carry annealing heat to said wire.

Another object of my invention is the provision of an annealing oven as set forth, having an oven chamber and a gas heating chamber constructed and arranged to provide for flow of annealing gas at a greater velocity through said oven chamber than through said heating chamber.

Still another object of my invention is the provision of an annealing oven as set forth, which is relatively simple and inexpensive to produce, which is highly efficient in operation, and which is rugged in construction and durable in use.

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 top plan of an annealing oven produced in accordance with my invention, some parts of the supporting structure therefor being broken away;

FIG. 2 is a view, partly in side elevation and partly in section, taken substantially on the line 2—2 of FIG. 1, some parts being broken away;

FIG. 3 is an enlarged longitudinal section taken substantially on the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary view corresponding to a portion of FIG. 3 on an enlarged scale;

FIG. 5 is a view partly in top plan and partly in horizontal section, taken on the line 5—5 of FIG. 2;

FIG. 6 is an enlarged fragmentary transverse section taken on the line 6—6 of FIG. 5; and

FIG. 7 is an enlarged fragmentary transverse section taken on the line 7—7 of FIG. 5.

In the preferred embodiment of the invention illustrated, an elongated generally rectangular casing is shown as comprising an outer jacket 1, an inner lining 2 inwardly spaced from the jacket 1 and heat insulating material 3 and 4 filling the space between the jacket 1 and lining 2. The jacket, lining and insulating material are

formed to provide vertically spaced top and bottom casing walls 5 and 6 respectively, laterally spaced vertical side walls 7 and 8, and opposed end walls 9 and 10. Preferably, the jacket 1 and lining 2 are fabricated from sheet metal, the insulating layer 3 being preferably made from relatively high heat resistant cementitious material, and the insulating layer 4 preferably being of relatively soft fibrous insulating material, such as glass or asbestos fibers and the like.

Rigidly secured within the casing is a horizontally disposed metallic partition member 11 which cooperates with the lining 2 of the bottom wall 6 to define an elongated duct-like oven chamber 12. The opposite end walls 9 and 10 cooperate with the bottom wall 6 to define an inlet and outlet respectively to the oven chamber 12, the inlet being indicated at 13 and the outlet being indicated at 14, see particularly FIG. 3. Other partition members 15 and 16 cooperate with the partition member 11 and upturned end portions 17 and 18 thereof to divide the interior of the casing above the oven chamber 12 into ducts 19 and 20, a blower chamber 21, and a heating chamber 22. A perforate baffle 23 is interposed between the duct 19 and the blower chamber 21, and a second perforate baffle 24 is interposed between the duct 20 and the heating chamber 22.

A rotary circulating fan or blower 25 is rotatably disposed within a fan housing 26 within the blower chamber 21, the housing 26 having an inlet opening 27 and an outlet duct 28 which opens through the partition member 15 to the heating chamber 22. The blower 25 is mounted on the lower end of a vertical shaft 29 that extends upwardly through a supporting member 30 having an enlarged lower end 31 that is received in an opening 32 in the top oven wall 5 and which is heavily insulated, as indicated at 33. The support member 30 is provided with a mounting flange 34 which rests upon the top surface of the top wall 5, and which is anchored thereto by mounting screws or the like 35. Preferably, the support member 30 is provided with conventional bearings, not shown, which journal the shaft 29 for rotation therein. Rotary movement is imparted to the blower 25 by a motor 36 and endless drive belts 37 entrained over pulleys 38 fast on the upper end of the shaft 29 and drive pulleys 39 fast on the shaft 40 of the motor 36. The motor 36 is rigidly secured to a mounting bracket 41 on the top wall 5 of the oven casing structure, see FIGS. 1 and 2. With reference particularly to FIG. 3, it will be seen that the blower 25 draws the gaseous material upwardly through the duct 19 from the left end of the oven chamber 12, and forces the gaseous medium through the heating chamber 22 toward the right hand end of the oven chamber 12, by means of the duct 20.

Means for heating the gas within the heating chamber 22 comprises a conventional resistance heating element 42 carried by a mounting frame 43 that is suspended within the heating chamber 22 from a hollow support member 44 that is filled with insulating material, indicated at 45. The support member 44 is received in an opening 46 in the top wall 5, and includes an anchoring flange 47 that is bolted or otherwise rigidly secured to the top casing wall 5. The support member 44 further carries a junction box 48 which encloses the usual electrical connections, not shown, between the heating element 42 and power conductor wires, also not shown. Baffle plates 49 and 50, within the hearing chamber 22, direct the gaseous medium from the blower duct 28 to the heating element 42, see FIGS. 3 and 5.

A tubular gas outlet 51 extends upwardly through the top casing wall 5 from that portion of the heating chamber 22 between the blower outlet duct 38 and the heating element 42, and is encompassed by a relatively thick layer of insulating material 52 enclosed by a metallic

jacket or the like 53. Discharge of gas from the heating chamber 22 through the outlet 51 is controlled by a damper 54 mounted on a rotary control shaft 55 extending transversely through the outlet 51 and jacket 53. The shaft 55 may be assumed to be connected to conventional means, not shown, for controlling the position of the damper 54.

The annealing oven is shown as being mounted on a supporting structure 56 by means of angle brackets or lugs 57 and adjustable legs in the nature of bolts or the like 58, the supporting structure 56 also supporting a pair of feed and take-up motors 59 and 60 respectively, which motors drive grooved feeding and take-up rolls 61 and 62 respectively. Strands of wire 63 are entrained over the feeding and take-up rolls 61 and 62 in laterally spaced parallel relationship, and extend longitudinally through the oven chamber 12. The wire strands 63 are also entrained over suitably journalled guide rolls 61' and 62', the former of which receives the wire strands from supply spools thereof, not shown, the wires 63 extending from the guide roll 62' for desired disposition elsewhere.

As the wire strands 63 pass through the elongated oven chamber 12, they are subject to the stream of gas flowing through the oven chamber from the duct 20 to the duct 19. This gas, which for the purpose of the present example may be considered as being superheated steam, is maintained at relatively high temperatures by the heating element 42, such temperatures being preferably between 700 and 1100° F. The velocity and temperature of the gas in the oven chamber 12 is such, relative to the speed of movement of the wire strands 63, that the wire becomes thoroughly annealed as it passes through the oven chamber 12.

Use of superheated steam or other suitable inert gas is desirable to protect the surfaces of the wire strands from becoming oxidized during the annealing operation. Hence, it is highly desirable that exterior air be excluded from the oven chamber 12, and for this purpose I provide liquid sealing means, now to be described. The liquid sealing devices, indicated generally at 64 and 65, are substantially identical in structure; hence, for the sake of brevity, but one thereof will be described in detail. As shown, the sealing device 64 is disposed adjacent the inlet 13 to the oven chamber 12, the sealing device 65 being disposed adjacent the outlet 14.

The sealing devices 64, 65 shown in detail in FIGS. 4, 6, and 7, comprise a partially open topped container 66, having opposed sidewalls 67 and 68, inner and outer end walls 69 and 70 respectively, a bottom wall 71, and a rigid transverse partition 72 disposed in relatively closely spaced relation to the inner end wall 69. Inwardly of the partition 72 and inner end wall 69, the container 66 is formed to define a rectangular passageway 73 that is aligned with the inlet 13, the container 66 being formed with a mounting flange 74 for reception of nut equipped studs or the like 75, by means of which the container 66 is mounted to the adjacent end wall of the oven structure. Sealing liquid such as water, indicated by the reference character X, is maintained between predetermined levels by upstanding open-topped drain pipes 76 and 77, the maximum level of the liquid X being below that of the bottom of the passageway 73. At its lower end, the partition 72 is provided with a plurality of openings 78, by means of which the level of the water X is maintained uniform at both sides of the transverse partition 72.

A flat topped rectangular manifold 79 extends across the container 66 adjacent the lower edge of an opening 80 in the paprtition 72 through which the strands of wire 63 pass, the manifold 79 having screw threaded openings 81 in its opposite sides and ends for reception of mounting screws or the like 82 which pass through suitable openings in the side walls 67 and 68 and partition 72 to anchor the manifold 79 in a horizontally extended position. Manifold 79 defines a distributing chamber 83 from which a plurality of discharge apertures 84 extend upwardly to the top surface of the manifold 79, the apertures 84 being disposed in a row extending transversely of the container 66. At its opposite ends, the manifold 79 is provided with inlet openings 85, one of which is closed by a conventional pipe plug 86, the other of which has connected thereto a liquid supply pipe 87 in which is interposed a control valve 88, the pipe 87 being assumed to be connected to a source of water under pressure, not shown. It will be noted that the discharge apertures 84 are disposed in closely spaced relation to the side of the manifold 79 that is bolted to the partition 72. The construction of the manifold 79 is such that, if desired, the same may be turned end for end in the container 66, to dispose the discharge apertures 84 in the row thereof remote from the opening 80.

A pair of superposed flat rectangular pads 89 and 90 are supported by the manifold 79, and extend across the opening 80 in the partition 72, the pads 89 and 90 being of resilient spongiose material, such as sponge rubber or porous cellulose acetate commonly used as the substitute for natural sponge in view of its great capacity for absorbing and holding water. A plate-like weight 91 normally rests upon the upper pad 89, and is provided with an upstanding flange 92 that engages the adjacent side of the partition 2 and cooperates with the pads 89 and 90 to completely close the opening 80 in the partition 72. As shown, the weight 91 is provided with a pair of handles or the like 93 by means of which the same may be easily set in place or removed. As shown most clearly in FIGS. 4, 6, and 7, the strands of wire 63 pass between the engaging faces of the pads 89 and 90, the material of the pads snugly encompassing the wire strands 63 so that air from the exterior of the oven is excluded from the passage 73 and the oven chamber 12.

In operation, the annealing oven is filled with an inert gas, such as super-heated steam, the steam being maintained at desired heat by the heating element 42 and circulated through the oven chamber by means of the blower 25. Water is supplied to the manifolds 97 of the water seals 64 and 65 at a predetermined rate of flow, and the motors 59 and 60 are energized to cause the wire strands 63 to be passed through the oven chamber 12. During passage of wire through the oven chamber 12, the wire becomes heated to annealing temperature, and is thereafter cooled as it passes between the water soaked pads 89 and 90 of the water seal 65. As the wire 65 moves between the water soaked pads 89 and 90 of the water seal 64 toward the oven chamber 12, the wire carries with it some of the water from the pads of the water seal 64. Some of this water drops back into the container 66 between the partition 72 and end wall 69, and some water is carried into the oven chamber through the inlet 13. Immediately upon entering the oven chamber 12, moisture adhering to the wire strands 63 evaporates and becomes heated substantially to the temperature of the circulating dry stream within the oven. Continued evaporation of moisture from the wire strands 63 tends to cause a pressure build-up within the system, which pressure is relieved by adjustment of the damper 54 in the vent 51.

With references to FIGS. 6 and 7, it will be seen that the drain pipes 76 and 77 are connected to a pipe 94 by the usual fittings, which pipe 94 may be assumed to extend to a suitable drain. It will be further noted that the containers 66 are provided with outlet fittings 95 that are normally closed by pipe plugs or the like 96, whereby substantially all of the water X may be drained from the containers 66. Also, adjacent their upper edges, the side walls 67 and 68 of the containers 66 are provided with inlet fittings 97 inwardly of the partitions 72, the fittings 97 being normally provided with pipe plugs or

the like 98. Removal of the plugs 98 permits introduction to the oven system of any desired gas through the oven system if gas other than super-heated steam is desired to be used.

While I have shown and described a commercial embodiment of my annealing oven, it will be understood that the same is capable of modification, and that modification may be made without departure from the spirit and scope of the invention as defined in the claims.

What I claim is:

1. In a wire annealing oven,

(*a*) casing structure defining an elongated oven chamber having an inlet at one end and an outlet at its other end,

(*b*) means for heating and circulating a gaseous medium longitudinally through said oven chamber,

(*c*) sealing means at opposite ends of said oven chamber admitting passage of wire strands therethrough but sealing said inlet and outlet against admission of air into said oven chamber,

(*d*) said sealing means each comprising a pair of superposed resilient spongiose pads in face to face engagement,

(*e*) the engaging faces of the pads of each pair thereof being aligned substantially with the longitudinal axis of said oven chamber and adapted to receive and engage strands of wire therebetween for passage of such strands longitudinally through said oven chamber, and

(*f*) means including a manifold element for supporting said pads in said face to face engagement, for introducing liquid to said pads to cause saturation thereof, and for removing excess liquid from said sealing means.

2. The structure defined in claim 1 in which said pad supporting means comprises,

(*a*) a container adapted to contain liquid to a predetermined level and having opposed side walls, inner and outer end walls, a bottom wall and a transverse partition intermediate said end walls.

(*b*) the inner end of said container at its upper portion defining a wire passage to the adjacent end of said oven chamber above the level of liquid in said container,

(*c*) said transverse partition defining the outer end of said wire passage,

(*d*) said manifold element extending transversely of said container and having an upper surface supporting the lower one of said pads and having a plurality of discharge apertures extending from the interior of said manifold to the upper pad engaging surface thereof, and liquid inlet means,

(*e*) said pads being disposed in abutting engagement with said transverse partition,

(*f*) means for introducing liquid to said manifold through said inlet,

(*g*) and means for maintaining said predetermined liquid level in said container at both sides of said transverse partition.

3. The structure defined in claim 2 in which said discharge apertures are disposed adjacent one side edge of said manifold, and in further combination with means releasably mounting said manifold to said container side walls and transverse partition, whereby said manifold may be turned end for end to shift said discharge apertures relative to said transverse partition and said pads.

4. The structure defined in claim 3 in which said transverse partition defines an opening at its lower end below the liquid level of said container for flow of liquid between opposite sides of said partition, said means for maintaining said predetermined liquid level including said liquid introducing means and an open topped discharge pipe extending upwardly from the container bottom wall adjacent the outer container end wall and to a predetermined distance above the container bottom wall and below the level of said wire passage.

5. The structure defined in claim 2 in further combination with means for exerting pressure on the overlying one of said pads against the underlying one thereof and comprising a removable plate-like weight in overlying engagement with said overlying pad, said weight and pads cooperating to close the adjacent end of said wire passage against entry of exterior air into said oven chamber.

6. In an annealing oven,

(*a*) casing structure defining an elongated oven chamber having an inlet at one end and an outlet at its other end, a blower chamber communicating with one end of said oven chamber, and a heating chamber communicating with said blower chamber and the other end of said oven chamber, said oven chamber, blower and heater chambers being defined in part by a longitudinally extending transverse heat conducting partition wall in said casing structure,

(*b*) a heating element in said heating chamber,

(*c*) a blower in said blower chamber for circulating a gaseous medium through said blower chamber, heating chamber and oven chamber,

(*d*) sealing means at opposite ends of said oven chamber admitting passage of wire strands therethrough but sealing said inlet and outlet against admission of air into said oven chamber,

(*e*) said sealing means each comprising a pair of superposed resilient spongiose pads in face-to-face engagement,

(*f*) the engaging faces of the pads of each pair thereof being aligned substantially with the longitudinal axis of said oven chamber and adapted to receive and engage strands of wire therebetween for passage of said strands longitudinally through said oven chamber, and

(*g*) means including a manifold element for supporting said pads in said face-to-face engagement, for introducing liquid to said pads to cause saturation thereof, and for removing excess liquid from said sealing means.

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