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3,091,441

APPARATUS FOR HEATING AND STRETCHING OF FABRICS

Filed Feb. 2, 1961

4 Sheets-Sheet 1

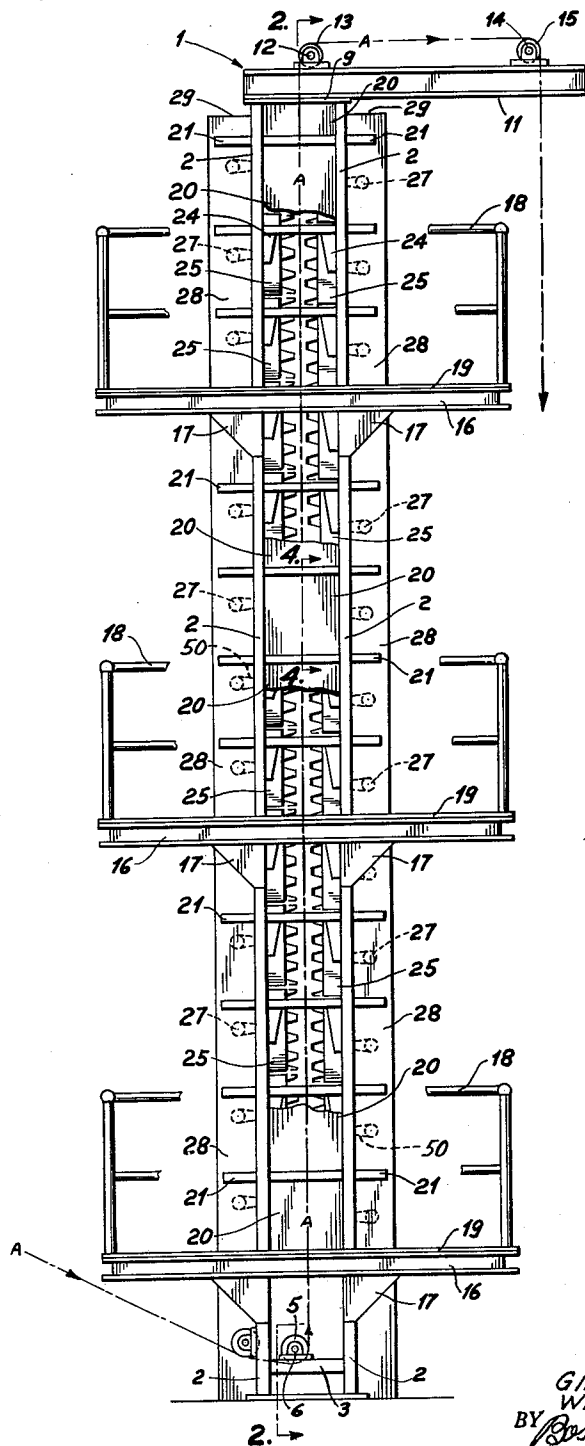


Fig. 1.

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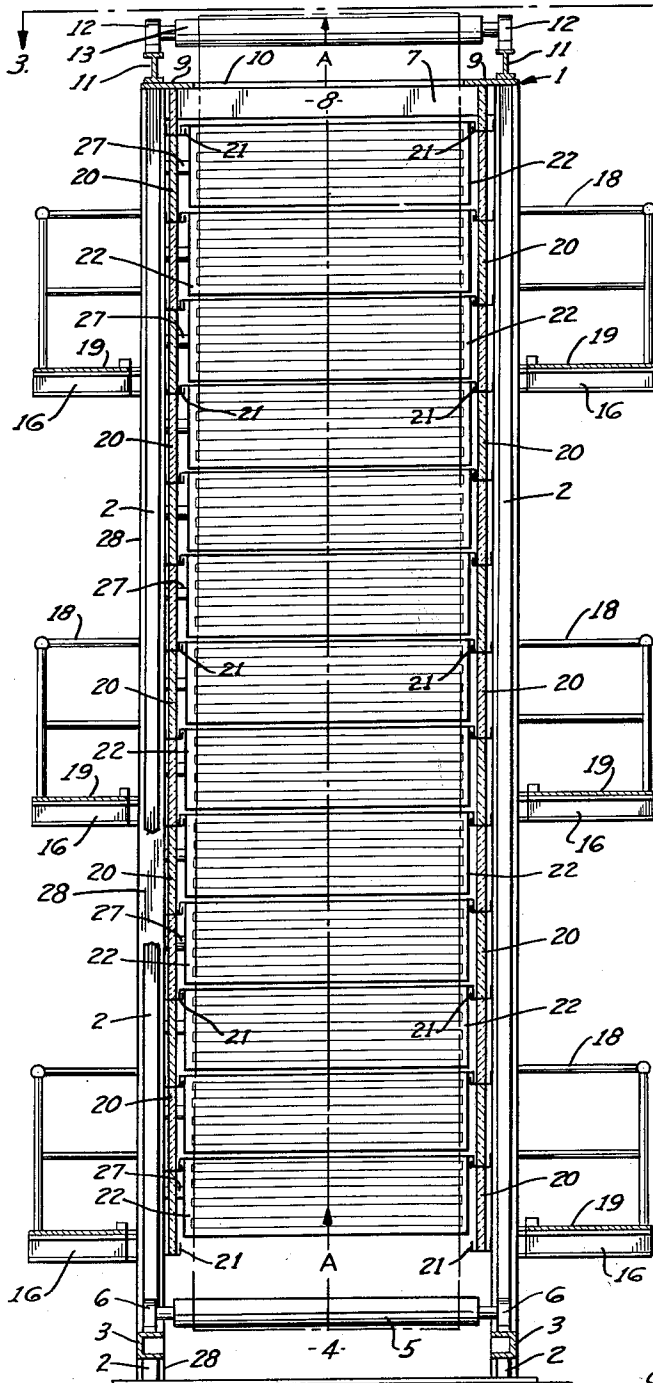


Fig 2.

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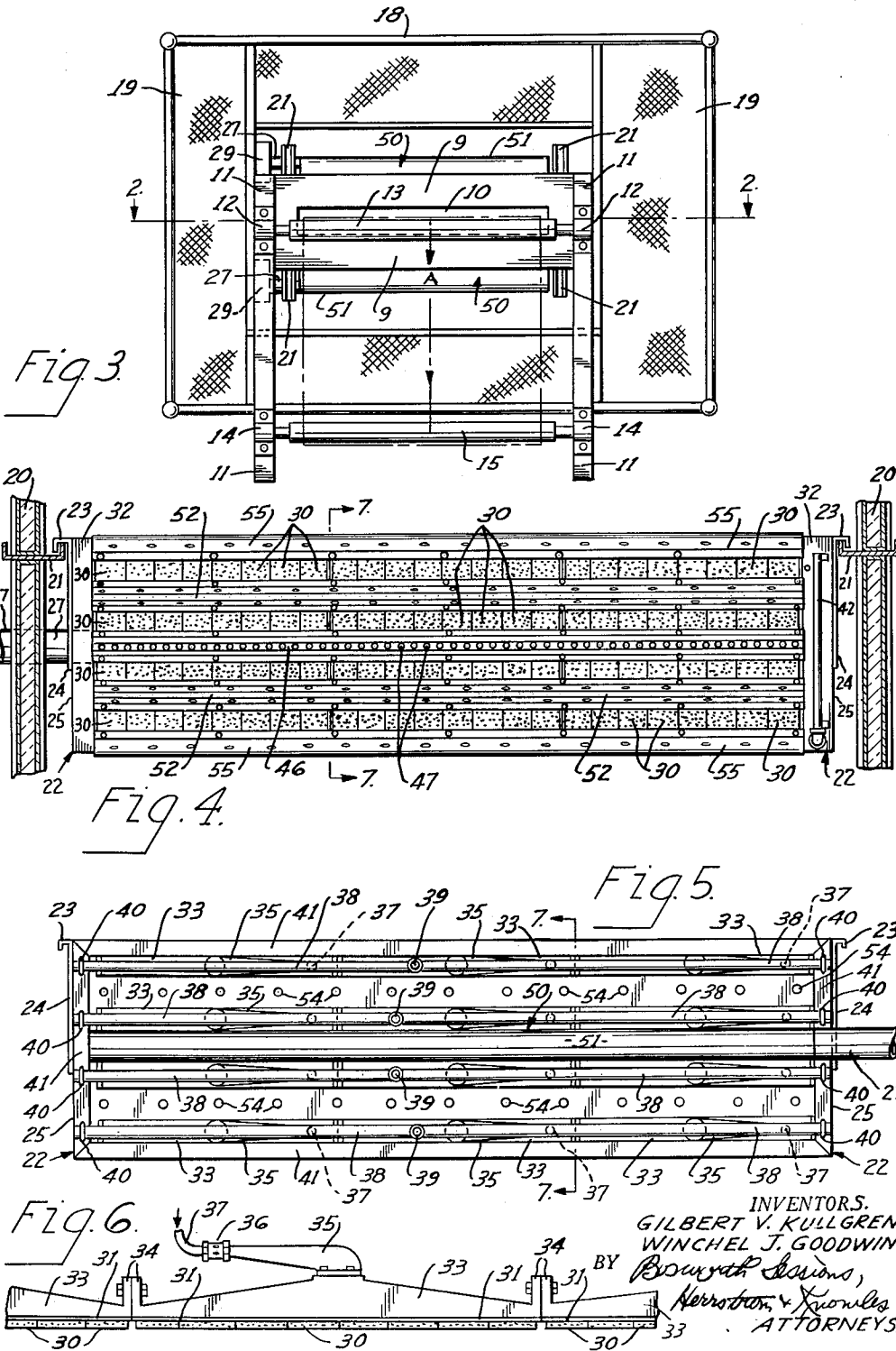
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APPARATUS FOR HEATING AND STRETCHING OF FABRICS

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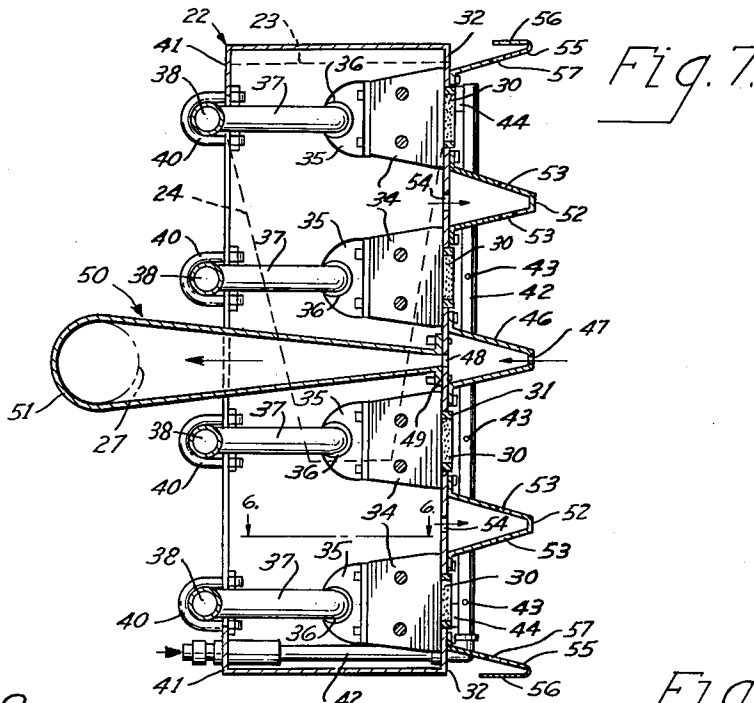
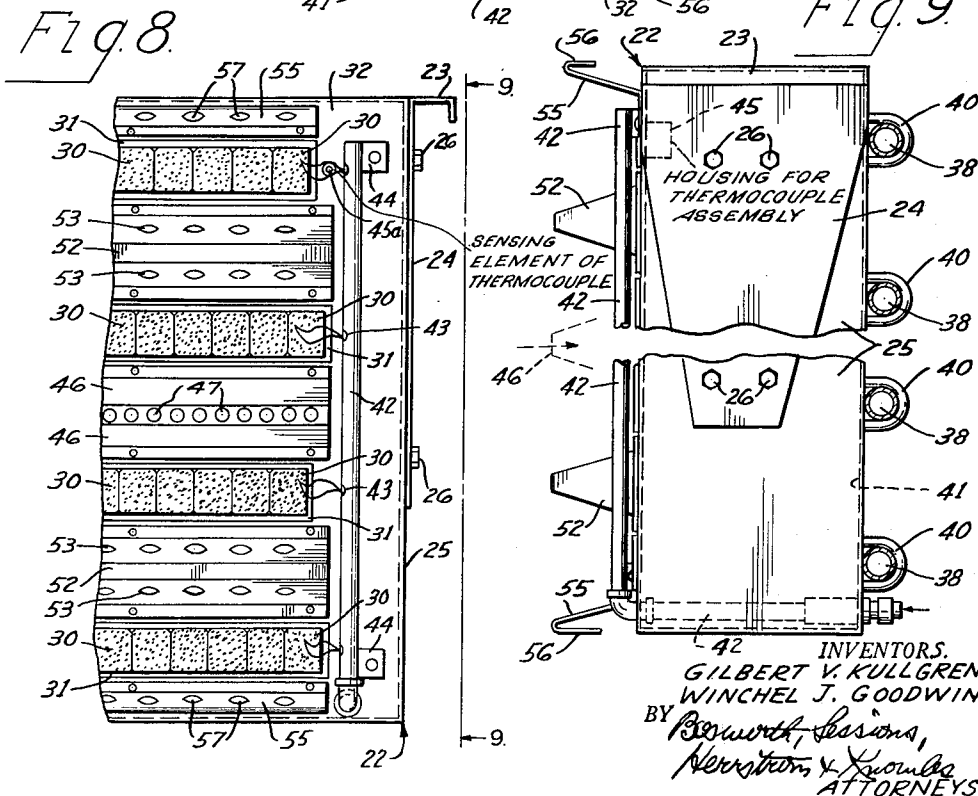
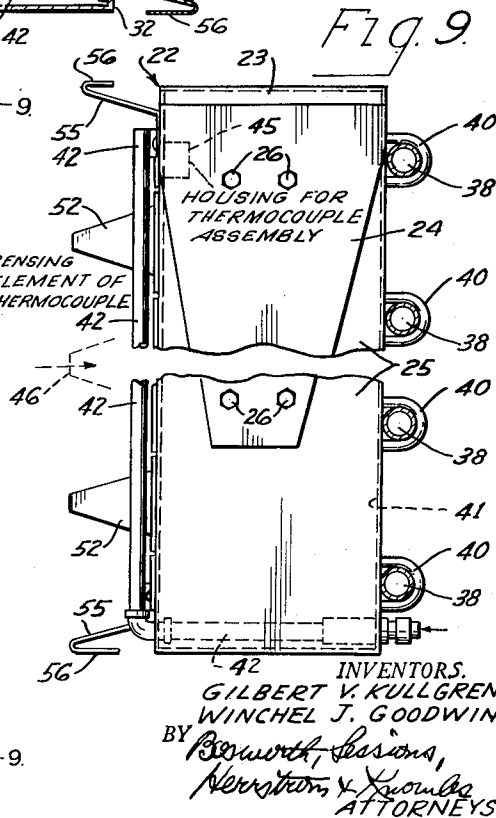
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3,091,441

APPARATUS FOR HEATING AND STRETCHING OF FABRICS

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3 Claims. (Cl. 263—3)

This invention relates to an industrial oven, particularly an oven of a kind usable for the hot-stretching of traveling fabric webs of polyamide, polyester, and similar synthetic resin threads.

To be useful at conventional web travel speeds, such an oven must be capable of directing onto the web large amounts of heat, whether supplied initially in the form of electrical energy, heated air, a combustible gas or some other form. The oven must further be capable of maintaining reliable control over the amount of heat directed onto the web, increasing or decreasing it as necessitated by increasing or decreasing rates of web travel. These requirements, particularly in ovens of the tower type, tend to make for installations that are excessively bulky, expensive to construct, and awkward to service.

It is a principal object of the present invention to overcome these objections. Pursuant to the invention, this is done by constructing the oven of a plurality of self-contained heating units of the nature of thin-walled metal boxes each of which may be introduced, removed or serviced in place independently of any of the others. In a preferred form of the invention, the individual heating boxes are capable of supplying a combustible mixture of gas and air, burning the gas, and discharging the products of combustion from the heating box, all without interference with or from adjoining heating boxes.

Preferably, the heating elements used in the individual heating boxes take the form of foraminous elements of metal or ceramic material lending themselves to quick response when called upon, as by suitable control apparatus, to direct increased or decreased amounts of infra-red radiation onto the web. Heating elements of both types are commercially available at the present time. By arranging a multiplicity of them in a plurality of parallel rows located as close together as may be practicable within the limits imposed by the dimensions of the heating box itself, great economy of space is achieved. This is true both of the individual heating boxes and of the oven as a whole, which, as a corollary, may be of reduced height as compared with prior industrial ovens of the tower type.

Other objects, advantages and features of the invention will be apparent from the description which follows and from the accompanying drawings, in which:

FIGURE 1 is an elevation with parts broken away of an oven of the tower type falling within the purview of the invention.

FIGURE 2 is a section with parts broken away taken on line 2—2 of FIGURE 1.

FIGURE 3 is a plan of the oven as seen from line 3—3 of FIGURE 2.

FIGURE 4 is an enlarged section taken on line 4—4 of FIGURE 1 showing, among other features of the invention, one of the heating boxes as seen in front elevation.

FIGURE 5 is a rear elevation of the heating box of FIGURE 4.

FIGURE 6 is a plan on a somewhat larger scale of a sub-assembly forming part of a representative heating box: see line 6—6 of FIGURE 7.

FIGURE 7 is a vertical section on a still larger scale through one of the heating boxes: see lines 7—7 of FIGURES 4 and 5.

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FIGURE 8 is a fragmentary front elevation of the heating box of FIGURE 7.

FIGURE 9 is an end elevation of the heating box of FIGURES 7 and 8: see line 9—9 of FIGURE 8.

Referring first to FIGURES 1 and 2, what is there designated 1 is a symmetrical hot-stretching oven of the tower type. The principal supporting structure of the oven consists (along with lesser structural elements) of four vertical steel columns 2 each of which takes the form of an H-beam. At their lower ends columns 2 are paired to form side frames by means of two horizontal channels 3 that are welded at their extremities to column 2: see FIGURE 2. Indicated at 4, the open area at the lower end of the oven is largely unobstructed. In it, however, is mounted a roller assembly including a direction-changing roller 5 the ends of which are supported in bearing blocks 6 affixed to channels 3. In passing through the oven, the web to be stretched follows the path indicated in FIGURES 1 and 2 by broken line A, entering the oven at its lower end, passing under roller 5, and proceeding upward in a plane that substantially coincides with the central vertical plane of the oven.

At the upper end of the oven, the supporting structure is characterized by two widely spaced horizontal cross-pieces 7 that extend transversely of channels 3: see FIGURE 2. Welded to columns 2, cross pieces 7 leave between them an open area 8 comparable to open area 4 at the lower end of the oven. Surmounting crosspieces 7 is a metal deck 9 provided with an oblong opening 10 through which the web is discharged: see FIGURES 2 and 3. As appears from FIGURE 2, deck 9 supports two I-beams 11 carrying the bearing blocks 12 for a direction-changing roller 13 that overlies roller 5 at the opposite end of the oven. The web proceeds along the path indicated in FIGURE 1 toward the projecting ends of I-beams 11. Upon the latter are mounted the bearing blocks 14 for a roller 15 which, in the embodiment of the invention illustrated in the drawings, directs the web downward.

At appropriate levels between the upper and lower ends of oven 1 are platforms, best seen in FIGURE 1, consisting of frames 16 made from steel I-beams, steel stiffening webs 17, guard rails 18, and floors 19 of checked metal plate.

The side of the oven appearing in FIGURE 1 above and below the several platforms 16 is nearly completely closed off by a vertical series of insulating panels 20. Although shown in FIGURE 1 as broken away, these panels extend from the level of the lowermost platform 16 to the level of deck 9 at the top of the oven. There is a like series of panels on the opposite side of the oven; i.e., the side seen at the left in FIGURE 2. Accordingly, the lateral edges of the web are flanked by these panels, which are held in upright position by suitable steadying means (not shown). Panels 20 are, however, mainly supported from beneath by rather wide horizontally extending steel channels 21 welded or bolted to columns 2. See, for example, the channels appearing just above the bottom of FIGURE 2 and the channels shown at the top of FIGURE 4.

As indicated in FIGURE 4, channels 21 are used also to support and carry the weight of the heating boxes, which are to be described hereinafter. From the ends of heating boxes 22, reversely bent portions 23 forming part of generally triangular plates 24 project downward into the bights in the channels. The latter are wide enough to receive both reversely bent portions 23 and insulating panels 20. Plates 24 are attached to the end walls 25 of the heating boxes by bolts 26: see FIGURES 8 and 9. Except for the two channels appearing near the bottom of FIGURE 2, paired channels on opposite sides of the oven thus support the various heating boxes with each such channel receiving portions of the supporting means

affixed to the end walls of two such boxes; see FIGURE 1.

As shown in FIGURE 1, heating boxes 22 on the same side of the oven are spaced somewhat from each other to allow for expansion and facilitate removal. In the sense that they overlies each other, the heating boxes may be considered to be superimposed or to form a stack notwithstanding the fact that they are out of actual contact. Scrutiny of FIGURE 1 will reveal further that on opposite sides of travel path A the heating boxes are offset vertically. This off-set is provided in order that any cool zones resulting from the spacing of the above-described heating boxes will not be paired with like cool zones on the other side of the web.

Off-setting of the heating boxes is accomplished by locating as in FIGURES 8 and 9 the triangular plates 24 attached to the heating boxes on one side of the web (the right-hand side seen in FIGURE 1) and locating somewhat below the tops of the respective heating boxes the corresponding triangular plates attached to the heating boxes on the opposite side (the left-hand side seen as in FIGURE 1) of the web. Inasmuch as channels 21 are equidistantly spaced from the bottom to the top of the oven and, as appears from FIGURE 2, occur in pairs at the various levels, the heating boxes on the left-hand side of the web, seen as in FIGURE 1, will be carried somewhat higher than those on the right-hand side. As a result, any two heating boxes confronting each other from opposite sides of the path of travel of the web will be out of registry, notwithstanding the fact that the channels supporting both of them are located at the same level.

From the respective heating boxes, exhaust conduits 27 extend horizontally through suitable openings in insulating panels 20 to vertical exhaust ducts 28 the upper ends 29 of which appear in FIGURE 3. There are two such ducts, both on the same side of the oven; viz., that shown in FIGURE 1. Ducts 28 are provided with fans (not shown) that draw in any moisture vapor, fumes and products of combustion emanating from heating boxes 22. Preferably, they are vented to the atmosphere through suitable duct work and associated ventilators (not shown).

In addition to end walls 25, each of the heating boxes 22 has closed top and bottom portions and front and rear side portions of the nature of walls. Foraminous heating elements, which in the embodiment of the invention shown take the form of ceramic plates 30, are supported in metal frames 31 (seen in FIGURES 7 and 8) that are set into the front walls of the heating boxes. As appears from FIGURE 8, the front wall 32 of each heating box mounts four such frames. Each frame carries a multiplicity of heating elements 30. By virtue of this construction, heating elements 30 are arranged in parallel rows that extend virtually from end to end lengthwise of the individual heating boxes. Preferably, frames 31 are staggered as shown in FIGURE 8 so that the ends of some of them will always project laterally beyond the limits of the web. The latter are indicated by dot and dash lines in FIGURE 2.

Back of each of the frames 31 is a series of three inlet manifolds 33 by which a mixture of gas and primary air is supplied to heating elements 30. Each of inlet manifolds 33 is long enough to permit it to supply the fuel needs of a series of heating elements 30. At the ends thereof, flanges 34 are provided to facilitate coupling the manifolds to each other as shown in FIGURE 6. At the center of each is a flared connecting piece 35 coupled as at 36 to an elbow 37 (FIGURES 5 and 7) supplying a mixture of gas and primary air to the heating elements. Elbow 37 is itself connected to a horizontal pipe 38 plugged at both ends (FIGURE 5) that receives the gas-air mixture through a nipple 39 from a flexible conduit (not shown). Near the ends thereof, pipes 38 are held in position by clamps 40 (FIGURES 5 and 7).

It will be noted from FIGURES 5 and 7 that although rear wall 41 mounts clamps 40, it does not close off the entire back of the heating box but is of skeletal con-

struction in the sense that it takes the form of a series of rim-like flanges in a common plane.

Mounted at one end of each heating box is an L-shaped fuel pipe 42 (FIGURES 8 and 9) which is apertured as at 43 to permit a series of pilot flames to play across the exposed surface of the end heating element in each frame. This is indicated in FIGURE 8 in diagrammatic fashion by the flames shown as emanating from apertures 43 in the vertical leg of pipe 42. The latter is held in place by brackets 44 attached to the front wall 32 of the heating box. A suitably located sparkplug (not shown) can be employed for purposes of ignition. At a convenient point, preferably on the inside face of front wall 32 of the heating box near the plugged upper end of pipe 42, is mounted a housing 45 for a conventional thermocouple assembly provided with an outwardly projecting temperature sensing element 45a; see FIGURES 8 and 9. Such thermocouple assembly forms part of the control system.

On the front wall 32 of each heating box, a single exhaust manifold 46 of reflective metal such as polished aluminum extends lengthwise of the heating box midway between two adjacent rows of heating elements. Seen in cross section, as in FIGURE 7, exhaust manifold 46 is more or less triangular in shape. It is provided at its apex with a series of openings 47 (FIGURE 8) through which moisture vapor, fumes and products of combustion are drawn into the manifold. The direction of flow is indicated by one of the arrows in FIGURE 7.

Suitable apertures 48 in the front wall of the heating box provide a means of communication between the interior of exhaust manifold 46 and an elongated horizontal collector 50 of sheet metal that extends lengthwise of the heating box from end to end thereof; see FIGURES 3 and 7. Provided at its outer extremity with a rounded head 51, collector 50 lends itself to connection at one of its two ends to one of the exhaust conduits 27 to which reference has already been made. Products of combustion and the like travel from exhaust manifold 46 into collector 50, into exhaust conduit 27, and thence into exhaust ducts 28. For each heating box, there is a single exhaust manifold 46, a single collector 50, and a single exhaust conduit 27.

Flanking exhaust manifold 46, but located respectively between the first and second and between the third and fourth rows of heating elements, are two polished aluminum reflectors 52. As in the case of exhaust manifold 46, reflectors 52 are more or less triangular in cross section; see FIGURE 7. On the inclined sides thereof they are provided with openings 53 for cooling air moving through openings 54 in front wall 32 of the heating box. Such air spills laterally out of openings 53 in reflectors 52, mixing with the products of combustion from foraminous heating elements 30.

Paralleling reflectors 52 and at the top and at the bottom of front wall 32 of the heating box are two half-reflectors 55; see FIGURE 7. Located as there shown, fabricated of polished aluminum, and reversely bent to the extent indicated at 56, half-reflectors 55 likewise are provided with lateral openings for incoming air. Such air reaches openings 57 through the shallow spaces which separate adjacent heating boxes. As previously pointed out, adjacent heating boxes are not mounted directly on each other but spaced slightly as shown in FIGURE 1. When the heating boxes are stacked in this manner, the reversely bent portions 56 of adjacent half-reflectors abut, producing structure similar to reflectors 52.

From the foregoing it will be seen that the preferred embodiment of the invention provides a simple, convenient way of mounting the heating elements within the heating boxes and the heating boxes within the oven in such manner that the web is not adversely affected by cool zones along its edges or along the path of its travel. Inasmuch as horizontally extending channels 21 are not closed at their ends, it is possible to slide the various heating boxes into and out of position with little or no

trouble. When it becomes desirable to replace or service a given heating box, it may be removed from the stack without disturbing the heating boxes which overlie or underlie it in the oven. In that it minimizes what is commonly called "down time," this is an important practical advantage.

If desired, the oven may be made unilateral rather than bilateral by omitting one stack of heating boxes.

Although not shown in the accompanying drawings, a control system similar to that shown and described in Kullgren et al. U.S. Patent 2,807,096 may be employed to cut in and cut out the various rows of heating elements and thus vary the intensity of the heat directed onto the web. If desired, the temperature of the web may be determined and controlled by means of a radiation pyrometer unit mounted at or near the top of the oven, as, for example, on the lower face of platform 9. Roll stands by which the web is tensioned as it passes through the oven will normally form part of the installation: such roll stands can be similar to those shown in Kullgren et al. U.S. Patents 2,807,096 and 2,807,097.

In the drawings, the heating elements have been shown as taking the form of ceramic plates, such, for example, as those shown and described in U.S. Patents 2,775,294 and 2,870,830 to Schwank. These and similar foraminous heating elements are characterized by a very high output of radiant energy in the infra-red range; accordingly, their use makes it possible to reduce the height of the oven as compared with ovens equipped with other types of heating elements. If desired, it is of course possible to dispense with the use of such heating elements, substituting for them and for the fuel supply systems which lie behind them a series of ducts for admitting hot air from a furnace outside the confines of the oven. If preferred, the foraminous heating elements shown in the drawings may be replaced by electrical heating elements, eliminating the piping required to bring gas and air into the combustion zone.

It is intended that the patent shall cover, by summarization in appended claims, all features of patentable novelty residing in the invention.

What is claimed is:

1. An industrial oven of the tower type comprising an upright supporting structure; means at one end of the structure for the admission of a moving web; means at the other end of the structure for the withdrawal of the web; means for guiding the web therebetween in a substantially vertical plane; horizontal channels forming part of the supporting structure, said channels extending normally to the plane of the web at the edges of its path of travel; insulating panels carried by such channels, said insulating panels extending vertically in free-standing relation to the remainder of the supporting structure; and, between the insulating panels, a plurality of stacked heating units on each side of the path of travel of the web, each of said heating units taking the form of a self-contained box with means therein for supplying a combustible mixture of gas and air, burning the gas, and continuously removing products of combustion at the rear of the box.

2. An oven according to claim 1 in which the heating boxes on opposite sides of the path of travel of the web are offset vertically.

3. An oven according to claim 2 in which the heating boxes are equipped with supporting means coupled in offset fashion to the horizontal channels.

References Cited in the file of this patent

UNITED STATES PATENTS

683,441	Cooley	Oct. 1, 1901
1,747,822	Foltz	Feb. 18, 1930
2,132,032	Jacobsen	Oct. 4, 1938
2,205,915	Wean et al.	June 25, 1940
2,546,538	Erhardt	Mar. 27, 1951
2,547,735	Blaha	Apr. 3, 1951
2,869,846	Bloom	Jan. 20, 1959

FOREIGN PATENTS

763,402	Great Britain	Dec. 12, 1956
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