United States Patent

[11] 3,618,914

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[21] Appl. No. **46,050**
[22] Filed **June 15, 1970**
[45] Patented **Nov. 9, 1971**

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[54] **APPARATUS FOR PROCESSING TEXTILE CORD**
20 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **263/3,** 34/152, 263/50
[51] **Int. Cl.** **F27b 9/28**
[50] **Field of Search** 263/3, 50; 266/3; 34/152, 155

[56] **References Cited**

UNITED STATES PATENTS

2,807,096	9/1957	Kullgren et al.	263/3
3,554,502	1/1971	Rye et al.	263/3
3,521,375	7/1970	Sanders, Jr.	263/3 X

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ABSTRACT: An apparatus for treating or processing textile cord, especially cords suitable for reinforcing pneumatic tires. The apparatus has a number of vertically stacked and spaced gas-fired burners with exposed flames for emitting infrared radiation. A continuous textile cord, or sheet of textile cord fabric is moved through the apparatus in heat-receiving relation past the exposed flame of burners. A screen or shield with adjustable openings is interposed between the moving cord and each burner for regulating the infrared radiation impinged on the cord. A sensor, responsive to the temperature of the cord, is utilized for changing the size of the openings of the shield to control the environment or heat conditions in which the cord is processed.

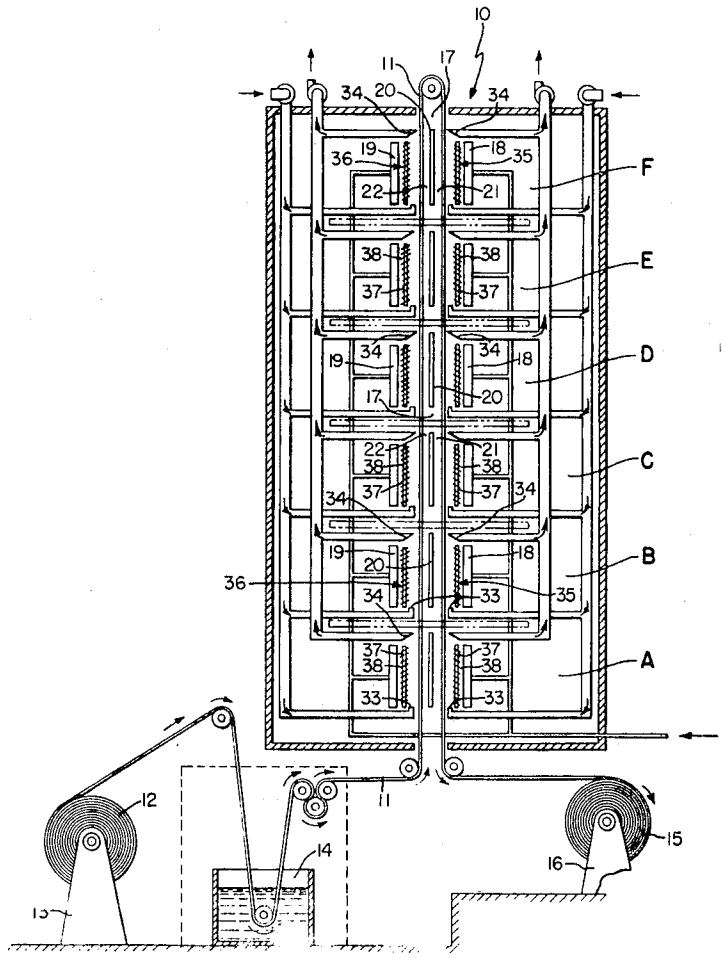
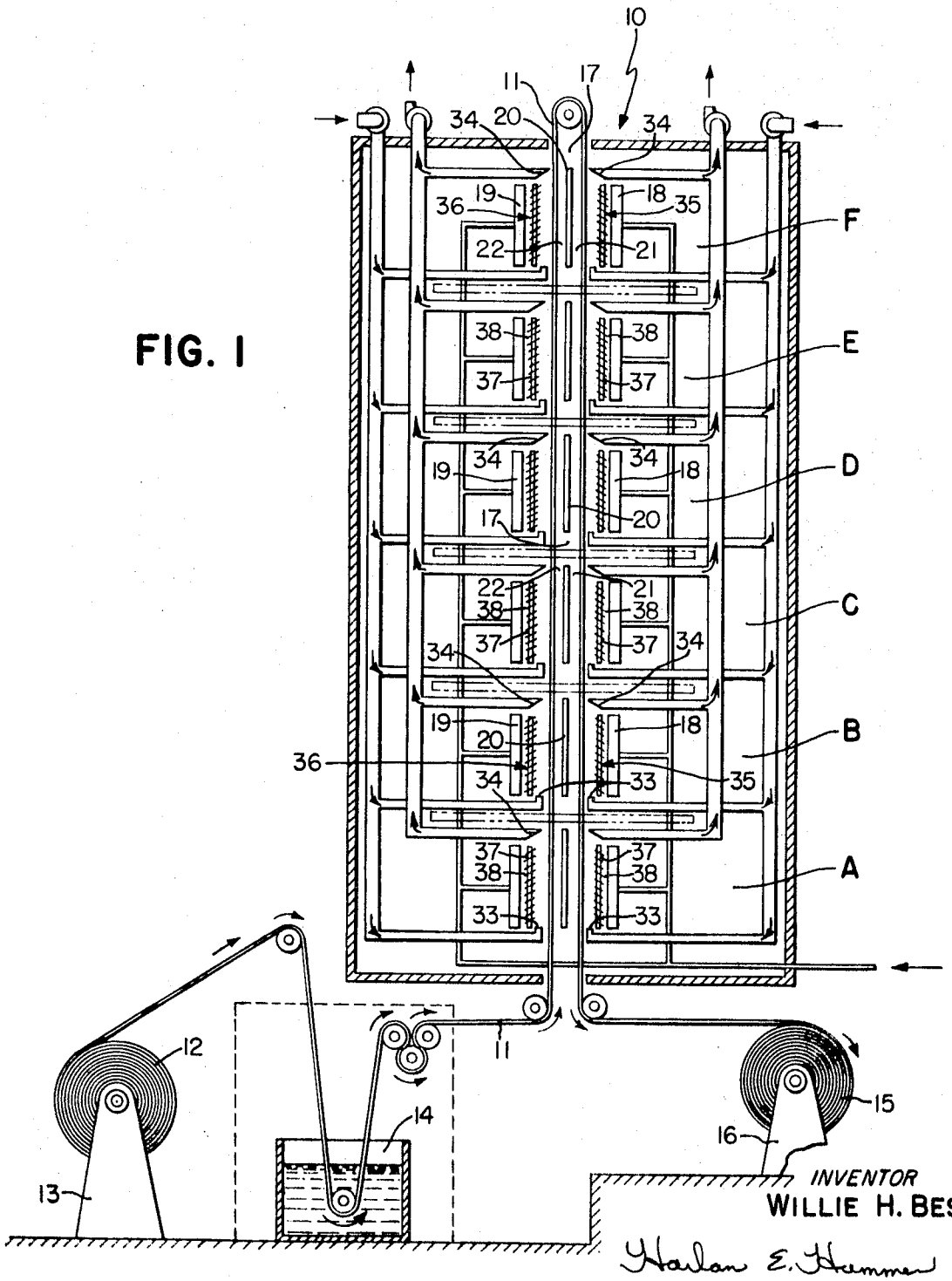


FIG. 1



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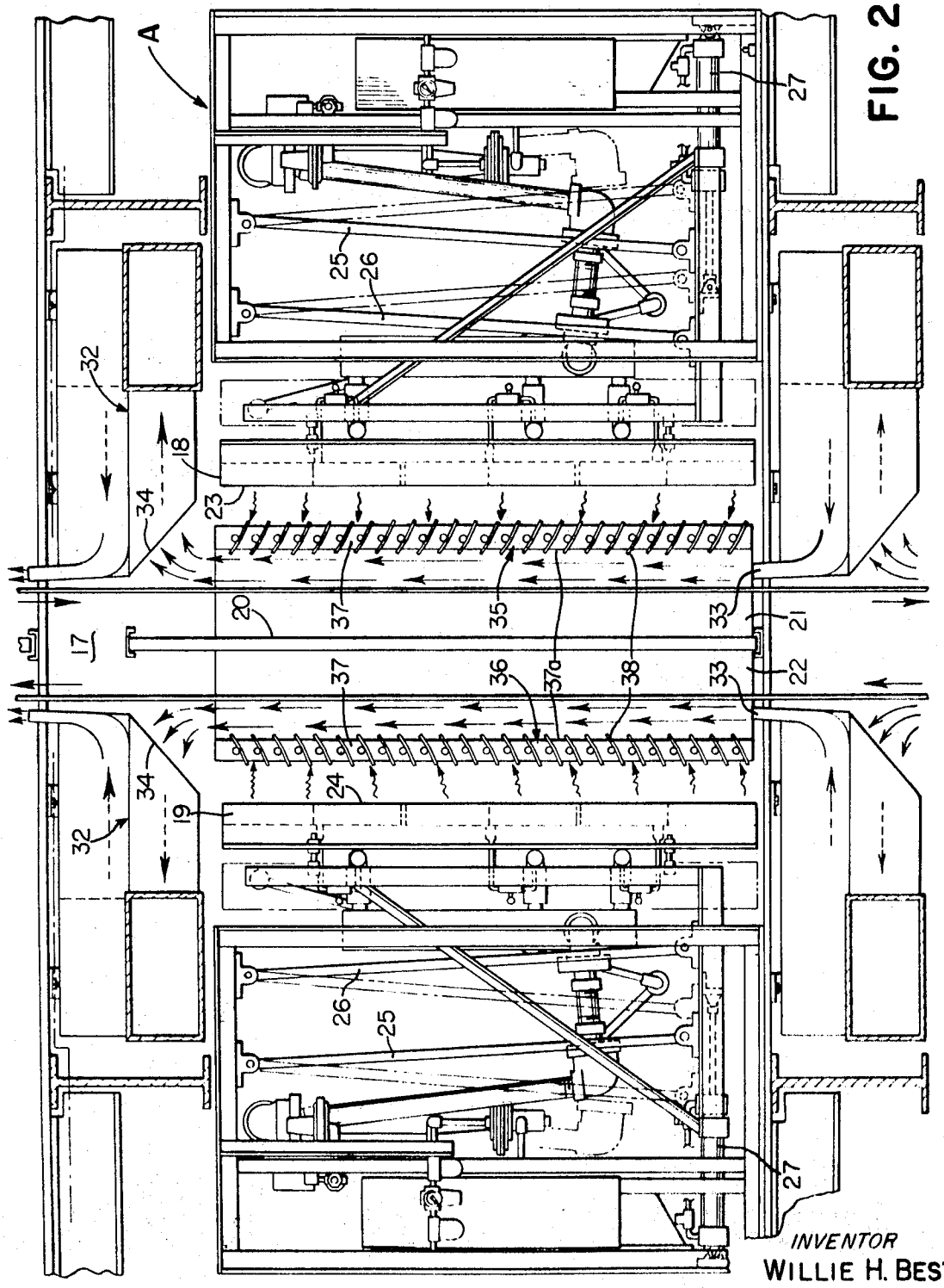


FIG. 2

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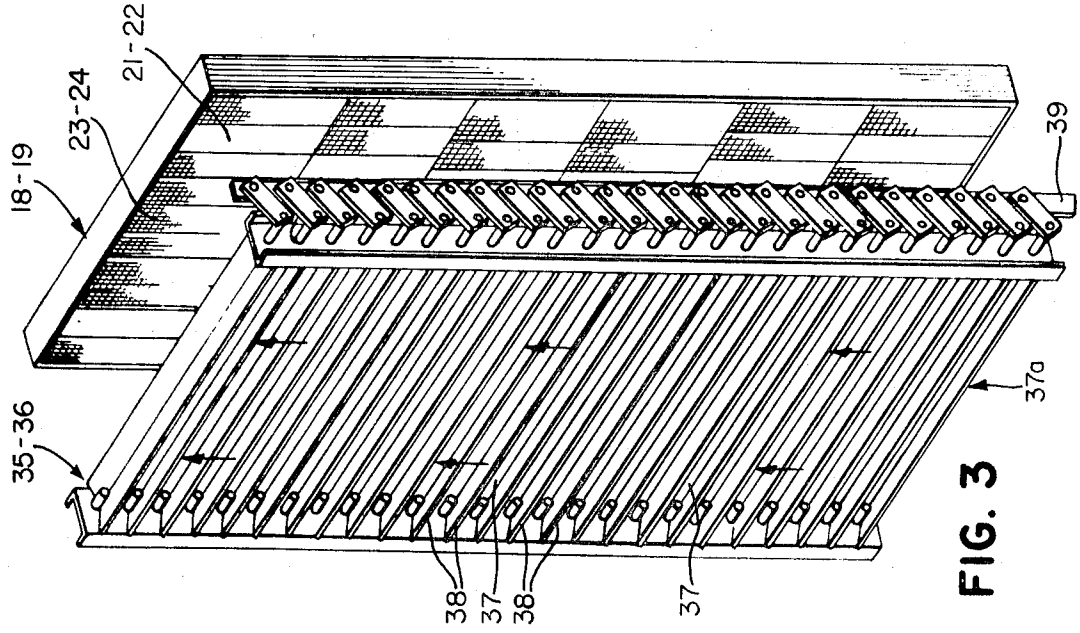
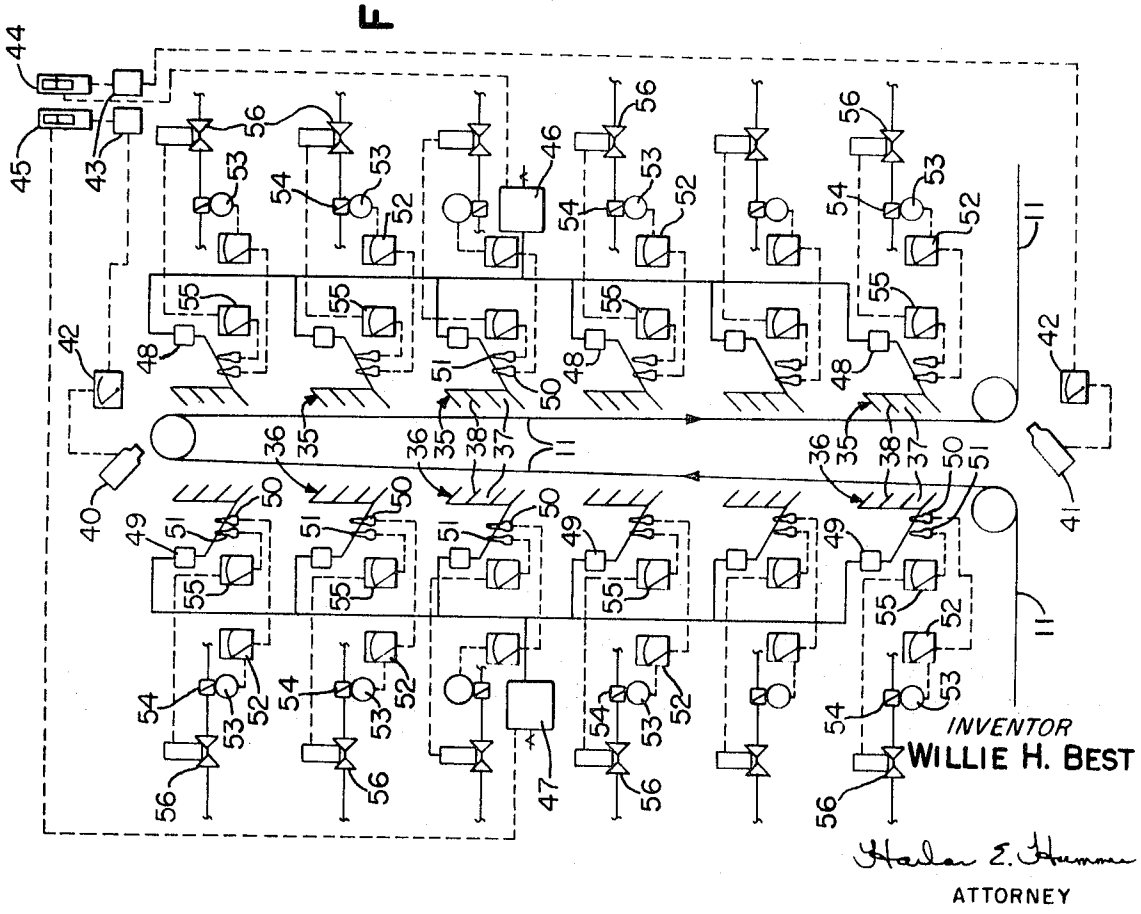


FIG. 3

FIG. 4



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APPARATUS FOR PROCESSING TEXTILE CORD

BACKGROUND OF THE INVENTION

Infrared burners using gaseous fuels, have proven to be an ideal source of energy for removing solvents or other liquid coatings from various types of fabrics employing natural or synthetic textile cords. The temperature of the fabric is not difficult to control when solvent is present in the fabric, because of the latent heat of evaporation of the solvent and the ability to control the temperature of the fabric at temperatures relatively close to the boiling point of the solvent. However, it is sometimes necessary to perform additional heat-treating or curing operations after the solvent is removed from the fabric. It is then that controlling the temperature of the fabric becomes a problem.

The energy level of an infrared system using gas-fired burners, must be rapidly changed in the event of line stoppage or change in line speed, because of the low mass and specific heat of the fabric. Then too, it is sometimes desirable to control the rate of temperature change in a fabric as well as the final temperature of the fabric. Normally, gas-fired burners do not respond fast enough to accommodate rapid changes in processing conditions commonly used in industry today, primarily because of the thermal inertia of the burners. The invention is directed to an infrared system which eliminates or substantially reduces this problem and has certain advantages over more conventionally designed convection air-type systems. For example, the gas load to an infrared system is usually less, because it is not necessary to change the temperature of large masses of circulating air as in a convection oven, Thus, for the same amount of energy transferred to the fabric, the exposure time of the fabric is substantially smaller in an infrared system.

Briefly stated, the invention is in an apparatus for processing a continuous textile cord fabric. The apparatus comprises at least one gas-fired heater with an exposed flame for emitting infrared radiation. Means are provided for moving a continuous sheet of textile cord fabric in heat receiving relation past the heater. A shield with adjustable apertures or openings is positioned between the moving fabric and heater. Means are provided for sensing physical properties of the fabric such as temperature or moisture content of the fabric and correspondingly regulating the size of the openings to control infrared radiation impinged on the moving fabric.

DESCRIPTION OF THE DRAWING

The following description of the invention will be better understood by having reference to the annexed drawing, wherein:

FIG. 1 is a cross section of an apparatus using gas-fired burners for processing textile cord fabric;

FIG. 2 is an enlarged section of the apparatus showing a pair of burners between which fabric is alternately moved;

FIG. 3 is a perspective view of a burner and shutter with adjustable louvers for controlling infrared radiation impinged on the fabric; and

FIG. 4 is a schematic diagram showing electrical and pneumatic circuitry for operating the shutters and heater.

DESCRIPTION OF THE INVENTION

Referring more particularly to FIG. 1, there is shown an infrared oven, generally indicated at 10, for processing textile cord fabric 11, especially suitable for building pneumatic tires. The oven 10 comprises a number of similar modular heating units A–F, which are disposed in vertically stacked relation. A roll 12 of the textile cord fabric 11 is taken from a letoff 13 and passed through a bath 14 containing a liquid coating, such as an adhesive for increasing the bond or adhesion between the textile cord and rubberized material used in the fabrication of pneumatic tires. The fabric 11 is moved from the bath 14 alternately through the oven 10 and wrapped on a roll 15 mounted on a windup assembly 16. The following description of the modular heating units A–F is in relation to unit A (FIG. 2), since all of the units are essentially the same.

The modular heating unit A comprises a partially enclosed heat treating chamber 17, including a pair of gas-fired burners 18 and 19, which are disposed in spaced relation on either side of a vertical plate 20 dividing the chamber 17 into two adjacent fabric-treating compartments 21 and 22.

The gas burners 18 and 19 have exposed mats 23 and 24 on which an open flame is formed. The gas burners 18 and 19 are preferably mounted for parallel movement towards and away from each other and the divider plate 20 by any suitable means, e.g. link arms 25 and 26 and operating cylinder 27, but can in some instances, be stationary.

A system 32 for circulating gas, e.g. air, under pressure, is associated with each of the fabric-treating compartments 21 and 22. The gas-circulating systems 32 each comprise a gas inlet 33 and exhaust 34, which are, respectively, in vertical spaced relation below and above the gas burners 18 and 19.

A pair of shields or shutters 35 and 36 are, preferably, disposed in fixed relation between the divider plate 20 and each of the burners 18 and 19 in generally vertically aligned relation between the gas inlet 33 and gas exhaust 34. The shutters 35 and 36 act to channel the streams of gas alongside the fabric 11 as the gas moves from the gas inlet 33 upwards toward and into the gas exhaust 34. The gas streams contact and scrub the fabric 11 helping to dry and set the liquid coating on the fabric 11.

The shutters 35 and 36 are provided with a number of adjustable apertures or openings, e.g. opening 37, for regulating infrared radiation passing through the shutters 35 and 36 into contacting, impinging relation against the moving fabric 11. For example, the shutters 35 and 36 are each provided with an enlarged opening 37*a* in which is mounted a number of movable louvers, e.g. louvers 38. The louvers 38 are rotatable to a number of different arcuate positions for varying the size of the apertures or openings 37 between adjacent louvers 38, or the enlarged opening 37*a* of each of the shutters 35 and 36. The louvers 38 are movable between a fully open position, where the louvers 38 are in horizontal parallel relation, to a fully closed position, where the louvers 38 are in a generally aligned and engaged vertical position and the openings 37 between adjacent louvers 38 are completely closed.

The louvers 38 of each shutter 35 and 36 are coupled to a rod or lever 39 (FIG. 3) for rotating in unison in response to vertical movement of the rod 39. Thus, the louvers can be moved to a number of arcuate positions between a fully open and closed position to vary the size of the apertures or openings 37, thereby controlling heat or infrared radiation impinged on the moving fabric.

Any suitable means, responsive to the temperature of the fabric 11, can be utilized for monitoring the treatment or processing of the fabric 11 and modulating or changing the arcuate position of the louvers 38 and consequent size of the openings 37 in corresponding relation to a difference in the actual temperature of the fabric 11 from a predetermined desired temperature at that particular point in the process. For example, a pair of conventionally designed photoelectromagnetic radiant temperature sensors 40 and 41 are provided for sensing the temperature of the fabric 11 as it moves upwardly and downwardly out of the oven 10. These particular sensors 40 and 41 are very selective in their spectro response and generally eliminate problems associated with water vapors and other infrared absorbents in the atmosphere, and can be used in ambient temperatures up to about 250° F. when the unit is cooled with water.

An electronic converter 42 is electrically associated with each of the sensors 40 and 41 for converting their sensed signals to millivolt signals. A second converter 43 is in electrical communication with each of the other converters 42 for changing the millivolt signals into current signals which are transmitted to, and used at the stations 44 and 45 for detecting any deviation from a prescribed treatment of the fabric 11 by comparing the signals received with predetermined desired signals.

Electrical signals for correcting the processing of the fabric in the compartments 21 and 22 are sent from the control sta-

tions 44 and 45 to a set of electropneumatic transducers 46 and 47, which convert the electrical signals to an air signal for operating a pair of lever-type air motors 48 and 49 with mechanical positioners for correspondingly moving the rods 39 axially to consequently rotate the louvers 38 of the shutters 35 and 36 to different arcuate positions for varying the size of the apertures or openings 37 in the shutters. A more sophisticated system can be designed using a pair of electropneumatic transducers for separately operating the shutters 35 and 36 of each modular heating unit A–F, rather than a single pair of transducers 46 and 47 for operating the shutters 35 and the shutters 36 of the oven 10 in unison.

An alternate system is provided for sensing and monitoring the temperature of the gas, e.g. air, between the shutters and adjacent gas-fired burners, and adjusting the flame of the burners to control this temperature and keep the shutters from being overheated and damaged. For example, a pair of thermocouples 50 and 51 are provided between the shutters 35 and 36 and adjacent burners 18 and 19. The thermocouple 50 is in electrical communication with a temperature controlling device 52 for sending an electrical signal to a conventionally designed actionator motor 53 used to operate a butterfly valve 54 for regulating gas pressure to the burners 18 and 19. The thermocouple 51, on the other hand, is in electrical communication with a high-temperature limit control 55 for protecting the shutters against excessive temperatures if other control functions fail. The high-temperature control 55 is in electrical communication with a fluid power safety valve 56 for shutting off gas to the burners 18 and 19.

Thus, it should be appreciated that the shutters 35 and 36 can be operated in unison or separately to regulate infrared radiation impinged against the moving fabric 11, by varying the size of the openings 37 between adjacent louvers 38. The aforementioned mechanisms for monitoring the process and changing the position of the louvers is related to the temperature of the moving fabric, rather than the speed at which the fabric moves through the oven 10, since the temperature of the fabric is the most important factor in the treatment of the textile cord fabric, and the speed, exposure, and other conditions of the process are adjusted to obtain and maintain desired temperatures at which the fabric is processed.

The invention is described particularly with the control of the system with respect to sensing temperature, but other control means could be employed such as sensing the solvent content of the processed fabric. In this case a sensor responsive to moisture content could be used to provide the primary signal for operation of the shutters.

While certain representative embodiments and details have been shown for the purpose of illustrating the invention, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

What is claimed is:

1. An apparatus for processing textile cord fabric, comprising:
   a. at least one gas-fired heater with an exposed flame for emitting infrared radiation;
   b. means for moving a continuous sheet of textile cord fabric in heat-receiving relation past the heater;
   c. at least one sensor for sensing a physical property of the moving fabric;
   d. a shield with a plurality of adjustable apertures, positioned between the heater and moving fabric during operation of the heater; and
   e. means responsive to the sensor for adjusting the size of the apertures to regulate infrared radiation impinged against the moving fabric.

2. The apparatus of claim 1, which includes:
   f. means for adjusting the flame of the heater in response to a change in the size of the apertures;

3. The apparatus of claim 1, which includes:
   g. means responsive to a change in the size of the aperture for retracting the heater in a direction away from the shield.

4. The apparatus of claim 1, which includes:
   h. means for mounting the shield and heater for unitary movement relative to the moving fabric.

5. The apparatus of claim 1, which includes:
   i. means for mounting the shield in fixed spaced relation from the moving fabric.

6. The apparatus of claim 1, wherein the shield includes a shutter with louvers movable between open and shut positions.

7. The apparatus of claim 6, wherein the means (e) for adjusting the apertures includes means for arcuately positioning the louvers in unison in a plurality of different positions between the open and shut positions of the louvers.

8. The apparatus of claim 7, which includes a first sensor disposed between the shutter and heater for sensing the temperature of the atmosphere therebetween, and means responsive to the sensor for adjusting the flame of the heater when said temperature reaches a predetermined level.

9. The apparatus of claim 8, which includes a second sensor disposed between the shutter and heater for sensing the temperature of the atmosphere therebetween, and means responsive to the second sensor for retracting the heater from the shutter when said temperature reaches a predetermined level different from the temperature at which the flame is adjusted.

10. The apparatus of claim 9, which includes means for shutting off the flame when the temperature of the atmosphere between the shield and heater reaches a predetermined level higher than the other temperature levels.

11. The apparatus of claim 1, wherein the sensor senses the moisture content of the fabric.

12. The apparatus of claim 1, wherein the sensor senses the moisture content of the fabric.

13. The apparatus of claim 12, wherein the sensor senses adhesive applied to the fabric for increasing the adhesion between the fabric and rubberized material used to produce tires.

14. An apparatus for processing textile cord fabric comprising:
   a. a plurality of gas-fired heaters disposed in stacked, spaced relation one above the other;
   b. means for moving a continuous sheet of textile cord fabric in heat-receiving relation successively past the heaters;
   c. at least one sensor for sensing a physical property of the moving fabric;
   d. a shutter positioned between the moving fabric and each of the heaters during operation of the heaters, said shutters each having an opening and a plurality of rotatable louvers for varying the size of the opening in the shutter; and
   e. means responsive to the sensor for rotating the louvers of at least one shutter to a number of different arcuate positions for varying the size of said opening in said one shutter and consequent infrared radiation impinged against the moving fabric.

15. The apparatus of claim 14, wherein the sensor senses the moisture content of the fabric.

16. The apparatus of claim 14, wherein the sensor senses the temperature of the fabric.

17. The apparatus of claim 16, which includes:
   f. means for adjusting the flame of a burner adjacent a partially closed shutter when the temperature of the atmosphere between the burner and shutter reaches a predetermined level.

18. The apparatus of claim 17, which includes:
   g. means for retracting a burner, adjacent a partially closed shutter, from the moving fabric when the temperature of the atmosphere between the shutter and burner reaches a predetermined level.

19. The apparatus of claim 18, which includes:
   h. means for discharging streams of gas, under pressure, into the space between the moving fabric and each shutter, the gas contacting and scrubbing the fabric to help dry a liquid coating applied to the fabric.

20. The apparatus of claim 19, which includes:

i. means for removing at least a portion of the gas after the gas becomes ladened with heat products generated by infrared radiation.

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