

Feb. 22, 1966

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3,235,931

APPARATUS FOR THE HEAT SETTING OF CLOTH LAYERS

Filed March 28, 1962

4 Sheets-Sheet 1

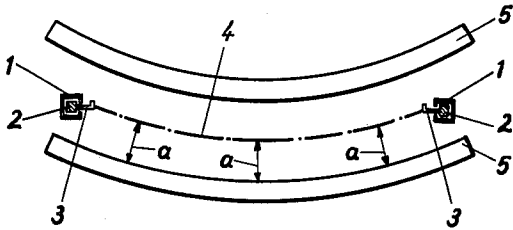


Fig. 1

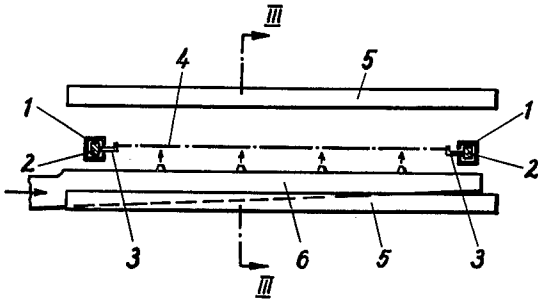


Fig. 2

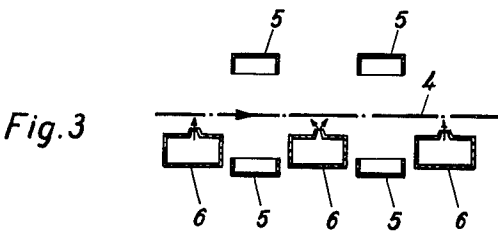


Fig. 3

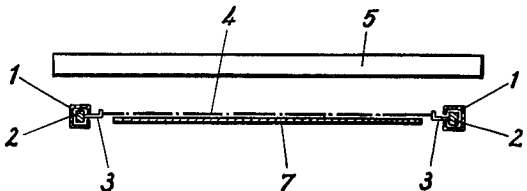


Fig. 4

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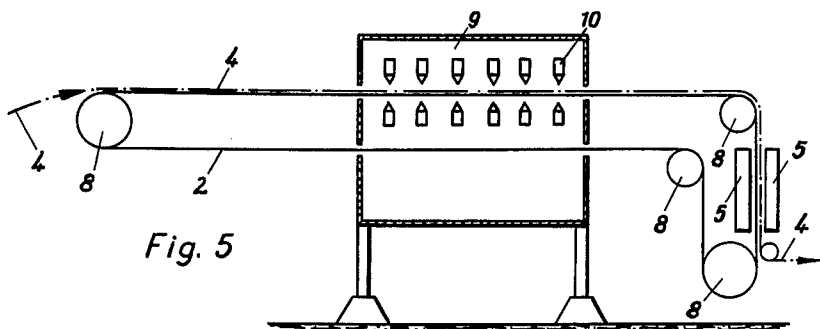
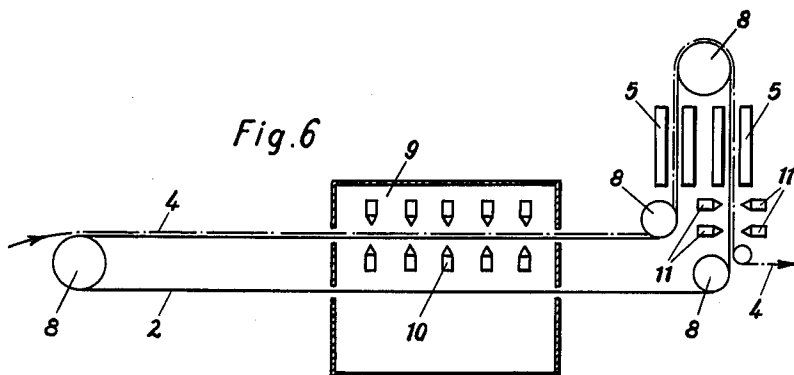
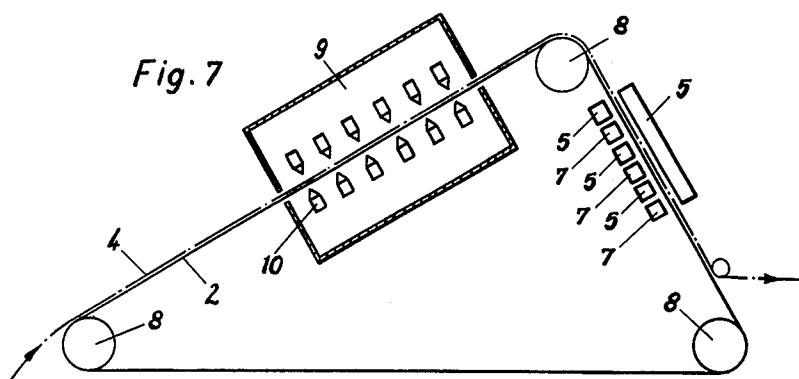
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

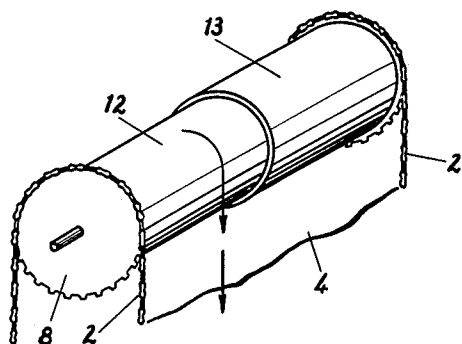


Fig. 8

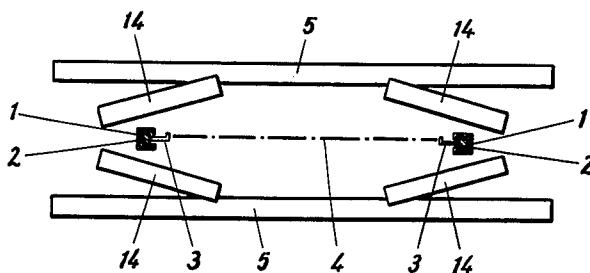


Fig. 9

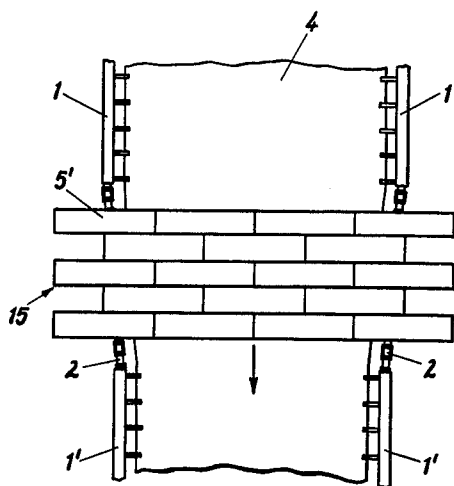


Fig. 10

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4 Sheets-Sheet 4

Fig. 11

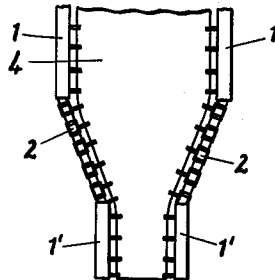
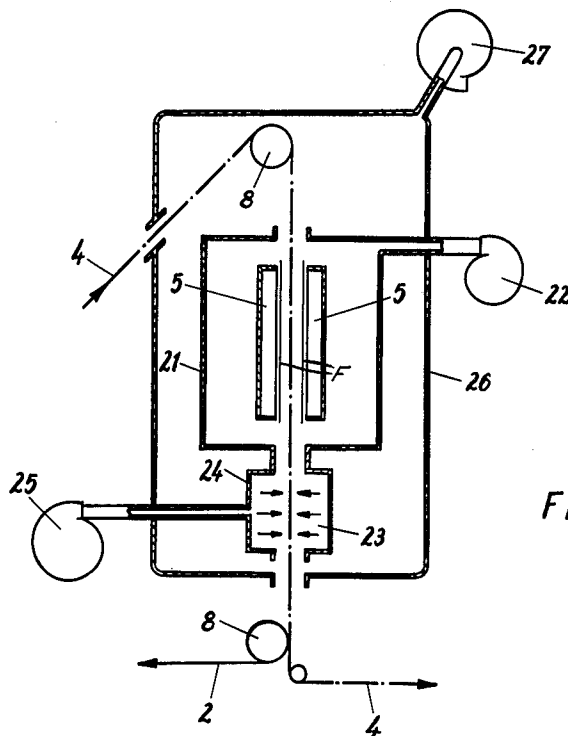


Fig. 12

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1

3,235,931

APPARATUS FOR THE HEAT SETTING OF CLOTH LAYERS

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Claims priority, application Germany, Apr. 1, 1961,
T 19,916; Apr. 14, 1961, T 19,976

3 Claims. (Cl. 26—1)

The present invention relates to a method and apparatus for the heat-setting of woven or knitted cloth layers which are made partly or entirely of synthetic fibers.

For producing the high temperatures within a cloth layer necessary for setting the same, various methods are known which may be classified in two groups. One of these groups includes setting by means of saturated steam or hot water under pressure, while the other group includes setting by means of dry heat which is generated especially by contact heating of the cloth layer with hot air or infrared radiation. The dry setting methods are usually preferred over the wet methods since they allow a continuous treatment of the cloth layer at atmospheric pressure. The conventional dry setting methods have, however, the disadvantage that very high temperatures on the order of 200° C. (approximately 400° F.) temperatures occur on the outer surface of the cloth layer since the heat which is required for the setting process is supplied from the outside thereof. Therefore to date it has been possible to set only dry fabrics. Furthermore, since at these high temperatures most dyes are no longer stable, it has been necessary to carry out the setting process prior to the dyeing process. The application of such high temperatures is also detrimental to mixed or blended fabrics since the natural fibers which are added are often badly affected by the temperatures involved. Furthermore, these conventional methods do not permit a setting of gray goods since the residues on the cloth layer which result from the manufacture, for example, oils and the like, will be decomposed by the setting temperature and will then soil the cloth layer or be baked into the same and thus damage the materials.

It is an object of the present invention to provide a setting method which overcomes the disadvantages of the conventional methods, and consists in the employment of radiators the energy of which will be absorbed by the synthetic fibers so that the fibers will be heated from the inside, while the surface of the fibers will remain relatively cool. For this purpose infrared radiators having an emission maximum which lies within the range of a wave length at which the synthetic fibers have a maximum absorptive capacity have proved especially successful. The emission spectrum of the infrared radiators may be limited by means of filters to the range of the desired wave length. Since the cloth layer is heated from the inside, it is also possible to cool the outer surface of the cloth layer within the setting zone, for example, by blowing air thereon.

A further object of the invention is to provide suitable apparatus which is especially adapted for carrying out the method according to the invention for heat-setting woven or knitted cloth layers which are made partly or entirely of synthetic fibers. This apparatus comprises suitable conveying means including tension chains for holding and guiding the cloth layer on its longitudinal edges, and infrared radiators which are mounted within the setting zone at least adjacent to one side of the cloth layer and having an emission maximum within the range of a wave length at which the synthetic fibers have a maximum absorptive capacity. Another feature of the invention consists in the provision of means for maintaining

2

the entire width of the cloth layer at a uniform distance from the infrared radiators within the setting zone.

While, for example, in the process of drying a cloth layer, it is of no particular importance as to whether the cloth layer is maintained at a uniform distance across its entire width from the infrared radiators since the drying process occurs along the outer surface of the cloth layer and it is only necessary to evaporate the water which adheres thereto, it is of a very great importance to maintain such a uniform distance during the setting process. In order to set the cloth layer uniformly, the same amount of energy must be absorbed by each point of the cloth layer and therefore the same energy density must be radiated upon each point of the cloth layer. Since the energy density of the radiation decreases in accordance with the square of the distance from the radiator, it is evident that it is of great importance that the distance of the cloth layer from the radiators be maintained as uniformly as possible.

Inasmuch as a cloth layer which is laterally secured on tension chains and is moved in a substantially horizontal direction is bound to sag between these chains, it is another object of the invention to provide special means for maintaining a uniform distance between the infrared radiators and the cloth layer across the entire width thereof. According to the present invention, it is, however, also possible to attain the mentioned object without requiring a special means by guiding the tension chains within the setting zone so as to extend at least substantially in a vertical direction, since the cloth layer may then be properly stretched without danger that it might sag.

These and further objects, features, and advantages of the present invention will become more clearly apparent from the following detailed description which is to be read with reference to the accompanying diagrammatic drawings, in which—

FIGURE 1 shows a cross section of a setting apparatus according to the invention with a sagging cloth layer and curved radiators;

FIGURE 2 shows a cross section similar to that as shown in FIGURE 1, but in which the cloth layer is held in a level position by blowing air thereon;

FIGURE 3 shows a cross section taken along line III—III of FIGURE 2;

FIGURE 4 shows a cross section similar to that as shown in FIGURE 1, but in which the cloth layer is mechanically supported;

FIGURE 5 shows a side view of an apparatus in which the cloth layer is guided in the setting zone so as to move in a vertical direction;

FIGURE 6 shows a side view of a further apparatus with a vertical setting zone;

FIGURE 7 shows a side view of an apparatus in which the cloth layer is guided in the setting zone in an oblique direction;

FIGURE 8 shows a perspective view of a guide roller as employed in the apparatus according to FIGURES 5 to 7;

FIGURE 9 shows a cross section of a setting apparatus which is provided with lateral radiators;

FIGURE 10 shows a plan view of the setting zone of another apparatus according to the invention;

FIGURE 11 shows an enlarged plan view of the means for guiding the tension chains according to FIGURE 10; while

FIGURE 12 shows a cross section of an apparatus for cooling the cloth layer within the setting zone and for drawing off vapors.

The apparatus according to the invention as illustrated in FIGURE 1 is provided with lateral chain rails 1 in which are guided endless tension chains 2 which are used

for conveying a cloth layer 4 the edges of which are attached upon hooked needles 3 projecting laterally from the chains 2. The chain rails 1 are adjustable relative to each other in accordance with the width of the particular cloth layer to be treated. The endless tension chains 2 are guided by means of guide pulleys, not shown at least some of which are driven for moving the chains. This conveying mechanism is of a type which is conventional in tenter frames and similar apparatus and therefore does not need to be described in greater detail herein.

Within the setting zone of the apparatus, infrared radiators 5 are mounted above and also below the cloth layer 4. The emission maximum of these infrared radiators 5 lies within the range of a wave length in which the synthetic fibers of the cloth layer have a maximum absorptive capacity. With the usual synthetic fabrics, this wave length amounts to about 0.12 mil or a multiple thereof. Insofar as it may be required, the emission spectrum of the infrared radiators may be limited by means of filters to the range of this wave length. In place of infrared radiators it is also possible to employ other types of oscillators, such as ultrasonic generators or high-frequency generators, the frequency of which must then be adjusted to the natural frequency of the molecules of the synthetic fibers.

As illustrated in FIGURE 1, the cloth layer 4 when guided horizontally sags downwardly due to its own weight. If the radiators 5 are straight or planar, as illustrated in FIGURES 2 to 4, the distances between the cloth layer and these radiators would differ at every point transversely of the cloth layer. This would mean that the density of the radiant energy reaching the cloth layer and thus the heating and setting thereof would also be irregular which would seriously affect the quality of the material. Provision should therefore be made that the distance a between the cloth layer 4 and the radiators 5 remains the same across the entire width of the cloth layer. This may be attained according to FIGURE 1 by making the radiators 5 of a curved shape in accordance with the sag of the cloth layer 4. The means for adjusting the chain rails 1 relative to each other may also be employed for stretching the cloth layer transversely so that its sag corresponds exactly to the curvature of radiators 5.

As illustrated in FIGURES 2 to 4, the cloth layer may also be prevented from sagging within the setting zone by the provision of suitable supporting means. According to FIGURES 2 and 3, air nozzles 6 for this purpose may be arranged within the setting zone underneath the cloth layer 4 and directed toward the latter. The air current which is ejected from these nozzles 6 is adjusted to the proper strength so as to carry the cloth layer and to hold it parallel to the plane of the radiators 5. This air current also serves for cooling the surfaces of the cloth layer so that the heat which is generated by the infrared radiators will be limited to the inside of the fibers and will not damage, for example, any colors on the surfaces of the material. Instead of being supported by air currents, the cloth layer 4 may be supported according to FIGURE 4 by mechanical means 7 which may consist, for example, of a net which travels with the cloth layer or a plate through which rays may penetrate. It may then be advisable to mount the radiators 5 at one side of the cloth layer only and in such a manner that the hooked needles 3 and the tension chains and their guide rails will not throw a shadow upon the cloth layer.

No special means for maintaining a uniform distance between the cloth layer and the radiators will be required if, as shown in FIGURES 5 and 6, the radiators 5 extend in a vertical direction and the cloth layer is also moved in a vertical direction within the setting zone. In such a case, there is no possibility that the cloth layer might sag. FIGURES 5 and 6 also indicate the manner in which the tension chains 2 are guided at the different turning points by sprocket wheels 8. According to these embodiments of the invention, the cloth layer 4 is at first

conveyed by the tension chains 2 in a horizontal direction and during this horizontal travel it passes through a drying apparatus 9 which consists of a box in which hot-air nozzles 10 are mounted. In the apparatus according to FIGURE 6, the cloth layer 4 after passing through the setting zone and between the radiators 5 therein also passes through a cooling zone which is provided with cold-air nozzles 11.

Instead of running horizontally within the area preceding the setting zone, the tension chains may also run in an oblique direction, as indicated in FIGURE 7 which shows the setting zone including the radiators 5 as being inclined. In order to prevent the cloth layer 4 from sagging, air nozzles 7 are again provided adjacent to the lower side of the cloth layer between the rod-shaped radiators 5. The air currents ejected from these air nozzles 7 hold the cloth layer in a flat position and also cool the surface thereof.

If the setting process is not to be followed by any further treatment but the cloth layer after being set is ready for sale, it is advisable to dry the cloth layer before it is set. Since the method according to the invention also permits dyed cloth layers to be set, such a material may be dyed immediately after a preliminary treatment, such as washing or bleaching, and may thereafter be dried and set. Prior to this invention, it was necessary, after the cloth layer was washed and bleached, to dry and set it before it could be subjected to the dyeing process which had to be followed by another drying operation. This conventional method is especially complicated since in order to limit the degree of distortion of the cloth layer during the washing, bleaching and dyeing processes as much as possible, the cloth layer has to be sewed together in the longitudinal direction into a tubular form for the wet finishing treatment, that is, for the washing, bleaching and dyeing processes, whereas for the subsequent drying and setting processes it is necessary to open the longitudinal seam to stretch out the cloth to its full width on tenter frames. According to the present invention, however, it is possible to set the gray goods before being washed and bleached, that is, before being sewed together to form a tubular fabric.

FIGURE 8 illustrates the telescopic roll or cylinder which is connected between the sprocket wheels 8 at each point where the tension chains 2 together with the cloth layer 4 have to be turned or reversed. Such a telescopic roll consists of two tubular parts 12 and 13 which may be partly inserted into each other so as to permit the distance between the sprocket wheels 8 to be adjusted in accordance with the width of the cloth layer 4 allowing the cloth layer to be supported across its entire width. By employing such telescopic rolls 12, 13, the cloth layer will be prevented from sagging or from becoming creased at the different turning or reversing points.

Although, due to the laterally projecting hooked needles 3 on the tension chains 2, the cloth layer is quite freely suspended and covered up only to a very slight extent, it has still been found that the marginal strips of the cloth layer are sometimes not sufficiently set. This deficiency may be overcome by providing marginal radiators 14 in addition to the main radiators 5.

The radiators 5 are preferably rod-shaped or sheetlike in form, as indicated, for example, in FIGURE 3 and FIGURE 5, respectively. The sheetlike radiators are preferably composed of a larger number of shorter rod-shaped radiator elements 5', as illustrated in FIGURE 10, which are preferably staggered relative to each other in order to insure the most uniform radiation. The use of individual radiator elements has the advantage that the outer elements 15 may be switched on or off in accordance with the width of the particular cloth layer to be treated. By switching individual radiator elements 5' on or off, it is also possible to vary very easily the amount of radiant energy which should be supplied to the cloth layer in accordance with the type of material to be treated and

the speed at which the cloth layer is being conveyed through the apparatus.

According to the embodiment of the invention as illustrated in FIGURE 10, the chain rails 1 and 1' terminate in front of and behind the setting zone. The distance between chain rails 1' is made smaller than that between rails 1 since the cloth layer 4 shrinks during the setting process. The important feature of this apparatus is that the cloth layer is not prevented by any tensional forces from following its natural shrinkage. By interrupting the chain rails 1 and 1' within the setting zone, the tension chains 2 are released from their guides and may therefore follow the natural shrinkage of the cloth layer 4, as is indicated diagrammatically in FIGURE 11.

In the further modification of the invention as illustrated in FIGURE 12, the setting zone extends in a vertical direction and the vertical radiators 5 are mounted within a box 21 into which air is blown for cooling the outer surface of the cloth layer 4, the inlet and outlet ends of which closely surround the cloth layer. Filters *f* may be employed for filtering all but a single preferred wavelength from the radiation. The air is supplied to the box 21 partly by a fan 22 from outside of the apparatus and partly from the cooling zone 23 which follows the setting zone. The cloth layer 4 is also surrounded at the cooling zone 23 by a box 24 into which air is blown by a fan 25. Boxes 21 and 24 are connected to each other so that at least a part of the air which is blown into the cooling zone can also enter into the setting zone. The air escapes from the two boxes 21 and 24 through the cloth inlet of the former and the cloth outlet of the latter. Since these discharge openings for the air are relatively small, an excess pressure is built up in the boxes 21 and 24 which insures a uniform distribution of the cooling air. Boxes 21 and 24 are enclosed in a further box 26 to which a suction fan 27 is connected so that a reduced pressure is produced in this outer box 26. The air which emerges from the radiator box 21 is therefore sucked up rather than being discharged toward the surroundings of the apparatus. This is of advantage especially when gray goods or wet goods are to be set at which occasion obnoxious gases or vapors may easily be developed. When employing the apparatus according to FIGURE 12, such gases or vapors are then drawn off without doing any harm or interfering with the operations outside of the apparatus.

Although my invention has been illustrated and described with reference to the preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed my invention, what I claim is:

1. An apparatus for setting a woven cloth layer made at least partly of synthetic fibers comprising conveyor means for guiding said cloth layer, a first box surrounding a portion of said conveyor means and having entrance and exit openings therein, radiation means disposed within said first box on either side of said cloth layer over the width thereof for heating all of the fibers thereof from within while maintaining the surface thereof relatively cooler, said radiation means being spaced from said entrance and exit openings to provide gaps therebetween, a second box surrounding said first box and substantially concentric therewith, pump means for applying relatively cooler air under pressure to said first box whereby an excess pressure is created in said first box to insure uniform distribution of the relatively cooler air and exhaust means for withdrawing air from said second box so that gases formed in said first box will be removed via said second box.

2. An apparatus for setting a woven cloth layer made at least partly of synthetic fibers wherein the cloth layer

is tensioned by means of tensioning chains comprising conveyor means for guiding said tensioning chains having a plurality of angularly disposed portions, a telescopic roller provided at each reversing point on said conveyor to assure faultless tensioning of the cloth layer at these points, infra-red radiators arranged on both sides of said cloth layer at a constant distance over the entire width thereof at a vertically disposed portion of said conveyor means, said radiators being composed of a plurality of smaller radiating elements which may be operated singly and whose maximum emission is within the range of a wavelength at which the synthetic fibers have their maximum absorption so that the fibers are heated from within and remain relatively cooler on the surface thereof, filter means adjacent said infra-red radiators for filtering all but a single preferred wave-length from said radiation, additional marginal radiators provided at the edges of said cloth layer, a first box surrounding all of said radiators and having openings therein, means for blowing air into said first box, a second box surrounding said cloth layer adjacent said first box and connected thereto, means for blowing air into said second box, a third box surrounding said first and second boxes and exhaust means for evacuating said third box so as to remove obnoxious gases therefrom.

3. An apparatus for setting a woven cloth layer made at least partly of synthetic fibers comprising conveyor means for guiding said cloth layer, a first box surrounding a portion of said conveyor means and having openings therein, radiation means disposed within said first box on either side of said cloth layer over the width thereof for heating all of the fibers thereof from within while maintaining the surface thereof relatively cooler, a second box surrounding said first box, pump means for applying air pressure to said first box and exhaust means for withdrawing air from said second box so that gases formed in said first box will be removed by said second box, said portion of said conveyor extending through said first box extending in a substantially vertical direction and further comprising a third box adjacent to said first box and connected thereto at the outlet for said conveyor means and a further pump means connected to said third box for supplying cooling air thereto.

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