

Nov. 14, 1961

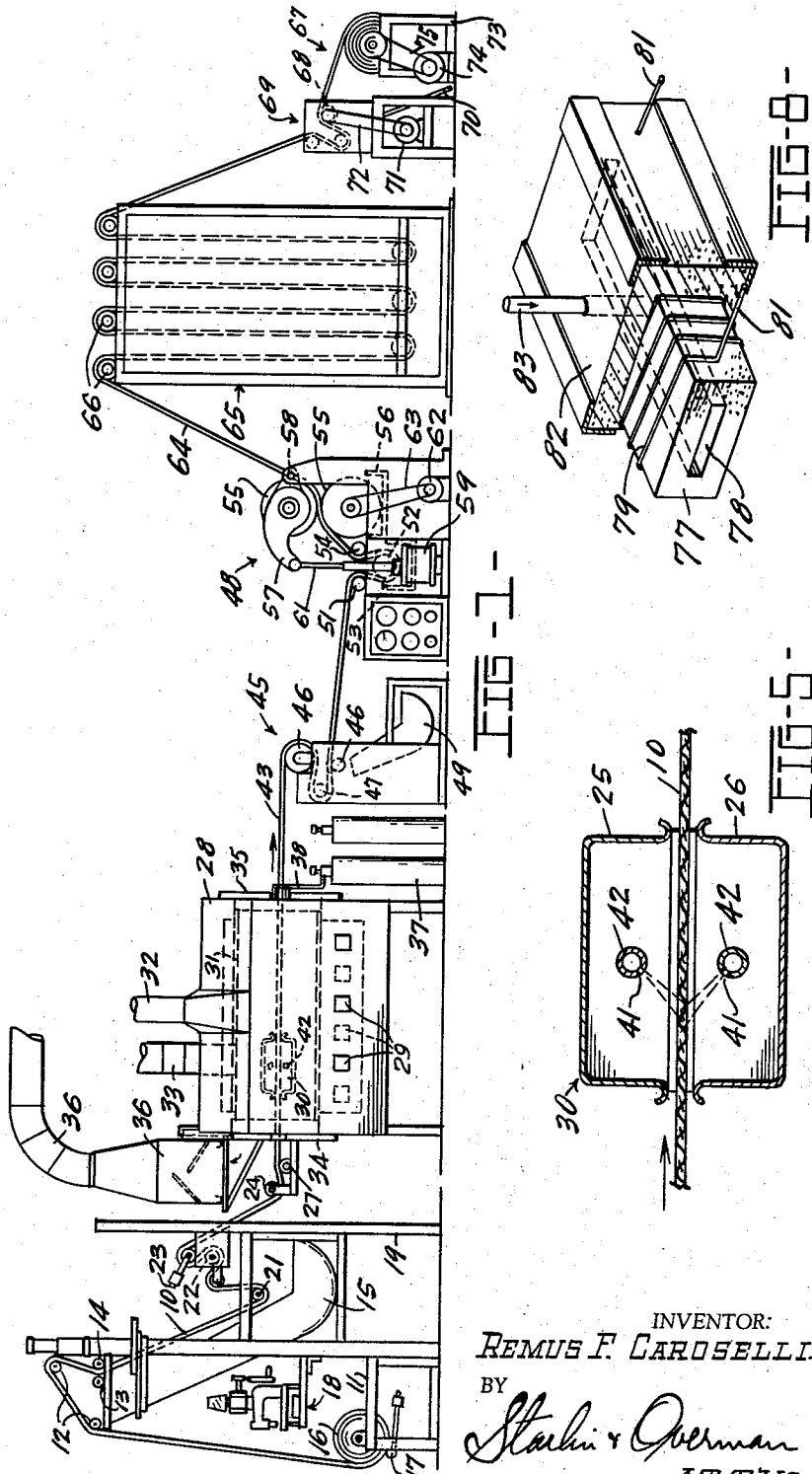
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3,008,846

METHOD FOR FLAMELESS HEAT CLEANING FIBROUS GLASS

Filed May 8, 1957

3 Sheets-Sheet 1



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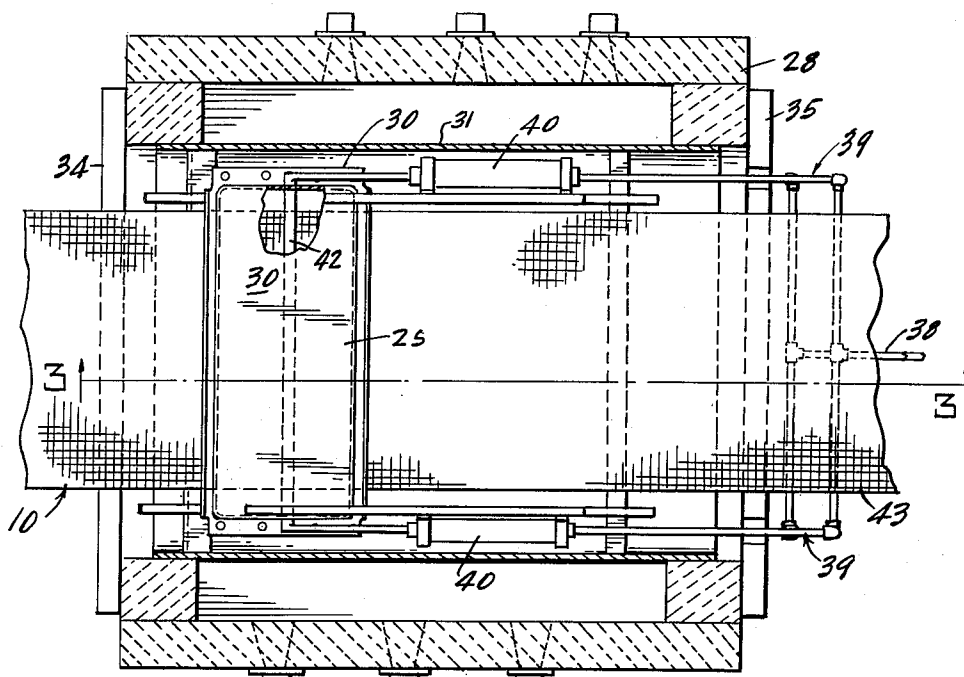


FIG-2-

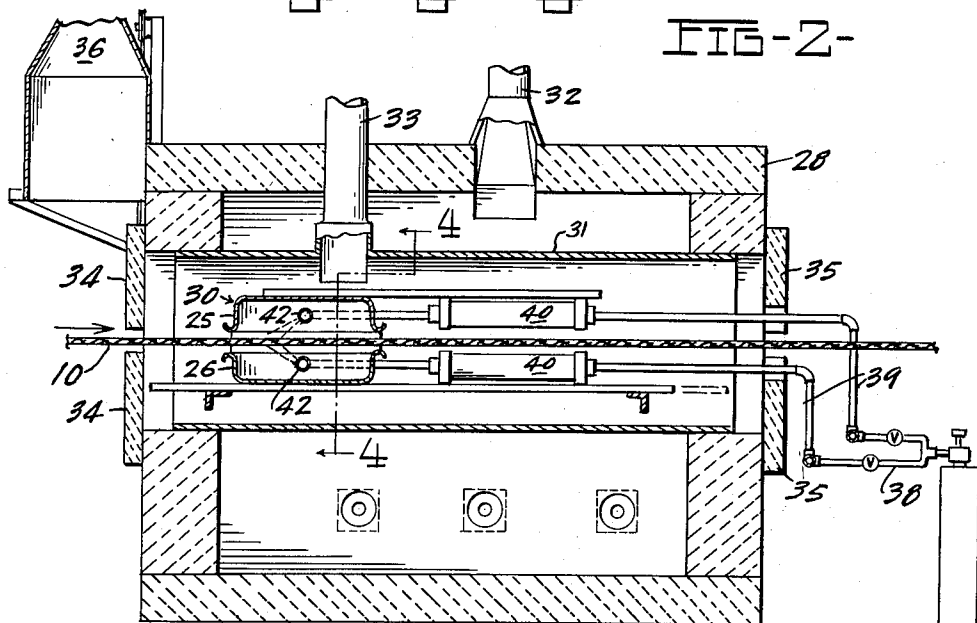


FIG-3-

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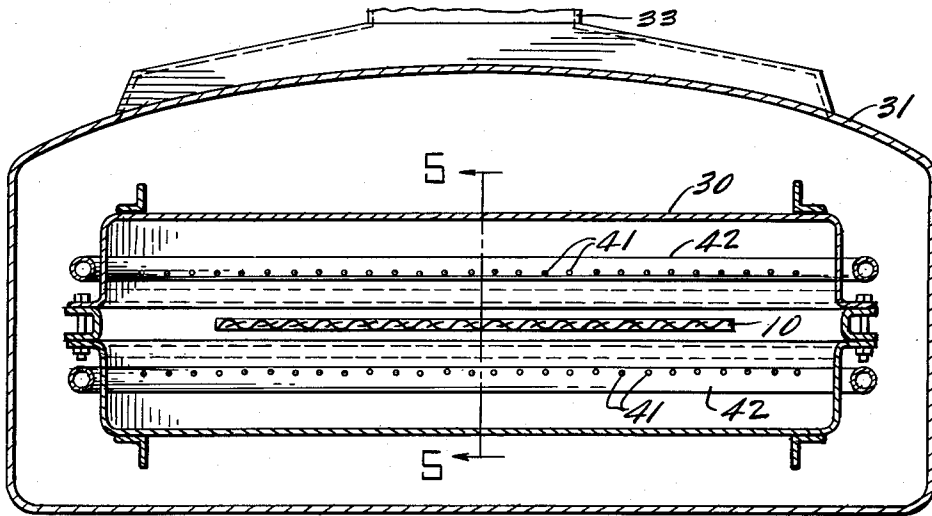


FIG-4-

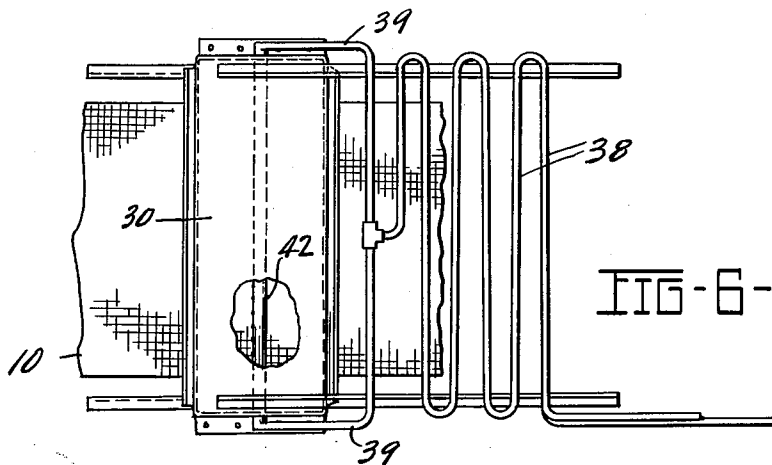


FIG-6-

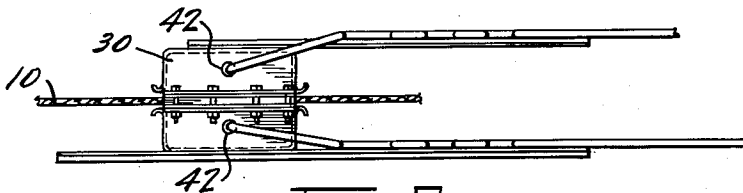


FIG-7-

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METHOD FOR FLAMELESS HEAT CLEANING FIBROUS GLASS

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6 Claims. (Cl. 117—54)

This invention relates to the treatment of fibrous glass and particularly to the treatment of fibrous glass fabric to improve the physical properties thereof.

In treating fabrics woven of fibrous glass, it is advantageous to clean the fabric prior to the treatment. For instance when dyeing or printing, heat cleaning of the fibers of the fabric is carried out since the fresh clean glass surfaces formed by heat cleaning are quite reactive and very receptive to chemical combination with treating substances. Yarns from which the fabric are woven become weave set during the heat cleaning.

Removal of the forming size or lubricant applied to the fibrous glass to facilitate forming and weaving is accomplished to present clean glass surfaces to which the fabric finish can readily adhere. The most complete cleaning in the past has resulted from burning or oxidizing the materials from the glass surfaces. Controlling burning is very difficult and at times unsatisfactory since carbon deposits and the like are sometimes formed which cannot be removed by further burning. These problems are more severe when thick heavy fabrics and staple fabrics are being treated.

It is an object of this invention to provide a new method for improving the physical properties of fibrous glass.

It is a further object to provide a method for heat cleaning, weave setting and otherwise improving the physical properties of fibrous glass fabrics.

Further objects will be apparent from the description which follows.

In the drawings:

FIGURE 1 is a side elevational view of apparatus for carrying out the invention;

FIGURE 2 is a sectional view of the oven;

FIGURE 3 is a section on line 3—3 of FIGURE 2;

FIGURE 4 is a view in cross section on line 4—4 of FIGURE 3;

FIGURE 5 is a view in section substantially on line 5—5 of FIGURE 4;

FIGURE 6 is a plan view of a modified form of an inner muffle;

FIGURE 7 is a view in elevation of the modified form of an inner muffle; and

FIGURE 8 is a perspective view of a small oven for carrying out the process.

The apparatus comprises a left-off stand 11, idler rolls 12, 12, a pair of pull rolls 13, 14, the former being driven and the latter being an idler. Idler roll 14 is adapted for movement through the horizontal plane into and out of contact with driven pull roll 13. The pull rolls are actuated when scray pan 15 is to be filled. Scray pan 15 is filled during lacing operations and when a splice is to be made between ends of fabric as when a new roll 16 is being placed on let-off stand 11. Roll 16 when supported in let-off stand 11 has a leather strap brake 17 which provides a constant resistance to unrolling of the fabric 10. A sewing machine 18 provided with a transverse railway carriage is mounted on frame 19 for securing the ends of rolls of fabric together.

Guide roll 21 is disposed above scray pan 15 as are the three tensioning rolls 22, 22. The uppermost tensioning roll is provided with a leather strap braking member 23. After the fabric passes over expander roll 24 where the longitudinal wrinkles in the cloth are removed

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and over guide roll 27, it passes into weave set oven 28. The weave set oven is provided with a plurality of gas burners 29, 29 which heat the oven to the desired temperature. The combustion products from the burners surround an outer stainless steel muffle 31 in the oven 28 and are then vented through exhaust stack 32.

Outer muffle 31 through which the fabric passes is provided with an inner muffle 30. The two parts 25, 26 of inner muffle 30 are disposed one above the other and extend transversely across the width of the muffle and fabric. Pipes 42, 42 within inner muffle 30 have a plurality of openings which direct streams of a fluid which does not support combustion at a 45° angle toward the surface of the fabric being treated and against the direction of travel of the fabric as it passes through the weave set oven. Stainless steel muffle 31 is vented through exhaust stack 33 which is positioned above the inner muffle and extends at its lower end across the width of stainless steel muffle 31. At the entrance and exit end of oven 28 are adjustable doors 34, 34 and 35, 35.

Above the entrance to the oven is an exhaust duct 36 adapted for removing gases given off by the fabric due to volatilization as the fabric passes into and through the oven.

Heat cleaned fabric 43 passes from the weave set oven 28 into draw roll unit 45 which comprises two motor-driven rolls 46, 46 positioned one above the other and one idler roll 47. The draw roll unit pulls the fabric through the weave set oven with the proper tension, and also feeds the fabric into padder 48. Draw roll unit 45 is provided with a scray pan 49 which is used when the fabric is to be heat cleaned only. When heat cleaning only, the fabric is directed to a roll-up unit immediately after passing over the draw roll unit 45 and the scray pan is used when changing rolls at the roll-up unit.

Driven rolls 46, 46 may be rubber covered or may be stainless steel rolls which are water cooled to help resist the oxidation which normally takes place because of the elevated temperatures to which the draw roll unit is subjected.

Padder 48 comprises a guide roll 51, an immersion roll 52 disposed within dip pan 53, expander roll 54 and a pair of padder rolls 55, 55. The padder rolls are large diameter rubber covered rolls, the rubber having a Shore "A" durometer hardness of about 65. The lowermost padder roll is partially submerged in the liquor contained in tank 56. The uppermost padder roll is journaled in lever arms 57 which are pivoted at pivot point 58 and connected to air cylinders 59 through linkage 61. The lower padder roll is driven by an electric motor 62 and drive chain 63 and the upper padder is free to turn on its own axis.

The finishing agent, which may or not include a dye as applied by padder 48, is set on the fabric by passing the treated fabric 64 through drying oven 65. The drying oven is provided with a plurality of chain-driven rolls 66, 66 over which the fabric passes in the required number of passes as it is being dried. After the fabric leaves the drying oven, it is directed to roll-up unit 67. Roll 68 of the take-up section 69 is driven by electric motor 71 through drive belt 72. The spindle of roll-up stand 73 is driven by motor 74 through drive belt 75. A scray pan 70 is disposed between take-up section 69 and roll-up unit 67. Take-up section 69 runs at a constant speed and feeds the fabric to roll-up stand 73. During the time required to remove full rolls of the finished product, the fabric is deposited in scray pan 70. The speed of the roll-up stand 73 varies as the roll size increases as this section is driven by a constant torque motor.

Although only one padder and one drying oven are shown, for many applications another padder and oven is inserted into the line between the drying oven 65 and roll-

up unit 67 shown in FIGURE 1. Any number of padders or padders and ovens may be inserted as desired. Two, three or more successive padding and drying steps are sometimes used.

The production equipment as described has a central direct current controlled drive system for regulating the speed of the fabric from draw roll unit 45 to roll-up unit 67. Rheostats are located at draw roll unit 45, oven 65, padder 48 and roll-up unit 67 to control the speed of the fabric so that the tension can be finely adjusted at each unit.

In FIGURES 2 and 3 the oven is shown in more detail. Inner muffle 30 is provided with pipes 42, 42 which introduce the fluid into the inner muffle for controlling the atmosphere within the inner muffle. Pipes 42, 42 are connected with a suitable supply of the fluid through interconnecting pipes. For instance, when nitrogen is used, a tank 37 of nitrogen is connected to both the upper and lower pipes 42, 42 as follows. The gas passes from tank 37 through line 38 and then through parallel lines 39, 39 to the ends of pipe 42. Line 39 has an enlarged portion 40 for heating the gas passing therethrough. The enlarged portion 40 is heated by the hot gases within outer muffle 31 and in turn heats the nitrogen or other gas passing therethrough. Thus the gas is introduced into both ends of pipe 42 and passes from the pipe through drilled ports 41, 41. The systems serving the upper and lower pipes 42, 42 of inner muffle 31 are similar as will be discerned from FIGURES 2, 3, 4 and 5.

In FIGURES 6 and 7 a modification of the inner muffle is shown. In this embodiment of the invention the incoming fluid is heated as it passes through a meandering pipe which is bent back upon itself as shown in the drawings. Such a setup provides greater surface area for transmission of heat to the incoming fluid. This modification has been found advantageous also in that the entire inner muffle and the pipes which connect it with the source of supply of fluid can be moved from the entrance end to the exit end of the oven as may be desired. It is advantageous to move the inner muffle with respect to the outer muffle when operating under certain conditions. If the rate of travel of the fabric being treated is increased, it is generally necessary to move the inner muffle toward the exit end of the oven to insure that no burning takes place within the oven during the heat cleaning and weave setting. When lightweight fabrics are being treated and also when the speeds with which the fabric is being advanced is decreased, it is desirable to move the inner muffle toward the entrance end of the oven to prevent burning. The above statements are not intended to indicate that slow speeds are used with lightweight fabrics; rather, it has been found that lightweight fabrics such as marisettes can be run at the greatest speed with very satisfactory results. Casement cloth and staple fabrics can likewise be heat cleaned and weave set at much greater speeds than formerly when equipment that actually burns the size materials from the fabric was used. Processing rates are increased as much as two times or more over conventional speeds used formerly.

In FIGURE 8 is shown a compact, electrically heated oven that is suitable for treating fabric at high rates of speed. This oven comprises a refractory block lining 77 having a rectangular opening 78 through which the fabric to be treated is advanced. About the lining 77 is wrapped an electrical heating coil 79 having terminal leads 81, 81. About the entire heating device is a layer of refractory cement 82. Inlet pipe 83 introduces a fluid which does not support combustion into the opening 78 through which the fabric passes as it is being heated. This compact apparatus is used to treat fabric at high rates of speed with great effectiveness. The material which is volatilized from the surfaces of the glass fibers and strands within the fabric passes from the opening in the heating device and can be collected in any suitable manner or allowed to escape into the atmosphere.

In starting the apparatus shown in FIGURE 1, a leader

cloth constructed of fibrous glass and heavy glass cords is used. A wooden shell or tube of leader cloth is placed on let-off stand 11 and brake 17 is released. The leader cloth is laced through the apparatus substantially following the path shown in FIGURE 1. Metal hooks or the like are used to pull the leader cloth through weave set oven 28. After the leader cloth is laced through draw roll unit 45, heavy glass cords which have been laced through the padder rolls 55, 55, drying oven 65, and roll-up unit 67 are secured to the leader cloth.

Once sufficient leader cloth has been taken through the charge end of the line, a roll of fabric to be treated is placed on the let-off stand and the cloth end is attached to the end of the leader cloth by using sewing machine 18. A single stitch seam using glass sewing thread is made.

After the lacing has been completed, weave set oven 28 and drying oven 65 are brought to operating temperature by lighting the gas burners in each. The temperature of the weave set oven 28 may be from about 1100° to about 2000° F. or higher. Drying oven 65 is maintained at a temperature of from about 200° to 400° F. and preferably from 275° to 375° F. The finish or after treatment solutions are prepared and introduced into dip pan 53 and adjoining tank 56.

A suitable finish comprises the following ingredients in weight percent:

Ingredient:	Percentage by weight
Polyvinyl alcohol (98% hydrolyzed)-----	1.5
Quaternary nitrogen compound (reaction product of an amide reacted with triethanolamine)-----	8
Stearato chromic chloride-----	2
Water-----	88.5

As the process continues more finish is added to dip pan 53 as required to replace that being applied to the fabric. Other suitable finishes include those of U.S. Patent 2,686,737, issued August 17, 1954. Pigments and dyestuffs are added to the finish as desired. The yarns from which the fabric is woven may be treated with such materials as the gelatin size disclosed in U.S. Patents 2,245,620 and 2,371,933, issued to Hans Steinbach on June 17, 1941, and March 20, 1945, respectively.

The central drive is energized and the process is then commenced. The fabric to be treated is advanced through weave set oven 28 by the action of draw roll unit 45. As the fabric comes up to the temperature of the oven, the components of the size composition upon the fabric volatilize off and the products of volatilization pass upwardly through stack 33 and out the entrance of the oven and thence through stack 36. The fabric is entirely heat cleaned and weave set as it passes through the oven. Jets of nitrogen or other suitable fluid from pipes 42, 42 preferably are directed at a 45° angle toward the oncoming fabric as shown in FIGURE 5. A true white fabric is achieved. This fabric 43 can then be dyed true color shades or if it remains undyed, a true white product is provided. Air cylinders 59 are set so that the pressure on the padder rolls 55, 55 is proper. In the padder unit the fabric is drawn through dip pan 53 and then through padder rolls 55, 55 which distribute the finishing agent throughout the fabric and remove the excess finish. The excess finish is collected in tank 56 and is returned to dip pan 53 through a connecting tube. The tension of the fabric between the draw roll unit 45 and padder 48 is controlled by adjusting the speed of the padder rolls 55, 55 with a rheostat which is a part of the D.C. central drive system. As the fabric travels through drying oven 65, moisture is removed from the finish on the fabric and the finish becomes set upon the fabric.

When the need for a new roll arises, roll 14 is moved into contact with roll 13 and rolls 13 and 14 are speeded up to accumulate enough fabric in the scray pan 15 to allow time for the splicing operation. When the splice has been made, roll 14 is again moved to the open posi-

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tion and driven roll 13 is stopped. When treating fabric such as marquisette, pull rolls 13 and 14 are maintained in a closed or in contact position except when a splice is being made. A supply of fabric is maintained in the scray pan 15 at all times, the amount being controlled by adjusting the speed of pull rolls 13, 14. Heavy fabrics such as casement fabrics and staple fabrics are not folded in the scray pan 15 except when it is necessary to make a splice.

Generally the fabric is passed through the weave set oven and then through the first padder when an emulsion of polyethylacrylate and dye or other suitable finish is applied. The fabric is then dried at a temperature of from 275° to 300° F. and a further treatment such as a dispersion of stearato chromic chloride is applied at the second padder and the fabric again dried.

For the purposes of illustration and not intending to limit the invention thereto, operating conditions which have been used successfully will be described. A casement cloth was advanced through the oven at a speed of 40 feet per minute, the oven being maintained at a temperature of 1150° F. Nitrogen was bled into the inner muffle during the cleaning operation. The fabric treated was very white. It was found that the ignition loss of the product was 0.1%. Other portions of fabric treated in the same manner had an ignition loss of about ½ of 1%. These low ignition losses indicate that the heat cleaning is complete as required.

A bouclé fabric was advanced through the treating apparatus at a rate of 36 feet per minute and was heat cleaned to a white product using an oven temperature of 1220° F. Very satisfactory results were obtained under these conditions. No flame was used in carrying out the process.

Casement fabrics were treated at a feed rate of 40 feet per minute at oven temperatures of about 1200° F. with satisfactory results. Using similar temperatures in the oven, the feed rate was advanced to 50 feet per minute with a white fabric being produced. The feed rate can be increased if the temperature of the oven is increased. For instance, a casement fabric was treated at a rate of 67 feet per minute when the oven temperature was 1300° F. with very satisfactory results.

Marquisette fabric has been treated successfully at a feed rate of 120 feet per minute when the oven temperature is maintained at about 1350° F.

As an example of the improvement obtainable by the use of the apparatus of this invention, a casement fabric was fed through the oven at 80 feet per minute which is double the normal speed used in treating with equipment utilizing a flame. The oven was maintained at a temperature of 1350° F. and it was found that the fabric treated was very white and had a bursting strength of 170 pounds, as measured by the Mullenburst test, as compared to normal strengths of 125 pounds obtained when cleaning with a flame. In addition the fabric had improved resistance to abrasion.

Unexpectedly it has been found that the properties of the products treated by the methods of this invention are much better than those produced by equipment utilizing a flame for cleaning. Not only is the fabric perfectly heat cleaned and weave set, but greater strengths in the products are achieved. It would seem that burning the materials from the fabric would produce the cleaner fabric; however, volatilization of the size materials is a great improvement over burning since complete cleaning is achieved and physical properties are at the same time improved over those formerly obtainable. The great strengths of the glass fibers are retained even after the fabric has been treated. Uniform results always can be obtained. This may be true since the need for first carbonizing the ingredients of the size and then completely

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burning the carbon products off is no longer depended upon in cleaning the fabric. Rather, the materials are controllably volatilized with complete removal always being obtained.

Various fluids can be used to control the atmosphere within the treating zone. Nitrogen is a preferred gas to be used. Very satisfactory cleaning with attendant retention of good physical properties of the fabric is achieved by the use of nitrogen. Other gases and liquids can be used. These include helium, carbon dioxide, water and the like. Nitrogen can be satisfactorily supplied by disassociating ammonia and using the nitrogen in the muffle and utilizing the hydrogen in any way desired.

Various modifications may be made within the spirit and scope of the following claims.

I claim:

1. Method of continuously heat cleaning and weave setting a glass yarn fabric comprising advancing a glass fabric having volatile, combustible materials on the surfaces of the fibers into a treating zone, heating said fabric while in said treating zone to a temperature sufficiently high to drive off all volatile materials from the surfaces of the fibers, exhausting the volatile materials from the treating zone in a direction opposed to the advancement of the fabric, introducing a fluid into the treating zone which will not support combustion, and removing the glass yarn fabric from the treating zone.

2. Method of heat cleaning a glass fabric comprising providing a heated treating zone through which fabric can be passed continuously, advancing glass fabric having combustible materials thereon into the treating zone at sufficient speed to reduce the temperature and pressure at the entrance end of the treating zone, introducing a fluid which will not support combustion into said treating zone at a rate sufficient to prevent combustion, exhausting combustible and non-combustible materials from the entrance end of said treating zone, and removing the heat cleaned fabric from the exit end of said treating zone.

3. Flameless cleaning of a glass fiber fabric comprising advancing a fabric having volatile, combustible materials on the surfaces of the fibers into a treating zone, heating the confined fabric in the treating zone to a temperature sufficiently high to drive off all volatile materials from the fibers, exhausting the volatile materials from the treating zone in a direction opposed to the advancement of the fabric, introducing an inert gas into the treating zone to prevent self-ignition within the treating zone and to purge the volatile materials from the treating zone, and removing the heat cleaned fabric from the treating zone.

4. The process of claim 3 wherein nitrogen is introduced as the inert gas.

5. The method of claim 3 wherein a finish is applied to the heat cleaned fabric and then set by heating and drying.

6. The method of claim 3 wherein a dye is included as a part of the finish for coloring the fabric.

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