United States Patent [19]

Payet et al.

[11] **3,712,086**

[45] **Jan. 23, 1973**

[54] **APPARATUS FOR PRODUCING A DURABLE PRESS IN GARMENTS CONTAINING CELLULOSE OR CELLULOSIC DERIVATIVES**

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[22] Filed: **Oct. 26, 1971**

[21] Appl. No.: **192,285**

Related U.S. Application Data

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[52] **U.S. Cl.** ..... **68/5 C**, 68/5 E

[51] **Int. Cl.** **D06c 1/00**

[58] **Field of Search** ..... 68/5 R, 5 A, 5 B, 5 C, 5 D, 68/5 E

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Assistant Examiner—Philip R. Coe
Attorney—George H. Fritzinger

[57] **ABSTRACT**

A novel apparatus for treating fabric articles containing cellulosic material to impart thereto a durable press comprises a treating chamber having means for providing therein formaldehyde and sulphur dioxide gases, and steam according to the weight of the cellulosic material in the fabric articles being treated, and for then cutting off the steam and supplying dry heat to raise the temperature in the chamber to at least 250°F. Further, the chamber has suitable blowers and air ducts to enable the chamber to be flushed with fresh air and/or steam to rid the garments of residual odors.

10 Claims, 13 Drawing Figures

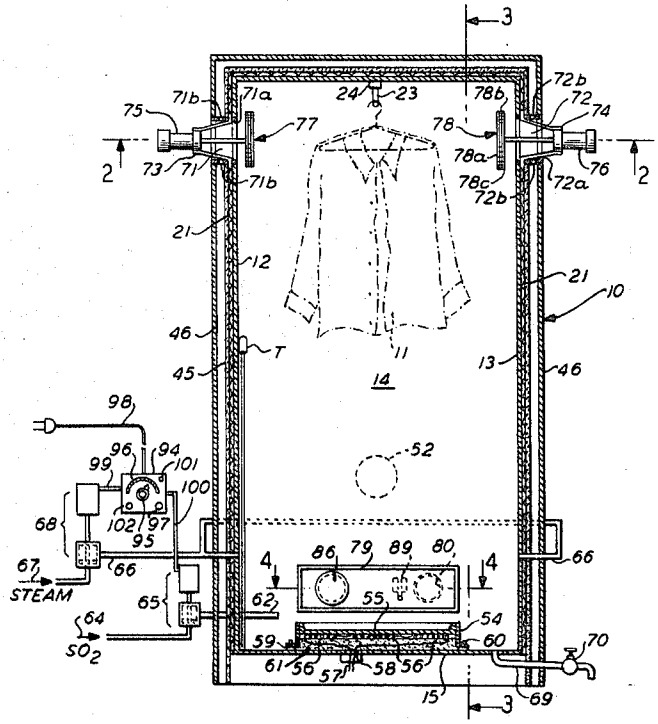


FIG. 1

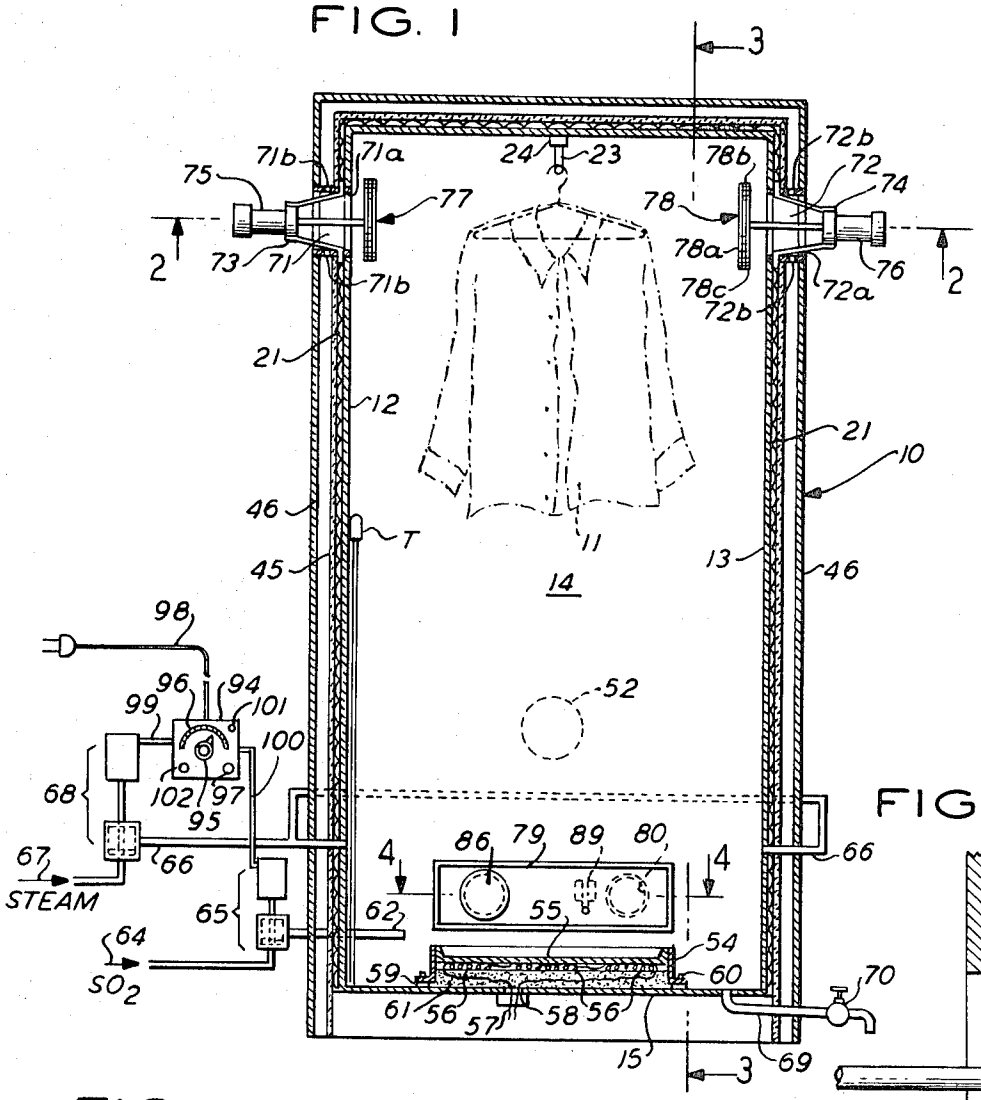


FIG. 2A

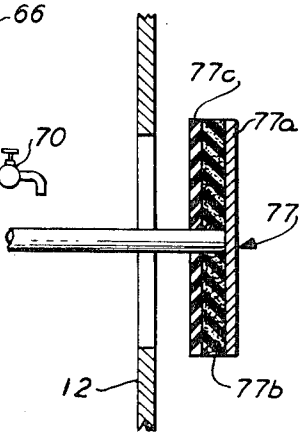
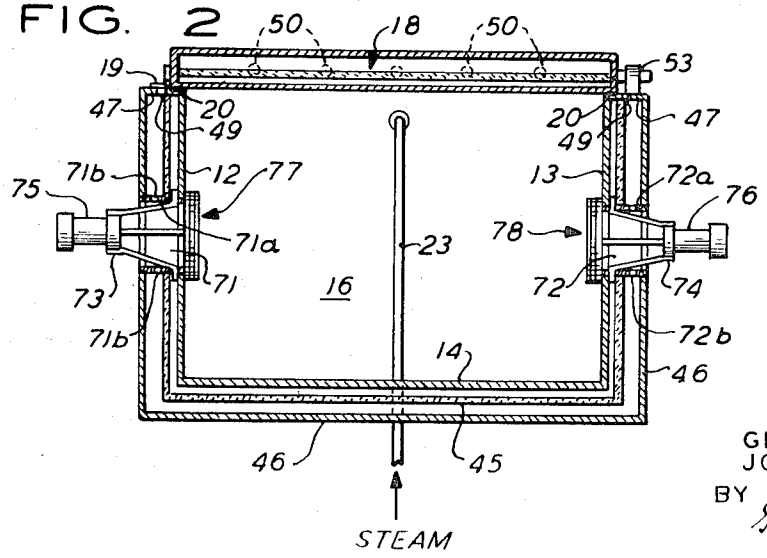


FIG. 2



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FIG. 3

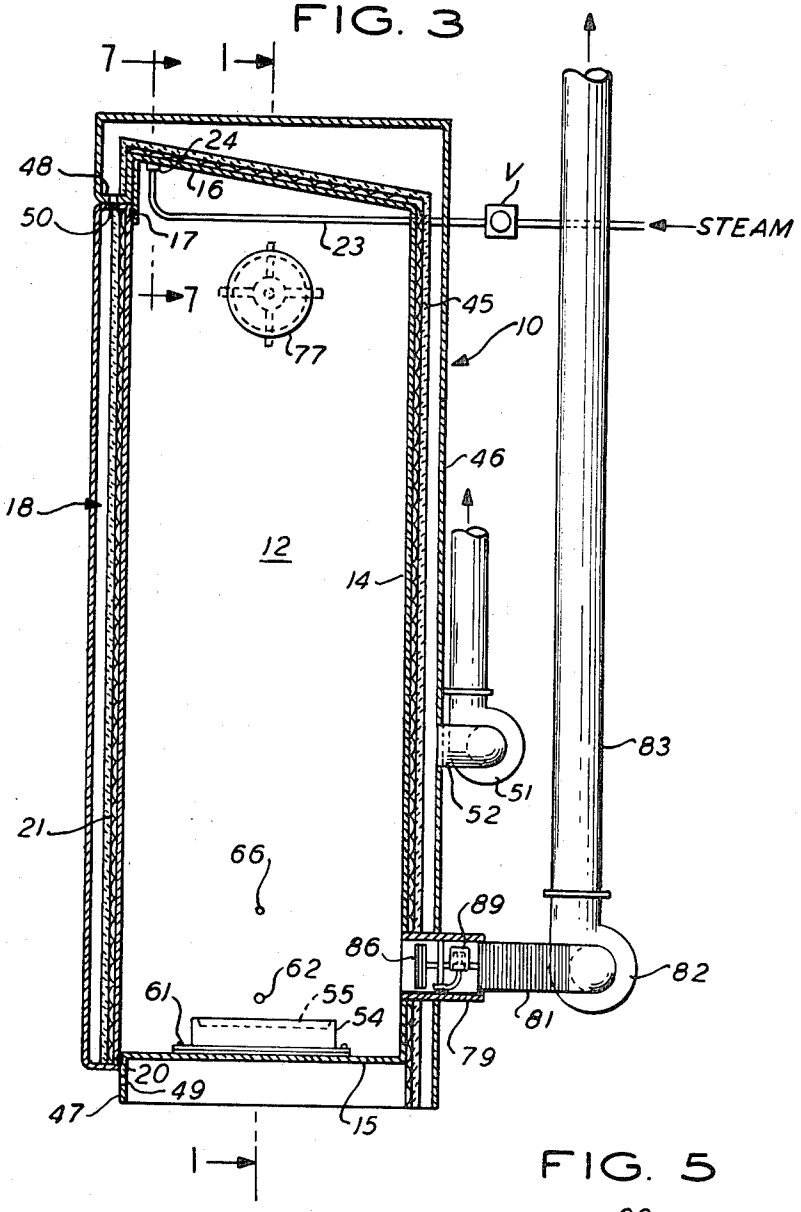


FIG. 4

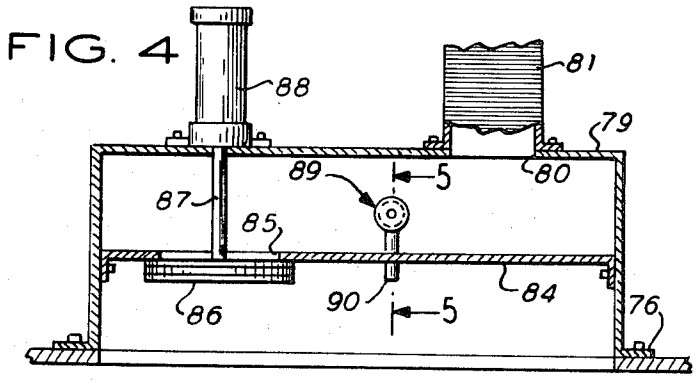
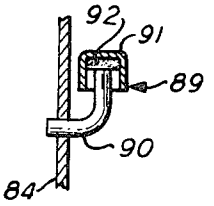


FIG. 5



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FIG. 6

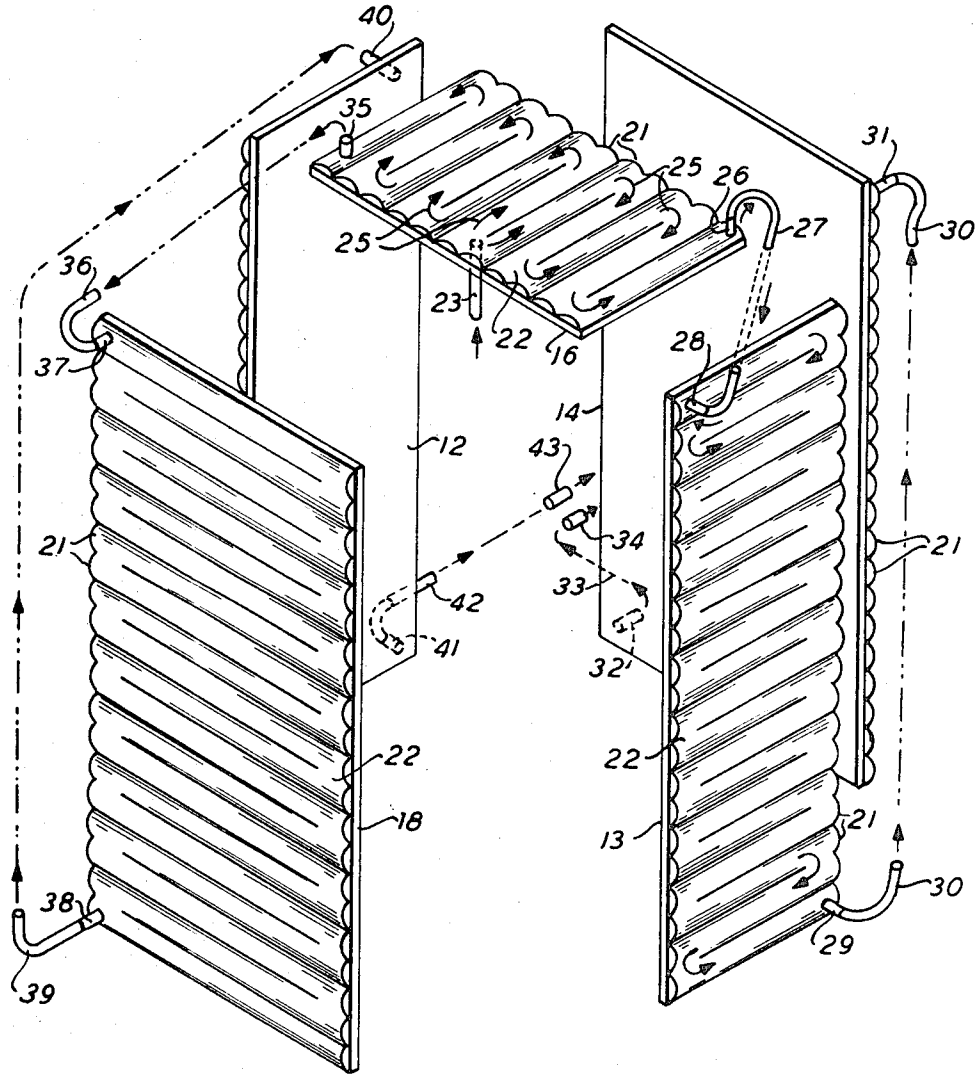
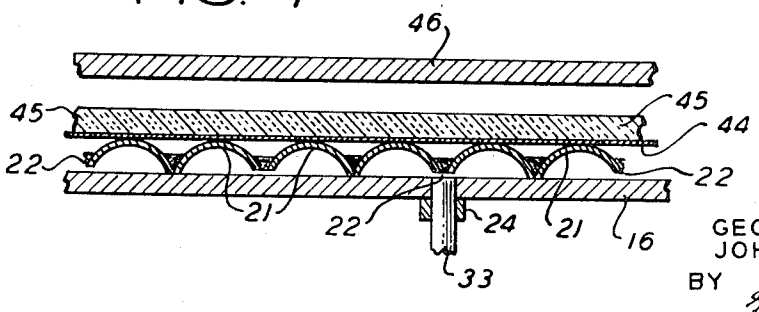


FIG. 7



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FIG. 8

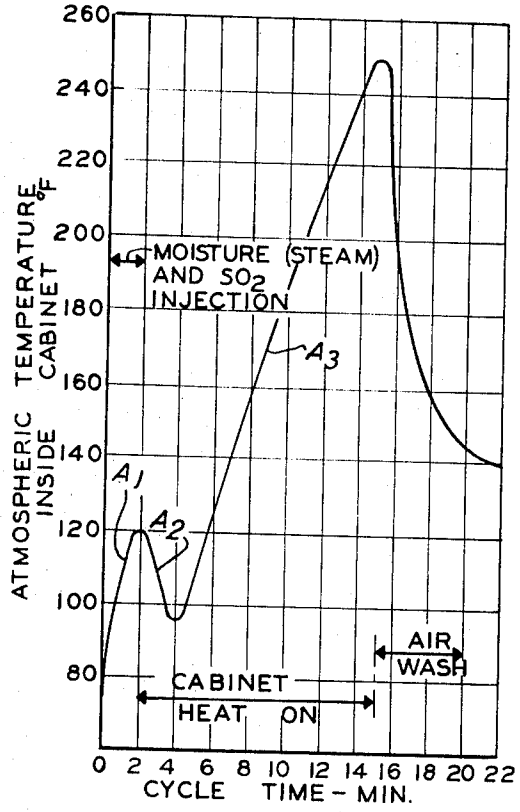
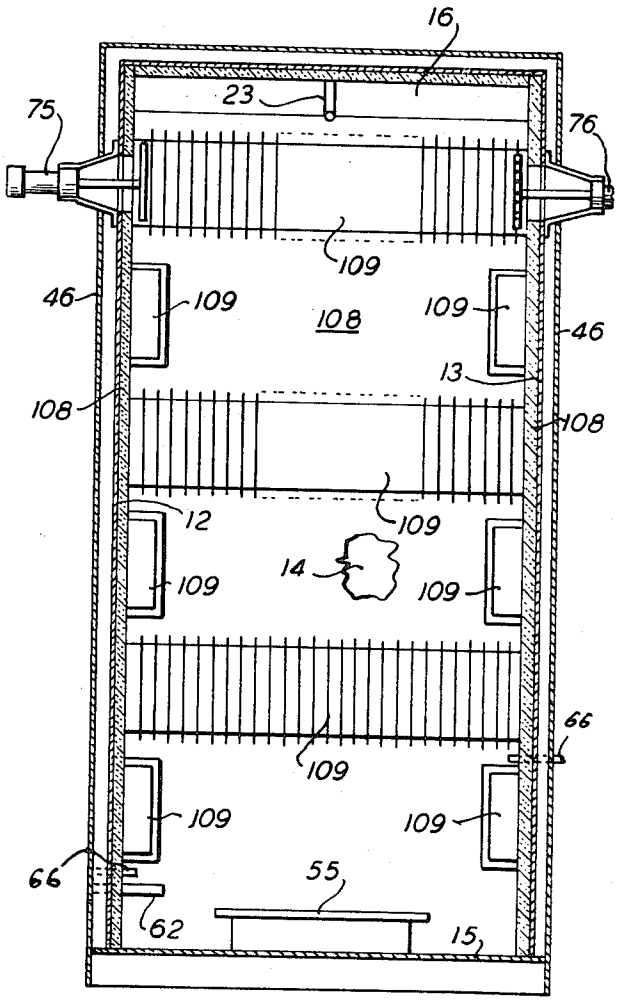


FIG. 9



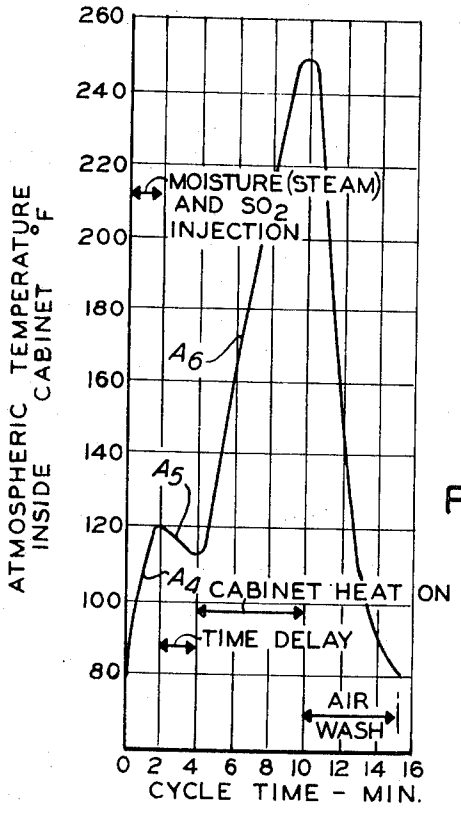


FIG. 10

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FIG. 11

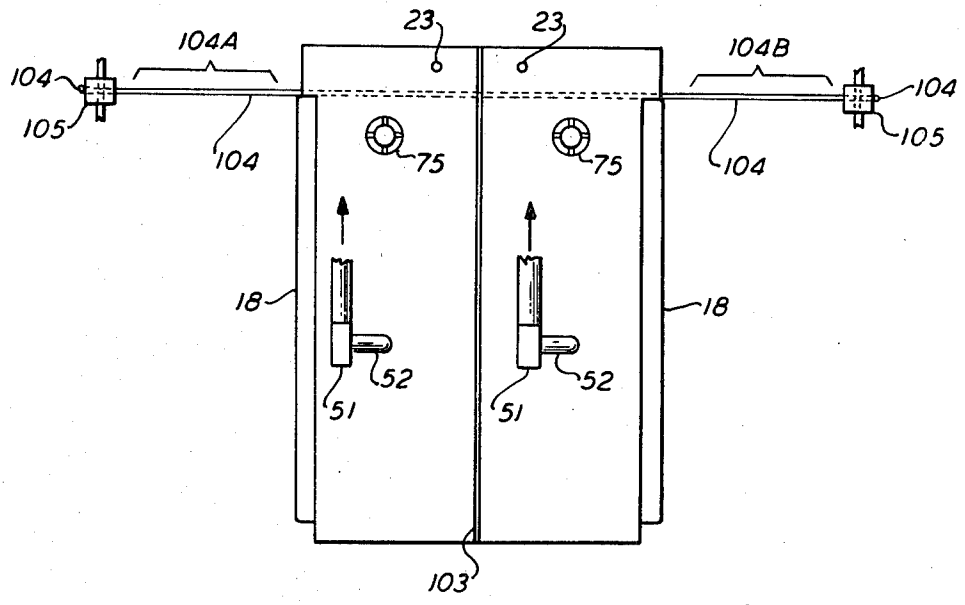
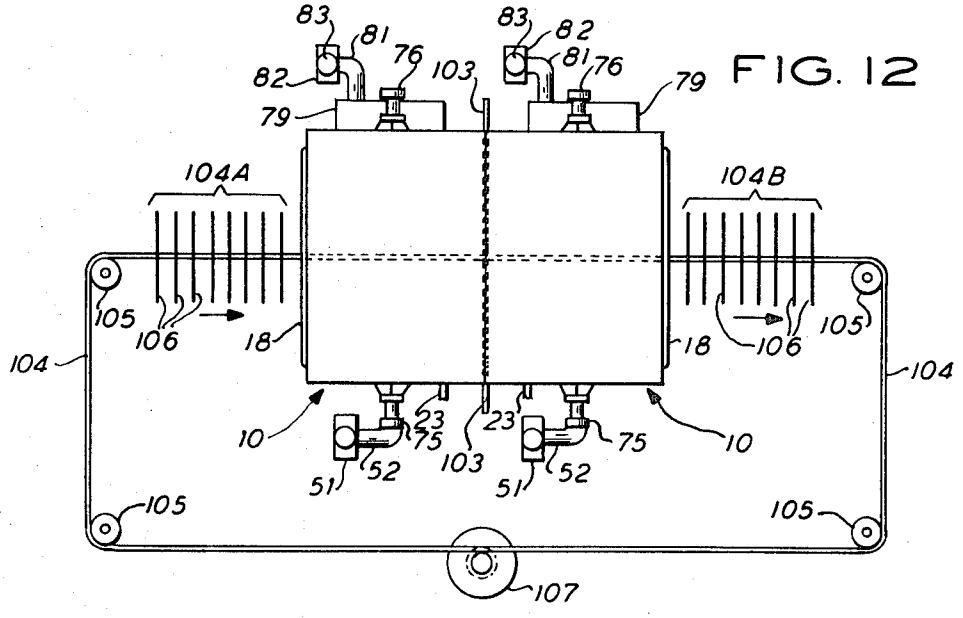


FIG. 12



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APPARATUS FOR PRODUCING A DURABLE PRESS IN GARMENTS CONTAINING CELLULOSE OR CELLULOSIC DERIVATIVES

This application is a division of our application Ser. No. 846,884, now U.S. Pat. No. 3,660,013, filed Aug. 1, 1969, and entitled METHOD AND APPARATUS FOR PRODUCING A DURABLE PRESS IN GARMENTS CONTAINING CELLULOSE OR CELLULOSIC DERIVATIVES.

The invention is specifically described in terms of treating garments but is applicable to any cellulosic or part cellulosic fabric articles of cloth or cloth-like nature including bed "linens," tablecloths, curtains, drapes, etc., as well as those of non-woven or felted material such as "disposables" — i.e., garments made of paper or paper-like material. The term "fabric articles" is herein used to comprehend all the items of this general category.

Cellulose fabrics comprise long polymers having attached (OH) radicals which can be reacted with cross-linking molecules between the polymers. These cross-links permit some slippage between the polymers under stress, but return the polymers to their initial relationships when outside stresses are removed. By introducing such linkages into a cellulose fabric a durable press is obtained. Formaldehyde is well known to produce such linkages when diffused through the cellulose fabrics in the presence of an acidic catalyst, heat and moisture. An example of such a catalyst is sulphurous acid which can be produced in the apparatus from sulphur dioxide and moisture. It is known on a laboratory scale that cotton will crosslink in the presence of steam, formaldehyde vapor and sulphur dioxide gas but it is not known that this method can be carried out dependably and economically on a commercial scale.

An object of the invention is to provide a novel apparatus for carrying out the novel method of our invention in an effective and efficient manner to produce a durable press having improved properties.

Another object is to provide an apparatus for imparting a durable press to cellulose fabrics on a commercial scale within a sufficiently short time cycle and with lower concentrations of formaldehyde gas and sulphur dioxide gas.

Another object is to provide an improved apparatus which is adapted for treating individual batches of cellulose or cellulosic-blend clothing under controlled conditions to assure a consistently good durable press.

Another object is to provide an improved apparatus for imparting a durable press to cellulosic fabrics, which has a sufficiently low installation cost and short time cycle to render the apparatus practical for commercial use by yard goods stores, garment manufacturers, retail stores and cleaning and dyeing shops.

These and other objects and features of the invention will be apparent from the following description and the appended claims.

In the description of our invention reference is had to the accompanying drawings, of which:

FIG. 1 is a front vertical section on line 1—1 of FIG. 3 showing a treating chamber for carrying out the present invention according to one embodiment thereof;

FIG. 2 is a horizontal section on the line 2—2 of FIG. 1;

FIG. 2*a* is a fractional sectional view to enlarged scale also on the line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view on the line 3—3 of FIG. 1;

FIG. 4 is a horizontal sectional view through the blower box on line 4—4 of FIG. 1;

FIG. 5 is a fractional sectional view on the line 5—5 of FIG. 4;

FIG. 6 is an exploded diagrammatic view showing an arrangement of heating channels on the back sides of the internal walls of the treating chamber;

FIG. 7 is a fractional sectional view on the line 7—7 of FIG. 3 showing the interconnecting passageways between successive heating channels;

FIG. 8 is a graph showing a typical temperature *v.* time cycle curve in the treating process by the embodiment shown in FIGS. 1 to 7;

FIG. 9 is a diagrammatic view showing a front elevation with the front door removed of a treating box according to a second embodiment of the invention;

FIG. 10 is a graph showing a typical temperature *v.* time cycle of the treating process according to the second embodiment of our invention;

FIG. 11 is a side elevational view of two treating boxes in sequential arrangement with a conveyor running therethrough; and

FIG. 12 is a top plan view of this sequential box arrangement.

The embodiment of our invention shown in FIGS. 1 to 7 comprises a treating box 10 for receiving batches of prepressed cotton or cotton-blend clothing 11 and of providing the same with a durable press by the novel treating method of our invention. This is a rectangular box which may for example be similar in outward size and shape to a large upright refrigerator. The box is double-walled and insulated between the walls but has steam heating channels applied against the outer sides of the inner walls for heating the inner treating chamber. The inner walls are preferable made of aluminum and comprise left and right vertical sidewalls 12 and 13 (FIG. 1), a back wall 14 (FIG. 2), a horizontal bottom wall 15 and a slanting top wall 16 which is inclined downwardly from front-to-back as shown in FIG. 3 to avoid dripping of any possible condensation onto the garments being treated. The inner walls are welded airtight at their seams into a unitary upright construction open at the front except for a short wall section 17 depending from the top wall 16. (FIG. 3). The remaining front opening is closed by a door 18 hinged at its left side as indicated at 19. The door overlaps the side edges of the inner walls and is sealed airtight thereagainst when closed by an intervening sealing strip 20.

Applied against the outer side of each inner wall of the box and door 18 is a series of side-by-side semicylindrical channel members 21. These channel members are welded along their edges to each other and to the inner walls of the box except at their end portions. At the end portions alternate pairs of adjacent edges of the channel members are cut away at 22 from the wall of the box and welded only to each other to provide interconnecting passageways between the channel members at the ends thereof. (FIGS. 6 and 7). In this way a continuous duct is formed proceeding zig-zag along each inner wall of the box with the inner wall constituting one side of each duct.

Steam for heating the inner chamber is led via a valve V and a pipe 23 through the back wall 14 near the top

of the box and midway the sides thereof. The pipe extends to a point near the front door **18** and then curves upwardly through the top wall **16** to which it is secured airtight by a fitting **24** (FIG. 3). This horizontal portion of the pipe is free of condensation because of its heated condition and serves as a rack on which hangers for the clothing being treated may be attached. The extension of the pipe **23** through the top wall is at a junction between two ducts **21** (FIG. **6**) so that the steam will divide between the two ducts on the top wall **16** as indicated by the arrows **25**. By way of example, the steam ducts on the several walls may be connected as follows: At the end of the last duct at the right side of the top wall **16** the steam is led via a nipple **26**, connecting tube **27** and nipple **28** to the first duct at the top of the side wall **13**; at the end of the last duct at the bottom of the side wall **13** the steam is led by a nipple **29**, connecting tube **30** and nipple **31** to the first duct at the top of the back wall **14**; and at the end of the last duct at the bottom of the back wall **14** the steam is led back to the source via a nipple **32**, tube **33** and intervening trap **34**. Similarly, at the end of the last duct at the left side of the top wall **16** the steam is led via a nipple **35**, flexible tube **36** and nipple **37** to the top duct on the door **18**; at the end of the last duct at the bottom of the door **18**, the steam is lead via a nipple **38**, flexible tube **39** and nipple **40** to the first duct at the top of the left side wall **12**; and at the last duct at the bottom of the side wall **12** the steam is led back to the source via a nipple **41**, tube **42** and intervening trap **43**. The bottom wall similarly could be steam heated if desired.

Applied against the outer side of the ducts **21** are layers **44** of asbestos paper, and applied against the asbestos paper are layers **45** about one and one-half inch thick of fiber glass having its aluminum side facing outwardly for the purpose of providing a smooth unimpeded surface for air flow. Spaced about one and one-half inches from the fiber glass are the respective walls of an outer steel shell **46**. This shell has a flanged front edge **47** in a vertical plane which closes the space between the shell and inner walls at the front of the box along the sides and bottom thereof. Also, there is a horizontal flanged edge **48** between the lower portion of the top wall section **17** and the confronting portion of the shell. The door **18** underlies the horizontal flanged edge **48** and is sealed against the vertical flanged edges **47** at the bottom and sides of the door and against a lower strip of the wall **17** below the flanged edge **48** at the top of the door.

Just beyond the sides, top and bottom of the door **18** there are small slots or openings **49** in the flanged edge **48**, and at the top of the door there is a series of openings **50** in the horizontal flanged edge **48**. These openings allow air to be drawn inwardly past the side edges of the door **18** responsive to an exhaust blower **51** connected by a pipe **52** at the back of the box to the space between the inner walls and shell **46**. This suction blower draws away gases which may leak from the box past the seal of the door to prevent these gases from escaping into the room in which the treating box is located. The chance of any gas leakage is kept however at a minimum by a latch **53** diagrammatically indicated in FIG. **2**, which holds the door closed with pressure against the seal when the latch is locked.

Centrally located on the bottom wall **15** of the treating box is a formaldehyde reactor comprising a shallow rectangular case **54** having an inset top wall **55** forming a tray for receiving a quantity of solid paraformaldehyde. This case **54** contains electric heating coils **56** connected by an outgoing cable **57** leading through an opening **58** in the bottom wall **15** to a voltage supply. The case **54** is secured by bolts **60** to the bottom wall **15**. The space between the electric heating coils and the bottom wall **15** is filled with a fiber glass insulation **61**. This reactor is adapted to heat the solid paraformaldehyde in the tray **55** and vaporize the same during a treating operation.

Extending through a side wall of the box **10** at a level above the tray **55** is a pipe **62** connected to a source **64** of sulphur dioxide (SO_2) through a solenoid valve **65**. Also, in each side wall **12** and **13** at a level above the tray **55** is a pipe **66** terminating flush with the inside surface of the side wall. These pipes are connected to a source **67** of steam through a solenoid valve **68**. A drain pipe **69** and valve **70** leading from the bottom wall of the chamber permits any water condensation to be drained after each press cycle.

In the walls of the box near the upper part thereof are portholes **71** and **72**. These portholes are lined by walls **71a** and **72a** extending inwardly from the outer shell through the inner side walls of the box. Overlying these portholes are respective spiders **73** and **74** secured as by bolts to the inner walls **12** and **13**. Mounted on the central hubs of these spiders are air cylinders **75** and **76** having armatures extending inwardly through the portholes and carrying respective dampers **77** and **78** at their inner ends. The damper **77** comprises a circular metal plate **77***a* as of stainless steel, a disk **77***b* as of silicone sponge applied to the metal plate and a disk **77***c* of solid silicon rubber applied to the sponge disk (FIG. **2***a*). Similarly, the damper **78** comprises the corresponding parts **78***a*, **78***b* and **78***c*. The dampers stand normally open (FIG. **2**) and are closed and opened by air pressure to the air cylinders (FIG. **1**). In the walls of the portholes are openings **71b** and **72b** through which air is drawn inwardly responsive to the suction blower **51** so that any gas leakage past the dampers **77** and **78** when the dampers are closed may not escape into the atmosphere.

In the back wall of the box near the bottom thereof is a rectangular opening covered by a damper box **79** (FIGS. **1**, **3**, **4** and **5**) having a rim flange **76** bolted to the outer shell. This damper box has a porthole **80** in its back wall near one end thereof coupled by a duct **81** to a suction blower **82**. This blower has an outlet duct coupled by a stack **83** to the outside. The back half of the damper box is divided from the front half by a partition wall **84** having a porthole **85** therein at the other end of the damper box. This porthole is closed by a damper **86** (such as the dampers **77** and **78**) secured to the armature **87** of an air cylinder **88** bolted to the back wall of the box (FIG. **4**). Operation of the air cylinders **75**, **76** and **88** in an inward direction open these dampers (FIG. **1**) to enable the blower **82** to draw the gases from the treating chamber and to circulate air therethrough. To permit any rising pressure in the treating box to be relieved when the pressure reaches a predetermined level, as when steam and sulphur dioxide are injected into the box, a blow-off valve **89** is pro-

vided in the damper box **79**. This valve comprises a tube **90** extending through the partition wall **84** and having a turned-up end portion at the outer side of the wall **84** closed by a weighted cap **91** resting on the end of the tube. The cap has an internal silicone rubber gasket **92** to provide a good seal so long as the pressure is below the blow-off level.

The present method is carried out by placing the garments in the closed chamber and then injecting formaldehyde and sulphur dioxide gases and steam. During the injection of these gases the chamber is not heated other than by the heat of the steam. The initial temperature of the chamber may be at room temperature, say 70° to 80°F, or the chamber may be preheated but not in excess of 150°F. The steam is then cut off and the chamber allowed to cool to saturate the treating atmosphere and cause a greater condensation of steam through the fabrics being treated. When the box is initially at room temperature the steam is injected until the internal temperature reaches approximately 120°F, whereupon the steam is cut off and the chamber allowed to cool typically from 10° to 25°F. If the chamber is in a preheated condition — i.e., above room temperature not in excess of 150°F — the temperature may be allowed to cool after the steam is cut off by more than the temperature rise due to the steam before the auxiliary heating is applied. By proper timing of the auxiliary heating, depending upon the type of auxiliary heating apparatus, the internal temperature is raised following the temperature drop just noted to a temperature of 250°F to complete the crosslinking operation. Thereupon, the chamber is allowed to cool and outside air is circulated through the chamber for several minutes to rid the garments of residual odors. Also, if necessary, steam may thereafter be circulated through the chamber for several minutes and then again outside air for several minutes to rid the garments wholly of any residual odors.

In a more precise procedure for carrying out the above method by the treating apparatus above-described, consistently good results are obtained starting with the treating chamber at or about room temperature and with the reactor heater for the paraformaldehyde in a preheated condition but not to full vaporizing temperature. The garments to be treated are then placed on coat hangers attached to the pipe **23**, the desired quantity of paraformaldehyde is placed on the tray **55**, the reactor heater is turned up to full temperature, and the door **18** and all dampers are closed. Low pressure steam of approximately 4 p.s.i. is then admitted via the pipe **66** and sulphur dioxide gas is admitted via the pipe **62** for a period of approximately two minutes during which time the paraformaldehyde is being vaporized. During this period the steam, sulphur dioxide and formaldehyde gases permeate through the fabrics and the temperature in the chamber rises because of the steam typically to about 120°F. This is shown by the first portion A_1 of the curve of FIG. **8**. The time for carrying out this operation is typically about two minutes. At the end of this period the steam valve V is opened to start heating the chamber. However, since the steam ducts **21** are outside the chamber walls, there is a delay in heat transmission into the chamber causing the internal temperature to fall about 25° in the next two minutes as shown by the second portion A_2 of the curve of FIG. **8** before the temperature begins to rise from the auxiliary heating. This temperature drop is a very important step in the present invention because it causes the treating atmosphere to become saturated with a resultant greater condensation of steam through the fabrics being treated. This greater condensation reduces the required concentrations of formaldehyde and sulphur dioxide and shortens the treating cycle. At the end of the two minute temperature drop the heat from the steam ducts **25** causes the internal temperature to being to rise. This rise continues for a period of about ten minutes as shown by the portion A_3 of the curve of FIG. **8** before the temperature reaches 250°F to complete the cross linkage operation. The time required to bring the temperature to 250°F is important only from an economy standpoint since the completion of the linkage reaction depends only on the temperature reaching the 250°F value. Accordingly, a time is selected taking into account the usual steam sources, thermal mass of the box, etc., which enables the box temperatures to be increased to 250°F or thereabout in a period comensurate with practical requirements and with maximum economy. When the temperature reaches 250°F the steam valve V is turned off — preferably by automatic control from the thermostat T in the chamber — and the garments are purged by air and optionally also by steam to remove the residual odors.

The amounts of formaldehyde and sulphur dioxide for each treating operation depend by the present invention on the volume of the treating chamber. For example, the volume of the treating chamber may be approximately 35 cubic feet. In terms of percentage by volume at atmospheric pressure the sulphur dioxide range is typically from 0.1 to 2 percent, and the formaldehyde range is from 2 to 10 percent. This volume range of formaldehyde is obtained by placing paraformaldehyde on the tray **55** in an amount from 26.25 grams (2 percent) to 131.1 grams (10 percent). However, for maximum results, the sulphur dioxide is provided at a volume percentage of 1.02 percent and the formaldehyde at 6.19 percent. This volume percentage of formaldehyde is obtained by placing 80 grams of paraformaldehyde on the tray **55**. The maximum points in these ranges should not be exceeded because more than 2 percent sulphur dioxide will cause undue degradation of the fabric, and concentrations of formaldehyde above the range noted provides an explosive hazard.

The amount of moisture required for each treating operation is dependent primarily on the weight of the cellulose in each batch of garments being treated. If the clothing being treated is all cellulose the total weight of the batch is considered in determining the amount of moisture required. However, if the clothing is a blend of a given percentage of cellulose with another fiber, then only that percentage of the overall weight is considered in determining the amount of moisture required. It is desired that the moisture content of the clothing should reach from 10 to 20 percent on a weight basis during a treating operation, but preferably the moisture content is to be held between 15 to 17 percent. A variable injection of steam into the treating chamber is achieved by controlling the time interval

the steam valve **68** is held open during each treating operation. For this reason the solenoid valve **68** is controlled by a timer **94**. This timer has a time setting knob **95** registering with a scale **96**, and has a start button **97** for starting a treating operation and a start button **102** for starting a purge operation, as later described. The timer is connected to a power supply via a connector cable **98** and is connected to the solenoid valve **68** by a connector cable **99**. Upon placing a batch of clothing in the treating chamber and then closing the door **18** the operator will press the start button **97** to start the flow of steam into the treating chamber for an interval depending upon the setting of the knob **95**. The scale **96** may be calibrated in terms of the weight of cotton cloth in the batch being treated so that the operator after weighing a batch can readily set the knob for the right steam injection.

The timer **94** is also connected by a cable **100** to the sulphur dioxide control valve **65** to energize this valve for an interval independent of the setting of the knob **95** each time the start button **97** is pressed. However, this time interval of energization of the valve **65** may be adjusted to the desired setting for any given size of treating chamber by an adjusting screw **101** preferably as by a tool such as a wrench or screw driver.

The purging of the garments to rid them of residual odors is carried out by first replacing the gases in the treating chamber with room air as by opening the dampers **77** and **78** at the sides of the treating chamber, opening the damper **86** of the damper box **79** and starting the exhaust blower **82**. After the exhaust blower **82** has run from 3 to 5 minutes to replace the gases in the treating chamber with outside room air, the garments may be removed. However, if further purging is required the dampers are closed to seal the treating chamber and the steam purge button **102** on the timer **94** is pressed to open the steam valve **68** without however opening the valve **65** controlling the sulphur dioxide gas. The timer **94** is adapted to hold the steam valve **68** open for a period of from 2 to 5 minutes when the purge button **102** is pressed. After the treating chamber is again exhausted from two to five minutes as above-described, the batch of clothing may be removed. Still further, the cycle of adding steam and of then exhausting the treating chamber may be repeated.

Durability of crosslinks to acidic washing is superior to that found in conventional resinous type durable press. This is shown in Table I by the crease recovery for acid souring vapor phase treated samples and conventional resinated samples of the same type where the Symbol (W+F) means the recovery along the warp plus the recovery along the fill, it being understood that complete recovery in each direction would be 180°.

TABLE I CREASE RECOVERY AFTER ACID SOURING WITH SULPHURIC ACID

	Conventional Durable Press (W+F)	Vapor Phase (W+F)
Original	304.0	315.0
Souring 30 min. pH 5.0 at 175°F	280.3	306.0
Souring 30 min. pH 3.0 at 175°F	276.7	305.7

Softness of hand is much greater than in conventional resin type durable press as there is no surface resin to give the fabric a "harsh" handle.

Retention of hand on successive washing — As there is no surface resin which is subsequently washed off, vapor phase treated fabrics retain their handle after numerous washings, whereas conventional resin type durable press becomes softer and softer after nominal washings.

Superior Abrasion Resistance of vapor phase samples is due primarily to the softer hand, as the fabrics have not been embrittled with resins as in the case of resin type durable press. As an example, two like fabrics were compared, one containing conventional resin type durable press, the other the vapor phase treatment. These samples are shown in Table II.

TABLE II ABRASION LOSS OF FIBER WEIGHT IN ACCELERATOR AT 3,000 RPM FOR 3 MINUTES

Sample No.	Orig. Weight(g)	Final Weight(g)	% Fiber Retained	% Fiber Lost
619P Conventional Durable Press	3.8791	3.1699	81.7	18.3
618P Vapor Phase Durable Press	3.9893	3.4217	85.8	14.2

Both good wet and dry wrinkle recovery is evidenced in vapor phase durable press fabrics as shown in the following Table III.

TABLE III WET AND DRY CREASE RECOVERY

Sample No.	dry W.	crease F.	recovery (W+F)	wet W.	crease F.	recovery (W+F)
618P (Vapor Phase)	155.0	160.0	315.0	152.0	156.3	308.3
619P (Durable Press)	150.0	154.3	304.3	132.3	143.0	275.3

Stain release is superior in vapor phase treated samples with respect to oily materials. Literature has shown that oily materials adhere to the resinous type crosslinking which are not present in vapor phase crosslinked samples. A 65/35 polyester cotton blend fabric, one piece durable press treated with resins in the textile mill was compared to the same fabric vapor phase treated. These samples were stained and washed, and are compared in the following Table IV.

TABLE IV STAIN REMOVAL ON RESIN DURABLE PRESS VS VAPOR PHASE DURABLE PRESS

Sample No.	Treatment	No. Washes	Catsup	Chocolate Syrup	Salad Dressing
374	Vapor Phase	3	4	4	5
376	Vapor Phase	3	4	4	4+
377	Vapor Phase	3	4	4	5
379	Resin—Durable Press	3	4+	4	4–
380	Resin — Durable Press	3	4	4	4–

Ratings for soil removal are as follows:
1 - No change 2 - Slight change
3 - One half stain 4 - Stain not quite gone
5 - Stain completely removed

Alteration capabilities are very simplified where vapor phase treatments are employed, as garments may be altered prior to rendering the fabric durable press. In conventional resin type durable press, the alterations must be made after the garment is rendered durable press. Creases are then durable and cannot be changed as alterations require.

In the alternative embodiment of the invention shown in FIGS. **9** and **10**, the same form of temperature — time relationship during the treating process is obtained to effect the same durable press with the use of lesser concentrations of treating agents than has been heretofore obtainable and again the period of each treating operation is substantially reduced. In this embodiment, the steam ducts **21** and insulation **45** are removed from between the internal chamber walls **12 – 14** and **16** and the outer shell **46**, and instead the inside walls **12 – 14** and **16** are covered with a one inch thick insulation **108** of expanded silica known as "Careytemp", and a series of finned steam-operated heater units **109** are mounted on the inside walls against the insulation **108**. These internal heating units **109** may comprise three vertically spaced units on the back wall **14** and three intervening units on each side wall **12** and **13**. No heating units are placed against the top and bottom walls **15** and **16** or against the door **18**.

Since the heating units **109** are inside the chamber to heat the internal atmosphere directly they are capable of heating the treating chamber with relatively little time delay. Accordingly, in carrying out the treating process starting with the chamber at room temperature, the formaldehyde and sulphur dioxide gases and the steam are provided in the chamber for about 2 minutes causing the internal temperature to rise again to about 120°F from the heat of the steam, as shown by the portion A_4 of the curve of FIG. **10**. Next, the steam injection is cut off and the chamber is allowed to cool for about two minutes without any auxiliary heating applied. This causes the temperature to fall as shown by the portion A_5 of the curve of FIG. **10**. This fall may typically be from 10° to 15°. The steam is then turned on the heating units **109** causing the internal temperature to begin to rise immediately as shown by the portion A_6 of the curve of FIG. **10**. Further, since the heating units **109** are directly in the chamber the internal temperature rises to about 250°F to complete the cross-linkage reaction in only about 6 minutes. Thereupon, as before, this steam is cut off from the heating units **109** and the chamber is allowed to cool. Also, the fabrics may then be purged with room air and/or steam to rid them of residual odors as may be required.

In order to expedite the treating of fabric articles by the present method on a production basis two treating boxes **10** may be placed in sequential arrangement as shown in FIGS. **11** and **12**. The back walls of these boxes are removed, and the boxes are set back-to-back with a pair of sliding doors **103** therebetween and with the front doors **18** at the front and back of the sequential arrangement. The exhausts **51–52** and **79–83**, and the steam inlet pipes **23**, which were on the back walls, are now appropriately mounted on the right and left walls as indicated. The horizontal portion of the pipe **23** which served as a rack for holding the work being treated is now offset suitably and in its place at a level just above the doors **18** is a conveyor belt or chain **104**. This conveyor chain is trained around guide rollers **105** in a complete circuit. The rectilinear portion **104A** of the conveyor chain ahead of the first box comprises a loading station on which a series of hangers **106** are attached bearing garments or other fabric articles to be treated, and the rectilinear portion **104B** following the second box comprises an unloading station where the hangers are removed. The first box may be used for treating the garments with the steam, formaldehyde and sulphur dioxide, the same as described, and the second box may be used for purging the garments with room air and/or steam to rid the garments of residual odors also in the manner as described. Upon opening the doors **18** and **103** the conveyor chain may be advanced as by a motor **107** through steps to shift the work loads from the loading station to the first box, and concurrently from one box to the next and from the second box to the unloading station.

The embodiments of our invention herein particularly shown and described are intended to be illustrative and not necessarily limitative of our invention since the same are subject to changes and modifications without departure from the scope of our invention, which we endeavor to express according to the following claims.

We claim:

1. An apparatus for treating fabric articles containing cellulosic material to impart a durable press thereto, comprising a treating chamber for said articles, means for exposing the articles in said chamber to steam, formaldehyde gas and sulphur dioxide gas, means for heating said chamber after the steam is cut off to a temperature of at least **250°F**, a surrounding wall spaced from the wall of said chamber, and means for circulating air through the interwall space between said chamber and said surrounding wall.

2. The apparatus set forth in claim **1** wherein said heating means is provided in said interwall space in thermal contact with the wall of said chamber.

3. The apparatus set forth in claim **2** including insulating means applied against said heating means and spaced from said outer wall leaving an air space for flow of air from said circulating means.

4. The apparatus set forth in claim **1** wherein said heating means is in direct contact with the treating atmosphere.

5. The apparatus set forth in claim **1** including an air inlet duct for said chamber and a damper for said duct, said outer wall having air holes for permitting a flow of outside air into said interwall space in the vicinity of said air inlet duct, and a suction fan connected to said interwall space for causing any leakage of gas through said duct when said damper is closed to be drawn via said air holes into said interwall space and exhausted.

6. The apparatus set forth in claim **1** including a door for said chamber through which the chamber is loaded and/or unloaded, said outer wall extending to the boundary of said door and being sealed thereat to the wall of said chamber, said outer wall having air holes at said boundary, and a suction fan connected to said interwall

space for drawing air inwardly through said air holes to exhaust any leakage of gas from around said door.

7. The apparatus set forth in claim 1 wherein the means for exposing the articles in said chamber to steam includes means for injecting said steam into said chamber, and manually settable means for controlling the amount of steam injected in proportion to the weight of the cellulosic material in the fabric articles being treated.

8. An apparatus for treating fabric articles containing cellulosic material to impart a durable press thereto, comprising a treating chamber for said articles, means for exposing the articles in said chamber to steam, formaldehyde gas and sulphur dioxide gas, means for heating said chamber after the steam is cut off to a temperature of at least 250°F, and a top wall for said chamber slanting downwardly to cause condensation thereon to drain downwardly and not drip on the fabric articles being treated.

9. An apparatus for treating fabric articles containing cellulosic material to impart a durable press thereto, comprising a treating chamber for said articles, means for exposing the articles in said chamber to steam, formaldehyde gas and sulphur dioxide gas, means for heating said chamber after the steam is cut off to a temperature of at least 250°F, a rail in said chamber in which hangers bearing said fabric articles can be attached, and means for heating said rail so that steam is prevented from condensing thereon and dripping onto the fabric articles being treated.

10. The apparatus set forth in claim 9 wherein the means for heating said chamber includes steam jacketed heating means and wherein said rail constitutes a pipe extending across said chamber for leading steam to said heating means.

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