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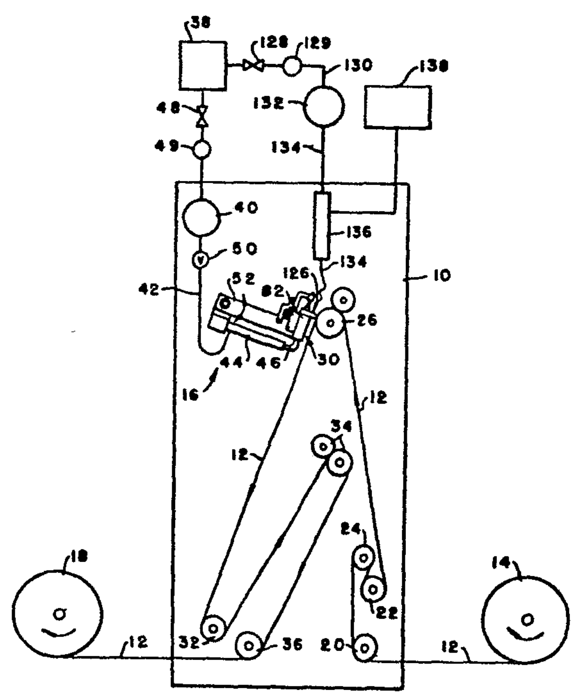
(54) Improved apparatus for imparting visual surface effects to relatively moving materials.

(57) The material 12 to be patterned is moved past an elongated manifold 56 formed by plates 102 and 104 clamped together with a shim plate 116 and comb like shim plate 112 therebetween providing channels for hot air to flow out onto the material 12. The manifold 56 is clamped by clamps 58 onto a larger manifold 54 into which the hot air is fed through pipes 46 at intervals alongs its length. The air flows across the larger manifold in a first direction, through passages 86 and an outlet slot 88 and thence through one point 104 of the smaller manifold. The flow through the smaller manifold is at right angles to the flow through the larger manifold whereby distortions and pattern disturbances arising from thermal gradients are reduced.



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IMPROVED APPARATUS FOR IMPARTING VISUAL SURFACE EFFECTS TO RELATIVELY MOVING MATERIALS

This invention relates to improved apparatus for pressurized heated fluid stream treatment of relatively moving materials to provide visual surface effects therein, and more particularly, to improved apparatus for precise selective application of discrete, high temperature, pressurized streams of air or gaseous materials against the surface of a thermally modifiable, relatively moving substrate material, such as a textile fabric containing thermoplastic yarn or fiber components, to thermally modify the same and impart a visual change and/or pattern effect therein.

BACKGROUND OF THE INVENTION:

Various apparatus have been proposed for directing heated pressurized fluid streams, such as air or steam, into the surface of moving textile fabrics to alter the location of or modify the thermal properties of fibers or yarns therein and provide a pattern or visual surface change in such fabrics. Examples of such prior art equipment and methods of application of the pressurized fluid streams to a relatively moving material are disclosed in the following U. S. Patents:

U.S. 2,110,118	U.S. 3,403,862
U.S. 2,241,222	U.S. 3,434,188
U.S. 2,563,259	U.S. 3,585,098
U.S. 3,010,179	U.S. 3,613,186

It is believed that such prior art treatment devices as described in the aforementioned patents, because of the nature of the equipment disclosed, are not capable of producing precise, intricate, or well defined patterns of wide variety in the fabrics, but generally can only produce limited, relatively grossly defined patterns, or surface modifications of a random, non-defined nature in the materials. In utilizing high temperature pressurized streams of fluid, such as air, to impart visual surface patterns to textile fabrics containing thermoplastic materials by thermal modification of the same, it can be appreciated that highly precise control of stream pressure, temperature, and direction is required in all of the individual heated streams striking the fabric to obtain uniformity and preciseness in the resultant pattern formed in the fabric. In addition, there are ever present difficulties in regulating the flow of high temperature fluid streams by use of conventional valving systems to selectively cut the stream flow on or off in accordance with pattern control information.

More recently, (GB 2 065 035 A), apparatus has been developed for more precisely and accurately controlling and directing high temperature streams of pressurized fluid, such as air, against the surface of a relatively moving substrate material, such as a textile fabric containing thermoplastic yarns, to impart intricate patterns and surface changes thereto. Such apparatus includes an elongate pressurized heated air distributing manifold having a narrow elongate air discharge slot extending across the path of fabric movement in close proximity to the fabric surface. Located within the manifold is a shim plate having a notched edge which resides in the discharge slot to form parallel spaced discharge channels through which the heated pressurized air passes in narrow, precisely defined streams to impinge upon the adjacent surface of the fabric. Flow of the individual heated air streams from the channels is controlled by the use of pressurized cool air which is directed by individual cool air supply tubes communicating with each channel to direct cool air into each discharge channel at a generally right angle to its discharge axis to block the passage of heated air therethrough. Each cool air tube is provided with an individual valve and the valves are selectively cut on and off in response to signal information from a pattern source, such as a computer program, to allow the heated air streams to strike the moving fabric in selected areas and impart a pattern thereto by thermal modification of the yarns.

To maintain more uniform temperature in the individual heated air streams along the full length of the distributing manifold, pressurized air is supplied to the distributing manifold through a bank of individual electric heaters which communicate with the manifold at uniformly spaced locations along its length and are regulated to introduce heated air at the desired temperature along the full length of the manifold.

Although such apparatus as described above provides for highly precise and intricate hot air patterning of substrate materials, it can be appreciated that the temperature and pressure of each of the individual pressurized streams of high temperature air striking the surface of the substrate material must be uniform across the full width of the substrate being treated, otherwise irregular patterning of the substrate occurs. For example, in treatment of textile pile fabrics containing thermoplastic pile yarns, the streams of heated air striking the pile yarns in selected areas of the fabric cause the yarns to thermally deform, longitudinally shrink, and compact into the pile surface, forming narrow, precisely defined grooves or recesses which provide a desired patterned appearance in the pile surface. If the temperature or pressure in any of the air streams across the width of the fabric varies significantly from the others, the resultant patterned groove or recess formed thereby will be more or less pronounced in the pattern and correspondingly detract from the appearance of the final product.

In handling and distributing the high temperature air, a temperature drop occurs in the heated air during its passage through the manifold from the heater source to its point of discharge from the manifold. Furthermore, when pressurized cool air is employed to block selected of the heated air discharge channels of the manifold to produce a desired pattern, as in the aforementioned apparatus, there is a momentary cooling of the manifold housing around the heated air discharge channel blocked by the cool air, resulting in a slight temperature drop in adjacent heated air streams striking the fabric, as well as a reduced temperature in the heated air stream discharged from the channel after it is unblocked. When a large number of discharge channels across the manifold are simultaneously blocked by cool pressurized air, the cooling effect on the manifold housing becomes more pronounced. In addition, a pressure build-up of heated air can occur in the manifold itself, causing undesired temperature and pressure variations in the heated air streams during the patterning operation, and contributing to overheating of the heater elements.

It has also been found that temperature drops of the kind described above can cause differential thermal expansion of the manifold housing which results in a displacement or bending of the manifold along its longitudinal axis. Such distortions become magnified in proportion to the length of the manifold, and present a serious problem when the distortions cause a variation in the distances of the manifold discharge outlets from the surface of the substrate material. If certain of the discharge outlets along the manifold are moved away from the substrate, the temperature, pressure, and preciseness of their streams striking the fabric will be reduced, resulting in a non-uniform patterning of the substrate across its width. Correspondingly, if certain of the manifold discharge outlets are moved closer to the substrate surface due to thermal distortion of the manifold, pattern variations are again produced across the substrate. Additionally, the substrate may be damaged by overheating due to higher temperature of the streams striking the substrate or by direct contact of the substrate with the hot manifold.

It is therefore an object of the present invention to provide improved apparatus of the type hereinabove described for directing fluid streams having uniformly high temperature and pressure into the surface of a relatively moving substrate material to impart a precise visual pattern or surface appearance thereto.

The starting point of the invention is set out in the introductory part of claim 1 below, being based upon the aofrementioned published application GB 2 065 035.

The invention is characterised in the characterising part of claim 1 and various advantageous developments of the invention are defined in the dependent claims.

The preferred embodiment of the invention comprises improved fluid distributing manifold means for directing discrete streams of pressurized heated fluid, such as hot air, into the surface of a relatively moving substrate, in particular substrate materials containing thermoplastic components, to impart a precise pattern or surface change thereto. The manifold means comprises a pair of elongate manifold housings coupled together and defining respective first and second pressurized fluid-receiving compartments. Heated fluid is supplied to the first elongate manifold housing compartment through multiple inlets, uniformly spaced along its length, and the heated fluid passes through the first housing compartment in a particularly directed path generally perpendicular to its length to facilitate uniform distribution and temperature in the fluid along the length of the housing. The heated fluid from the first housing passes into the second elongate housing compartment which is provided with pressurized fluid discharge outlet channels spaced in parallel relation along the length of the housing to direct streams of fluid generally at a right angle into the surface of the substrate material. The manifold housings are constructed and arranged so that the flow path of fluid through the first housing is generally at a right angle to the discharge axes of the fluid stream outlets of the second manifold housing. The second manifold housing is disposed across the path of movement of the substrate material and has a plurality of heated fluid discharge outlets spaced along the manifold for discharging pressurized streams of heated fluid, such as hot air, into the surface of the substrate across its width to thermally modify and alter the surface appearance of the substrate. Discharge of the streams of heated air from the manifold housing outlets is controlled by selectively introducing a pressurized fluid, such as air, having a temperature substantially lower than the temperature of the heated air, into the discharge channel of each heated air discharge outlet to block the passage of heated air therethrough. The pressurized cool air is introduced into each hot air discharge channel at a substantially right angle to its discharge axis by an individual cool air supply line which is provided with a control valve operated in accordance with pattern information to activate and deactivate the flow of pressurized cool air to the heated air discharge channels.

Temperature drops in the heated air during its passage through the manifold cause differential expansion of the first manifold housing which produces a bowing or bending effect along the longitudinal length of the housing. Because of the generally symmetrical arrangement of the first manifold housing mass about a plane parallel to the predominant flow of fluid through the housing, this differential expansion tends to be similarly symmetrical. As a result, the bowing or bending effects tend to be directed in a plane generally perpendicular to the plane of the discharge outlets of the heated air streams, and therefore parallel to the surface of the substrate. Thus, the displacement of the manifold is resolved in a plane so as to minimize any movement of the discharge outlets toward or away from the substrate, eliminating resultant patterning irregularities in the treated substrate caused by such forces.

The first manifold housing is provided with baffle means, fluid passageways, and filter means to evenly distribute the fluid along the length of the housing and filter the same during its passage through the housing. Quick-release clamping means are provided for supportably attaching the second housing to the first housing to permit its quick removal and replacement during pattern changes and maintenance of the apparatus.

To counteract the localized cooling of the second manifold housing by the blocking cool air, the second housing is provided with a plurality of hot air outlets located between the heated air discharge channels which communicate by passageways with the second manifold housing compartment to allow a continuous bleed off of a small amount of heated air from the second manifold housing compartment. This heated bleed off air contacts the wall portions of the second manifold housing adjacent the heated air discharge channels to heat the same, thus reducing the aforementioned localized cooling effect and minimizing the time necessary to re-establish a satisfactory heated air stream in a previously blocked channel, thereby avoiding resultant patterning irregularities in the substrate material resulting therefrom.

In addition, continuous bleed-off of heated air from the second manifold housing during patterning prevents overheating of the heaters and reduces pressure build up of heated air in the manifold housing when the heated air streams are blocked by the cool air.

BRIEF DESCRIPTION OF THE DRAWINGS:

Objects and details of the invention will be better understood from the following detailed description of preferred embodiments thereof, when taken together with the accompanying drawings, in which:

Figure 1 is a schematic side elevation view of apparatus for pressurized heated fluid stream treatment of a moving substrate material to impart a surface pattern or change in the surface appearance thereof, and incorporating novel features of the present invention;

Figure 2 is an enlarged partial sectional elevation view of the fluid distributing manifold assembly of the apparatus of Figure 1, taken along a section line of the manifold assembly indicated by the line II-II in Figure 7;

Figure 3 is an enlarged sectional view of end portions of the elongate manifold assembly, taken generally along line III-III of Figure 2 and looking in the direction of the arrows;

Figure 4 is an enlarged side elevation view of end portions of the elongate baffle member of the manifold assembly, looking in the direction of arrows IV-IV of Figure 2;

Figure 5 is an enlarged broken away sectional view of the fluid stream distributing manifold housing portion of the manifold assembly as illustrated in Figure 2;

Figure 6 is an enlarged broken away plan view of an end portion of the fluid stream distributing manifold housing looking in the direction of the arrows VI-VI of Figure 5;

Figure 7 is an enlarged plan view of end portions of the manifold assembly, taken generally along line VII-VII of Figure 2 and looking in the direction of the arrows; and

Figure 8 is a front elevation view of the fluid distributing manifold housing looking in the direction of arrow VIII in Figure 7;

Figure 9 is an enlarged sectional elevation view of a modified form of fluid distributing manifold housing from that shown in Figures 2 and 5.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS:

Referring more specifically to the drawings, Figure 1 shows, diagrammatically, an overall side elevation view of apparatus for pressurized heated fluid stream treatment of a moving substrate material to impart a pattern or visual change thereto. As seen, the apparatus includes a main support frame including end frame support members, one of which 10 is illustrated in Figure 1. Suitably rotatably mounted on the end support members of the frame are a plurality of substrate guide rolls which direct an indefinite length substrate material, such as a textile fabric 12, from a fabric supply roll 14, past a pressurized heated fluid treating unit, generally indicated at 16. After treatment, the fabric is collected in continuous manner on a take-up roll 18. As shown, fabric 12 from supply roll 14 passes over an idler roll 20 and is fed by a pair of driven rolls 22, 24 to a main driven fabric support roll 26 to pass the surface of the fabric closely adjacent the heated fluid discharge outlets of an elongate fluid distributing manifold assembly 30 of treating unit 16. The treated fabric 12 thereafter passes over a series of driven guide rolls 32, 34 and an idler roll 36 to take up roll 18 for collection.

As illustrated in Figure 1, fluid treating unit 16 includes a source of compressed fluid, such as an air compressor 38, which supplies pressurized air to an elongate air header pipe 40. Header pipe 40 communicates by a series of air lines 42 spaced uniformly along its length with a bank of individual electrical heaters indicated generally at 44. The heaters 44 are arranged in parallel along the length of manifold assembly 30 and supply heated pressurized air thereto through short, individual air supply lines, indicated at 46, which communicate with assembly 30 uniformly along its full length. Air supply to the fluid distributing manifold assembly is controlled by a master control valve 48, pressure regulator valve 49, and individual precision control valves, such as needle valves 50, located in each heater air supply line 42. The heaters are controlled in suitable manner, as by temperature sensing means located in the outlet lines 46 of each heater, with regulation of air flow and electrical power to each of the heaters to maintain the heated fluid at a uniform temperature and pressure as it passes into the manifold assembly along its full length. Typically, for patterning textile fabrics, such as pile fabrics containing thermoplastic pile yarns, the heaters are employed to heat air exiting the heaters and entering the manifold assembly to a uniform temperature of about 370°C-510°C.

The heated fluid distributing manifold assembly 30 is disposed across the full width of the path of movement of the fabric and closely adjacent the surface thereof to be treated. Although the length of the manifold assembly may vary, typically in the treatment of textile fabric materials, the length of the manifold assembly may be 1.93 meters or more to accommodate fabrics of up to about 1.8 meters in width.

As illustrated in Figure 1 and in Figure 7, the elongate manifold assembly 30 and the bank of heaters 44 are supported at their ends on the end frame support members 10 of the main support frame by support arms 52 which are pivotally attached to end members 10 to permit movement of the assembly 30 and heaters 44 away from the surface of the fabric 12 and fabric supporting roller 26 during periods when the movement of the fabric through the treating apparatus may be stopped.

Details of the improved heated fluid distributing manifold assembly of the present invention may be best described by reference to Figures 2-9 of the drawings. As seen in Figure 2, which is a partial sectional elevation view through the assembly, taken along line II-II of Figure 7, the manifold assembly 30 comprises a first large elongate manifold housing 54 and a second smaller elongate manifold housing 56 secured in fluid tight relationship therewith by a plurality of spaced clamping means, one of which is generally indicated at 58. The manifold housings 54, 56 extend across the full width of the fabric 12 adjacent its path of movement. Clamping means 58 comprises a plurality of manually-operated clamps 60 spaced along the length of the housings. Each clamp includes a first portion 62 fixedly attached, as by welding, to the first manifold housing 54, and a second movable portion 64 pivotally attached to fixed portion 62 by a manually operated handle and linkage mechanism 66. Second portion 64 of clamp 60 includes an adjustable threaded screw and bolt assembly 68 with elongate presser bars 70 which apply pressure to manifold housing 56 through a plurality of spacer blocks 72 which are attached to the surface of housing 56 at spaced locations along its length (Fig. 7).

As best seen in Figure 2, first elongate manifold housing 54 is of generally rectangular cross-sectional shape, and includes a pair of spaced plates forming side walls 74, 76 which extend across the full width of the path of fabric movement, and elongate top and bottom wall plates 78, 80 which define a first elongate fluid receiving compartment 81, the ends of which are sealed by end wall plates 82 suitably bolted thereto. Communicating with bottom wall plate 80 through fluid inlet openings 83 (Fig. 4) spaced uniformly therealong are the air supply lines 46 from each of the electrical heaters 44. The side walls 74, 76 of the housing are connected to top wall plate 78 in suitable manner, as by welding, and the bottom wall plate 80 is removably attached to side walls 74, 76 by bolts 84 to permit access to the fluid receiving compartment. The plates and walls of the housing 54 are formed of suitable high strength material, such as stainless steel, or the like.

The manifold housings 54, 56 are constructed and arranged so that the flow path of fluid through the first housing 54 is generally at a right angle to the discharge axes of the fluid stream outlets of the second manifold housing 56. In addition, the mass comprising side walls 74, 76 and top and bottom wall plates 78, 80 of first manifold housing 54 is substantially symmetrically arranged on opposing sides of a plane bisecting the first fluid receiving compartment 81 in a direction parallel to the elongate length of manifold housing 54 and parallel to the predominant direction of fluid flow, i.e., from inlet openings 83 to passageways 86, through the housing compartment 81. Because the mass of the first housing 54 is arranged in a generally symmetrical fashion with respect to the path of the heated fluid through the housing compartment 81, thermal gradients and the resulting thermally-induced distortions in the first housing 54 also tend to be similarly symmetrical. As a consequence, any distortion of the manifold assembly caused by expansion and contraction due to temperature differentials tends to be resolved in a plane generally parallel to the surface of the textile fabric 12 being contacted by the heated fluid streams. This resolution of movement of the manifold assembly minimizes any displacement of the manifold discharge outlet channels 115 toward or away from the fabric 12 as a result of non-uniform thermal expansion of the manifold assembly. Any remaining unresolved thermally-induced displacement of the manifold housing 54 may be corrected by use of jacking members or other means to supply corrective forces directly to the manifold housing.

As best seen in Figures 2, 3 and 7, upper wall plate 78 of manifold housing 54 is of relatively thick construction and is provided with a plurality of fluid flow passageways 86 which are disposed in uniformly spaced relation along the plate in two rows to communicate the first fluid receiving compartment 81 with a central elongate channel 88 in the outer face of plate 78 which extends between the passageways along the length of the plate. As seen in Figures 3 and 7, the passageways in one row are located in staggered, spaced relation to the passageways in the other row to provide for uniform distribution of pressurized air into the central channel 88 while minimizing strength loss of the elongate plate 78 in the overall manifold assembly.

As seen in Figures 2 and 4, located in first fluid receiving compartment 81 and attached to the bottom wall plate 80 of the housing 54 by threaded bolts 90 is an elongate channel-shaped baffle plate 92 which extends along the length of the compartment 81 in overlying relation to wall plate 80 and the spaced, fluid inlet openings 83. Baffle plate 92 serves to define a fluid receiving chamber in the compartment 81 having side openings or slots 94 adjacent wall plate 80 to direct the incoming heated air from the bank of heaters in a generally reversing path of flow through compartment 81. As seen in Figure 2, disposed above channel-shaped baffle plate 92 in compartment 81 between the fluid inlet openings 83 and fluid outlet passageways 86 is an elongate filter member 96 which consists of a preforated, generally J-shaped plate 98 with filter screen 100 disposed thereabout. Filter member 96 extends the length of the first fluid receiving compartment 81 and serves to filter foreign particles from the heated pressurized air during its passage therethrough. Access to the compartment 81 by way of removable bottom wall plate 80 permits periodic cleaning and/or replacement of the filter member, and the filter member is maintained in position in the compartment 81 by frictional engagement with the side walls 74, 76 to permit its quick removal from and replacement in the compartment 81.

As best seen in Figures 2, 5, and 8, second smaller manifold housing 56 comprises first and second opposed elongate wall members 102, 104, each of which has an elongate recess or channel 108 therein. Wall members 102, 104 are disposed in spaced, coextensive parallel relation with their channels 108 in facing relation to form upper and lower wall portions of a second fluid receiving compartment 110, in the second manifold housing 56. Ends of the second fluid receiving compartment 110 are closed by end plates 111 (Fig. 7). The opposed wall members 102, 104 are maintained in spaced relation by an elongate front shim plate 112 which has a plurality of parallel, elongate notches 114 (Fig. 6) in one side edge thereof, and a rear elongate shim plate 116 disposed between the opposed faces of the wall members 102, 104 in fluid tight engagement therewith. As seen in Figures 5, 6, and 8, the notched edge of shim plate 112 is disposed between the first and second wall members along the front elongate edge portions thereof to form, with wall members 102, 104, a plurality of parallel heated fluid discharge outlet channels which direct heated pressurized air from the second fluid receiving compartment 110 in narrow, discrete streams at a substantially right angle into the surface of the moving fabric substrate material 12. Dowel pins 117 in second compartment 110 facilitate alignment of shim plate 112 between wall members 102, 104. Typically, in treatment of textile fabrics, such as pile fabrics containing thermoplastic pile yarn or fiber components, the discharge channels 115 of manifold 56 may be 0.3 mm wide and uniformly spaced on 2.54 mm centers, with 756 discharge channels being located in a row along a 1.93 meter long manifold assembly. For precise control of the heated air streams striking the fabric, the discharge outlet channels are preferably maintained between about 0.50 to 0.77 mm from the fabric surface being treated.

Lower wall member 104 of the second manifold housing 56 is provided with a plurality of fluid inlet openings 118 which communicate with the elongate channel 88 of the first manifold housing 54 along its length to receive pressurized heated air from the first manifold housing 54 into the second fluid receiving compartment 110. Wall members 102, 104 of the second manifold housing 56 are connected at spaced locations by a plurality of threaded bolts 120, and the second manifold housing 56 is maintained in fluid tight relation with its shim members and with the elongate channel 88 of the first manifold housing 54, by the adjustable clamps 60. Guide means, comprising a plurality of short guide bars 122 attached to the second manifold housing 56 and received in guide bar openings in brackets 124 attached to the first manifold housing 54, ensure proper alignment of the first and second manifold housings during their attachment by the quick-release clamps 60.

As seen in Figures 1, 2, 5, and 8 of the drawings, each of the heated fluid discharge outlet channels

115 of the second manifold housing 56 which direct streams of air into the surface of fabric 12 is provided with a tube 126 which communicates at a right angle to the axis of the discharge channel to introduce pressurized cool air, i.e., air having a temperature substantially below that of the heated air in second fluid receiving compartment 110, into the heated fluid discharge outlet channel to selectively block the flow of heated air through the channel in accordance with pattern control information. Air passing through the tubes 126 may be cooled by a water jacket 127 which is provided with cooling water from a suitable source, not shown. As shown in Figure 1, pressurized unheated air is supplied to each of the tubes 126 from compressor 38 by way of a master control valve 128, pressure regulator valve 129, air line 130, and unheated air header pipe 132 which is connected by a plurality of individual air supply lines 134 to the individual tubes 126. Each of the individual cool air supply lines 134 is provided with an individual control valve located in a valve box 136. These individual control valves are operated to open or close in response to signals from a pattern control device, such as a computer 138, to stop the flow of hot air through selected discharge channels 115 during movement of the fabric and thereby produce a desired pattern in the fabric. Detailed patterning information for individual patterns may be stored and accessed by means of any known data storage medium suitable for use with electronic computers, such as magnetic tape, EPROMs, etc. As seen in Figures 5, 6, and 8, located in the lower wall member

104 between each of the pressurized-heated fluid discharge outlet channels 115 is a fluid outlet tube 140. Each outlet tube 140 is in continuous communication with the fluid receiving compartment 110 of housing 56 by a passageway 142 formed by an arcuate groove cut into the upper surface of lower wall member 104 between each discharge outlet channel 115 formed by the wall members and shim plate 112. Each of the fluid outlet tubes 140 is positioned at a right angle or greater to the axes of discharge of the outlet channels 115, as measured from that portion of the outlet channel closest to the fabric surface, to continuously bleed off a portion of heated pressurized air from the fluid receiving compartment 110 through passageways 142 and to direct the same away from the surface of the moving fabric 12 (Fig. 3). The continuous flow of hot air through passageways 142 which extend parallel to channels 115, heats the wall portions of the manifold housing 56 and surface portions of the shim plate 112 between the discharge channels to counteract the cooling of the same when pressurized cool air is introduced into the channels for blocking heated air stream discharge therefrom.

By continuously bleeding off a portion of pressurized heated air from the fluid receiving compartment 110, excess heat and pressure which build up in the compartment during blocking of the discharge channels 115 is reduced to minimize pattern distortions in the fabric resulting therefrom. Continuous bleed off of hot air from the manifold compartment also reduces the frequency of regulation of power to the individual heaters 44 to maintain air at a desired temperature entering the manifold assembly 30, and prevents possible overheating or burn out of the heaters when air flow therethrough could be reduced by excessive pressure build up in compartment 110.

The amount of air continuously bled off from the fluid receiving compartment 110 through tubes 140 may be varied by use of tubes of varying internal cross-sectional area. Typically, for patterning textile fabrics containing thermally deformable components, it has been found that improved results in pattern uniformity have been achieved when the total internal cross-sectional area of the outlet tubes 140 is about one-half or more of the total cross-sectional area of the discharge outlet channels 115 of the manifold housing 56.

Under certain conditions, it may not be necessary to heat the manifold housing 56 and shim plate 112 to counteract the effect of the blocking stream of pressurized cool air from tube 126. However, where the use of such blocking streams could result in a build-up of heat and pressure sufficient to shorten heater life or induce problems in power regulation, it is foreseen that tubes 140 may be located so as to exit heated air from compartment 110 from any convenient location, such as depicted at 140A of Figure 5.

Figure 9 shows a modified form of manifold assembly from that shown in Figures 1-8 wherein a second manifold housing 200 without tubes 126 is employed in the manifold assembly to pattern the substrate material. The construction and attachment of the manifold housing 200 to the main housing 154 is substantially identical to the fluid distributing manifold housing 56 of Figures 1-8 with the exception of tubes 126 of cooler fluid for blocking discharge of the heated fluid from the manifold channels. Housing 200 includes upper and lower elongate wall members 202, 204 with notched shim plate 206 and rear shim plate 208 defining the hot fluid receiving compartment therein. The notches of shim plate 206 are spaced at desired locations along the edge of the plate to produce a pattern of continuous stripes along the length of the moving substrate, and stripe pattern changes may be affected by quick release of the manifold housing 200 from the main manifold housing 154 and replacement of the shim plate 206 therein with shim plates having other notch pattern configurations.

By the use of front and back shim plates between the upper and lower wall members of the manifold housing 56 as illustrated in the embodiment of Figures 1-8, or 200 as indicated in the modification shown in Figure 9 thereof, the sealing surfaces of the upper and lower wall members may be smoothly machined in a single machining operation to ensure fluid tight seal of the housing compartment. The use of two shims of equal thickness to seal the manifold housing compartment also permits the use of notched shim plates of different thicknesses to vary the cross-sectional dimension size of the discharge channels, as desired, without having to provide a different manifold housing construction to accommodate pattern shim plates of different thicknesses.

As seen in Figures 2, 5, and 9, an additional elongate filter medium or screen 210 may be disposed in the second fluid receiving compartment of the manifold assembly to facilitate filtration and distribution of the pressurized heated air prior to its discharge onto the moving substrate material.

As can be understood from the foregoing detailed description of preferred embodiments of the invention, the manifold assembly comprising first and second manifold housings provides a heated pressurized fluid flow path from the bank of heaters which passes through the first manifold housing in a direction generally perpendicular to its elongate length and perpendicular to the axes of discharge of the pressurized fluid streams from the second fluid receiving compartment. Such passage provides uniform distribution of the heated fluid, such as air, in the manifold assembly prior to its discharge onto the fabric substrate. Typically, it has been found that during passage of heated air from the heaters through the first manifold housing to achieve the desired mixing of the air, temperature drops of as much as about 48°C occur in the air stream, ignoring the substantial cooling effects induced by the blocking streams of cooler fluid, when used. Such temperature drops cause differential expansion of the first manifold housing which produces a bowing or bending effect along its longitudinal length which is directed by the arrangement and configuration of the manifold assembly in a plane generally parallel to the surface of the fabric substrate and perpendicular to the plane of the discharge axes of the streams from the second manifold housing. Thus, the displacement of the assembly is resolved in a plane so as to minimize any movement of the discharge outlets of the second housing toward or away from the fabric, eliminating resultant patterning irregularities in the treated fabric caused by such forces. Cooling effects induced by the streams of pressurized cooler fluid used to selectively block the heated fluid streams may be compensated by continuously bleeding off heated fluid from the second manifold housing, thereby heating wall portions of the manifold housing, as well as preventing the build up of excess heat and pressure within the second fluid receiving compartment.

CLAIMS

1. Apparatus for directing pressurized, heated fluid on to material moving relative to the apparatus, comprising an elongated manifold with a discharge opening from which the fluid is discharged in one or more streams across the width of the material, characterised in that the manifold (30) comprises a first manifold housing (54) with inlet means (46) for introducing the fluid into a first compartment (81) generally uniformly along the length thereof, and a second manifold housing (56) attached to the first housing and having the said discharge opening (115) feeding out of a second compartment (110) in the second housing, the first and second housings having outlet means (88) and inlet means (118) respectively distributed along their lengths and communicating with each other and so spaced from the first said inlet means (46) and the discharge oepning (115) respectively, that the fluid flows across the first compartment (81) in a first mean direction substantially perpendicular to the length of the manifold and flows across the second compartment (110) in a second mean direction substantially perpendicular both to the length of the manifold and to the first mean direction.

2. Apparatus according to claim 1, characterised in that the mass of the first housing (54) is substantially symmetrically arranged on opposite sides of a plane which bisects the first compartment (110) in a direction parallel to the length of the first compartment and parallel to the first mean direction.

3. Apparatus according to claim 1 or 2, characterised in that the second housing (56) is attached to the first housing (54) by quick-release clamping means (58) allowing the second housing to be removed from the first housing to facilitate replacement and maintenance of component parts of the second manifold housing.

4. Apparatus according to claim 1, 2 or 3, characterised by baffle means (92) in the first compartment (81) between the inlet and outlet means (46 and 88) thereof for reversing the path of flow of fluid through the compartment during its passage therethrough.

5. Apparatus according to claim 4, characterised in that the first housing inlet means comprises a plurality of inlet openings (46) generally uniformly spaced along the length of the housing through a wall portion (80) thereof, and in that the baffle means comprises an elongate channel-shaped plate (92) extending along the length of the first compartment (81) over the said wall portion and inlet openings to define a fluid-receiving chamber in the compartment (81) having side openings (94) adjacent the said wall portion (80) and along the length of the housing.

6. Apparatus according to any of claims 1 to 5, characterised by filter means (96) removably disposed in the first compartment (81) along the length thereof and between the inlet means (46) and outlet means (88).

7. Apparatus according to claim 6, characterised in that the filter means (96) comprises a perforated screen (100) spanning the first compartment (81) along its length and frictional engaging side wall portions (74, 76) of the housing to permit its ready removal therefrom for maintenance of the apparatus.

8. Apparatus according to any of claims 1 to 7, characterised in that the first housing outlet means comprise a plurality of passageways (86) through a wall member (78) of the housing, the passageways being disposed in two mutually staggered rows along the length of the housing, and an elongated channel (88) in the outer face of the wall member (78) extending between the rows of passageways (86) along the length of the housing, the passageways communicating with the channel (88) at substantially uniformly spaced locations along its length.

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9. Apparatus according to claim 8, characterised in that the second housing inlet means comprises a plurality of inlet openings (118) disposed in substantially uniformly spaced relationship along the length of the housing and communicating with the elongated channel (88) in the outer face of the first housing wall member (78).

10. Apparatus according to claim 9, characterised in that the first and second housings (54 and 56) are attached with wall surface portions of the housings providing a fluid seal between the second housing inlet openings (118) and the elongated channel (88) in the outer face of the first housing wall member (78).

11. Apparatus according to claim 3 and claim 10, characterised in that the clamping means (58) press the second housing at spaced locations along its length to maintain the wall surface portions of the housings in fluid seal engagement.

12. Apparatus according to claim 11, characterised by guide means (122, 124) on the housings (54, 56) to ensure proper alignment of the housings during attachment of the second housing to the first housing by the clamping means (58).

13. Apparatus according to any of claims 1 to 12, characterised in that said second manifold housing comprises first and second opposed elongate wall members each having an elongate channel therein, said wall members being disposed in spaced coextensive parallel rèlation with their channels in facing relation to form upper and lower wall portions of said second-fluid receiving compartment, a first elongate shim plate having a plurality of generally parallel notches spaced along an elongate side edge thereof, the notched edge of said first shim plate being positioned between said first and second elongate wall members along an elongate edge portion thereof and in

contiguous relation therewith to form said fluid stream discharge outlet means of said second housing, a second elongate shim plate positioned between said first and second wall members along the opposite elongate edge portion of said first and second elongate wall member in contiguous relation therewith, an end wall member attached to each end of said first and second wall members in fluid-tight relation with said wall members and said shim plate, and wherein said attaching means includes means for applying pressure on said first and second elongate wall members to maintain contiguous surfaces of said shim plates in fluid-tight relation therewith.

14. Apparatus as defined in claim 1 wherein said second manifold housing includes a plurality of fluid discharge outlet channels disposed in parallel spaced relation along said second fluid receiving compartment for directing discrete streams of heated, pressurized fluid against the surface of said substrate material.

15. Apparatus as defined in claim 14 comprising means for directing pressurized cool fluid into selected of said fluid discharge outlet channels to selectively block the passage of heated fluid therethrough.

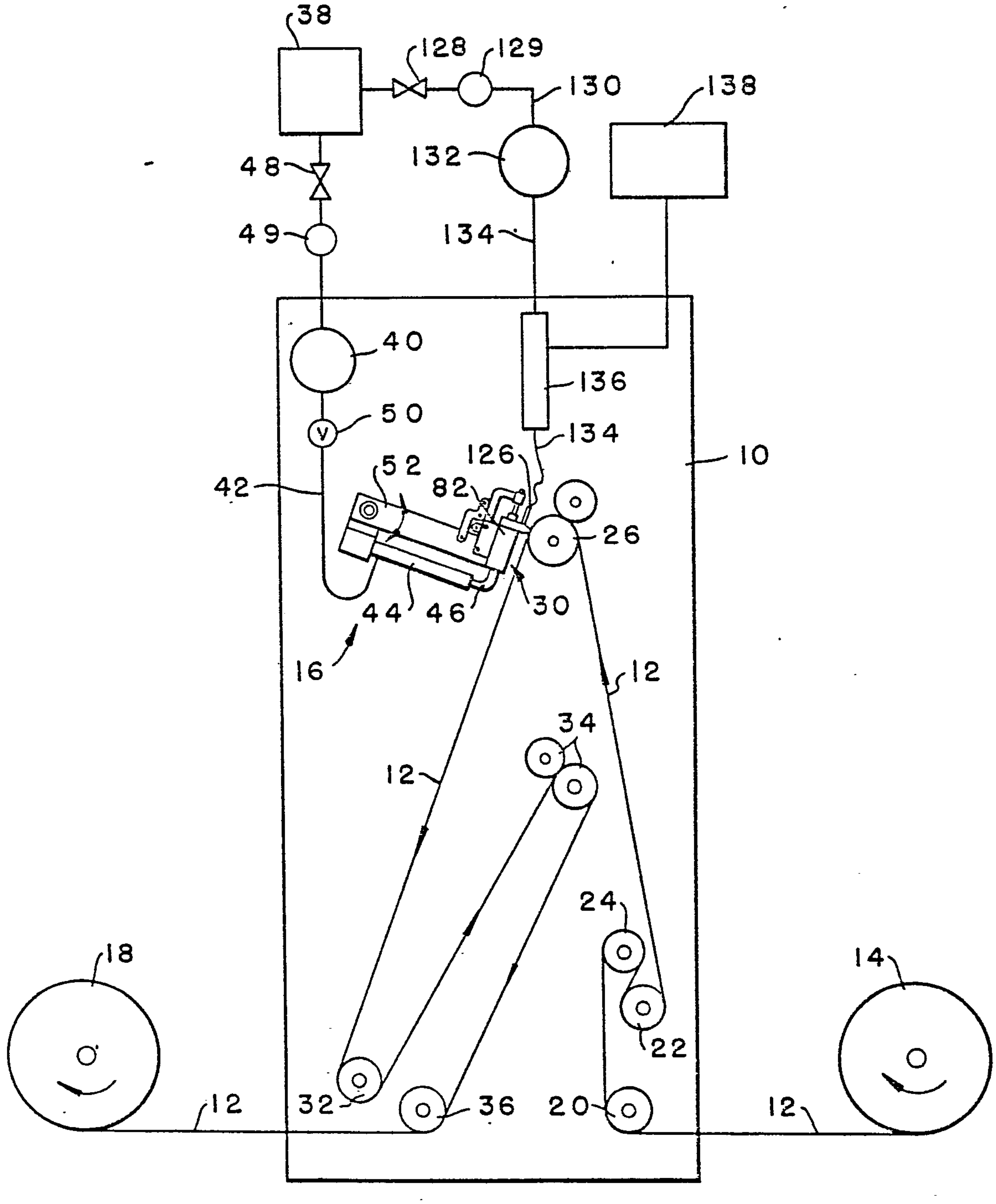
16. Apparatus as defined in cliam 15 comprising fluid passage means for directing pressurized heated fluid from said second fluid receiving compartment through wall portions of the manifold adjacent the fluid discharge outlet channels to heat the wall portions adjacent the channels.

17. Apparatus as defined in claim 16 wherein said passage means includes a heated fluid outlet in said second manifold housing located between each of said discharge channels, and a passageway communicating each outlet with said second fluid receiving compartment to permit continuous flow of heated fluid in said compartment through the passageway and from said manifold.

18. Apparatus as defined in claim 17 wherein said manifold includes a pair of elongate wall members extending across the path of relative movement of the substrate material in opposed spaced relation and with opposed elongate edge portions of the wall members defining an elongate slot therebetween, an elongate shim plate having a notched side edge and positioned with said notched side edge within said slot to define, with said edge portions of the wall members, said discharge outlet channels of the manifold, and wherein said passageways and said fluid outlets communicate with surface portions of said shim plate between said channels to continuously heat the same and reduce cooling thereof by pressurized cool fluid employed to block selected of the discharge channels of the manifold.

19. Apparatus as defined in claim 18 wherein said passageways and fluid outlets are located in an elongate edge portion of one of said wall members, and wherein the axis of discharge of heated fluid from each of said outlets defines an angle of at least about 90° with the axes of discharge of heated fluid streams from said discharge channels, as measured from that portion of the outlet channel closest to the substrate surface, to direct heated fluid from said manifold outlets away from the surface of the relatively moving substrate material.

20. Apparatus as defined in claim 19 wherein said passageways extend generally parallel to the manifold discharge outlet channels and communicate along their length with surface portions of said shim plate between said notches therein, and wherein said fluid outlets include tubes communicating with said passageways and terminating beyond said manifold one wall member.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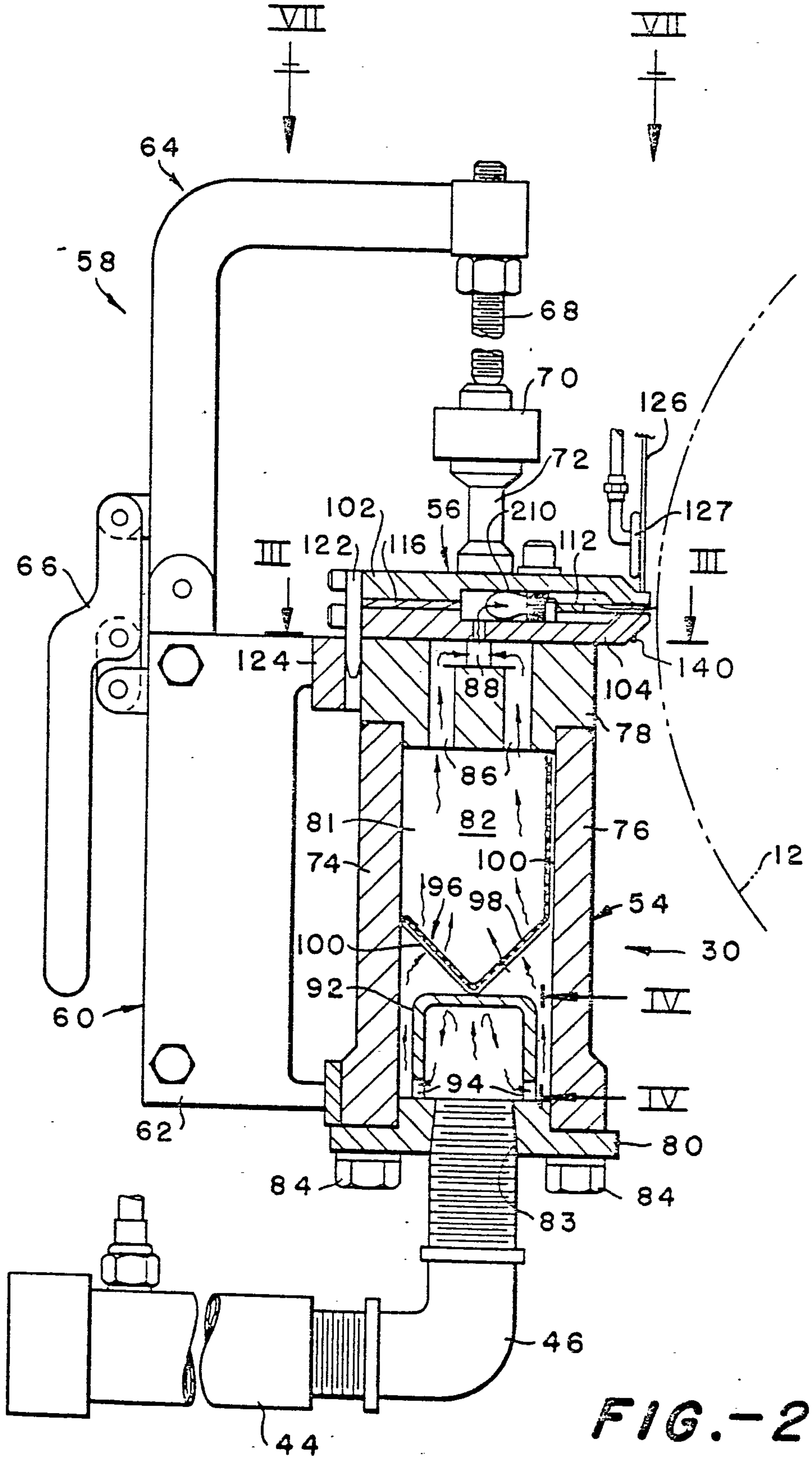
12

FIG.-1-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81
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76
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44

FIG.-2-

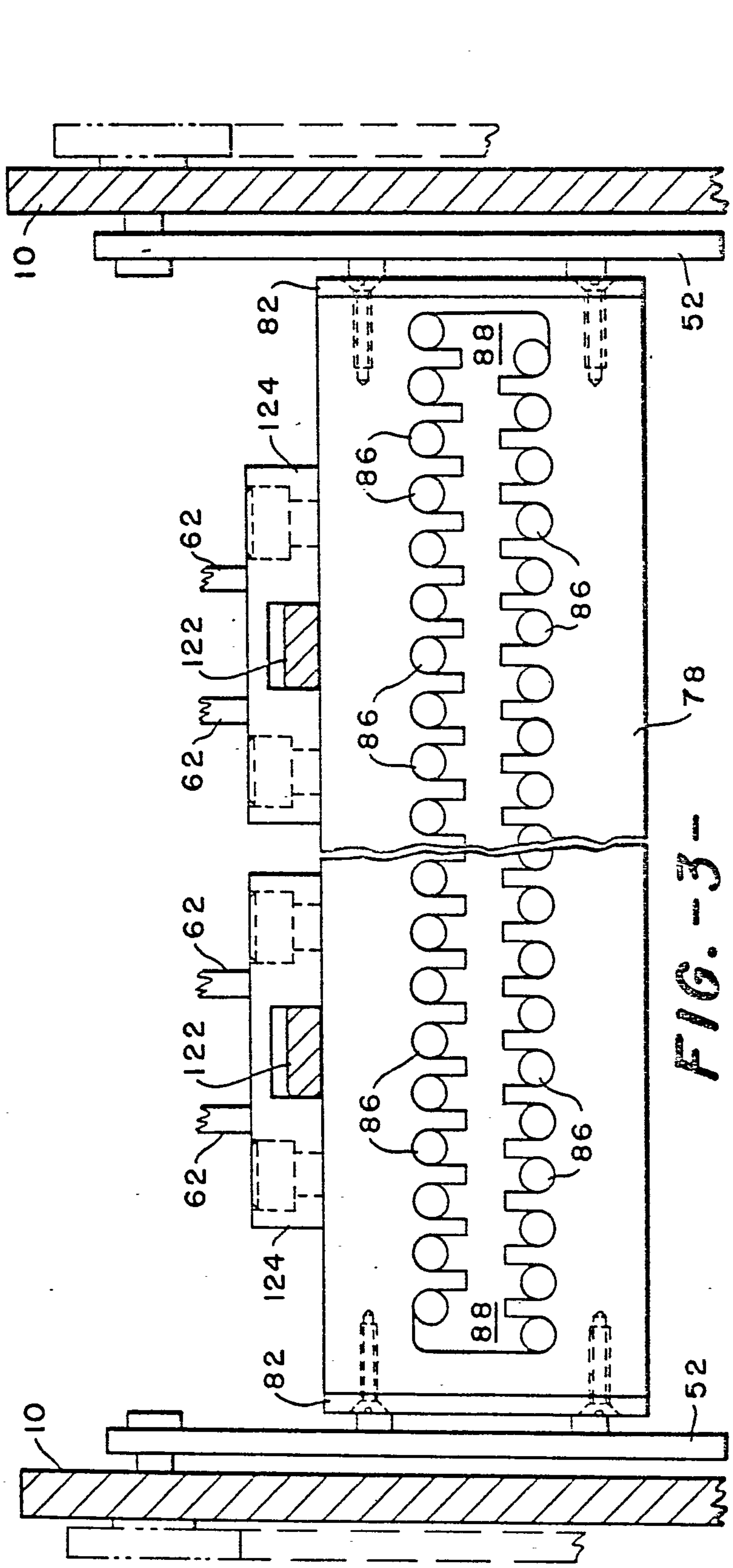

FIG. -3-

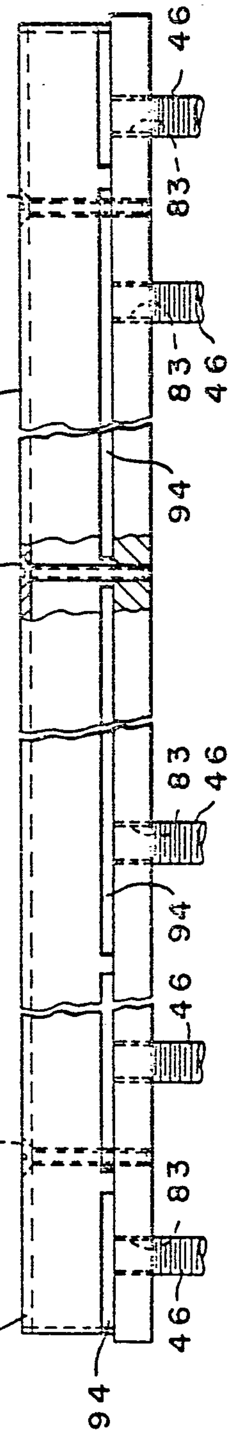

FIG. -4-

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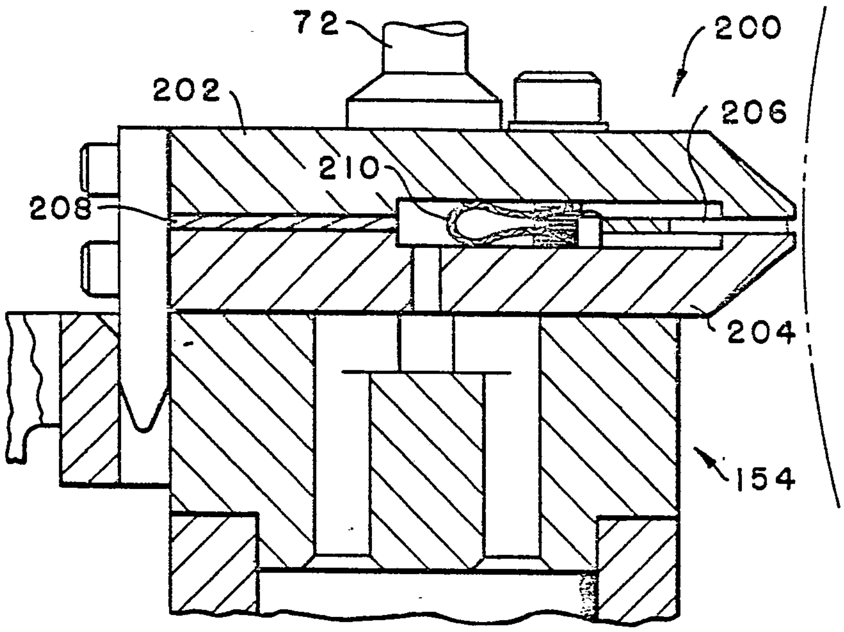

FIG.-9-

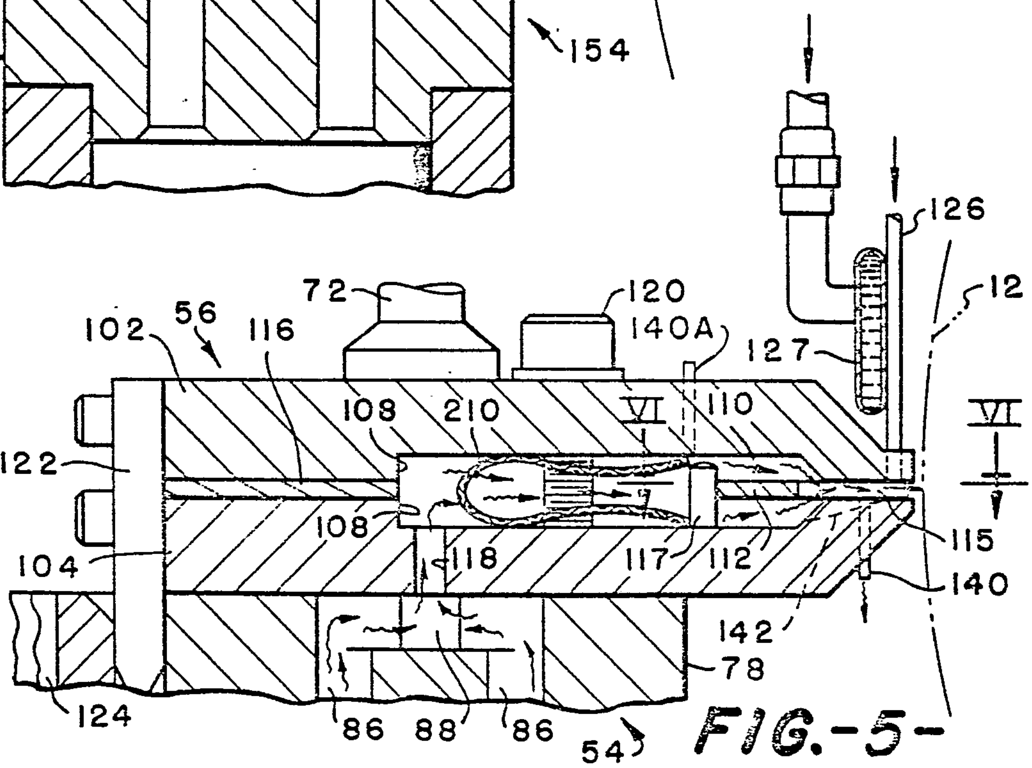

FIG.-5-

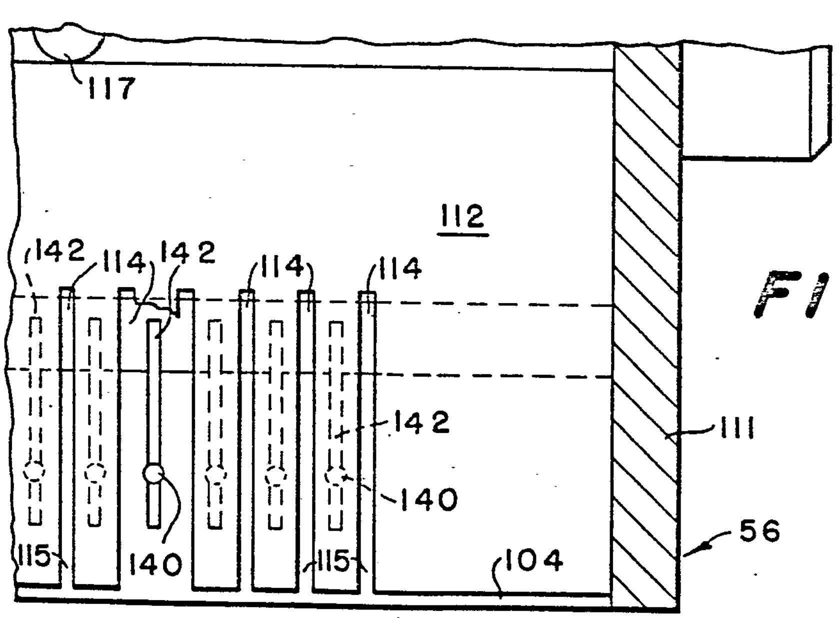

FIG.-6-

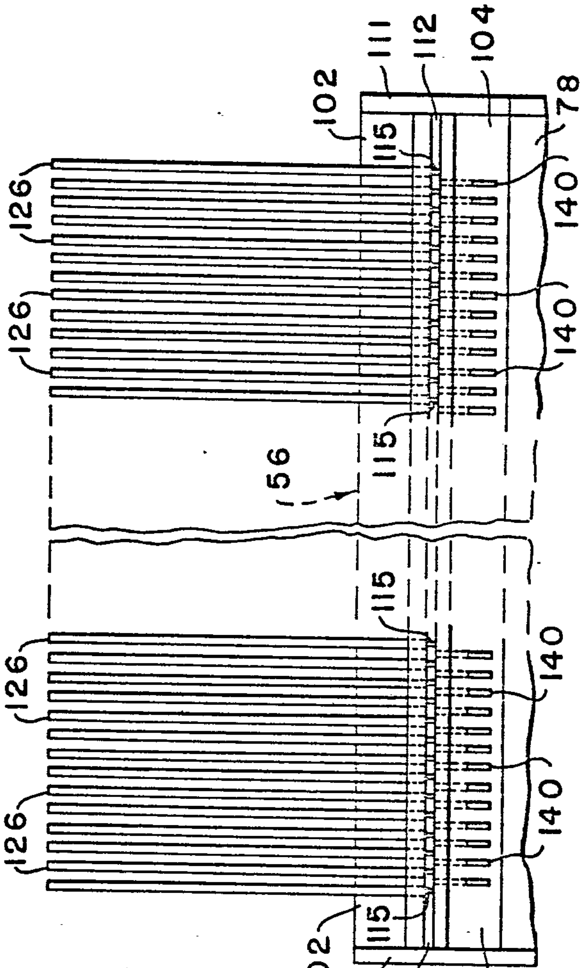
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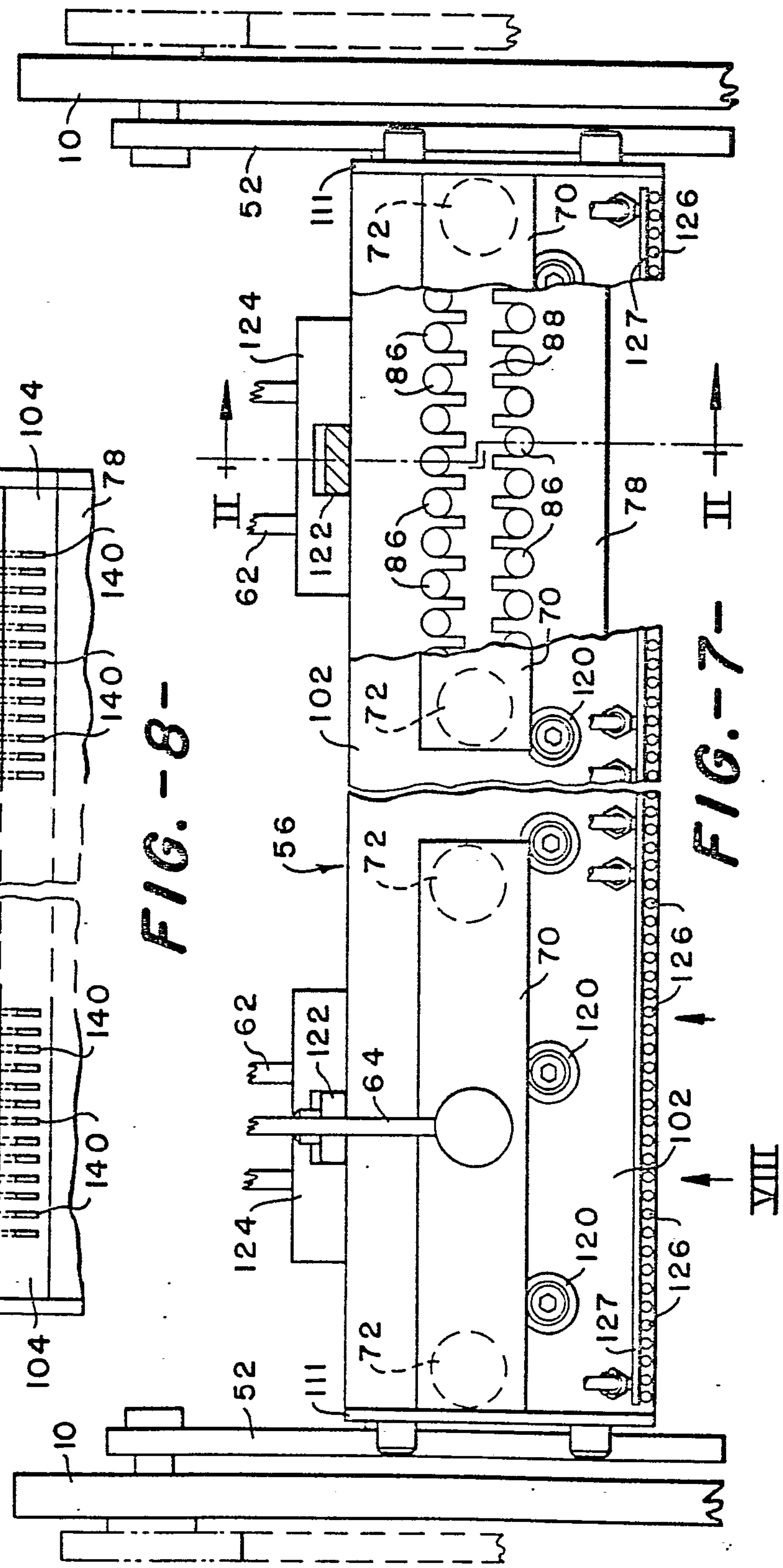
FIG.-8-


10
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II
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102
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56
64
VIII

FIG.-7-

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European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 82 30 0329

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
P,D A	GB-A-2 065 035 (MILLIKEN RESEARCH) ---		D 06 C 23/00
A	US-A-3 635 625 (PHILLIPS PETROLEUM) ---		
A	US-A-3 729 784 (J.P.STEVENS) ---		
D,A	US-A-3 613 186 (J.P.STEVENS) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			D 06 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14-05-1982	PETIT J.P.

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