Oct. 19, 1971 C. P. MAZZONE ET AL 3,613,186

APPARATUS FOR PRODUCING SCULPTURED EFFECTS ON PILE FABRICS

Filed Oct. 7, 1969 4 Sheets-Sheet 1

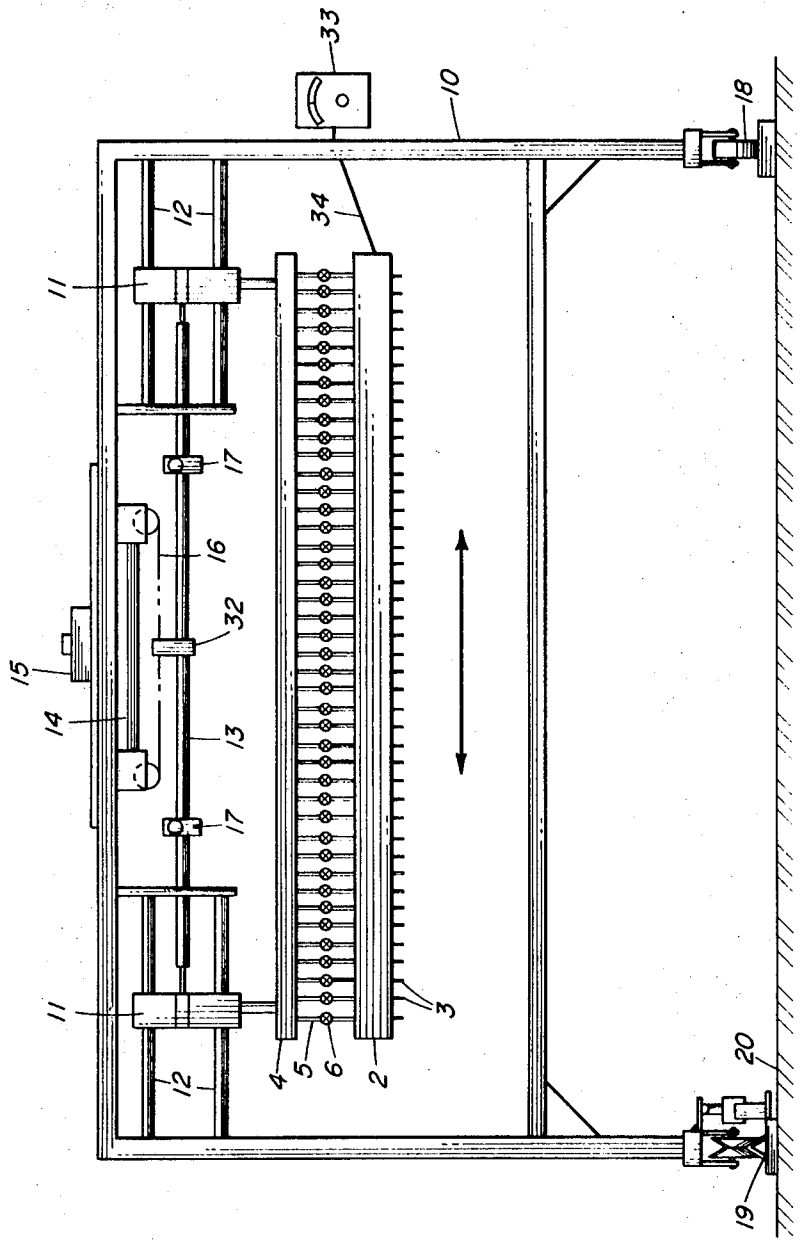


FIG. 1

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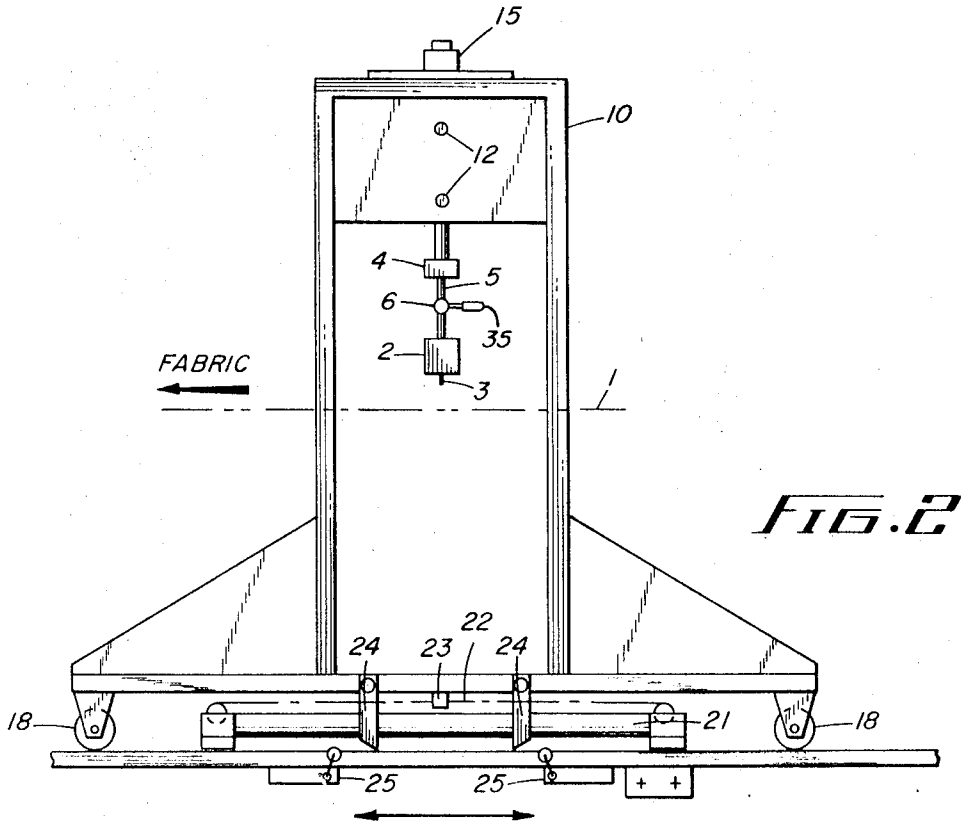


FIG. 2

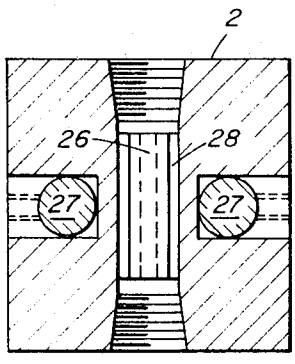


FIG. 4

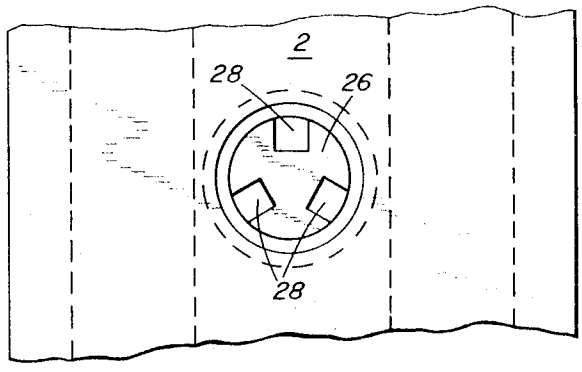


FIG. 5

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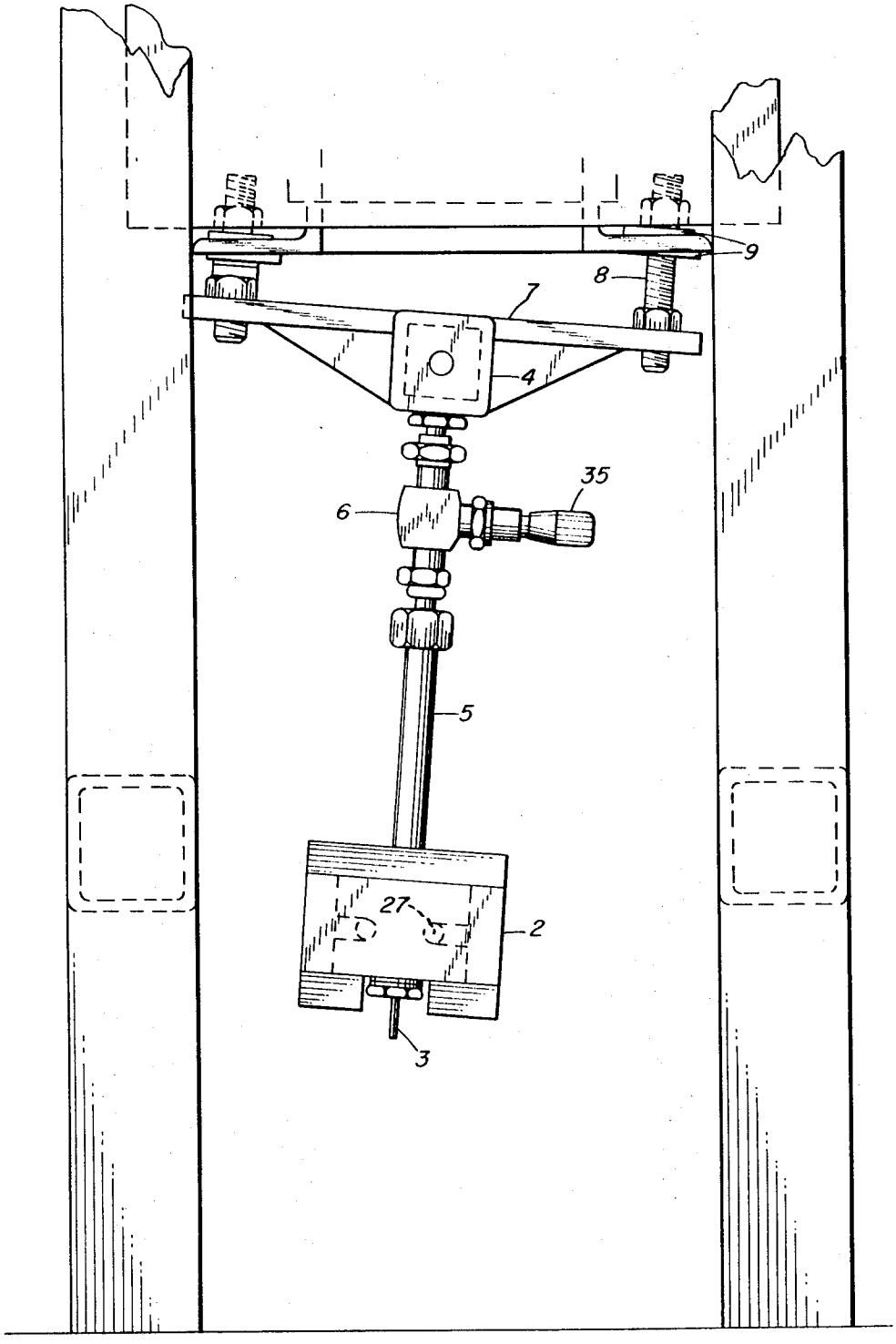


FIG. 3

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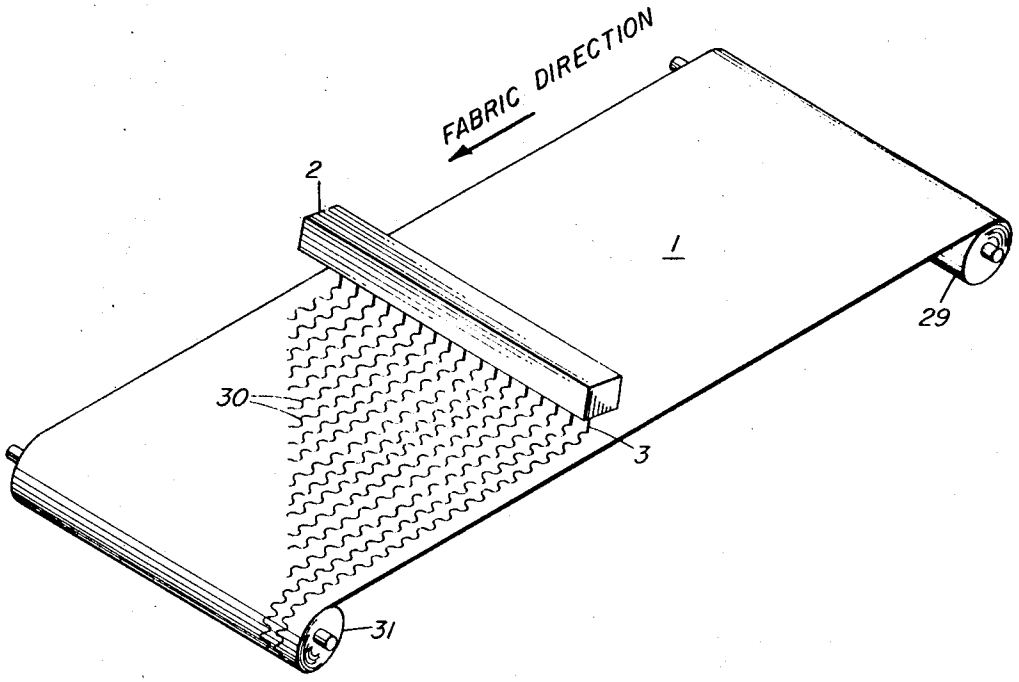


FIG. 6

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3,613,186

APPARATUS FOR PRODUCING SCULPTURED EFFECTS ON PILE FABRICS

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Int. Cl. D06c 23/00, 29/00
U.S. Cl. 26—2 R 9 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus and process is described for moving a series of jets in two directions over a fabric, which may also be moving, or in one direction if the fabric motion provides the other, or the jets may be stationary and the fabric moving in one or more directions. The jets are in a heater manifold and individually supplied by connectors having individual micrometric valve adjustments, the heater head being adjacent the jets and the air and control valves being located where they are not at high temperature. Means are also described for tilting the jet heads so that the jets may direct hot fluid, such as hot air, at an angle which is adjustable from 90°. The blast of hot fluid from the heated jets softens the nap or pile of the fabric and also bends it down, so that a sculptured effect is produced which resists numerous washings. Typical fabrics are napped acetates and other synthetic fabrics with thermoplastic threads.

BACKGROUND OF THE INVENTION

There is a considerable demand for pile or napped fabrics which have sculptured designs. In the past this has often been done by cutting nap or pile threads to form depressed lines or valleys. Very beautiful designs can be produced, but the cost is high and the machinery required very expensive and complicated. This high cost has seriously restricted the field of use of such sculptured fabrics.

Numerous pile or napped fabrics are made with threads of synthetic materials which are thermoplastics, such as cellulose acetate, polyesters, polyamides, and the like. It was proposed to emboss designs with heated gravure rolls but the procedure has presented a number of practical limitations. The rolls are very expensive, and of course a separate roll is needed for each particular design. Other and even more serious limitations are imposed by the fact that there is a direct contact of the metal roll with the threads of the pile fabric and this has required very critical temperature control, as if the roll is too hot, ends of threads can melt instead of soften, and stick to the roll. This has necessitated as a practical matter using temperatures sufficiently low so that this does not occur. However, when this is done, the sculptured designs may not be permanent, particularly with acetate fabrics, and disappear after one or a small number of washings and have never been practical with napped fabrics in which the nap is brushed, resulting in breaking of the ends of the threads, and practical sculptured designs in acetates, such as triacetate, have not been achieved. Where a fabric is to resist a number of washings, for example five or more, the gravure roll embossing process has not been practically successful.

An interesting apparatus has been proposed and is described in the Thal et al. Pat. 3,256,581, of June 21, 1966. This apparatus involves a combustion chamber in which fuel and air is burned to produce hot gases which are then manifolded and led through individual flexible pipes to individual jets. The jets can be moved along or across

a fabric and can slide on rods being guided by the jets moving in slots of a metal guide. The shape of the slots of course causes the jets to slide sideways on their rods where the slots are curved. It is possible to use the Thal et al. device to produce sculptured pile fabrics without touching the fabric with hot metal as in the hot roll process described above. However, in certain respects the Thal et al. device has given rise to a number of problems, with the solution of which the present invention deals. When hot gaseous jets are used, it is essential that an exact and precise control of temperature and gas flow to each jet be maintained, because, contrary to an engraved roll, where there is a firm metal design pressing into a pile fabric, the threads have to be softened and blown down by contact with the hot gas blasts from the jets. This precision of control is very difficult to achieve in the Thal et al. device and practically impossible to maintain exactly uniform. The combustion of fuel in the burning chamber of Thal et al. produces gases the exact temperature of which is difficult to control. The problem is made more difficult by the fact that each jet receives the hot gases through relatively long, flexible pipes or tubes, which are quite long and introduce an amount of cooling which in practice will result in variation in temperature for different jets during operation.

An equally serious problem raised by the Thal et al. device is an exactly uniform gas flow. Micrometric flow valves are very difficult to maintain at the high temperature of the combustion gases. In the Thal et al. device there are no individual micrometric valves. This makes precise flow control impractical to maintain, just as the long flexible conduits make exact temperature control to individual jets equally impractical. This is not to say that the Thal et al. machine cannot be used to produce sculptured effects on deep pile fabrics, but the precision of control is seriously compromised, and so far as is known, the Thal et al. device has never been practically usable to produce sculptured fabrics with brushed napped fabrics, and particularly with such fabrics of triacetate. With very deep sculpturing in deep pile fabrics, the variation from jet to jet might be tolerated better, although, of course, such variation is not desirable.

Another practical problem presented by the Thal et al. device is that the jets have to be in a fixed position at right angles to the fabric in order to follow the guiding slots. For some purposes, particularly with brushed napped fabrics, better results can be obtained if the jets are somewhat slanted. Also, because the jets have to follow slots, this imposes a certain limit on machine output due to the relatively high friction in the curved slots. Furthermore, Thal et al. describes an intermittent, rather than a continuous operation.

SUMMARY OF THE INVENTION

The present invention covers a process and apparatus which in one aspect may be considered as an improvement over the machine of the Thal et al. patent. It is an advantage that improvement is obtained without any sacrifice of any of the desirable features of the patent. The invention will first be described in its apparatus aspect.

Instead of individually movable jets, in the present invention the jets are rigidly mounted in a heater head and heated by indirect contact, such as electrical heating elements and the like. The rigid, hot head is connected to a similar rigid air manifold by tubes for each jet, which are preferably quite short, each tube being provided with a micrometrically controllable flow valve, the structure including hot heater head, and the relatively cool air manifold is moved as a whole in two directions by sliding the manifolds on slide bars in a frame and moving the whole frame at right angles to this motion.

It is also possible to tilt the manifold and the head, together with the jets, to permit discharging the fluid, such as air, from each jet at an angle to the fabric which moves below the head. Positive and precise tilting control is included. The motion of the manifold and heater head in the two directions may be effected by any suitable means. A very simple and reliable means which is preferred is by the well known adjustable double-acting air cylinders which drive the framework and within it the manifold and head by cables. The length of each movement can be individually controlled by stops and suitable microswitches which control conventional solenoid-operated air valves on the cylinders. Speed of each movement is adjustable by throttling adjustments on the two pairs of cylinders, and may be varied so that there will be a different speed of movement in one direction from that in another where this is desired for certain particular patterns. Speed, and hence output, is not restricted by high friction guide slots and can be as high as the effective temperature and air jet velocities permit with particular fabrics. The designs which can be sculptured on brushed fabrics, such as brushed acetates, acrylics, and the like, are quite permanent and withstand many washings without significant loss of the sculptured appearance.

Variation in design can also be introduced by having somewhat different air flows in some of the jets than in others. This can be precisely adjusted because the adjustment valves are operating at low temperature and they stay in adjustment once set.

For certain designs the motion of the fabric itself, in at least one direction, may be synchronized with the movements of the air manifold and heater head, or these may be stationary.

Because the flow to each jet is controlled by a micrometric valve of its own operating in a low temperature environment, it becomes practical to cut off the flow in certain jets altogether in order to produce a different design or pattern. This confers an added versatility which is not practical with jets which are supplied each with their individual non-adjustable flexible tubing.

Since the action of the preferred air cylinder drive or of others is electrically controllable, this makes it possible to control patterns by simple computers, which permits an extremely wide choice of patterns. It is not necessary to use different slotted plates for each pattern, and this is an additional advantage of the present invention.

Another practical operating advantage is presented by the fact that many of the components, such as air cylinder drives, electric heating elements, and the like, are commercially available products, which further reduces the cost of the machines of the present invention.

Reference has been made above to operating the apparatus of the present invention and/or performing the process with a continuous movement of the fabric being sculptured. For many purposes and with many designs this is desirable, but the invention is in no sense limited thereto as it is perfectly possible to move the fabric intermittently, in which case compound motion of framework and manifolds and heads within it is usually necessary. If desired, during the intermittent movement, flow through the jets can be temporarily shut off by a suitable ON and OFF valve to the compressed air supply. It is also possible, of course, to lift up the jets, but this requires further complications if it is to be effected during the operation of the machine, and is, in general, not preferred.

In addition to the improved apparatus, the present invention also involves an improved process, as it makes practical, for the first time, sculpturing fabrics which thermoplastic surfaces, such as brushed nap triacetates, to produce sculptured effects which are washable. The principal use of the present invention is for producing actual sculptured effects; however, in some cases it may be used for producing a design on the surfaces which shows up later on dyeing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation in semi-diagrammatic form;

FIG. 2 is a similar elevation at right angles to FIG. 1;

FIG. 3 is an enlarged detail similar to FIG. 2 but showing tilt adjustment;

FIG. 4 is a section through the heat head at one jet;

FIG. 5 is a plan view looking down at the same location as FIG. 4, and

FIG. 6 is a diagrammatic representation of a fabric with a simple design being produced.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Looking at FIG. 6, the fabric, which is shown as moving, is designated **1**. In the figure a heater block head **2** is shown with jets **3** which produce a wavy pattern **30** as the fabric moves from left-off roll **29** to take-up roll **31**. As FIG. 6 is purely diagrammatic, the means for imparting motion to the heated block and its jets and their particular design is not shown.

FIGS. 1 and 2 show the motion of the air manifold, heater block and jets in somewhat greater detail. The block and jets bear the same reference numerals as above in FIG. 6. Air is introduced into an air manifold **4** from a source of compressed air (not shown). Each jet is connected from the air manifold **4** through the heater block **2** by individual tubes **5**, which in FIG. 1 are shown diagrammatically as lines. The tubes are very short as compared to the manifold and heater lengths, for example about an order of magnitude shorter. The unitary structure of manifold and heater block can slide on guide bars **12** by slides **11** which are connected to it and which, in turn, are connected to each other with a rod **13**. The guide bars **12** are mounted in a movable framework **10** which can move at right angles to the movement of the manifold and heater block on wheels **18** which run on triangular tracks **19** on the floor **20** on which the whole machine is mounted. Reciprocation of the rod **13** is by a double acting air cylinder **14** which, being of well known design, is shown more or less diagrammatically. The cylinders move a cable **16** which drives the rod **13** through a projection **32**. Reciprocation of the air cylinders is effected by a standard design of control valve and air regulator **15**, which is sold, for example, by the Schrader Company, and as it is a well known design is shown in FIG. 1 in purely diagrammatic form. Heat is applied to the heater block by wires **34** controlled by a temperature control **33**. As these devices are standard elements, the showing is purely diagrammatic.

Turning now to FIGS. 2 and 3, it will be seen that the pipes connecting the air manifold **4** are provided with micrometric air flow control valves **6**. These valves are also of known design and are actuated by a micrometric vernier knob **35** similar in design to that appearing on micrometer calipers. As these valves are of a known design, they are shown only in outline since the internal structure is not changed by their incorporation into the present invention.

FIG. 3 shows the manifold **4** attached to a plate **7** which can be adjustably tilted by bolts **8** and cams **9** bearing on extensions of the slides **11**. FIG. 3 shows an adjustment which has slightly tilted the jets **3** in the heater block **2**. This figure also shows the electric heating rods **27**.

FIG. 2 illustrates the motion of the framework **10** in more detail than is shown in FIG. 1. The frame, which is carried by the wheels **18**, as has been described, is moved by another air cylinder **21** of the same design as the air cylinder **14** in FIG. 1, which also drives a cable **22** that attaches to a projection **23** on the frame. The length of travel both of the framework **10** in FIG. 2 and of the manifold and heater block within the frame in FIG. 1 is controlled by adjustable stops **17** in FIG. 1

and **24** in FIG. 2. In the latter figure it will be seen that at the extremes of travel they strike microswitches **25**. The same is true of the stops **17** in FIG. 1, but in order to maintain the clarity of the figure and its semi-diagrammatic form, the microswitches are not shown. The switches of course control the Schrader motion control valves by conventional electric control, which is, therefore, also not shown.

FIG. 4 is a cross-section through the heater block **2** taken at one of the jets and showing the passage **26** for the jet, which has been removed from FIG. 4 in order not to confuse the drawing. In order to produce more effective heating surface from the rods **27**, they are in heat conducting relations with projections **28**, which are best seen in FIG. 5. These projections break up the air stream passing through the passage **26** to its jet. This also increases the hot surface in contact with the air.

Various different designs can be produced by placement of the stops **17** and **24**, which stops are fastened by set screws in the particular positions, the screws not being shown. As the stops actuate microswitches in FIGS. 1 and 2, their control is essentially electric, and so, if it is desired to operate a machine by computer or other device which sends its commands out electrically, the switches can be bypassed and the cylinder control valves directly operated by the computer-steered electric control. As the simple designs of computers for patterns are well known, they are not shown in the drawings. It is, howver, noted that where desirable an all-external electric control can be used in place of the stops and microswitches which have been described.

When the fabric shown in FIGS. 2 and 6 is a brushed nap synthetic fabric, for example a triacetate fabric, the design is sculptured into the nap and is quite wash fast, without showing any significant change in design or appearance.

For certain fabric designs it is desirable to cut out of operation some of the jets, and this is simply done by closing their micrometric valves. Since these valves have numbered positions, they can be brought back to any particular flow rate which is desired where a design is changed to one which uses all of the jets. The exact temperature and air flow through the jets depends on the particular fabric in which the sculptured design is to be made and also on the rate at which fabric moves and jets move which is determined by the practically achievable output of the machine. For any particular fabric the valves **6** are adjusted for a particular flow together with a particular temperature on the temperature control **33**. When an entirely new fabric is to be sculptured, it is sometimes necessary to adjust the valves and temperature as well as speed of motion of the jets to achieve the desired results. Once the desired pattern has been achieved by a few routine experiments, the settings of the temperature controller **33**, the valves **6**, and the controls for air cylinder operation are noted, for, of course, all of these controls have marks or dials, and whenever a similar fabric design is to be produced, the controls are set to the predetermined points for the particular fabric. Once set, they remain fixed and there is no problem of variable cooling through long flexible connecting tubes and the like. The pattern is accurately reproduced every time. While the particular temperature used and air flow, which determines, among other things, the actual temperature of the air leaving the jets, will vary with the particular fabric and type of design, the invention is not limited to any particular temperature or air flow. The factors should be adjusted always within the range below that at which the nap of the fabric is melted to too great a degree. This is, of course, determined for every new fabric by the short series of routine tests for optimum temperatures which have been referred to above.

It has been proposed in the past to actually burn sculptured patterns into the pile of fabrics, either by heat or by chemical action. While with great care sculptured patterns can be produced, control is critical, and it is almost impossible to operate without some damage or weakening of the fabric itself. In the process of the present invention and with the improved apparatus thereof, patterns can be produced with no damage to the fabric itself and with reliably reproducible conditions, which do not even change with some changes in ambient temperature because the jets are so near to the fabric that external conditions within the range normally encountered in a factory have no effect. Of course some elementary common sense must be used, and a violent blast of cold air across the jets as the pattern is being developed should be avoided.

While the description of the apparatus emphasizes the flow of hot fluids through the jets, this flow may also include finely divided solids, such as pigments.

While the machine is primarily useful with brushed nap or pile fabrics, it can be used with other fabrics having a thermoplastic surface, either of thermoplastic fibers or a finish.

We claim:

1. In a machine for producing sculptured effects on fabrics having thermoplastic surfaces by moving thereover in a predetermined pattern jets emitting hot fluids to soften and sculpture the threads, the improvement which comprises,

(a) a heated jet holding head provided with a plurality of jets and means for heating it uniformly at each jet,

(b) a fluid supplying manifold substantially unheated and connecting valved conduits from said manifold extending to the jets in the heated jethead, said manifold-jethead and connecting conduits constituting a unitary whole, the valves having micrometrically adjustable, actuating means,

(c) means for reciprocating the manifold-jethead unitary structure through a predetermined path,

(d) means for reciprocating the manifold-jethead unitary structure through a second path at right angles to the first,

(e) the reciprocating means being positively power actuatable, and

(f) means for moving a napped or pile fabric to be sculptured in close proximity to the jets in the moving jethead.

2. A machine according to claim **1** in which the head containing the jets is electrically heated.

3. A machine according to claim **1** in which the connecting conduits are axially much shorter than the manifold or jethead lengths.

4. A machine according to claim **3** in which the head containing the jets is electrically heated.

5. A machine according to claim **4** in which the fluid is air and the head containing the jets is of metal in heat exchanging contact with the electric heating means and presenting extensive surface to air flowing through the jets, whereby rapid heating of the air passing through each jet is effected.

6. A machine according to claim **5** in which the air manifold-jethead unitary structure is mounted in a framework and is slidable on guides, and the framework is mounted on wheels movable on tracks substantially at right angles to the sliding manifold-jethead structure.

7. A machine according to claim **6** comprising means for tilting the manifold-jethead unitary structure to a tilted position in a plane at right angles to the travel of said structure and maintaining the tilted position.

8. A machine according to claim **6** in which the sliding motion in the framework and the movement of the framework on its wheels are both effected by double acting air cylinders and means are provided for electrically controlling said cylinders to reciprocate the manifold-jethead structure and the framework in paths of predetermined length.

9. A machine according to claim 8 comprising means for tilting the manifold-jethead unitary structure to a tilted position in a plane at right angles to the travel of said structure and maintaining the tilted position.

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U.S. Cl. X.R.

26—69 R; 69—28