United States Patent [19]

Johnson

[11] **3,894,413**

[45] **July 15, 1975**

[54] **DYEING AND PRINTING OF MATERIALS**

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[73] Assignee: **Deering Milliken Research Corporation**, Spartanburg, S.C.

[22] Filed: **Jan. 3, 1974**

[21] Appl. No.: **430,526**

[52] **U.S. Cl.** ..... **68/205 R**

[51] **Int. Cl.** **B05c 5/00**

[58] **Field of Search** ..... 68/205 R, 203; 118/8

[56] **References Cited**

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Assistant Examiner—Philip R. Coe
Attorney, Agent, or Firm—H. William Petry; Luke J. Wilburn, Jr.

[57] **ABSTRACT**

Apparatus for the application of dyestuffs and other liquids to moving textile materials to provide a printed pattern thereon, wherein means are provided for adjustably positioning the point of application of the liquids onto the textile materials to compensate for misalignment which might occur due to wear of the conveyor transporting the textile material to be printed.

11 Claims, 6 Drawing Figures

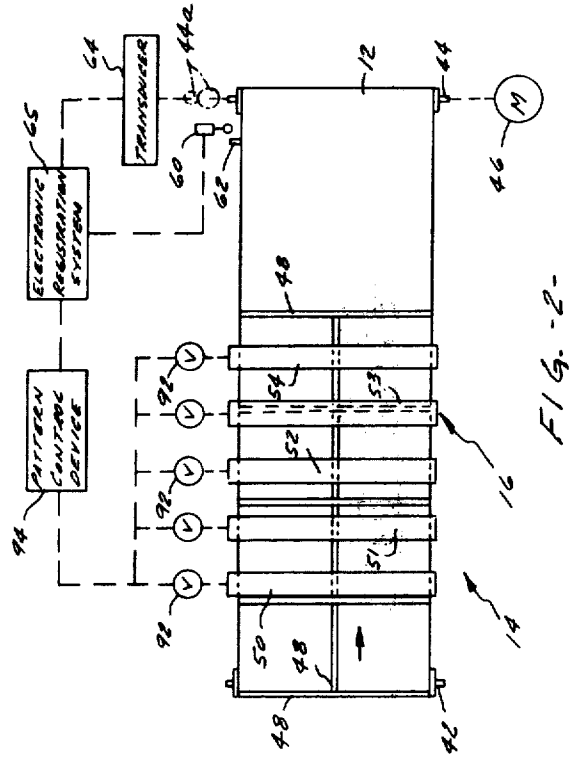


FIG. -2-

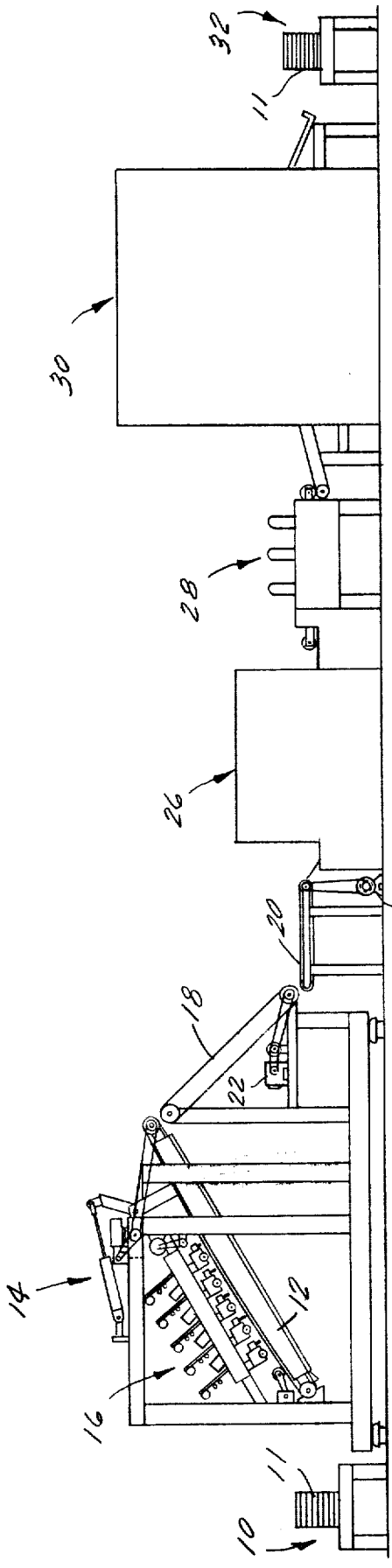


FIG. -1-

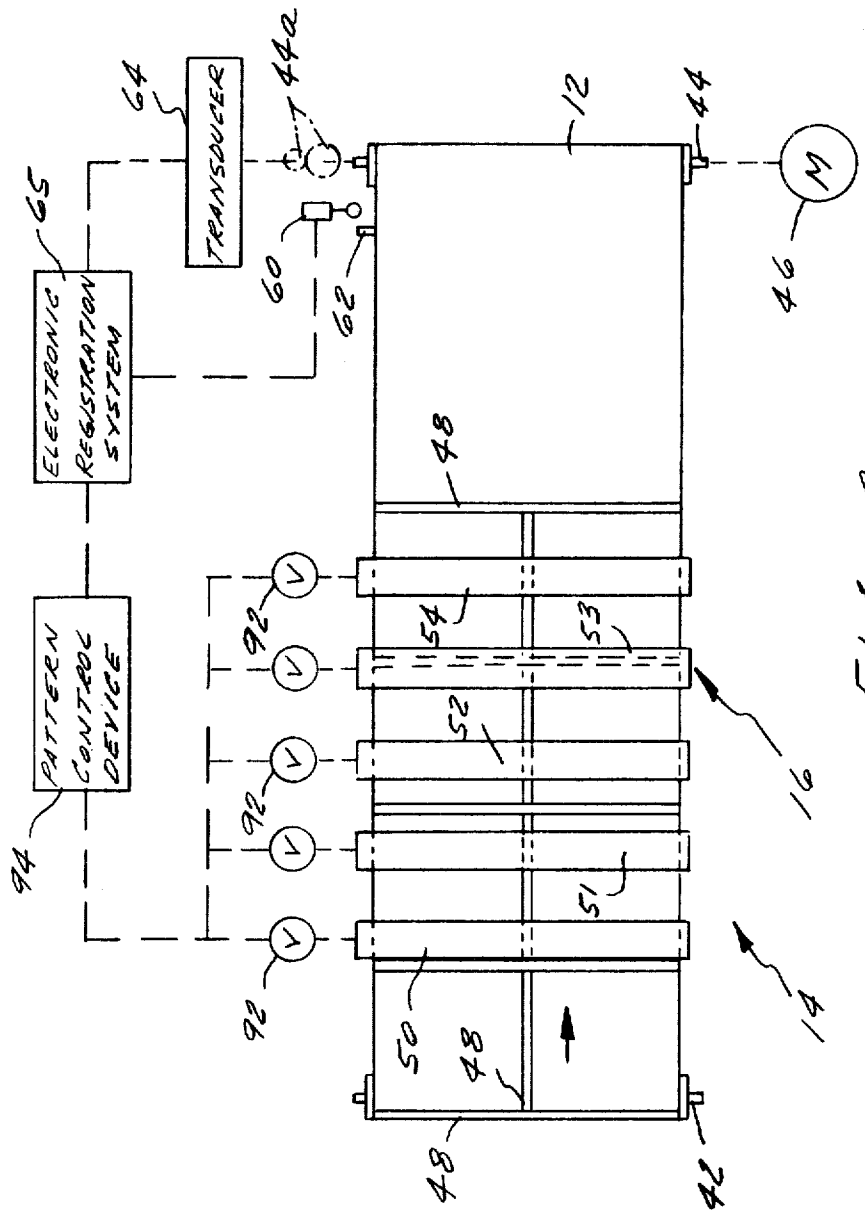

64
TRANSDUCER
44a
12
44
65
ELECTRONIC REGISTRATION SYSTEM
60
62
46
48
92
54
53
52
16
PATTERN CONTROL DEVICE
94
51
50
48
14
48
42

FIG. -2-

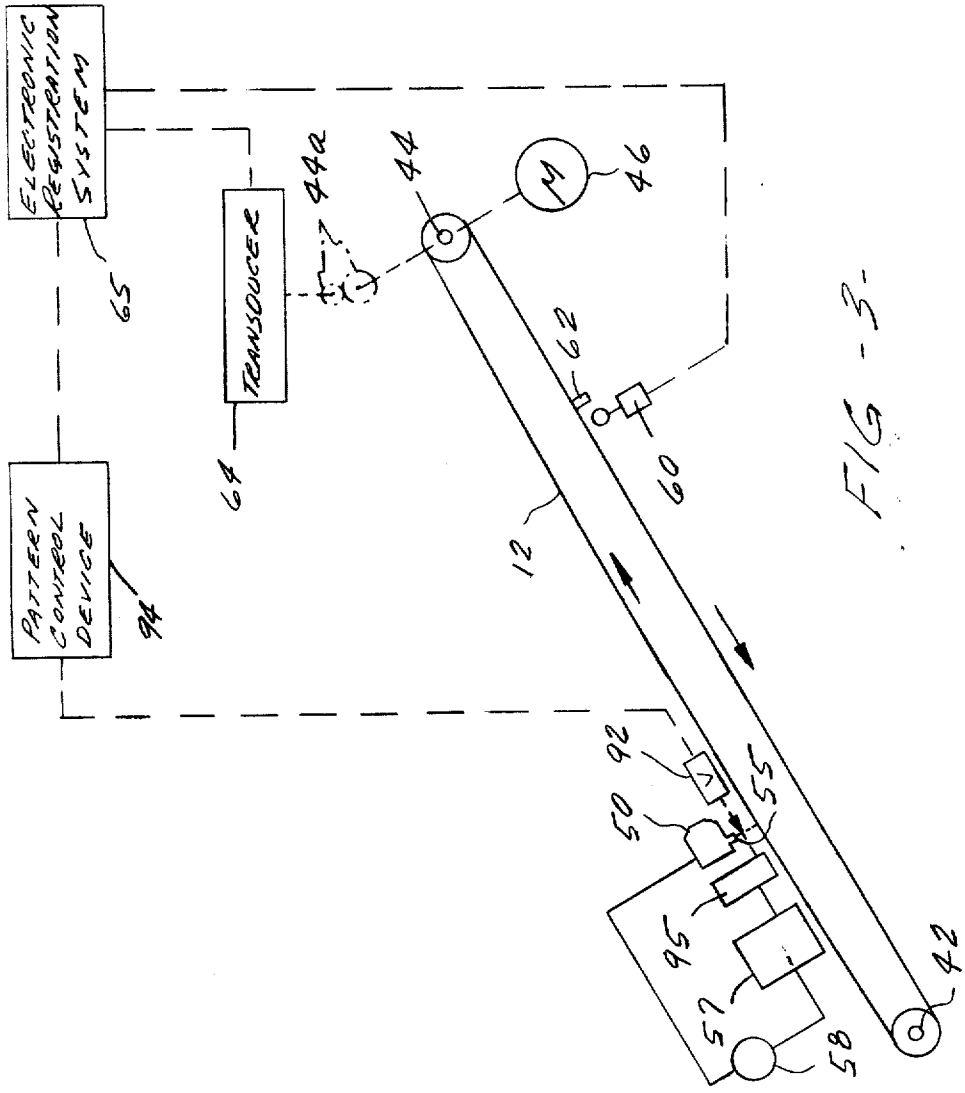

ELECTRONIC REGISTRATION SYSTEM
65
TRANSDUCER
64
44a
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62
60
12
PATTERN CONTROL DEVICE
94
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58
42

FIG - 3 -

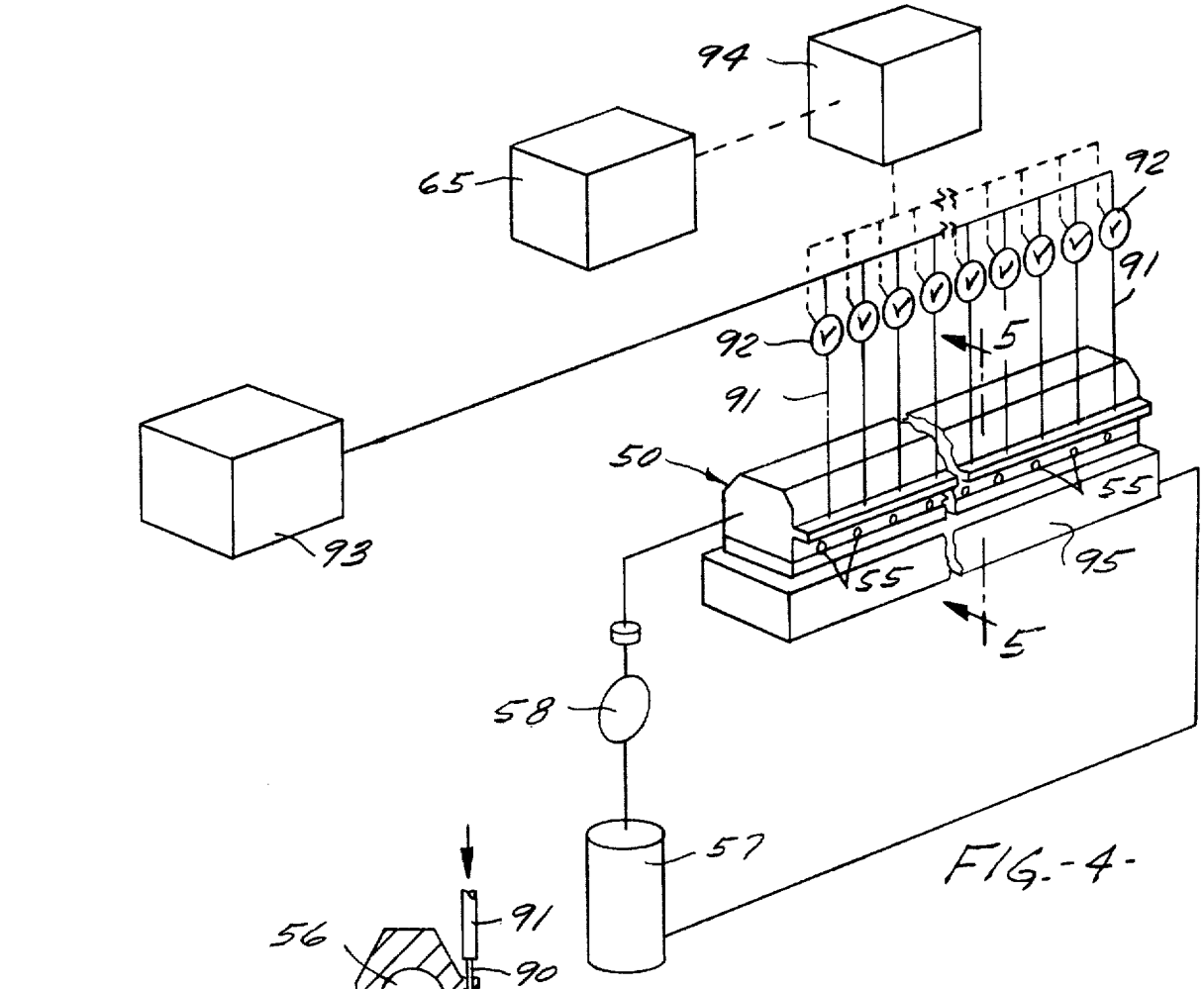


FIG.-4-

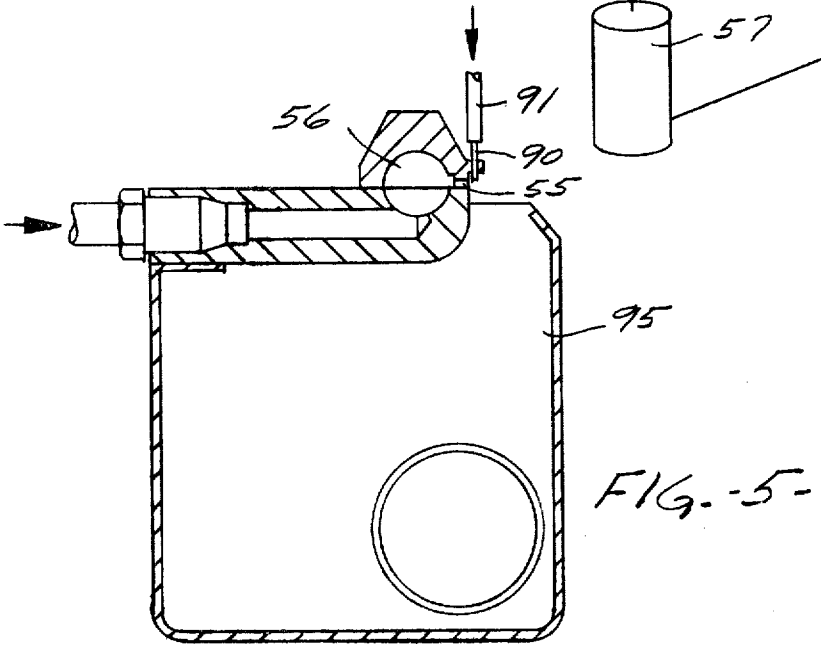


FIG.-5-

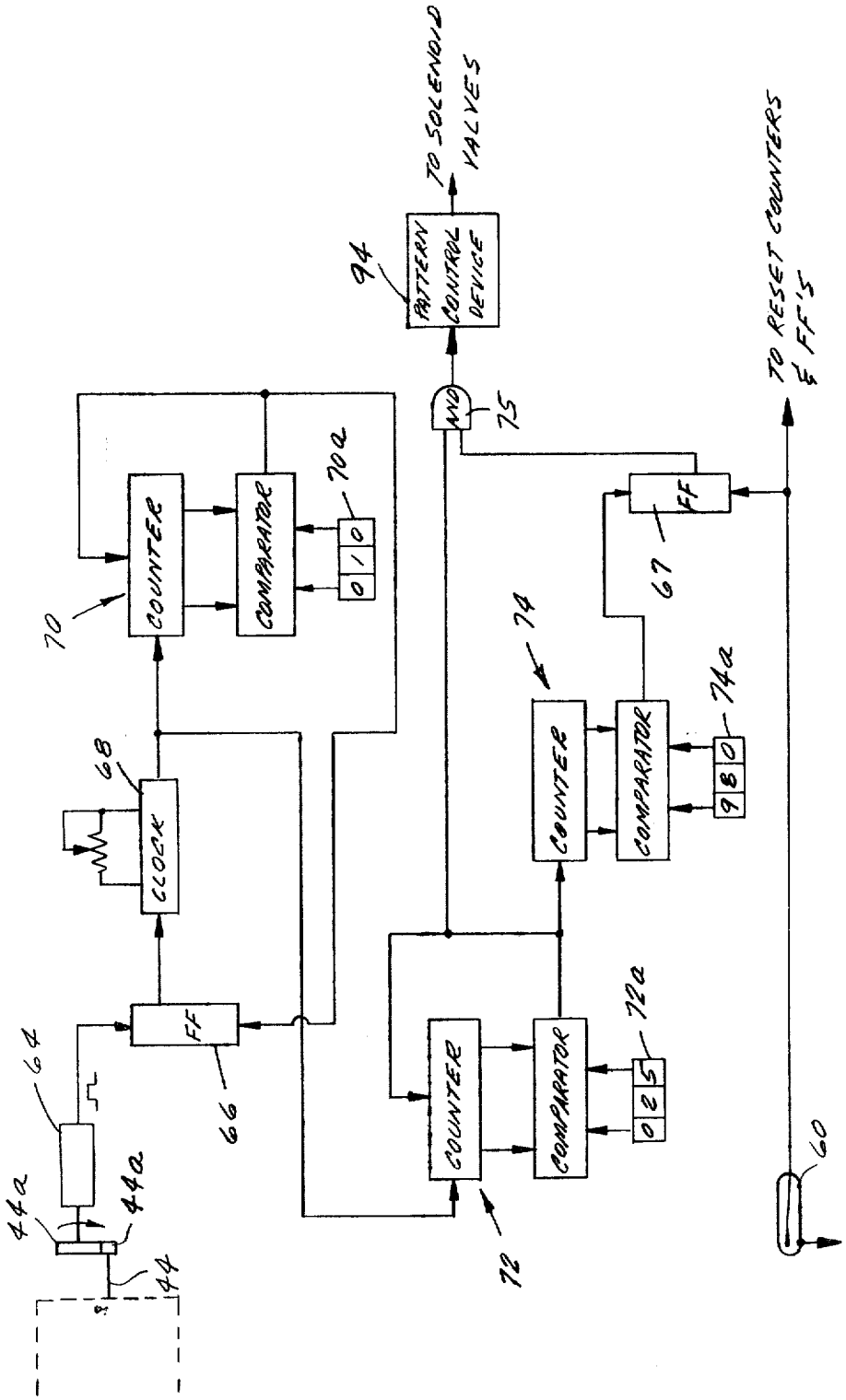

TO SOLENOID VALVES
PATTERN CONTROL DEVICE
94
AND
75
TO RESET COUNTERS & FF'S
FF
67
COUNTER
COMPARATOR
70
70a
0 1 0
74
74a
9 8 0
72
72a
0 2 5
CLOCK
68
FF
66
64
44a
44
60

FIG. 6.

DYEING AND PRINTING OF MATERIALS

This invention relates to the application of dyestuffs and other liquids to textile materials and, more particularly, to the printing of textile fabrics having relatively porous surfaces, such as pile carpets.

Textile fibers and fabric materials have long been colored with natural and synthetic dyes, and, in particular, printed by color decoration of the surface or surfaces of the materials in definite repeated forms and colors to form a pattern. Such color printing of textile fabrics has been accomplished in various ways. Earlier forms of printing used carved blocks charged with colored paste pressed against the fabric. Subsequently, speed of printing was increased by development of roller printing wherein moving fabrics are sequentially contacted by engraved metal rollers each containing a different color dye to form the desired pattern thereon. Textile fabrics are also printed by sequential contact with screens each having a porous portion of a pattern and carrying a particular color dyestuff.

More recently, it has been proposed to print textile fabrics, including pile carpets, by the programmed spraying or jetting of plural colored dyes onto the surface of the moving fabric. Typical of such processes and apparatus are described in U.S. Pat. No. 2,804,764; U.S. Pat. No. 3,502,044; and British Pat. No. 978,452. Generally, such apparatus consists of a plurality of dye applicator bars or manifolds spaced along the direction of movement of the textile material and each containing multiple dye nozzles or jets extending transversely across the moving material. Each jet may be activated by suitable electric, pneumatic, or mechanical means to dispense dyes onto the moving material, and pattern control to apply the dyes in a desired sequence may be accomplished by various conventional programming devices, such as mechanical cams and drums, coded punch tapes, magnetic tapes, computers, and the like.

U.S. Pat. Nos. 3,443,878 and 3,570,275 disclose specific means for applying jets of dyes to print a fabric by use of continuously flowing dyestreams which are deflected by a stream of air or a mechanical deflector to permit impingement of the dyestream upon the fabric or recirculation to a dye supply reservoir. Control of such systems to form printed patterns may be accomplished by various of the aforementioned programming and control means.

The apparatus of the present invention comprises a jet printing machine having a series of gun bars each containing plural dye jets extending across the width of an endless conveyor. The gun bars are spaced along the conveyor, and textile materials are carried by the conveyor past the gun bars where dyes are applied to form a pattern thereon. The application of dye from the individual dye jets in the gun bars may be controlled by suitable conventional pattern control means of the type heretofore mentioned.

The endless conveyor may be constructed of various materials to suitably support the textile materials during their passage adjacent the gun bars. In the present case the conveyor is composed of a sprocket and chain mechanism on which a plurality of metal slats are mounted; however, other materials such as flexible belts and pulleys, pin chains, and the like may be employed.

In the operation of such conveyor mechanisms, there is inherently a gradual change occurring in the conveyor length due to wear of the various components, such as the chains, sprockets, or the like. Since accurate positioning of the dyes on the moving textile materials is essential for good pattern definition and registration, it is desirable to provide means for compensating for conveyor "stretch" and misalignment due to wear when programming the points of application of the dyes. Therefore, the present invention is directed to a jet printing apparatus employing means for compensating for changes in conveyor length and/or its misalignment due to wear in order to permit more accurate placement of dyes or other liquids in desired locations on textile materials carried on the conveyor during the printing of patterns thereon.

The present invention will be better understood by reference to the accompanying drawings which disclose a specific embodiment of the invention, and wherein:

FIG. 1 is a schematic side elevation of apparatus for the jet dyeing and printing of textile materials;

FIG. 2 is an enlarged schematic plan view of the jet dye applicator section of the apparatus of FIG. 1, showing in more detail the cooperative relation and operation of the conveyor with the jet gun bars;

FIG. 3 is a schematic side elevation view of the jet dye applicator section seen in FIG. 2 and showing only a single jet gun bar of the applicator section and its operative connection to the dye supply system for the gun bar;

FIG. 4 is a more detailed perspective view of the jet gun bar seen in FIG. 3, and shows its operative connection to its dye supply system and the pattern control components of the apparatus;

FIG. 5 is an enlarged schematic sectional view of the gun bar of FIG. 4, taken generally along line 4—4 thereof; and

FIG. 6 is a schematic diagram showing the electronic registration system for controlling the operation of the jet gun bars in coordinated response to movement of the textile material conveyor.

Referring more specifically to the drawings, FIG. 1 shows a jet printing apparatus for printing textile materials, such as pile carpets, tiles, and the like. As seen, the apparatus consists of a supply table 10 from which a plurality of carpet tiles 11 are laid manually, or by suitable mechanical means, not shown, onto the lower end of an inclined conveyor 12 of a jet applicator section 14, where the tiles are suitably printed by the programmed operation of a plurality of jet gun bars, generally indicated at 16, which dispense streams of dye or other liquid onto the tiles during their passage. The printed tiles leaving the applicator section are moved by conveyors 18, 20 driven by motors 22, 24 to a steam chamber 26 where the tiles are subjected to a steam atmosphere to fix the dyes on the textile material. The printed tiles leaving steam chamber 26 are conveyed through a water washer 28 to remove excess unfixed dye from the tiles, and then pass through a hot air dryer 30 to a collection table 32 where the dried tiles are accumulated manually, or by suitable means, not shown, for subsequent use.

Details of the apparatus of the present invention are further shown by reference to FIGS. 2–5. FIG. 2 is an enlarged schematic plan view of the jet applicator section 14 of FIG. 1 and shows the endless conveyor 12, the supporting chains and sprockets of which (not shown) are suitably supported for movement on rotat-

able shafts **42, 44** one of which, **44** is driven by motor means **46.** For printing carpet tiles of rectangular or square shape, the surface of conveyor **12** is provided with a series of separator bars or spacers **48** which accurately position the tiles in spaced relation to each other on the supporting slats of the conveyor. During movement of the conveyor, the tiles pass sequentially adjacent and beneath substantially identical gun bars **16,** five of which, **50–54,** are shown schematically, spaced along the path of travel of the conveyor and extending across its full width.

As best seen in FIGS. **3** and **4** which shows only the single gun bar **50** for sake of clarity, each gun bar contains a plurality of individual jet orifices **55** disposed along the bar and positioned to direct dyes in narrow streams toward the surface of the pile carpet tiles as they pass thereby. Each gun bar includes a dye supply manifold **56** (FIG. **5**) communicating with the jet orifices **55** which is supplied with liquid dye from a separate dye reservoir tank **57.** Pump means **58** supplies liquid dye from reservoir tank **57** under pressure to manifold **56** and the jet orifices **55.** During operation, liquid dye is expelled continuously in small streams or jets from the orifices **55** toward the material to be printed.

Positioned adjacent and at a right angle to the outlet of each jet orifice is an outlet **90** of an air supply tube **91** (FIG. **5**), each of which communicates with a separate solenoid valve **92** (FIG. **4**). The solenoid valves, which are of the electric to fluidic interface type, such as L1F 180D3A12 made by The Lee Company of Westbrook, Connecticut are suitably supported in the jet dye applicator section **14** and are supplied with air from an air compressor **93.** Although the valves for each gun bar are shown in FIGS. **2** and **3** as a single valve symbol **92,** for clarity, it is to be understood that a solenoid valve and individual air supply tube is provided for each jet orifice of each gun bar such that individual streams of dye can be individually controlled. The valves are controlled by a pattern control device or mechanism **94** to normally provide streams of air to impinge against the continuously-flowing dyestreams and deflect the same into a catch basin or trough **95** from which the dye is recirculated to the dye reservoir tank **57.** The pattern control device **94** for operating the solenoid valves comprises, in the present embodiment, a conventional computer device with magnetic tape transport for pattern information storage. Generally, for printing repeating patterns, the magnetic tape may be provided with a repeating sequence of information which is transmitted to the solenoid valves until a desired number of tiles have been printed. In the present case, a series of 10 tiles may be placed in spaced relation to each other on the conveyor belt and the pattern control device is initially activated as the leading edge of the first tile presents itself beneath the first gun bar **50.** Information from the magnetic tape and computer is then fed to cut the solenoid valves off and on and sequentially print the tiles with the desired pattern as they pass beneath the sets of the gun bars.

In operation of the presently disclosed apparatus with the pattern control device supplying no information, dye under pressure is continuously supplied in a stream from each jet orifice **55** toward the textile material to be printed. Every solenoid valve is normally open to supply streams of air to impinge against the continuously flowing dye streams and deflect them all into the troughs of the gun bars for recirculation. As the first of the series of tiles to be printed passes beneath the first gun bar and the pattern control device is actuated, certain of the normally open solenoid air valves are closed so that the corresponding dye streams are not deflected but impinge directly upon the textile material. Thus, by cutting on and off the solenoid air valves in a desired sequence, a printed pattern of dye is placed on the textile material during its passage.

As heretofore mentioned, during continued use of the printing apparatus of the present invention, the conveyor transporting the textile materials tends to elongate due to the mechanical wear of the components parts of the conveyor, such as the chains and sprockets on which the conveyor is mounted. Thus, unless some means is provided to permit adjustment of the point of initiation of the signals from the computer and tape to the air valves, the pattern of dye being placed on the materials will tend to become misaligned with the materials to be printed.

Thus, to compensate for the wear of the conveyor and to insure that the streams of the dyestuffs strike the carpet tiles at the precise locations to form the patterns thereon, electrical control means are provided for adjusting the time the pattern control device sends each signal of information to activate the solenoid valves. As broadly shown in FIGS. **2** and **3,** the control system comprises a synchronization switch **60,** a transducer **64,** and an electronic registration system **65.** Switch **60** is periodically engaged by a mechanical trip finger **62** attached to the edge of the conveyor **12,** while transducer **64** is operatively connected to the shaft **44** to convert mechanical movement of conveyor **12** to an electrical signal.

As best shown in FIG. **6** which is a schematic block diagram of the electrical control system for activating the pattern control device, transducer **64,** which may be of mechanical, optical, or an electromagnetic type such as an Optitac SP 270 manufactured by Frontier Electronics, is mechanically connected to shaft **44** by gears **44***a* to emit a desired number of pulses per revolution of the shaft and per inch of travel of the conveyor. In the present example, transducer **64** is geared to emit 25 electrical pulses per inch of travel of the conveyor. Pulses from transducer **64** pass to the electronic registration system which is composed of a pair of flip-flops **66, 67,** a clock **68,** three pairs of counter/comparator devices **70, 72, 74,** and an "and" gate **75** all operatively connected, as indicated, by electrical conductor lines. In the present registration system, the flip-flops are of the type U6A9001DC, made by Fairchild Corp., while each pair of the counter/comparator devices are composed of a BCD Decade Counter (Fairchild U6B9310DC) and a 5 Bit Comparator (Fairchild U6B9324DC). The clock is a conventional oscillator or multivibrator, such as a Vectron CO-231, or a Fairchild U6A9601DC configured as an oscillator.

In operation, when synchronization switch **60** is activated by trip finger **62** just as the first carpet tile on the conveyor reaches gun bar **50,** it resets flip-flops **66, 67,** and counter sections of counter/comparators **70, 72,** 74. The first pulse from transducer **64** to arrive at the flip-flop **66** sets the flip-flop to start the clock **68** oscillating. Pulses from clock **68** pass to counter/comparators **70** and **72.** The comparator section of counter/comparator **70** is manually set with a number (shown on manually adjustable digital indicator **70***a* as 10) which allows this number of clock pulses to pass to

counter/comparators **70** and **72** before resetting counter section **70** and the flip-flop **66**, thus stopping oscillation of the clock. The second transducer pulse arriving at flip-flop **66**, in like manner, sets the flip-flop and again starts clock **68** oscillating. Again pulses from clock **68** pass to counter/comparators **70** and **72**. Comparator section of counter/comparator **70** again permits the set number of clock pulses to pass to counter/comparators **70** and **72** before resetting the flip-flop **66** and counter section **70**, again stopping oscillation of the clock. Each pulse from the transducer, in like manner, is handled by the counter/comparator **70**.

The comparator section of counter/comparator **72** is set with a number (shown on manually adjustable digital indicator **72***a* as 25) which allows this number of clock pulses to pass to counter section **72** before a pulse is emitted from counter/comparator **72**. As indicated by the electrical conductor lines in FIG. **6**, this pulse passes to counter/comparator **74**, back to reset counter/comparator **72**, and to the pattern control mechanism **94**. Upon receiving a pulse from counter/comparator **72**, mechanism **94** sends one of its stored pattern signals to momentarily cut off one or more of the solenoid valves which permits impingement of the corresponding dyestreams on the carpet tiles. When counter/comparator **74** has received a given number of pulses from the counter/comparator **72** (shown on manually adjustable digital indicator **74***a* as 980), it transmits a signal to flip-flop **67** to set the flip-flop and disable and gate **75**, preventing further of such signals or pulses from being transmitted to the pattern control device by counter/comparator **72**. This setting on indicator **74***a* is selected according to the number of tiles or length of textile material to be printed in one cycle of operation of the pattern control device.

In the present case, for convenience the conveyor is loaded with ten tiles which are printed with ten repeating color patterns in accordance with a single cycle of the pattern control device. Thereafter, no activation signals are sent to the pattern control device by the registration system **65** until the registration system has been set at 0 and readied for counting by tripping the synchronization switch when the conveyor has completed one cycle of movement. The trip finger **62** on the conveyor is positioned to activate the synchronization switch once each complete cycle of the conveyor belt. By setting the number of pulses to be received by counter/comparator **74** at such a number as to allow all tiles placed on the conveyor to be printed in one circuit of conveyor movement, the magnetic tape of the pattern control device may be rewound each complete circuit of the conveyor.

From the foregoing it can be seen that each pulse transmitted by the transducer in response to movement of the conveyor can be broken down into multiple series of pulses which can be accurately counted and divided into groups so as to send signals to the pattern control device at precisely-defined positions of the conveyor with respect to the gun bars. If the length of the conveyor, and thus the position of the conveyor and the tiles thereon tends to vary in use due to wear, a manual adjustment of the digital settings of the counter/comparator devices **70, 72, 74** permits accurate and very fine "tuning" or adjustment of the signals which are sent to trigger the pattern control device, and thus accurate placement of the dyestuffs at desired locations on the tiles transported by the conveyor.

Thus, as can be seen, each transducer pulse is transmitted through the electronic registration system and its series of counter/comparators in such a manner that it is multiplied and divided by use of additional pulses to create a resultant signal activation of the pattern control device. By controlling the multiplier and divider settings on the counter/comparators, activation pulses may be sent to operate the pattern control device at any desired times and positions of travel of the conveyor. Therefore, when the length of the conveyor tends to "stretch" or vary due to wear of the conveyor parts, the activation of the pattern control device can be manually adjusted to insure the accurate placement of the dyestreams at their correct locations in the textile materials to form the printed pattern.

Although the invention has been described with reference to the color printing of textile material, such as carpet tiles, other forms of liquid can be applied to print a desired pattern on the textile material. For example, chemicals may be applied to the textile substrate to remove or otherwise chemically modify certain portions thereof and provide a patterned or printed effect. Although the apparatus is shown with a series of 5 gun bars, a single gun bar or more than 5 gun bars may be employed in accordance in the present invention.

That which is claimed is:

1. In apparatus for dyeing and printing of textile material to form a pattern thereon including a conveyor for moving the textile material in a path of travel, applicator means positioned along the conveyor for applying plural streams of liquid to the textile material during its passage thereby, and pattern control means for selectively directing individual of the streams of liquid from the applicator means onto the moving textile material to produce a pattern thereon; the improvement therewith comprising means for actuating the pattern control means in response to position of the conveyor to facilitate accuracy of placement of the pattern on the textile material on the conveyor, said actuating means comprising means for emitting a plurality of electrical pulses in response to and during the movement of the conveyor, means for sensing the number of said pulses emitted during movement of the conveyor and for activating said pattern control means in response to the sensing of a predetermined number of said pulses, and means for adjustably selecting said predetermined number of sensed pulses whereby activation of said pattern control means may be initiated at precise positions of the conveyor travel.

2. Apparatus as defined in claim **1** wherein said electrical pulse emitting means includes transducer means operatively connected to said conveyor for converting movement of said conveyor into electrical pulses.

3. Apparatus as defined in claim **2** wherein said electrical pulse emitting means further includes oscillator means operatively connected to said transducer means for emitting a plurality of pulses in response to each pulse emitted by said transducer means.

4. Apparatus as defined in claim **3** wherein said sensing and activating means comprises counter and comparator means operatively connected to the output of said oscillator means and to said pattern control means for transmitting a signal to said pattern control means after receiving a number of pulses from said oscillator means.

5. Apparatus as defined in claim 3 wherein said sensing and activating means includes first and second counter/comparator means operatively connected to said oscillator means in parallel, means operatively connecting the output of said first counter/comparator means to said oscillator means for stopping said oscillator means from emitting electrical pulses after a number of pulses have been emitted thereby, and said second counter/comparator means includes means for sending a signal to said pattern control means after receiving a number of pulses from said oscillator means.

6. Apparatus as defined in claim 5 wherein said first counter/comparator means includes manually adjustable means for selecting the said number of pulses emitted by said oscillator means before the stopping of the oscillator means.

7. Apparatus as defined in claim 6 wherein said means for stopping said oscillator means includes a first flip-flop operatively connecting the output of said transducer to said oscillator means.

8. Apparatus as defined in claim 5 wherein said sensing and activating means further includes third counter/comparator means operatively connected to the output of said second counter/comparator means for receiving signals therefrom, and means operatively connected to the outputs of said second and third counter/comparator means to prevent passage of signals from said second counter/comparator means to said pattern control means after a number of such signals are received by said third counter/comparator means.

9. Apparatus as defined in claim 8 wherein said third counter/comparator means includes manually adjustable means for selecting said number of such signals received by said third counter/comparator means.

10. Apparatus as defined in claim 9 wherein said means for preventing passage of signals from said second counter/comparator means to said pattern control means includes a second flip-flop connected to the output of said third counter/comparator means and an "and" gate operatively connected to the output of said second counter/comparator means and said second flip-flop.

11. Apparatus as defined in claim 10 including means operatively connected to said counter/comparator means and said first and second flip-flops to reset said counter/comparator means and flop-flops at a predetermined position of said conveyor.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,894,413 Dated July 5, 1975

Inventor(s) Harold L. Johnson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 30, the word after "disable" should read --"and"--.

Signed and Sealed this

fifteenth Day of *June 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks