

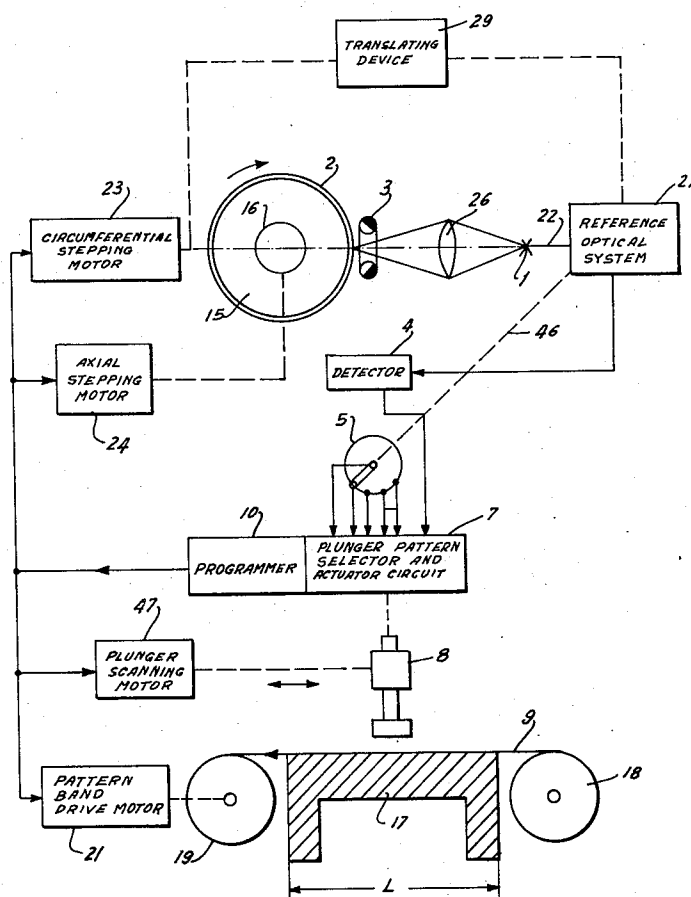
- [54] **PATTERN BAND FOR MULTICOLOR CIRCULAR KNITTING MACHINES**
1,957,646 5/1934 Hinton..... 178/5.2
2,083,960 6/1937 Nakanishi..... 139/319
2,845,096 7/1958 Pasquet..... 139/319
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- [22] Filed: **Feb. 5, 1969**
- [21] Appl. No.: **796,754**
- [30] **Foreign Application Priority Data**
Feb. 6, 1968 Germany..... 1635945
- [52] U.S. Cl..... **346/1, 66/1 R, 139/319,**
178/5.2 R, 346/33 A, 346/33 MC
- [51] Int. Cl..... **D04b 37/02**
- [58] **Field of Search**..... 346/33 A; 178/5.2 D, 5.2 R,
178/5.4 CR, 6.6; 139/319, 317, 318, 333;
66/50, 1; 356/173, 195
- [56] **References Cited**
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Primary Examiner—Joseph W. Hartary

[57] **ABSTRACT**

A pattern of indicia representative of the distribution of colors along a selected path of a multicolor pattern sample is registered on a fixed-length segment of a pattern band that controls a circular knitting machine. The selected path is photoelectrically scanned N times in succession and compared individually with N reference colors during the respective scans. A plunger settable during each scan in a separate one of N stamping patterns scans the fixed segment of the pattern band N times in synchronism with the scans of the pattern sample. The plunger impresses its stamping pattern on the fixed segment in response to each coincidence of the pattern sample and the associated reference color.

4 Claims, 2 Drawing Figures



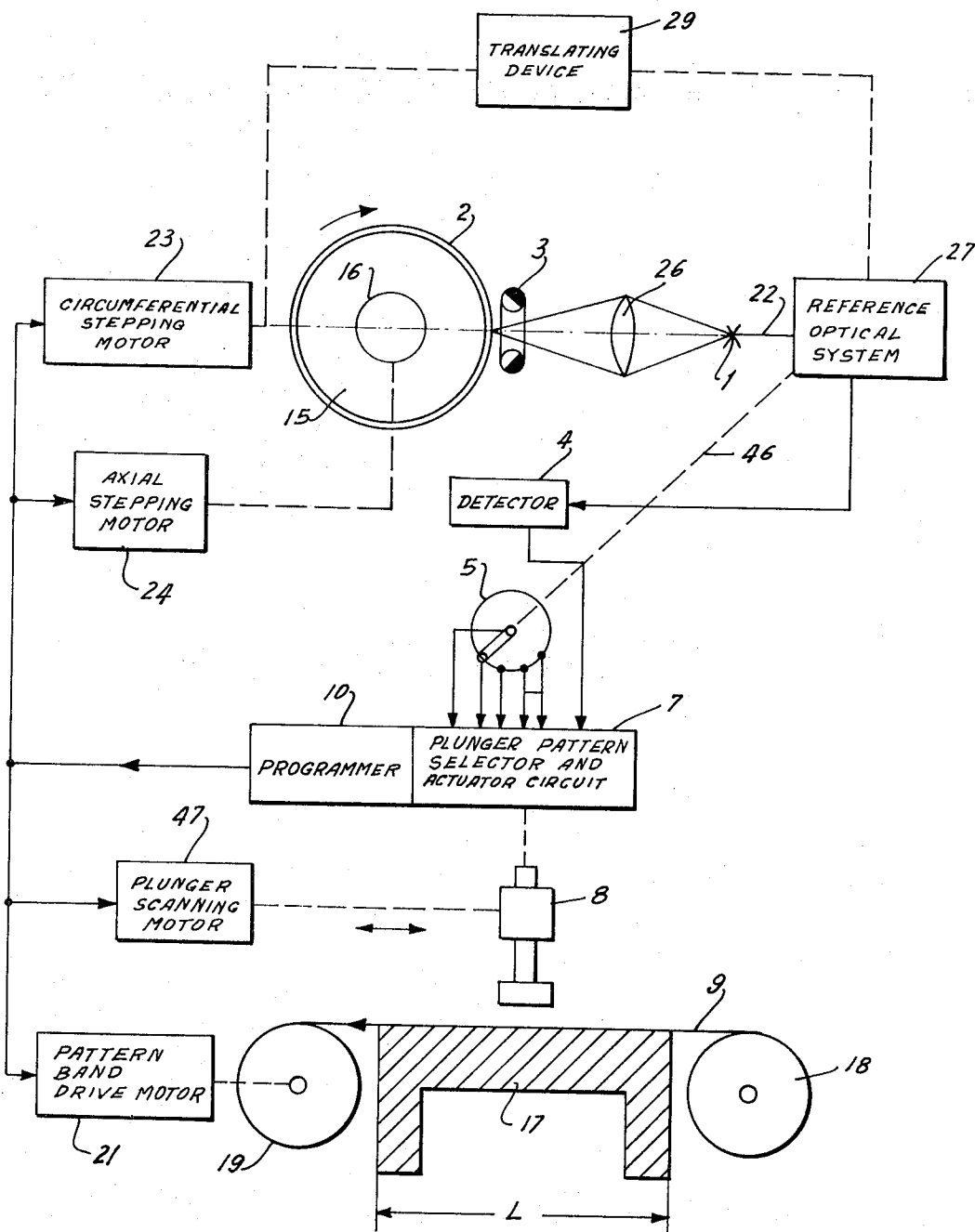
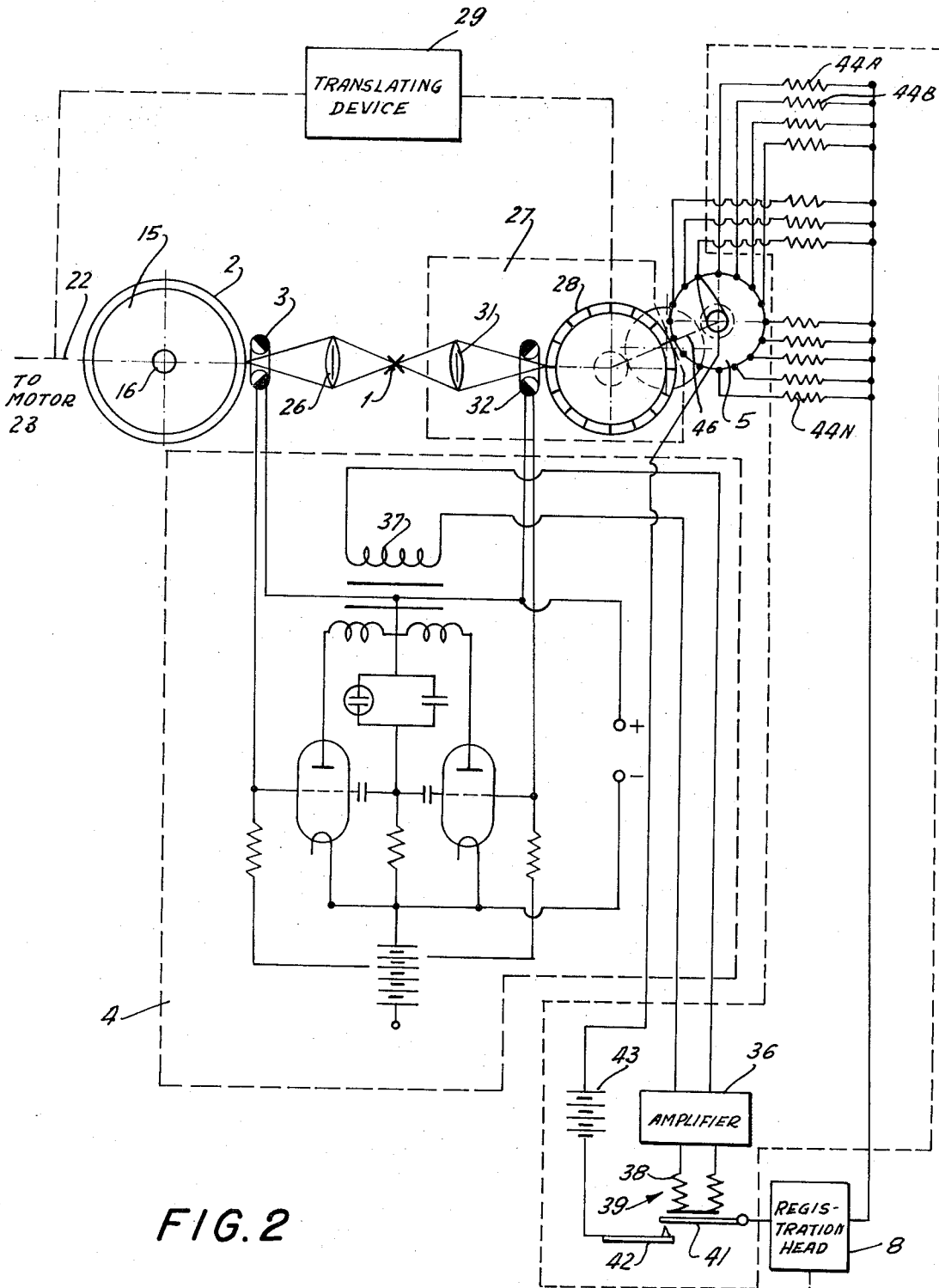


FIG. 1

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PATTERN BAND FOR MULTICOLOR CIRCULAR KNITTING MACHINES

BACKGROUND OF THE INVENTION

Flat-bed knitting machines of the type described, e.g., in FIGS. 4-8 of U.S. Pat. No. 2,173,488, issued to W. S. Tandler, et al., may be employed to produce fabric in accordance with multicolor pattern samples. For this purpose, each line of the pattern may be photoelectrically scanned color by color. At the conclusion of each scan, only those jacks and needles handling the threads of the color selected during that scan are engaged to knit stitches. Consequently, when programming pattern cards or bands to automatically control such flat-bed machines, indicia representing the successively scanned colors in the pattern sample must be affixed on separate cards or, alternatively, on successive portions of a pattern band. One example of the programming of pattern cards suitable for sequential operations on flat-bed machines is given in U.S. Pat. No. 2,083,960, issued to K. Nakaniski.

The use of pattern bands carrying indicia representative of such sequentially employed colors is not suitable for the control of circular knitting machines of the type shown, e.g., in FIGS. 1-4 of the above-mentioned Tandler patent. In such a machine, jacks and needles handling threads that exhibit the color distribution along the scanned path of the pattern sample are engaged in succession to knit stitches of the corresponding colors as the sample is scanned. It follows that pattern bands for the control of such operations must likewise be provided with indicia arranged in accordance with the actual color distribution of the scanned path of the sample.

SUMMARY OF THE INVENTION

The registration, on a single fixed-length segment of a pattern band, of indicia representative of the actual color distribution along a selected path of a multicolor pattern sample, may be accomplished with the arrangement of the present invention. The selected path is scanned N times in succession, where N represents the number of colors that may be present in the sample. The color distribution along the selected path is compared during successive scans with separately selected ones of the N colors (hereafter "reference colors").

A plunger settable in one of N stamping patterns individually corresponding to the N colors is scanned over the fixed-length segment of the pattern band in synchronism with the corresponding scan of the selected path on the pattern sample. When a region on the selected path of the sample is reached whose color corresponds to the then-selected reference color, the plunger is actuated to stamp the corresponding indicia on the associated portion of the pattern band segment. Thus, during successive scans, the separate indicia impressed on the segment will cooperate to form an overall pattern representative of the actual color distribution along the selected path of the pattern sample.

If it is desired to transfer indicia representing more than one selected multicolor path to the pattern band, the latter may be indexed through a distance at least equal to the length of the fixed segment at the conclusion of each cycle of N scans to present a fresh region of the pattern band to the plunger at the start of the next cycle.

BRIEF DESCRIPTION OF THE DRAWING

The nature of the invention will appear more fully from the following detailed description taken in conjunction with the appended drawing, in which:

FIG. 1 is a pictorial diagram of a pattern band registration arrangement in accordance with the invention; and

FIG. 2 is a schematic diagram showing certain portions of the apparatus of FIG. 1 in more detail.

DETAILED DESCRIPTION

Referring to the drawing, FIG. 1 depicts schematically an illustrative embodiment of the invention for stamping, on a fixed-length segment 11 of a pattern band 9, for a circular knitting machine (not shown), a pattern of indicia corresponding to the actual color distribution along a selected path of a multi-color pattern sample 2. The sample 2 is stretched out on the periphery of a drum 15, which is affixed to a shaft 16 for rotation about an axis perpendicular to the plane of the drawing.

Each pattern band segment 11 to be stamped is of length L, and extends across a suitable anvil member 17 from a supply drum 18 to a take-up drum 19. The drum 19 may be rotated to move the pattern band 9 by means of a suitable drive motor 21, which is controlled in the manner described below.

The drum shaft 16 may be indexed circumferentially about its axis to bring successive peripheral regions of the pattern sample 2 into alignment with an axis 22 of a light source 1, which is assumed to contain all the colors of the spectrum. The peripheral movement of the drum 15 is effected by a stepping motor 23. The latter is arranged, in a manner controlled by programmer 10, to cyclically rotate the drum 15 about its axis N times in succession, where N is a desired maximum number of discrete colors to be represented on the pattern band. After each complete cycle of N scans, the drum 15 may be indexed by a second stepping motor 24 in a direction along the drum axis, i.e., perpendicular to the plane of the drawing. Accordingly, successive circumferential strips of the pattern sample 2 may be brought into the plane of the drawing by the motor 24, while successive regions of the periphery of each such strip may be brought into registration with the axis 22 by the motor 23. In this way, the total sample 2 may be scanned in discrete strips, N times per strip. Alternatively, if desired, the sample may be scanned N times in succession along a helical path (not shown) that cover the entire surface of the sample at one time, as described in the above-mentioned Tandler patent for circular knitting machines. Such a helical pattern may be generated, e.g., by simultaneously driving the motors 23 and 24. In the first case, the indicia to be stamped along the fixed segment 11 of the pattern band 9 are representative of the color distribution along the circumferential sample pattern strip in registration with the plane of the drawing; in the second case, the indicia are representative of the color distribution along the entire helical path. For purposes of illustration, the remainder of the description will treat the color distribution to be represented as that of the single circumferential strip (shown in the Figure).

Light rays from the source 1 are directed against the aligned peripheral strip of the pattern 2 through a focusing lens 26. If, as is customary, each peripheral re-

gion of the strip exposed to the focused rays consists of a single opaque color, the light reflected therefrom will be essentially monochromatic. The reflected light is intercepted by an annular photocell 3, whose output is applied to a first input of a coincidence detector 4. (As shown in FIG. 2, the detector 4 may take the form of a balanced amplifier having a transformer-coupled output.)

Light rays from the source 1 are also applied to a reference optical system 27. The system 27 includes a color wheel 28 having N opaque reference colors spaced at equal angular intervals around its periphery. Each successive color on the wheel may be moved into registration with the axis 22 of the lamp 1 at the start of each revolution of the drum 15 during the N-Scan cycle. For this purpose, the wheel 28 may be indexed by the stepping motor 23 through a suitable translating device 29, such as a pawl and ratchet mechanism.

Light from the lamp 1 is focused on the aligned color of the wheel 28 through a second focusing lens 31. The monochromatic reflected rays from the wheel 28 are sensed by a second annular photocell 32, whose output forms the second input of the detector 4. Such output is ideally equal to the output of the photocell 3 when the portion of the pattern sample strip aligned with the axis 22 matches the corresponding aligned reference color. The detector 4 provides a suitable output control signal (i.e., a mill) whenever such coincidence occurs between the sample and reference colors.

The output of the detector 4 is coupled to a plunger selector and actuator circuit 7.

The circuit 7 includes an amplifier 36 coupled to transformer secondary winding 37 forming the output of the detector 4. The output of the amplifier 36 drives coil 38 of a relay 39, which is assumed to be in its energized condition except when the detector 4 exhibits a null output. Relay 39 has a movable contact 41 and a fixed contact 42 which are in engagement (i.e., closed) only when the relay is deenergized.

Each time a null is obtained from the detector 4 in response to color coincidence between the aligned portions of the pattern sample 2 and the color wheel 28, an energizing path for a registration head 8 (illustratively a solenoid-actuated plunger) is completed via the now-closed relay contacts 41 and 42, a DC source 43, a rotary selector switch 5, and one of N differently valued resistors 44a, 44b - - - 44n selected by the switch 5.

Each movement of the color wheel 28, which is effected at the start of a scan of the pattern sample 2 to position a new reference color on the lamp axis 22, is transmitted via a link 46 to the stepping switch which indexes the next succeeding one of the resistors 44a, 44b - - - 44n into the energizing path for the plunger 8. Since each of the resistors 44 has a different resistance value, each selection of a different reference color on the color wheel 28 impresses a different energizing current on the plunger 8. It is assumed that the latter is designed, in a conventional manner, such that the stamping face (not shown) of the plunger may be provided with N separate and selectable coded stamping patterns corresponding to the N resistors 44 and individually representative of the N reference colors; separate patterns may be set by passing the separate energizing currents through the plunger. Thus, the selection of one of the resistors 44a, 44b, - - - 44n by the switch 5 causes

the plunger 8 to exhibit the corresponding unique stamping pattern.

The plunger 8, which is movably positioned over the fixed-length segment 11 (FIG. 1) of the pattern band 9, is scanned longitudinally over such segment by a stepping motor 47 coupled to the programmer 10 and driven in synchronism with each revolution of the drum 15. In this way, each region of the segment 11 scanned by the plunger 8 corresponds to a region of the associated circumferential strip of the pattern sample 2.

Actuation of the plunger 8 upon the occurrence of a null output from the detector 4, while the plunger 8 is scanning in synchronism with the drum 15, will cause the plunger to move downward into engagement with the opposed region of the pattern band segment 11. Upon such engagement, the plunger 8 will stamp the segment 11 with indicia corresponding to the then-selected reference color. Thus, if brown is the instantaneous reference color set by the color wheel 28 at the start of a synchronized scan of the plunger 8 and pattern sample 2, the pattern band segment 11 will be stamped during such scan with indicia representative of the color brown at each point of the segment 11 corresponding to the brown portions of the pattern sample strip. Similarly, if the next reference color selected by the color wheel is blue, the pattern band segment will be stamped, during the associated scan of the plunger 8, with indicia representative of the color blue at each point therealong corresponding to the blue portions of the scanned strip; and so forth. Since the pattern band is held stationary during each cycle of N scans of the drum 15 and plunger 8 (during which time all N reference colors are scanned), the resultant distribution of indicia stamped on the pattern band segment 11 during such scan cycle will represent the actual distribution of colors on the pattern sample strip.

Following each cycle of N synchronized scans of the drum 15 and plunger 8 and the corresponding indexing of the color wheel 28 (FIG. 2) through the N reference colors, the programmer 10 (FIG. 1) may be arranged to (1) trigger the axial stepping motor 24 to move the next circumferential strip of the sample 2 in a direction perpendicular to the plane of the drawing and into registration with the axis 22; (2) trigger the pattern band drive motor 21 to longitudinally index the band 9 through a distance at least equal to the length L to bring a new segment of the band into registration with the anvil member 17 and under the scanning path of the plunger 8; and then (3) trigger the circumferential stepping motor 23 to initiate a new cycle of N scans of the drum 15 and the plunger 8. In this way, the actual color distribution along separate paths of a single pattern sample, or of separate pattern samples, may be translated faithfully into a stamped pattern of corresponding indicia on separate fixed-length segments of the band 9.

It will occur to those skilled in the art (1) that the various electro-optical and mechanical scanning functions of the described embodiment of the invention can be replaced by equivalent magnetic or other types of scans by making appropriate changes in the apparatus; and (2) that the stamped indicia registered on the pattern band 9 may be replaced by equivalent arrangements of punched holes, magnetic domains, or the like.

What is claimed is:

1. A method of registering, on a fixed-length axial segment of a continuous, elongated pattern band suit-

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able for controlling a circular knitting machine, a pattern of mechanical indicia (e.g., punched holes) representative of the actual distribution of at least three colors along a selected path of a multicolor pattern sample, which comprises the steps of:

cyclically scanning the selected path of the pattern sample N times in succession, where N is the number of colors;

cyclically scanning the fixed segment of the pattern band N times in succession in synchronism with the scans of the selected path of the pattern sample so that each scanned region of the fixed segment corresponds uniquely to a scanned region of the selected path;

comparing, during successive ones of the N scans in each cycle, the color distribution of the selected path with separate ones of N reference colors corresponding to the colors along the selected path; and

pressing, during each scan, mechanical indicia representative of the corresponding reference color on each region of the segment corresponding to a region of the selected path at which a coincidence occurs between the pattern sample and the reference color during the associated comparing step.

2. A method as defined in claim 1, comprising the further step of axially moving the pattern band through a distance at least equal to the fixed segment after the termination of each cycle of N scans.

3. For use with a circular knitting machine, apparatus for registering, along a fixed-length axial segment of a continuous, elongated pattern band, a pattern of mechanical indicia (e.g., punched holes) representative of the actual distribution of at least three colors along a selected path of a multicolor pattern sample, which comprises:

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means for comparing regions of a color pattern with a selectable one of N reference colors where N is the number of colors along the selected path, the reference colors corresponding individually to the colors along such path;

means for generating a control signal upon each coincidence of a color pattern region and a reference color;

normally unactuated registration means positionable opposite the pattern band segment and operable in a selectable one of N modes individually corresponding to the N reference colors for pressing mechanical indicia of the selected reference color on the opposed region of the pattern band segment;

means for synchronously scanning the comparing means over the selected path and the registration means over the pattern band segment N times in succession to position the registration band over a region of the segment corresponding uniquely to a region of the selected path during each scan;

means operative during each of the N scans for selecting a different reference color of the comparing means and for selecting the corresponding mode of the registration means; and

means responsive to the occurrence of each control signal for actuating the registration means to press the selected mechanical indicia of the registration means on the opposed region of the pattern band segment.

4. Apparatus as defined in claim 3, further comprising means operative at the end of each cycle of N scans for axially indexing the pattern band through a distance at least equal to the fixed length to expose a new segment of the pattern band to a succeeding scan cycle of the registration means.

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