

[54] DETECTION DEVICE FOR ERRORS IN THE ANGULAR POSITION OF A PATTERN CONTROL DRUM FOR A TEXTILE MACHINE

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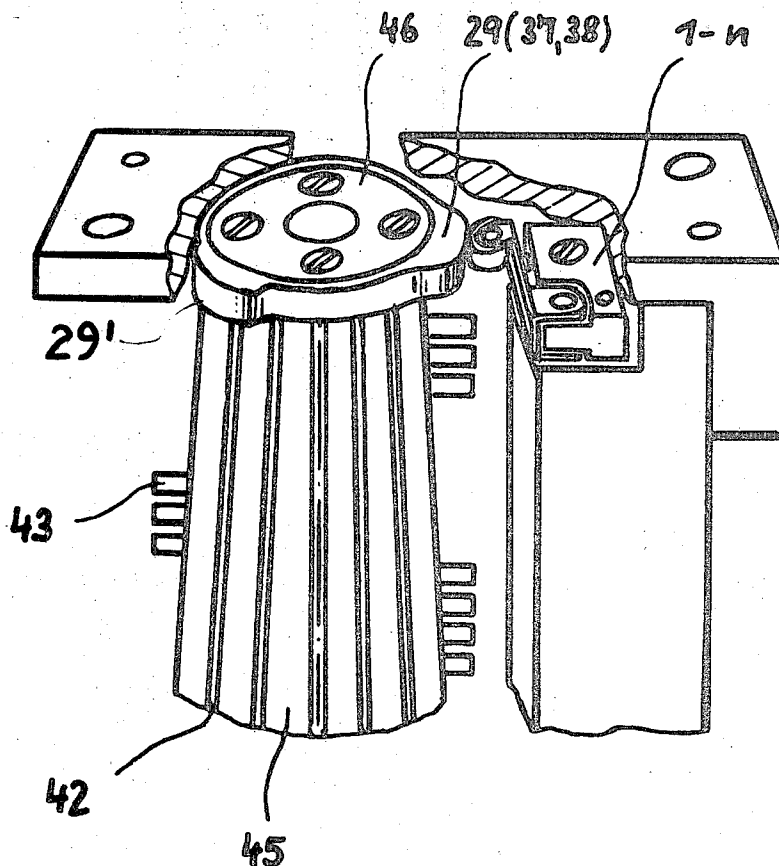
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[57] ABSTRACT

The Jacquard pattern controllers are formed as holders for pattern jacks, and mounted for indexing movement with movement of the textile machine, typically a flatbed or circular knitting machine; to monitor the position of the pattern holders, electrical switches are fixed in location with respect to the holders, which are provided with switch operating cams, or the like, the electrical contacts being connected in a supervisory circuit which determines the state of the switches and, when one of the switches is not in its predetermined state, gives an alarm signal and stops the machine. The supervisory circuit may be a pair of circuits, through which the switches are all connected in parallel, the circuit sensing whether the switches are all open, or all closed, and at least one switch not being in its proper position, causing the alarm.

17 Claims, 3 Drawing Figures



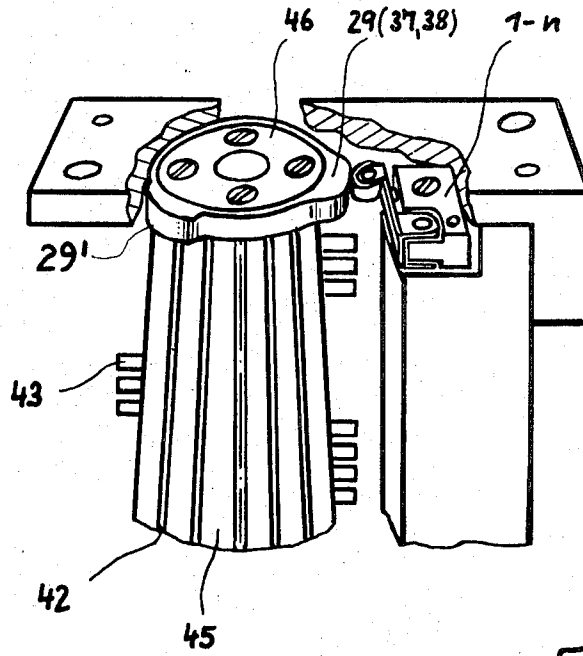


Fig. 1

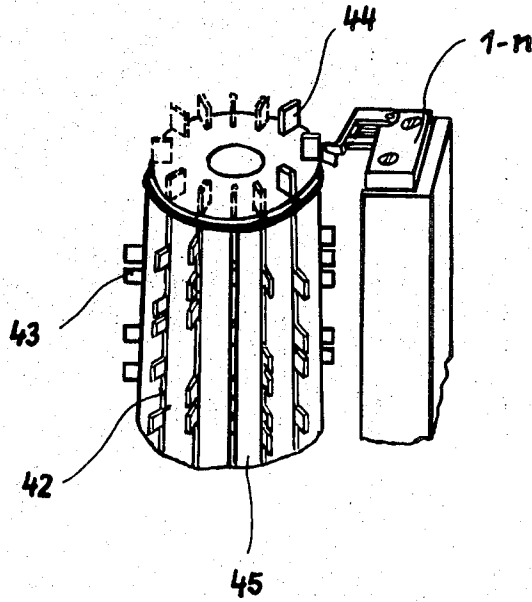


Fig. 2

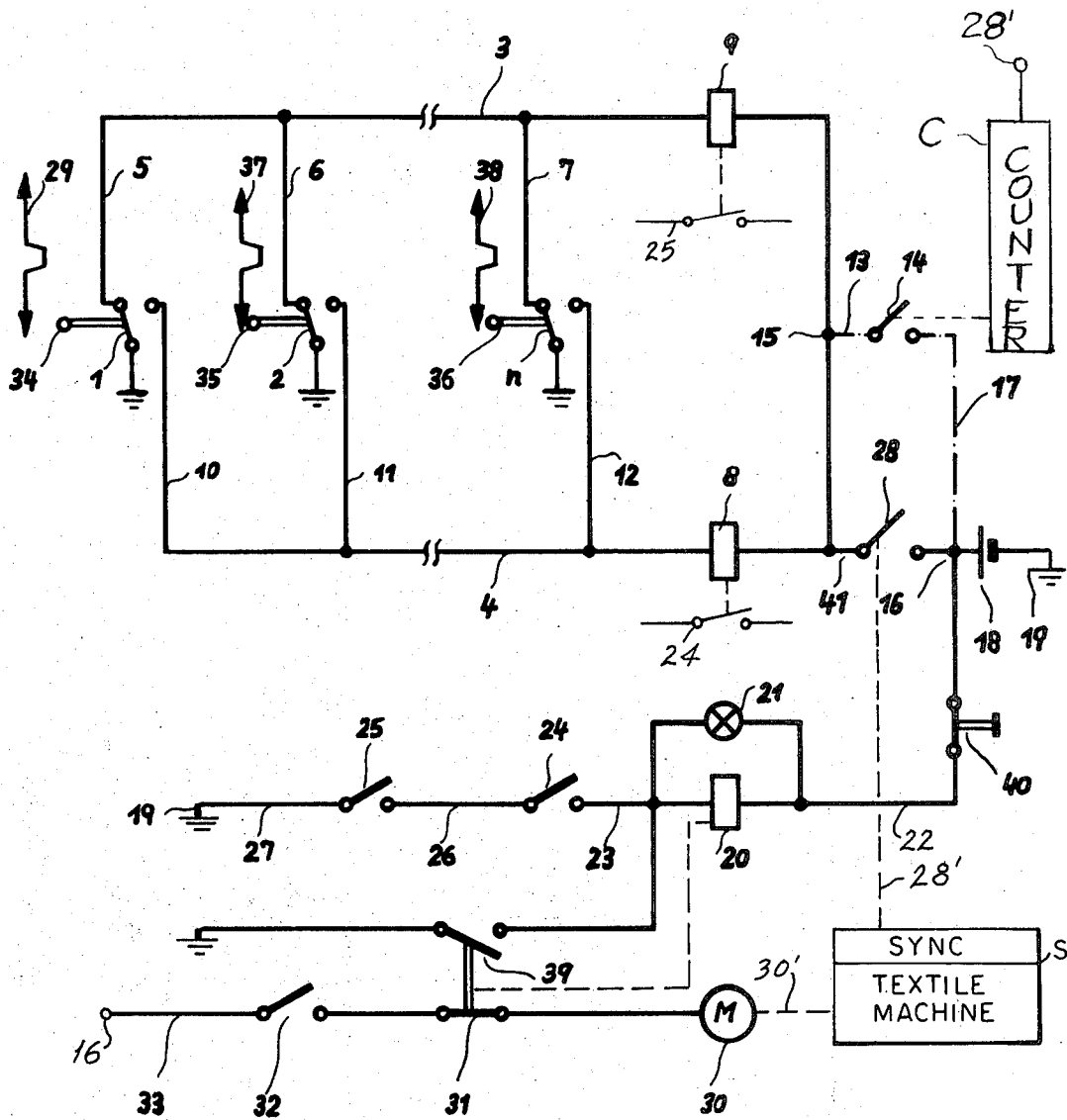


Fig. 3

DETECTION DEVICE FOR ERRORS IN THE ANGULAR POSITION OF A PATTERN CONTROL DRUM FOR A TEXTILE MACHINE

The present invention relates to textile machinery having Jacquard pattern controllers, and more particularly to knitting machines in which the Jacquard pattern controllers are indexed with the movement of the knitting machine, and to supervisory and monitoring apparatus to indicate whether or not all of the Jacquard controllers are in their proper index position at all times.

Knitting machines, and particularly circular knitting machines have many different types of apparatus which can be changed to knit various patterns. Each of these apparatus, typically Jacquard pattern controllers, may have a plurality of possible positions. At definitely predetermined times, or positions within a pattern program, the pattern controlling apparatus must have predetermined positions so that the fabric will be knitted, or woven in accordance with the predetermined pattern and machine parts, to be engaged by the pattern, are properly so engaged. If the pattern carriers are not in their proper position, the knitted, or woven pattern may be wrong or have mistakes; additionally, the machinery in use may be damaged.

If a large number of pattern control apparatus, such as Jacquard-type pattern controllers are to be used, it may be possible that one or the other of the pattern selector drums does not follow the indexing movement synchronized with movement of the machine. This may occur due to a mechanical fault, an electrical fault, a mistake in programming, or an error when resetting the Jacquard selector, for example upon change of a pattern.

Errors in positioning of the pattern selectors can be discovered only usually after a rather substantial amount of fabric has been made; the machine must then be stopped for correction of the error. Programming errors due to failure of indexing of selected pattern selectors are frequently discovered only by visual inspection, and often only after much off-pattern material has been made.

It is an object of the present invention to provide a supervisory or monitoring apparatus for use with textile machines, which may be weaving machines or knitting machines, and which monitors the position of Jacquard pattern controllers at selected intervals in the pattern repeat cycle, so that errors in the manufacture of the fabric will be discovered, as least, within one pattern repeat.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, the Jacquard pattern selector holders, typically pattern drums, have switch contact operating means thereon, for example cams or the like which open and close, to control switches located at predetermined positions with respect to the cams. The control switches are incorporated in a supervisory circuit. The switch operating elements, and the switches are so arranged that when the pattern controllers are in their proper positions, all switches are either open, or closed; the supervisory circuit will then indicate the position of all the switches as being proper; if one of the switches should, however, be in the other position, that is, either closed or open (when it should be open or closed, re-

spectively), then an alarm is given and the machine is stopped.

In accordance with a feature of the invention, more than one switch operating element may be associated with the pattern holders, so that the position of the pattern holders can be tested at various times within a pattern repeat cycle.

The invention will be described in connection with supervisory control of the pattern position of Jacquard pattern selector drums, to be supplied with pattern selector jacks, as used on a circular knitting machine; the invention is, however, applicable to other types of textile machinery, such as flatbed knitting machines, and all types of weaving looms, which are provided with a pattern selector which moves cyclically throughout a pattern cycle, in indexing motions.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a perspective view, partly broken away of a contacting and switching arrangement applied to a Jacquard pattern drum for use in a circular knitting machine, the machine itself having been left off for purposes of clarity;

FIG. 2 is a perspective schematic view of a different embodiment of a Jacquard pattern selector drum, with selector jacks inserted therein, the selector jacks operating a supervisory apparatus; and

FIG. 3 is a schematic circuit diagram of the interconnection of the control switches of the apparatus of FIGS. 1 and 2.

The textile machine, in the present case the knitting machine has a group of Jacquard pattern drums 45 located along its circumference, the drum 45 rotating in indexing motion in synchronism with the machine, by drive means (not shown) such as a gear in driving engagement with the bottom of drum 45, and in turn driven from the main gear of the textile machine. Thus, as the circular knitting machine rotates or, as a flatbed machine goes through a knitting stroke, or as the weaving machine goes through a shuttle insertion, the drum 45 is indexed, in accordance with a predetermined pattern motion (indexing occurring at each cycle, or stroke, or at a plurality of cycles or strokes, as programmed). Any selected or desired number of pattern selectors may be used and incorporated in the monitoring system of the present invention. The pattern selector drums 45 have a cover 46 screwed thereon, which is formed with a projection forming a cam 29. Other similar types of apparatus are formed with similar cams which, in the schematic circuit diagram, have been given the reference numerals 37, 38. The cams are so arranged on the pattern drum that a switch 1 of all the pattern drums is either closed, or open. The number of switches depends on the number of pattern selectors, switches 1, 2, n being indicated, wherein n may be any number, that is, the number of pattern controllers to be monitored. The pattern drum 45 is formed with slots 42 into which pattern selector jacks can be inserted, which have selector butts 43. In the embodiment of FIG. 2, the pattern jacks, inserted in the slots 42 carry an axial extension 44, and the switches 1, 2 n are so arranged that they are engaged by the projections 44, to be closed when a projection is opposite the switch. Selected butts 44, forming the projections, may be broken off so that in selected indexing positions the switches 1, 2 n may

be open. For certain apparatus it is of advantage to utilize the form of the invention illustrated in FIG. 1. The cover plate 46 may have more than one cam land formed thereon, such as land 29' which, as shown, spans more than one indexing position. Two lands are shown each spanning two slots, into which Jacquard selector jacks can be inserted.

Other operating or control elements for the switches 1, 2,n can be provided, such as pins on the pattern drum 45 itself, which may be selectively removable, or may be fixed thereon; the shape of the pins, or cams formed on a separate disc 46 (FIG. 1) is subject to wide design changes; for example, the cam can be formed as a continuous contour with depressions therein when the switch is to be operated, rather than a projecting land 29, as shown. Particularly good check, or supervision of indexing of the drums is obtained when the cams are so arranged that the switch will respond with respect to a cam which is aligned with a selector jack placed to require an even number of indexing steps with respect to a certain base position, and a second different cam, which is arranged to have an odd number of indexing steps, or strokes from the base position. One of the cams to test for alignment of all the pattern selector drums is preferably arranged one or two steps before the end of a pattern cycle so that, if faulty material is being made, a new pattern will not be started and the machine will be stopped before a next pattern repeat cycle begins. The distance between a pair of cams, or test positions on the selector drums 45 is preferably at least two indexing steps, but may be more, for example half a revolution of drums 45. Drums which have twelve grooves, to accept twelve pattern jacks may have one or two control elements for the switches 1, 2,n which span, or are activated for three consecutive indexing positions, and are not activated for three further ones; then again activated for three positions and not activated for the remaining three; or, the other way around, to provide a practically continuous test, and detecting incorrectness of the angular position of the pattern drum, resulting in faulty fabric, in three indexing motions of the pattern selectors.

The switches associated with the pattern selectors are interconnected in a circuit as seen in FIG. 3, wherein the switches 1, 2,n are shown, and the associated cams 29, 37, 38 operating the switches are indicated schematically. The cams 29, 37, 38 bear against cam followers 34, 35, 36 to change the position of the switches 1, 2,n, or to leave them as shown in the drawing of FIG. 3, in their indicated position. The switches, which are transfer switches, are all connected in parallel, by lines 5, 10; 6, 11; and 7, 12, respectively, to a pair of switch control lines 3, 4. The switch control lines are in series with the coils of relays 8, 9, associated with relay contacts 24, 25 respectively. The relay coils 8, 9 are connected together to a junction point 41 which is connected in series with a main switch 28. Switch 28 connects to an energizing line 16, for example to a terminal of a source of current, shown schematically as a battery 18 which is connected to ground at 19.

Switch 28 is operated in synchronism with the movement of the textile machine, for example, in case of a circular knitting machine or circular loom with its rotation or, in case of a flatbed machine or loom, with its stroke. The machine is indicated only schematically at

S. Synchronization of the switch 28 is schematically indicated by dashed line 28'.

The contacts of the relays of coils 8, 9 are included in a control or monitor circuit, which is shown on the lower half of FIG. 3. The switch contacts 24, 25 are in series between ground, a line 27, line 26 and a junction point 23. Junction point 23 is additionally connected to a normally open contact 39 of a relay having coil 20; the other terminal of the circuit, indicated at line 33, and which may be connected to terminal 16 of the source of current, is connected through main switch 32 and the normally closed contacts 31 of relay coil 20 to the main drive motor 30 of the textile machine. Dashed line 30' indicates the synchronization of the main drive motor with the textile machine, and hence with switch 28.

OPERATION

Let it be assumed that the main circuit switch 32 is closed, motor 30 is accordingly operating, and the textile machine is working. At a certain point within the textile machine, determined by the synchronization and corresponding to a certain indexed position of the Jacquard selectors, that is, to a certain point of time within the operating cycle of the machine, switch 28 will be closed, thus providing energization to junction 41. If, at this point, all the switches 1, 2,n of the Jacquard selector drums 45 are in the position shown in FIG. 3, then relay coil 9 will be energized, causing closing of switch 25. Relay coil 8 will not, however, be energized and switch 24 will be open. Switches 24, 25 are in series and are both connected to relay coil 20 which operates the contacts 31, 39, and is in parallel with an alarm device 21, such as an alarm light and bell. Coil 20 and alarm device 21 are connected over line 22 and a manually operating reset switch to junction 16, that is, to the source of power. If only relay 9 is energized, the alarm circuit of lines 23, 20, 22, and alarm indicator 21 will not be activated. Let it be assumed that, upon further indexing movement, all cams 29, 37, 38 go to a position in which all switches 1, 2,n change over from the position indicated in FIG. 3 to the terminals at the right of the transfer contact. Upon the next closing of switch 28, that is, upon the next synchronization with a predetermined pattern drum position, relay coil 8 will be energized and contacts 24 will close. If all switch cams 29, 37, 38 have moved downwardly, relay coil 9 will be not energized, contact 25 will be open and again, alarm relay 20 and indicator 21 will not operate, since under these conditions all selector drums have properly indexed. If, however, one of the selector drums have not followed the proper indexing movement, that is, if any one of the switches 1, 2,n has a position different from the others, then both relay coils 8, 9 will be energized when switch 28 closes, both contacts 24, 25 will close, thus energizing relay coil 20 and providing power to alarm device 21. Energization of relay 20 causes opening of the switch 21, thus stopping of the machine motor 30, and additionally causes closing of the normally open contact 39 to close a holding circuit to keep relay 20 energized if the machine continues to rotate due to its inertia, and switch 28 again opens. This circuit can be re-set by manual opening of switch 40, after the fault has been corrected.

The circuit, with a minimum of apparatus and complexity thus indicates whether all switches 1, 2,n

are in their proper, corresponding position at predetermined times within the machine operating cycle, thus indicating that the associated Jacquard selectors have properly indexed. If, however, a single one, or more of the Jacquard selectors are not in their proper position, that is, have not followed the proper indexing movement, then the switches associated therewith will be in a position different from those of the other switches, both relays 8 and 9 will be energized and an alarm will be given.

The switches may have various forms; change-over switches, as shown, for example of the microswitch type and operated by cams or control butts on the selector jacks of Jacquard selectors are simple and reliable. Any number of switches can be connected in parallel similar to the switches 1, 2, n, by appropriate connection lines to switch control lines 3, 4, the switch arms themselves being grounded.

The setting of the switches 1, 2, n can be interrogated by other controls, independent of the machine and not determined by the synchronization of switch 28. Switch 28 is held open (or a series connected switch is opened) and an auxiliary bypass circuit formed of the series connection of junction 15, connected to junction 41, line 13, manually operable switch 14 and connection 17 to junction 16 is provided (shown in chain-dotted lines). Thus, switch 14 can be operated at any time, for example during set-up, or supervision or test of the machine, to determine the setting of the various Jacquard selectors. The sequencing of interrogation, automatically, by synchronization of the closing of switch 28 with the operation of the textile machine can be controlled as desired. Switch 14 can be operated from the machine, or other test apparatus, to test for example at given instances of time, per machine revolution, after a number of revolutions, or as desired. A suitable test period is once after each pattern repeat. A counter C, the stepping of which is controlled by the machine, counts the machine revolutions and closes switch 14 after the machine has made the revolutions corresponding to a complete pattern. For other tests, circuits including a switch similar to switch 14 can be connected in parallel therewith. For example, if desired, other apparatus than the Jacquard selectors may be included in the circuits of lines 3, 4. By properly sequencing the cams for similar controllers, and by specific sequencing of the interrogation by switch 28 or 14 in accordance with machine operating cycles, and the number of cycles, similar controllers may be arranged to be in different positions, with respect to a base position which result in switch setting such that they still provide proper, "correct" output, if this is desired; similarly, different type of apparatus can be included in the monitoring system. The system itself can readily be expanded by incorporation with further control apparatus, stopping only selected operations which prove to be faulty, but permitting continued operation of apparatus which is in order.

The present invention is particularly suitable with striping apparatus on circular knitting machines, which have a common pre-selection, and in which the pattern carriers or holders are transported in dependence on machine rotation by switching from the machine itself. The pattern carriers which control the insertion apparatus of the striping knitting machine directly, or indirectly, can thus be checked or monitored once or more per revolution thereof, to determine whether they are

in proper phase and cycled sequence. Monitoring of the striping apparatus is also applicable for the insertion or removal of a reinforcing thread.

Switch 28, as well as other switches, similar to switch 28 (or switch 14) determines the sequencing of the monitor check and can be closed, in circular knitting machines, once for each machine rotation, and in flat-bed knitting machines, once per stroke. Gearing can be provided so that the switch is operated only once per pattern repeat sequence; if the indexing of selected drums 45, within a pattern repeat differs from those of other drums, then a separate, synchronized switch, similar to switch 14 is preferably provided, to check the position of the switches 1, 2, n.

Various changes and modifications may be made within the inventive concept. The synchronization pulse from line 28 can be obtained, for example, by a repetitively closing switch, operated by cams, or a gear geared to the main gear or drive of the machine; or, by other apparatus synchronized with the rotation, or stroke of the machine, for example by pulsed or triggered mechanical, solid-state switches, counters or other apparatus as well known in the art.

The invention has been explained and described specifically in connection with the setting of Jacquard selectors on circular knitting machines; other equipment than Jacquard selectors can be checked in a similar way, such as pattern repeat cams, pattern skip cams, and the like. Such cams, or cam operators are customarily also mounted on indexing drums, similar to the Jacquard selectors and the application of the present invention to control apparatus for textile machines, and specifically for circular knitting machines, of such other indexible devices will be obvious.

The indication to be given whether the setting of the various Jacquard selectors (or other equipment) is in order can be such that all the switches are either open, or closed; it is, of course, equally possible to reverse the setting of the circuit so that, under test conditions, all circuits should be opened and, upon current flow, indicating closing of one circuit, the machine will not operate, or an alarm will be given. The circuit, therefore, in general indicates if all switches have the same setting, that is, are all open, or all closed, and indicates if one or more switches are out of phase.

In a particularly useful setting, the first, or next to the last setting of the Jacquard selectors is to be tested, and the circuits are so arranged that, if all selectors are in proper order, the switches 24, 25 will be closed. This then provides a start up check, to test whether, upon start-up, all the selectors are in their proper order. Unless for the first pattern, upon the first revolution of the machine, all the selector elements are in proper order, the machine will not start. If the last preceding position is selected, rather than the first, a check is made before a new pattern will start, or one indexed position back of the one which controls the pattern, thus also indicating that the next pattern to be knitted will be perfect. A cam such as cam 29' (FIG. 1) spanning the last and first indexed positions would be particularly suitable for such an arrangement.

The present invention provides a versatile, yet simple and reliable monitoring and checking arrangement in textile machines, which can readily be adapted to various patterns, pattern selectors, and by selective, or concurrent use of switches 28 and 14, can provide repetitive, continuous check on the setting of pattern selector

elements, as the pattern proceeds, as well as additional check on setting of these elements as controlled by command or control apparatus, or the repeat on the fabric.

We claim:

1. Textile machine having a plurality of revolving drum pattern holders (45), which carry out indexing movement synchronized with machine operation, said machine including a monitoring supervisory system to check the respective index position of said pattern holders comprising
 - an electrical switch (1, 2, . . . n) associated with each of the pattern holders to be monitored, said switch being in fixed location adjacent to the respective pattern holders;
 - switch operating means (29, 29', 37, 38) located on each side of the pattern holders having a switch associated therewith and settable on the pattern holders in position relative to the pattern to place the switch in a predetermined state when the respective pattern holder has a predetermined index position;
 - a supervisory circuit (5, 10; 6, 11; 7, 12; 3, 4) connected to all the switches associated with the pattern holders to be monitored;
 - means (14, 28) to interrogate the switches with respect to their state including means to cyclically energize the supervisory circuit to determine the state of the switches;
 - and indicator means (20, 39, 31) connected to said supervisory circuit responsive to a determination that at least one of the switches (1, 2, . . . n) associated with the pattern holders (45) is not in the state which corresponds to a predetermined index position of the pattern holders (45) at the time of interrogation to indicate misindexing of at least one of said pattern holders.
2. Machine according to claim 1, wherein the switch operating means comprises cam means having at least one switch operating position for each revolution of the drum.
3. Machine according to claim 2, wherein the switch operating position extends for a distance corresponding to one index step of the drum.
4. Machine according to claim 1, wherein the switch operating means comprises selectively settable switch engaging means.
5. Machine according to claim 1, wherein the switch operating means comprises selectively settable switch engaging means having an engagement position (29') spanning at least two index positions of the drum.
6. Machine according to claim 1, wherein the switch operating means comprises a cam having at least two operating positions, one located at an even number of index steps from a starting position and the other located at an odd number of index steps from the starting position.
7. Machine according to claim 6, wherein the operat-

ing position located at an even number of index steps is removed by at least two steps from the final index position.

8. Machine according to claim 1, including pattern jacks inserted in the pattern holder and wherein the switch operating means is formed by a switching portion on the pattern jacks.
9. Machine according to claim 8, wherein the switch is located to be operated by a butt of the pattern jack.
10. Machine according to claim 1, wherein the switch comprises a transfer switch; selected index positions of the holders connecting the switch in either of one or the other position;
 - and a supervisory circuit is connected to sense whether or not all switches are in the same selected position, failure of at least one switch to be in its selected position causing response of the indicator means.
11. Machine according to claim 10, wherein the switches are all connected in parallel;
 - and the interrogating means comprises a sensing circuit including a circuit responding if, and only if at least one of the switches is in a position other than the selected position.
12. Machine according to claim 1, wherein the textile machine is a circular striping type knitting machine; and the pattern holders are jointly indexed in synchronism with machine rotation.
13. Machine according to claim 1, wherein the supervisory circuit is connected to sense whether or not all switches are in the same selected position, failure of at least one switch to be in its selected position causing response of the indicator means.
14. Machine according to claim 1, wherein the means interrogating and cyclically energizing the supervisory circuit comprises means (28) synchronized with machine operation.
15. Machine according to claim 1, wherein the means interrogating and cyclically energizing the supervisory circuit comprises means counting machine repeat operations and energizing the supervisory circuit after a predetermined number of said repeat operations.
16. Machine according to claim 15, wherein the machine is a circular knitting machine and said repetitive operation comprises revolutions of the circular knitting machine;
 - and the predetermined number of revolutions is determined by the number of revolutions required for a repetitive pattern repeat sequence of the fabric being made on the machine.
17. Machine according to claim 1, wherein the indicator means are interconnected with the main switch of the machine and inhibit operation of the machine unless all of the switches associated with the pattern holders are in the position corresponding to the proper index position.

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