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(54) **Method for determining the position of magnetoelectric selectors for needles of the needle cylinder in knitting machines for hosiery and the like**

(57) A method for determining the position of magnetoelectric selectors around the needle cylinder in knitting machines for hosiery and the like which comprise a needle cylinder (11) in the curved surface of which there is a plurality of axial slots (12), each slot (12) accommodating a needle (2) and at least one selection element (1), and selectors (3) which comprise permanent magnets (4) and coils (5) which laterally face the needle cylinder (11) at the level of the selection elements (1), comprising the following steps:

generating electromagnetic disturbances, by way of the rotation of the needle cylinder (11) and the passage of the selection elements (1) at a selector (3), in order to obtain electric signals which represent the passage of each selection element (1);
sampling each one of the electric signals starting from a zero value of an encoder (10) connected to the needle cylinder (11) and storing the samples obtained at each elementary step (14) of the encoder (10);
analyzing each one of the signals in order to detect the times of passage in front of each one of the selectors (3) and correlating the times with the samples in order to determine the position of the selectors (3) with respect to the selection elements (1) of the needle cylinder (11), so as to determine times for sending actuation signals to the selectors (3) in order to select chosen needles (2) in each case.

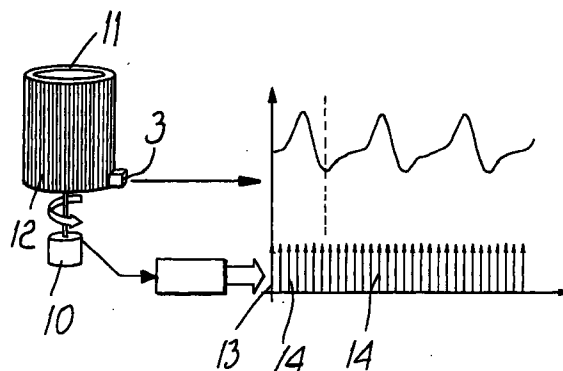


Fig. 3

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Description

[0001] The present invention relates to a method for determining the position of magnetoelectric selectors around the needle cylinder in knitting machines for hosiery and the like.

[0002] More particularly, the method according to the invention is aimed at automatically determining the position of magnetoelectric selectors in order to precisely actuate the needles of the needle cylinder.

[0003] It is known that electronic selection of the needles of the needle cylinder in knitting machines for hosiery and the like allows to select the path of each needle of the cylinder. The needle is actuated by a sub-needle arranged below it and is in turn actuated by a pin.

[0004] For the sake of simplicity, it is assumed that the needle is selected when high and deselected when low.

[0005] The selection actuator (also known as selector) comprises a permanent magnet and an electric coil which is actuated by an electronic part.

[0006] Figure 1 schematically illustrates the selection mechanism, where the reference numeral 1 designates the pin, the reference numeral 2 designates the corresponding needle, and the reference numeral 3 designates the selector, which comprises a permanent magnet 4 inside which a coil 5 is arranged.

[0007] Figure 1 illustrates two cases, i.e., the case in which the pin selects the needle, pushing it upwards, and the case in which the needle is instead not selected.

[0008] In practice, where there is no current I in the coil 5, the permanent magnet 4 applies an attraction force to the pin 1, as shown by the arrow 6, and the pin is slightly deformed and forced to take a path which causes the descent of the needle 2 arranged above it.

[0009] If instead the coil 5 is crossed by a current pulse I of adequate shape and intensity, it generates a magnetic field which cancels out the field generated by the permanent magnet 4. In this case, therefore, no attraction force is applied to the pin 1, which remains in the inactive position due to its intrinsic elasticity. The path taken in this case causes the needle to be pushed upwards and therefore selection occurs.

[0010] This last situation is indicated by the arrow 7.

[0011] The problem encountered in electronic selection of the needles of a needle cylinder in knitting machines for hosiery and the like is due to the fact that the needles, together with the corresponding sub-needles and pins (the sub-needles have been omitted for the sake of simplicity in the Figures, particularly in Figure 1), are arranged in slots which lie parallel to the axis of the needle cylinder and are arranged on the curved surface of said cylinder.

[0012] Due to production tolerances or actual manufacturing defects, the needles may not be equally spaced from each other, and this causes difficulties in selecting them.

[0013] Furthermore, the magnetoelectric selectors are positioned manually, assuming that the needles are all at the same distance from each other.

[0014] If this were not true, the positioning of the selectors would be incorrect and it would not be possible to actuate the intended needle.

[0015] For this purpose, in order to correctly position the selectors with respect to the needles, the permanent magnets are currently moved manually into such a position that at the encoder zero of the needle cylinder the selectors are in the ideal position for needle selection and it is then necessary to adjust the position of the selectors so as to compensate for any imperfectly equidistant positions of the needles.

[0016] This manual positioning, in addition to requiring considerable time and testing, is of course inaccurate.

[0017] The aim of the present invention is therefore to provide a method for determining the position of magnetoelectric selectors around the needle cylinder in knitting machines for hosiery and the like in which it is possible to determine the exact position of said selectors with respect to the needle cylinder.

[0018] Within the scope of this aim, an object of the present invention is to provide a method for determining the position of magnetoelectric selectors around the needle cylinder in knitting machines for hosiery and the like in which the selectors can be positioned regardless of the precision with which the needles are inserted in the needle cylinder.

[0019] Another object of the present invention is to provide a method for determining the position of magnetoelectric selectors around the needle cylinder in knitting machines for hosiery and the like in which it is possible to synchronize the current pulses sent to the selector with the position of the pins in front of the active region of each selector.

[0020] Another object of the present invention is to provide a method for determining the position of magnetoelectric selectors around the needle cylinder in knitting machines for hosiery and the like which is highly reliable, relatively easy to provide and at competitive costs.

[0021] This aim, these objects and others which will become apparent hereinafter are achieved by a method for determining the position of magnetoelectric selectors around the needle cylinder in knitting machines for hosiery and the like which comprise a needle cylinder in the curved surface of which there is a plurality of axial slots, each slot accommodating a needle and at least one selection element, and selectors comprising permanent magnets and coils which laterally face the needle cylinder at the level of the selection elements, characterized in that it comprises the following steps:

generating electromagnetic disturbances, by way of the rotation of the needle cylinder and the passage of said selection elements at a selector, in order to obtain electric signals which represent the passage

of each selection element;

sampling each one of said electric signals starting from a zero value of an encoder connected to said needle cylinder and storing the samples obtained at each elementary step of said encoder;

analyzing each one of said signals in order to detect the times of passage in front of each one of said selectors and correlating said times with said samples in order to determine the position of said selectors with respect to said selection elements of the needle cylinder, so as to determine times for sending actuation signals to said selectors in order to select chosen needles in each case.

[0022] Further characteristics and advantages of the invention will become apparent from the description of preferred embodiments of the method according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic view of the principle of magnetoelectric selection of the needles of a needle cylinder in knitting machines for hosiery and the like;

Figure 2 shows the waveform of the signal generated across the coil of the selector when a pin passes in front of the sensitive region of the selector;

Figure 3 is a schematic view of the process for automatically learning the position of the selectors with respect to the needle cylinder, according to the present invention;

Figure 4 shows the waveform of the signal detected across the coil when one of the pins of the needle cylinder is eliminated;

Figure 5 shows the same signal as Figure 4 when three pins to the left and three pins to the right are removed, leaving a single central pin;

Figure 6 shows the placement of thresholds for identifying positive and negative peaks of the signal;

Figure 7 shows the waveform of the signal detected across the coil of the selector if some of the pin slots formed in the needle cylinder are incorrectly spaced;

Figure 8 shows the signal detected across the selector coil, together with the signal of the encoder, if the encoder is not positioned correctly with respect to the axis of the needle cylinder;

Figure 9 shows the signal detected across the coil of a selector together with the waveform of the driving current of the coil; and

Figure 10 shows the optional programming of the driving current of the coil.

[0023] With reference to the above Figures, and particularly to Figures 2 to 8, the method according to the invention is as follows.

[0024] First of all it should be noted that the method is applied to knitting machines for hosiery and the like which have a needle cylinder provided with, on its curved surface, a plurality of axial slots, each accommodating a needle and at least one selection element. Said selection element can be, for example, a pin interacting with a sub-needle which in turn performs the actual actuation of the needle (its lifting or lowering). Accordingly, the selection pins are referenced as selection elements in the continuation of the description.

[0025] As mentioned, the problem consists in synchronizing the current pulses with the pins that in each instance are in front of the active region of each selector.

[0026] An automatic learning function based on the current induced in the coil of the selector when the pin passes at a certain speed on front of the active region of the selector 3 is used for this purpose.

[0027] The passage of the pin in fact produces an alteration in the magnetic balance, which in turn generates an electric signal across the coil 5. In this case, the coil behaves like a proximity sensor. The shape of the current depends on many factors, such as for example the dimensions of the pin, its speed, its distance from the adjacent pins, the dimensions of the so-called active or sensitive region of the selector 3, etcetera.

[0028] In any case, the detected signal has a rather typical shape, and after being suitably filtered and amplified it has the shape shown in Figure 2 when displayed on the screen of an oscilloscope.

[0029] Every time a pin 1 passes in front of the sensitive region of a selector 3, a signal of the type shown in Figure 2 is measured across the corresponding coil 5.

[0030] The two peaks of the signal roughly correspond to the entry and exit of the pin 1 into and from the active or sensitive region of the selector 3.

[0031] During the automatic learning step, in a fully automatic manner a microprocessor, described herein-after, connects one coil 5 at a time to an acquisition circuit, which filters the signal, amplifies it and sends it to an analog/digital converter. The signal is then sampled at constant space intervals (generated by means of an encoder which is designated by the reference numeral 10 in Figure 3). The reference numeral 11 instead designates the pin cylinder and the reference numeral 12 designates the slots in which the pins, the corresponding sub-needles and the needles (not shown) are inserted.

[0032] The reference numeral 13 designates the encoder zero at which sampling of the signal acquired at the coil 5 of the selector 3 begins.

[0033] In the example of Figure 3, approximately six elementary steps after zero, i.e., after six elementary steps of the encoder designated by the reference numeral 14, the first "useful" pin 1 enters the active region of the selector; i.e., it is possible to read on the oscilloscope a first signal having a complete waveform, as shown in Figure 2.

[0034] At each pulse, the signal of the coil 5 is sampled and digitized.

[0035] The needle cylinder 11 is rotated continuously at a preset and constant speed (preferably around 200-300 rpm). In this manner, the pins pass in front of the selectors 3 rapidly enough to generate a signal whose amplitude is sufficient to allow decoding by the automatic learning software.

[0036] As shown by Figure 3, signal sampling begins at the encoder zero, which is generated once for each turn. After this, it is possible to obtain a sample of the signal on each elementary step, i.e., on each unit of movement of the encoder 10. After a complete turn of the needle cylinder 11, the memory contains a digital representation of the intended signal, i.e., a sequence of as many numbers as there are elementary steps in the turn made by the encoder 10.

[0037] These data are processed in order to find the first peak (where a peak is defined as any lower or higher point reached by the signal waveform).

[0038] In the example shown in Figure 3, the first peak occurs six elementary steps 14 after the encoder zero 13. Accordingly, this is the position of the selector 3, i.e., during command execution the software will wait for six elementary steps 14 after the reference of the encoder zero 13 before starting to send current pulses on this selector. In this manner, the selector is perfectly synchronized with the encoder zero and therefore it need not be positioned manually, since in this case even if the position of the selector is not the preset one, because manufacturing errors have altered the nominal distance, the automatic learning function allows to overcome this problem.

[0039] Of course, once started at the appropriate time, all subsequent pulses remain automatically synchronized, since the distance between the pins 1 is constant and known.

[0040] However, this solution allows to know the exact position of the selector 3 on the needle cylinder 11 only in relation to the space of a pin 1; actually, one does not know which one of the pins passed first in front of the selector after the encoder zero 13, because the signals emitted by the coil 5 are all identical.

[0041] However, it is necessary to know at all times which pin is in front of the selector 3 in order to be able to actuate the lifting or lowering of the pin programmed by the operator for each needle of the cylinder 11.

[0042] Accordingly, it is necessary to provide a reference on the cylinder so as to exactly know when said reference passes in front of the selector 3.

[0043] For this purpose, a preset pin is eliminated and the signal therefore has the form shown in Figure 4, in which in the region that corresponds to the eliminated pin, designated by the reference numeral 15, there is no peak the pin being not present.

[0044] Since with certain types of needle cylinder 11 or pin 1 the signal may not be clear but may instead have considerable noise, it can be useful to provide a

more clear reference on the needle cylinder 11, for example by isolating a specified pin at the center of a region without pins.

[0045] Accordingly, Figure 5 shows a portion of a signal, designated by the reference numeral 16, which corresponds to the preset pin 1, which is in a central position with respect to two adjacent regions 17 and 18 in which there are no peaks because the pins have been eliminated.

[0046] For example, in the case of Figure 5 three pins 1 have been removed to the left and to the right of the signal 16 that corresponds to the preset pin.

[0047] The distance of the preset pin from the encoder zero can be calculated on the basis of the number of elementary steps (i.e., sampling operations) 14 occurring between the encoder zero 13 and the preset pin 1.

[0048] To conclude, therefore, each selector 3 is identified in its position in terms of whole needles plus a fine position. The first position allows to know which needle or pin is being actuated in each instance, while the second position allows to know exactly when to start the pulse for actuating the pin 1.

[0049] In order to decode the sampled data it is necessary to use two thresholds which allow to identify the positive and negative peaks of the signal.

[0050] Figure 6 shows an upper threshold 20, a lower threshold 21 and a reference zero 22.

[0051] The reference zero 22 is sampled in the absence of a signal (for example when the cylinder 11 is not moving) and is acquired before starting the automatic learning procedure and therefore activating the encoder 10.

[0052] As shown in Figure 6, by means of the upper threshold 20 and of the lower threshold 21 it is possible to recognize the absence of the signal and therefore to identify the delimited pin, which in the case of Figure 6 would be arranged at the reference numeral 23 that designates the illustrated vertical arrow.

[0053] In order to calculate the threshold, it is noted that the amplitude of the signal is not always fixed but depends on various factors, the main one being the rotation rate of the needle cylinder 11.

[0054] Accordingly, it is not possible to determine preset threshold values; said values must instead be determined in real time during signal processing. In the method used, the upper threshold 20 is calculated by determining the arithmetical mean of all the samples whose value is higher than the reference zero 20. Likewise, the lower threshold 21 is the arithmetical mean of all the samples below the reference zero 22.

[0055] In this manner, the upper threshold 20 and the lower threshold 21 are automatically optimized as a function of the amplitude of the signal being considered.

[0056] However, if the peaks of the signal vary considerably in amplitude, the thresholds 20 and 21 calculated as explained above might not allow to decode the signal.

[0057] For example, pins 1 might appear to be missing

which are actually present but generate a signal which is so low as to fail to exceed the thresholds. Accordingly, a plurality of pins 1, instead of a single one as actually occurs, would be reported missing.

[0058] Accordingly, an excessively high error would result and the process would not be reliable.

[0059] An iteration mechanism is therefore used which varies the thresholds 20 and 21 (widening and/or narrowing them) until the intended condition is found: a single missing pin 1 or an isolated pin in a region having no pins.

[0060] Only after unsuccessfully trying all the possible thresholds 20 and 21 is an error signal generated.

[0061] The above-mentioned iteration process, in which it is possible to perform a large number of iterations in order to decode the signal of each coil 5, also has another important diagnostic function. The greater the noise in the signal, the higher the number of iterations; accordingly, this process can reveal any anomalies or critical aspects in the electromagnetic circuit of the selector 3 which may subsequently cause malfunctions during the execution of the pulses for selecting the needles of the cylinder 11.

[0062] Furthermore, the above-described automatic learning allows to measure the eccentricity and other inaccuracies of the mechanical system constituted by the encoder 10 and the cylinder 11.

[0063] These inaccuracies may be due to various causes, including:

- axial misalignment between the encoder 10 and the cylinder 11;
- eccentric or uneven distribution of the cuts or slots 12 on the cylinder 11 in order to accommodate the selection pins 1;
- deformed or otherwise unreliable pins 1 (with the possibility of precisely identifying the number of the pin 1 at issue that is damaged).

[0064] The automatic learning function also allows to count the number of signals between two encoder zero pulses 13, checking that the number of slots 12 of the cylinder 11 is actually the number programmed in the machine. It is also possible to check that the electric wires of the coil 5 are not inverted for connection: in this case the sampled signal would in fact appear to be exactly inverted around the reference zero 13.

[0065] If, for example, the slots 12 formed in the curved surface of the needle cylinder 11 are not equidistantly arranged, it is possible for example to bring forward or delay the pulses at the coil 5 so as to synchronize with the inconstant position of the slots 12 in the cylinder 11; or it is possible to vary the power level of the pulse in order to act on more critical pins 1.

[0066] As mentioned, the fine position of each selector 3 is calculated on the basis of the signal of a single pin 1, after which the selection control pulses are sent to preset encoder positions, assuming that all the pins are

perfectly equidistant.

[0067] In order to prevent slight inaccuracies of the mechanical system from leading to selection errors, it is possible to introduce a step which allows to acquire the exact position of each pin of the cylinder.

[0068] If one considers the case of a defective cylinder 11, in which some pin slots 12 are inappropriately spaced, in particular for example considerably closer to each other, the signal arriving from the coil 5 used as sensor as a function of the elementary steps 14 generated by the encoder 10 can be plotted as shown in Figure 7, which shows that the elementary steps 14 that originate from the encoder are regular over time (reference should be made to the graduated scale in the lower portion of the Figure).

[0069] This indicates that the rotation rate of the encoder 10 is constant and that the needle cylinder 11 and the encoder 10 are perfectly centered with respect to each other.

[0070] On the contrary, the signal that arrives from the coil (wave in the upper part of Figure 7) has an inconstant period.

[0071] As mentioned, the encoder 10 indicates no variation in the rotation rate: this allows to deduce that the defect relates to the position of the slots 12 in the needle cylinder 11.

[0072] If commands at regular intervals were generated in this case, it would not be possible to avoid selection errors in this abnormal region of the cylinder, in which the slots are, for example, considerably closer to each other.

[0073] However, it is possible to precisely measure the absolute fine position of each pin 1 for each one of the selectors 3 and store it in a table, which is given here by way of example so as to reference the example of Figure 7.

SELECTOR x		
pin	size	position
1	8	0
2	7	8
3	7	15
4	5	22
5	5	27
6	4	32
7	5	36
8	5	41
9	7	46
10	7	53
11	8	60

(continued)

SELECTOR x		
pin	size	position
...	...	...

[0074] During the selection of the needles (or of the pins 1) it is therefore sufficient to send a control pulse which is synchronized with the position of its pin. In the example of Figure 7, the control pulses are the rectangular pulses designated by the reference numeral 30, which have a variable duration according to the level of the corresponding signal.

[0075] The table lists, for a generic selector x, the number of pins, their size in elementary step 14, and their position with respect to the encoder zero 13.

[0076] The above-described method can equally be applied even in the presence of other anomalies, for example if the axis of the encoder 10 is misaligned with respect to the axis of the needle cylinder 11. In this case one would obtain an eccentric rotation of the encoder 10 (constant angular velocity but variable peripheral velocity). The generated elementary steps 14 would be affected by a sort of accordion effect, while the signals originating from the coil 5 would be perfectly regular. The effect would therefore be the one plotted in Figure 8, in which the elementary steps 14 are clearly affected by an accordion effect.

[0077] Therefore, by means of the automatic learning function, it is possible to detect the fine position of all the pins 1 present in the needle cylinder 11 with respect to the encoder 10. After this, the commands are sent once again with the correct synchronization and are thus locked to the real position of each pin 1.

[0078] The actuation pulses directed to the selectors, particularly to the coils 5 of the selectors 3, have been plotted as rectangular waveforms. Actually, they can assume a more complex profile which can be programmed entirely.

[0079] With reference to Figure 9, the waveform of the signal arriving from the coil 5 used as sensor and the waveform of the current pulses sent to said coil when it acts as an actuator are clearly shown.

[0080] In Figure 9, the signal is designated by the reference numeral 35, while the current pulses are designated by the reference numeral 36.

[0081] The pairing of the two curves, i.e., of the signal 35 and of the actuation pulses 36, is purely theoretical, since the two phenomena cannot actually occur simultaneously. While automatic learning on a coil 5 is in progress it is in fact clearly not possible to use said coil to select a pin 1.

[0082] Figure 9 must therefore be considered only as explanatory, since it aids in visualizing the relation between the current pulse 36 and the position of the pin 1 within the active region of the selector.

[0083] The two negative and positive peaks of the sig-

nal 35, designated by the reference numerals 37 and 38 respectively, designate in fact the entry and exit, respectively, of the pin 1 into and from the active region of the selector 3. The center of the coil, designated by the reference numeral 39, is the centered position of the pin with respect to the active region of the selector 3.

[0084] It can be noted that the pulse has an initial stage with a higher amplitude, designated by the reference numeral 40, which ensures a faster rise of the current and in turn a quicker canceling-out of the flux (with consequent release of the pin 1) even in the presence of leaks in the magnetic circuit, which would tend to delay the response.

[0085] Once the pin 1 has disengaged from the selector 3, a less intense current is sufficient, as shown by the reference numeral 41, i.e., a steady-state current in order to prevent the pin from being attracted again by the permanent magnet 4 of the selector 3 before leaving the active region.

[0086] A lower current level of course entails reduced consumption and reduced heating of the coils, which are thus more reliable.

[0087] Finally, when the pin is proximate to the exit from the active region, the current can be cut off completely, as plotted at 42 in Figure 9.

[0088] During the maintenance stage 41, the value of the demagnetizing current can be chosen between two preset values: levels 1 or 2. Each selector is usually permanently associated with one of these two current values. This can be useful in some kinds of machine in which the selectors are arranged on two different mechanical profiles which affect them magnetically and can therefore require two separate levels of current in order to ensure safe release of the pins 1.

[0089] The current required to release the pin 1 is termed demagnetizing current and is designated by the upward-pointing arrow 43, while the downward-pointing arrow 44 designates a magnetizing current.

[0090] In some cases, a current of the opposite sign, i.e., a magnetization-boosting current, may be useful; said current is represented by the portion 45 of the curve of the current and should help the permanent magnet 4 to maintain the engagement of the pins 1 that must not be selected.

[0091] Since it has merely a support function, said current does not need a preliminary step similar to the step designated by the reference numeral 40 in Figure 9.

[0092] The expression "static advance" is used to designate the number of trailing elementary steps 14 by which the pulse is to be brought forward with respect to the center of the coil 39; this value is preset according to the physical dimensions of the active region and to other typical parameters of the machine (for example the dimensions of the pin 1, the distance between the pins, the characteristics and dimensions of the selector 3, etcetera).

[0093] This advance is used by the automatic learning

function in order to determine the fine position of each selector 3. The advance can also be changed dynamically during selection. In practice it has been observed that it is useful to provide greater advances at the higher rotation rates.

[0094] The time allocation of the three steps of the pulse 40, 41 and 42 can also be varied dynamically at will during selection. Typically, for example, as the speed of the machine increases, the pulse is gradually brought forward, as mentioned, and the duration of the step 40 increases, consequently reducing the duration of the steady-state step 41.

[0095] The possibility to program the pulses has proved to be flexible and useful. Various methods of actuating the selectors have in fact been tested in various machine models.

[0096] For example, if it is necessary to select a set of contiguous needles, the step 40 of the current pulse is produced only at the first needle, as shown in Figure 10, while return to zero, step 42, occurs only at the last needle of the needle cylinder 11.

[0097] As shown by Figure 10, the first pulse has an initial step 40 and two steady-state steps 41. The subsequent four pulses have all steady-state steps. The last one has two first steady-state steps and a third step for return to zero. With some kinds of selector 3, this system has proved to be the most effective in ensuring the release of the innermost pins of the set of needles to be selected.

[0098] In practice it has been observed that the method according to the invention fully achieves the intended aim and objects, since it allows to exactly determine the position of the selector with respect to the pins of the needle cylinder, so as to avoid an absolutely precise manual positioning of the selectors.

[0099] The above described method also allows to detect any pin positioning anomalies, determining their position with respect to the encoder zero of the corresponding encoder connected to the needle cylinder.

[0100] The method thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may further be replaced with other technically equivalent steps.

[0101] The disclosures in Italian Patent Application No. MI98A001227 from which this application claims priority are incorporated herein by reference.

[0102] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A method for determining the position of magnetoe-

lectric selectors around the needle cylinder in knitting machines for hosiery and the like which comprise a needle cylinder (11) in the curved surface of which there is a plurality of axial slots (12), each slot accommodating a needle (2) and at least one selection element (1), and selectors (3) which comprise permanent magnets (4) and coils (5) which laterally face the needle cylinder (11) at the level of the selection elements (1), characterized in that it comprises the following steps:

generating electromagnetic disturbances, by way of the rotation of the needle cylinder (11) and the passage of said selection elements (1) at a selector (3), in order to obtain electric signals which represent the passage of each selection element (1);

sampling each one of said electric signals starting from a zero value of an encoder (10) connected to said needle cylinder (11) and storing the samples obtained at each elementary step (14) of said encoder (10);

analyzing each one of said signals in order to detect the times of passage in front of each one of said selectors (3) and correlating said times with said samples in order to determine the position of said selectors (3) with respect to said selection elements (1) of the needle cylinder (11), so as to determine times for sending actuation signals to said selectors (3) in order to select chosen needles in each case.

2. A method according to claim 1, characterized in that it comprises the step for defining a reference on said needle cylinder (11) in order to identify which selection element (1) of said cylinder (11) is in front of one of said selectors (3).
3. A method according to claim 1, characterized in that the step for creating said reference on the needle cylinder (11) causes the elimination of at least one needle selection element (1) in order to facilitate the analysis of the electrical signals induced by the passage of said selection elements (11) in front of each one of the selectors (3).
4. A method according to one or more of the preceding claims, characterized in that an upper threshold (20) and a lower threshold (21) are determined with respect to a reference threshold (22) for said electrical signals induced by the passage of the selection elements (1) in front of each one of said selectors (3), said reference threshold (22) corresponding to the value sampled when the signal is not present, the peaks of said electrical signals being outside a band that lies between said upper threshold (20) and said lower threshold (21).

5. A method according to one or more of the preceding claims, characterized in that it comprises a step for varying said thresholds (20,21) in an iterating manner in order to compensate for the noise of said electrical signals. 5
6. A method according to one or more of the preceding claims, characterized in that it comprises a step for counting the number of said signals between one encoder zero (13) and the next in order to determine the correct spacing of said selection elements (1) on said needle cylinder (11). 10
7. A method according to one or more of the preceding claims, characterized in that it comprises the steps for determining the position of each one of said selection elements (11) in relation to each one of said selectors (3) and in storing said positions in a table together with the dimensions of the electrical signals related to said selection elements (1). 15
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8. A method according to one or more of the preceding claims, characterized in that said signals for actuating said selectors (3) have a programmed duration in order to provide a step for demagnetizing said permanent magnet (4) of each one of said selectors (3) for the release of the selection element (1) and the actuation of the corresponding needle (2), a step for maintaining said actuation signal in a steady-state mode, and a reset step. 25
30
9. A method according to one or more of the preceding claims, characterized in that said steady-state step corresponds to the retention of said selection element (1) in the released position, said actuation signals being current driving signals in which said demagnetizing step provides for a value (43) of the current which is higher than in said steady-state step. 35
40
10. A method according to one or more of the preceding claims, characterized in that each one of said actuation signals provides for a magnetizing step during which the amplitude of said signals has the opposite sign with respect to the amplitude of said demagnetizing and steady-state steps, said magnetizing step of each current driving signal contributing to maintain the non-selected selection elements (1) in the position in which they are attracted by the magnets (4) of said selectors (3). 45
50

55

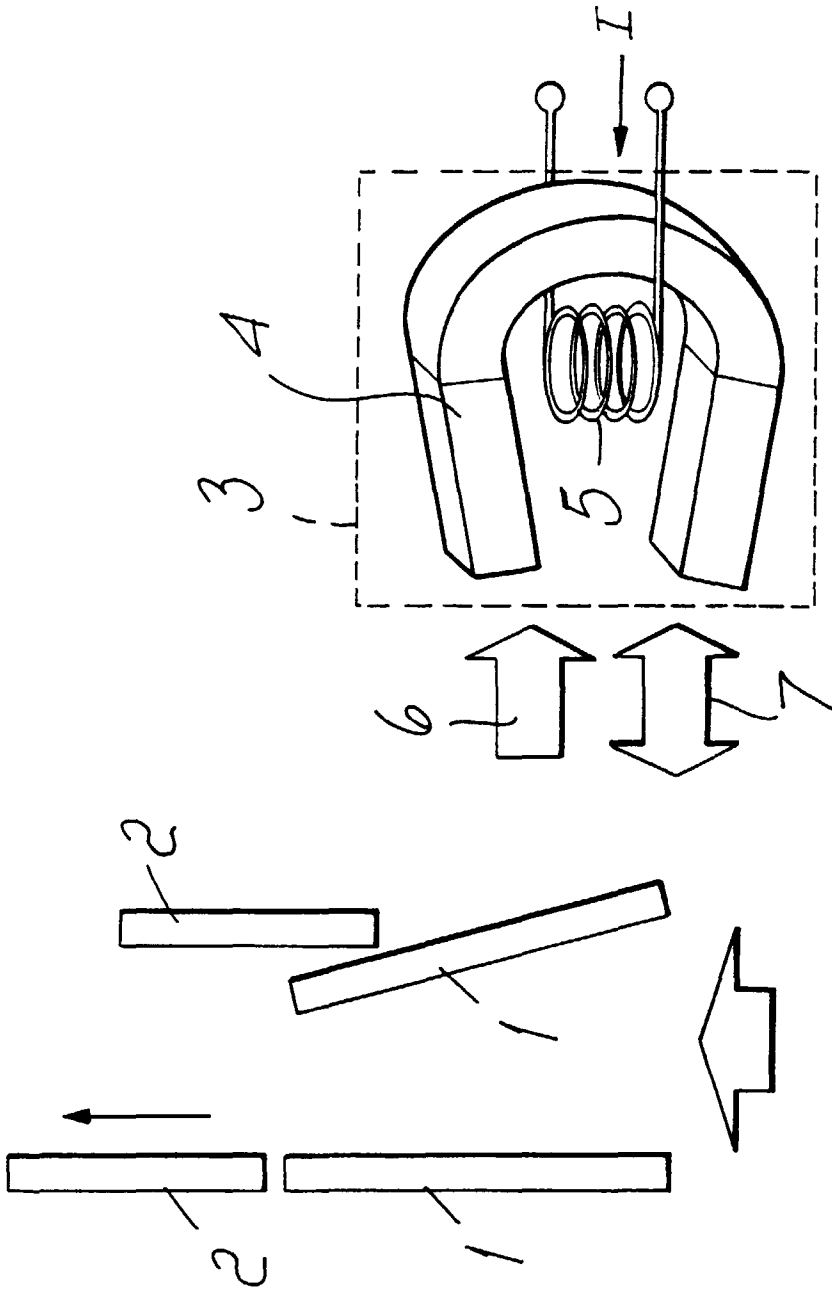


Fig. 1

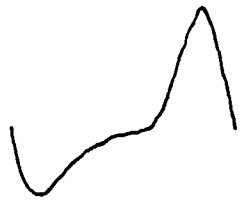


Fig. 2

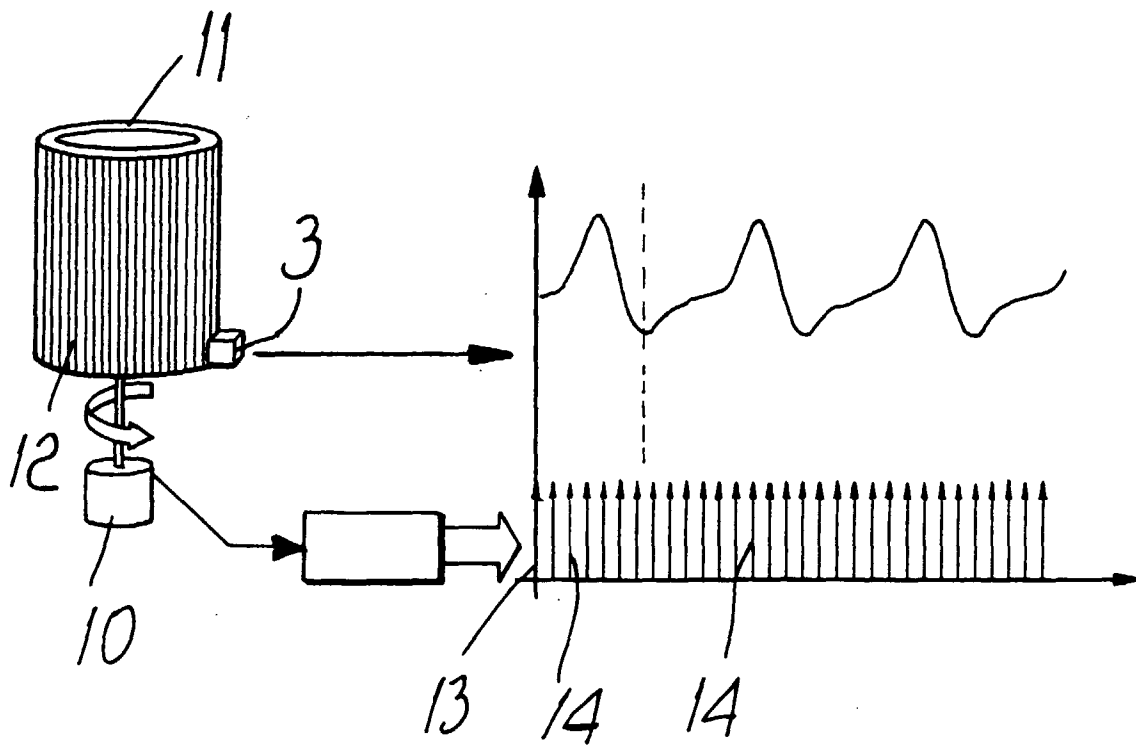
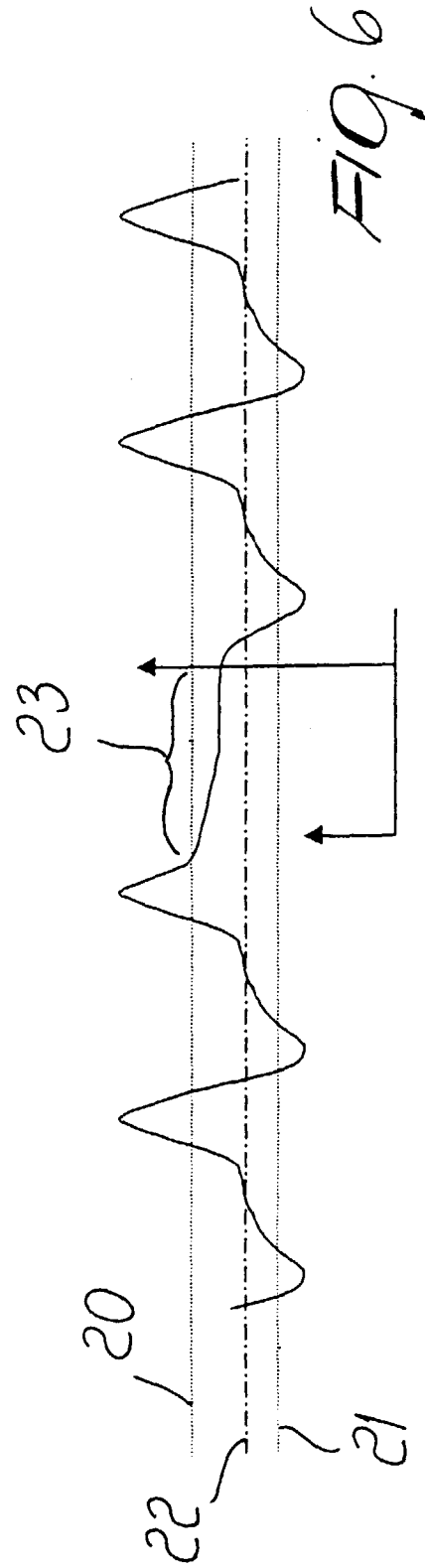
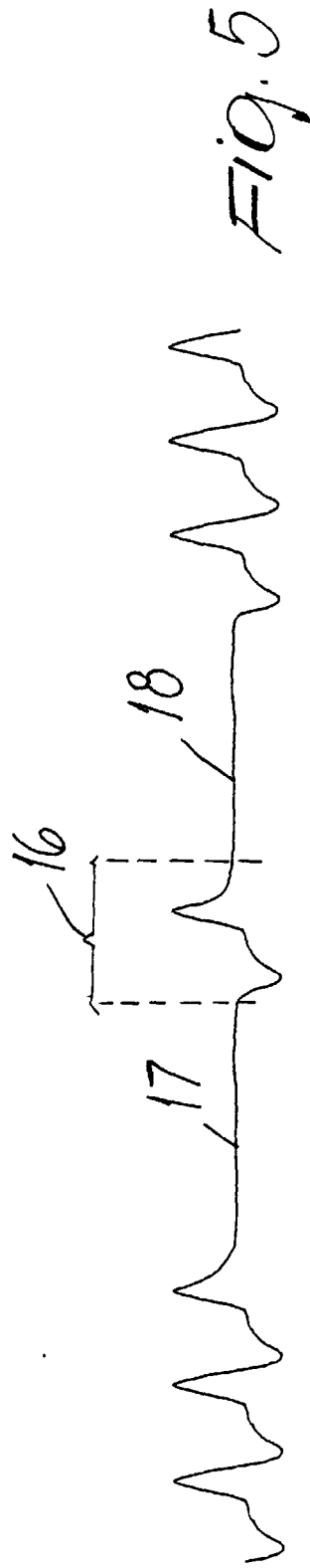
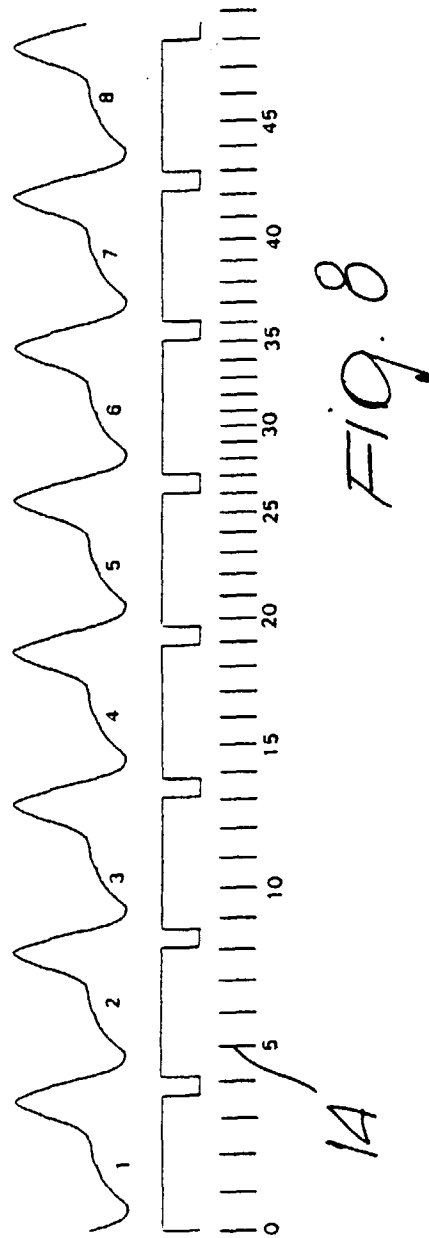
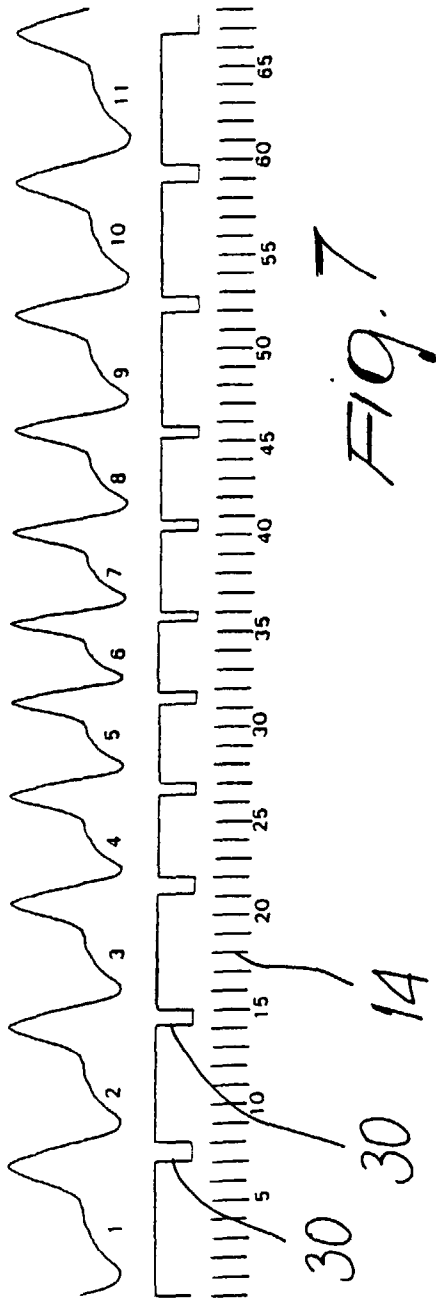


Fig. 3





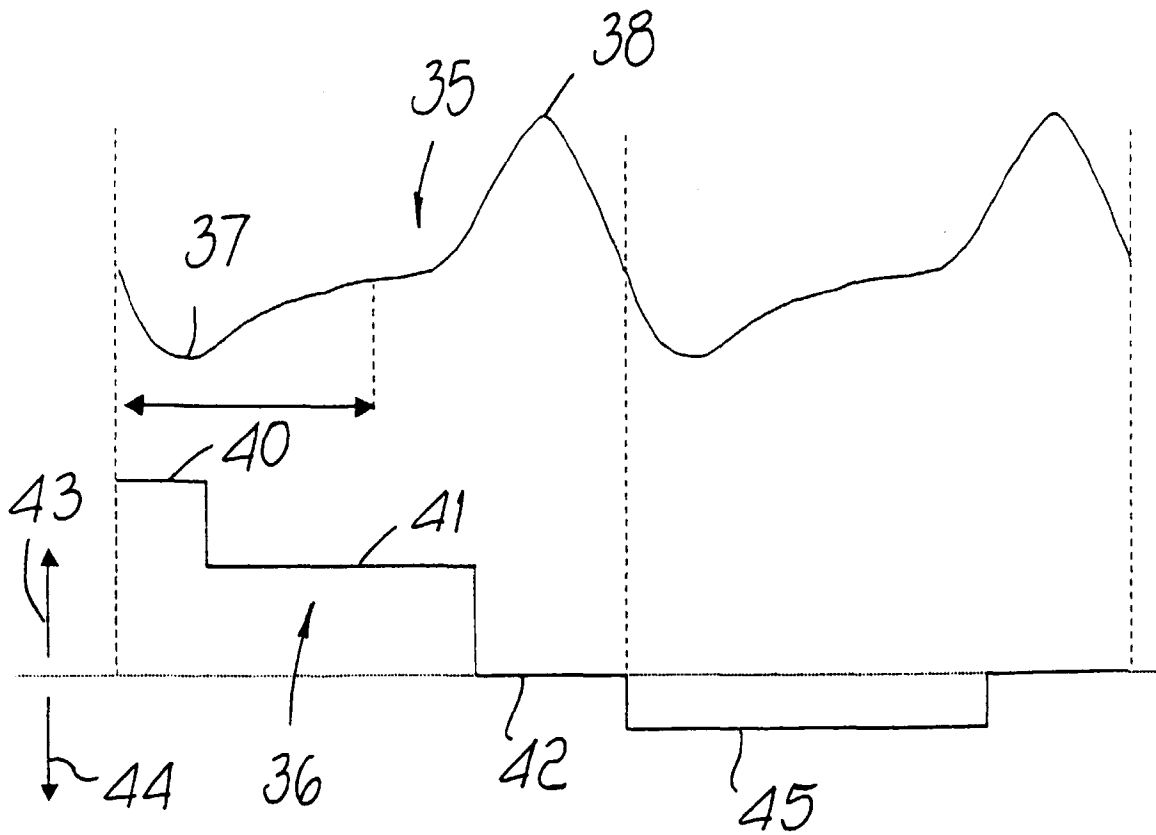


Fig. 9

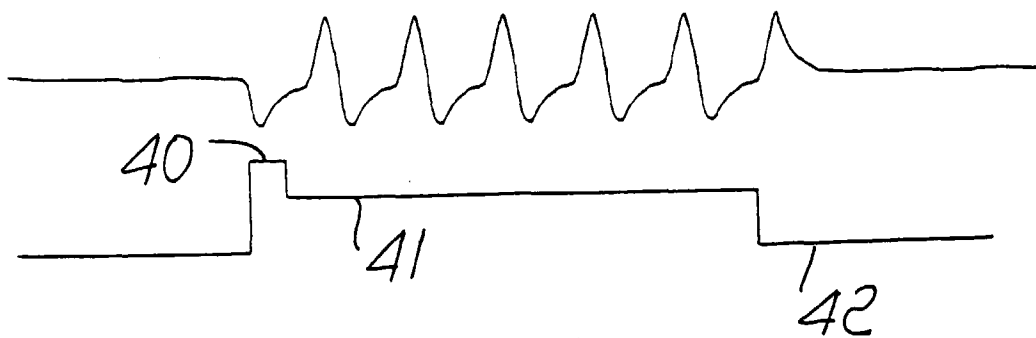


Fig. 10