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Bartels, Manfred

[11] **3,885,405**

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[54] **SYSTEM FOR SELECTING THE NEEDLES OF A KNITTING MACHINE ACCORDING TO A PROGRAM**

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[73] Assignee: **Empisal Knitmaster Luxembourg S.A.,** Luxembourg

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May 11, 1974 Germany 2422880

[52] **U.S. Cl.** ..... **66/75;** 66/154 A
[51] **Int. Cl.** **D04b 7/00**
[58] **Field of Search** ... 66/75, 154 A, 126 R, 127.64, 66/78, 60

[56] **References Cited**

UNITED STATES PATENTS

2,157,989	5/1939	Lawson	66/75
2,821,073	1/1958	Mehnert	66/75 X
3,472,287	10/1969	Ribler	66/75 UX
3,641,788	2/1972	Mori et al.	66/154 A
3,717,014	2/1973	Kohler	66/75 R
3,818,728	6/1974	Erb	66/75

FOREIGN PATENTS OR APPLICATIONS

45-34786	7/1970	Japan	66/75
1,445,318	5/1966	France	66/75
1,082,420	12/1954	France	66/75

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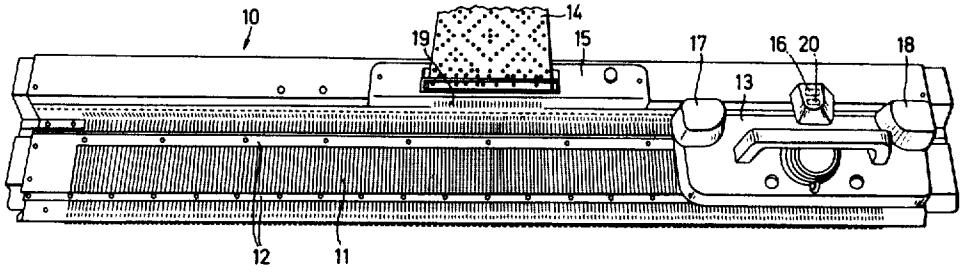
[57] **ABSTRACT**

This disclosure relates to a knitting machine which includes a needle bed having a plurality of needles mounted thereon in side-by-side relation. Also mounted on the needle bed for traversing movement is a carriage. The carriage is provided with a pair of mechanical data storage dials one of which has needle setting arms thereof set in accordance with the pattern of a data carrier and the other of which has the arms thereof already set with the arms set in needles as the carriage traverses the needle bed. The data carrier may either be in the form of a preprinted program sheet or a base sheet adapted to have placed thereon by the individual the desired pattern data.

10 Claims, 9 Drawing Figures



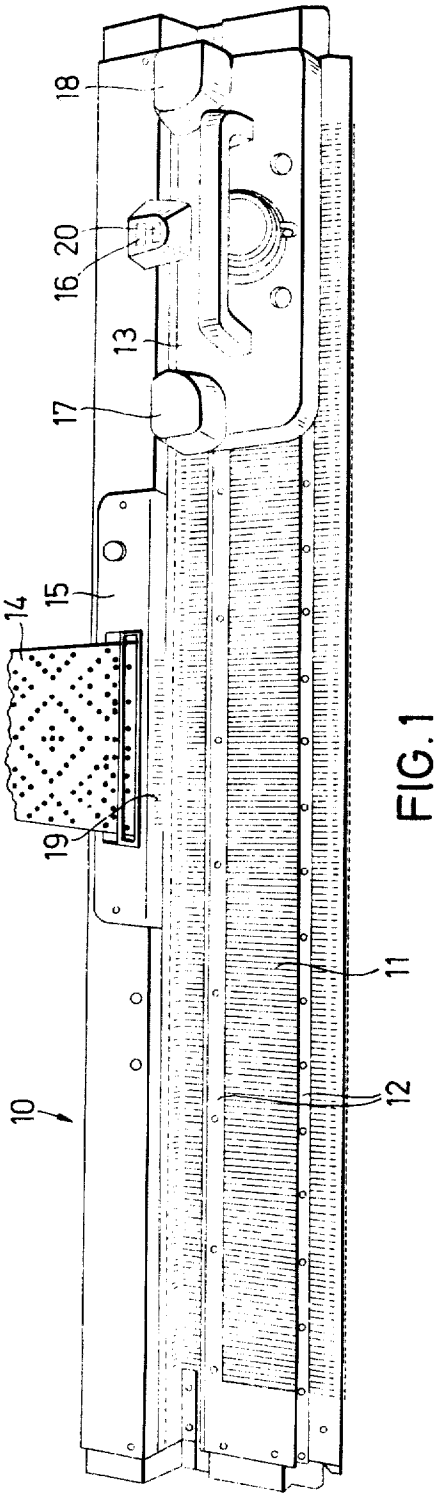

18
20
16
13
17
15
14
19
11
12
10

FIG. 1

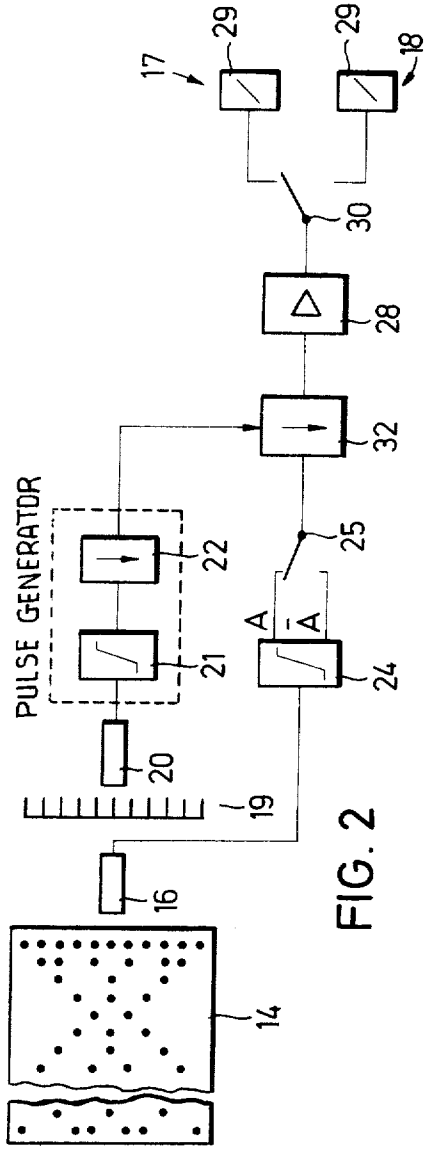

17
29
29
18
30
28
32
25
22
21
PULSE GENERATOR
A
Ā
24
20
19
16
14

FIG. 2

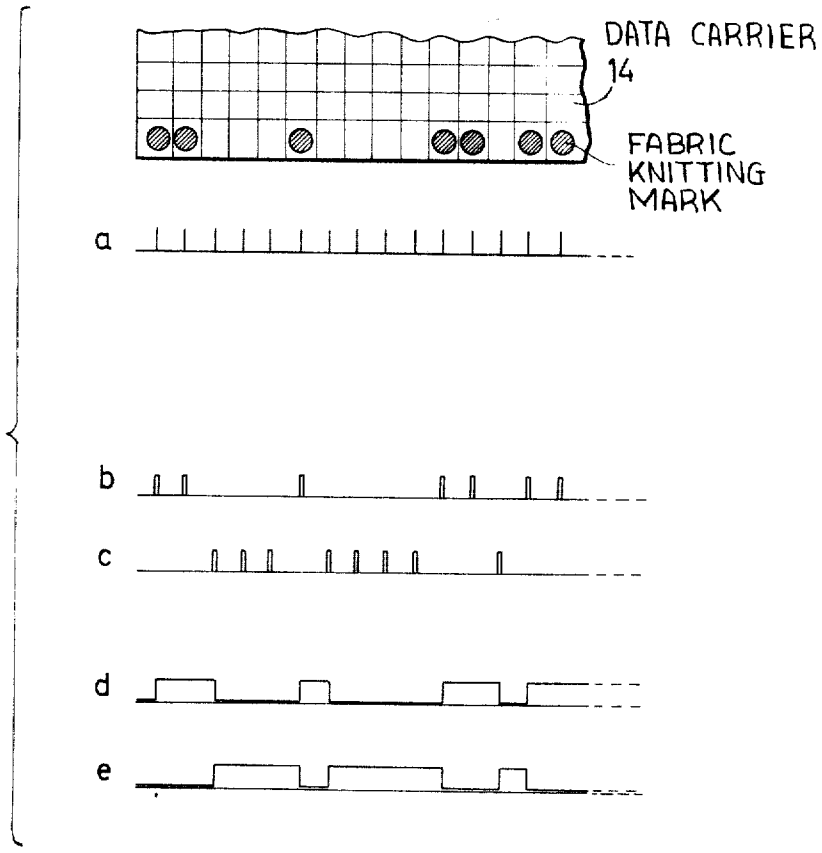


FIG. 3

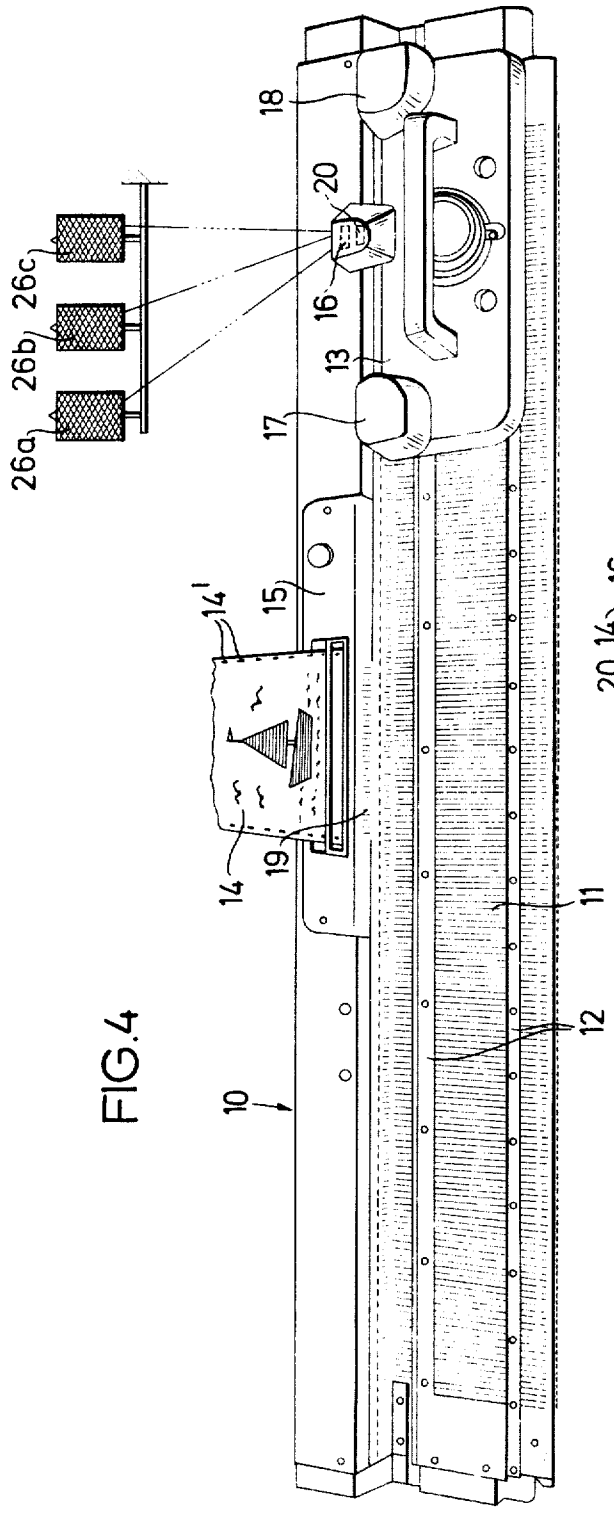


FIG.4

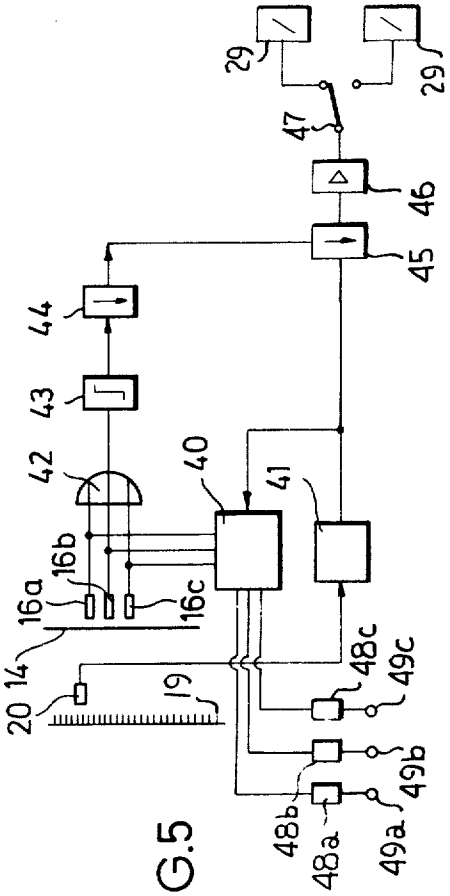


FIG.5

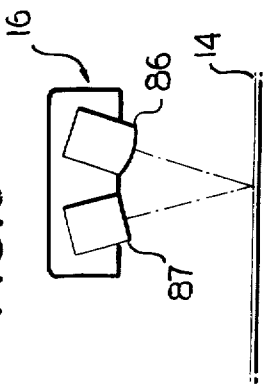


FIG.6

FIG. 9

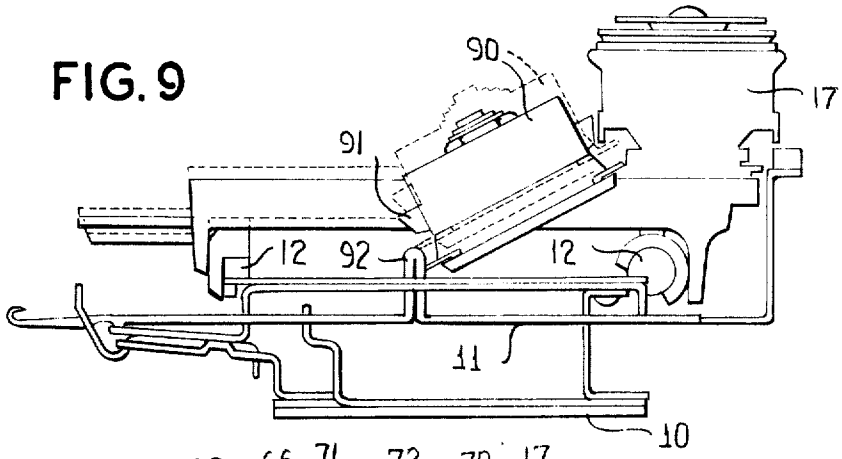


FIG. 7

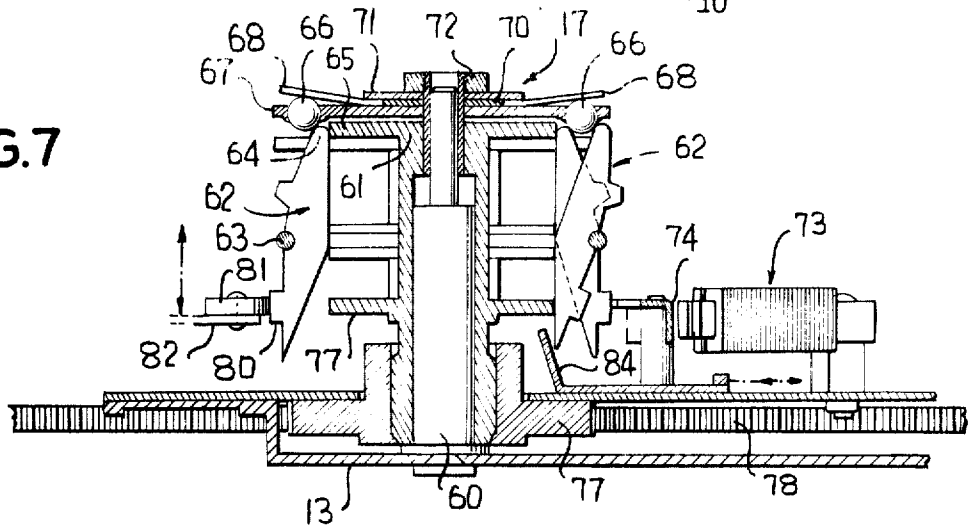
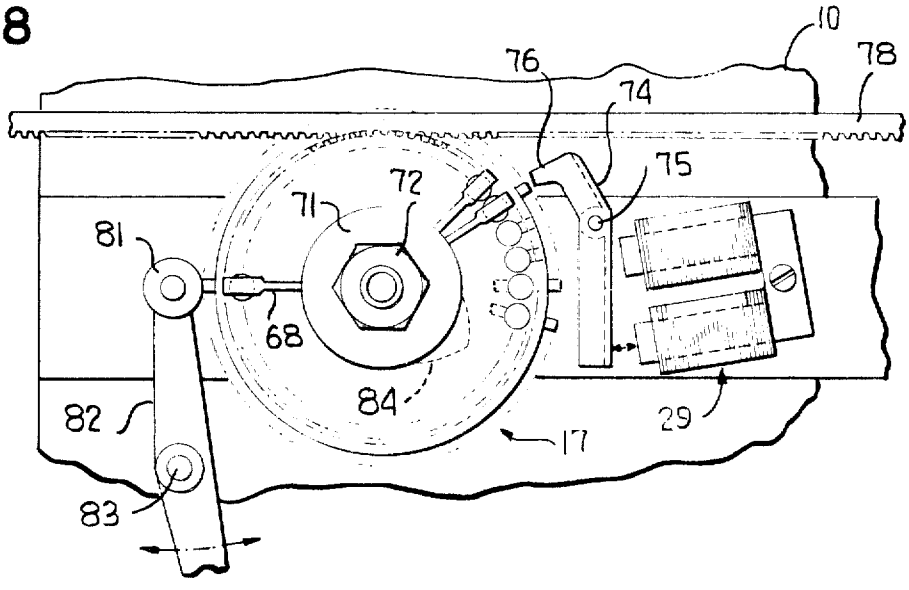


FIG. 8



SYSTEM FOR SELECTING THE NEEDLES OF A KNITTING MACHINE ACCORDING TO A PROGRAM

This invention relates in general to new and useful improvements in knitting machines, and more particularly to a system for selecting the needles of a knitting machine, particularly a hand knitting machine, according to a program. The knitting machine includes a carriage traversable along the length of a needle bed and containing mechanical data storage dials which store the data representing a pattern when the carriage traverses a data carrier associated with the needle bed, and which mechanical data storage dials set the elements operating the needles by means of a selector arm.

In hand knitting machines in which the needles are tricked side-by-side into a needle bed, a carriage is movable across the needles along the length of the bed for operating the elements controlling the needles by reference to a selectable program so that the needles will knit the corresponding pattern. In prior machines the pattern is provided in binary coated form and in the form of a punch card which can be inserted alongside the needle bed in an intermittently feeding card holder. The punched holes in the card cause projecting coating pins to be displaced when the card is inserted. When the carrier traverses the coating pins a data storage dial on the carrier is set according to the coated pattern and transfers this by means of a selector arm to the element controlling the knitting needles. As a rule, one data storage dial each is provided for traverse and return of the carriage so that one of the data storage dials can select the needles for knitting a row of the pattern while the other storage dial is being reset by the coating pins according to the next row of the pattern.

In such prior hand knitting machines, the transmission of the coated pattern to the needles is purely mechanical notwithstanding the fact that punch pattern cards are used. The selection of the coating pins by the holes in unpunched areas of the pattern card is also mechanical. This leads to considerable wear of the pattern cards which must be made of strong material and produced at the knitting machine factory. Moreover, the selection of the coating pins is rather noisy. If a housewife desires the program her own pattern, the production of a pattern card is extremely difficult and can be accomplished only with the help of a special punching tool.

It has been proposed to mount a data carrier directly on the carriage and to read the data carrier by photoelectronic means. The data carrier may be in the form of a perforated disc which rotates together with the data storage dial. According to perforations, i.e., the light permeable openings in the disc, the lever arms of the data storage dial are deflected or left in their positions of rest. The presence of the data carrier on the data storage dial in many instances in undersirable. Furthermore, once again such data carrier requires punching which is difficult for the average home knitting machine to effect. In view of the foregoing, it is an object of this invention to provide a programmed needle selecting system for a knitting machine which permits the simplest possible data carrier to be used, and which, nevertheless, insures a precise transmission of the pattern code to the data storage dial.

In order to achieve the foregoing object, in accordance with this invention it is proposed to provide a system comprising a reading head which scans the data carrier without contacting the data carrier, and interval pulse generator which generates an interval pulse each time the carriage has traversed a distance equal to the spacing of neighboring needles, and a reading head connected to a gating circuit which transmits a signal or signal changes corresponding to the output signals of the reading head only in the presence of an interval signal.

According to the invention, the data carrier is located alongside the needle bed and is directly scanned by the reading head on the carriage when the carriage traverses the data carrier. The data carrier does not, therefore, serve for mechanically displacing pins which, in turn, cooperate with the traversing carriage. The original data carrier is directly scanned noisily and without coming into contact with the scanning means. Consequently, there is substantially no wear. The interval signals insure that the individual pattern points are read only at specified times, namely when the reading head is in the center above a pattern point. Uncertainity regarding the scanned information is thus avoided.

When the invention is applied to a hand knitting machine, it is preferred to provide a photo-electronic method of scanning in which the data carrier bearing color marks is scanned by a photo-electric transducer. The color marks may be pencil lines or pencil dots applied by the user of the knitting machine to a data carrier material. This enables a housewife to design her own patterns and to draw the pattern on paper bearing a line grid which then serves as a data carrier. All she has to do is to black in certain squares or to mark them with dots or dashes and to leave other squares blank. The interval signal, which is substantially shorter than the time needed for the carriage to move from one needles to the next, insures that the electronic evaluation of the coated markings will be effected in the center of each coating square. Any uncertainity interpretations is thus excluded.

A very advantageous feature of the invention is the possibility of using a data carrier which bears no reference grid and which contains a representation of the pattern that is to be knitted in the form of continuous contour lines and colored areas. This arrangement permits a data carrier made of paper or plastics materials to be used upon which a pattern or design has been drawn in continuous contour lines or by coloring areass with areas suitable crayon or the like since the needle selector according to the invention will then automatically convert the pattern into a patterned knitting. The data carrier may be written or painted upon with a felt pencil or a wax crayon. The only requirement is that the contour must be sufficiently well defined to permit the photo-electric scanning device to discriminate reliably between colored and plain areas. The division of the data carrier surface into the surface elements of a grid is therefore performed by the selecting system itself.

Notwithstanding the proposal to have the housewife prepare her own pattern, ready printed data carriers can be supplied. The printing of attractive patterns is a matter of presenting no technical difficulties. On the other hand, as set forth above, a pattern may also be applied to the data carrier by hand. Transfers, scissor

cuts and so forth can also be applied to the data carrier.

The invention further permits a data carrier to be provided with lettering which can be converted to a knitted pattern.

In a preferred embodiment of the invention, an optically operable inverting switch is provided to permit a negative of the pattern on the scan data carrier to be knitted. This inverting switch thus provides the simplest possible means of inverting pattern, for instance, by transposing the colors in a two color pattern. This simple switch thus saves the work of interchanging the yarns. The function of the switch is merely to energize the magnet which cooperates with the lever of the data storage dial at the particular times at which it should be de-energized in accordance with the original patterns and conversely.

For the purpose of scanning the data carrier, several possibilities are available to a person skilled in the art. For example, scanning may be performed with the aid of an inductive reading head using a high frequency oscillating circuit which is damped or detuned by the presence of a damping medium in the magnetic field. Magnetic scanning which avails itself to the Hall effect or of field plates is also feasible. However, in practice, it may be preferred to make use of a photo-electric system of scanning. For such a purpose suitable reading heads which work by reflected light are available. Such reading heads comprise a light conductor which conveys the light beam from a luminescence diode, an incandescent lamp or the like to the point which is being scanned. In the middle of the bundle of light-conducting fibres is a phototransistor or the like which converts the light emitted by the light conductor and reflected by the data carrier into electrical signals. Such photo-electric reading heads can, without difficulty, be designed to have a resolving power on the order of 1/10th of a millimeter.

For the generation of the interval pulses diverse possibilities are also available. For example, the interval pulse generator may be connected to the data storage dial to generate pulse whenever the carriage is traversed a distance equal to the needle spacing and the dial has been indexed accordingly. In such a case, arrangements must be made to insure that the interval signals will be effective only when the scanning head crosses the data carrier. In other words, means must be provided for switching the interval pulse generator on and off. An alternative possibility is to provide marks on the needle bed and to scan these marks by a reading head of an interval pulse generator. The marks should be pitched to equal the needle spacing and cooperate with the reading head of the interval pulse generator without direct contact therewith. This type of reading head is also readily available and advantage can be taken of one of the several possibilities that have already been described.

In order to facilitate the accurate feeding of the data carrier for a line-by-line scan, the data carrier is provided with perforations along its longitudinal edges.

In a preferred embodiment of the invention, several optical reading heads, which respond to different colors, are provided to feed the scanned color information to a color data store on the carriage, which color data store controls the provision of the correspondingly colored yarn to the appropriate loop-forming needle. Such an arrangement is capable of automatically producing a color knitting by copying a colored pattern. The color data store must be capable for each needle of storing the required color information obtained from a color reading head. In the course of the next traverse of the carriage along the length of the needle bed, this color information is then submitted to the thread carrier at the same time as the needle selection takes place, the thread carrier insuring that the correctly colored yarn is presented to the appropriate needle.

With the above and other objects in view that will hereinafter appear, the nature of the invention will be more clearly understood by reference to the following detailed description, the appended claims and the several views illustrated in the accompanying drawings:

IN THE DRAWINGS:

FIG. 1 is a schematic top perspective view of a hand knitting machine in accordance with this invention.

FIG. 2 is a block diagram of the signal processing system for the data input into the data storage dial of the machine of FIG. 1.

FIG. 3 is a schematic view showing the sequence of pulse trains for different modes of operation of the signal processing system of FIG. 2.

FIG. 4 is a top perspective view similar to FIG. 1 and shows a hand knitting machine for knitting in several colors.

FIG. 5 is a block diagram of the wiring schematic for the system of FIG. 4.

FIG. 6 is a schematic view showing the details of one of the reading heads.

FIG. 7 is a schematic sectional view taken through one of the data storage dials.

FIG. 8 is a fragmentary plan view of the data storage dial of FIG. 7 and shows further the details thereof.

FIG. 9 is a schematic elevation of a modified dial.

Referring now to the drawings in detail, it will be seen that the knitting machine of FIG. 1 includes a needle bed 10 containing a large number of knitting needles 11 tricked into the bed in side-by-side relation. Ways 12 extend along the length of the bed for the manual traverse of a carriage 13. During the carriage traverse, the needles 11 are operated according to a preset program by selector arms mounted within the carriage 13 and not visible in FIG. 1, but to be in part described hereinafter.

The program, i.e., the pattern that is to be knitted, is determined by a data carrier 14. The data carrier 14 may be in the form of a sheet of squared paper attached to a holder 15 and adapted to be intermittently fed from line to line. The data carrier 14 is scanned by a reading head 16 or sensor which projects from the carriage 13 and passes across the data carrier 14 without actually contacting the same.

The data is supplied on the data carrier 14 in the form of dots or dashes, or may have the form of continuous contour lines or surface areas. The data is scanned by the reading head 16 and the information is transferred to data storage dials 17, 18 which will be described in more detail hereinafter. At this time it is pointed out that each of the dials 17, 18 contains 24 levers in a circle corresponding to 24 pattern in a line on the data carrier 14.

With reference to FIGS. 7 and 8 wherein there is illustrated, for example, the data storage dial 17, it will be seen that the data storage dial includes a fixed shaft 60 which is suitably mounted on the carriage 13. The shaft 60 is provided with a mounting head 61 on which

a plurality of the lever arms, each generally identified by the numeral **62**, is centrally pivotally mounted by means of a retaining member **63**.

Each lever arm **62** is vertically disposed and has a rounded upper end portion **64** which, in the operative position of the lever arm, bears against an upper stop **65**. The upper portion **64** is held against the stop **65** by means of a ball detent **66** which is seated in a retaining plate **67** carried by the upper part of the mounting head **61** for rotation therewith. The ball detent **66** is urged downwardly by means of individual spring elements **68** of a spring plate **70**. An upper disc **71** and a nut **72** hold the plate **67** and the spring plate **70** in place.

Movement of the lever arms **62** from their operative positions to an inoperative position is accomplished by means of an electromagnet unit **29** in association with a lever **74** pivotally mounted on the carriage **13** as at **75** and having a lever arm engaging portion **76**. When the electromagnet unit **29** is energized, the lever **74** is pivoted in a counterclockwise direction with the lever arm engaging portion **76** engaging that lever arm **62** then aligned therewith so as to move the lower part of the lever arm radially inwardly to an inoperative position against a lower stop **77**. In order to effect such movement of the lever arm **62**, it is necessary that the upper portion **64** thereof pass beneath the associated ball detent **66**. It will be readily apparent from the right hand upper part of FIG. **7** that the ball detent **66** functions to retain an associated lever arm **62** in its set position so that each lever arm is bistable.

The lower part of the head **61** is provided with a gear **77** which is engaged with a fixed rack **78** carried by the needle bed **10**. Thus, when the carriage **13** moves from one needle to the next, each of the data storage dials **17,18** is indexed by the annular pitch of adjacent lever arms.

Each of the lever arms **62** is provided with a projecting part **80** which is engageable with a follower **81** of a lever arm **82** pivotally mounted on a pivot **83**. The lever arm **82** actuates the mechanism which, in turn, sets the needles **11**. It is to be understood that the lever arm **82** may be selectively shifted to an inoperative position so that the particular data storage dial with which it is associated will be inoperative to set the needles **11**.

It is also pointed out here that each of the data storage dials **17,18** has associated therewith a reset device **84**. The reset device **84** is in the form of a cam which, when properly positioned, will engage the lower portion of each lever arm **62**, as the data storage dial rotates, to move the same from its rest position to its operative position. The cam **84** may be selectively moved between its operative and inoperative positions so that at the end of a traverse of the carriage **13** wherein the particular data storage dial was operative to set the needles, may be reset to their operative positions so that on the return traverse of the carriage, the lever arm **62** of that particular data storage dial may again be reset by the pattern setting system.

In the position of the carriage **13** shown in FIG. **1**, the lever arms **62** of the data storage dial **17** causes the needles **11** to be operated according to the preset program when the carriage is traversed to the left. The lever **82** of the data storage dial **18** is set so as to have no effect on the needles. As the reading head **16** passes over the data carrier **14**, the data is read and stored in the data storage dial **18** which has been previously reset. The data storage dial **18** does not transfer its information to the needles **11** until the following return traverse (to the right) of the carriage **13** while the data storage dial **17** is being set according to a fresh row of data from the data carrier **14**.

Referring once again specifically to FIG. **1**, with reference also being made to FIG. **2**, it will be seen that the needle bed **10** carries a grid base **19** across the width of the data carrier **14**. This base serves for the generation of an interval signal. The marking lines of the base **19** are so located that each line is exactly midway between two grid lines of the data carrier **14**. The markings of the grid base **19** are sensed by a second reading head **20** carried by the carriage **13**.

Referring now to FIG. **6**, it will be seen that the reading head **16** has been schematically illustrated as including a light source **86** and a photo-electric transducer **87**. Light is directed onto the data carrier **14** by the light source **86** and is reflected into the pick up of the photo-electric transducer in the manner schematically illustrated. It is, however, pointed out here that, as previously described, the light source **86** may include a bundle of light-conducting fibers which convert the light emitted by a light conductor and in the middle of the bundle of light-conducting fibers there will be positioned a further fiber or fibers which transmit the reflected light to the photo-electric transducer **87**. The signal processing system will be best understood by reference to FIG. **2**. The signal from the reading head **20** is applied by means of a pulse control circuit **21** to a monostable multivibrator **22** which remains in its nonstable state for only a few useces and generates short square wave pulses of defined length and amplitude. The threshold circuit, in conjunction with the monostable vibrator **22**, forms an interval pulse generator which generates pulses at a repetition frequency corresponding to the speed of traverse of the carriage **13**. These pulses control a second monostable multivibrator **32** which functions as a gate.

The photo-electric reading head **16** scans one line of the data carrier **14** at a time. The data may be provided on the data carrier **14** in the form of black dashes or dots. The output signals of the reading head **16** are directed to a threshold circuit **24** having two complementary outputs A,$\bar{A}$. These complementary outputs are alternatively connected by a switch **25** to the signal input of the second monostable multivibrator **32** which has an operate of a few m secs.

As is shown in FIG. **3**, line *a*, the intervals pulses applied by the pulse generator to the gate **32** are shown as a function of time. In line *b* there is shown the output signal of the monostable multivibrator **32** when the switch **25** is in position A. It will be seen that a pulse of prescribed length appears in the output of the monostable multivibrator **32** only when the reading head **16** responds to a mark on the data carrier **14**.

Conversely, when the switch **25** is in the position $\bar{A}$, the resultant output of the monostable multivibrator **32** will be that shown in line *c* of FIG. **3** in which the pulses appear at the time when the pulses in line *b* are absence. Hence by operating the switch **25**, the complement of each pattern can be selected and knitted.

The output signals of the monostable multivibrator **32** are supplied by way of an amplifier **28** selectively to the electromagnet **29** of one of the data storage dials **17,18**. A selector switch **30** is operated when the carriage **13** changes direction so that the results of the

scan are transferred in alternation to the magnet **29** of one or the other of the data storage dials **17,18.**

It is to be understood that it is possible to change the operating time of the monostable multivibrator to three secs, for example, if a particular mode of operation of the magnets **29** is desired. For instance, if the multivibrator **32** is set at a particular interval time by a pulse from the threshold circuit **24,** it may remain in its position until at one of the following interval times no pulse is received from the threshold circuit **24** and the multivibrator **32** again changes state, and conversely.

Line *d* of FIG. **3** shows the shape of the resultant pulses which are applied to the electromagnets **29** when the operating time of the multivibrator **32** is long and the switch **25** is connected to the output A. Line *e* of FIG. **3** is the relatively complementary state when the switch **25** takes the output from output $\bar{A}$.

In this mode of operation, the automatic reset of the multivibrator **32** after a few seconds prevents the energized electromagnet **29** from remaining in the energized state for too long of a time, as might occur if the carriage **13** were left in a stationary position with the reading head **16** aligned with the data carrier **14.** It is to be understood that if this occurs, the operative magnet **29** will then be de-energized. This type of safety device is particularly advisable in the case of battery operated machines.

At this time, it is pointed out that the data carrier **14** is to be advanced after each traverse of the carriage **13.** The advance may be manual or, if desired, some suitable advancing mechanism may be provided. It is also pointed out here that after each traverse of the carriage **13,** the needles **11** are manually reset in any desired manner.

Although in FIGS. **7** and **8** there has been illustrated schematically the data storage dial **17,** the means for setting the lever arms thereof and the means for both resetting the lever arms and for transmitting the influence of the lever arms to the needles, used to be understood that in actuality, the details could be quite different. As is shown in FIG. **9,** each of the data storage dials **17,18** may have associated therewith an auxiliary data storage dial **90** have having merit thereon needle actuating lever arms **91.** The auxiliary data storage dial **90** will have the same number of lever arms **91** as the number of lever arms **62** on the main data storage dial **17.**

It is to be understood that the auxiliary data storage dial **90** will rotate synchronously with the corresponding main data storage dial **17** and as the two data storage dials rotate, the lever arms on the two dials will interact so that the lever arm **62** of the dial **17** will set the lever arms **91** of the dial **90.** Then, after the lever arms of the dial **17** have rotated about 270°, they will engage the resetting cam **84** and be automatically reset.

With particular reference to FIG. **9,** it will be seen that the auxiliary data storage dial **90** is mounted for upward movement. During the time the lever arms **62** are actuating the lever arms **91,** the dial **90** will be in its elevated position wherein the arms **91** thereof will rotate above the butt **92** of the associated needle **11.** Thus the dial **90** will be inoperative to move the needles **11** in the traverse of the carriage **13** at which time the information is being transmitted to the particular dial **17** or **18** in question. Then at the end of the data transmitting traverse for the particular auxiliary data storage dial, that dial will be lowered to its solid line position of FIG. **9** so as to be operative on the needles **11** during the return traverse of the carriage **13.**

It is to be understood that the knitting machine which is only fragmentarily illustrated in FIG. **9** is a known knitting machine and is known as Model **321** Knitter of Empisal Knitmaster Luxembourg S.A. located at 2 bis Boulevard Royal, Luxembourg. A more complete disclosure of the dial arrangement of FIG. **9** is found in the Service Manual for Model 321 Knitter (see FIG. **34** on page 30) and the Supplement To Service Manual for Model 321 Knitter July 1972, both relating to the Model 321 Knitter of Empisal Knitmaster Luxembourg S.A. 2 bis Boulevard Royal, Luxembourg.

Reference is now made to FIGS. **4** and **5** wherein a slightly modified form of knitting machine is illustrated. Basically, the knitting machine is the same except that the reading head **16** is modified so as to be utilized on conjunction with a multicolor, for example three colors, data carrier **14.**

The program, i.e., the pattern that is to be knitted, is provided on the data carrier **14,** which may be in the form of a sheet or card made of paper or plastics material. Both longitudinal edges of the card are provided with perforations **14'** to permit a reliable line-for-line feed. The data carrier **14** is scanned by a cluster of reading heads **16***a*, **16***b*, **16***c* which each respond to a different preselected color. These reading or scanning heads are mounted on the carriage **13** which is traversed past the data carrier **14** without touching the same in the manner described above with respect to the embodiment of FIG. **1.**

The data on the data carrier **14** forms a pattern of surface areas or continuous lines. If the pattern consists of lines they should have a predetermined minimum thickness, depending upon the needle gauge and the needle bed **11.** The pattern scanned line-for-line by the cluster of reading heads **16***a*, **16***b*, **16***c* which are preferably adjusted to scan the same points simultaneously. The information in the form of the signal for one of the reading heads is transferred to one of the data storage dials **17,18.** The information as to which of the three reading heads has responded at any particular pattern point is also stored in a color data storage register which can be secondly read.

With reference to the wiring schematic of FIG. **5,** when one of reading heads **16***a*, **16***b*, **16***c* responds, each reading head being responsive to a different color, this color information is taken to the color data storage register or store **40.** However, the information is not stored until the reading head **20** has generated an interval signal which is applied by way of a pulse forming circuit **41** to an interval pulse input of the color data store **40.** At this time it is pointed out that the pulse forming circuit **41** corresponds to the threshold circuit **24** FIG. **2.**

The signal from any one of the reading heads **16***a*, **16***b*, **16***c* is taken to an OR-GATE **42** which combines these output signals for operating a threshold circuit **43** which generally corresponds to the threshold circuit **21** of FIG. **2.** The threshold circuit **43** triggers a monostable multivibrator **44** which corresponds to the multivibrator **22.** A pulse of specific length will appear in the output of the multivibrator **44** only when at the instance of the interval pulse one of the three reading heads **16***a*, **16***b*, **16***c* respond to a marking on the data carrier **14.** In the same way as the multistable vibrator

44 is actuated, the color data store 40 is triggered by the output signal of the pulse forming circuit 41.

It is to be understood that the threshold circuit 43 in conjunction with the multivibrator 44 forms an interval pulse generator which generates pulses at a repetition frequency corresponding to the traverse of the carriage 13. These pulses control a second monostable multivibrator 45 which works in the manner of a gate. It is to be understood that a pulse of a prescribed length appears in the output of the multivibrator 45 only when one of the reading heads 16*a*, 16*b*, 16*c* responds to a mark on the data carrier 14.

The output signals of the multivibrator 45 are applied by way of an amplifier 46 to the electromagnet 29 of the data storage dial 17 or 18. A selector switch 47, corresponding to the selector switch 30 controls the electromagnet 29 to which the output of the amplifier 28 is directed with the selector switch 47 being operated when the carriage 13 changes direction.

One of the three colors of yarn 26*a*, 26*b*, 26*c* is associated with each of the reading heads 16*a*, 16*b*, 16*c*. The three yarns run into the carriage 13 and can be individually engaged by thread carriers 49*a*, 49*b*, 49*c*. The thread carriers are controlled by the color information store 40 in such a way that the correct thread is engaged with the needle. To this end thread carrier selectors 48*a*, 48*b*, 48*c* for the thread carriers 49*a*, 49*b*, 49*c*, respectively, are provided and are connected to the color data store 40 for energization thereby in timed relation to the movement of the carriage 13 along the needle bed 10. It is to be understood that the color of the yarn on a bobbin 26*a* will correspond to the color to which the reading head 16*a* selectively responds and the same is true of the other reading heads and bobbins.

Only two preferred embodiments of the invention have been specifically illustrated described herein, it is to be understood that minor variations may be made in the lever arm setting systems without departing from the spirit of scope of the invention, as defined by the appended claims.

I claim:

1. A system for selecting needles of a knitting machine of the type including a needle bed supporting a plurality of needles disposed in side-by-side relation and a carriage mounted on said needle bed for movement transversing said needle, a mechanical data storage dial carried by said carriage and including a plurality of arms settable to actuate the needles in a pattern, a data carrier associated with said needle bed for traversing by said carriage, and control means responsive to said data carrier for automatically setting said arms, said control means including a reading head carried by said carriage for scanning said data carrier, pulse generator means carried by said carriage for generating an interval pulse when said carriage traverses a distance equal to the spacing of adjacent needles, and circuit means including a gating circuit connected to said reading head and said pulse generator means for transmitting a signal generated by said reading head only in the simultaneous presence of an interval pulse from said pulse generator means, and arm setting means operable in response to said signal to set a corresponding arm of said data storage dial.

2. A needle selecting system according to claim 1 wherein said circuit means includes a selectively operable inverting switch for providing said signals in inverted relation to said data carrier and provide a pattern which is the negative of said data carrier pattern.

3. A needle selecting system according to claim 1 wherein said reading head is a photo-electronic reading head responsive to reflected light and includes a light source and a photo-electric transducer.

4. A needle selecting system according to claim 1 wherein said pulse generator means includes a second reading head carried by said carriage, and fixed interval markings carried by said needle bed.

5. A needle selecting system according to claim 1 wherein said circuit means includes a multivibrator of the tye which changes state when an output signal of said reading differs from a next preceeding signal simultaneously with the presence of one of said interval pulses.

6. A needle selecting system according to claim 5 wherein said multivibrator is of the type which automatically resets at the end of a predetermined maximum operated time.

7. A needle selecting system according to claim 1 wherein said carriage is mounting on said needle bed for back and forth movement, there are two of said data storage dials each operable in one direction of movement only of said carriage with that data storage dial which is inoperable being reset by said control means.

8. A needle selecting system according to claim 7 wherein there are separate ones of said arm setting means associated with each of said data storage dials, and said circuit means includes a selector switch for selecting the appropriate arm setting means in accordance with the direction of movement of said carriage.

9. A needle selecting system according to claim 1 wherein said data carrier is in the form of a grid bearing sheet suitable for having a pattern applied thereto.

10. A needle selecting system according to claim 1 wherein said knitting machine is of the type for selectively applying threads of different colors, said data carrier is of multiple colors in accordance with the different colors of thread, there are a plurality of said reading heads each responding to a different one of a plurality of selected colors, and said circuit means includes a color data store for selectively presenting to selected needles a thread in accordance with said data carrier.

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