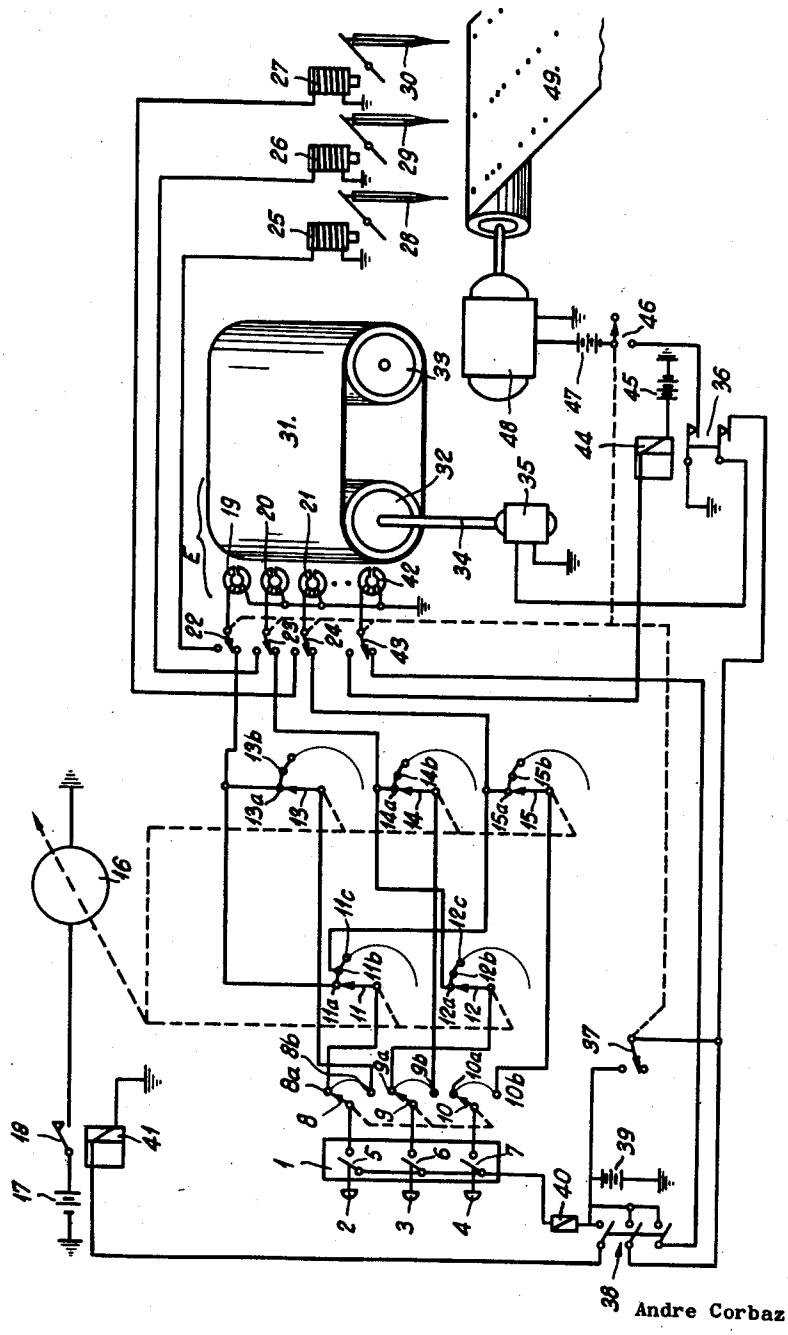
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APPARATUS FOR PRODUCING A PROGRAMME FOR CONTROLLING A KNITTING MACHINE

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APPARATUS FOR PRODUCING A PROGRAMME FOR CONTROLLING A KNITTING MACHINE

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The present invention relates to an apparatus for producing a programme intended to control the selection of the needles of an automatic circular or flat knitting machine comprising a number of knitting stations for producing patterned knitwear.

With automatic knitting machines as at present known it is possible to obtain knitwear having multi-coloured or relief patterns by repetition of an elemental pattern or design. The selection of the needles in such machines is controlled by programmes which are pre-set in accordance with the pattern which it is desired to reproduce. These programmes, which generally consist of metal drums or films, travel past the knitting stations of the machine and control needle-selecting systems, either through storage devices or directly, depending upon whether the machine comprises such storage devices.

In machines of the first type, the storage device generally consists of a wheel called a "pattern wheel" provided at each knitting station and simultaneously performing the functions of reading the information contained in the programme, of the storage device intended to store such information, and of selecting the knitting needles. The pattern wheel must therefore store the information affecting the entire width of the elemental design and ensure that it is repeated throughout the width of the knitted article.

It is obvious that the capacity of such a wheel, which is determined by the number of reading and selecting elements disposed along its periphery, is limited in practice and that consequently the same is the case with the width of the elemental pattern which it is desired to reproduce.

The same is the case with regard to the length of the design, which depends upon the capacity of the programme. Since the metal film must supply a force for controlling the selectors, its mechanical strength must be sufficiently high, whereby its overall dimensions are obviously increased. On the other hand, the perforations in such a film must be sufficiently large to permit the passage of the mechanical feeler members, which also increases the length of the film for a given number of items of information. Thus, with a programme film of reasonable dimensions, the length of the elemental pattern remains very limited.

This disadvantage of machines comprising pattern wheels, residing in the limitation of the dimensions of the elemental design which they can reproduce, is not obviated in machines of the second type, in which the selection of the needles is directly controlled by the programme film. In this case, since the length of such a film is a function of the number of stitches in a row and of the number of rows in the height of the design, the reproduction of large designs would necessitate films or drums of very large overall dimensions, the use of which on the machines would be complicated and difficult.

It is obvious that this limitation in regard to the dimensions of the elemental pattern constitutes a considerable disadvantage in existing machines, and it is for this reason that the present development in the field of circular knitting machines is directed towards producing machines with which it is possible to obtain knitted articles composed of elemental patterns whose dimensions are not limited and can be varied at will.

On the other hand, the method of producing a programme consisting of a metal film or chain is somewhat complicated and involves a number of separate operations which must be carried out by skilled operatives, whereby this method is rendered fairly costly.

The invention has for its object to provide for the production of programmes capable of controlling the selection of the needles in such machines, and to simplify the production at present known. The apparatus herein employed is characterized by the fact that items of information intended for the knitting stations which are to knit one row of stitches are transmitted by means of electric pulses to a group of switches whose number is equal to the number of such knitting stations, the number of switching positions of each of the switches corresponding to the number of groups of stations which knit one row, and in that the said pulses are directed to a recording and reproducing device which is capable of storing the items of information arriving successively for each group of stations which are to knit one row, of storing them until the items of information concerning all the groups have arrived, and of thereafter simultaneously re-transmitting them to a mechanism intended to write the programme on a support in such manner as to obtain an information track for each of the knitting stations.

The apparatus of the invention is characterized by the fact that it comprises pulse producing means having a keyboard including at least two keys, each of which is intended to actuate a member controlling a pulse output channel and electric pulses in that channel corresponding to a particular item of information, which member is connected through a switch to at least one group of switches whose number is equal to the number of knitting stations which have to knit one row of stitches in the knitted article, each of the switches of one group having a number of switching positions which corresponds to the number of such groups of knitting stations and being connected to a recording and reproducing device which is in turn connected to a mechanism for writing the programme on a support, so as to obtain an information track for each of the knitting stations.

One constructional form of the installation according to the invention is diagrammatically illustrated by way of example in the accompanying drawing.

It is to be noted that, for the purpose of avoiding the repetition of identical members and circuits which may be included in such an installation and of which the number determines the capacity of the programmes which can be produced by such an installation, only the minimum necessary for an understanding has been illustrated in the drawing. Thus, the number of different colours or reliefs which may be included in an elemental pattern of the knitted article obtained by means of a programme which can be produced with the illustrated installation is limited to three.

The installation comprises a keyboard **1** having three keys **2** to **4**, which are intended to actuate electric contacts, **5** to **7** respectively, in pulse output channels to two-position switches **8** to **10** respectively. The latter are arranged to be simultaneously controlled (as indicated by chain lines) and are intended to connect the contacts **5** to **7** to two groups of selector switches, comprising respectively two switches **11** and **12** and three switches **13** to **15**. All of these selector switches **11** to **15** are simultaneously controlled by an electric motor **16** driven by a direct-voltage source **17** by way of a switch **18**.

The number of switching positions in the selector switches **11** and **12** and **13** to **15** respectively will depend upon the number of knitting stations to be controlled by the programme which is to be produced by the installation. If this number of knitting stations is, for example, twenty-four, the selector switches **11** and **12** will each

comprise twelve switching positions and the selector switches 13 to 15 eight positions each. These various switching positions of the switches 11 and 12 and 13 to 15 respectively provide connection to a recording and reproducing device, in the present instance to a magnetic recorder E comprising a number of pulse receiving channels including magnetic heads capable of operating as recording and reproducing heads, equal to the number of recording channels or tracks which the programme is to comprise, and therefore to the number of knitting stations which the latter is to control, for example twenty-four. Of these twenty-four heads, only the three heads 19 to 21 are illustrated in the drawing, this being sufficient for an understanding. Each of these heads is connected through a switch 22 to 24 respectively, on the one hand to one of the switches of each of the two groups 11, 12 and 13 to 15, and on the other hand to an electromagnet 25 to 27 respectively, which is intended to control a punching device 28 to 30 respectively.

The recorder E comprises in addition a magnetic tape 31 driven by a driving system diagrammatically represented by two cylinders 32 and 33, a shaft 34 and a motor 35. The latter may be connected through contactors 36 and 37 and 36 and 38 respectively to a direct-voltage source 39.

The triple-pole contactor 38 is controlled by a relay 40 connected in series with the keyboard 1 and the source 39. It connects the latter also to a pre-selection counter 41 controlling the switch 18 and to a further magnetic head 42 provided in the recorder E. The head 42 is also connected through a switch 43 to a pre-selection counter 44 which is in turn connected to a direct-voltage source 45. The counter 44 is intended to control the bipolar contactor 36, the other pole of which is connected through a switch 46 and a direct-voltage source 47 to a motor 48. The latter is intended to drive through an intermittent driving mechanism (not shown) the support 49 on which the programme is to be written.

The switches 22, 23, 24 and 43 of the magnetic heads, and the switches 37 and 46 are adapted to the simultaneously actuated (as indicated by chain lines).

It will be obvious that the installation described and illustrated will comprise other members which are generally employed in installations of this nature, such as amplifiers, signal-shaping circuits, phase-shifting devices and the like. Since these members are not essential to an understanding of the invention or of the principle of the operation of the installation, they have not been illustrated or described.

The production of a programme by means of the installation described and illustrated takes place in the following manner:

The operator will choose the position of the switches 8 to 10 (8*a*, 9*a*, 10*a*, or 8*b*, 9*b*, 10*b*) in accordance with the number of colours or in accordance with the number of different reliefs of the elemental pattern which is to be reproduced in the knitted article. These switches are in output channels through which items of information concerning a row of stitches to be knitted will be sent in the form of electric pulses to the recording device. Thus, in the case of a two-colour pattern, the switches 8 to 10 will be disposed in the position illustrated in the drawing (8*a*, 9*a*, 10*a*). It will thus be seen that only the contacts 5 and 6 controlled by the keys 2 and 3 respectively are connected to the recorder E, which is effected by way of the two selector switches 11 and 12. On the other hand, when items of information concerning a three-colour pattern are to be transmitted, the switches 8 to 10 will be disposed in their other position (8*b*, 9*b*, 10*b*), whereby it will be possible for the three contacts 5 to 7 to be connected to the recorder E through the three selector switches 13 to 15.

Thus, it will be assumed that a two-colour pattern is concerned and that the switches 8 to 10 are in the position illustrated in the drawing. All the other switches and contactors also occupy the position illustrated in the drawing. The operator will therefore follow the first line of the standard pattern, point-by-point (one point corresponding to one stitch of the knitted article), by depressing either one of the two keys 2 and 3, depending upon which of the two colours is concerned.

Depression of the key 2 results in closing of the contacts 5 and consequently of the circuit 5—8—8*a*—11—11*a*—22—19—ground—39—40—5. A pulse will therefore be sent from the source 39 into the head 19 and recorded on the tape 31. Since the relay 40 has closed the triple-pole contactor 38, the source 39 will also be connected to the counter 41, to the head 42 and to the motor 35, which will result, respectively, in the counting of the recorded pulse, the recording of a signal on a special track of the recorder E and the rotation of the shaft 34 through a predetermined angle and therefore the advance of the tape 31.

Depression of the key 3 will result in the sending of a pulse into the head 20 via 6—9—9*a*—12—12*a*—23. which pulse will also be recorded on the tape 31, but on another track. The counter 41 will therefore count a further pulse, the head 42 will record a further signal on the same special track and the motor will advance the tape 31.

When the items of information for all the points of a line of the pattern have been transmitted and recorded, the counter 41, which has been adjusted at the outset to the number of points of the line, will produce the closing of the switch 18 and consequently the driving of the motor 16 through an angle necessary for bringing the switches 11 and 12 into the position 11*b*, 12*b*. It will readily be seen that the contact 5 will then be connected to the head 24 and the contact 6 to a succeeding head not shown. Thus, each change of position of the switches 11 and 12 will permit the recording of the items of information concerning a further line and intended to control two other knitting stations. The number of lines which will be recorded will therefore be equal to the number of magnetic heads (number of knitting stations) divided by the number of colours, in the present instance twelve.

In order to assist the operator in observing the recorded lines, there could be provided an indicating system, for example a luminous or acoustic signal, or a signal for locking the keys similar to that employed for the end of a line in typewriters. Such a system could be controlled, for example, by the last position of the switches 11 and 12 and 13 to 15 respectively.

It is to be noted that the length of the loop formed by the tape 31 is adapted to the number of points comprised in a line of the standard pattern (elemental pattern to be repeated in the knitted article). This number of loops corresponds to the number of items of information transmitted by the active keys, in the present instance 2 and 3, and recorded by two heads on two tracks. The number of signals recorded on a single track by the head 42 will therefore be equal to the number of points of a line.

When the recording of the items of information for all the knitting stations has been completed, the operator will devote his attention to the writing of the programme on the support 49. For this purpose, he will place the switches of the magnetic heads 22, 23, 24 and 43 in the reproducing (reading) position. The switches 37 and 46 will also be disposed in their other position. The motors 35 and 48 will therefore be started and will drive the tape 31 and the support 49 respectively. The items of information read by the magnetic heads will be transmitted in the form of pulses to the electromagnets 25, 26 . . ., which will act on the punching devices 28, 29 . . ., so that the latter punch the support 49 and thus write the programme.

The writing of the programme will continue, by cyclic repetition of the items of information recorded on the

tape 31, until the pre-selection counter 44 causes the double contactor 36 to open. This will happen when the number of signals recorded on the tape 31 by means of the head 42 and thereafter cyclically read back by the latter and transmitted to the counter 44 reaches the number to which the latter has been adjusted, namely the number of stitches which the knitted article is to comprise over its entire width.

When the writing of the programme corresponding to the recorded items of information has been completed, the operator will re-set the installation to the recording position and, after erasure, will recommence the recording of a further series of items of information concerning succeeding lines, and so on until the reading of the pattern is complete.

The programme thus consisting of the punched support 49 will comprise all the items of information necessary for obtaining a knitted article having the desired pattern. It will also comprise the items of information concerning the repetitions of the pattern in the direction of the width of the knitted article. The machine which it is to control need not be provided with storage devices, which limit the width of the elemental pattern, as hereinbefore stated. On the other hand, since the method of reading the programme may be such that it has not to supply any force, its mechanical strength may be very low. The support may be very thin and may consist of a very flexible material from which very great lengths of tape may be obtained which take up very little space. The dimensions of the perforations may also be small, so that it is possible to reduce the length and the width of the tape for a given number of items of information. Consequently, the length of the elemental pattern is not too limited.

The installation hereinbefore described for the production of a programme is extremely simple to use, and it can readily be used by an unskilled person. It is merely necessary to read the pattern point-by-point by following one line and to actuate the keys of the keyboard in accordance with the colour of the represented stitches. When the recording is complete, it is sufficient to change over the recorder from the "record" position to the "reproduce" position. Everything else takes place automatically.

It is to be noted that the operator can ascertain at any instant what point of the line of the pattern he has reached by reading the number indicated on the pre-selection counter 41, which number corresponds to the number of items of information recorded. The counter 41 is automatically re-set at each line change. The counter 44 is re-set at each change of the recorder from "reproduce" position to the "record" position.

If it is desired to keep a check on the items of information recorded in the form of a copy of the standard pattern, the installation could comprise a device controlled by the keys of the keyboard simultaneously with the electric pulses. This device could be, for example, a form of mechanical or electric typewriter comprising only one character and one multi-colour ribbon.

It will be obvious that the invention is not limited to the constructional form of the installation illustrated and described. Thus, for example, if it is desired to avoid the electric contacts in the keyboard, this circuit make and break means could be replaced in another constructional form of the installation by photo-electric means. The keys of the keyboard could control light beams acting on photo-transistors. The same is the case with regard to the magnetic recorder and the programme writing mechanism. Both of them could be replaced, for example, by optical devices.

I claim:

1. An apparatus for producing a programme to control the selection of the needles of an automatic knitting machine providing a plurality of knitting stations, said apparatus comprising electric pulse producing means having selectively operable keys and output channels corresponding to the keys for feeding pulses produced through operation of the keys, pulse counting means operably connected with a group of said keys for counting up to a predetermined number the pulses produced by said pulse producing means in response to operation of any of the keys of said group of keys; pulse recording and reproducing means selectively operable to record and reproduce pulses and having pulse receiving and recording channels corresponding in number to the number of the knitting stations of the machine; selector switches in the pulse output channels of said group of keys, said selector switches corresponding in number to the number of knitting stations which as a group are to knit a corresponding one row of stitches, in the knitted article, and each of said selector switches having a plurality of switching positions corresponding in number to the number of groups of stations, of which each group of stations is to knit a corresponding one row of stitches, in the knitted article, said selector switches collectively having output connection with a corresponding group of said pulse receiving and recording channels and being operable in response to count of said predetermined number of pulses by said pulse counting means so as to connect a different group of said pulse reeciving and recording channels with said output channels of said group of keys when said pulse recording and reproducing means is being operated as a recorder of the pulses of said pulse producing means; a programme support having an information track for each of the knitting stations; and pulse operated means associated with said programme support and responsive to pulse reproducing operation of said pulse recording and reproducing means, so as to compose, from the pulse reproduced, a programme on said support.

2. Apparatus according to claim 1, wherein said pulse producing means includes, for each key of said group of keys, circuit make and break means responsive to operation of the key to open and close said output channel, corresponding to the key, relative to a source of electrical supply.

3. Apparatus according to claim 1, wherein a magnetic recorder of said pulse recording and reproducing means includes a plural track recording component and a number of magnetic heads corresponding in number respectively to the tracks of said recording component and to the number of knitting stations of the knitting machine, said switches being connected in pulse feeding relation to different ones of said heads for said pulse recording and reproducing means to make a record of the pulses of said pulse producing means along said tracks of the recording component, and said magnetic heads being pulse reproducing heads when said recording and reproducing means is in pulse reproducing operation.

4. Apparatus according to claim 3, wherein said pulse operated means comprises electromagnets, each of which is connected to a corresponding one of said heads of the recording and reproducing means, and said electromagnets control punches which punch the support and thus produce the programme.

5. Apparatus according to claim 3, wherein said plural track recording component is in driven connection with an electric motor and said magnetic recorder of said pulse recording and reproducing means includes a supplemental magnetic head associated with a corresponding additional track of said plural track recording component, and said motor and supplemental magnet head receive a pulse, in response to any of the keys of said group of keys being operated, the pulse received by the motor driving said motor and said plural track recording component, and the pulse received by said supplemental magnetic head being recorded on said additional track.

6. Apparatus according to claim 5, wherein said supplemental magnetic head and additional track reproduce the pulses recorded on the latter track when said record-

ing and reproducing means is operated by said motor as a pulse reproducer, and said supplemental magnetic head is connected to a pre-selection counter which counts the pulses reproduced by the supplemental head for said motor to be stopped when the number of pulses reproduced by said supplemental head reaches a predetermined number.

7. An apparatus for producing a programme to control the selection of the needles of an automatic knitting machine providing a plurality of knitting stations, said apparatus comprising electric pulse producing means having selectively operable keys and output channels corresponding to the keys for feeding pulses produced through operation of the keys, pulse counting means operably connected with said keys for counting up to a predetermined number the pulses produced by said pulse producing means in response to operation of any of said keys; pulse recording and reproducing means selectively operable to record and reproduce pulses and having pulse receiving and recording channels corresponding in number to the number of the knitting stations of the machine; first and second groups of selector switches selectively connected in the pulse output channels of first and second numbers of said keys, said selector switches of said first and second groups respectively corresponding in number to different first and second numbers of knitting stations which as a group are to knit a corresponding one row of stitches, in the knitted article, and the number of switching positions of the selector switches in said first and second groups of switches being different and corresponding to the number of groups of stations, of which each group of stations is to knit a corresponding one row of stitches, in the knitted article, said selector switches of the selected group of said switches having output connection with a corresponding number of said pulse receiving and recording channels and said switches in the selected group of said switches being operable in response to count of said predetermined number of pulses by said pulse counting means so as to connect a further like corresponding number of said pulse receiving and recording channels with said pulse producing means when said pulse recording and reproducing means is being operated as a recorder of the pulses of said pulse producing means; a programme support having an information track for each of the knitting stations; and pulse operated means associated with said programme support and responsive to pulse reproducing operation of said pulse recording and reproducing means, so as to compose, from the pulses reproduced, a programme on said support.

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