United States Patent [19]

Bourgeois

[11] **3,818,724**

[45] **June 25, 1974**

[54] **DATA PROGRAMMING DEVICE, PARTICULARLY FOR CONTROL OF KNITTING MACHINES**

[75] Inventor: **Norbert Paul Bourgeois**, Troyes, France

[73] Assignee: **Etudes et Bonneterie S.A.**, Laussane, Switzerland

[22] Filed: **June 26, 1972**

[21] Appl. No.: **266,350**

[30] **Foreign Application Priority Data**

July 1, 1971 Switzerland 9703/71

[52] **U.S. Cl.** ..... **66/50 R**, 340/173 R

[51] **Int. Cl.** **D04b 15/78**

[58] **Field of Search** ..... 340/173 SP, 173 R; 66/50 R, 154 A, 75

[56] **References Cited**

UNITED STATES PATENTS

3,161,859	12/1964	Medwin et al.	340/173 SP
3,492,659	1/1970	Lee	340/173 R
3,504,132	3/1970	Wallace, Jr.	340/173 R
3,611,319	10/1971	Hyatt	340/173 SP
3,641,516	2/1972	Castrucci et al.	340/173 SP
3,735,367	5/1973	Bennett, Jr.	340/173 SP
3,776,003	12/1973	Krause	66/75 X

FOREIGN PATENTS OR APPLICATIONS

1,961,096	7/1971	Germany	66/50 R
1,123,873	8/1968	Great Britain	66/50 R
1,165,368	9/1969	Great Britain	66/154 A

Primary Examiner—Wm. Carter Reynolds

Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

A data programming device for the selective control of the needles of a circular or straight bar knitting machine includes a two plane matrix whose points of intersection may be connected by one of several types of diode plug either without a resistor or with a certain value of resistor in series, thereby defining several different types of data, each plug advantageously having means for visually indicating the type of data it defines. The rows and columns are associated with electronic switches to enable interrogation thereof by means of a computer, and a discriminator circuit is provided for identifying the different types of data during interrogation.

3 Claims, 4 Drawing Figures

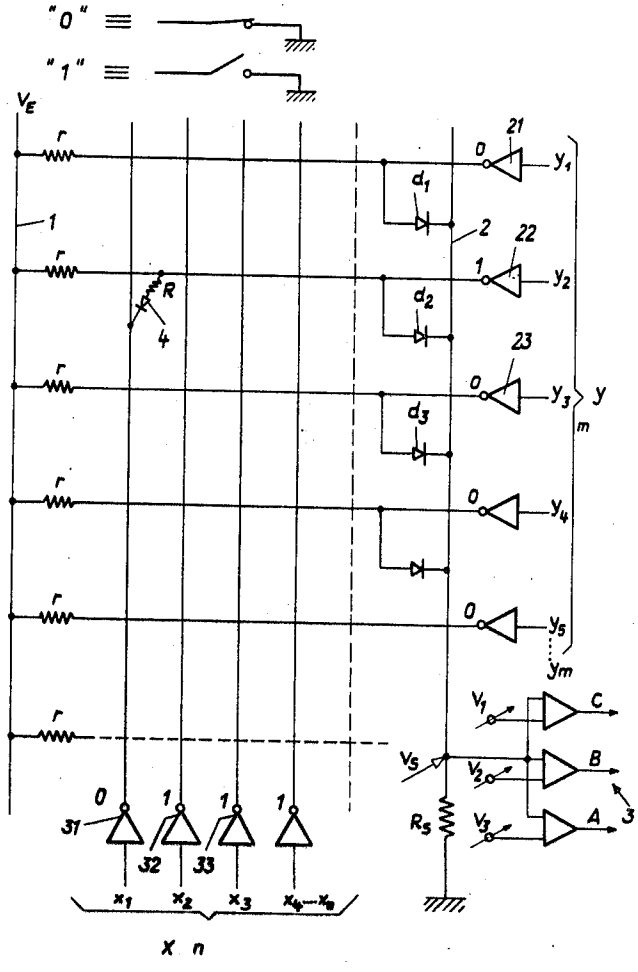
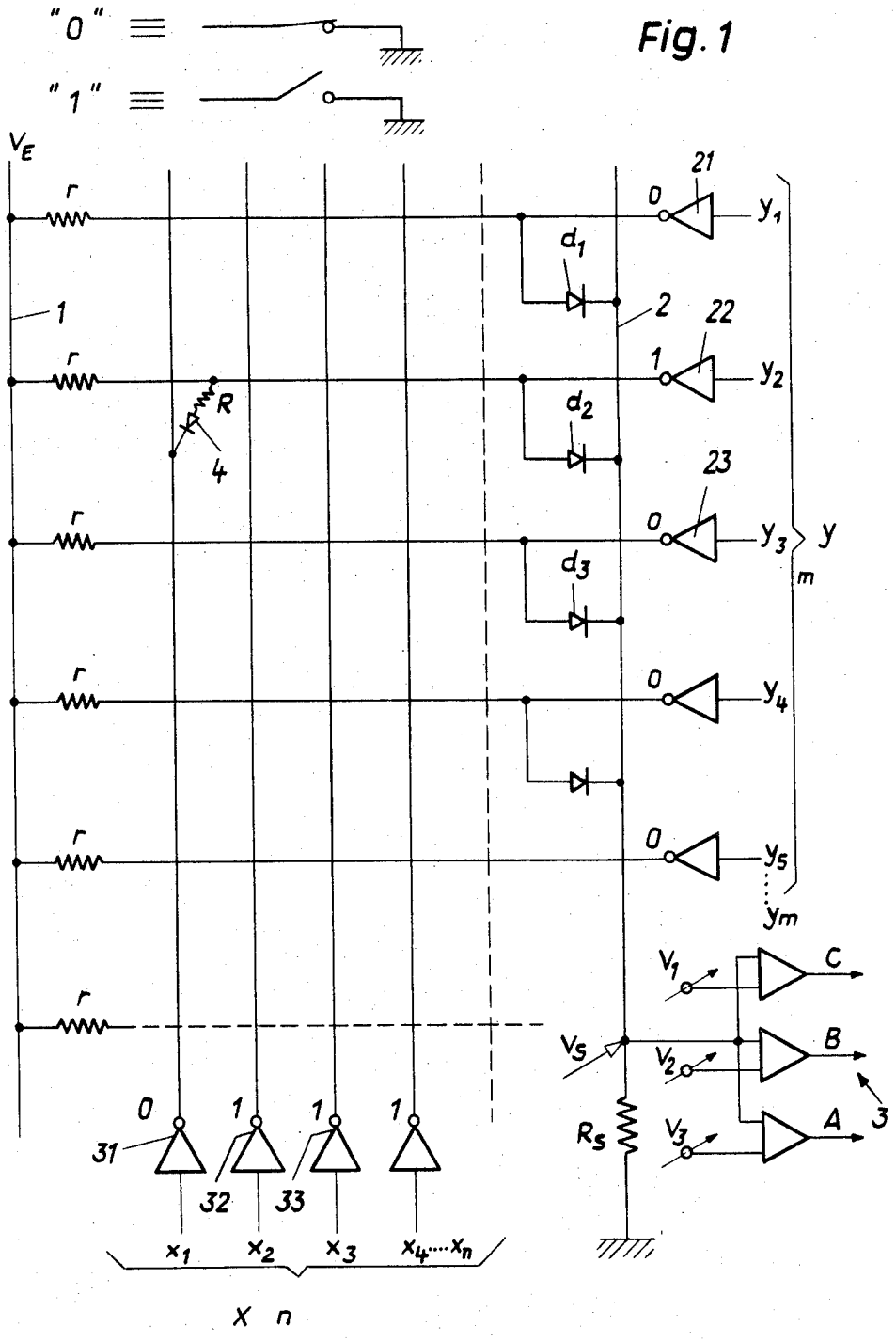


Fig. 1


"0" ≡
"1" ≡
V_E
r
1
R
4
d_1
d_2
d_3
2
21
22
23
0
1
y_1
y_2
y_3
y_4
y_5
y_m
y
m
V_1
V_2
V_3
V_S
R_S
C
B
A
3
31
32
33
x_1
x_2
x_3
$x_4 \cdots x_n$
X n

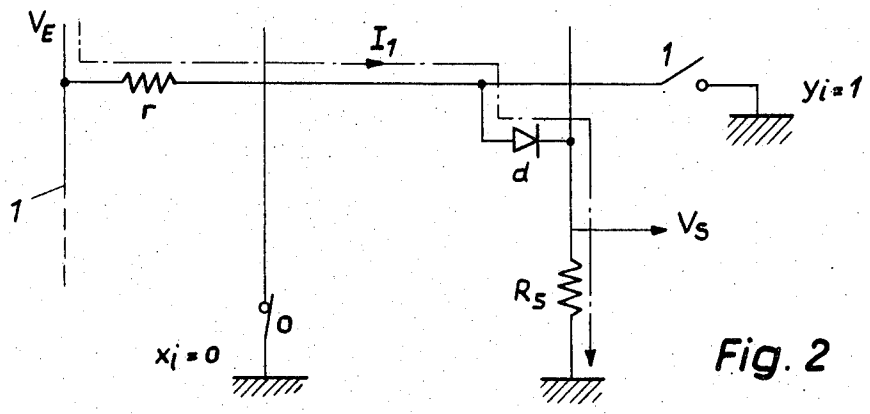


Fig. 2

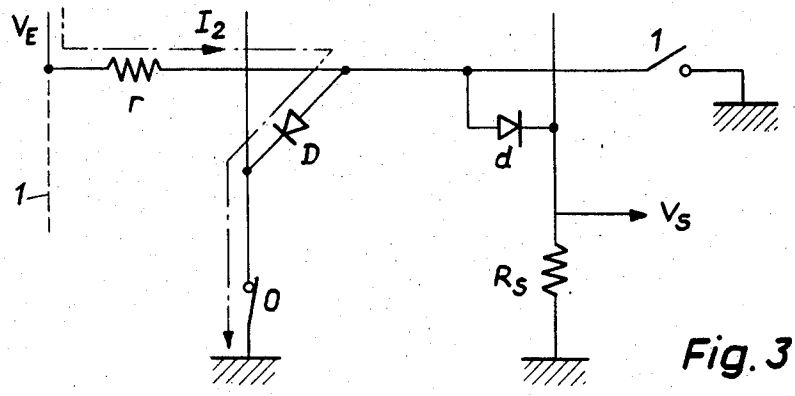


Fig. 3

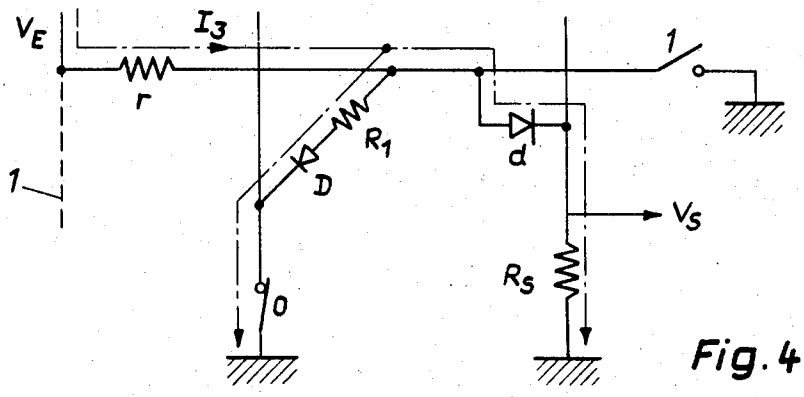


Fig. 4

DATA PROGRAMMING DEVICE, PARTICULARLY FOR CONTROL OF KNITTING MACHINES

The invention concerns data programming devices particularly for the selective control of knitting elements, such as needles or associated accessories of knitting machines, of the type comprising a two-plane matrix including conducting rows and columns adapted to be connected together at their points of intersection by means of movable conducting elements, and means for interrogating the matrix.

On such knitting machines which may be circular or straight bar knitting machines, the provision of patterned knitting and more particularly knitting with colored designs requires the employment of programs carrying data for the individual control of the elements to be selected by means of selector members such as electro-magnets acting during operation of the machine.

Numerous types of programs are used, including tapes or films carrying a series of longitudinal data tracks which continuously move in front of reading means detecting the data passing by with a view to transmitting it to the selector members.

The advantage of such programs is to enable the knitting of designs having a very large area. However, apart from the difficulty of providing programs for large knitted designs, when they are being made they generally require the provision of a particular arrangement of the data thus excluding any possibility of visually controlling the model to be reproduced.

To provide designs of smaller area, it is advantageous to rely upon programming matrices with which the operator can directly display the different points corresponding to the model pattern without the aid of an appropriate code.

Most known matrices have two series of parallel conductor members, namely a series of rows and a series of columns disposed transversally to the rows and in a different plane, in a manner to form a grid. Facing each point of intersection, these conducting members have a perforation able to receive a movable plug, generally equipped with a diode, which enables the setting up of a contact between each row and column for the unidirectional flow of an electric current.

Each point of the matrix is interrogated and, according to the presence or absence of a plug, it is possible to define two distinct types of data.

The provision of certain contextures such as knitting having designs in several colors implies, for each point of the design corresponding to one stitch, as many types of available data as the number of colors in the design to be reproduced. Such matrices with two planes are thus insufficient for programming knitting with designs in three or more colors.

One solution is to use several two-plane matrices. In addition to the large number of circuits required, this solution notably complicates the operator's task since, as the moment of display, he must take into account that each matrix corresponds to only two colors of the model.

Another solution is to provide a single matrix including several planes of superimposed columns. Despite the fact that such matrices enable a visual control of the program compared to the design to be reproduced, use thereof is made very delicate by the complexity of the means employed corresponding to each plane and notable the necessity of providing certain conducting

plugs with one or several insulating sleeves, in a manner to avoid any risk of unintended contact with the columns of certain planes.

An object of the invention is to provide a data programming device, particularly for the selective control of knitting elements such as needles or associated accessories of knitting machines of the circular or straight bar type, which obviates the above drawbacks.

According to the invention, a data programming device comprises a two-plane matrix including series of conducting rows and columns crossing at points of intersection, means for connecting the rows and columns at said points of intersection including a plurality of movable conducting elements having different characteristics and defining several different types of data, means for interrogating the matrix, and means for identifying said different types of data during interrogation of the matrix.

The accompanying drawings schematically show, by way of example, an embodiment of a device according to the invention. In the drawings:

FIG. 1 is a diagram showing the arrangement of the two-plane matrix of the device as well as a part of the circuits associated therewith; and

FIGS. 2 to 4 are diagrams showing three possible cases of operation of the device of FIG. 1.

The programming matrix of the device of FIG. 1 comprises a first plane composed of m conducting rows Y1, Y2, Y3 . . . Y*m* having one of their ends connected, via input resistors *r* and a common conducting lead 1, to a source of electric current supplying a voltage V*e*.

The opposite end of each row Y is connected on the one hand to an electronic switch 21, 22, 23 . . . etc and, on the other hand, via a diode d_1, d_2, d_3. . . etc to a common conducting lead 2 whose end is grounded via an output resistor R*s*. Lead 2 is also connected to the inputs of an analog voltage discriminator circuit 3, with three digital outputs A, B and C.

The second plane of the matrix is composed of *n* conducting columns $x_1, x_2, x_3 \ldots x_n$, disposed transversely to the rows Y and each connected to an electronic switch 31, 32, 33 . . . etc. The switches of both the columns X and the rows Y are grounded.

The number of points of intersection of the different rows and columns represent the programming capacity of the matrix. Each point of intersection has a socket for receiving a movable conductor element setting up a contact between the corresponding row and column, this element being formed by a diode plug 4 which can be of one of three types, in order to provide several possible different types of data. The three plug types include a single diode D only (FIG. 3); a diode D and a resistor R_1 of a certain value connected in series (FIG. 4); or a diode D and a resistor R_2, having a value different to R_1, connected in series. These different types of plugs 4 carry identification means such as a symbol, number, letter, shape or color facilitating recognition thereof by the operator.

Assuming that the matrix is to be used for the programming, the matrix is programmed by assigning one color to each possible type of data at the points of intersection of the matrix, so that color No 1 corresponds to the absence of a plug, color No 2 to plugs with a single diode D, color No 3 to plugs with a diode D and a resistor R_1, and color No 4 to plugs with a diode D and a resistor R_2.

The "0" state of a row or column signifies that this row or column is at ground potential. The associated electronic switch is thus closed.

The "1" state of a row or column signifies that no current can pass along the portion of the row or column in which the open electronic switch is placed.

Three of the four possible cases encountered during interrogation of the different points of intersection of the matrix are schematically shown in FIGS. 2 to 4, the four cases being:

1. No plug — Color No 1 (FIG. 2)

The voltage Vs available at the terminals of the resistor Rs is proportional to the current I_1 supplied by Ve via r, d and Rs.

2. Plug 4 with a single diode D — Color No 2 (FIG. 3)

The totality of the current I_2 supplied by Ve is bypassed to earth via r and D. No current flows through d and Rs, and Vs is therefore at earth potential.

3. Plug 4 with diode D and resistor R_1 — Color No 3 (FIG. 4)

Part of the current I_3 supplied by Ve through r passes through R_1, and another part through d and Rs. The current flowing through d and Rs thus has a different value to I_3 since it is a fraction of I_3.

4. Plug 4 with diode D and resistor R_2 — Color No 4

This case, not shown, is similar to the preceding case but the current flowing through d and Rs has a different value because R_2 has a different value to R_1.

The voltage Vs available at the terminals of the resistor Rs thus has a different value in each of the four possible cases.

This voltage Vs is compared to three standard voltages V_1, V_2, V_3 in the analog voltage discriminator 3.

The digital outputs A, B, C of the discriminator define a code, associated with each of these cases, as follows:

	A	B	C
Color No. 1	1	1	1
Color No. 2	0	0	0
Color No. 3	1	0	0
Color No. 4	1	1	0

For example, to program the needles of a rotary bed circular knitting machine with 32 knitting stations to knit a four-color design, supposing that the number of needles on the machine is divisible by the number of systems, the programming device can be used in associated with the machine in the following manner.

The 32 knitting stations of the machine are divided into eight groups of four stations each corresponding to a supply of yarn of one of the four colors of the design. During knitting, for each of the 32 needles that are simultaneously presented in front of the selecting members associated with the thirty two knitting stations, an order corresponding to actuation or non-actuation must be given according to a color determined by the corresponding point of intersection of the matrix. Interrogation of the matrix takes place through actuation of electronic switches controlled by a computer (not shown), the operating of whose various sequences is closely associated with that of the machine.

The matrix, interrogated by the computer, supplies 32 binary words (of three bits A B C) associated with 32 of the machine's needles.

Moreover, the 32 knitting stations are coded according to their yarn supply in the same manner as that of the selector outlets.

The outputs A, B, C are compared in a digital manner to the bits of the code of the knitting stations and the result of the comparison determines the actuation or non-actuation for each coded needle. In the case where the number of needles on the machine cannot be divided evenly by the number of systems, i.e. where there are not 32 orders to distribute simultaneously, it is sufficient if the computer controlling the interrogation of the matrix and the transmission of the orders received takes into account these phase displacements.

By providing a greater number of discrete different values of the resistors R connected in series with certain of the diode plugs, it is possible, with a two-plane programming matrix, to define a greater number of different types of data which can be identified by a single discriminator circuit.

What is claimed is:

1. A two plane matrix data programming system particularly adapted for selective control of knitting elements such as needles or associated knitting machine accessories used for the creation of multicolored patterns using more than two colors in a knitting machine, said data programming system comprising: a series of conducting rows defining a first plane; a series of conducting columns perpendicular to said series of conducting rows and defining a seond plane parallel to and in overlapping relation to said first plane, said conducting rows and columns crossing at a plurality of points of intersection, said points of intersection each corresponding to a knitting loop; a plurality of movable current conducting members having various preselected conduction characteristics and connecting selected conducting rows and columns at certain points of intersection whereby data representing any one of more than two catagories of information corresponding to more than two different types of loops may be stored at each of said points of intersection; interrogation means operatively coupled to each of said points of intersection for determining the state of each of said points of intersection including whether the row and column at a point of intersection are connected by a movable conducting member, the absence thereof indicating a first preselected state, and if the row and column is connected, determining the magnitude of the current carried by the specific movable conducting member; and means for identifying the plurality of data catagories respectively stored at said points of intersection, said identifying means operatively coupled to said interrogation means.

2. A programming system according to claim 1, in which the movable conducting members are comprised of diode plugs.

3. A programming system according to claim 1 wherein the movable conducting members are comprised of diode plugs and a resistor of a preselected value connected in series with the diode.

* * * * *