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Geirhos et al.

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[54] **METHOD OF AND APPARATUS FOR PREPARING A PROGRAM FOR A TEXTILE MACHINE**

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June 1, 1971 Germany ..... P 21 27 151.2

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[51] **Int. Cl.** **D03d 49/00**, G06f 3/08

[58] **Field of Search** 340/172.5; 139/319

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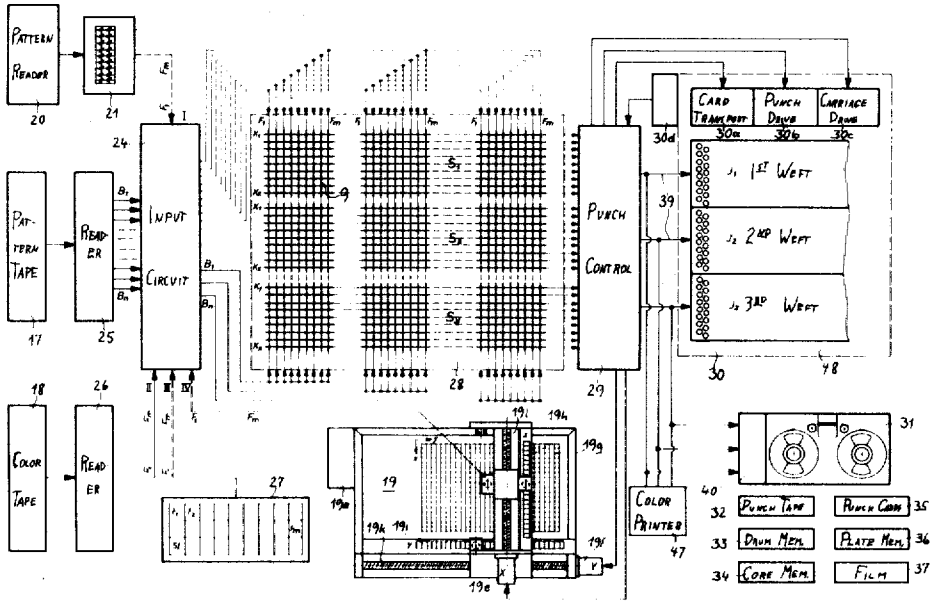
[57] **ABSTRACT**

A design carrying lines of color effects each indicating an arrangement of particular warp and weft threads according to particular patterns is scanned and all of the color-effect data are stored in a memory. The various patterns are stored in another memory as a plurality of parallel data trains having a common start and subdivided into a plurality of weft words. The color-effect data for the first pattern line is read out of its memory and combined with the pattern data, with, if necessary, the first weft word being read and reread repeatedly as the first color-effect line is read out. The second weft word is similarly repeated for the second color-effect line and so on until the entire warp repeat is completed. The combined signals are fed via a crossbar arrangement to the inputs of a punching machine or the like which prepares the finished program.

24 Claims, 7 Drawing Figures



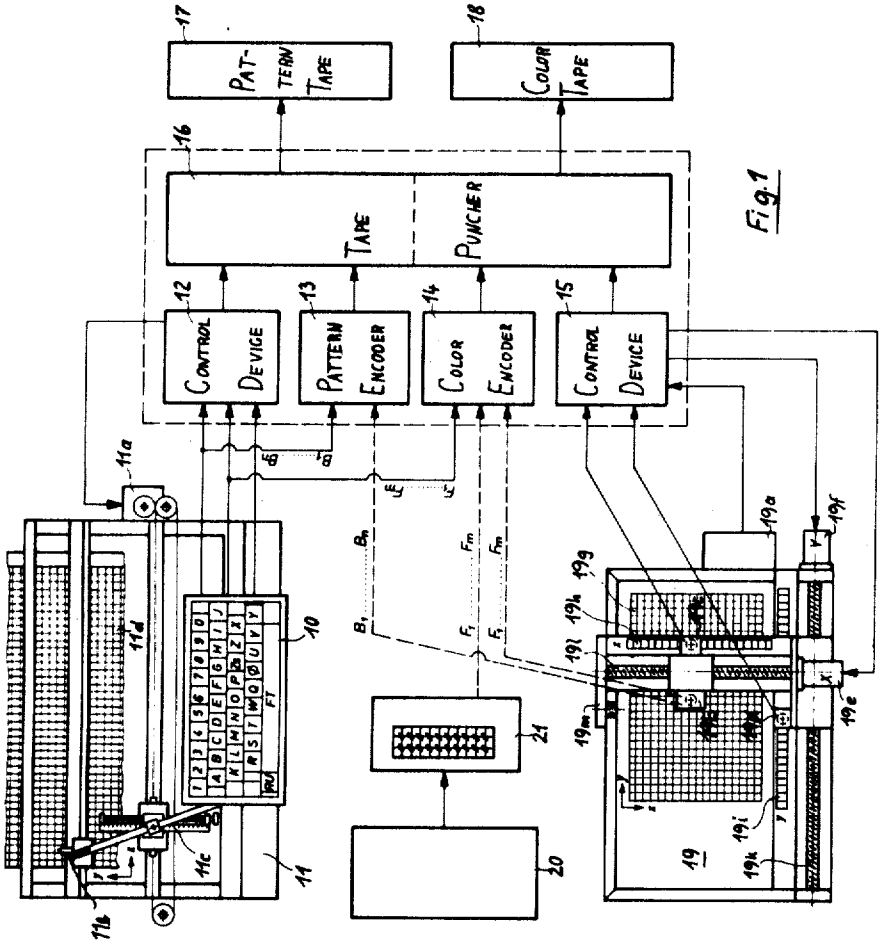

17
PAT-TERN TAPE
18
COLOR TAPE
16
TAPE PUNCHER
12
CONTROL DEVICE
13
PATTERN ENCODER
14
COLOR ENCODER
15
CONTROL DEVICE
11a
11b
11c
11d
11
10
20
21
19
19a
19b
19c
19d
19e
19f
19g
19h
19i
19k
19l
19m

Fig. 1

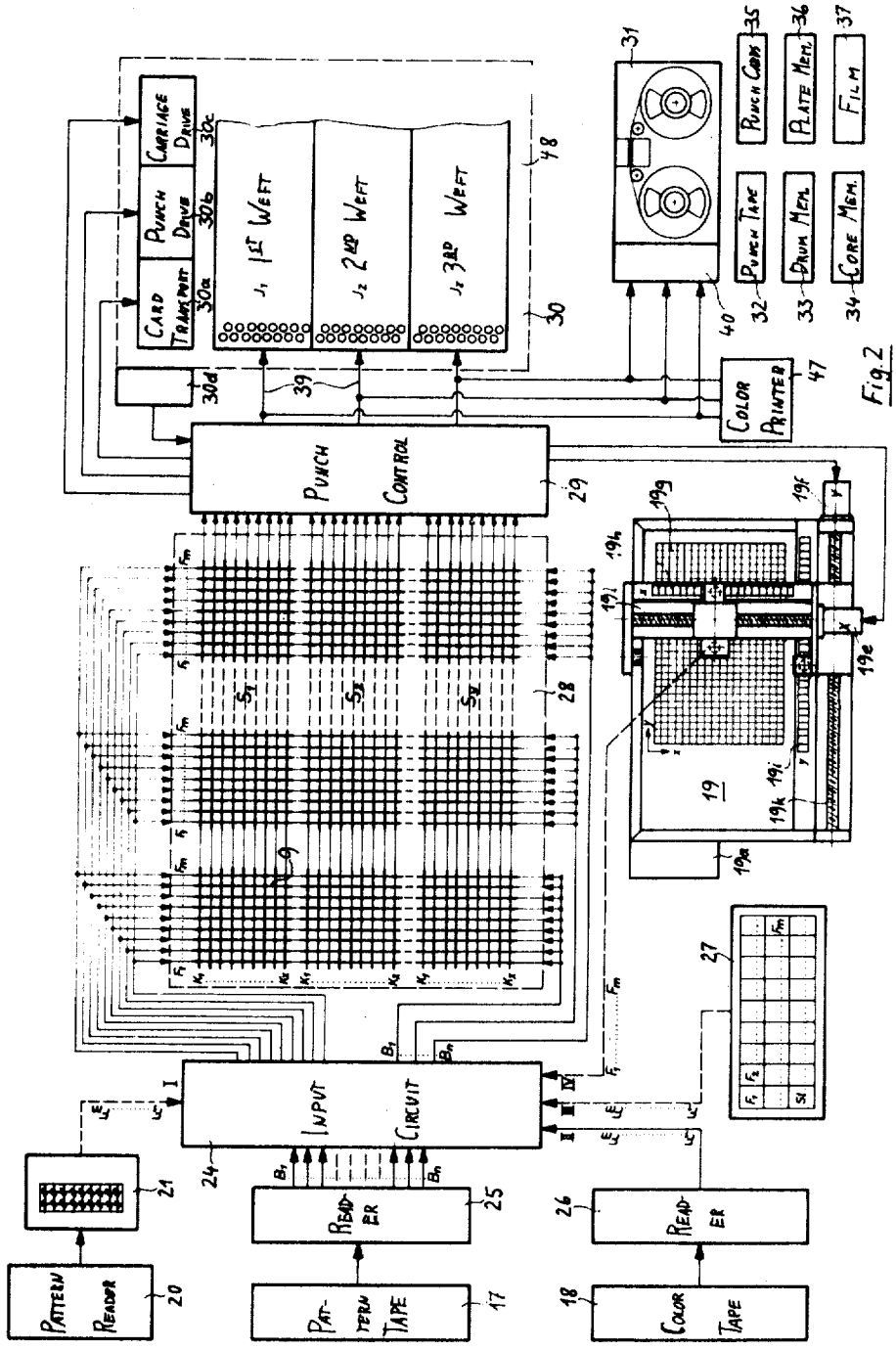

PUNCH CONTROL
INPUT CIRCUIT
PATTERN READER
PAT-TERN TAPE
COLOR TAPE
READER
COLOR PRINTER
PUNCH TAPE
DRUM MEM.
CORE MEM.
PLATE MEM.
FILM
PUNCH CARD
CARD TRANSPORT
PUNCH DRIVE
CARRIAGE DRIVE
1ST WEFT
2ND WEFT
3RD WEFT

Fig. 2

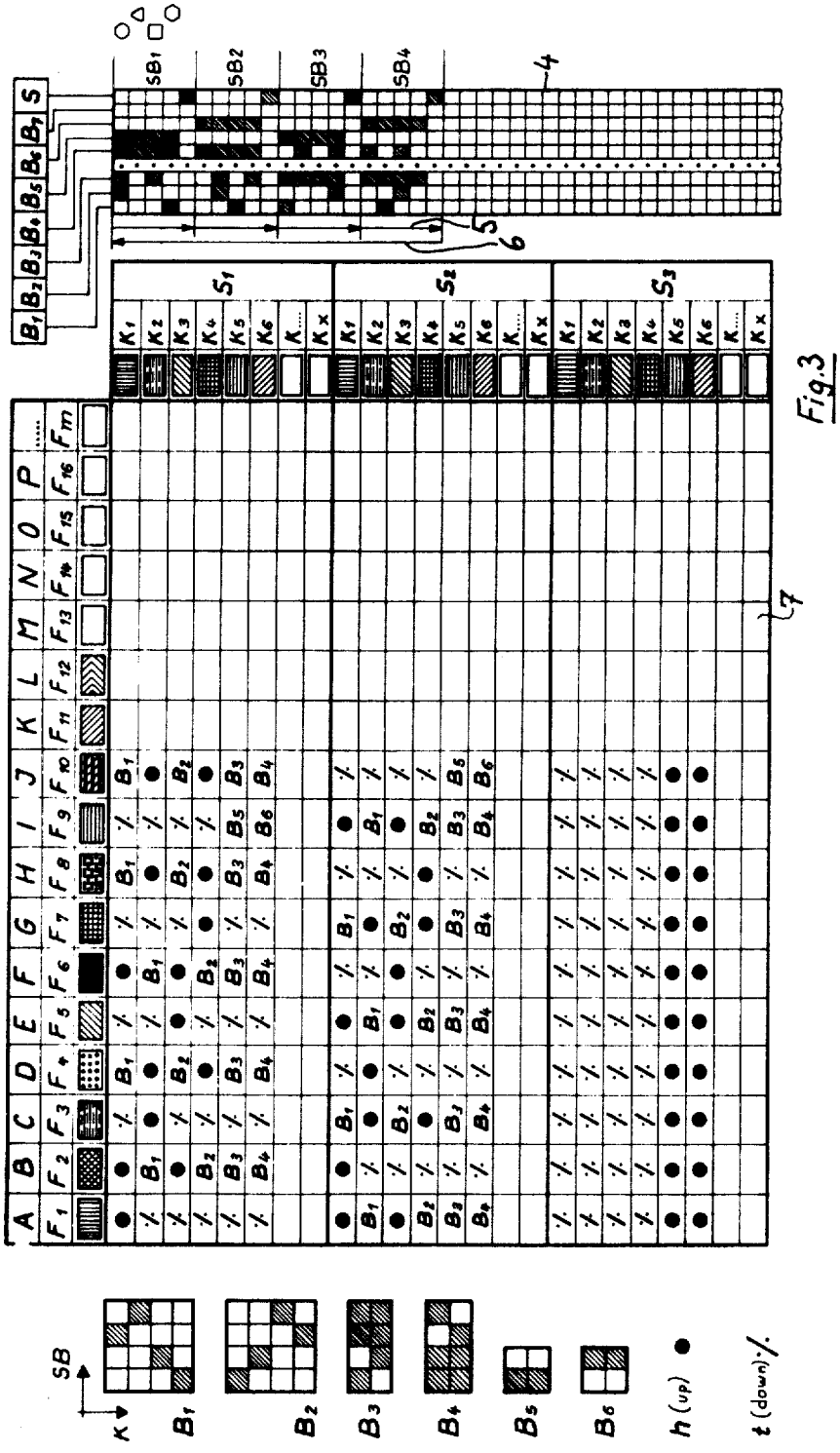


Fig.3

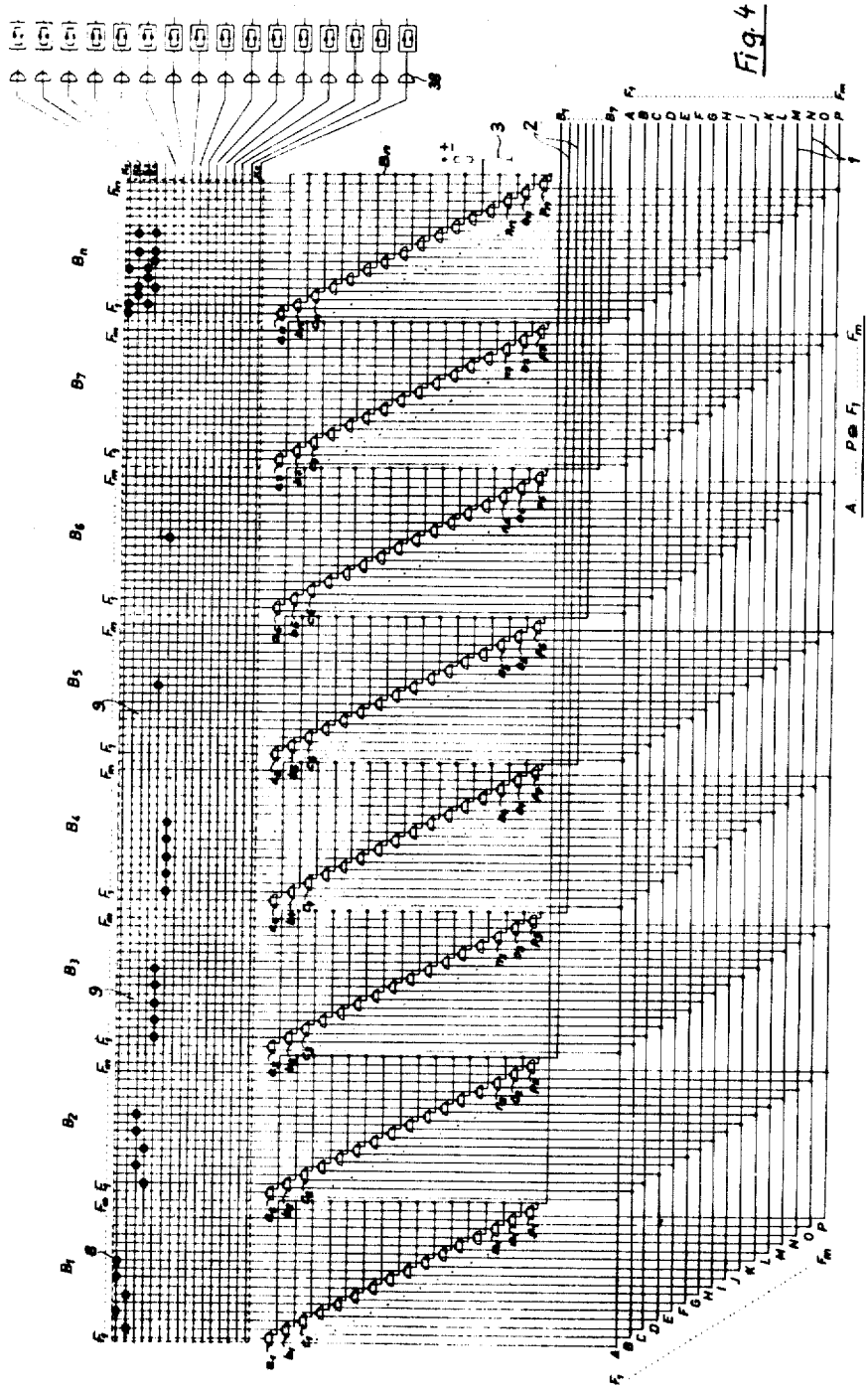
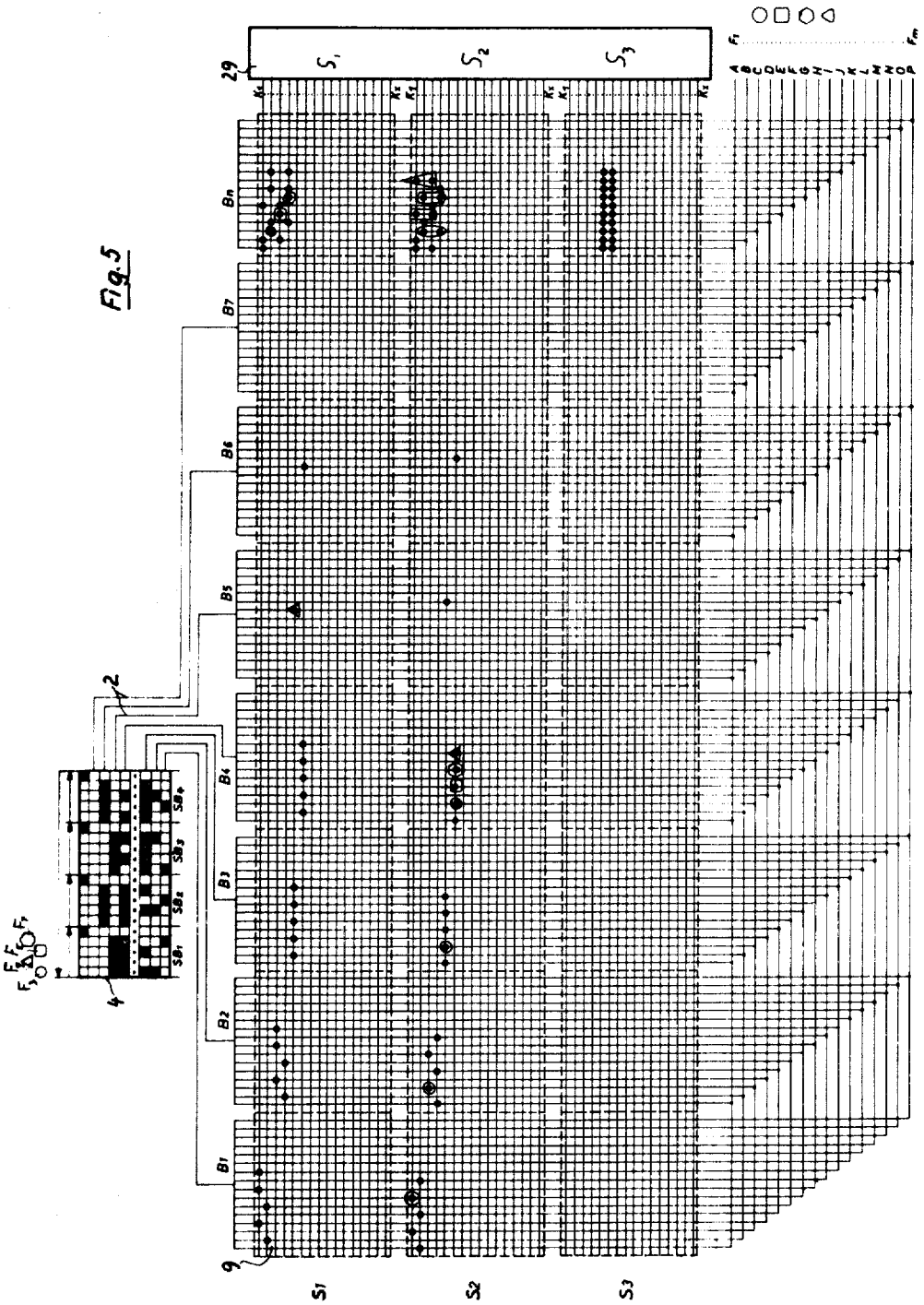


Fig. 4

Fig. 5



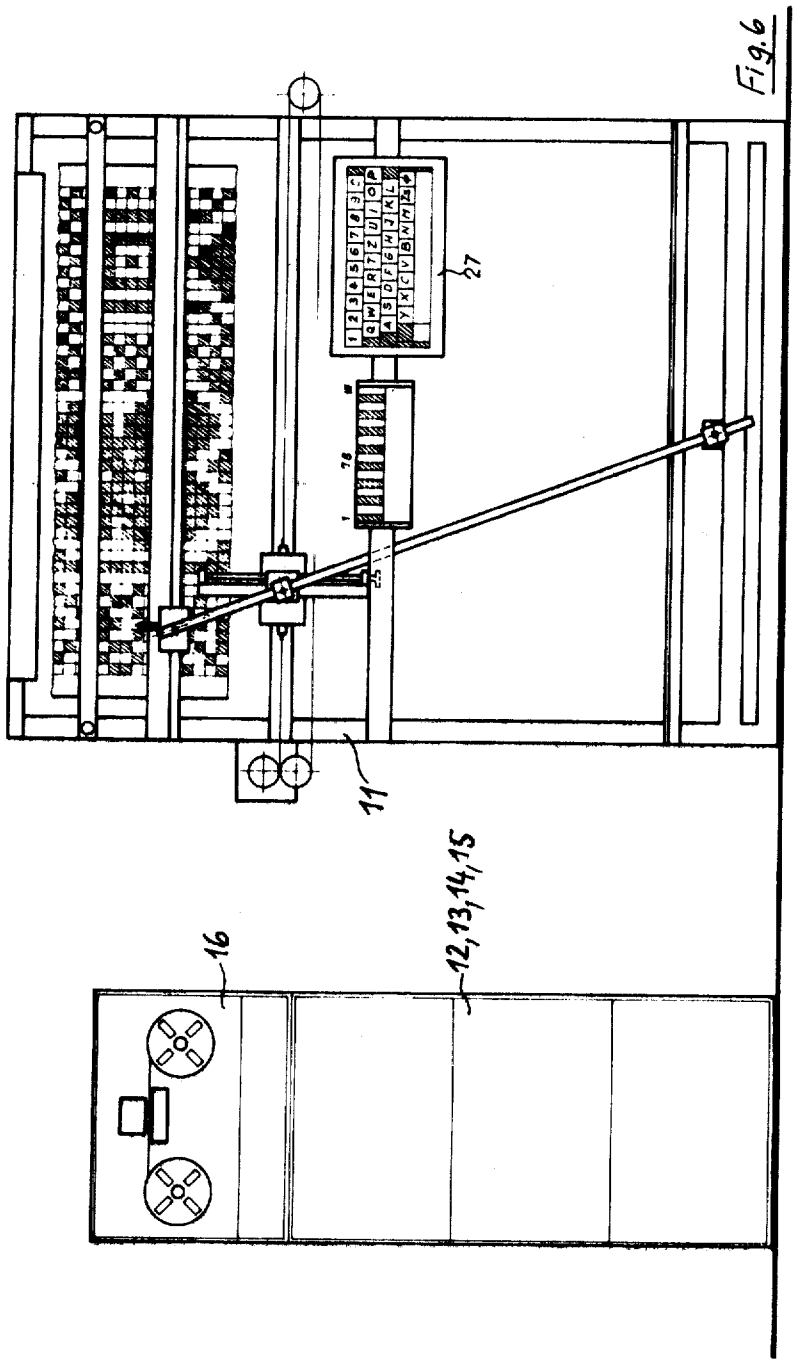


Fig.6

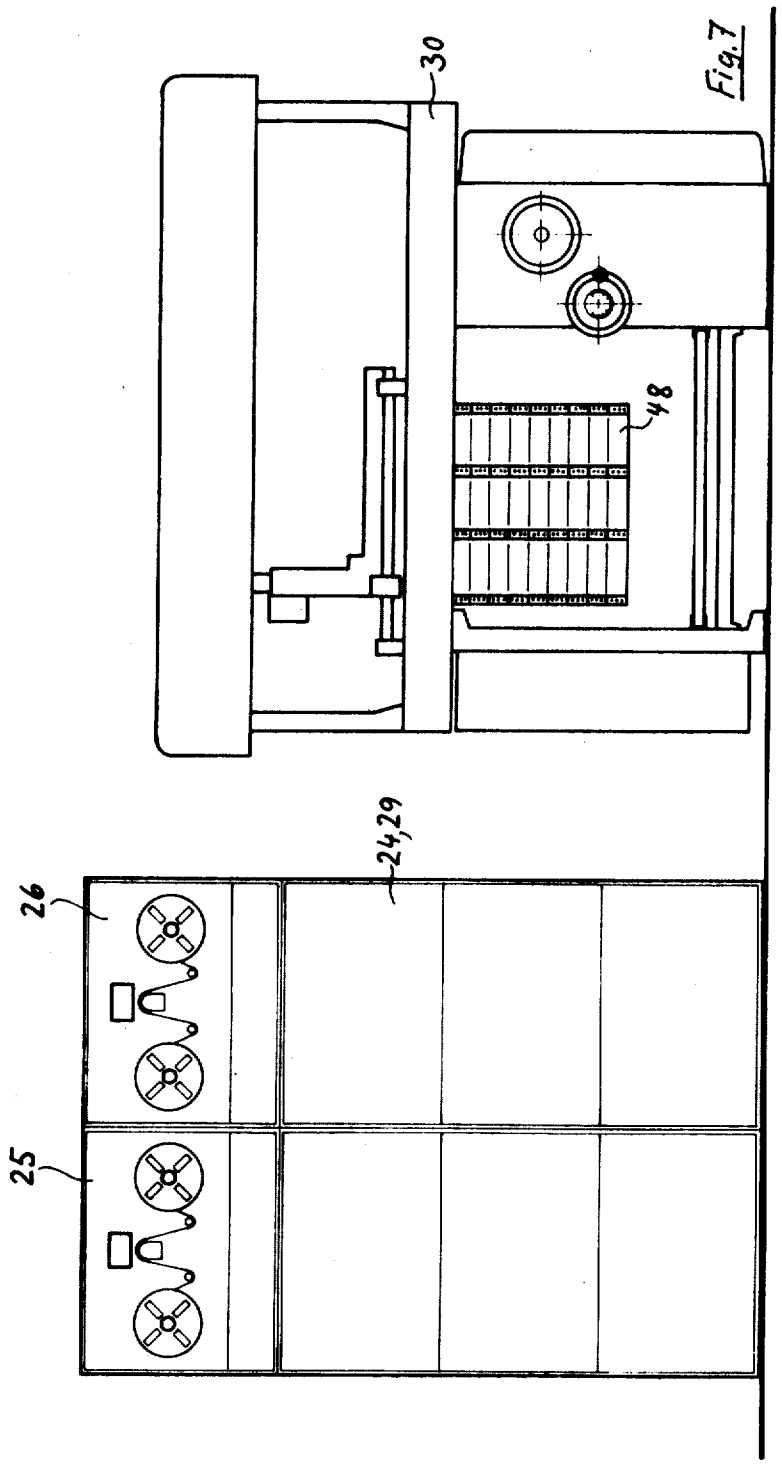


Fig. 7

METHOD OF AND APPARATUS FOR PREPARING A PROGRAM FOR A TEXTILE MACHINE

FIELD OF THE INVENTION

The present invention relates to a method of preparing a program for a textile machine. More specifically this invention concerns the reduction of a textile design to a program, such as a series of jacquard cards.

BACKGROUND OF THE INVENTION

In the textile industry, designs may be formed on goods by the use of intricate weaving, knitting, embroidering, and similar methods. To this end the desired design is generally supplied on color-coded graph paper or point paper which is subdivided into a multiplicity of parallel rows each in turn formed by a succession of color effects or color-effect indicia. These effects or indicia indicate which color the designated spot is to have in the finished goods, what type of weave, knit, or stitch is to be used in that region, or a combination of the two.

For the sake of simplicity the discussion here is limited to jacquard weaving e.g. of rugs or carpetry, although it should be understood that similar principles apply to raschel knitting, embroidering, and many other methods by which patterned and designed textiles are produced.

In a jacquard machine it is well known to use a plurality of warp threads and even a plurality of weft threads, all of different coloration. Thus, for instance, a light green spot in a design may be produced by raising the dark green warp threads and picking a light green weft through the warp shed. In this manner a great many very subtle colors can be achieved using only a few different warp colors and a few different weft colors, or even a single weft yarn.

If the region of a particular color is to be rather extensive this will produce lengthy floats that cannot be permitted in good fabrics. To this end not only may, as described above, the dark-green warp and light-green weft be combined in a simple weave on the top of the goods, but the other yarns will be drawn in occasionally, so that, say, a four-shaft twill may be produced using some yellow warp threads in addition to the green ones. The combinations of course are multiplied in practice such that what may be a single color effect on the design actually represents a combination of quite a few warp threads with several weft threads in a plurality of different weave patterns. Apparatus for producing jacquard cards for such looms has, therefore, been highly complex.

For example, it is not uncommon to produce a first series of cards, so-called "precards" or preliminary cards, which carry the patterns or weave combinations, and a second series of cards for the color effects, to provide complicated card readers and harnesses connecting the card readers to a jacquard punching apparatus.

OBJECTS OF THE INVENTION

It is therefore an an object of the present invention to provide an improved method of and apparatus for producing a program for a textile machine.

Another object is the provision of a method which is simple and which can even, once set up, allow the automatic scanning and reduction of a design to a useful program.

SUMMARY OF THE INVENTION

These objects are attained according to the present invention in a method whereby each color effect indicia of the design is broken down into its constituent weave patterns and warp and weft colors. Each weave pattern is then stored in a memory as a bit track. The tracks are all parallel and have a common start and a common end and are each subdivided into a plurality of weft data words. The bits of the tracks are aligned in parallel rows transverse to the direction of the tracks so that, for instance, all of the third bits of all of the different tracks each representing a different pattern may be read simultaneously. The overall length of the bit tracks is equal to a number of bits which is evenly divisible by the number of bits in any of the pattern sequences. Thus if one pattern sequence has three bits and another has eight, and a third pattern has a repeat of 12 bits, a bit-track length of 24 bits will be employed. For more complicated designs it will be necessary to repeat some of the patterns scores of times in order to produce repeating bit tracks all of identical length and all subdivided into coextensive weft-data words of identical length. The term "memory" is here used to describe any data-storage device capable of recording the various standard weave patterns so that the latter can be read repetitively (iteratively) and in a stepwise manner. Such memories may include punched tapes, magnetic tapes, core-type storage devices and shift registers.

The design is then read along one weft line and at the same time one weft-data word region of the parallel bit tracks is read as many times as necessary depending on how much greater the weft line of the design is than the weft-data word. Thus each color-effect indication on the design is translated into a signal which is combined with a signal corresponding to the respective bit in the weft-data word according to the established definition or reading for that color effect. Thus, for example, in a jacquard system using one weft yarn, 30 warp yarns of three different colors, and two different patterns, one having a four bit repeat and one having a 16-bit repeat (thus arranged in 16-bit long bit tracks subdivided into two eight-bit weft words) one color effect might mean that the first and third warp threads are to be woven with the weft yarn in an oxford-cloth pattern while a second color effect might signify that the second warp yarn is to be woven in an eight-shaft sateen weave.

As the next weft line of the design is scanned the next weft word in the memory is repeatedly scanned so that the various weaves, when continued along the warp of the goods, will come out right; the twills will be diagonally in line, any ribbing or cording will remain evenly spaced, and so on.

Since in a jacquard machine the weave is controlled by only two things—which weft thread is used and which warp threads are raised — it is paramount that the reading for each color effect be properly assigned to the proper pick and lifting movements. To this end, as in the above example, with one weft thread, three different colors of warp thread, and two different patterns, the first color-effect would correspond to the information: oxford cloth with first and third warp colors. The second color effect would be: eight-shaft sateen with second warp color. According to the present invention a crossbar distributor arrangement, henceforth

designated simply as a crossbar is used having an array of parallel conductors in one direction corresponding in number to the number of punches in the card puncher, and an array of parallel conductors orthogonal to the first array and connectable thereto, the transverse conductors being equal in number to the number of possible color effects. In the above cited example, a crossbar having three main conductors each associated with a respective warp-thread color and crossed by two transverse conductors are all that would be necessary. Each transverse bar is connected through an electronic gate with one pattern input and one color-effect input. According to the reading or definition for the color effect, jumpers are provided at the necessary crossover points. The jumpers may be simple conductive bridges or diodes as in a diode matrix. In the example discussed above jumpers can be provided between the output of the gate connected to the oxford-cloth input and to the first color effect input and the first and third conductors. The other gate which is connected to the eight shaft sateen and to the second color effect inputs would have its output connected to only the second conductor. Thus when color effect two, for example, is read on the design, the second warp thread corresponding to that part of the design is only lifted every eighth time a color-effect reading is exacted to produce the desired eight-shaft sateen. Thus only when the input from the color effect scanner and from the memory reader to the particular gate are live will the corresponding hole be punched in the card to raise the corresponding warp thread. For the first color effect, there will be a signal on the line from the memory reader which corresponds to the bit track for the oxford cloth—a simple on off alternation—for every other incoming color effect signal whether it be the one requiring use of that pattern or not. Thus the first and third warps will be lifted.

The output of the crossbar is connected to a card puncher. (See *Der Spinner und Weber*, 20, 1956 ad DAS 1 290 895). Another suitable arrangement is a card puncher wherein a shift register is employed as the input so that when a number of registers is filled which corresponds to the number of punches, the punches are electrically actuated to punch the card, and then these registers are cleared. Thus in the above example, assuming a puncher with eight punches is employed, after the third color effect is entered the row will be punched in the card, with the very last or ninth bit being held over for punching in the first spot of the next row.

According to further features of the present invention it is possible to employ automatic scanning of the design. First of all the various weave patterns are entered in the memory which is advantageously a loop of punch tape. Then the definitions for the color effects are entered in the crossbar and the design scanning device may be set in motion to produce the necessary jacquard cards or a data carrier for generating these cards fully automatically.

As mentioned above, the principles of the present invention can be applied to textile machines other than jacquard looms, and can be used to prepare programs which are not necessarily punched on cards. It is quite possible, for instance, to employ the concepts of the present invention to raschel knitting machines to excellent effect, as well as to many types of embroidery machines which have data carriers of one sort or another.

The color effects are advantageously not fed directly into the device where they are combined with the weave effects, but are first punched into a tape or otherwise stored. In this manner when a rug or the like is being produced with several weft threads the line of the design need only be read once, with its color effects recorded. Then this recording of these color effects can be played back for the serial production of the different cards for the different weft filaments, since each weft filament will have a different set of definitions for the various color effects. In this manner, assuming four weft threads, after the first weft line of the pattern is read the set of cards for the first weft thread is punched. Then before the reading of the second weft line the recording of the color effects for the first weft line is played back three more times and each time again combined with the pattern information for stamping of the three other sets of cards.

Thus in a system having two filaments in each weft system the first card is punched during the scanning of the first weft line of the design, then the remaining cards are punched. During the scanning of the second line the $(z + 1)$ card is stamped, and during the scanning of the third weft line of the design the $(2z + 1)$ card is punched.

The memory for the color effects is, according to another feature of this invention, also used to store the various control signals for running the programmer. A core memory having room for 1,344 bits is usually sufficient for use as the color effect memory or the pattern memory, this being the capacity of a jacquard card system.

It is possible to associate a color printer with the machine according to the present invention to check the accuracy of the program which has been made. This apparatus will bring out the necessary colors of the overlying warp threads to give an exact picture of just what the finished fabric will look like, without the necessity of setting up an entire loom just for experimentation purposes.

A color effect may be a color-coded region on the design, a particularly hatched region on the design, or even a numbered region as in a paint by numbers design. Each color effect may or may not bear any relationship to the actual coloration of the finished textile, so that an area marked blue on the design, for instance, may mean that a blue 4-shaft twill is to be used there, or it may just mean that the first weft yarn whatever its color, is to go over the first, third, and fifth warp yarns while the second weft yarn will form a herringbone twill with the second warp yarn. The number of combinations is great indeed.

DESCRIPTION OF THE DRAWINGS

The above and other objects, features, and advantages will become apparent from the following, reference being made to the accompanying drawings in which:

FIG. 1 is a schematic view of the various possibilities for deriving the color-effect and weave data;

FIG. 2 is a diagram showing how the data is fed to a punching machine via a crossbar;

FIG. 3 is a table showing the definitions for the color effects of a particular cloth sample;

FIG. 4 is a circuit diagram showing the connection of the color-effect and weave data to the punches for the warp thread systems;

FIG. 5 is a circuit diagram showing the connection between the crossing elements of the crossbar distribution grid according to the data of FIG. 3;

FIG. 6 is a view of a design reading device with a punch tape cutter; and

FIG. 7 is a view of a punch machine with a punch tape reader for color-effect data and weave data.

SPECIFIC DESCRIPTION

As seen in FIG. 2 the various data F_1–F_m for the color effects and the data B_1–B_m for weave patterns are derived in various manners and fed via a circuit **24** to a crossbar **28**. A keyboard **27** may be used to feed in the color-effect signals F_1–F_m, each key corresponding to a specific color effect, with the output being fed over a cable III to the circuit **24**. Alternately a pattern **19***g* may be read by a coordinate-reading mechanism **19** with its output fed via a multiconductor cable IV to the circuit **24**. A so called designograph or automatic design or pattern reading machine **20** may feed a 1,344-bit core memory **21** which is in turn connected through another multiconductor cable I to the circuit **24**. This memory **21** can be cleared line by line for repeat punching of jacquard cards.

It is also possible to store the weave data B_1–B_m on a tape **17** which is read by a device **25** and fed to the input circuit **24**, and the color data may be stored on a color tape **18** which is read by a device **26** connected via a cable II to the circuit **24**. These color-effect data are coded and punched into the tape **18** in an order derived from the design and then transmitted in decoded form with each color effect F_1–F_m being sent over a particular wire of the cable II to the input circuit **24**. Of course only one of the various lines I–IV is used at a time, for which reason only one is shown as a solid line.

The means by which the tapes **17** and **18** may be produced are shown in FIG. 1 in detail.

The color data F_1–F_m are derived from a pattern reading device **11** which has the input keyboard **27** whose individual keys A–P are each associated with a particular color effect F_1–F_m. The output of the keyboard **27** is fed to a color encoder **14** which is connected to a puncher **16** capable of cutting the tape **18**. This output is also fed to a control device **12** connected to the indexing motor **11***a* of the reader **11**. Each time a key is actuated on the board **27** the control device indexes the pointer **11***b* of the reader **11** a single square of the design **11***d* in the direction shown by the arrow *x*. This control **12** also counts so that when the end of a row on the pattern **11***d* is reached it returns the pointer **11***b* to the left-hand side to read another row, after raising the pattern **11***d* one square or weft line in the *y* direction. The pivot point **11***c* of the pointer **11***b* may be moved so that each indexing step just corresponds to the width of a square in the *x* direction. Each depression of one of the keys A–P causes a particular code to be punched into the tape **18** transverse to its longitudinal direction.

The same apparatus may also be used to produce a similar pattern tape **17** which gives the pattern or weave data in which case this information is fed to a pattern encoder **13**. In contrast to the coding of the color-effect data the pattern or weave data are simply entered in parallel longitudinal rows on, as shown here, an eight-hole paper tape. Each warp thread lifting is represented by a hole.

FIG. 1 also shows a coordinate reading device **19** which can be used for automatically reading color-effect or pattern information from a design **19***g*. This device has a photoelectric color sensor **19***b* which is indexed across the pattern **19***g* block by block in both *x* and *y* directions. The movement in the *x* direction is effected by a motor **19***e* which rotates a spindle **19***l* threadedly coupled to the sensor **19***b*. In the *y* direction a motor **19***f* connected to a spindle **19** *k* threaded into a slider **19***m* carrying the motor **19***e* is provided. A pair of graduated strips **19***h* and **19***i* is provided, the strips extending in the *x* and *y* directions, respectively, and associated with sensors **19***c* and **19***d* which can detect their graduations. Each time the sensor **19***b* makes a color-effect or pattern reading the motor **19***e* is actuated by a control device **15** to advance the sensor **19***b* until the sensor **19***c* carried thereon comes over the next graduation on the strip **19***h*. Then another reading is taken by sensor **19***c* and so on until the last graduation on **19***h* is reached, at which time the motor **19***f* is actuated by a control device **15** to advance the entire slider **19***m* one graduation in direction *y* and the motor **19***e* is reversed to return the sensor **19***c* to the graduation of strip **19***h* at its opposite end. At this moment the next *x* line is read. Should, for some reason, the sensor **19***b* be unable to read the color, it stops and the correct reading may be ascertained and entered on read-in device **19***a*, whereupon the automatic scanning will be resumed. The graduations on strips **19***h* and **19***i* are made to correspond to the spacing of the data on the design **19***g*. The scanner **19***b* can be moved continuously and only make a reading when one of the lines on a strip **19***h* or **19***i* is crossed, or as described above, it may stop for each reading.

Whether input device **11**, **20**, or **19** is used, the color information is fed into a color encoder **14** and, if any of these devices is used to derive weave information, this information is fed into a pattern encoder **13**.

FIG. 3 shows the various weave patterns and the pattern data for a particular example of fabric. The goods here have six different weave patterns B_1–B_6 plus *h* for a warp lift (a hole in the jacquard card in the corresponding location) and *t* for a nonperforated portion of the card. The warp direction is shown by arrow K and the weft direction by arrow SB. The first weave pattern B_1 is entered in the first channel or line on the tape **4**, the second weave pattern B_2 in the second channel or line, and so on.

In this case the six weave patterns B_1 – B_6 shown are relatively simple. The largest pattern requires four spaces in the weft direction and four spaces in the warp direction, and all of the other patterns fit into such a four-by-four square, so that the tape **4** need only be sixteen bits longs. In addition to these 16 bits a hole is punched in column S after such weft word SB_{1-4} to give the eight-track tape **4** an overall length of twenty bits. This tape is formed into a closed loop so that the end of word SB_4 runs into, with interposition of control hole S, the beginning of weft word SB_1.

As a single weft line of a pattern is read a single word of the tape **4** is repeatedly scanned so that each time a color-effect is fed in either from a scanner as described above or from another punch tape a transverse line of a weft word is read. Thus for instance, if the first line (indicated by a small circle) of weft word SB_1 is being read as color effect F_3 is fed in only the second warp thread K_2 will be lifted for the first weft thread S_1. For

weft thread S_2 the warp threads K_{2-6} will all be lifted since either their respective column F_3 has dots or indicates a pattern which in the first line of the tape **4** has no warp lift. Since K_1 is supposed to be woven in pattern B_1 for color effect F_3 with weft thread S_2 and the corresponding space in the first row of tape **4** indicates no warp lift, this thread K_1 is left down. For weft thread S_3 only warp threads K_5 and K_6 are lifted, as is always the case for this third weft thread which serves mainly to hold the fabric so produced together.

The dots which represent a hole in the corresponding location of the respective jacquard card, and which hence signify no particular weave pattern, are not coded into the tape **4** since the effect they are to have is easily brought about by an arrangement described below.

It is not impossible when several very complicated weave patterns are used that a tape loop several hundreds of bits long will have to be produced, in which case the respective weft words will only be read a few times for each corresponding weft line of a design. When smaller jacquard machines having around 400 needles are used it is entirely possible that each weft word on the tape **4** will have as many bits as there are needles, and that the loop is simply read straight through. This is the case when patterns having a common multiple greater than the number of needles are combined in a single design. Of course such a tape will have as many weft word as there are in each warp repeat, so that a tape **4** carrying literally thousands of transverse rows of information is possible.

In the illustrated example the seventh longitudinal channel on the tape, shown as B_7 is left empty. If more than seven or eight weave patterns are required two or more such tapes may be used. It is also possible to code this weave pattern information into a magnetic tape, a core memory, or any other kind of storage device. Here punch tape is used because of its extreme cheapness and its ease of handling and storing.

FIG. **4** shows a crossbar **7** for the first weft thread. This arrangement is subdivided into eight regions or fields **9** each having as many horizontal, as seen in the view, conductors as there are punches in the card puncher and as many vertical conductors in each region **9** as there are possible color effects. In this example since only six different warp threads are used and only ten different color effects only the upper left-hand corner of each region **9** is used, having **60** crossover points.

The vertical conductors of the first field corresponding to respective color effects F_1–F_m are connected to the outputs of respective NOR gates a_1, b_1, c_1 . . . p_1. The second field, which corresponds generally to weave pattern B_2, is similarly connected to NOR gates a_2, b_2, c_2 . . . p_2 and so on for the other regions **9**. One input of each of the gates a_1–a_n is connected to the input line A for color effect F_1, and each gate b_1–b_n is similarly connected to line B for color effect F_2 and so on. In addition each gate a_1–p_1 has its other output connected to the input line for weave pattern B_1, and gates a_2–p_2 are connected to the input line for pattern B2 and so on across the cross bar.

Each horizontal bar of the crossbar **7** is connected through an inverter **38** to the tape punch control **29** where it is connected to the individual solenoids controlling the punches. All of the gates a_n–p_n have one input connected to a constantly energized line.

Diode jacks **8** may be inserted into the crossover points on the crossbar in order to connect specified horizontal conductors to specific vertical conductors. These jacks are inserted according to the reading or definition table of FIG. **3**. More specifically for the field **9** corresponding to color effect F3, for example all of the crossover points between the lines corresponding to color effects F_2, F_4, F_6, F_8 and F_{10} are connected to the horizontal conductor corresponding to the sixth warp thread K_6, just as shown on the FIG. **3** table. The connections on the field **9** corresponding to weave pattern B_n, for a hole in a card are similarly made as determined by the dots on the FIG. **3** table. This weave B_n may be the ground color, or may be an underlay pattern necessary to stabilize the textile so produced.

Assuming that none of the input lines B_1–B_n and F_1–F_m are live, every gate a_1–p_n will have zero on both its inputs and will thereby generate a one. These ones will be conducted by the many diode jacks **8** to all of the first six horizontal lines and thence to the top six inverters **38** which will convert them into zeroes. The punches of the device **29** will not be activated by these zeroes.

The same type of crossbar arrangement is used for the other two weft threads in the present embodiment, as shown in FIG. **5**. Three jacquard cards J_{1-3} are thus produced simultaneously.

To go back to the example given above, if the color effect F_3, indicated by a small circle, is read simultaneously with the first row of word SB_1 all of the jacks shown surrounded by small circles will conduct to punch card J_1 for the first weft filament S_1 so that in the first warp system thread K_2 only is lifted, for the second weft filament S_2 warp threads K_{2-6} are lifted, and as mentioned above warp filaments K_5 and K_6 only are lifted for the third weft filament S_3. Thus input lines B_2, B_3, B_4, B_5 and B_n are all live when this color effect F_3 is read in to produce the series of holes described immediately above in the cards J_1–J_3. The various signals to produce these holes can be stored in three respective shift registers until a whole line on the jacquard card can be punched, or they may be immediately punched into the cards.

Once the F_3 information is taken by the punch **29** the tape **4** is advanced to the second row, indicated by a small triangle. If color effect F_9 is now read in, those intersections surrounded by a triangle will be affected in the following relationship: S_1–only K_5; S_2–K_1, K_3, and K_6; and S_3–K_5 and K_6. On the third reading, assuming F_5 to be the color effect, the points surrounded by small squares will be affected, and on the fourth reading with color effect F_7 those points surrounded by a small hexagon will be affected. After this fourth reading the control hole S will be read and the fifth color-effect signal will be combined again with the first row (small circle), the sixth with the second row (small triangle) etc., until the end of the weft line on the design in which case the second weft word SB_2 on tape **4** will be similarly read and reread. After the fourth weft line on the design is read, in conjunction with repetitive reading of weft word SB_4, the first word SB_1 is started over again for the fifth design weft line.

Switch **3** shown in FIG. **4** indicated that the line B_n can be activated by either positive or negative voltage, as can any of the gates a_1–p_n. It is similarly possible to eliminate the inverters **38** and use AND gates in the place of the NOR gates.

Advantageously, as shown in FIG. 2, the punch 30 is connected to three outputs 39 from the punch control 29. This punch 30 has an automatic card advancer 30*a*, a punch drive 30*b*, and a carriage drive 30*c* for moving the punches along the cards as described in German Auslegeschrift 1,290,895. In addition a manual input 30*d* is provided to perform any corrections that might be required.

The outputs 39 are connected through a parallel-series converter 40 to a tape deck 31 for convenient storage of the information for punching new cards at a later date. In addition it is possible to provide an auxiliary record of the punching by means of a punch tape 32, a card puncher 35, a magnetic drum memory 33, a core memory 34, a plate memory 36, or a film 37, as also shown schematically in FIG. 2.

FIG. 6 shows a pattern reading apparatus 11 combined with a tape puncher 16 whose control devices 12–15 are shown. In FIG. 7 the mechanical parts of a punch 30 can be seen as well as a reading apparatus 25, 26 for the data carriers with the color-effect and weave-pattern data. Underneath this device are the various control devices 24, 29 which serve to punch the deck 48 of cards. In addition a color printer 47 (FIG. 2) may be connected to these outputs 39 to check the accuracy of the program.

The apparatus according to the present invention allows even a small weaving, knitting, or similar textile concern to prepare its own programs for its textile machines. Any design, even a hand drawing on graph paper, can be quickly reduced to the necessary program cards by a worker knowing no more than the basics of textile design. All the programmer need do is reduce the design table as shown in FIG. 3 to a punched tape, and then set the design itself up in a scanner. If certain weaves are encountered frequently they can be stored on tapes and automatically punched into the pattern tape. Once the program cards are used, if any alteration is to be made, it is a relatively simple job to return to the original color and pattern tapes and rewrite the necessary portions for punching of a new set of cards.

We claim:

1. A method of making a data carrier for controlling a textile machine based on a design formed by a multiplicity of color-effect indicia arrayed in a plurality of weft lines and each representing a particular arrangement of warp and weft filaments in at least one of a plurality of repeating patterns, said method comprising the steps of:

entering the patterns in at least one memory as respective parallel trains of bits, each train being subdivided into at least two weft-data words representing each at least one weft repeat of the respective pattern, the weft-data words of all of said patterns having equivalent starting positions in said memory;

reading stepwise the color-effect indicia of a line of said design to produce a succession of color-effect signals;

reading stepwise said weft words out of said memory synchronously with the reading of said color-effect indicia and selectively combining the readout so made with said signals according to predetermined definitions of said color effects; and

transferring the combination of said readout and said color-effect signals to a data carrier.

2. The method defined in claim 1 wherein said readout and said color-effect signals are combined in a crossbar having its conductors in one direction operatively connected to means for registering information on said data carrier and having its transverse conductors connected to gates to whose inputs are fed said readout and said color-effect signals, the selective combination being effected by connecting certain of said conductors in one direction to certain of said transverse conductors according to the definition of each color effect.

3. The method defined in claim 2 wherein said textile machine is a jacquard loom and said data carrier is a jacquard card.

4. The method defined in claim 3, further comprising the step of:

scanning said pattern and generating therefrom said succession of color-effect signals;

encoding said signals;

registering the encoded signals in a second memory, said signals being read out of said second memory for combination with said weft words.

5. The method defined in claim 4, further comprising the step of entering control signals for said machine in said second memory along with said encoded signals.

6. The method defined in claim 1, further comprising the step of transferring said combination from said data carrier to a jacquard card.

7. The method defined in claim 1, further comprising the steps of:

reading the color-effect indicia of the next weft line of said design to produce a corresponding succession of color-effect signals;

reading out of said memory synchronously with the reading of said color-effect indicia for said next weft line the weft word of said patterns following said one weft word and combining this readout with the color-effect signals for said next weft line; and

transferring the combination of said readout of said next weft word and said color-effect signals of said next weft line to said data carrier.

8. The method defined in claim 1 further comprising the steps of reading said data carrier and printing the data thereon in color.

9. The method defined in claim 1 wherein said patterns are entered into said memory in binary form.

10. An apparatus for making a data carrier for controlling a textile machine based on a design formed by a multiplicity of color-effect indicia arrayed in a plurality of weft lines and each representing a particular arrangement of warp and weft filaments in at least one of a plurality of patterns, said apparatus comprising:

a memory;

means connected to said memory for entering the patterns into said memory as respective parallel trains of bits, each train being subdivided into at least two weft-data words representing each at least one weft repeat of the respective pattern, the weft data words of said patterns having equivalent starting positions in said memory;

means for reading the color-effect indicia of one of said lines of said design to produce a succession of color-effect signals;

means connected to said memory for reading said weft words out of said memory synchronously with the reading of said color-effect indicia;

means connected to both of the reading means for selectively combining the readout so made with said signals according to predetermined definitions of said color-effects; and

means connected to the combining means for transferring the combination of said readout and said color-effect signals to a data carrier.

11. The apparatus defined in claim **10** wherein said combining means includes a plurality of gates each corresponding to one of said color-effects and each having one input connected to said memory, another input connected to said means for reading said color-effect indicia, and an output, said means for transferring said combination including a crossbar having a plurality of output conductors, a plurality of input conductors, and means for interconnecting said conductors, each input conductor being connected to the output of one of said gates.

12. The apparatus defined in claim **11** wherein said design represents a plurality of weft filaments, said crossbar having a plurality of sets of output conductors, each set corresponding to a particular weft filament.

13. The apparatus defined in claim **11** wherein said means for interconnecting said conductors is a plurality of diode jacks.

14. The apparatus defined in claim **11**, further comprising a design scanner and a second memory connected thereto, said means for reading said color-effect indicia being connected to said second memory.

15. The apparatus defined in claim **14** wherein said second memory has a capacity of at least 1,344 bits.

16. The apparatus defined in claim **11** wherein said scanner includes a keyboard for entering said color-effect signals.

17. The apparatus defined in claim **14** wherein said scanner includes a photoelectric eye and means for displacing same across said design.

18. The apparatus defined in claim **17** wherein said scanner includes a pair of elements arranged at right angles to each other and each carrying graduations and means on said scanner for sensing said graduations and taking a reading from said design with said eye.

19. The apparatus defined in claim **11** wherein said means for transferring further includes a puncher for punching holes in jacquard cards.

20. The apparatus defined in claim **19**, further comprising secondary memory means for storing the combination of said readout and said color-effect signals.

21. The apparatus defined in claim **20** wherein said secondary memory means includes a parallel-series converter connected to said transferring means.

22. The apparatus defined in claim **11** wherein said memory is a closed loop of punched tape.

23. The apparatus defined in claim **11** wherein said machine is a jacquard loom.

24. An apparatus for punching cards for a jacquard machine comprising:

a memory having a plurality of parallel tracks;

means connected to said memory for entering a plurality of weave patterns into respective tracks of said memory as trains of bits, each train being subdivided into at least two weft-data words representing each at least one weft repeat of the respective pattern, the weft-data words of said patterns having the same position in said memory with respect to readout therefrom;

means for generating a succession of color-effect signals;

means connected to said memory for reading said weft words out of said memory synchronously with the generation of said color-effect indicia;

multiplicity of gates each having one input connected to the color-effect generating means, another input connected to the pattern-memory reading means, and an output;

a crossbar having a plurality of parallel input conductors connected to the outputs of said gates and a plurality of output conductors crossing said input conductors;

means for connecting particular output conductors to particular input conductors according to predetermined definitions of said color-effects; and

a punching device having a plurality of punches each operatively connected to one of said output conductors.

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