United States Patent [19]

Seitz

[11] **3,745,243**

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[54] **SYSTEM FOR PRINTING A PATTERN WITH K LINES EITHER POINT BY POINT OR LINE BY LINE**

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[73] Assignee: **Firma Franz Morat GmbH,** Stuttgart-Vaihingen, Germany

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **178/6.6 R,** 178/5.2 A, 178/DIG. 3

[51] **Int. Cl.** **H04n 1/06,** H04n 1/46

[58] **Field of Search** ..... 66/154 A; 139/317, 139/318, 319; 178/5.2 R, 5.2 A, 6.6 R, 6.6 B, 6.7 R, DIG. 3

[56] **References Cited**

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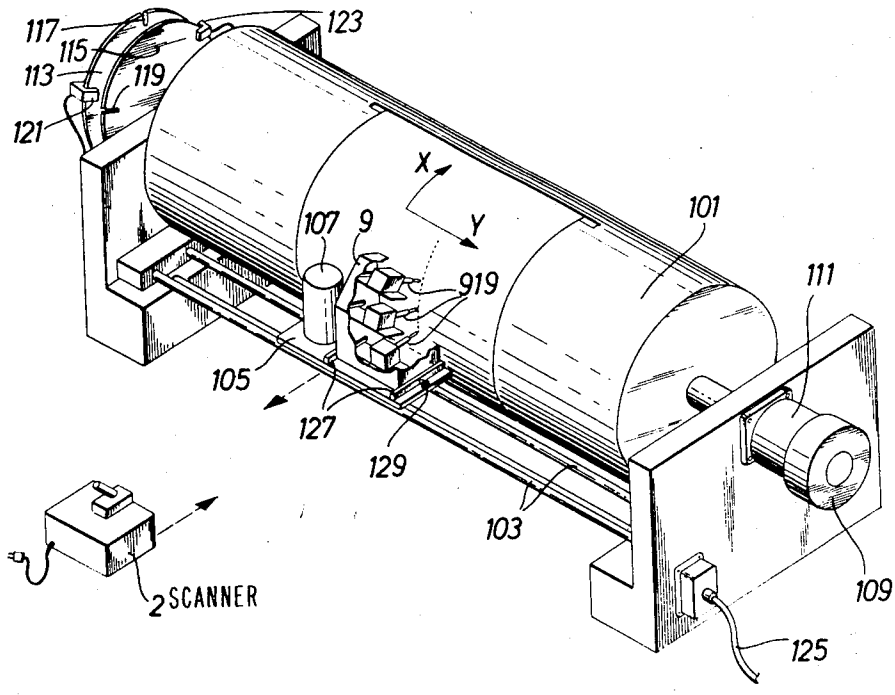
Primary Examiner—James W. Moffitt

Attorney—John Lezdey et al.

[57] **ABSTRACT**

The system has, in combination, a support arrangement for supporting a drawing paper and a printing arrangement for printing a pattern on this drawing paper: There is a transport device for producing a relative movement in two directions between the support arrangement and the printing arrangement. Electrical signals are produced which give information about all characteristics of the pattern and these signals are fed to the printing arrangement to print out the pattern either point by point or line by line. The system further includes an arrangement for automatically printing out the first m points or the first part of each line of the pattern following the printing out of the relevant complete line. There is also an arrangement for automatically printing out the first n lines of the pattern following the printing out of all of the k lines of the pattern.

16 Claims, 14 Drawing Figures



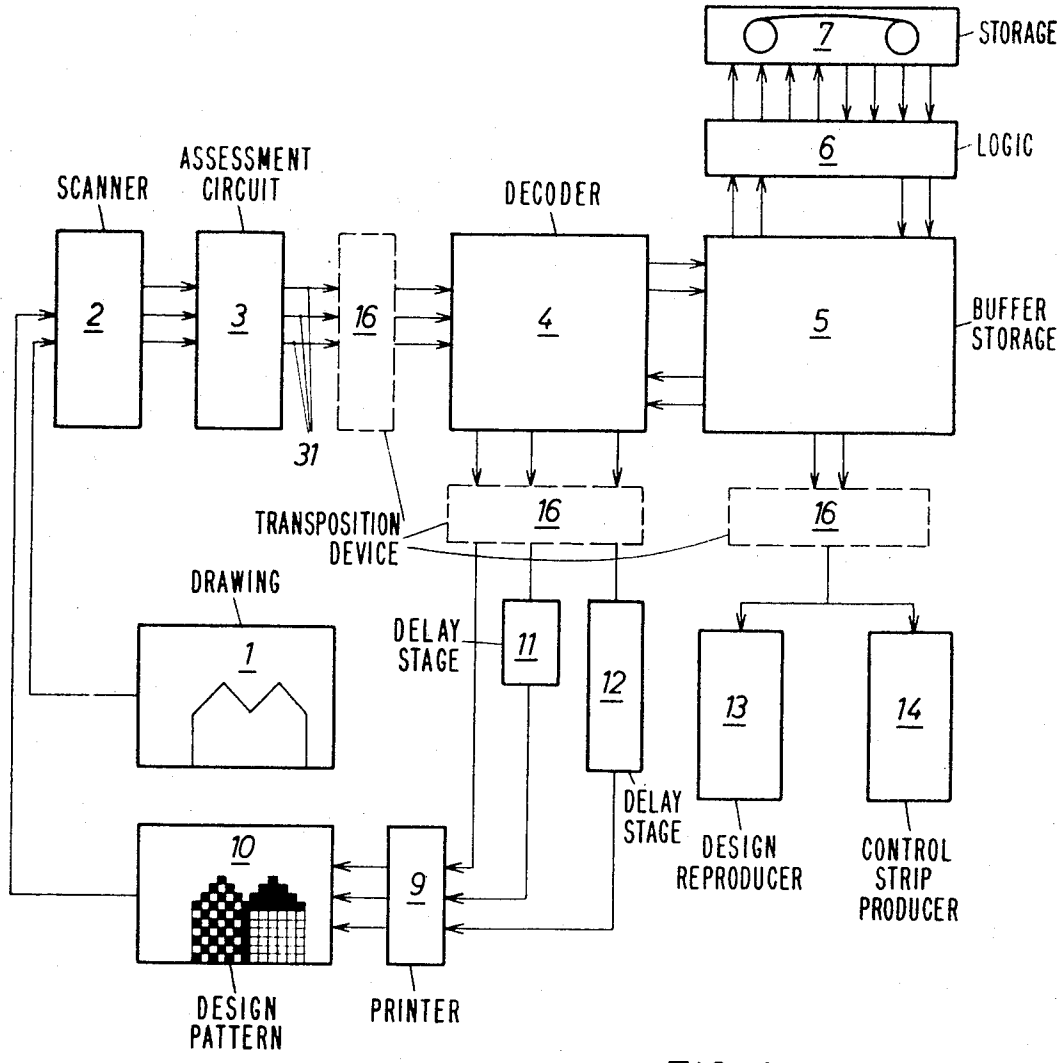

7
STORAGE
6
LOGIC
SCANNER
ASSESSMENT CIRCUIT
DECODER
2
3
16
4
5
BUFFER STORAGE
31
TRANSPOSITION DEVICE
16
16
DRAWING
1
DELAY STAGE
11
12
13
14
DELAY STAGE
DESIGN REPRODUCER
CONTROL STRIP PRODUCER
10
9
DESIGN PATTERN
PRINTER

FIG. 1

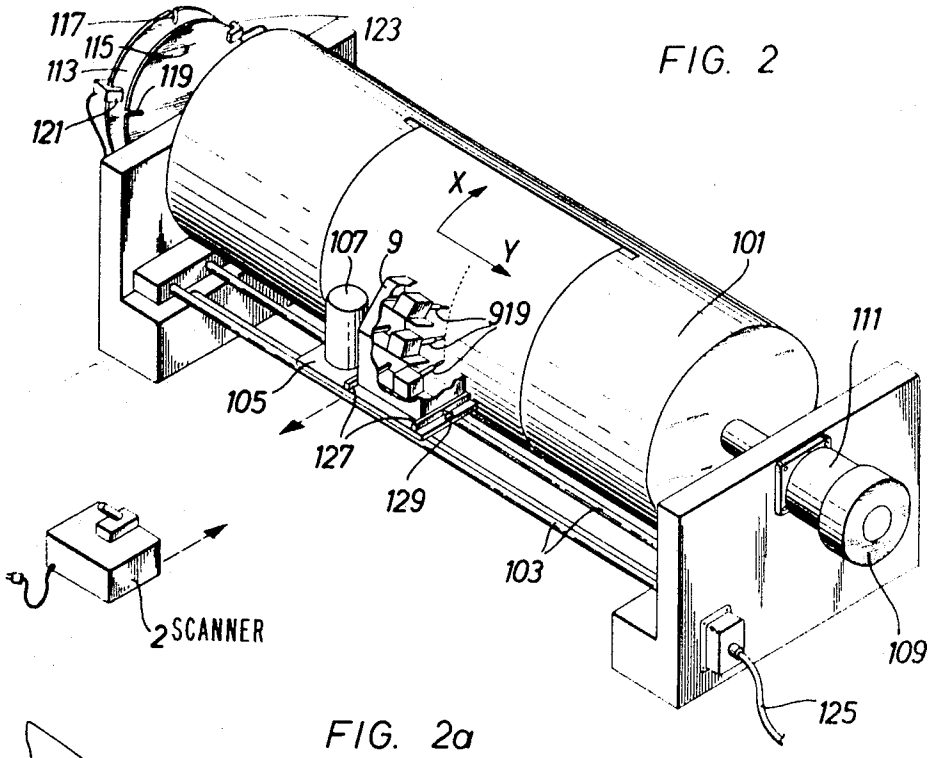

117
115
113
119
121
123
X
Y
107
9
919
101
111
105
127
129
103
109
125
2 SCANNER

FIG. 2

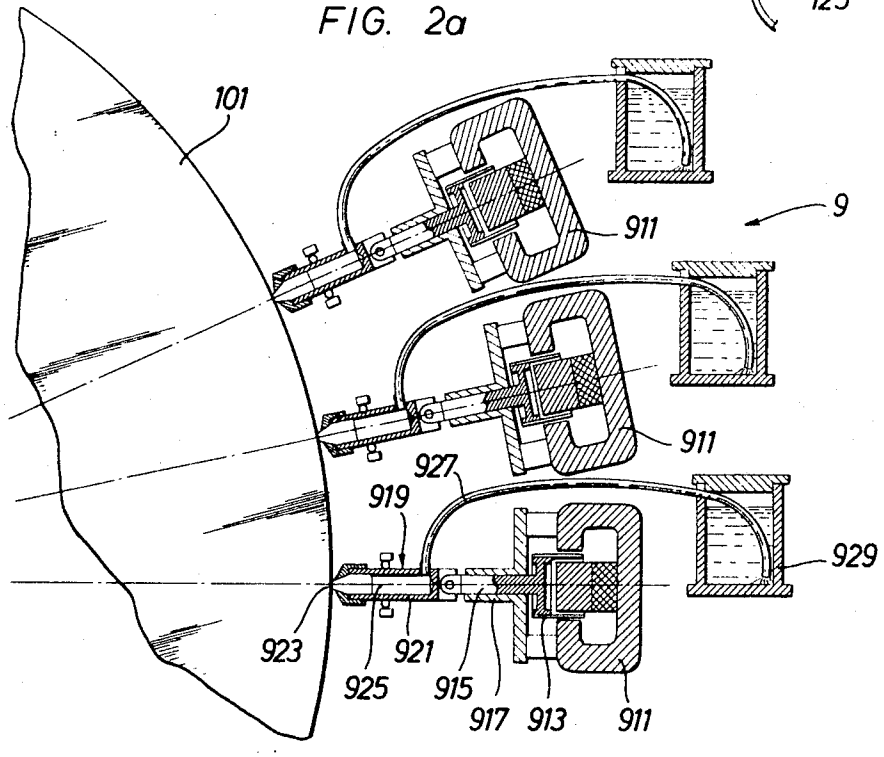
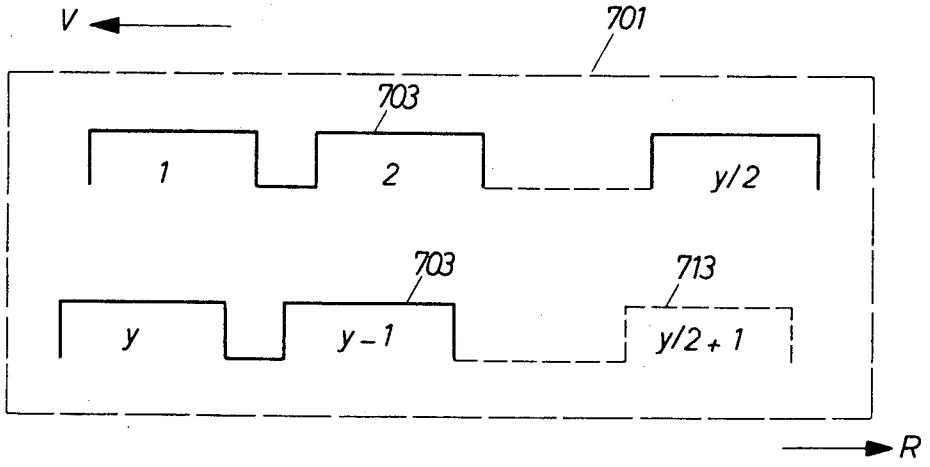

101
911
9
911
927
919
929
923
921
925
915
917
913
911

FIG. 2a

FIG. 3



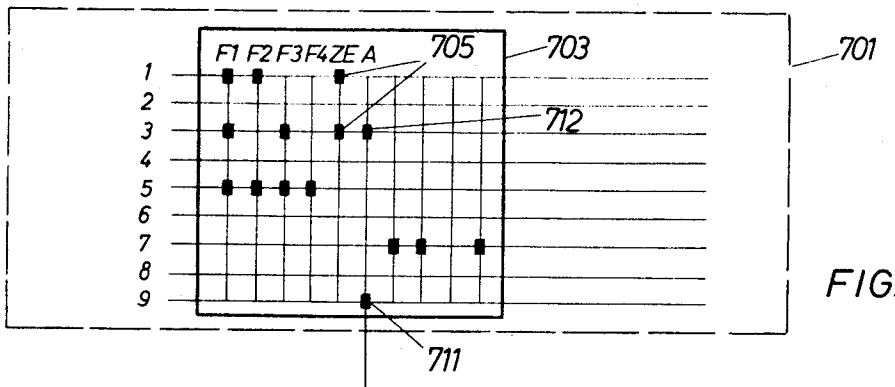


FIG. 3a

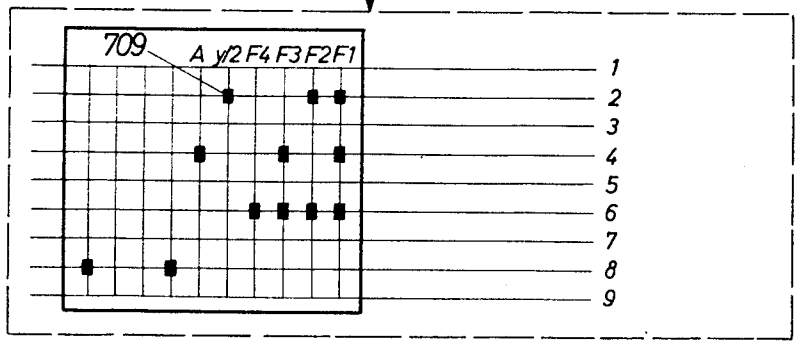


FIG. 3b

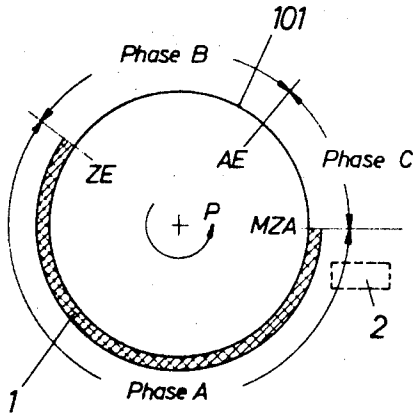

101
Phase B
ZE
AE
Phase C
P
MZA
2
1
Phase A

FIG. 4a

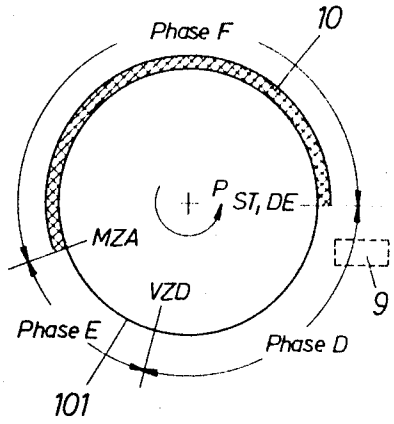
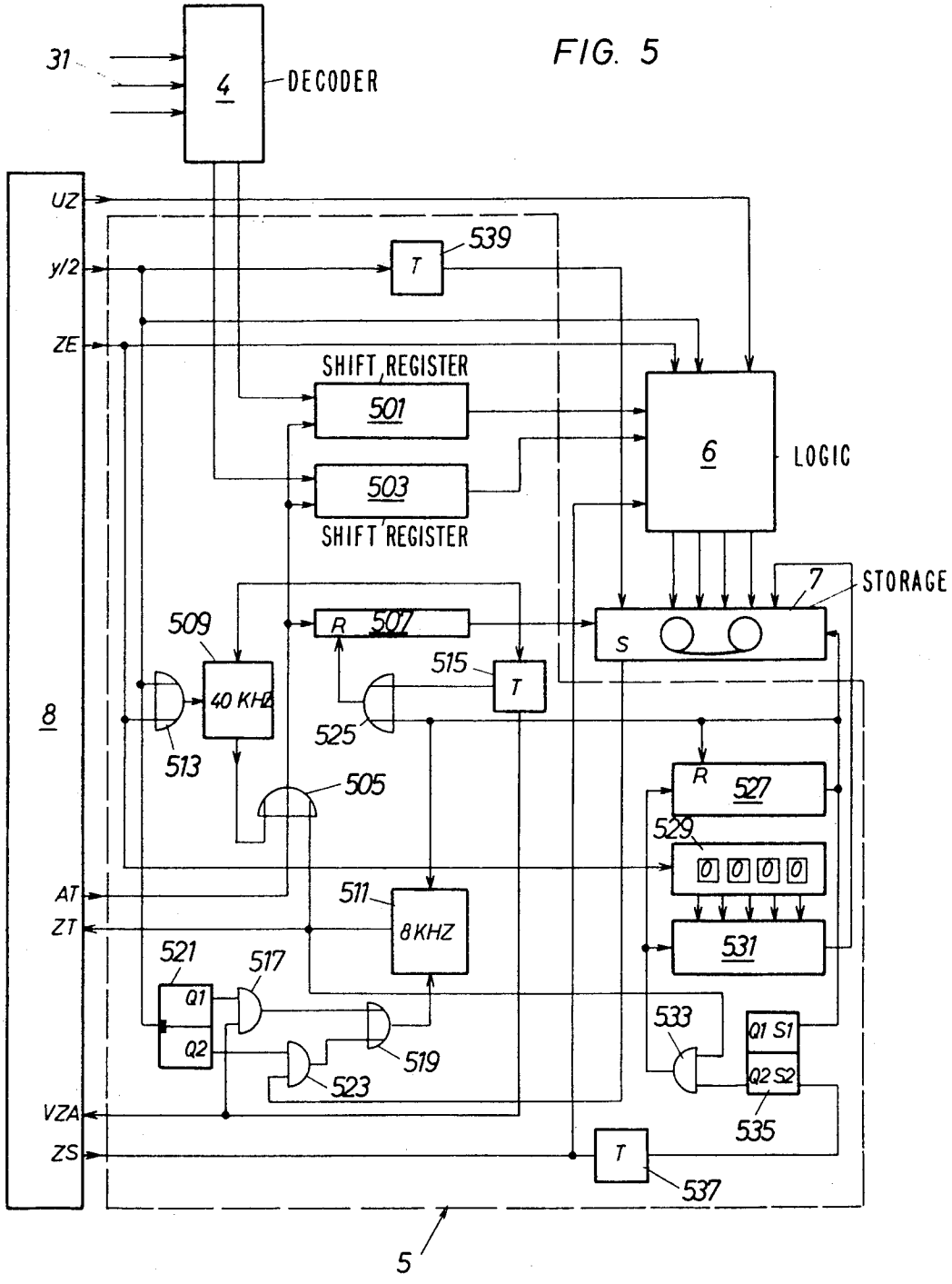

Phase F
10
P
ST, DE
MZA
VZD
9
Phase E
Phase D
101

FIG. 4b

FIG. 5


31
4
DECODER
UZ
y/2
ZE
T
539
SHIFT REGISTER
501
503
SHIFT REGISTER
6
LOGIC
7
STORAGE
509
R 507
S
515
T
40 KHZ
513
525
505
8
R 527
529
0 0 0 0
AT
ZT
511
8 KHZ
531
521
517
Q1
Q2
519
523
533
Q1 S1
Q2 S2
535
VZA
ZS
T
537
5

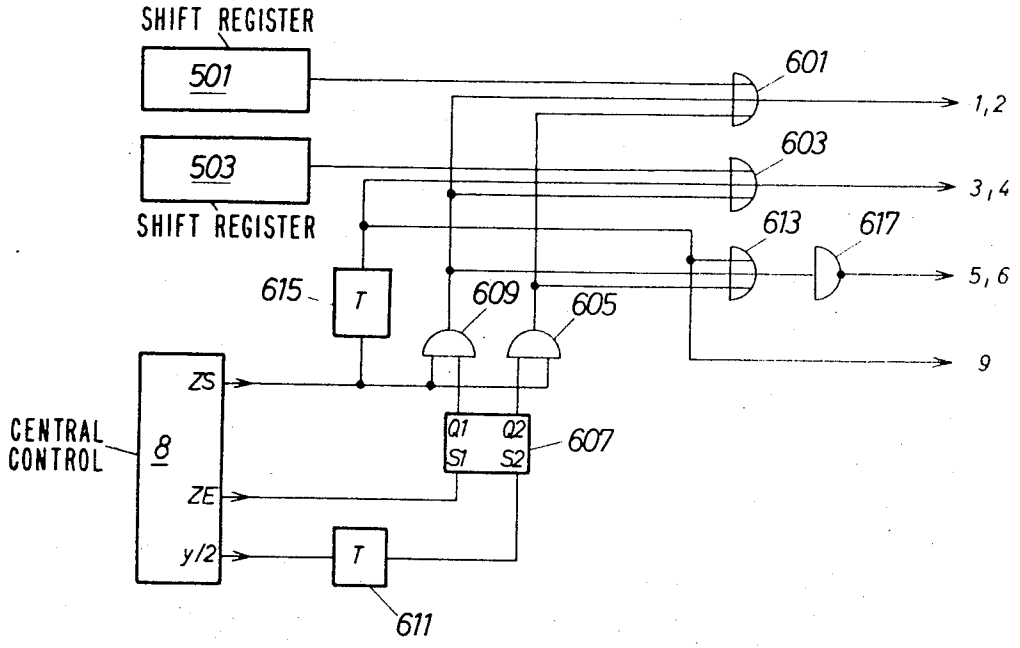

SHIFT REGISTER
501
503
SHIFT REGISTER
601
603
613
617
615
T
609
605
1,2
3,4
5,6
9
CENTRAL CONTROL
8
ZS
ZE
y/2
Q1
Q2
S1
S2
607
T
611

FIG. 6

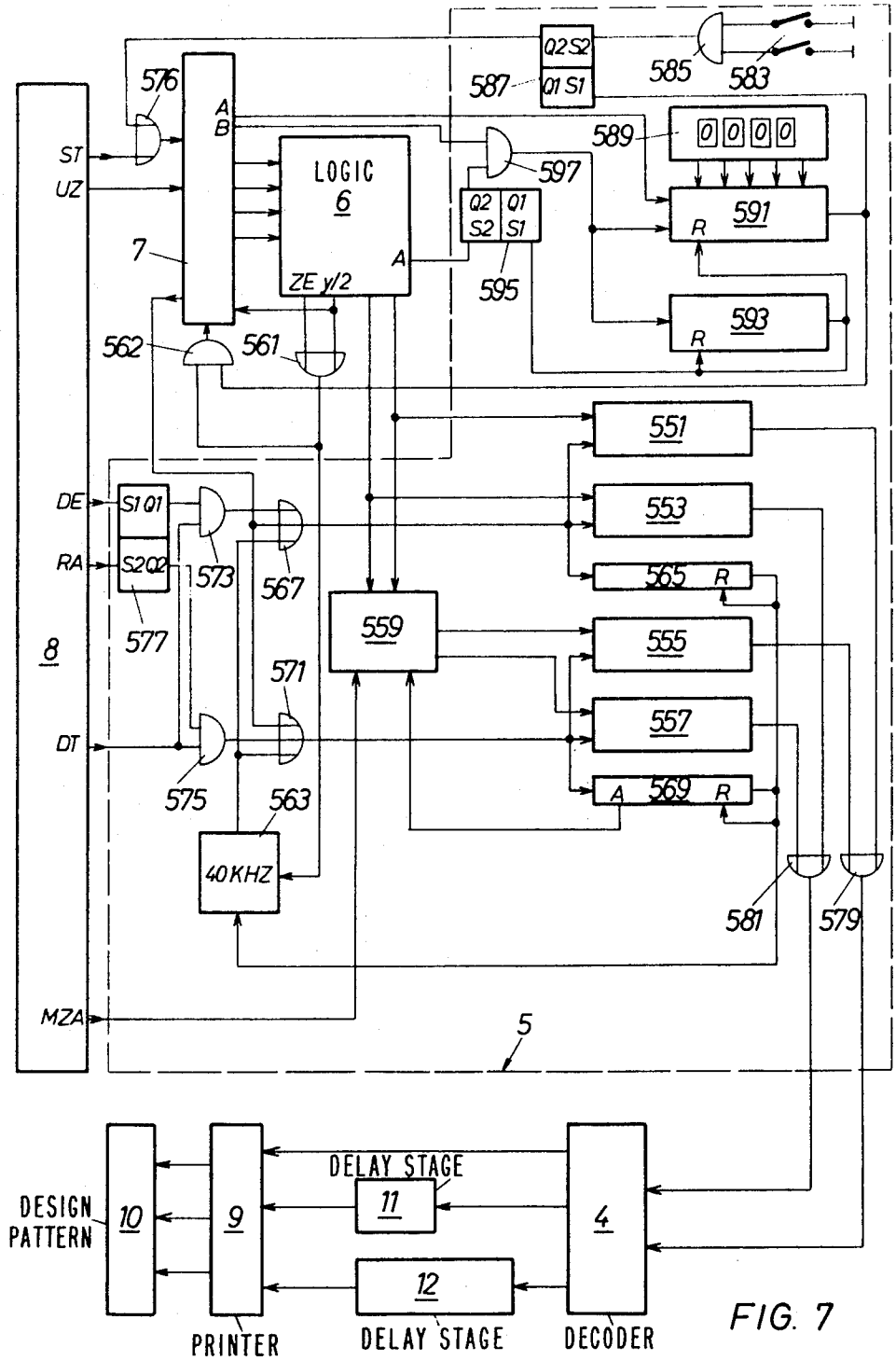
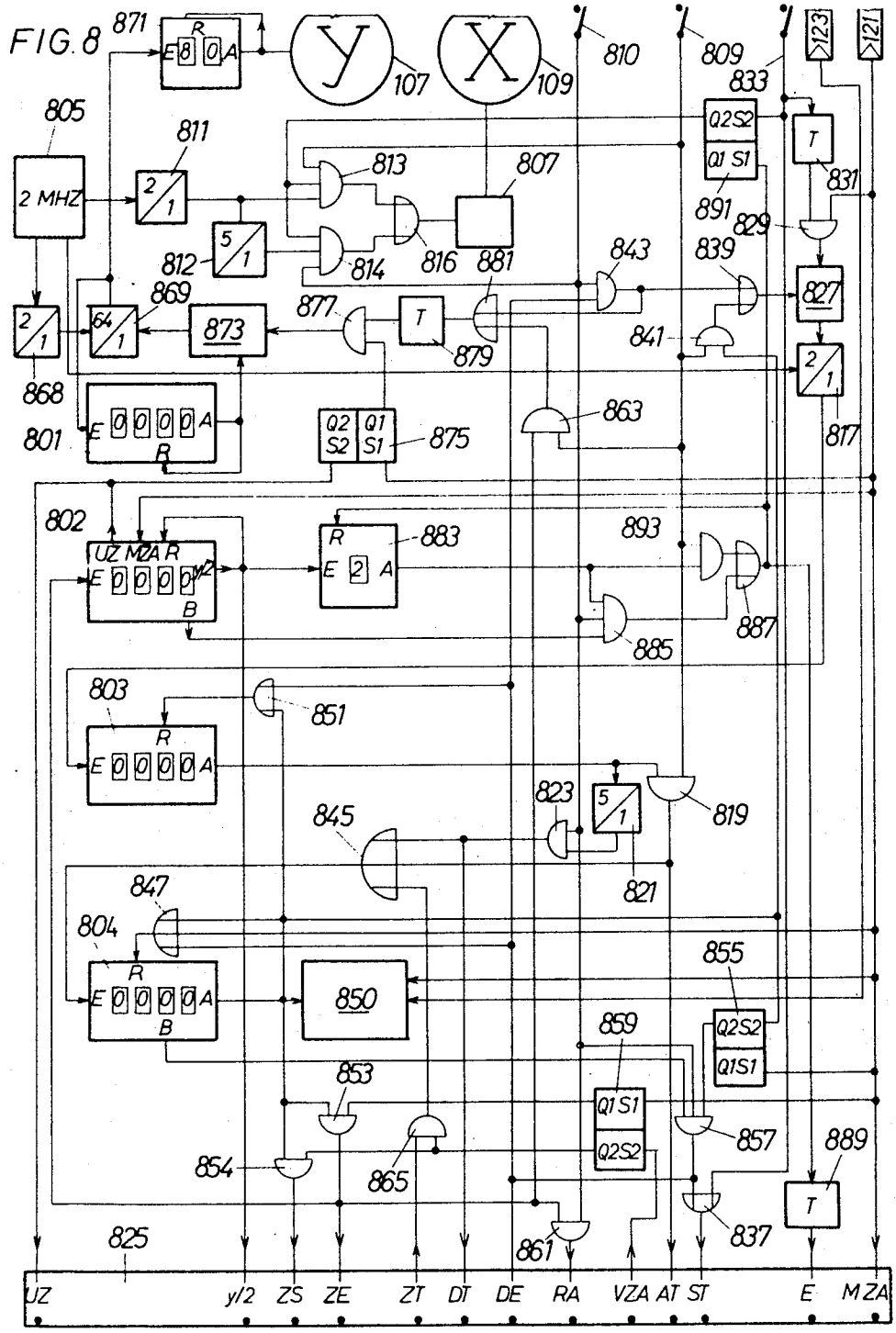

ST
UZ
7
576
A
B
LOGIC
6
ZE y/2
A
562
561
Q2 S2
Q1 S1
587
585
583
589
0 0 0 0
597
Q2 S2
Q1 S1
595
591
R
593
R
551
553
565 R
559
555
557
A 569 R
581
579
DE
S1 Q1
RA
S2 Q2
573
567
577
8
571
DT
575
563
40 KHZ
MZA
5
DESIGN PATTERN
10
9
PRINTER
DELAY STAGE
11
12
DELAY STAGE
4
DECODER

FIG. 7

9 Sheets-Sheet 8

FIG. 8



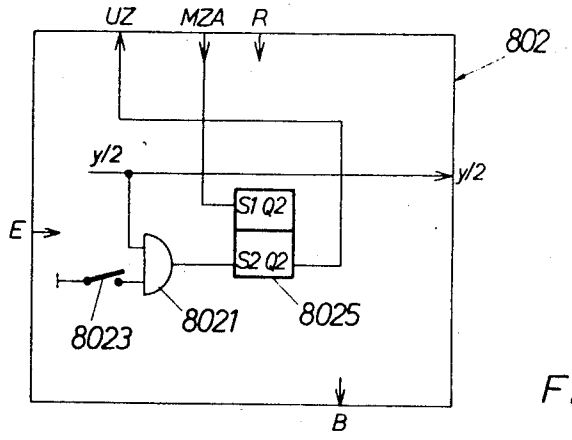

UZ
MZA
R
802
y/2
y/2
E
S1 Q2
S2 Q2
8023
8021
8025
B

FIG. 8a

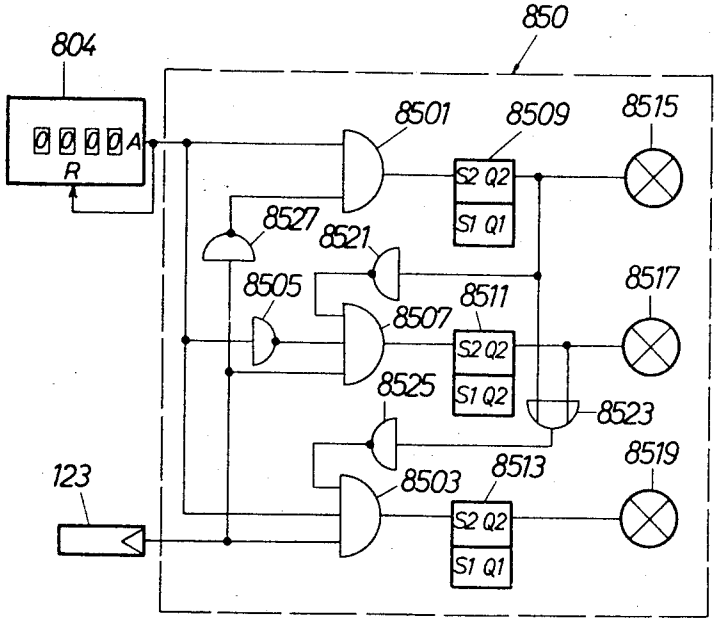

804
0 0 0 0 A
R
850
8501
8509
8515
S2 Q2
S1 Q1
8527
8521
8505
8511
8517
8507
S2 Q2
S1 Q2
8525
8523
123
8513
8519
8503
S2 Q2
S1 Q1

FIG. 8b

SYSTEM FOR PRINTING A PATTERN WITH K LINES EITHER POINT BY POINT OR LINE BY LINE

The invention relates to a device for printing a pattern with K lines point by point or line by line.

From British Pat. No. 1,190,600 a device is known by means of which a printer is moved in such a way over a drawing paper that for each point scanned a corresponding point is printed out. An important disadvantage of this device consists in the fact that it is not possible to see from the printed pattern whether it continues correctly in width or in height if it is used for controlling a machine, for example a knitting machine, a machine for the production of mozaic pictures or a device for the production of a control strip for such machines, and therefore is repeated many times in width and/or height.

When the known device is used it is only possible to check the correct repetition of the pattern after the printing of the pattern by supplementing manually the first *m* points in each line and the first *n* lines after the last line.

The invention is therefore based on the problem of providing a device by means of which these repetitions of the pattern can be checked both in the line direction and also in height without any appreciable loss of time.

Starting off from the device referred to above, the invention consists of a device for the automatic printing of the first m points or of the first part of each line of the pattern in conjunction with the printing out of the relevant complete line and/or a device for the automatic printing out of the first n lines of the pattern in conjunction with the printing out of all K lines of the pattern.

The invention provides the important advantage that the printing out of the pattern repetition takes place almost without loss of time. In the case of the device according to the above-mentioned British Pat. 1,190,600 this means that first of all one line is scanned and is printed out simultaneously, that then whilst the scanner head is at a standstill a pattern repetition is carried out in the line direction and that after this a commencement is made with the scanning or printing out of the next line. After the scanning of all the lines the scanner head is locked, whilst at the same time the first *n* lines are printed out again.

The devices for the automatic printing out of the pattern repetition preferably contain some form of storage devices in which the information required for the repetitions of the pattern are temporarily stored for so long as they are required for the printing operation.

The invention can be applied to all devices for printing out a multicoloured pattern. In particular it is not restricted to those devices in which the scanning operation and the printing operation take place almost simultaneously. Instead, it is also possible to scan any drawing in an earlier process stage and to store the scanning signals so obtained permanently in a storage device. If then in a later stage of the process the stored information is used for the control of the printer, the information which has been read out of the storage device can be subjected to temporary storage in the same way as the scanning signals above.

Although the invention is not restricted to the use of any type of temporary storage, shift register stages are preferred.

The invention is described below in conjunction with the drawing on the basis of a special example of execution.

FIG. **1** shows diagrammatically the overall structure of the device according to the invention.

FIGS. **2** and **2***a* show details of the scanning and printing device.

FIGS. **3**, **3***a* and **3***b* shows the nature and manner in which the scanned signals are stored.

FIGS. **4***a* and **4***b* show the different phases during the scanning or printing operation when using the scanning and printing device represented in FIG. **2**, and **2***a*.

FIG. **5** shows diagrammatically the circuit arrangements necessary for transferring the scanned signals into the storage device.

FIG. **6** shows a part of the logic used in the device according to FIG. **5**.

FIG. **7** shows in diagrammatical form the circuit arrangement which is necessary for converting the items of information stored in the storage device into control signals for the printing device.

FIGS. **8**, **8***a* and **8***b* show in diagrammatical form a central control unit and parts thereof.

FIG. **1** shows in diagrammatical form the overall structure of a device according to the invention for the automatic scanning of a freely drawn drawing, the so-called artist's drawing **1**, and for the automatic printing out of a drawing composed of individual colour dots, the so-called desigh pattern **10**. The artist's drawing **1**, like the design pattern **10**, is generally drawn in a number of colours, but it can also consist of zones with different tones of grey or the like if these lead to different reflection or transmission behaviours. Furthermore the artist's drawing **1**, like the design pattern **10**, generally possesses the size of a motif or repeat, that is to say it displays the smallest regularly recurring pattern, for example, of a textile article or of a mosaic picture.

During the scanning operation the artist's drawing **1** is scanned line by line by means of an optical/electrical scanning head **2**. The scanning signals so obtained are assessed in an assessment circuit **3** and/or classified and are then fed via coding an decoding unit **4**, a buffer storage **5** and a logic **6** to a storage unit **7** in which they are stored permanently in digital form.

During the printing operation the items of information stored are first of all read out of the storage device **7** and then via the logic **6**, the buffer storage **5** and the coding and decoding unit **4** they are fed to a printer **9**, which prints a drawing paper point by point and in this way produces a design pattern **10** corresponding to the artist's drawing but consisting of a large number of individual dots after the fashion of a screen, each screen dot being printed in a single colour. The individual dots of the finished design pattern **10** are, for example, allocated to one stitch of a knitted article or to one mosaic stone of a mosaic picture.

By comparing the design pattern **10** with the original artist's drawing **1** the designer can determine whether the knitting pattern or mosaic picture equivalent to the design pattern **10** correpsonds to his ideas in an optimum manner or whether there are still alterations to be made. After such alterations have been carried out (for example the point by point correction of the design pattern **10**) and after wiping out the items of information stored during the scanning of the artist's drawing, the design pattern **10** is then scanned so that in the storage device **7** it is now the information corresponding to the

corrected design pattern 10 which is stored. The operations described can be repeated as often as is necessary until during the printing operation a design pattern 10 is printed out which appears to be optimum, which is the same thing as saying that the stored information which is to be used later on for other purposes corresponds exactly with the desired design pattern 10.

In order to avoid its being necessary for the entire design pattern 10 to be re-scanned and stored every time, it is provided according to the invention that the information fed into the storage device 7 is provided with addresses. In this way it is possible to correct the stored information stage by stage. Preferably measures are provided which permit of an exchange of all those items of information which are allocated to a preselected line of the design pattern 10.

Between the printer 9 and the storage device 7 it is possible, according to the construction of the printer, also to insert delayed stages 11 and 12 in order to delay in relation to one another the items of information corresponding to the individual colours.

If it is found that the stored items of information read exactly to the desired design pattern, the storage device 7 is read out once again. The items of information read out are used via the buffer storage 5 and further devices not shown in the drawing either for the direct control of a machine 13 reproducing the design pattern 10 or are fed to a device 14 for the production of a control strip which is suitable for the electronic control of such machines.

Between the assessment circuit 3 and the storage device 7 or between the storage device and the machine 13 or device 14 it is also possible to insert a device 16 in order to bring the signals into a desired order, which is known in knitting technology, for example, as "transposition."

With the device described on the basis of FIG. 1 it is possible in the same way to scan artist's drawings 1 which have been drawn without screen processing and screen-processed design patterns 10. Furthermore it contains devices which will be described later on and by means of which it is possible to carry out changes of scale, that is to say an artist's drawing 1 can be stretched or compressed as desired over its entire width or height. This advantage makes it possible on the one hand to print with a constant dot size and on the other hand also to assess an artist's drawing if it has been drawn on a wrong scale or on a scale which is not pleasant visually. Since furthermore the scanning of an artist's drawing 1 is equivalent to the scanning of a design pattern 10, reference will only be made below to the artist's drawing 1 during the scanning operation.

During the scanning operation the artist's drawing 1 is stretched on to a drum 101 mounted so that it can rotate (FIG. 2), for example in such a way that its Y axis runs parallel to the axis of the drum and its X axis runs at right angles to the axis of the drum in the circumferential direction of the drum 101. On two rails 103 running parallel to the axis of the drum there is mounted a carriage 105 so that it can slide and which can be moved backwards and forwards by means of a stepping motor 107 in the Y direction along a generatrix of the drum 101. The scanning head 2 is mounted on the carriage 105.

Before the commencement of the scanning, the scanner head 2 is set at the beginning of the first line of the artist's drawing running in the direction X, so that during the first effective rotation of the drum the first line is scanned. At the end of the first line or of each successively scanned line so many stepping impulses are fed to the stepping motor 107 that the scanner head is located at the beginning of the next rotation of the drum exactly over the commencement of the next line of the artist's drawing 1 to be scanned.

During the printing operation the paper to be printed is stretched accordingly on the surface of the drum in such a way that its Y axis runs parallel to the axis of the drum and its X axis runs in the circumferential direction of the drum 101. The printer 9, on the other hand, is mounted on the carriage 105. As is the case during the scanning, the paper to be printed is printed 'ine by line until the pattern 10 is finished. The printer 9 is preferably equipped with printing pins 919 at a distance from one another in the X direction.

In order to achieve as high as possible a scanning speed, the scanning according to the invention is carried out in a completely automatic continuous process, in which during the entire scanning or printing operation the drum 101 is rotated continuously by means of a stepped or synchronous motor 109 and an intermediate gear 111, and the carriage 105 is moved forwards step by step.

The gear 111 can be designed as a change-over gear for adjusting a number of circumferential speeds of the drum 101. However, the adjustment of different rotation speeds of the drum 101 can be carried out by purely electrical means, as is described later on on the basis of the central control unit (FIG. 8). The correct adjustment is carried out preferably when actuating the keys "scanning" or "printing".

According to FIG. 2*a*, the printer 9 preferably contains several permanent magnets 911 which are fixed to a common support and into the air gap of each of which there projects a moving coil 913, to which a pin 915 is fixed, which is mounted so as to slide in a guide 917. At the other end of each pin 915 there is fixed a printer pin 919 which contains a tube 921, at the outer end of which there is provided a printing nib 923 made of felt or fibre material. Immediately adjoining the printer tip 923 in the tube 921 there is an insert 925 made of absorbent ceramic, felt or fibre material, with which a flexible pipe 927 is connected, which leads to an ink container 929.

The flexible pipes 929 are also filled according to the invention with a suitable fibre material and absorbent material, such as for example cotton wool, is preferably also provided in the ink container 929. As fibre material it is possible to use the width material which is usually employed in felt ends. Because of the wick action and the fact that at no point in the path of flow a free flow of the ink is possible, the feed of ink to the printer tip 923 takes place extremely uniformly. Even when a printer tip is unused for a long time during a printing cycle, no troublesome drops of ink occur when printing starts again nor any empty places caused by drying out. Before a renewed use after a very long period of standstill it is sufficient to dip the printer tips briefly in spirit.

The restoration of the moving coils 913 after a deflection can be carried out as in the case of loudspeakers by mechanical means or electrically by means of a push-pull circuit.

A further improvement in the application of ink is achieved by not directing the printer pins to the same point and therefore setting them obliquely, but aligning

them in such a way that the printer tips when in the pushed-forward position are at a distance from one another along a straight line or on an arc of a circle.

The advance of the carriage **105** is to be carried out in a period of time during which scanning or printing are not carried out at the same time. In the form of execution described here, therefore, the circumference of the drum is greater than the maximum possible extent of the artist's drawing **1** in the X direction. As a result of this, during the scanning or printing there is always a part of the circumference of the drum free between the end of one line and the beginning of the next line so that the Y advance can always be carried out whilst this free part is passing by the scanner head **2** or the printer **9.** According to other forms of execution, the drum **101,** so that there is sufficient time left for the Y advance, after the scanning or printing of one line can be allowed to rotate once more and during this second rotation the scanning or printing operation is blocked, or both forms of execution can be used in conjunction with one another, if for example the scanning operation takes place considerably more rapidly than the printing operation.

On the axis of the drum there are mounted rotatable signal discs **113, 115** with gap or hole markings **117, 119,** which are scanned with optical/electrical scanning devices **121, 123,** or any other signal transmitters. The markings **117, 119** can be adjusted accurately on the beginning of the line or the end of the line of the artist's drawing **1,** so that the scanning devices emit an electrical signal during each rotation of the drum **101** at the beginning of the line or at the end of the line. Below it will be assumed that the marking **117** is adjusted to the beginning of the line and the marking **119** is adjusted to the end of the line. The signal produced the marking **117** is therefore designated as the MZA signal (mechanical commencement of line) and the signal produced by the marking **119** is designated as the MZE signal (mechanical end of line).

On the frame supporting the drum **101** there is provided a connecting plug for a cable **125,** in which all the leads are fitted by means of which the voltages, signals etc. required for the operation of the drum or produced during the operation of the drum are fed in or collected.

According to one form of execution of the invention, the carriage **105** possesses a guide **127** into which it is possible to insert as desired either the scanner head **2** or the printer **9.** A screw **129** is used to fix it. According to another form of execution, it is possible to provide two separate drums **101,** which are only used either for the scanning operation or for the printing operation. According to further forms of execution of the invention it is possible to arrange a second carriage **105** on the rails **103,** which is transported by the same or a different stepped motor **107** in the Y direction. This arrangement is advantageous if it is desired to scan and print simultaneously. Finally, it is also feasible to arrange the carriage for the scanner head on the front of the drum and the carriage for the printer on the back of the drum.

For the purpose of scanning the artist's drawing **1** it is possible to use a scanner head **2** according to British Pat. No. 1,170,947 and 1,190,093, to which reference is expressly made here. Such scanner heads serve to pick up the light reflected from the illuminated artist's drawing and contain in the main three photo-diodes and three colour filters arranged in front of these, through which there is fed to each photo-electric cell only the light from a narrow range of wavelengths (for example blue, green, red). The photo-diodes have preliminary amplifiers connected up after them, which are brought to the same output level for the white basic colour of the artist's drawing **1.** The digital conversion of the analog signals which appear at the outputs of the preliminary amplifiers is carried out by post-amplifiers with suitably variable threshhold values in the separation circuit **3** arranged after the scanning head **2,** which possesses three outputs **31** (FIG. **1**) corresponding to the three photo-diodes. In the case of a four-colour artist's drawing (blue, green, red, white), when scanning a blue, green or red point there occurs a signal at one of the three outputs, whereas when scanning a white point a signal appears simultaneously at all three outputs. In the case of the additional use of the colours turquoise, lilac and yellow, when such a colour is scanned signals appear at two outputs of the separation circuit **3.** These signals are fed to the coding and decoding unit **4.**

In the coding and decoding unit **4** the items of colour information which correspond to the possible conditions at the outputs **31** have binarily coded words allocated to them. When four colours are used, words are sufficient for this purpose with two bits each, such as for example "**11**" for colour **1,** "**10**" for colour **2,** "**01**" for colour **3** and "**00**" for colour **4.** Since further items of information are stored in addition to the colour combinations, each of these words is enlarged still further by one bit in the logic **6,** so that in all three-digit words occur. In order to increase the reliability in avoiding error it is also possible to use parity bits. Finally it is possible to record each word twice. Since coding and decoding units are adequately known, we shall refrain from describing any further details.

According to one example of execution of the invention, one uses as storage unit a magnetic tape **701** (FIGS. **3,** *3a, 3b*), because this is advantageous for reasons of cost. However, in order to ensure that the magnetic tape can be used for the direct control, for example, of a knitting machine operating at 1,000 Hz, the recording of the items of information on the magnetic tape must be carried out in a special manner.

According to FIG. **3** the magnetic tape **701** is recorded blockwise, each information block **703** recorded containing all the items of information regarding one line of the artist's drawing **1.** In FIG. **3** the information blocks **703** are numbered consecutively from **1** to *y* in order to show the order of sequence in which they are recorded. Accordingly, whilst the magnetic tape **701** is travelling forwards (arrow V) the first half **1** to *y*/2 of all the information blocks **703** is recorded, whilst the remaining *y*/2 + **1** to *y* information blocks **703** are recorded during the return travel (arrow R). At the end of each information block **703** a special symbol is recorded. This special symbol has the meaning "end of line" in the information blocks **1** to *y*/2-**1** and *y*/2 + **1** to y-**1,** and indicates the end of a line in the artist's drawing **1** ("ZE symbol **705**" in FIG. *3a*). A special symbol which is written at the end of the last information block *y*/2 recorded during forward running means that the half of all the lines of the artist's drawing **1** have been recorded. This special symbol is referred to below as "first *y*/2 symbol", and the electrical signal allocated to it is referred to as the "first *y*/2 signal". A

symbol 709 which is identical in coding with the y/2 symbol (FIG. 3a), which is referred to below as the "second y/2 symbol" is recorded during the return travel at the end of the last information block. It indicates that now all the lines of the artist's drawing 1 have been scanned and recorded.

Since a three-digit binary word is allocated to each special symbol and each colour information, both during forward running and return running of the magnetic tape 701 three tracks are required. A further track each during forward running and return running is required in order to write an address between the informaition blocks which during the correction of the design pattern 10 serves to find the information block allocated to a given line and to replace it by a new information block. This is advantageous if the pattern has, for example, 500 or 1,000 lines, but only a few lines have to be corrected.

Finally a ninth track of the magnetic tape 701 is required in order to record synchronisation symbols 711 during forward running (FIG. 3a) and which are read during the return running of the tape and make it possible for the information blocks written during the return running to be arranged essentially at the same place as the information blocks written during the forward running. Instead of a synchronisation symbol, however, it is also possible to use for this purpose the line end and y/2 symbols.

The subdivision of the requisite tracks is, for example, as follows:

Forward running / Return running	Track 1 / Track 2	Track 3 / Track 4	Track 5 / Track 6	Track 7 / Track 8	Track 9 / —
Colour 1	1	1	1	0	0
Colour 2	1	0	1	0	0
Colour 3	0	1	1	0	0
Colour 4	0	0	1	0	0
Line end	1	1	0	0	0
y/2	1	0	0	0	0
A	0	1	0	1	1

The A symbol 712 (FIG. 3a) means that the address of an information block immediately follows this symbol.

The address for a given information block is in each case suspended on the previous information block for the purpose for the simplification of the entire device. This means that the first information block is immediately followed by the address for the second information block and the last information block is immediatly followed by the address for the first information block. If, therefore, during a search the tape is stopped after finding the address looked for, it is possible to begin immediately with the recording or the reading out of the desired information block. In FIG. 3a, for example, an information block 703 is represented, which is written during forward running and consists of the words for four colours F1 to F4, a line end symbol, an address symbol and a four-letter address. FIG. 3b, on the other hand, shows the last information block recorded during return running, which differs from the information block according to FIG. 3a by the y/2 symbol and a different address. This information block also begins where the synchronisation symbol 711 of the information block 703 allocated to it and recorded during forward running is located.

If the motif, and consequently the artist's drawing 1 or the pattern 10 consists of an odd number of lines, then in order to maintain the written organisation, an empty block 713 is formed at a defined place which can be seen from FIG. 3, which it is true is located at the same place as the information block y/2 + 1, but possesses no information in any single track.

When entering and reading back the magnetic tape 701 is operated by a start/stop mechanism, that is to say during the recording of an information block or empty block 703 or 713 it is transported continuously past the recording/reading threads which are not shown in the drawing and is kept so long there until all the symbols are available which are necessary for the entry into storage of an information block. At the end of the y/2-th information block it is switched over from forward running to return running by the first y/2 signal and then the recording of the remaining information blocks commences in the same way as during forward running. As a result of the second y/2 signal it is switched over once again from return running to forward running.

After this the recording/reading heads for the tracks 1, 3, 5, 7 and 9 must be located at a point in the magnetic tape 701 which is located in front of the first information block, so that during the next start of the magnetic tape 701 (reading cycle or correction) the entire first information block is included. Since at the starting or stopping of the tape, however, different time intervals are required and these time intervals can also vary, this must be ensured by special measures, for example the synchronisation symbols according to the invention in track 9, which according to FIG. 3a are located in the same place as the address symbols 712. During the return running of the magnetic tape 701, the reading head for the track 9 is switched on, which then always produces a synchronisation signal if the magnetic tape has a synchronisation symbol 711 in track 9. The synchronisation signals then act via a gate to release the entry into storage of the next information block, so that the information blocks y/2 + 1 to y begin and end practically where the information blocks 1 to y/2 begin and end. On the basis of the addresses and of the time interval which is required for stopping the tape, there also occurs the switching over from forward running to return running or vice versa by the two y/2 symbols in such a way that during the next starting of the tape the entire following information block is included.

The circumference of the drum 101 (FIG. 2) according to one form of execution of the invention is so much larger than the maximum possible width of the artist's drawing 1 or pattern 10 in the direction X so that during the period of time in which the uncovered part of the drum 101 runs past the scanning head 2 or the printer 9, the scanned information can be placed on the magnetic tape 701 (scanning operation) or a stored information block 703 can be read out and processed in such a way (printing operation) that all the control signals necessary for a line can be made available to the printer as the drawing paper travels past.

The phases arising from this during the scanning or printing are represented diagrammatically in FIGS. 4a, b.

FIG. 4a shows the scanning operation in which the drum 101 is rotated in the direction of the arrow P, the scanning head 2 is mounted on the carriage 105 and the

artist's drawing 1 is stretched on a part of the circumference of the drum.

During a phase A one line of the artist's drawing is scanned during each rotation of the drum. The phase A is introduced by the MZA signal (FIG. 2) produced by the marking 117. The scanning signals obtained are pushed into the temporary storage 5 and are transmitted to the magnetic tape 701 during a phase B which is introduced by the line end signal. It is true that the line end signal corresponds in time to the MZE signal produced by the marking 119, but it is electronically produced. The phase B is ended by an address end signal produced by another counter, which indicates that the information block corresponding to one line of the artist's drawing and also the address for the next information block have been placed on the magnetic tap 701. In a phase C, which is located between the address end signal and the MZA signal, there is no scanning nor recording on the magnetic tape 701. During the phases B and C there also takes place the setting of the carriage 105 to the next line of the artist's drawing. The duration of the phases A, B and C depends on the width of the artist's drawing 1 in the direction X and the time necessary for adjusting the carriage 105.

During the printing operation, according to FIG. 4b the drawing paper is stretched on the drum 101 which is rotated in the direction of the arrow P, and which after the printing operation forms the design pattern 10. The printer 9 is mounted on the carriage 105. After a start signal which is produced by means of a hand switch on the occasion of the first start and then afterwards is always produced by a counter after the printing out of a complete line as a "printing end signal," the reading out of an information block 703 on the magnetic tape 701 commences and the feed of this information block into the temporary storage 5.

The phase D is ended by a signal which is produced by a comparison counter of the temporary storage unit and indicates that the information block is ready for the printing operation in the temporary storage unit 5. This signal will be referred to below as the comparison/-counter/printing signal. In a phase E, which depends upon the length of a line of the design pattern 10, nothing happens. When the next MZA signal appears, a phase F then begins, in which the information which is ready in the temporary storage unit 5 is printed out. The end of printing signal then introduces the reading of the next information block and the moving of the carriage 105 forward by one line.

Below the temporary storage unit 5 is described which is surrounded by a broken line in FIGS. 5 and 7. The temporary storage unit 5 receives from the central control unit 8 (FIG. 8) the necessary control signals or supplies these signals to it.

FIG. 5 shows those parts of the temporary storage unit 5 which are required for the scanning operation, all the unessential parts or the parts which are obvious to the technician being omitted.

The temporary storage unit 5 contains as essential components two shift registers 501 and 503 which preferably contain at least as many storage elements as is derived from the sum of the screen dots of a line and the bits necessary for the special symbols and addresses.

The words formed in the coding and decoding unit 4 are offered to the two shift registers 501/503 parallel to the two information inputs. To the clock inputs of the shift registers 501, 503 it is possible to feed via an OR member 505 the impulses of the scanning clock (AT) formed at the output AT of lhe central control unit 8. The output of the OR member 505 is also connected with the counter input of a comparison counter 507 which is adjusted in a fixed manner to the number of the storage cells of the shift register 501, 503 and gives a comparison/counter/scanning signal when this number is reached.

With the clock inputs of the shift registers 501, 503 and the counter input of the comparison 507 there are also connected via the OR member 505 the outputs of two clock generators 509 and 511, the clock generator 509 supplying impulses with a relatively high sequence frequency (rapid stroke, for example 40 KHZ) and clock generator 511 supplying impulses with a relatively smaller sequence frequency (recording stroke, for example 8 KHZ), the latter being fed also as counter clock signals to an input ZT of the central control unit 8.

Line end or $y/2$ outputs of the central control unit 8 at which the line end or $y/2$ signals appear are connected via an OR member 513 with a start input of the clock generator 509, the stop input of which is connected with the output of the comparison counter 507.

The output of the comparison counter 507 is also connected via a delayed action stage 515 on the one hand with the comparison counter scanning input of the central control unit 8 and on the other hand via an AND member 517 and an OR member 519 with the start input of the clock generator 511. The other input of the AND member 517 is attached to the output Q1 of a flip-flop 521 whose clock input is connected with the output $y/2$ of the central control unit 8 and whose output Q2 is connected via a further AND member 523 with the other input of the OR member 519. The other input of the AND member 523 is connected to an output S of the storage device 7, from which the synchronisation signals stored in a track 9 are taken.

The output of the comparison counter 507 is finally also connected with the start input of the storage device 7 and, via the delayed action stage 515 and an OR member 525 with a restoring input R.

The stop input of the storage device 7, the stop input of the clock generator 511 and the other input of the OR member 525 are connected with the output of an address counter 527. The address counter 527, a binary counter 529 and a shift register 531 serve for writing in the particular address. The input of the binary countr 529 is connected with the line end output of the central control unit so that it is set by the end of line signals at each case to the address of the next following information block. As its initial position is the number 1, it is adjusted to the address of the second line by the end of line signal appearing after the scanning of the first line, so that this second line is suspended on the first information block. Correspondingly, the binary counter 529 is set to the address of the first line by the end of line signal of the last line, so that the first line is suspended on the last information block 703.

The binary counter 529 feeds the address set into the shift register 531, from which it is transferred by the time signals coming from the clock generator 511 to tracks 7 or 8 of the magnetic tape when an AND member 533 is accordingly prepared by the output Q2 of a flipflop 535. The input S2 of this flipflop is connected via a delayed action stage 537 with the counter stop

output of the central control unit, whereas the input S1 is connected to the output of the address counter 527, which is also located on its return input.

With the output of the AND member 533 there is also connected the input of the address counter 527, so that it also counts those strokes which are fed to the clock input of the shift register 531. The address counter is set to the number of bits which each address comprises, thus for example the number 9 or 10 if 500 or 1,000 screen dots are to be addressed per line. As a result of the end of address signal appearing at the output of the address counter the comparison counter 507 is also set back and the magnetic tape is halted.

The storage device 7 has an input which is connected with the output y/2 of the central control unit 8 via a delayed action stage 539. This input leads to a switch which is not shown in the drawing, which carries out the switching over from forward travel to return travel on the appearance of the first y/2 signal and the switching over from return travel to forward travel on the appearance of the second y/2 signal.

The outputs of the shift registers 501 and 503 are connected with two inputs of the logic 6. Further inputs of the logic are connected with the counter stop, y/2 and line end outputs of the central control unit 8. The tracks 1, 3, 5 and 9 of the magnetic tape 701 are recorded via the four outputs of the logic 6 during forward running, whilst the tracks 2, 4 and 6 are recorded during return running.

A further input of the logic 6 is connected with an UZ output (odd number of lines) of the central control unit 8. When the odd number of lines signal appears, an empty block 713 (FIG. 3) is recorded.

The logic 6 serves to prepare the signals required in the recording operation for the recording heads of the storage units 7 or during the printing operation to feed the information read out from the storage device 7 in the requisite order and sequence to the temporary storage 5. FIG. 6 shows diagrammatically that part of the logic 6 which is necessary for the recording operation. The part necessary for the printing operation is similarly constructed with the flow of information in the opposite direction.

According to FIG. 6 each input of two OR members 601 and 603 is connected with one of the outputs of the shift registers 501 and 503. To each other input of the OR members 601, 603 there are fed the output signals of an AND member 605, the one input of which is connected with the output Q2 of a flipflop 607 and the other input of which is connected to the counter stop output of the central control unit. A third input of the OR member 601 is connected with the output of an AND member 609, whose one input is connected with the output Q1 of the flipflop 607 and whose other input is connected with the counter stop output of the central control unit 8. The two inputs S1 and S2 of the flipflop 607 are connected with the end of line output or via a delayed action stage 611 with the y/2 output of the central control unit 8.

The outputs of the AND member 605 and 609 are connected with two inputs of an OR member 613, the third input of which is connected via a delayed action stage 615 with the counter stop output of the central control unit 8, the output of which has a reversing stage 617 connected after it.

The part of the logic 6 shown in FIG. 6 possesses four outputs shown diagrammatically, at which the signals to be fed to the tracks 1, 2 or 3,4 or 5, 6 or 9 are statically ready in the correct order of sequence and are scanned via gates with the recording stroke developed by the clock generator 511 (FIG. 5).

The delayed action stage 611 is intended to ensure that in the event of a y/2 signal appearing, this is delayed in relation to the end of line signal which appears almost simultaneously by the amount by which the output Q2 of the flipflop 607 is set. The delayed action stage 615, on the other hand, must delay the counter stop signal by exactly one stroke, so that when the counter stop signal appears the special symbol end of line or y/2 is first of all recorded in the tracks 1 to 6 and then the special symbol A is recorded in the next stroke. At the same time as the address symbol, the synchronisation symbol is recorded in track 9 during forward running. The switching over to the different recording or reading heads takes place automatically during the switching over of the storage unit 7 from forward travel to return travel or vice versa.

FIG. 7 shows those parts of the temporary storage 5 which are required for the printing operation, and once again all the unessential parts have been omitted. Furthermore, in order to make it easier to understand, the part of the temporary storage 5 required for the printing operation is represented in FIG. 7 as a system independent of the part according to FIG. 5 required for the scanning operation. Many of the components of the temporary storage unit 5, for example the shift registers 501 and 503, however, can be used both during scanning and during printing.

The part of the temporary storage 5 necessary for the printing operation contains as essential components four shift registers 551, 553, 555 and 557, which preferably have the same number of storage cells as the shift registers 501 and 503. The information inputs of the shift registers 551 and 555 or 553 and 557 are in each case connected in parallel, but an information barrier 559 is arranged in front of the information inputs of the shift registers 555 and 557. As a result of the information barrier 559 the information inputs of the shift registers 555 and 557 are kept free from information at certain intervals of time without the shift stroke fed to the stroke inputs being interrupted. The information inputs of the shift registers are located on the two information outputs of the logic 6, to which there are offered serially the words stored on the magnetic tape 701 during the reading operation of the reading heads of the storage device 7.

The part of the logic 6 required for the printing operation is not shown in detail, because it can be understood from the mode of operation of the device as a whole, and otherwise is similar to the part shown in FIG. 6 with the flow of information passing in the opposite direction. Besides the two information outputs at which the colour information stored in tracks 1, 3 or 2, 4 appear, the logic 6 possesses an end of line output and a y/2 output, at each of which signals appear when an end of line symbol 705 or a y/2 symbol 709 (cf. FIGS. 3a, b) are read out by means of the reading heads at the end of an information block 703. The end of line output of the logic 6 is connected via an OR member 561 and an OR member 562 arranged after this on the one hand with the stop input of the storage unit 7 and on the other hand with the start input of a clock generator 563. The y/2 output of the logic 6 leads on the one hand also to the OR member 561 and on the other hand

to an input of the storage device 7 which is connected with the switch for switching over from forward travel to return travel or vice versa.

The stroke inputs of the shift registers **551, 553,** together with the input of a comparison counter **565** which is set at the number of storage elements of the shift registers, are located on the output of an OR member **567,** whereas the stroke inputs of the shift registers 555/557 are connected with the input of a comparison counter **569** corresponding to the comparison counter **565** at the output of an OR member **571.** On each input of the OR members **567** and **571** there is connected the output of the clock generator **563** (rapid stroke, for example 40 KHZ) and at each other input there is connected an AND member **573** or **575.** Each input of the AND members **573, 575** is connected to a printer stroke output of the central control unit **8.** The other input of the AND member **573** is connected to the output Q1 of a flipflop **577,** the output Q2 of which is connected with the other input of the AND member **575.** The input S1 of the flipflop **577** is connected to an end of printing output and its input S2 is connected to a motif connection output of the central control unit **8.**

The third inputs of the OR members **567, 571** are finally connected with an output of the storage device 7 which supplies the read stroke for the tracks **1** to **6.** To this output there is fed, for example, by a switching arrangement which is usual in commercial magnetic tape recorders a stroke signal whenever the word just read from the magnetic tape **701** has a binary "1" in at least one place. Since according to the table given above in connection with FIG. 3 each word recorded on the magnetic tape **701,** regardless of whether it is dealing with a colour or a special symbol, possesses a binary "1" in at least one place, in the example of execution described here when each stored word is read out a stroke signal is produced, whereas when reading out an empty block **713** (cf. FIG. 3) from the commencement of the reading of the synchronisation symbol in track **9** up to the commencement of the reading of the following synchronisation signal no stroke signals are produced on the read strobe output. The magnetic tape **701** therefore runs away over the empty block during the printing operation at the commencement of the return travel.

A further start output of the central control unit **8** is connected with an input of an OR member **576,** the output of which leads to the start input of the storage device **7.**

The outputs of the comparison counters **565** and **569** are connected with the stop input of the clock generator **563** so that this is stopped by every comparison/counter/printing signal (cf. FIG. *4b*). Furthermore these outputs are connected to the return inputs of the two comparison counters.

The information carrier **559** possesses a start input which is connected with a further output A of the comparison counter **569.** This output A can be adjusted manually to any value of the comparison counter **569,** so that the information barrier **559** is switched on at any desired counter position. The information barrier **559** is switched once again to through passage by each successive MZA signal.

The outputs of the shift registers **551, 555** are connected via an OR member **579,** those of the shift registers **553, 557** are connected via an OR member **581** to the coding and decoding unit **4,** from which the decoded information is fed via the shift registers **11, 12** to the printer **9,** which prints out the design pattern **10.**

The part of the temporary storage **5** required for the printing operation also possesses a device by means of which, after setting the corresponding address, each desired information block on the magnetic tape **701** can be started in a search run. This device contains a double key **583** which on the one hand adjusts the central control unit to "printing" and on the other hand adjusts the magnetic tape drive to continuous running. The signal appearing via an AND member **585** sets the output Q2 of a flipflop **587,** which switches the magnetic tape drive and can be switched via the OR member **576,** even if stop signals are fed to the stop input via the end of line output or *y*/2 output of the logic **6.**

The desired address is provided by means of a binary counter **589** by setting the number of lines. With the binary counter there is connected a comparator **591,** to the information input of which there are fed the address bits taken from an output A of the storage device **7.** Furthermore, an address counter **593** is provided, the output of which, with its own resetting input R, is connected with the resetting input R of the compararor **591** and the input S1 of the flipflop **595.** The address counter **593** is set at the number of bits per address.

The stroke inputs of the comparator **591** and of the address counter **593** have fed to them stroke signals via an AND member **597** when this has been prepared via the output Q2 of the flipflop **595.** The input S2 of the flipflop is connected with an output A of the logic **6,** via which the A signals are fed in. The other input of the AND member **597** is connected with an output B of the storage device **7,** from which the read strobe of tracks **7** or **8** are taken as stroke impulses.

The mode of operation of this device is as follows. After a given address has been set in the binary counter **589** and after the flipflops **587** and **595** have been set at the outputs Q1, the key **583** is operated, as a result of which the magnetic tape drive is started. At the start, the magnetic tape can be located in any position. With the rear flank of each A signal the AND member **597** is prepared, so that the successive read strobe impulses push the address announced by the A signal into the comparator **591.** If this does not indicate any identity with the address standing in the binary counter **589,** the address counter **593,** the comparator **591** and the flipflop **595** are set back by the last stroke impulse of the output B.

When the next A signal appears, the same processes take place. If when the desired address is reached, identity is confirmed by the comparator **591,** then via its output the magnetic tape is stopped and the flipflop **587** is set back, by which means the search run is ended. As the address of an information block **703** is located in each case at the end of the preceding information block, the recording/reading heads of the storage unit **7** are now located immediately in front of the addressed information block so that the temporary storage **5** can be switched over to "scanning" and a new line can be scanned and stored.

On the basis of FIGS. **8, 8a** and **8b** the central control unit **8** is described below which controls the progress of all operations which take place during the scanning and printing or storing or reading of the information into or out of the storage unit **7.** The central control unit **8** thus comprises not only all the devices for producing the various start, stop, stroke and synchronisa-

tion signals, but also those devices which are necessary for adaptation to artist's drawings 1, design patterns 10 of different sizes or sizes of screen dots.

The central control unit 8 contains as essential parts the step motor 107 for driving the carriage 105 in the Y direction and the synchronous motor 109 for driving the drum 101 in the X direction (cf. also FIG. 2). There are allocated to the step motor 107 a Y screen gauge counter 801 (referred to below as the YRMZ counter) and a Y screen point counter 802 (referred to below as the YRZ counter). With the YRMZ counter it is possible to adjust the size of a scanning or printing point in the Y direction, whereas with the YRZ counter 802 it is possible to set the number of screen dots of the artist's drawing in the Y direction. Accordingly there are allocated to the synchronous motor 109, which arranges for the transportation of the artist's drawing or pattern in the X direction, an XRMZ counter 803 (X screen gauge counter) and an XRZ counter 804 (X screen dot counter).

The different signals fed to the counters or motors are derived from a joint rectangular generator 805. The generator 805 is connected via a frequency converter 807 with the synchronous motor 109. Between the generator 805 and the frequency converter 807 there is inserted in addition a 2:1 divider 811 when a key "scanning" 809 is depressed and a 5:1 divider 812 when a key "printing" 810 is depressed. The result of this is that the drum 101 during the scanning operation is driven at a higher rotation speed than during the printing operation. Between the two dividers 811 and 812 and the frequency transformer 807 there are also inserted two AND members 813 and 814 and also an OR member 816. The drum 101 is driven completely uniformly by the synchronous motor 109.

For scanning the artist's drawing 1 or for printing the design pattern 10 in the X direction, a scanning stroke or a printing stroke are derived from the generator 805. For this purpose the generator 805 is connected via a 2:1 divider 817 with the input E of the XRMZ counter 803, the output A of which on the one hand is connected directly with the input of an AND member 819 and on the other hand via a 5:1 divider 821 with the input of an AND member 823. The other input of the AND member 819 is connected with the "scanning" key 809 and the other input of the AND member 823 is connected with the "printing" key 810. The outputs of the AND members 819 and 823 lead to two connecting terminals AT (scanning stroke) and DT (printing stroke), which are arranged on a connecting plate 825.

The divider 817 is released or blocked by a releasing circuit 827. The release is effected via an AND circuit 829, to the one input of which there is connected a general starting key 833 via a delayed action stage 831, whereas its other input is connected with the scanning device 121 (cf. FIG. 2). The starting key 833 also leads via an OR circuit 837 to a connecting terminal ST (Start), whereas the output from the scanning device 121 leads to a connecting terminal MZA (mechanical line commencement). The blocking of the divider 817 is carried out via an OR circuit 839, the one input of which is connected with the output of an AND circuit 841, the one input of which leads to the key "scanning" 809 and its other input leads to the output A of the XRZ counter 804. Connected to the other input of the OR circuit 839 is the output of an AND circuit 843, the one input of which is connected with the "printing" key 810 and the other input of which is connected with a connecting terminal DE (end of printing).

The AND circuits 819 and 823 are connected via an OR circuit 845 with the input E of the XRZ counter 804, the restoring input R of which is connected via an OR circuit 847 with the output A of the XRZ counter 804 and the connecting terminal DE. The output of the XRZ counter 804 is also connected to the input of a circuit 850, which is referred to below as "X-Test" and is described in detail later on on the basis of FIG. 8b.

In addition, the signals which appear at the output of the XRZ counter 804 are fed via an OR circuit 851 to the restoring input of the XRMZ counter 803, to the one input of each AND circuit 853 and 854 and finally to the input S2 of flip-flop 855.

The output Q2 of the flip-flop 855 leads together with an outpub B of the XRZ counter 804 via an AND circuit 847 either to the connecting terminal DE end of printing or via the OR circuit 837 to the connecting terminal ST. The input S1 of the flip-flop 855 is connected with the connecting terminal MZA which is also connected to the input S1 of a flip-flop 859, whose output Q1 is connected with the other input of the AND circuit 853, the output of which leads to a connecting terminal ZE (end of line), to the input E of the YRZ counter 802, to an input of an AND circuit 861 and finally to an input of an AND circuit 863, the other input of which is connected to the key 809. The output Q2 of the flip-flop 859 is connected on the one hand with the one input of an AND circuit 865, the output of which leads via the OR circuit 845 to the input E of the XRZ counter 804 and whose other input is connected with a connecting terminal ZT (counter stroke), and on the other hand with the other input of the AND circuit 854, the output of which goes to a connecting terminal ZS (counter stop).

The other input of the AND circuit 861 is connected with the "printing" key 810. Its output leads to a connecting terminal RA (connection of motif). The input S2 of the flip-flop 859 is connected with a connecting terminal VZA (comparison counter/scanning).

The drive of the stepped motor 107 takes place from the generator 805 via a 2:1 divider 868, a 64:1 divider 869 arranged after this and a storage counter 871 arranged after this, whose output A is connected with its restoring input R. The divider 869, which feeds its output signals also to the input E of the YRMZ counter 801, is released or blocked from time to time by a release circuit 873. The release takes place on the one hand via the output Q1 of a flip-flop 875 which is connected with the one input of an AND circuit 877, and on the other hand via a delayed action stage 879, which is connected with the other input of the AND circuit 877. The input of the delayed action stage 879 is connected with an OR circuit 881, on the inputs of which there are located the AND circuits 843 and 863. The blocking of the divider 869 and the restoration of the YRMZ counter 801 take place via the output A of the YRMZ counter 801.

The YRZ counter 802 possesses three outputs, namely one output $y/2$, which is decoded to one half of the number of lines of the artist's drawing 1, an output B which is decoded to the end switching off, and an output UZ (odd number of lines), the meaning of which will be explained later on on the basis of FIG. 8a.

The output $y/2$ is connected with a connecting terminal $y/2$ of the connecting plate 825, with the input E of

a counter 883 and with the restoring input R of the YRZ counter 802. The output of the counter 883 leads together with the key 810 and the output B of the YRZ counter 802 to the three inputs of an AND circuit 885, the output of which leads on the one hand via an OR circuit 887 and a delayed action stage 889 to a connecting terminal E (end switching off) and on the other hand only via the OR circuit 887 to the restoring input R of the counter 883 and to the input S1 of a flip-flop 891, the input S2 of which is connected with the T 833. The output Q2 of the flip-flop 891 is connected with an input each of the AND circuits of 813 and 814. Also the output A of the counter 883 leads together with the key 809 to the two inputs of an AND circuit 893, which is connected with the other input of the OR circuit 887.

The output UZ of the YRZ counter is connected with the input S2 of the flip-flop 875 and with a connecting terminal UZ (odd number of lines). The YRZ counter also possesses an input MZA which is connected with the connecting terminal MZA.

The YRZ counter 802 represented once again diagrammatically in FIG. 8a is constructed in such a way that when there is an even number of lines after scanning or printing the line $y/2$ it produces a first $y/2$ signal and after scanning or printing the last line it produces a second $y/2$ signal. It differs from the other counters in that it counts upwards not to the figure set, but twice to one half of the figure set. In order to achieve this, a special decoding of the individual decades can be selected. The further mode of operation of the YRZ counter 802 is to be seen from the substitution diagram of FIG. 8*a*.

When preselecting an even number the key 8023 is not depressed, as a result of which a flip-flop 8025 connected after the AND circuit 8021, the output Q2 of which is connected with the output UZ, remains permanently set at its output Q1. When the counter is adjusted, for example, to the number "20" and the counting cycle begins at "1", then the YRZ counter is adjusted to the number "2" by the ZE signal, end of line signal, appearing after the scanning of the first line. At the end of the scanning of the tenth line, the YRZ counter, because it is decoded at "10", is set back to the number "1" with the indication of a $y/2$ signal, so that it beings to count once again and after scanning the twentieth line it is set back whilst emitting the second $y/2$ signal.

In addition the YRZ counter 802 is decoded in such a way that when it is set at an odd number of lines it counts up twice up to the number $y/2+1/2$. Furthermore, when it is set at an odd number of lines there occurs at one input of the AND circuit 8021 a "1", because the key 8023 is depressed. This has the consequence that the counter, after scanning the line $y/2+1/2$ once again gives a $y/2$ signal extending over the duration of scanning of the next line but also is set at its output Q2 by the $y/2$ signal of the flip-flop 8025, so that a "1" occurs at the output UZ during the duration of the whole of the next line.

Let it be assumed that the YRZ counter is adjusted to the number "21", as a result of which the key 8023 is depressed automatically. In this case the YRZ counter is not decoded at 10.5, but at $y/2+1/2 = 11$. Consequently first of all 11 full lines of the artist's drawing are scanned before the $y/2$ signal appears, as a result of which Jhe storage device 7 is switched over from forward running to return running. As a result of the UZ signal appearing at the same time as the $y/2$ signal, in FIG. 8 the flip-flop 875 is set at its output Q2, so that the ZE signal, end of line signal, which also appears at the same time as the $y/2$ signal and which is delayed by the delayed action stage 879, does not reach the release circuit 873. As the UZ signal disappears together with the $y/2$ signal only after the appearance of the next end of line signal, this operation cannot be upset even by a MZA signal appearing in the meantime. According to FIG. 5, the UZ signal is also fed to the logic 6 in order to suppress any recordings on the magnetic tape 701 during the renewed scanning of the eleventh line, which corresponds to recording an empty block.

The consequence of this is that after scanning the eleventh line the stepped motor 107 is not set in motion and the eleventh line is scanned once again.

Because of this design of the YRZ counter 802 the second $y/2$ signal is not produced until the end of the 20nd line in the case of an odd number of lines. Because of the double scanning of the eleventh line, however, this corresponds to the scanning of exactly 21 lines, for which the YRZ counter 802 is set.

During printing it is possible for more or less the same operation to take place; i.e., when the UZ signal appears, as is represented in FIG. 8, one could block for the duration of one line on the one hand the Y advance and on the other hand by a connection to the storage unit 7 (cf. FIG. 7) the further movement of the magnetic tape. However, there is also the possibility during printing to use an entirely normal YRZ counter because the empty block after switching over from forward travel to return travel and after renewed starting of the tape would run past the reading heads without effect until the next following information block is read out without a fresh stoppage of the tape. The YRZ counter 802 therefore in the main only decides whether an empty block 703 is to be recorded or not on the magnetic tape 701.

In FIG. 8 the X-Test circuit 850 is shown in diagrammatical form. According to FIG. 8 its inputs are connected with the outputs of the XRZ counter 804 or the scanning device 123. The output of the XRZ counter 804 leads to one input each of AND circuits 8501 and 8503 and via a reversing stage 8505 with the input of an AND circuit 8507. The outputs of the AND circuits are connected with the inputs S2 of each flip-flop 8509, 8511 and 8513. The outputs Q2 of these flip-flops lead to lamps 8515, 8517 and 8519. The output Q2 of the flip-flop 8509 is connected via a reversing stage 8521 with an input of the AND circuit 8507 and, as is also the case with the output Q2 of the flip-flop 8511, via an OR circuit 8523 and a reversing stage 8525 with an input of the AND circuit 8503. Between the scanning device 123 and the the one input of the AND circuit 8501 there is also a reversing stage 8527. The inputs S1 of the flip-flops are connected with the connecting terminal MZA.

The X-Test circuit 850 is intended to ensure that the scanning of an artist's drawing 1 begins exactly at the desired commencement of line or ends at the desired end of line. The exact beginning at the commencement of line is ensured during the scanning operation by the MZA signal, after the marking 117 (FIG. 2) has been accurately adjusted whilst the drum 101 is standing still. Whether the scanning ceases exactly at the end of line determined by the marking 119 (FIG. 2) depends

on the adjustment of the XRMZ counter 803, because the number of screen dots per line, which is set by the XRZ counter 804, is determined in advance by the desired repeat or the desired number of dots per line. By means of the XRMZ counter 803, therefore, before commencing the scanning the width of a screen dot in the direction of the line must be adjusted in such a way that the total width of all the screen dots corresponds exactly to a line length.

As the XRMZ counter 803 can be adjusted very finely, first of all an approximate calculation is made as to the value at which it will have to be set. Then the drum 101 is set in motion by pressing the starting key 833 (FIG. 8). The Y step motor 107 can remain switched on or else it can be switched off.

After the arrival of an MZA signal (cf. FIG. 8) which sets all the flip-flops in FIG. 8*b* at their output Q1, the divider 817 is released in conjunction with the key "scanning" 809, as a result of which the XRMZ counter 803 begins to count. When the number which has been set is reached, the XRZ counter 804 is put forward one step which means that the first dot of the screen is scanned. After the scanning of all the dot points set by the XRZ counter 804, if the XRMZ counter 803 has been properly adjusted, a signal appears at the output A of the XRZ counter 804 exactly simultaneously with the MZE signal of the same length of the scanning device 123. If the two signals appear simultaneously, then the lamp 8519 lights up because the flip-flop 8513 is set to the commencement Q2. On the other hand, the two lamps 8515 and 8517 do not light up, because for the duration of the XRZ signal the AND circuit 8507 and for the duration of the MZE signal the AND circuit 8501 do not let through any signal to the relevant flip-flops.

If the XRZ signal appears before the MZE signal, then the lamp 8515 lights up, because before the appearance of the MZE signal at both inputs of the AND circuit 8501 there occurs a "1". The two other lamps do not light up because the flip-flops are set in each case with the rear flank of impulses and when this rear flank appears the flip-flop 8509 is already set so that at each input of the AND circuits 8507 and 8505 a "o" occurs when the MZE signal arrives. Something similar applies to the case where the XRZ signal arrives later than the MZE signal. In this case only the lamp 8517 lights up.

When the lamp 8515 lights up the width of each screen dot must be increased by a small amount so that by adjusting the XRMZ counter 803 to a larger number the XRZ signal appears somewhat later. Conversely the XRMZ counter 803 must be set at a smaller number if the lamp 8517 lights up. The more finely the XRMZ counter can be adjusted, the more accurately can the appearance of the XRZ signal be adapted to the appearance of the MZE signal; in the ideal case this can be carried out up to a value which is smaller than the width of the signal MZE or XRZ.

In the device according to the invention a Y-Test corresponding to the X-Test is not absolutely necessary. When starting up the apparatus, first of all the scanning head 2 is adjusted to the first line of the artist's drawing 1 stretched on the drum 101. Then the YRMZ counter 801 is adjusted to the Figure calculated and the central control unit is started up with the synchronous motor 109 switched off. By this means in a trial run the carriage is moved to beyond the last line of the artist's drawing. If the YRMZ counter is correctly adjusted, the scanning head remains exactly over the last line. If this is not the case, then fresh trial runs are carried out with an altered adjustment of the YRMZ counter until the number set is correct.

Contrary to the X-Test, and the Y-Test can be carried out with the drum 101 at a standstill, so that an automatically operating device would be superfluous for it. The accurate visual adjustment to a given point of the surface of the drum is facilitated by an eyepiece with crossed threads and a circle surrounding the crossed threads, the circle visible in the eyepiece rendering accurately visible that range of the drum which is comprised by the lens of the scanning head.

The adjustment of the screen size can be carried extra-ordinarily accurately with the help of the storage counter 871 and the YRMZ counter 801. The storage counter avoids an addition of the error which is unavoidable by adjusting the YRMZ counter 801 per screen dot, so that after each Y advance carried out, the total error is less than a motor step. If a motor step corresponds to an advance of the carriage 105 of 0.05 mm, then the total error at any point in the artist's drawing 1 is always smaller than 0.05 mm. The storage counter 871 can have a fixed adjustment or it can be adjustable. When one uses an adjustable storage counter 871, the YRMZ counter 801 can have a fixed adjustment.

The mode of operation of the part of the device according to the invention which is essential for scanning an artist's drawing 1 will be described below on the basis of FIGS. 4*a*, 5, 6 and 8.

After carrying out the X-Test and the Y-Test and the relative adjustment of the different counters, first of all all the flip-flops are set at their output Q1 by pressing a clearing key which is not shown in the drawing. Then the AND circuits 813, 841, 863, 893 and 819 are prepared by pressing the "scanning" key 809. The scanning operation then takes place completely automatically when the starting key 833 is depressed.

By pressing the starting key 833 the AND circuit 813 is prepared for passage, so that the synchronous motor 109 drives the drum 101 at the scanning speed. At the same time the starting signal is delayed by the delayed action stage 831 and until the drum 101 has reached its full rotation speed and synchronism. Only then is the AND circuit 829 prepared in such a way that when the next MZA signal arrives the divider 817 is released. After this release, the strokes of the divider 817 are fed to the XRMZ counter 803, from the output of which the scanning stroke is taken via the connecting terminal AT. The scanning strokes are fed according to FIG. 5 to the stroke inputs of the shift registers 501 and 503 and also to the comparison counter 507 and according to FIG. 8 to the XRZ counter 804. As a result of this, the words formed in the coding and decoding unit 4 (colour information) of a line are pushed into the shift register, as a result of which the phase A in FIG. 4a is ended.

When all the dots of a line have been scanned, a signal appears at the output of the XRZ counter 804 which is fed via the AND circuit 853 as an end of line signal on the one hand to the logic 6 (FIG. 6) and on the other hand to the starting input of the clock generator 509 (FIG. 5). As a result of this, the information blocks located in the shift registers 501 and 503 are pushed in rapid strokes as far as the end of the shift reg-

isters 501, 503, whilst on the other hand the scanning stroke is blocked via the AND circuit 841 (FIG. 8).

When the information block is pushed by the rapid stroke to the end of the shift registers 501 and 503, a capital VZA signal appears at the output of the comparison counter 507, which switches on the clock generator 511 with delayed action and sets the flip-flop 859 on the output Q2. Furthermore the VZA signal switches off the clock generator 509 without delayed action and switches on the magnetic tape drive of the storage device 7. When the magnetic tape has reached its full speed, the stroke signals of the clock generator 511 are used for the recording on the magnetic tape via the logic 6, of the information located in the shift registers 501 and 503. At the same time the stroke signals are fed via the connecting terminal ZT to the input of the XRZ counter. When this happens the setting of the flip-flop 855 brought about by the end of line impulse does not take effect because the signal appearing at the output B of the XRZ counter 804 only results in a resetting of the counter 804 during the printing operation via the end of printing connecting terminal. By the setting of the flip-flop 859 at its output Q2, the next signal emitted by the YRZ counter 804 which indicates that all the colour information has been recorded on the magnetic tape, is fed via the AND circuit 854 on the one hand to the logic 6 and on the other hand to the flip-flop 535.

As can be seen from FIG. 6, the counter stop signal ensures that the end of line signal stored in the flip-flop 607 during the preceding counting cycle of the XRZ counter is connected to the block of information which has just been recorded. When this stroke has passed, the flip-flop 535 is set via the delayed action stage 537, so that now the stroke signals of the clock generator 511 are fed via the AND circuit 533 to the stroke inputs of the shift register 531 and of the address counter 527. At this time the binary counter 529 is located on the address of the second information block, because it has been pushed forward by one stroke by this end of line signal which appeared previously. If the address has been completely recorded, the address counter 527 emits the end of address signal, which switches off the magnetic tape drive, switches off the clock generator 511 and sets back the comparison counter 507 and also the binary counter 527. Also as a result of the end of an address signal the flip-flop 535 is once again set on the output Q1. As a result of this the end of the phase B (FIG. 4*a*) is reached.

As a result of the end of line signal emitted during the first counting cycle of the XRZ counter 804 during phase A, independently of the recording operation just described according to FIG. 8 the stroke of the divider 869 is released with a slight delay, as a result of which the step motor 107 is carried forward by exactly as many steps as is necessary for the carriage 105 with the scanning head 2 now to be located over the second line of the artist's drawing. The blocking of the stroke signals of the clock generator 869 takes place after this position has been reached via the YRMZ counter 801.

After the termination of phase C, the next MZA signal appears, by means of which the XRZ counter 804 is set back again and the flip-flops 859, 855 and 875 are set at their output Q1. Furthermore the scanning stroke is released again via the AND circuit 829.

The operations described now repeat themselves sufficiently often until the first *y*/2 signal is emitted by the YRZ counter 802. This *y*/2 signal is then stored in the flip-flop 607 (FIG. 6) instead of the end of line signal and is recorded on the magnetic tape 701 instead of the end of line signal. Furthermore the *y*/2 signal according to FIG. 5 is used for switching over the storage device 7 from forward running to return running. This switching over, however, only takes place with the help of the delayed-action stage 539 when the last recorded information block is still provided with the address of the next information block. During the return run, the operations described then take place once again in a cyclic order of sequence, but it must be borne in mind that the track 9 of the magnetic tape is read. The result of this is that the information blocks are not recorded already on the appearance of the comparison counter scanning signal but only when at the output S of the storage device 7 a synchronisation signal appears which brings about the starting of the clock generator 511 via the AND circuit 523. In point of fact the AND circuit 523 is prepared by the *y*/2 signal instead of the AND circuit 517.

After the scanning of the last line of the artist's drawing 1 there appears at the output of the YRMZ counter 802 a second *y*/2 signal which in addition to the operations which the first *y*/2 signal introduces ensures that at the output of the counter 883 set at the number 2 there appears a signal which is fed via the OR circuit 887 and the delayed-action stage 889 to an end switch-off (not shown in the diagram). The delayed-action stage 889 is adjusted in such a way that although the address of the next information block is still recorded, nevertheless no renewed start of the magnetic tape can take place in the forwards direction. Furthermore the signal of the counter 883 is used for setting back the flip-flop 891, as a result of which the synchronous motor 109 is topped.

On the magnetic tape 701, according to FIG. 3, all the information blocks 703 are now recorded after the fashion of an endless loop, so that the magnetic tape can be read as often as desired by alternately switching over from forward travel to return travel or vice versa, without any time being lost by having to re-wind the magnetic tape. This type of recording on the magnetic tape also has considerable advantages as compared with the use of a magnetic tape which has been stuck together to form an endless loop, because the length of such an endless loop would depend on the number of information blocks to be recorded, if there were not to be too great a space between the last information block recorded and the information block which was recorded first.

The information recorded on the magnetic tape can now be used with the help of suitable devices for the direct production of a control strip or for the direct control of a machine 13 (FIG. 1), as is described in applicant's copending application Ser. No. 211,513 filed Dec. 23, 1971 to which reference is expressly made here.

A special advantage of the invention consists in the fact that the stored information is first of all read out and can be printed out to form a design pattern 10 with the help of the device previously described. As a result of this it is possible not only to determine whether the information stored does in fact lead to the desired pattern. Instead it is also possible for the design pattern to be corrected line by line or completely so long as the information stored corresponds exactly with the de-

sired pattern. A further important advantage consists in the fact that the machine 13 with the magnetic tape 701 can be controlled already prior to the production of a control strip. If it is a knitting machine, then the customer can produce a trial article and check this before he decides finally on the production of the control strip.

The printing operation is described below on the basis of FIGS. 4*b*, 7 and 8. It begins once again with the carrying out of an X test and a Y test and by setting all the flip-flops at the output Q1 by means of a clearing key or switching the information barrier 559 to passage. By operating the "printing" key 810 the AND circuits 843, 814, 885, 823, 857 and 861 are prepared. After the subsequent operation of the starting key 833 the drum 101 starts to rotate as in the case of the scanning operation, but at a smaller rotation speed in the proportion of 5:1, brought about by the divider 812, because this is more advantageous from the point of view of accuracy of printing. Furthermore, by means of the key 810 the AND circuit 823 is prepared so that also the printing stroke appearing at the connecting terminal DT possesses a frequency which is smaller in the proportion of 5:1.

By depressing the key 833, according to FIG. 7, the magnetic tape drive is started. As a result of this, whilst controlling the read-strobe the words of the first information blocks are pushed into the shift registers 551, 553, 555 and 557. The comparison counter 569 can be decoded at its output A to any desired number. The number set decides how many screen dots in each line will still be suspended on the end of any line (motif connection in the direction of the line). It will be assumed that the comparison counter 569 has been set at the number $m = 20$. The result of this is that after the recording of the first 20 words into the shift registers 555 and 557, the barrier 559 becomes effective so that no further information can be fed into these shift registers.

However, the barrier 559 does not prevent these 20 words being pushed forward by the read-strobe parallel to the first 20 words in the shift registers 551 and 553. After reading out an information block 703 from the magnetic tape there appears at the end of line output of the logic 6 an end of line signal which on the one hand switches off the magnetic tape drive and on the other hand switches on the clock generator 563 so that the information located in the shift registers is now pushed forward at high speed to the end of the shift registers. When the end of the shift registers has been reached, the comparison counters 565 and 569 emit a VZD signal, by means of which the clock generator 563 is switched off and the comparison counters are set back. In this way the phase D is concluded (cf. FIG. 4*b*).

The phase F is introduced by an MZA signal, by means of which the divider 817 in the central control unit 8 is released, so that the output signals of the XRMZ counter 803 appear as printing strokes on the connecting terminal DT. These printing strokes are first of all fed only via the AND circuit 573 to the stroke inputs of the shift registers 551 and 553, because the AND circuit 575 has not been prepared by the output Q2 of the flip-flop 577. The result of this is that first of all the information corresponding to a full line of the design pattern to be produced is pushed out of the shift registers 551 and 553 and fed via the coding and decoding unit 4 to the printer 9. The printer strokes are counted at the same time in the XRZ counter 804 of the central control unit 8.

When the set number of this counter has been reached, however, the printer stroke is not blocked as in the case of the scanning operation, because the "printing" key 810 is not connected with the AND circuit 841. Instead, the output signal of the XRZ counter 804 produces via the AND circuit 861 a motif connection signal which according to FIG. 7 sets the flip-flop 577 on the output Q2, so that the printer strokes now are fed via the AND circuit 575 to the shift registers 555 and 557. As a result of this the first 20 points of the line just printed are then printed once again immediately at the end of this line.

The counter 804 begins to count once again because although it has been set back by its input signal, the printer strokes still continue. Furthermore, its output signal has set the flip-flop 855 at the output Q2 so that now the AND circuit 857 is prepared. By this AND circuit 857, if the XRZ counter 804 has reached the number set at its output B, a signal is emitted which on the one hand acts as a starting signal to being about a renewed starting of the magnetic tape and on the other hand via the connecting terminal end of printing both an AND circuit 843 is reached, and also the flip-flop 577 is set back at the output Q1 according to FIG. 7. As the other input of the AND circuit 843 is prepared by the "printing" key 810, the end of printing signal reaches the release circuit 873 via the delayed-action stage 879, as a result of which, just as in the case of the scanning operation, a transportation of the carriage 105 is brought about by one screen dot in the Y direction. Furthermore the end of printing signal arrives via the AND circuit 843 at the release circuit 827, as a result of which the printer stroke is blocked. Finally the end of printing signal brings about the setting back of the XRMZ counter and the XRZ counter. In this way the end of phase F is reached (FIG. 4*b*).

The output B of the XRZ counter 804, if the different-coloured printer pins 919 (FIG. 2) are arranged so that they all print on the same point when they are operated, can also be adjusted to the number 20, because in this case the printing out of a full line is ended when the 20th dot of the line has been printed out for a second time. However, according to the invention in order to be able to reach a higher printing speed a printer is used whose different-coloured printer pins are at a distance of 24 screen dots from one another. In the case of four-colour printing, therefore, three printer pins 919 are provided, the two outer printer pins being at a distance of 48 screen dots. As the fourth colour one uses the colour of the base of the pattern, so that this colour does not need to be specially printed out. This means that the signals appearing at the output of the coding and decoding unit 4 have to be displaced in relation to one another by means of delayed-action stages, for example, the shift registers 11 and 12, by as many printer strokes as the printer pins 919 of the printer are at a distance from one another. As the maximum delay amounts to 48 printer strokes, the printer stroke cannot therefore be ended already at a position of the XRZ counter 804 of B=20, but only at a position of $B = 68$, so that also the information pushed through the shift registers 11 and 12 can still be printed out. The fact that the pushing printer strokes act for part of the time on empty shift registers 555 and 557 is immaterial, be-

cause as a result of this only words "oo" pushed out, which are allocated to the colour 4 and consequently to the colour of the base of the design pattern **10.**

After the appearance of the end of printing signal the magnetic tape **701** is started once again in order to read out the next information block. This is followed in periodic sequence by the operations already described until at the end of the first half of the information blocks a *y*/2 signal appears, by which there is brought about a switching over from forward travel to return travel.

After the printing out of the last line of the design pattern there also takes place a motif connection in the Y direction of the design pattern. This motif connection is set by the YRZ counter at the output B. For example it is possible, after printing out all the lines of the original artist's drawing **1,** once again to print out the first $n = 20$ lines with line repeat. In this case the output B of the YRZ counter **802** is adjusted to **20.**

When the second *y*/2 signal is emitted by the counter **883,** therefore, no E signal is produced, unlike the scanning operation. The end of printing signal, which is emitted after the printing out of the last information block, introduces instead a renewed starting of the magnetic tape in the forward direction. After the renewed reading out and printing out of the first **20** stored information blocks the AND circuit **885,** which has already been prepared by the static output signal of the counter **883** and the "printing" key **810,** allows the signal coming from the output B of the YRZ counter **802** to act as an E signal and bring about the end switching off of the entire apparatus.

The special advantage of the device used for the printing consists in the fact that the artist's drawing, although it is drawn without any motif connection, can be printed out with a motif connection. The designer can therefore not only carry out any corrections in the repeat himself, but he can also determine whether the motif connections in the X or Y direction are correct and if necessary also make corrections here.

The invention is not restricted to the example of execution described, because numerous possibilities of variation exist. For example it is possible to leave out the buffer storage and during scanning to record the magnetic tape **701** direct or during printing to control the printer **9** direct from the magnetic tape **701.** However, the advantage of the buffer storage consists in the fact that it is possible to operate with different scanning or printing speeds and that the scanning or printing speed is completely independent of the prescribed tape speed. As a result of this it is possible without any difficulties to scan or print screen dots with side lengths of between 0.6 and 3.0 mm. Since in addition all the operations are controlled by the joint clock generator **805,** there are no synchronisation problems of any kind.

Furthermore it is possible to deviate from the example of execution described with the selected sequence of scanning - storage - printing of the entire repeat in such a way that one operates with two drums **101** and one selects the sequence scanning - storing - printing for each individual line. However, for this it would be necessary to arrange the recording or reading heads of the storage device **7** in such a way that both during forward travel and also during reverse travel the recording heads would be arranged in front of the reading heads and consequently the stored information could be read out again immediately. For this form of execution one could either leave a sufficiently large part free on the drum used for the scanning in order to make possible the printing operation, or the two drums could rotate twice per line, so that during the first rotation the scanning was carried out and during the second rotation the printing was carried out. When doing this both the scanning head and also the printer head could be arranged on the same drum and even on the same rails **103** or on the same carriage **105,** because the Y advance would only have to take place every two rotations.

Instead of the magnetic tape storage unit **7** it is also possible to use other types of storage. However, the magnetic tape storage unit has the advantage that it is relatively cheap and that the information blocks do not necessarily have to be addressed, so long as one is dealing with small repeats.

When selecting a different type of storage unit care must be taken to see that the access time to the individual information blocks remains short. If the storage unit is to be used, for example, for the direct control of an electronically controllable knitting machine, then at no point of time may the search for and reading of an item of information or of a block of information take so long that the continuous knitting stroke of about 1,000 Hz cannot be maintained. If, for example, a magnetic tape is recorded continuously, that is to say not in the form of an endless loop, then the magnetic tape after reading out the last information block would have to be wound back for the renewed reading out of the first information block, which takes up a very great deal of time, especially if one is dealing with repeats with a very large number of lines and each line leads to an information block of about 100 milliseconds.

Besides magnetic tape storage units of the type described, therefore, those plate or drum storage units are also particularly suitable which possess one reading or recording head for each groove or track. Also a core storage unit with a matrix of 500 × 500 or more would be feasible, if care is taken to see that the stored information remains when switched off.

According to a further form of execution, instead of the line by line recording it is possible to carry out a point by point recording, the magnetic tape being started and stopped again for each point. This is advantageous particularly in the case of small repeats and makes it possible for them to be corrected point by point.

Furthermore, the invention is not restricted to a point by point control of the printer pins **108.** Preferably devices can be provided by means of which the printer pin or pins are pressed so long against the base as the colour to be printed remains unchanged, so that a line type of image is formed.

The motif connection can also be carried out with only one shift register, the information output of which is connected with the information input, so that the information is pushed around. In thise case, for printing out the beginning of the motif one again the first *m* items of information between the two printer strokes are pushed forward in the high-speed stroke.

The information blocks can also be recorded in different storage devices, for example plate or drum storage units, in the form of an endless loop, by first of all, for example, only recording the tracks **1, 3, 5** . . . *y* and then recording the tracks *y*-1, *y*-3 . . . **4,2.**

The device described can finally be extended for as many colours as desired by forming any number of end-

less loops on the magnetic tape for the same number of tracks, which, for example, contain all the information for three colours each. In these cases, however, several scanning and printing cycles are then necessary.

What is claimed is:

1. A system for printing out a pattern with *k* lines either point by point or line by line, comprising in combination: support means for supporting a drawing paper; printing means for printing a pattern on said drawing paper; transport means for producing a relative movement in two directions between said support means and said printing means; means for producing electrical signals which give information about all characteristics of said pattern and for feeding said signals to said printing means such that said printing means print out said pattern either point by point by line by line; first means for automatically printing out the first *m* points or the first part of each line of said pattern following the printing out of the relevant complete line and second means for automatically printing out the first *n* lines of said pattern following the printing out of all of said *k* lines of said pattern.

2. The system of claim 1, including at least one shift register for the automatic printing out of the first *m* points, in which the information corresponding to the first *m* scanned points is temporarily stored and from which information is read out again before the printing of the following line.

3. The system of claim 1, including temporary storage for the printing out of the first *n* lines of the pattern, in which the information corresponding to the first *n* scanned lines is temporarily stored.

4. The system of claim 1, including at least one shift register for the automatic printing out of the first part of a line from which the information is temporarily stored and information is read out again before the printing of the following line.

5. The system of claim 1, including a color assessment circuit for controlling a printer arranged after a scanner head which scans a pattern.

6. The system of claim 5, including a storage device between the color assessment circuit and the printer for the permanent storage of all the information obtained from the pattern.

7. The system of claim 6, wherein all the information corresponding to a line of the pattern is stored in the form of a cohesive information block.

8. The system of claim 7, including a temporary storage device connected to the storage device and into which a full information block is fed during the printing operation.

9. The system of claim 8, wherein the temporary storage device has two parallel shift register stages, the one shift register stage taking a complete information block, whereas the other shift register stage only takes the first *m* items of information of an information block.

10. The system of claim 8, wherein the temporary storage device only has one shift register stage and the information outputs are connected to the information inputs.

11. The system of claim 7, wherein the information blocks are so stored that the information block allocated to the first line is accessible again immediately after the reading out of the information block allocated to the last line.

12. The system of claim 11, wherein the storage device comprises a magnetic member.

13. The system of claim 11, wherein the storage device comprises a punched member.

14. The system of claim 11, wherein the storage device is a drum.

15. The system of claim 12, wherein the information blocks are recorded in the form of an endless loop.

16. A system for printing out a pattern with *k* lines either point by point or line by line, comprising in combination: support means for supporting a drawing paper; printing means for printing a pattern on said drawing paper; transport means for producing a relative movement in two directions between said support means and said printing means; means for producing electrical signals which give information about all characteristics of said pattern and for feeding said signals to said printing means such that said printing means print out said pattern either point by point or line by line, and means for automatically printing out the first part of each line of said pattern following the printing out of the relevant complete line.

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