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(71) Applicant: **SHARP KABUSHIKI KAISHA**
22-22 Nagaike-cho Abeno-ku
Osaka 545(JP)

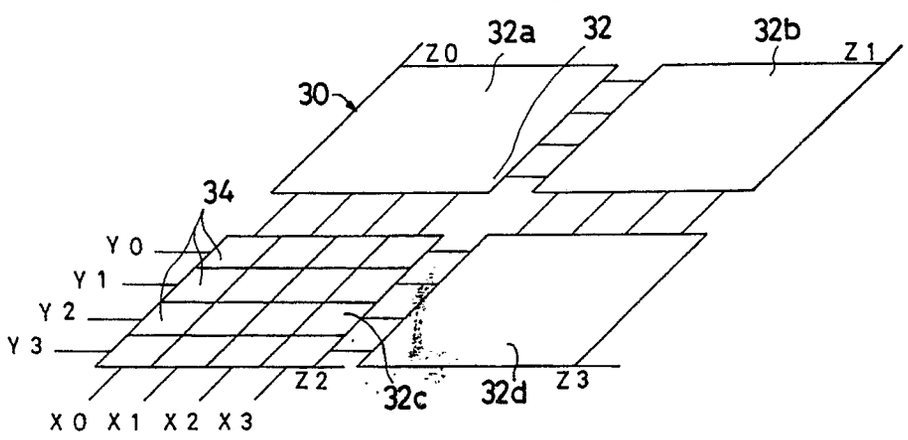
(72) Inventor: **Kawashimi, Yoshihisa**
3-1-4-306 Kataokadai, Kamimaki-cho
Kita-katsuragi-gun, Nara-ken(JP)

(74) Representative: **Brown, Kenneth Richard et al**
R.G.C. Jenkins & Co. 26 Caxton Street
London SW1H 0RJ(GB)

(54) Display device.

(57) A display device is provided with a display matrix including a plurality of display elements in a matrix way and divided into a plurality of sub-matrix blocks. The display device has a plurality of signal electrodes each connected to each row of the matrix for supplying display signals, each of the signal electrodes in one block being connected to each of the signal electrodes in other blocks at a correpsonding row respectively. The display device also has a plurality of scanning electrodes each connected to each column of the matrix for supplying active pulses, each of the scanning electrodes in one block being connected to each of the scanning electrodes in other blocks at a correpsonding column respectively. The display device is further provided with a plurality of matrix selection electrodes each equipped to each of the blocks for supplying a matrix selection signal which indicates one of the blocks, and a matrix selection control device connected to the signal electrodes and the selection electrodes for selectively allowing the signal electrodes to supply the display signals to the display elements in the block indicated by the selection signal.

Fig.3



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DISPLAY DEVICE

BACKGROUND OF THE INVENTION

1.Field of the Invention

The present invention relates to a display device having a display matrix which consists of a plurality of display elements, such as LCD (Liquid Crystal Display), EL (Electroluminescence display), VFD (Vacuum Fluorescence Display), LED (Light Emitting Diode), etc. disposed in a matrix way.

2.Description of the Related Art

As one of various kinds of display devices, there is a display device which has a display matrix provided with scanning electrodes and signal electrodes which are connected to an external driving circuit through control lines. Such a display device is shown in Fig.1.

In Fig.1, a display device 20 is provided with four scanning electrodes X0 to X3 and four signal electrodes Y0 to Y3. The display device 20 has a display matrix 22 which includes a plurality of segments (display elements) 24.

The scanning electrodes X0 to X3 are arranged in the X direction in a stripe way, each of which is connected with each column of the segments 24.

The signal electrodes Y0 to Y3 are arranged in the Y direction in a stripe way, each of which is connected with each row of the segments 24.

Each of the scanning electrodes X0 to X3 and the signal electrodes Y0 to Y3 are respectively connected to an external driving circuit through a plurality of control lines. The display device 20 is operated in a time divisional mode by the driving circuit.

In an operation of the display device 20, active pulses are supplied to the scanning electrodes X0 to X3 in a regular succession in a prescribed order from the scanning electrode X0. Display signals are supplied to the signal electrodes Y0 to Y3 in synchronization with the active pulses. By supplying those active pulses and display signals repeatedly at a high speed, a display data is time divisionally displayed on the display matrix 22.

Such a display device as describe above is defined here as a two dimensional matrix display device since which utilizes a two dimensional or flat plane-like display matrix controlled by use of two different kinds of electrodes. In this kind of two dimensional matrix display device, supposing that the number of the scanning electrodes is X and the number of the signal electrodes is Y, the X x Y pieces of segments can be controlled by use of the X + Y lines of the control lines.

In the above case, as the number of the segments equal to X x Y increases, the number of control lines equal to X + Y increases in a relatively rapid way.

Accordingly, this kind of two dimensional matrix display device raises a problem that, if the number of segments is required to be increased to a large number, the control lines, i.e. the number of the terminals of the driver circuit or the number of the driver circuits should be also increased to a quite large number in order to operate such a display device.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a display device having a display matrix, in which the display matrix with a large number of the segments can be controlled by a relatively small number of the control lines.

According to the present invention, the object can be achieved by a display device having a display matrix. The display matrix includes a plurality of display elements in a matrix way and is divided into a plurality of sub-matrix blocks. The display device has a plurality of signal electrodes each connected to each row of the matrix for supplying display signals, each of the signal electrodes in one block being connected to each of the signal electrodes in other blocks at a correpsonding row respectively. The display device also has a plurality of scanning electrodes each connected to each column of the matrix for supplying active pulses, each of the scanning electrodes in one block being connected to each of the

scanning electrodes in other blocks at a correpsonding column respectively. The display device is further provided with a plurality of matrix selection electrodes each equipped to each of the blocks for supplying a matrix selection signal which indicates one of the blocks, and a matrix selection control device connected to the signal electrodes and the selection electrodes for selectively allowing the signal electrodes to supply the display signals to the display elements in the block indicated by the selection signal.

In the display device of the present invention, the display matrix is divided into a plurality of sub-matrix blocks. Each of the signal electrodes in one block is connected to each of the signal electrodes in other blocks at a correpsonding row respectively. Each of the scanning electrodes in one block is connected to each of the scanning electrodes in other blocks at a correpsonding column respectively. The selection electrodes are equipped to each of the blocks. The matrix selection control device selectively allows the signal electrodes to supply the display signals to the display elements in the block indicated by the selection signal. Accordingly, the matrix blocks can be time divisionally operated by supplying the selection signals in a regular succession. The display elements in the block selected by the control device can be time divisionally operated by supplying the active pulses in a regular succession. Thus, a display data can be time divisionally displayed on the display matrix by supplying the display signals and the matrix selection signals in synchronization with the active pulses.

In such an operation of the display device, an external driving circuit, consisting of a LSI device for example, generates the display, scanning and selection signals. The driving circuit is connected to the display device through a plurality of control lines. The total number of the control lines equals to the sum of the numbers of the signal, scanning and selection electrodes, while the total number of the display elements equals to the product of the numbers of the signal, scanning and selection electrodes. Consequently, quite a large number of the display elements can be controlled by a relatively small number of the control lines.

By use of the present invention, for example, the number of the package pins of the LSI device as the driving circuit can be effectively decreased, or the number of the LSI devices as the driving circuits can be effectively decreased, resulting in an advantageous reduction in size and cost of the whole device using the present invention.

Further objects and advantages of the present invention will be apparent from the following description of the preferred embodiment of the invention as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a schematic perspective view showing a two dimensional matrix display device;
Fig.2 is a schematic perspective view showing a pseudo-display device of a three dimensional matrix structure to explain a first embodiment of the present invention shown in Fig.3;
Fig.3 is a schematic perspective view showing the first embodiment of the present invention;
Fig.4 is a block diagram of the display device of Fig.1;
Fig.5 is a block diagram of the display device of Fig.3;
Fig.6 is a block diagram of a second embodiment of the present invention;
Fig.7 is a graph showing a relationship between the number of control lines, the number of segments and the number of dimension of matrix display devices;
Fig.8 is a schematic plan view showing a constructional example of the display device of Fig.4;
Fig.9 is a schematic plan view showing a constructional example of the display device of Fig.5; and
Fig. 10 is a circuit diagram of a constructional example of the display device of Fig.9.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be described below with reference to the accompanying drawings.

Fig.2 shows a pseudo-display device 30p of a three dimensional display matrix type to explain the concept of a display device of a first embodiment according to the present invention shown in Fig.3.

In Fig.2, the device 30p is constructed by adding a concept of "height" to the display device 20 of Fig.1, namely, by piling two dimensional matrix blocks 32a,32b,32c and 32d in a Z (height) direction. Each of the blocks 32a,32b,32c,32d extends in a X direction and a Y direction in the same way as in the display matrix 22 of Fig.1,

The device 30p is provided with four scanning electrodes X0 to X3 and four signal electrodes Y0 to Y3.

Each scanning electrodes X0 to X3 is branched into four electrode portions arranged in a pile. Each of

the branched electrode portions of the scanning electrodes X0 to X3 is connected to each block 32a,32b,32c,32d. In the same way, each signal electrodes Y0 to Y3 is branched into four electrodes portions arranged in a pile. Each of the branched electrode portions of the signal electrodes Y0 to Y3 is connected to each block 32a,32b,32c,32d.

Each block 32a,32b,32c,32d includes sixteen segments (display elements) 34 in the same way as in the case of the display matrix 22 of the Fig.1. Namely, on each block 32a,32b,32c,32d, the scanning electrodes X0 to X3 are arranged in the X direction in a stripe way, each of which is connected with each column of the segments 34. On each block 32a,32b,32c,32d, the signal electrodes Y0 to Y3 are arranged in the Y direction in a stripe way, each of which is connected with each row of the segments 34.

Each block 32a,32b,32c,32d is connected to each matrix selection electrode Z0,Z1,Z2,Z3 respectively.

Each of the scanning electrodes X0 to X3, the signal electrodes Y0 to Y3 and the selection electrodes Z0 to Z3 are respectively connected to an external driving circuit through a plurality of control lines.

The driving circuit supplys active pulses to the the scanning electrodes X0 to X3, and display signals to the signal electrodes Y0 to Y3 in synchronization with the active pulses. The driving circuit also supplys matrix selection signals which selects one of the block 32a,32b,32c,32d as a displaying matrix block at each time period so as to enable time divisional displaying on each of the selected block.

Accordingly, in the device 30p, sixty four pieces of segments 34 can be time divisionally operated by twelve control lines.

Fig.3 shows a display device 30 of a first embodiment of the present invention.

In Fig.3, the display device 30 is constructed by disposing onto a single plane the four blocks 32a,32b,32c,32d of the device 30p of Fig.2. Thus, the display device 30 has a display matrix 32 composed of the four blocks 32a,32b,32c,32d.

The display device 30 is defined here as a three dimensional matrix display device since it is based on the three dimensional structure as shown in Fig.2 and is controlled by use of three different kinds of electrodes.

Accordingly, in the display device 30, sixty four pieces of segments 34 disposed on a single plane can be time divisionally operated by twelve control lines which connect each of the scanning electrodes X0 to X3, the electrodes Y0 to Y3 and the selection electrodes Z0 to Z3 to the driving circuit. As a comparison, in the two dimensional type display device 20 shown in Fig.1, at least sixteen control lines are required to control sixty four pieces of the segments 24.

More generally in the display device 30, supposing that the number of the scanning electrodes is X, the number of the signal electrodes is Y, and the number of the selection electrodes is Z, the X x Y x Z pieces of segments can be controlled by use of the X + Y + Z lines of control lines connected to the driving circuit.

Fig.4 shows a block diagram of the two dimensional matrix display device 20.

In Fig.4, the display device 20 includes the display matrix 22 composed of only one block of two dimensional display matrix with two input signals S1 and S2, which indicate the display signals and the active pulses respectively.

Fig.5 shows a block diagram of the three dimensional matrix display device 30.

In Fig.5, the display device 30 includes the display matrix 32 composed of four blocks of two dimensional matrix blocks 32a,32b,32c,32d with three input signals S1, S2 and S3, which indicate the display signals, the active pulses and the selection signals respectively supplied from a driving circuit 35.

Fig.6 shows a block diagram of a four dimensional matrix display device 40 of a second embodiment of the present invention.

As in the same way of defining and constructing the three dimensional matrix display device 30 based on the two dimensional matrix display device 20 as explained with reference to Fig.2, the four dimensional matrix display device 40 is defined and constructed.

Namely, the display device 40 includes a display matrix 42 composed of four blocks of three dimensional matrix blocks 42a,42b,42c,42d, each of which has a same construction of the display matrix 32 of the display device 30 of Fig.5. The blocks 42a,42b,42c,42d are arranged on a single plane and provided with matrix selection electrodes which are connected to each of the blocks 42a,42b,42c,42d and to which selection signals S4 are supplied. The selection signal S4 selects one of the blocks 42a,42b,42c,42d as a displaying matrix block at each time period so as to enable the time divisional display of the display device 40, in cooperation with the display signal S1, the active pulse S2, and the selection signal S3. The display signal S1 and the active pulse S2 are supplied from a driving circuit 45a. The selection signals S3 and S4 are supplied from a driving circuit 45b. The driving circuits 45a and 45b are synchronized to each other.

In the display device 40, supposing that the number of scanning electrodes for the signal S2 is X, the number of signal electrodes for the signal S1 is Y, the number of matrix selection electrodes for the signal

S3 is Z, and the number of matrix selection electrodes for the signal S4 is V, the X x Y x Z x V pieces of segments of the display matrix 42 can be controlled by use of the X + Y + Z + V lines of control lines connected to the driving circuits 45a,45b for the time divisional display operation.

As in the same way of defining and constructing the three dimensional matrix display device 30 based on the two dimensional matrix display device 20, and defining and constructing the four dimensional matrix display device 40 based on the three dimensional matrix display device 30, as explained above, a N dimensional matrix display device can be defined and constructed according to the present invention.

Namely, the N dimensional matrix display device includes a display matrix composed of a plurality of the (N-1) dimensional matrix blocks, arranged on a single plane and provided with matrix selection electrodes which are connected to each matrix block and to which the matrix selection signal is supplied from the driving circuit.

By increasing the number of the dimension of the matrix display device of the present invention, it is made possible to control a large number of the segments efficiently with a relatively small number of the control lines.

The Table 1 and Fig.7 show how the maximum number of the segments, which are able to be controlled by the two to eight dimensional matrix display devices, changes depending on the total number of the control lines. In the Table 1 and Fig.7, the 2-dimensional matrix corresponds to the display device 20 of Fig.4, the 3-dimensional matrix corresponds to the display device 30 of Fig.5, and the 4-dimensional matrix corresponds to the display device 40 of Fig. 6.

In the Table 1 and Fig.7, it is clearly shown that, as the total number of the segments is increased, the matrix of the larger number of the dimension is more advantageous in order to restrict the increase of the total number of the control lines.

TABLE 1

TOTAL NUMBER OF CONTROL LINES	MAXIMUM NUMBER OF SEGMENTS ABLE TO BE CONTROLLED						
	BY 2-DIMENSIONAL MATRIX	BY 3-DIMENSIONAL MATRIX	BY 4-DIMENSIONAL MATRIX	BY 5-DIMENSIONAL MATRIX	BY 6-DIMENSIONAL MATRIX	BY 7-DIMENSIONAL MATRIX	BY 8-DIMENSIONAL MATRIX
2	1	0	0	0	0	0	0
3	2	1	0	0	0	0	0
4	4	2	1	0	0	0	0
5	6	4	2	1	0	0	0
6	9	8	4	2	1	0	0
7	12	12	8	4	2	1	0
8	16	18	16	8	4	2	1
9	20	27	24	16	8	4	2
10	25	36	36	32	16	8	4
11	30	48	54	48	32	16	8
12	36	64	81	72	64	32	16
13	42	80	108	108	96	64	32
14	49	100	144	162	144	128	64
15	56	125	192	243	216	192	128
16	64	150	256	324	324	288	256
17	72	180	320	432	486	432	384
18	81	216	400	576	729	648	576
19	90	252	500	768	972	972	864
20	100	294	625	1024	1296	1458	1296
21	110	343	750	1280	1728	2187	1944
22	121	392	900	1600	2304	2916	2916
23	132	448	1080	2000	3072	3888	4374
24	144	512	1296	2500	4096	5184	6561
25	156	576	1512	3125	5120	6912	8748
26	169	648	1764	3750	6400	9216	11664
27	182	729	2058	4500	8000	12288	15552
28	196	810	2401	5400	10000	16384	20736

Fig.8 shows a two dimensional matrix display device 20a as a constructional example of the display device 20 of Fig.4. In this example, the display matrix 22 consists of a LCD panel which is composed of sixteen LCD elements. Each LCD element is disposed at each intersection of the scanning electrodes X0 to X3 and the signal electrodes Y0 to Y3.

Fig.9 shows a three dimensional matrix display device 30a as a constructional example of the display device 30 of Fig.5.

In Fig.9, the display matrix 32 consists of four block 32a,32b,32c,32d. Each block 32a,32b,32c,32d consists of a LCD panel which is same as the display matrix 22 of Fig.8. The scanning electrodes X0 to X3 and the signal electrodes Y0 to Y3 are commonly used for all the blocks 32a,32b,32c,32d. The selection electrodes Z0 to Z3 are respectively connected to each block 32a,32b,32c,32d.

Fig.10 shows a circuit diagram of a three dimensional matrix display device 30b as a constructional example of the disply device 30a of Fig.9.

In Fig.10, the display device 30b is provided with four blocks 32a,32b,32c,32d. Each block 32a,32b,32c,32d is provided with sixteen segments each consists of a TFT (Thin Film Transistor) 51 and a LCD element 52 of capacity type.

One of the source and drain of each TFT 51 is connected to one of the scanning electrodes X0 to X3 for supplying the scanning pulses from the external driving circuit to the LCD element 52 connected to the other of the source and drain of the TFT 51. The gate of each TFT 51 is connected to the output of one of AND gates 53.

The AND gates 53 function to select one block from the blocks 32a,32b,32c,32d as the block to which the display signal is supplied to each TFT 51 through the signal electrodes Y0 to Y3. The first input terminal of each AND gate 53 is connected to one of the selection electrodes Z0 to Z3 for supplying the matrix selection siganl from the external driving circuit to each block. The second input terminal of each AND gate 53 is connected to one of the signal electrodes Y0 to Y3.

In an operation of the display device 30b, the selection signals on the Z0 to Z3 are turned to high level in a regular succession. When the selection signals on the Z0 to Z3 are turned to high level, the corresponding AND gate allows the display signal to pass therethrough. When the selection signals on the Z0 to Z3 are turned to low level, the corresponding AND gate does not allow the display signal to pass therethrough. The display signals and the matrix selection signals are supplied in synchronization with the active pulses. Accordingly, by supplying those active pulses, display signals and matrix selection signals repeatedly at a high speed, a display data can be time divisionally displayed on the matrix panel 32 consisting of the four blocks 32a,32b,32c,32d.

As described above, according to the present embodiment, because the blocks 32a,32b,32c,32d use commonly the scanning electrodes X0 to X3 and the signal electrodes Y0 to Y3, the time divisional display of the sixty four segments can be controlled by only twelve electrodes, i.e only twelve control lines in total.

In the above described embodiment, the LCD element 52 is utilized as the display element. Instead, an EL element, a VFD element, a LED element etc. can be utilized as the display element.

Many widely different embodiments of the present invention may be constructed without departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiments described in this specification, except as defined in the appended claims.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the scope of the invention.

There are described above novel features which the skilled man will appreciate give rise to advantages. These are each independent aspects of the invention to be covered by the present application, irrespective of whether or not they are included within the scope of the following claims.

Claims

1. A display device, comprising:
a display matrix including a plurality of display elements in a matrix way and divided into a plurality of sub-matrix blocks;
a plurality of signal electrodes each connected to each row of said matrix for supplying display signals, each of said signal electrodes in one block being connected to each of said signal electrodes in other blocks at a correpsonding row respectively;
a plurality of scanning electrodes each connected to each column of said matrix for supplying active pulses,

each of said scanning electrodes in one block being connected to each of said scanning electrodes in other blocks at a correpsonding column respectively;

a plurality of matrix selection electrodes each equipped to each of said blocks for supplying a matrix selection signal which indicates one of said blocks; and

a matrix selection control means connected to said signal electrodes and said selection electrodes for selectively allowing said signal electrodes to supply said display signals to said display elements in said block indicated by said selection signal.

2. A display device according to Claim 1, wherein said control means comprises a plurality of gate means, each of which is connected to each of said selection electrodes and is disposed in a portion of each of said signal electrodes, for allowing said display signal to pass therethrough when said selection signal is supplied thereto.

3. A display device according to Claim 1, wherein said display element comprises one selected from the group consisting of a LCD element, an EL element, a VFD element and a LED element.

4. A display device according to Claim 1, wherein each of said display elements includes a TFT which is connected to each of said signal electrodes and each of said scanning electrodes.

5. A display device according to Claim 1, further comprising a driving circuit connected to said signal electrodes, said scanning electrodes and said control means through a plurality of control lines for supplying said display signal, said scanning signal and said selection signal respectively.

6. A matrix display device in which each picture element is controlled by signals applied to a respective pair of data and scanning electrodes, the device comprising data and scanning terminals for supplying signals to said electrodes, each terminal being arranged to supply a plurality of electrodes so as to form groups of picture elements with each picture element of a group being fed by signals from the same pair of data and scanning terminals as a corresponding picture element in the or each other group, means being provided to enable the groups in succession to respond to the signals supplied to said terminals.

Fig. 1

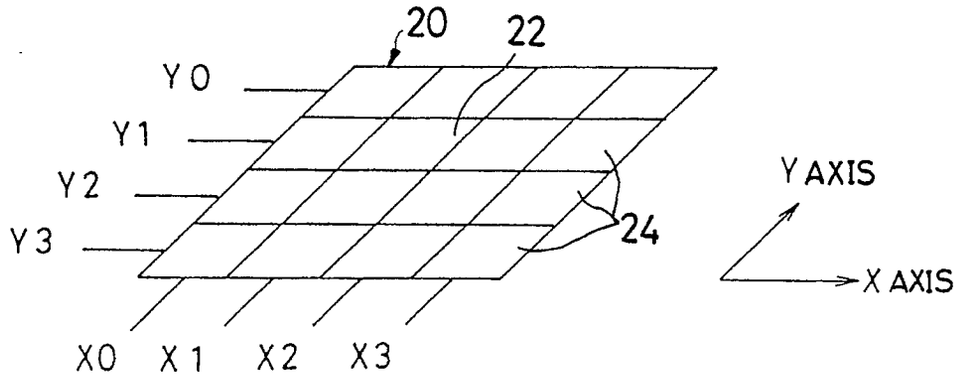

Fig. 2

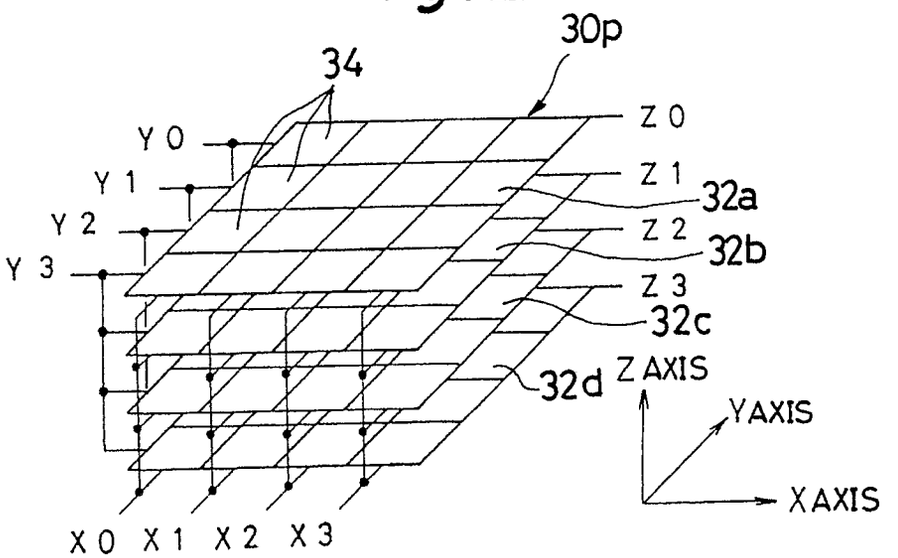

Fig. 3

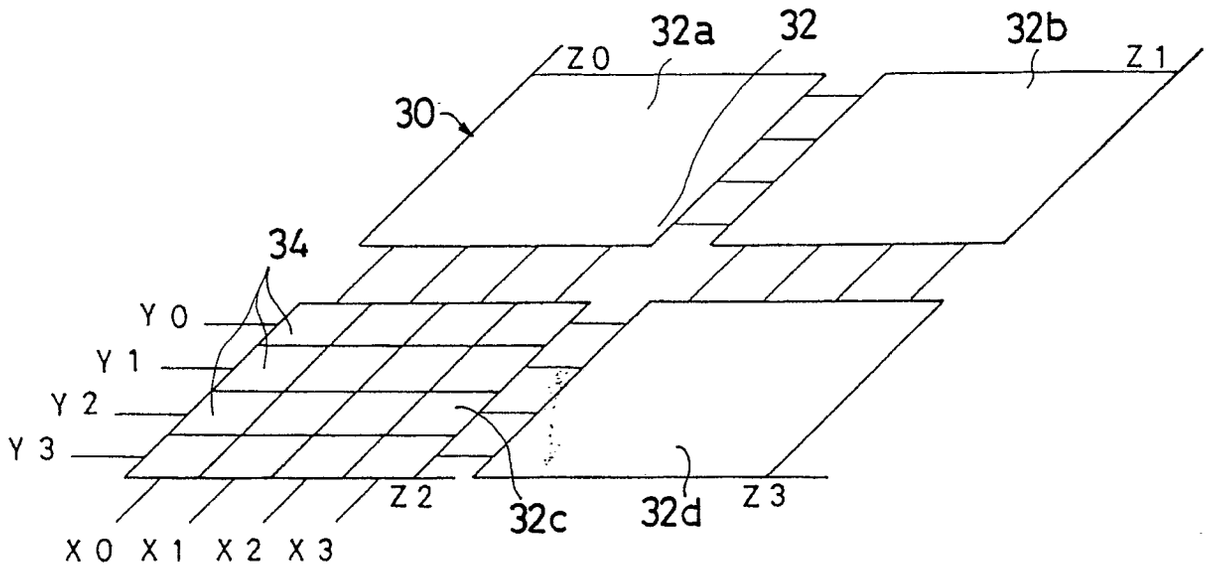

Fig. 4

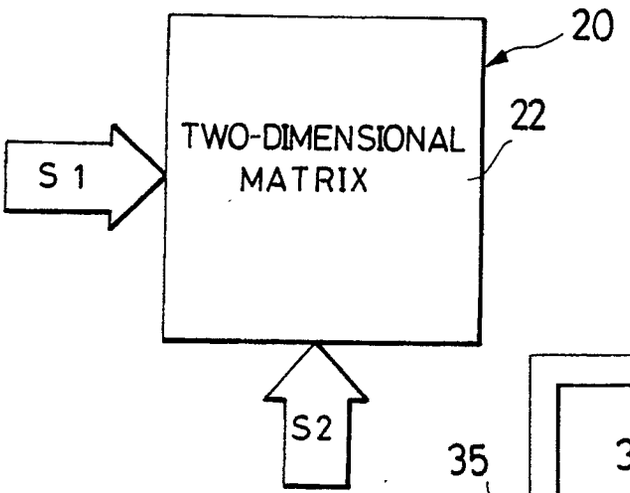

Fig. 5

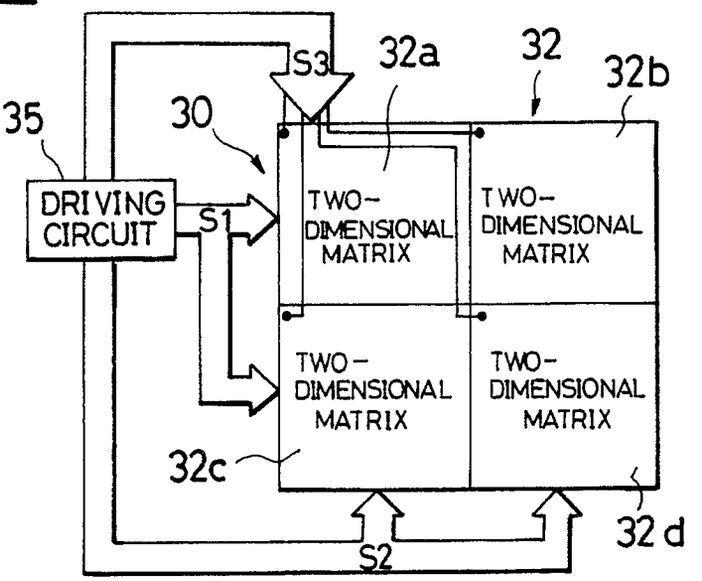

Fig. 6

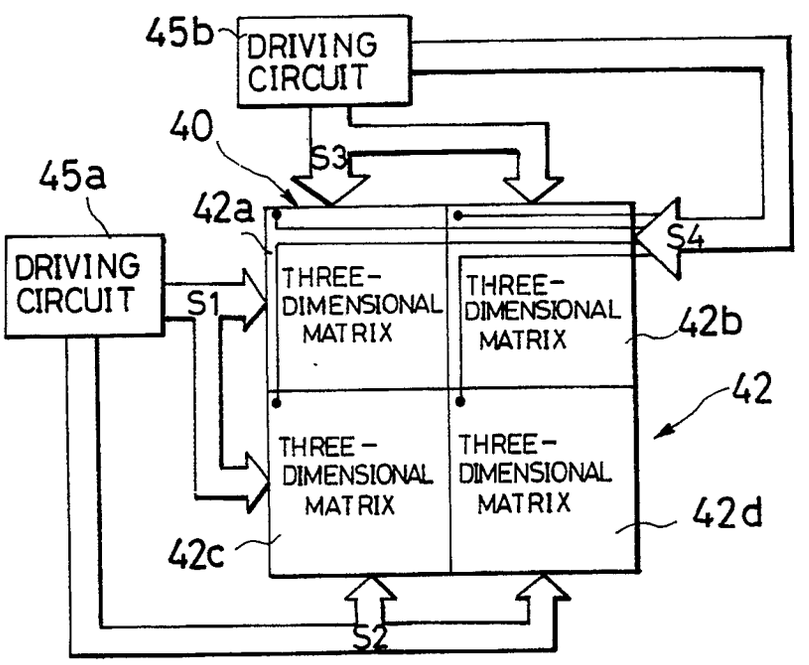

Fig. 7

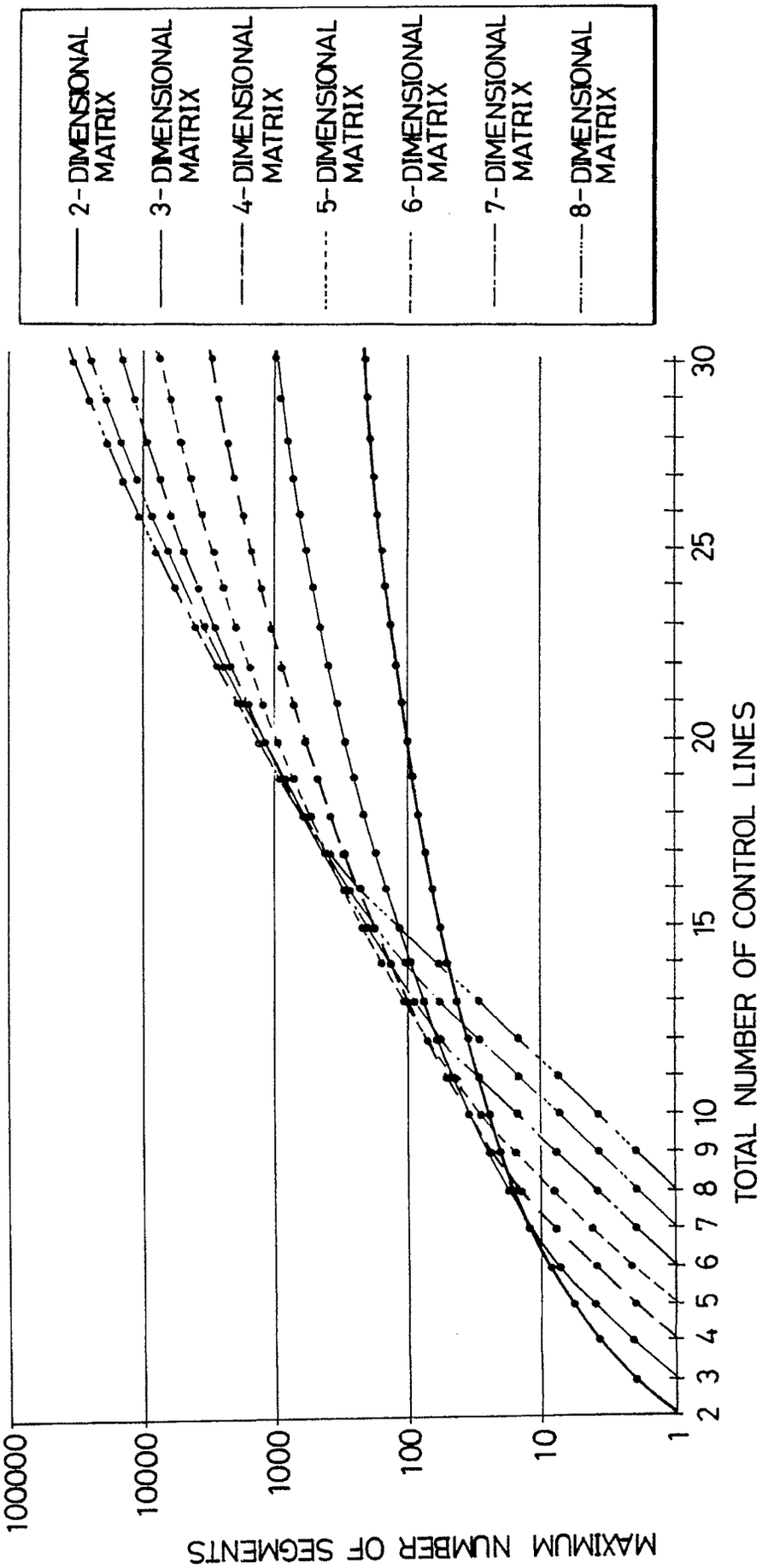
2-DIMENSIONAL MATRIX
3-DIMENSIONAL MATRIX
4-DIMENSIONAL MATRIX
5-DIMENSIONAL MATRIX
6-DIMENSIONAL MATRIX
7-DIMENSIONAL MATRIX
8-DIMENSIONAL MATRIX
MAXIMUM NUMBER OF SEGMENTS
100000
10000
1000
100
10
1
2 3 4 5 6 7 8 9 10 15 20 25 30
TOTAL NUMBER OF CONTROL LINES

Fig. 8

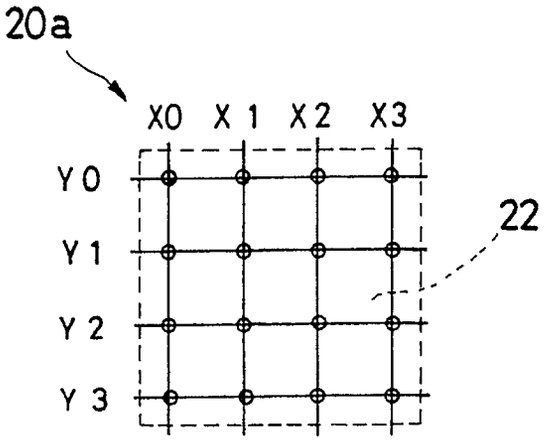
20a
X0 X1 X2 X3
Y0
Y1
Y2
Y3
22

Fig. 9

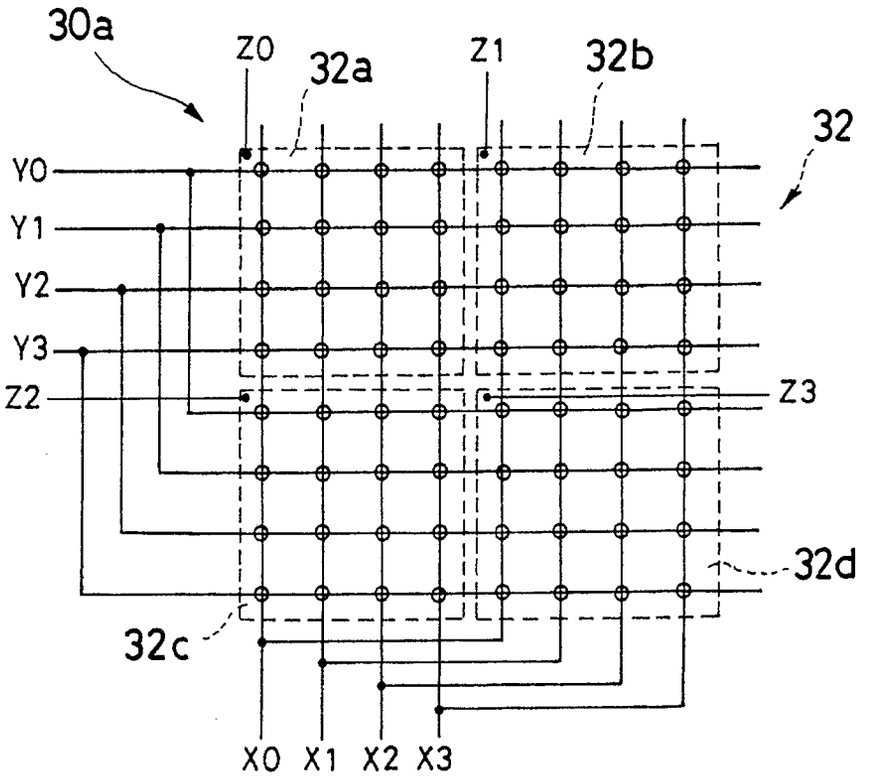
30a
Z0
32a
Z1
32b
32
Y0
Y1
Y2
Y3
Z2
Z3
32d
32c
X0 X1 X2 X3

Fig. 10