(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 421 517 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90202542.8**

(51) Int. Cl.5: **G09F 9/30**, G02F 1/1343

(22) Date of filing: **25.09.90**

(30) Priority: **28.09.89 NL 8902412**

(43) Date of publication of application:
10.04.91 Bulletin 91/15

(84) Designated Contracting States:
DE FR GB IT NL

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(54) Alpha-numerical display device.

(57) In an alpha-numerical display the segments are split up into (interconnected) sub-segments in such a way that characters can always be displayed in a manner analogous to that for a matrix display. This provides the advantages of a great freedom of choice of characters with a drive mode (1:n multiplexing, n ≦ 4) yielding a large viewing angle and a high contrast.

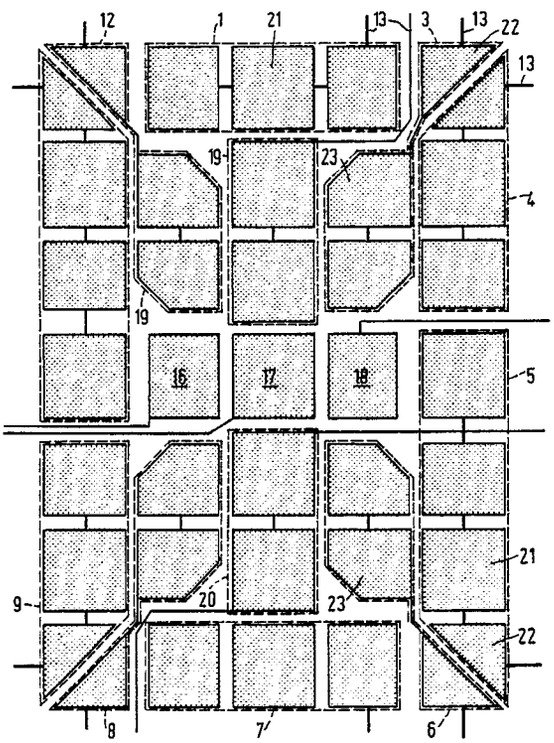


FIG.4

EP 0 421 517 A1

ALPHA-NUMERICAL DISPLAY DEVICE.

The invention relates to a display device for displaying alpha-numerical characters, which device comprises an electro-optical material between a first supporting plate having at least one electrode and a second supporting plate having a plurality of electrode segments.

A display device of this type is known from United States Patent no. 3,781,864. In this Patent a liquid crystal display device is shown with a counterelectrode on the one supporting plate and 7 electrode segments for each character on the other supporting plate, and it describes the drive mode for such a display device. Substantially only numerals are shown while using the so-called direct drive method. In this drive method a segment to be visualized is continuously driven, while the polarity of the drive voltage is periodically changed so as to prevent degradation of the liquid crystal. Therefore, a separate connection is required for each electrode segment.

It has been possible to reduce the number of required connections in such display devices by splitting up the undivided electrode into two or more parts and by ensuring the drive mode by way of multiplex drive (1:2 multiplexing, 1:3 or 1:4 multiplexing). Notably at a higher multiplex degree (5 or more) this leads to a more complicated drive mode as well as to a lower effective drive voltage across the picture segments to be driven. Notably when using liquid crystalline material as an electro-optical medium, such a lower effective voltage leads to a decrease of the viewing angle. The contrast also deteriorates at a multiplex degree of more than 4.

Since the shape of the segment electrodes is fixed, the variation of characters to be displayed is also limited in this case.

The latter is much less the case if the characters are composed of elements arranged in accordance with a matrix, for example, n rows and m columns defining nxm character elements. As n and m increase, the characters can be fixed more accurately. However, this requires a complicated drive circuit (1 : n multiplexing), while the effective voltage may even further decrease due to the lower duty cycle (1/n) (n is generally high, for example, $n \geq 8$).

It is one of the objects of the invention to provide a display device of the type described in the opening paragraph in which the advantages of a drive mode using a low multiplex degree (up to 1:4) and a display device based on the matrix principle are combined as much as possible.

To this end a display device according to the invention is characterized in that the electrode segments comprise sub-segments most of which are substantially square-shaped, rectangular or parallelogram-shaped and occupy at least a part of character elements arranged in the form of a matrix.

The second supporting plate preferably has at least twelve electrode segments and the square-shaped, rectangular or parallelogram-shaped sub-segments occupy the majority of the character elements.

The use of a low multiplex degree yields a large viewing angle and a high contrast, while the division into sub-segments gives the device a matrix structure which with a suitable division of the sub-segments leads to a wide range of characters to be displayed.

The invention will now be described in greater detail by way of example with reference to the accompanying drawings in which

Fig. 1 shows diagrammatically the division according to the invention of a plurality of electrode segments,

Fig. 2 shows a matrix of character elements,

Fig. 3 shows the display of a plurality of alpha-numerical characters by means of a display device according to the invention, while

Fig. 4 shows another division of a plurality of electrode segments, and

Fig. 5 shows the display of alpha-numerical characters associated with the division of Fig. 4.

Fig. 1 shows diagrammatically the division of the electrode segments 1, 2, 3, ..., 12 on one of the supporting plates of a display device. The device also comprises a second supporting plate having one or more counterelectrodes (at most 4), while an electro-optical material, for example, a liquid crystalline medium is present between the two supporting plates. The boundaries of the different electrode segments 1, 2, 3, ..., 12 are denoted by means of broken lines in Fig. 1.

According to the invention the electrode segments are divided into sub-segments 21, 22, 23, which sub-segments are formed in such a way that they substantially entirely one of the character elements 30 on their own or together with other sub-segments in a matrix of character elements 30, occupy one of the character elements 30, as is shown in Fig. 2.

For example, electrode segment 1 comprises three substantially square-shaped sub-segments 21 in this embodiment, which sub-segments correspond to the character elements 30^{ab}, 30^{ac}, 30^{ad} in Fig. 2.

Electrode segment 2 comprises four substantially square-shaped sub-segments 21, which sub-

stantially entirely cover the character elements 30^{bc}, 30^{cc}, 30^{ec} and 30^{fc}, as well as a connection track 15 which connects the sub-segments 21 associated with the character elements 30^{cc} and 30^{ec}, and a triangular sub-segment 22 which together with a triangular sub-segment 22 associated with electrode segment 10 substantially entirely covers the character element 30^{dc}. Electrode segment 3 comprises a triangular sub-segment 22 which together with a triangular sub-segment 22 associated with electrode segment 4 substantially entirely covers the character element 30^{ae}. Furthermore, the electrode segment 3 comprises two pentagonal sub-segments 23 at the location of the character elements 30^{bd}, 30^{cd}, while electrode segment 4 further comprises two substantially square-shaped sub-segments 21 at the location of the character elements 30^{be} and 30^{ce}. Similarly, electrode segment 5 comprises three substantially square-shaped sub-segments 21 and a triangular sub-segment 22 which together with a triangular sub-segment 22 of electrode segment 6 again substantially entirely covers the character element 30^{ge}, while electrode segment 6 further comprises two pentagonal sub-segments 23.

Electrode segment 7 comprises three substantially square-shaped sub-segments 21. The electrode segments 8 and 9 can be described similarly as the electrode segments 3 and 4. In addition to the mentioned triangular sub-segment 22, the electrode segment 10 comprises two substantially square-shaped sub-segments 21. The electrode segments 11 and 12 may be described similarly as the electrode segments 5 and 6.

In the above-described configuration with twelve electrode segments the substantially square-shaped sub-segments occupy the majority of the character elements 30 (22 out of 35 character elements).

The electrode segments have connection conductors 13 for external connections. If desired, the electrode segment 2 may be connected at two ends, which is shown diagrammatically by means of the dot-and-dash line 14.

Since the electrode segments can be driven directly or with a low multiplex degree (by means of a selection circuit which is not further described), a large viewing angle and a high contrast is obtained when using a liquid crystal display device. A satisfactory display of alpha-numerical characters can be simultaneously obtained by means of the sub-division into sub-segments. A plurality of characters has been shown in Fig. 3 for the purpose of illustration.

Another division with fifteen electrode segments is shown in Fig. 4. The electrode segments 1, 3, 4, 5, 6, 7, 8, 9, 11 and 12 are comparable to those in Fig. 1. Instead of the electrode segments 2, 10, the device according to Fig. 4 now has electrode segments 16, 17, 18 each comprising one segment and occupying the character elements 30^{db}, 30^{dc} and 30^{dd} as well as the electrode segments 19 and 20. Each electrode segment 19, 20 comprises two square-shaped sub-segments 21 at the location of the character elements 30^{bc}, 30^{cc} and 30^{ec}, 30^{fc}, respectively. For the purpose of illustration, Fig. 5 shows a plurality of characters displayed by means of a sub-division of (sub-) segments according to Fig. 4.

The invention is of course not limited to the examples shown, but many other shapes, notably of the sub-segments 21, are possible, for example, rectangular or parallelogram shapes. Different distributions of the sub-segments over the electrode segments are alternatively possible.

Claims

1. A display device for displaying alpha-numerical characters, which device comprises an electro-optical material between a first supporting plate having at least one electrode and a second supporting plate having a plurality of electrode segments, characterized in that the electrode segments comprise sub-segments most of which are substantially square-shaped, rectangular or parallelogram-shaped and occupy at least a part of character elements arranged in the form of a matrix.

2. A display device as claimed in Claim 1, characterized in that the second supporting plate has at least twelve electrode segments and the substantially square-shaped, rectangular or parallelogram-shaped sub-segments occupy the majority of the character elements.

3. A display device as claimed in Claim 1 or 2, characterized in that at least eight electrode segments comprise a plurality of substantially square-shaped, rectangular or parallelogramshaped sub-segments.

4. A display device as claimed in Claim 3, characterized in that at least one of the eight electrode segments also comprises a triangular sub-segment which together with a triangular sub-segment of another electrode segment substantially entirely occupies a character element.

5. A display device as claimed in any one of the preceding Claims, characterized in that the electro-optical material is a liquid crystalline material.

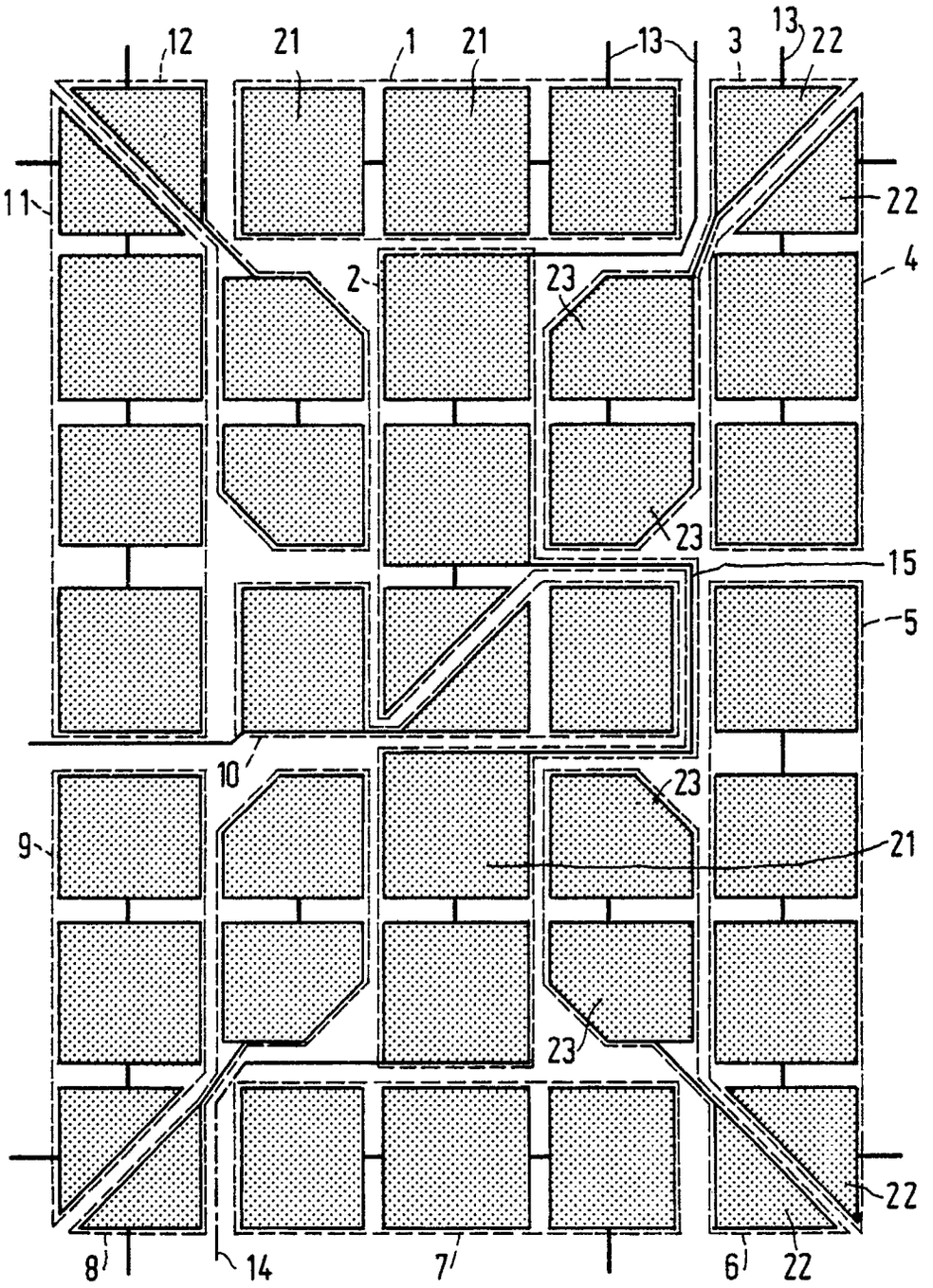


FIG.1

aa 30	ab 30	ac 30	ad 30	ae 30
ba 30	bb 30	bc 30	bd 30	be 30
ca 30	cb 30	cc 30	cd 30	ce 30
da 30	db 30	dc 30	dd 30	de 30
ea 30	eb 30	ec 30	ed 30	ee 30
fa 30	fb 30	fc 30	fd 30	fe 30
ga 30	gb 30	gc 30	gd 30	ge 30

FIG.2

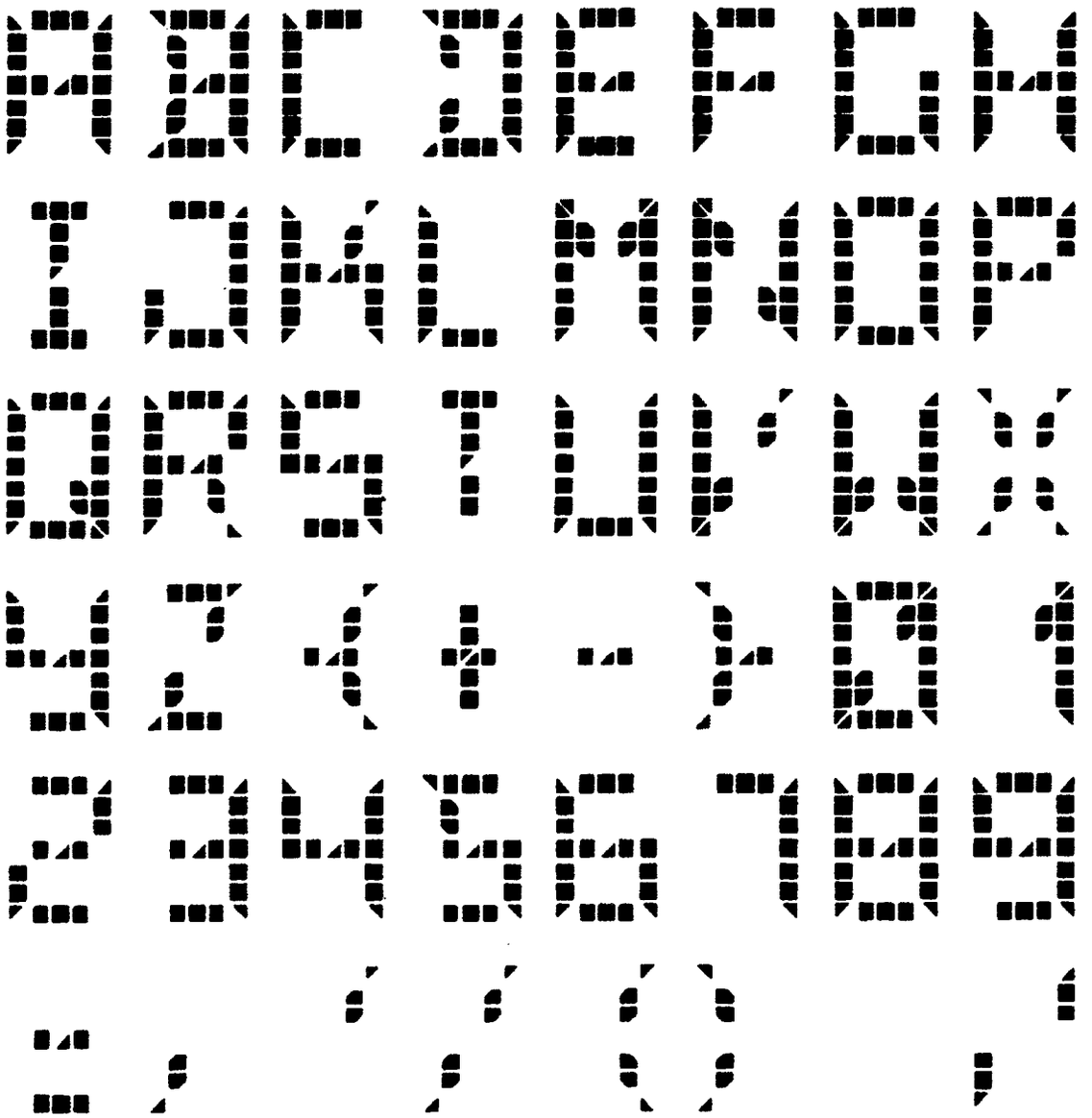


FIG. 3

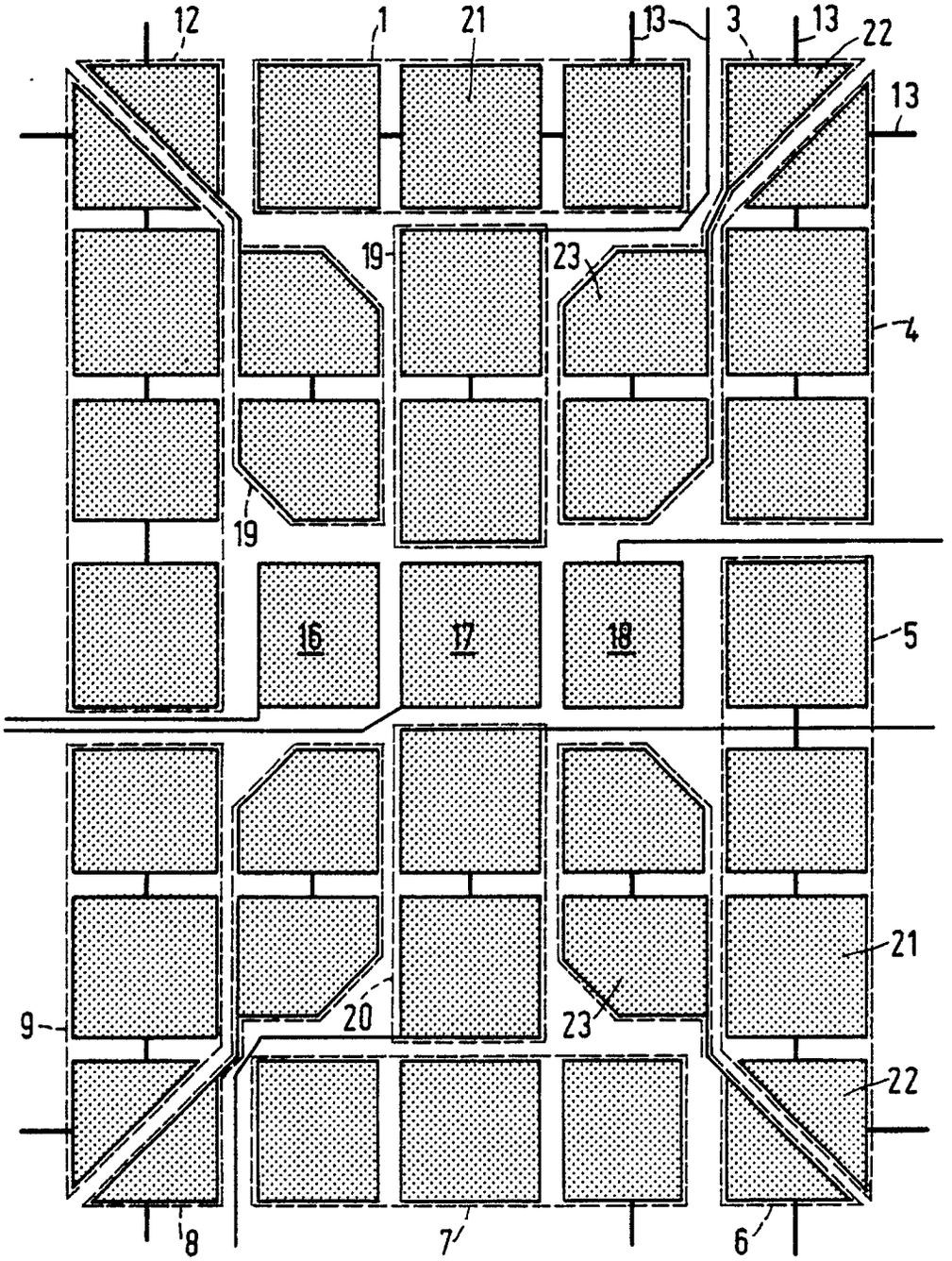


FIG.4

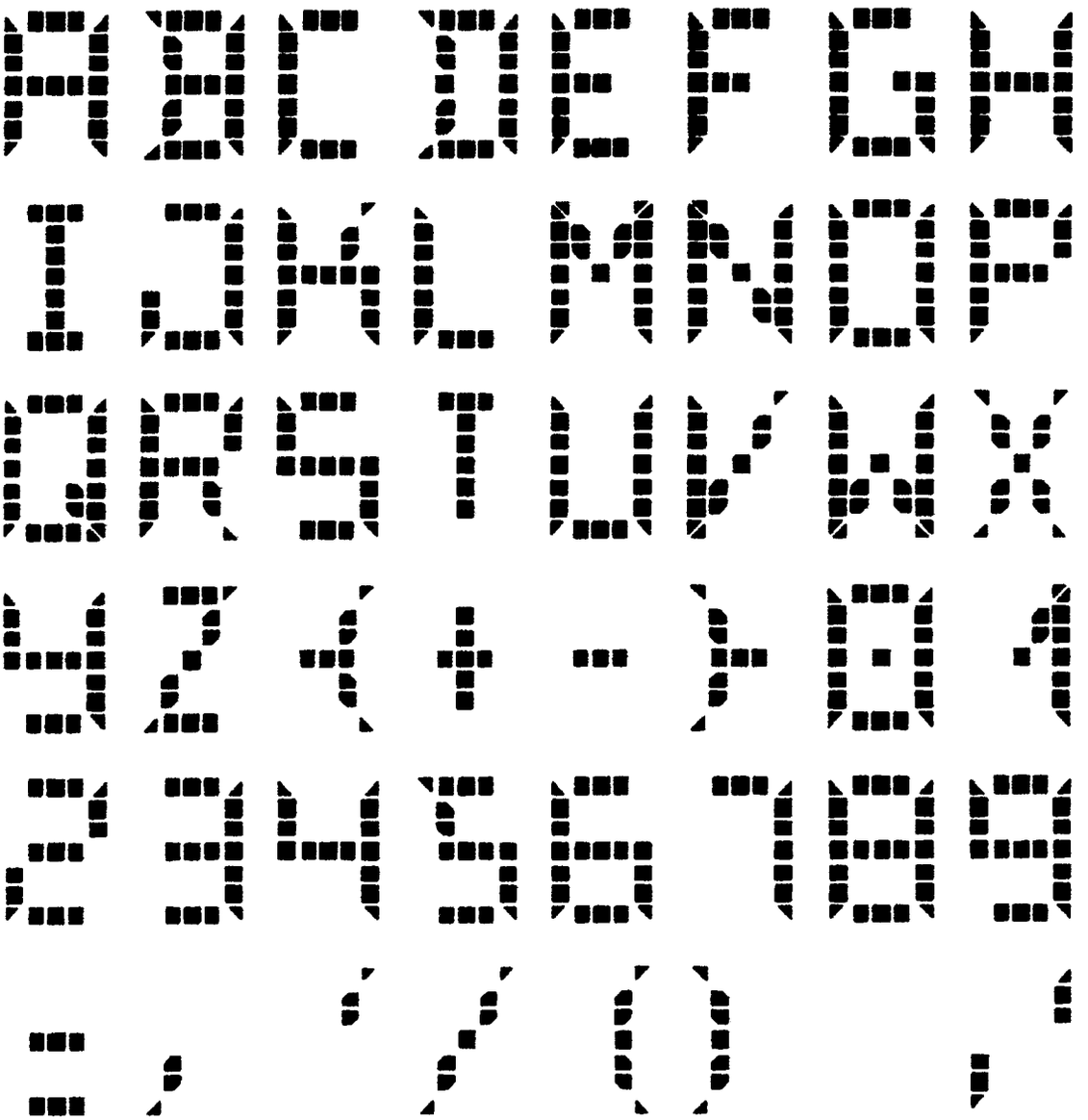


FIG.5

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EUROPEAN SEARCH REPORT

Application Number

EP 90 20 2542

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	DE-A-3 346 630 (SWF) * Page 15, lines 06-33; figure 11 *	1-3,5	G 09 F 9/30 G 02 F 1/1343
Y	EP-A-0 164 152 (N.V. PHILIPS') * Page 1, line 29 - page 2, line 36; page 5, lines 01-35 *	1-3,5	
A	EP-A-0 255 158 (N.V. PHILIPS') * Column 1, line 29 - column 2, line 16; column 5, lines 20-42 *	1,2,4,5	
A	EP-A-0 180 685 (AUTOPHON. AG) * Page 3, lines 16-27; page 4, line 09 - page 5, line 09 *	1,2,4,5	
A	EP-A-0 146 285 (STC) * Page 6, lines 29-36; page 9, lines 7-22 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

G 09 F 9
G 02 F 1

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	10 January 91	DIOT P.M.L.

CATEGORY OF CITED DOCUMENTS

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