

Display Device in Matrix Form

5 The invention relates to a display device
according to the preamble to claim 1.

A display device of this type is known from DE 89
13 499 U1. In this known display device the
10 interleaved individual matrices have their own
partial control arrangements, to which pieces of
partial display information are passed from a
central control system. The display information is
made up from the pieces of partial display
15 information. The partial control arrangements in
this case actuate the associated partial image
dots via their own control lines.

This type of control of a matrix with four
20 interleaved partial matrices not only requires a
high outlay on control means but also complex
wiring of the matrix. In addition, setting of the
matrix is only rapid when the partial control
arrangements actuate all the partial image dots to
25 be set in parallel. This however involves extreme
outlay on setting switches in the partial control



arrangements, as each partial image dot must be provided with its own setting switch.

5 There is known from DE 40 24 499 C1 a circuit arrangement for a display device with a matrix comprising bistable matrix points in which, for monitoring purposes, the columns or lines are actuated in succession, all the matrix points of the column or of each line are set or reset.

10 However, no display can be set and deleted with this circuit arrangement, since as a rule in a display only a portion of the matrix points of a column or line is set. Also, in the display, a matrix point can only be reproduced in one colour.

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The object of the invention is to provide a display device of the type aforementioned in which the desired display may be shown extremely rapidly and in a plurality of colours, with considerably reduced complexity in control systems.

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This object is achieved according to the invention on the one hand in that, in the column direction, the electromagnets of the flaps are actuatable in succession by means of a column control arrangement in a half-column manner, the resetting reference potential being connectable

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to the respectively actuated half-column in a first partial step, and the setting reference potential being connectable thereto in a second partial step, and in that, in the line direction, the electromagnets of the flaps are actuatable in parallel by means of a line control arrangement, the resetting potential being respectively connectable to all of the half-lines in the first partial step of a column actuating process, and the partial display information corresponding to the actuated half-column being respectively connectable as the setting potential to the associated half-lines in the second partial step of the column actuating process, or in an equally advantageous manner, in that, in the column direction, the electromagnets of the flaps are actuatable in succession by means of a column control arrangement in a half-column manner, the resetting reference potential being connectable to the respectively actuated half-column in a resetting cycle, and the resetting potential being respectively connectable simultaneously to all of the half-lines by means of a line control arrangement during each column actuating process, and in that, in a setting cycle, the electromagnets of the flaps are actuatable in a half-column manner in succession with setting



reference potential by means of the column control arrangement, the partial display information, corresponding to the actuated half-column, being respectively connectable as the setting potential to the associated half-lines during each column actuating process.

By means of the subdivision of the matrix points into half-columns and half-lines, all the partial matrices may be set in an actuating cycle with correspondingly predetermined pieces of partial display information in a half-column manner. Thus the control lines in the column direction are reduced to the number of half-columns, i.e. double the number of columns in the matrix, and the control lines in the line direction to the number in the matrix. The actuation operates serially in column direction, and in parallel in the line direction, so that the partial image dots may be both set and re-set extremely rapidly, especially as the setting and resetting pulses need only exist for a few milliseconds in order to actuate the flaps.

The structure of the matrix in one embodiment is such that each half-line has both a resetting line and a setting line, in that each resetting



line is connected to one of the connections of
all of the electromagnets of the flaps of the
associated half-line via rectifiers, which are
permeable to the resetting potential, in that each
5 setting line is connected to one of the
connections of all of the electromagnets of the
flaps of the associated half-line via rectifiers,
which are permeable to the setting potential, in
that the other connections of the electromagnets
10 of the flaps are connected to associated half-
column lines, and in that the column control
arrangement has resetting switches and setting
switches, which are assigned to the individual
half-columns, and the line control
15 arrangement has setting and resetting
switches, which are assigned to the individual
half-lines.

The column control arrangement and the line
20 control arrangement are actuatable by a display
control means, e.g. a processor, to which the
display information is suppliable from a memory in
the form of partial display information which is
assigned to the individual half-columns.

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For displaying text, the memory contains the
display information in half-columns and half-lines



as the values "0" and "1", the value "1" signifying the setting of the associated flap into the exposure position.

5 The invention will be explained in more detail with reference to an embodiment given by way of example and illustrated in the drawings, which show:

- 10 Fig. 1: a circuit diagram of a display device according to the invention;
- Fig. 2: schematically, the structure of the matrix;
- Fig. 3: schematically, a matrix point on the matrix;
- 15 Fig. 4: schematically, the structure of the display information in the memory, and
- Fig. 5: the matrix point with the flaps and control lines.

20 As Fig. 1 shows, a matrix M with matrix points mp consisting of four partial image dots of different colours has a column control arrangement SpSt and a line control arrangement ZSt. A central display control arrangement ASt controls the column

25 control arrangement SpSt and the line control arrangement ZSt. An input EG determines which display information is to be displayed at the



matrix. Various pieces of display information are stored in a memory ASp. Thus a specific text may be selected by means of a text memory TxSp. The memory ZSp then converts the letters of the text
5 into bits of partial display information and places these in the predetermined squares in the matrix M.

Fig. 2 shows schematically the structure of the
10 matrix M. Each matrix point mp has an optical fibre which is illuminated in accordance with the colour assigned to the partial matrix. The optical fibres of a partial matrix may be combined to form an optical fibre bundle, and may be simultaneously
15 illuminated through a corresponding filter. The light-emitting end of each fibre may be covered or exposed by means of a flap, so that the partial image dot can be included with its assigned colour in the display, or may be eliminated therefrom.
20 Thus, as Fig. 3 shows schematically, the partial image dot b1 may be white, the partial image dot b2 yellow, the partial image dot b3 green and the partial image dot b4 red. this arrangement of a matrix point mp is repeated over all the columns
25 x1 to xn and over all the lines y1 to ym. For control purposes the columns x1 to xn are subdivided into half-columns x11, x12 to xn1, xn2



with associated control lines, and the lines y_1 to y_m into half-lines y_{11} , y_{12} to y_{m1} , y_{m2} with associated control lines.

5 The control information present at or passed to the display control device AST corresponds to the display information in which the value "0" signifies a covered optical fibre, and the value "1" an exposed optical fibre. With the columns x_1 to x_n and the half-columns x_{11} , x_{12} to x_{n1} , x_{n2} ,
10 and with the lines y_1 to y_m and half-lines y_{11} , y_{12} to y_{m1} , y_{m2} , the structure of the control information corresponds to the structure of the matrix M . A half-column forms a piece of partial display information T_{inf} , which is transferred
15 parallel into the assigned half-column of the matrix M .

As Fig. 4 shows, the display information can be subdivided into equal-sized squares B_1 , B_2 , B_3 and
20 B_4 , like the matrix M . The squares B_1 , B_2 , B_3 , B_4 ... are of such size that the letter of a text can be displayed. If a text is supplied by the text memory $TxSp$, than the text is converted letter by letter with the aid of the memory ZSp into the
25 corresponding partial display information. The display control arrangement AST positions the partial display information in the assigned square.



of the matrix M. This procedure is repeated until the text has been set letter by letter in the corresponding squares B1, B2, B3, B4 ... in the matrix M.

5 Figure 5 shows the electrical structure of a matrix point mp (x1, y1) with the four electromagnets of the flaps $kx1y11$, $kx12y11$, $kx11y12$ and $kx12y12$. These electromagnets of the flaps are connected with one respective contact to
10 the assigned control lines of the half-columns x11 and x12. The respective other contacts lead via two respective rectifiers Ds and Dr to the setting line and the resetting line of the assigned half-columns y11 or y12. The electromagnet of the flap
15 $kx11y11$ is assigned to the half-column x11, and to the half-line y11, the electromagnet of the flap $kx12y11$ to the half-column x12 and half-line y11, the electromagnet $kx11y12$ to the half-column x11 and half-line y12, and the electromagnet of the
20 flap $kx12y12$ to the half-column x12 and half-line y12.

The half-line y11 has a setting line y11s and a resetting line y11r, and the half-line y12 a
25 setting line y12s and a resetting line y12r. Each setting line y11s or y12s is assigned to a setting switch shz1 or shz2, which via the rectifier Ds



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connects the setting potential + to the setting
line y11s or y12s. During setting, the selected
half-column x11 or x12 is connected via a setting
switch shsp1 or shsp2 to the set reference
5 potential earth.

Assigned to each resetting line y11r or y12r is a
resetting switch rhz1 or rhz2 which via the
rectifier Dr connects the reset counter potential
10 earth to the resetting line rhz1 or rhz2. During
resetting, the selected half-column x11 or x12 is
connected via a resetting switch rhsp1 or rhsp2 to
the resetting potential +. The rectifiers Dr and
Ds are so incorporated that, upon setting or
15 resetting, the current flow flows in one direction
or another through the electromagnet of the flap.
A short-time pulse is sufficient here. The flap is
then retained by residual magnetism in the set
position until the electromagnet is actuated in
20 the other flow direction.

The control cycle may be realised in two ways.
Setting and resetting may comprise a self-
contained cycle. Before a new piece of display
25 information is set, all the flaps are returned
into the covered position. This is achieved by
actuating the half-columns x11, x12 to xn1, xn2 in

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succession via their resetting switches rhsp1 or rhsp2 with the resetting potential +. Upon each actuation of a half-column x11, x12 to xn1, xn2. all the resetting lines y11r or y12r are actuated via the resetting switches rhz1 or rhz1 with the resetting reference potential earth. Thus, in one step, all the set flaps of the selected half-column are returned to their covering positions. If the resetting cycle is carried out then, in one setting cycle, the flaps may be set from half-column to half-column in accordance with the display information in Fig. 4. Upon actuation of the half-column x11, the information associated with the matrix point mp (x1, y1) will lead to setting of the flap kx11y12, and upon actuation of the half-column x12, to setting of the flap kx12y11. After the setting cycle, all pieces of partial display information TInf of the display information are transferred into the half-columns of the matrix M. The associated flaps expose the partial image dots, and the matrix M emits the corresponding display. The partial image dots of each matrix point mp may be set, or not set, at will.

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The setting cycle and the resetting cycle may also be interleaved one in another. Before a selected

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half-column x_{11} , x_{21} to x_{n1} , x_{n2} is set, in a first partial step the half-column is firstly reset and then set in accordance with the associated partial display information T_{inf} . This has the advantage that the half-column need only be addressed once. With each newly selected half-column, the resetting and setting procedure is repeated, until the cycle is completed and terminated at the last half-column. A new piece of display information is then overwritten from half-column to half-column.

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Claims



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1. Display device, having a matrix formed from matrix points disposed in columns and lines, wherein each matrix point comprises four partial image dots which are of different colours and are each split into two half-columns and two half-lines, wherein each partial image dot is formed by the end of an optical fibre, which is accordingly illuminated in colour, and the end of said optical fibre at the light-emitting end being coverable and exposable by means of a bistable flap, which is actuatable in a pulse-like manner by means of an electromagnet, and wherein the electromagnets of the flaps for exposing the ends of the optical fibres with setting and setting reference potential and for covering the ends of the optical fibres with resetting and resetting reference potential are actuatable by means of a control arrangement according to a bit of display information selected from a storage means, characterised in that, in the column direction ($x_1 \dots x_n$), the electromagnets ($K_{x_1 y_{11}}$, $K_{x_1 y_{12}}$; $K_{x_2 y_{11}}$, $K_{x_2 y_{12}}$; ...) of the flaps are actuatable in succession by means of a column

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control arrangement (SpSt) in a half-column manner (x11, x12 ... xn1, xn2), the resetting reference potential (+) being connectable to the respectively actuated half-column (x11, x12) in a first partial step, and the setting reference potential (earth) being connectable thereto in a second partial step, and in that, in the line direction (y1 ... ym), the electromagnets (Kx11y11, Kx12y11; Kx11y12, Kx12y12; ...) of the flaps are actuatable in parallel by means of a line control arrangement (ZSt), the resetting potential (earth) being respectively connectable to all of the half-lines (y11, y12 ... ym1, ym2) in the first partial step of a column actuating process, and the partial display information (TInf) corresponding to the actuated half-column (x11, x12... xn1, xn2), being respectively connectable as the setting potential (+) to the associated half-lines (y11, y12... ym1, ym2) in the second partial step of the column actuating process.

2. Display device, having a matrix formed from matrix points disposed in columns and lines, wherein each matrix point comprises four partial image dots which are of different colours and are



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each split into two half-columns and two half-lines, wherein each partial image dot is formed by the end of an optical fibre, which is accordingly illuminated in colour, and the end of said optical fibre at the light-emitting end being coverable and exposable by means of a bistable flap, which is actuatable in a pulse-like manner by means of an electromagnet, and wherein the electromagnets of the flaps for exposing the ends of the optical fibres with setting and setting reference potential and for covering the ends of the optical fibres with resetting and resetting reference potential are actuatable by means of a control arrangement according to a bit of display information selected from a storage means, characterised in that, in the column direction (x_1 x_n), the electromagnets (K_{x1y11} , K_{x1y12} ; K_{x12y11} , K_{x12y12} ; ...) of the flaps are actuatable in succession by means of a column control arrangement ($SpSt$) in a half-column manner (x_{11} , x_{12} ... x_{n1} , x_{n2}), the resetting reference potential (+) being connectable to the respectively actuated half-column (x_{11} , x_{12} x_{n1} , x_{n2}) in a resetting cycle, and the resetting potential (earth) being respectively connectable simultaneously to all of the half-lines (y_{11} , y_{12} y_{m1} , y_{m2}) by means of a line control arrangement



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(ZSt) during each column actuating process, and in that, in a setting cycle, the electromagnets (Kx11y11, Kx11y12; Kx12y11, Kx12y12;...) of the flaps are actuatable in a half-column manner in succession with setting reference potential (earth) by means of the column control arrangement (SpSt), the partial display information (TInf), corresponding to the actuated half-column (x11, x12... xnl, xn2), being respectively connectable as the setting potential (+) to the associated half-lines (y11, y12... yml, ym2) during each column actuating process.

3. Display device according to claim 1 or 2, characterised in that each half-line (y11, y12... yml, ym2) has both a resetting line (y11r, y12r...) and a setting line (y11s, y12s...), in that each resetting line (y11r, y12r...) is connected to one of the connections of all of the electromagnets (Kx11y11, Kx12y11; Kx11y12, Kx12y12; ...) of the flaps of the associated half-line (y11, y12 ... yml, ym2) via rectifiers (Dr), which are permeable to the



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resetting potential (+ or earth respectively), in that each setting line(y11s, y12s...) is connected to one of the connections of all of the electromagnets (Kx11y11, Kx12y11; Kx11y12, Kx12y12; ...) of the flaps of the associated half-line (y11, y12 ... ym1, ym2) via rectifiers (Dr), which are permeable to the setting potential (earth or + respectively), in that the other connections of the electromagnets (Kx11y11, Kx11y12; Kx12y11, Kx12y12; ...) of the flaps are connected to associated half-column lines, and in that the column control arrangement (SpSt) has resetting switches rhsp 1, rhsp2, ...), which are assigned to the individual half-columns, and the line control arrangement (Zst) has resetting switches (rhz1, rhz2, ...), which are assigned to the individual half-lines, and setting switches (shz1, shz2, ...), which are assigned to the individual half-lines.

4. Display device according to one of claims 1 to 3, characterised in that the column control arrangement (SpSt) and the line control arrangement (Zst) are actuatable by a display control means (ASt), e.g. a processor, to which the display information is suppliable from a



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memory (ZSp) in the form of partial display information which is assigned to the individual half-columns.

5. Display device according to claim 4, characterised in that the memory (ZSp) contains the display information in half-columns (x11, x12 xn1, xn2) and half-lines (y11, y12 ym1, ym2) as the values "0" and "1", the value "1" signifying the setting of the electromagnets (Kx11y11, Kx12y11; Kx12y11, Kx12y12; ...) of the associated flap into the exposure position.

6. Display device according to claim 4 or 5, characterised in that, for the display information which is in the form of a text, the matrix (M) is split-up into identical squares (B1, B2, B3, B4, ...), the size of which is adapted to the display of a letter (e.g. in a partial matrix of 4x5 matrix points), and in that the partial display information associated with the letters can be learned from the memory (ZSp) whilst controlling a text memory (TxSp).



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