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(54) DRIVING SYSTEM AND METHOD FOR AN ELECTROLUMINESCENT DISPLAY

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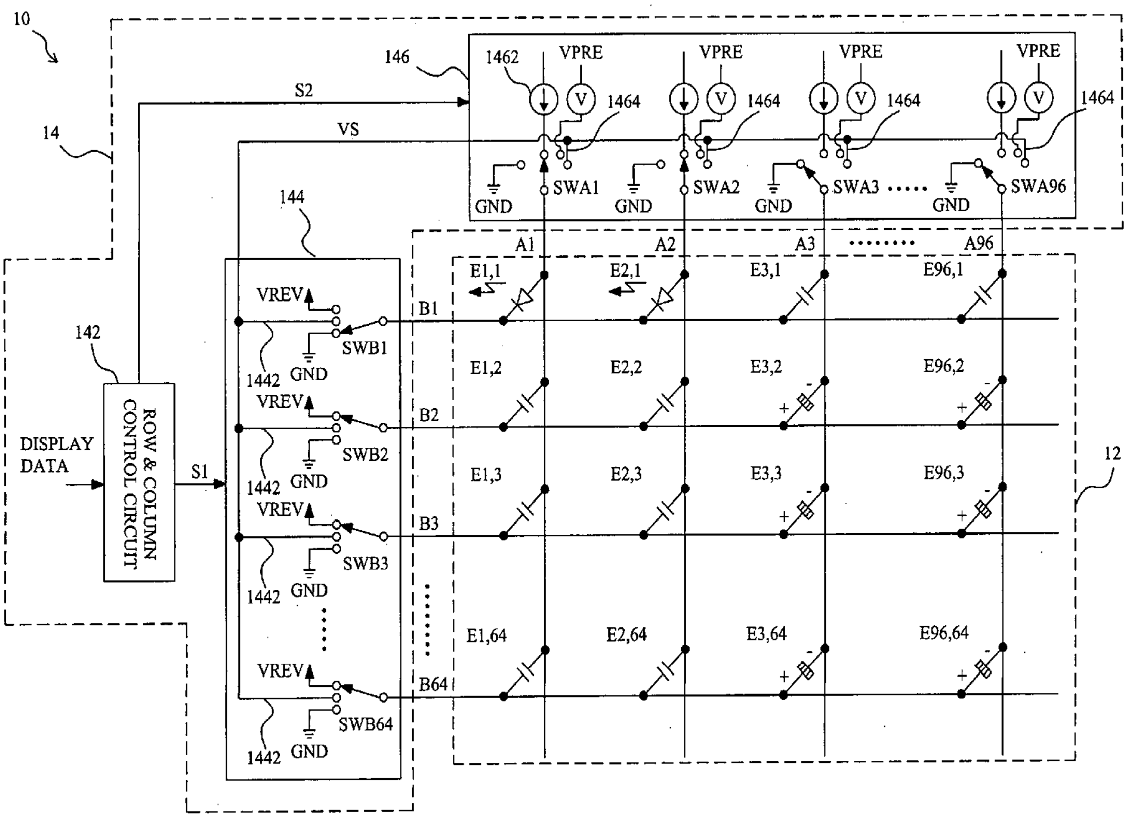
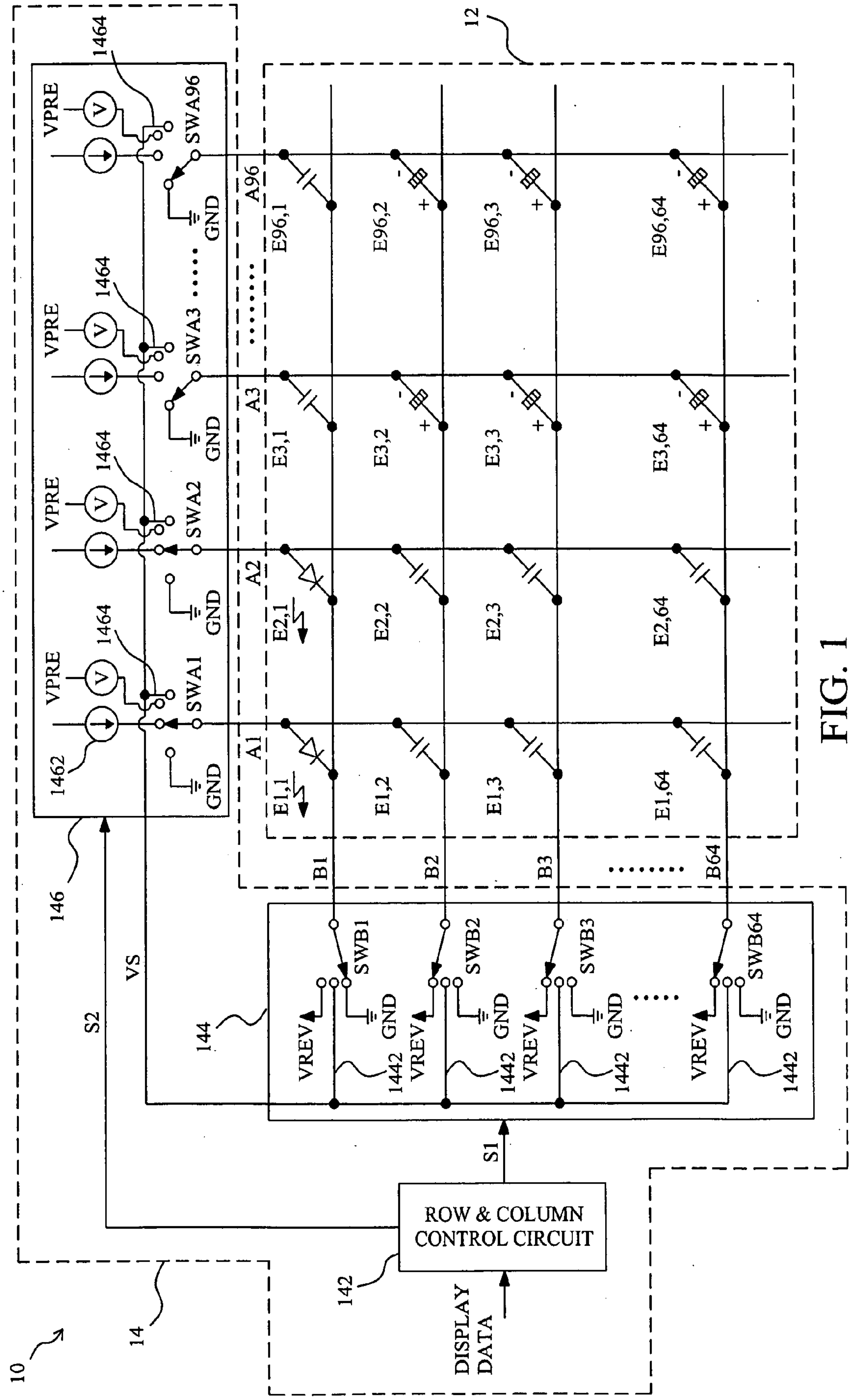
(57) ABSTRACT

A driving system and method for electroluminescent displays which by connecting the electroluminescent elements that have been lighted up to the electroluminescent elements that are to be lighted up causes charge to be shared among the elements, so as to increase the voltage level at the anodes of the electroluminescent elements which are to be lighted up, thereby reducing the power consumption and increasing the response speed.




10
14
12
146
144
142
1462
1464
VPRE
V
SWA1
SWA2
SWA3
SWA96
GND
A1
A2
A3
A96
E1,1
E1,2
E1,3
E1,64
E2,1
E2,2
E2,3
E2,64
E3,1
E3,2
E3,3
E3,64
E96,1
E96,2
E96,3
E96,64
B1
B2
B3
B64
SWB1
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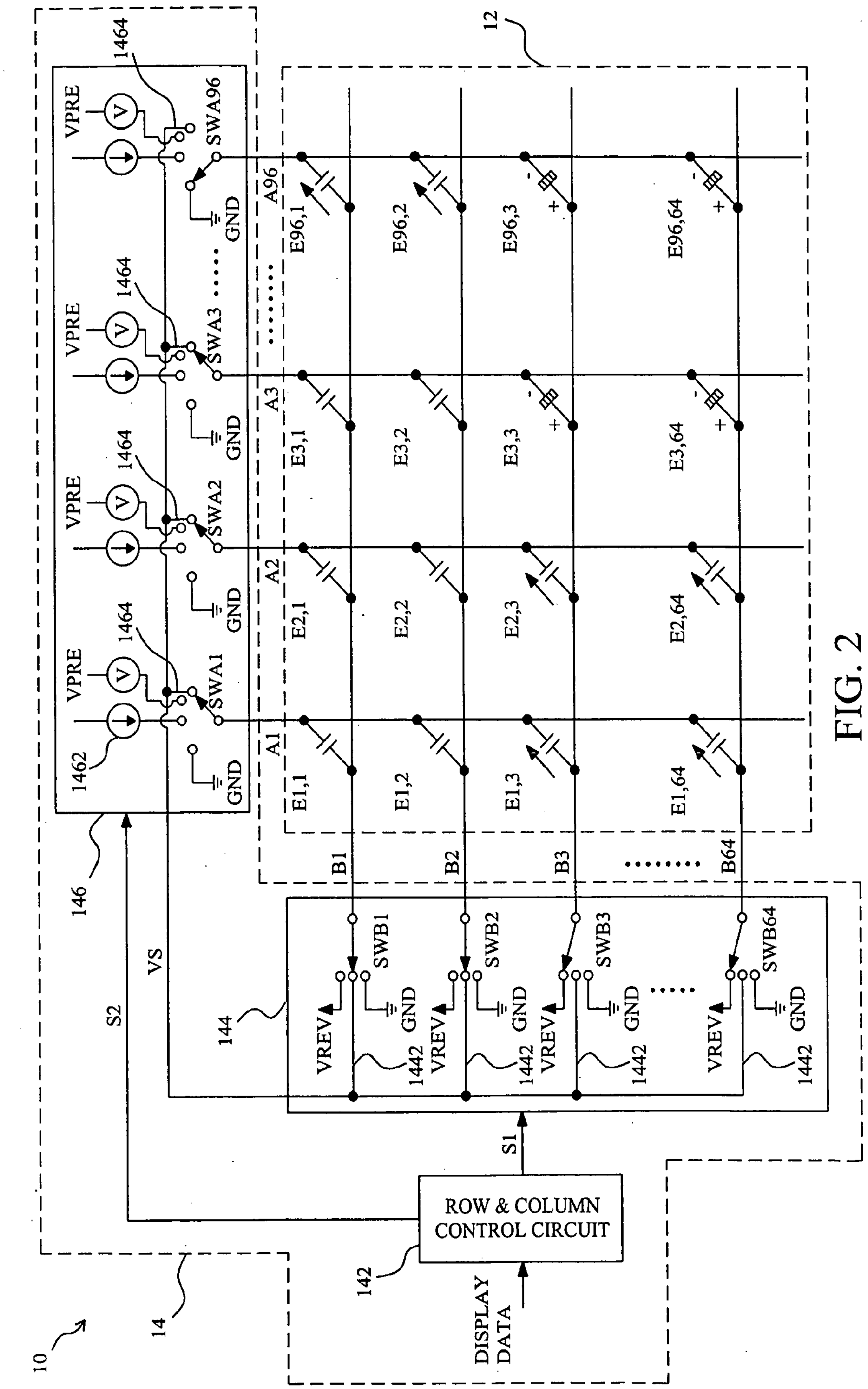
VREV
1442
VS
S2
S1
ROW & COLUMN CONTROL CIRCUIT
DISPLAY DATA

FIG. 1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E1,1
E1,2
E1,3
E1,64
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E2,3
E2,64
E3,1
E3,2
E3,3
E3,64
E96,1
E96,2
E96,3
E96,64
B1
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B3
B64
144
SWB1
SWB2
SWB3
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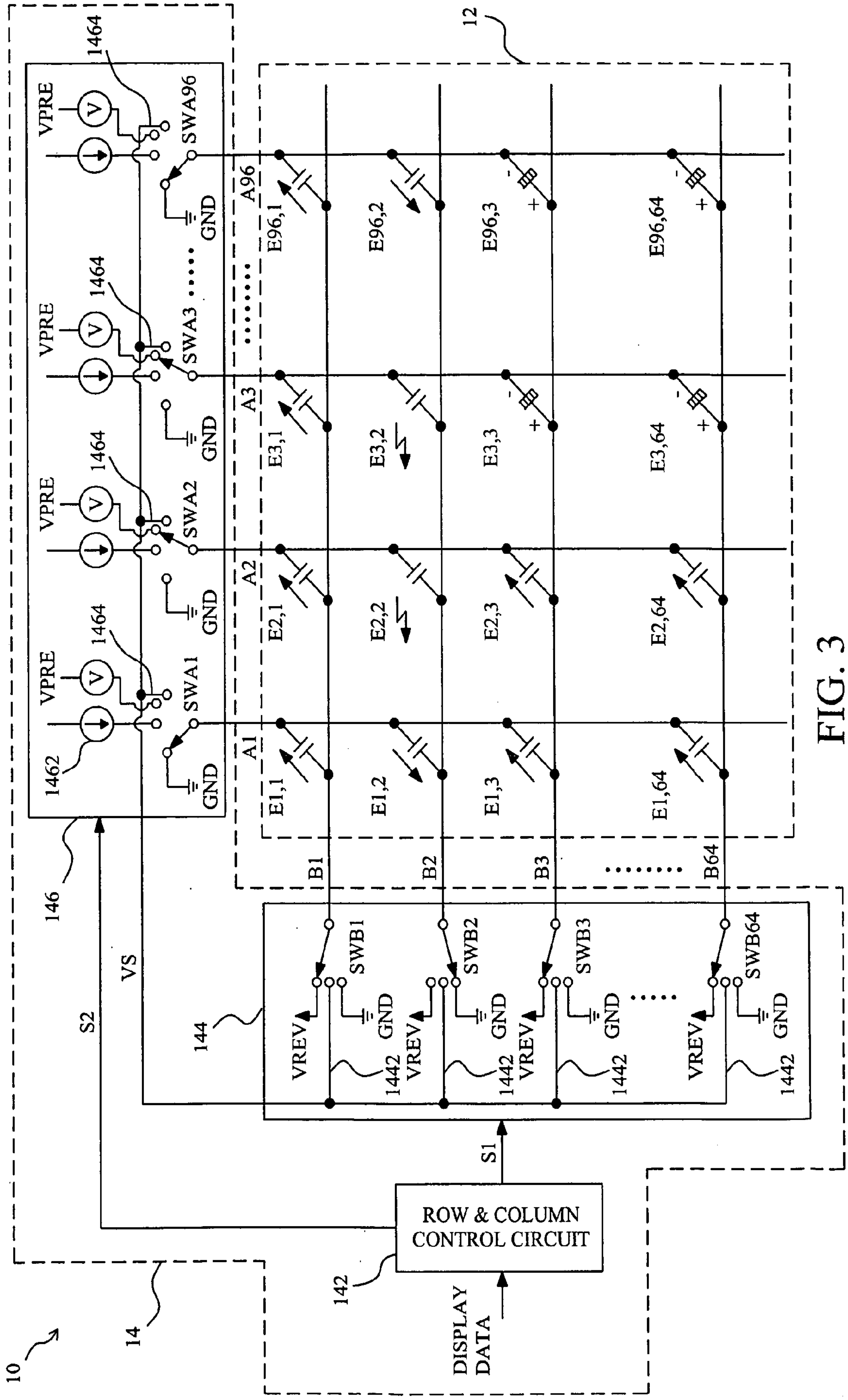
VS
S2
S1
ROW & COLUMN
CONTROL CIRCUIT
142
DISPLAY
DATA

FIG. 2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ROW & COLUMN CONTROL CIRCUIT
DISPLAY DATA
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S2
VS
144
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SWA2
SWA3
SWA96
GND
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A96
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B2
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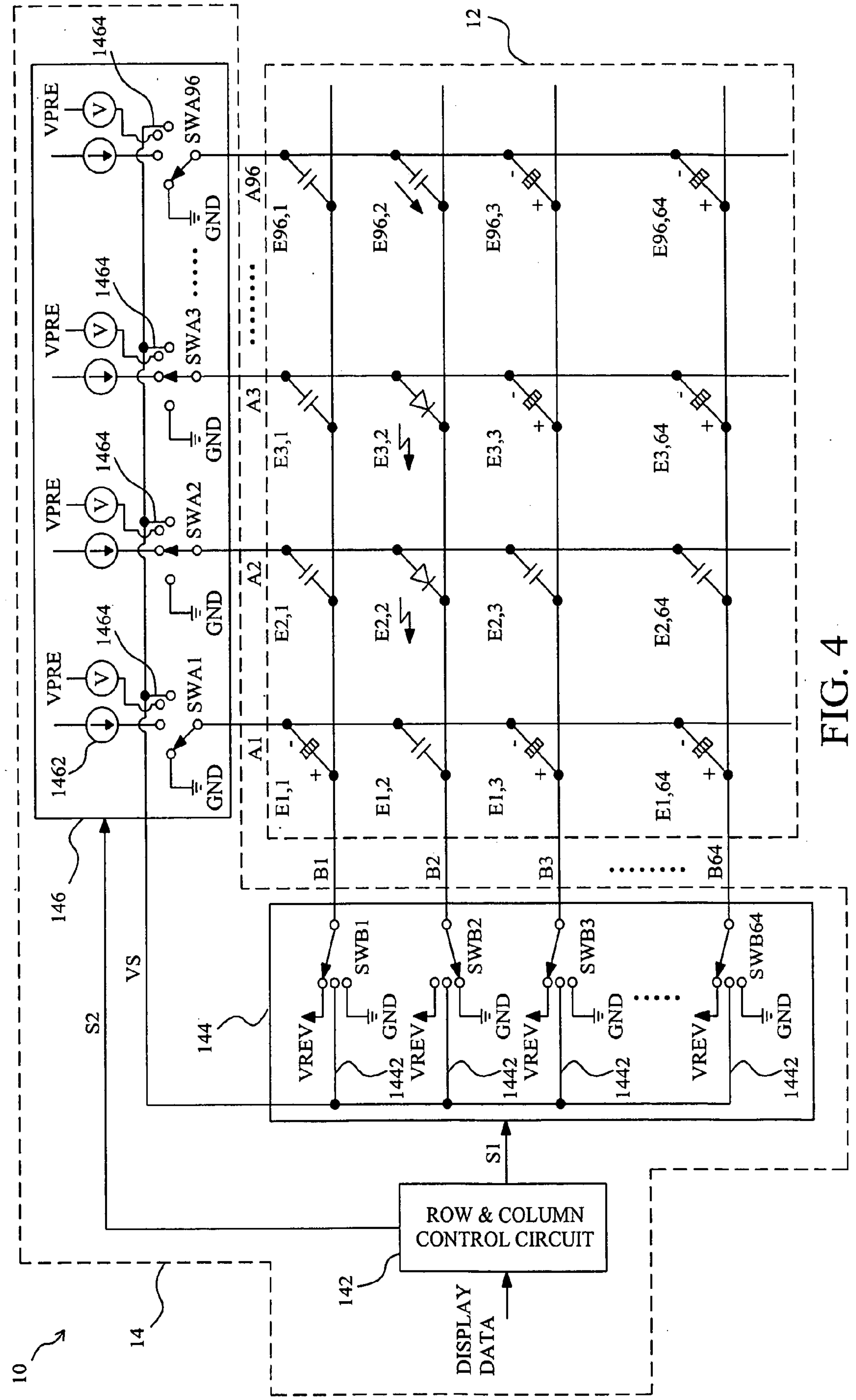
B64
SWB1
SWB2
SWB3
SWB64
VREV
E1,1
E1,2
E1,3
E1,64
E2,1
E2,2
E2,3
E2,64
E3,1
E3,2
E3,3
E3,64
E96,1
E96,2
E96,3
E96,64

FIG. 3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E2,1
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E2,3
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E3,1
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144
SWB1
SWB2
SWB3
SWB64
VREV
1442
VS
S2
S1
ROW & COLUMN CONTROL CIRCUIT
142
DISPLAY DATA

FIG. 4

DRIVING SYSTEM AND METHOD FOR AN ELECTROLUMINESCENT DISPLAY

FIELD OF THE INVENTION

[0001] The present invention is related generally to an electroluminescent display and, more particularly, to a driving system and method for an electroluminescent display.

BACKGROUND OF THE INVENTION

[0002] A typical electroluminescent display comprises an array of electroluminescent elements arranged in rows and columns in which the anodes of the electroluminescent elements on each row are electrically connected to one of a plurality of anode lines and the cathodes of the electroluminescent elements on each column are electrically connected to one of a plurality of cathode lines, and a driving system to switch the anode lines and the cathode lines between two phases according to display data for specifically lighting up one or ones of the electroluminescent elements.

[0003] To speed up the electroluminescent elements in an electroluminescent display to light up, the driving system disclosed by U.S. Pat. No. 5,844,368 to Okuda et al. precharges the electroluminescent element that is to be lighted up. In this driving scheme, however, all the anodes and cathodes of the electroluminescent elements are grounded for the electric charges thereon to be completely discharged before an electroluminescent element is lighted up and as a result, each time the electroluminescent element is charged from 0 V when it is to be lighted up, which requires greater power consumption. Furthermore, the current supplied to the electroluminescent elements by the current source of the driving system is so small that the electroluminescent display slowly responds to the driving control.

[0004] On the other hand, the driving system proposed by U.S. Pat. No. 6,501,226 to Lai et al. comprises switches each of which is inserted between two adjoining cathode lines of the electroluminescent element array, and turns on the corresponding one or ones of the switches between the cathode line being scanned and the next cathode line to be scanned to equalize the electric charges in the electroluminescent elements on the currently scanned cathode line and on the next cathode line to be scanned, so as to reduce the power demand of lighting up the electroluminescent elements.

[0005] There is still a need of reduced power demand and enhanced performance in response speed for an electroluminescent display.

SUMMARY OF THE INVENTION

[0006] An object of the present invention is to provide a driving system and method for an electroluminescent display to attain less power demand and faster response.

[0007] In an electroluminescent display having a driving system to drive an array of electroluminescent elements according to a display data, the anodes of the electroluminescent elements on the same column are electrically connected to one of a plurality of anode lines, and the cathodes of the electroluminescent elements on the same row are electrically connected to one of a plurality of cathode lines. In the driving system, according to the present invention, a row and column control circuit generates two control signals from the display data, an anode line driving circuit in response to the first control signal switches each of the anode lines among connections of a current source, a first node and ground, and a cathode line scanning circuit in response to the second control signal switches each of the cathode lines among connections of a reverse voltage, a second node and ground, wherein the first and second nodes are electrically connected together. When one or more of the electroluminescent elements are to be lighted up, the anode lines connected to their anodes and the anode lines connected to the electroluminescent elements currently being canned are switched to connect to the respective first nodes, and the cathode lines connected to their cathodes and the cathode lines connected to the electroluminescent elements currently being canned are switched to connect to the respective second nodes, such that part of the electric charges in the electroluminescent elements currently being lighted up are recycled and transferred to the electroluminescent elements to be lighted up. Therefore, the power demand to light up the electroluminescent elements is reduced. Further, before the anode line is switched from the first node to the current source, it is switched to connect to a power source to precharge thereto, so as to enhance the response speed of lighting up the electroluminescent elements to be lighted up.

BRIEF DESCRIPTION OF DRAWINGS

[0008] These and other objects, features and advantages of the present invention will become apparent to those skilled in the art upon consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings, in which:

[0009] FIG. **1** shows an electroluminescent display according to the present invention;

[0010] FIG. **2** shows the electroluminescent display of FIG. **1** in a first phase of operation;

[0011] FIG. **3** shows the electroluminescent display of FIG. **1** in a second phase of operation; and

[0012] FIG. **4** shows the electroluminescent display of FIG. **1** in a third phase of operation.

DETAIL DESCRIPTION OF THE INVENTION

[0013] FIG. **1** schematically depicts an electroluminescent display **10**, which comprises an array **12** of organic electroluminescent elements Ex,y (x=1, 2, . . . , 96; y=1, 2, . . . , 64) and a driving system **14** connected to the organic electroluminescent elements Ex,y with a plurality of drive lines Ax (x=1, 2, . . . , 96) and a plurality of scan lines By (y=1, 2, . . . , 64). In the array **12**, the organic electroluminescent elements Ex,y are arranged in such a manner that the anodes of the organic electroluminescent elements Ei,y on the i-th column are connected to the i-th anode line Ai, and the cathodes of the organic electroluminescent elements Ex,j on the j-th row are connected to the j-th cathode line Bj. In the driving system **14**, a row and column control circuit **142** generates two control signals S**1** and S**2** according to a display data for a cathode line scanning circuit **144** and an anode line driving circuit **146**, respectively, such that each of the cathode lines B**1**-B**64** is switched among connections of a power source supplying a reverse voltage VREV, a node

1442 for providing a virtual voltage VS, and ground GND by the cathode line scanning circuit **144**, and each of the anode lines A**1**-A**96** is switched among connections of a current source **1462**, a power source supplying a precharge voltage VPRE, a node **1464** for providing a virtual voltage VS, and ground GND by the anode line driving circuit **146**. The nodes **1442** and **1464** for providing the virtual voltages VS for the anode lines A**1**-A**96** and the cathode lines B**1**-B**64** are connected together. As exemplary shown in FIG. **1**, the cathode line B**1** is grounded, the rest of the cathode lines B**2**-B**64** are all connected to the reverse voltage VREV, two anode lines A**1** and A**2** are connected to the respective current sources **1462**, the rest of the anode lines A**3**-A**96** are grounded, and thus in the array **12**, only the organic electroluminescent elements E**1**,**1** and E**2**,**1** are lighted up.

[**0014**] FIGS. **2**-**4** show how the driving system **14** operates when the organic electroluminescent elements E**2**,**2** and E**3**,**2** are to be lighted up from the state shown in FIG. **1**. In the first step, as shown in FIG. **2**, the cathode lines B**1** and B**2** connected with the organic electroluminescent elements E**1**,**1**, E**2**,**1**, E**2**,**2** and E**3**,**2** are switched by the cathode line scanning circuit **144** to connect to the respective nodes **1442**, and the anode lines A**1**, A**2** and A**3** connected with the organic electroluminescent elements E**1**,**1**, E**2**,**1**, E**2**,**2** and E**3**,**2** are switched by the anode line driving circuit **146** to connect to the respective nodes **1464**. Since the nodes **1442** and **1464** are connected together, the charges in the organic electroluminescent elements E**1**,**1**, E**2**,**1**, E**3**,**1**, E**1**,**2**, E**2**,**2** and E**3**,**2** are shared among those elements, which equalizes the voltages of the organic electroluminescent elements E**1**,**1**, E**2**,**1**, E**3**,**1**, E**1**,**2**, E**2**,**2** and E**3**,**2**, and consequently builds up a virtual voltage VS on the nodes **1442** and **1464**. In this step, part of the electric charges in the currently lighted organic electroluminescent elements E**1**,**1** and E**2**,**1** are transferred to the organic electroluminescent elements E**2**,**2** and E**3**,**2** to be lighted up, so that the electric charges can be recycled to save energy. In the phase shown in FIG. **2**, the voltages on the active anode lines A**1**, A**2** and A**3** and on the cathode lines B**1** and B**2** become the virtual voltage VS, while the voltages on the inactive anode lines remains at the ground level and the voltages on the inactive cathode lines remains at the reverse voltage VREV.

[**0015**] In the next step, as shown in FIG. **3**, the anode lines A**2** and A**3** connected with the organic electroluminescent elements E**2**,**2** and E**3**,**2** to be lighted up are switched by the anode line driving circuit **146** to connect to the respective precharge voltages VPRE, the cathode line B**2** connected with the organic electroluminescent elements E**2**,**2** and E**3**,**2** to be lighted up is switched by the cathode line scanning circuit **144** to ground GND, and the rest of the anode lines Ai's and the cathode lines Bj's are switched to ground GND and the reverse voltage VREV, respectively. In this step, the organic electroluminescent elements E**2**,**2** and E**3**,**2** to be lighted up are precharged by the power sources VPRE so as to speed up their response. In the operation shown in FIG. **3**, the voltages on the active anode lines A**2** and A**3** become the precharge voltage VPRE, the voltage on the active cathode line B**2** become the ground level, the voltages on the inactive anode lines remains at the ground level, and the voltages on the inactive cathode lines remains at the reverse voltage VREV.

[**0016**] As shown in FIG. **4**, after the anodes of the organic electroluminescent elements E**2**,**2** and E**3**,**2** are precharged to the precharge voltage VPRE, the anode lines A**2** and A**3** of the organic electroluminescent elements E**2**,**2** and E**3**,**2** are switched by the anode line driving circuit **146** to connect to the respective current sources **1462** to light up the organic electroluminescent elements E**2**,**2** and E**3**,**2**. In the operation shown in FIG. **4**, the voltages on the active anode lines A**2** and A**3** remain at the precharge voltage VPRE, the organic electroluminescent elements E**2**,**2** and E**3**,**2** are lighted up, the voltages on the active cathode line B**2** remains at the ground level, the voltages on the inactive anode lines remain at the ground level, and the voltages on the inactive cathode lines remain at the reverse voltage VREV.

[**0017**] In the process of lighting up the electroluminescent elements, by switching the anode lines and the cathode lines among the three phases of operation, the electric charges in the electroluminescent elements which have been lighted up are recycled and transferred to the electroluminescent elements to be lighted up, thus reducing the power demand, and the subsequent precharging step further improve the response speed thereof.

[**0018**] While the present invention has been described in conjunction with preferred embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and scope thereof as set forth in the appended claims.

What is claimed is:

1. A driving system for an electroluminescent display having an array of electroluminescent elements arranged in a plurality of rows and columns in such a manner that anodes of the electroluminescent elements on each of the columns are connected to a corresponding anode line, and cathodes of the electroluminescent elements on each of the rows are connected to a corresponding cathode line, the driving system comprising:

a row and column control circuit for generating a first control signal and a second control signal according to a display data;

an anode line driving circuit in response to the first control signal for switching each of the anode lines among connections of a current source, a first node and ground; and

a cathode line scanning circuit in response to the second control signal for switching each of the cathode lines among connections of a reverse voltage, a second node and ground;

wherein the first and second nodes are electrically connected together.

2. The driving system of claim 1, wherein the anode line driving circuit further switches each of the anode lines to connect to a precharge voltage before switching it from the first node to the current source.

3. A driving method for an electroluminescent display having an array of electroluminescent elements arranged in a plurality of rows and columns in such a manner that anodes of the electroluminescent elements on each of the columns are connected to a corresponding anode line, and cathodes of the electroluminescent elements on each of the rows are connected to a corresponding cathode line, the method comprising the steps of:

switching the anode and cathode lines connected with the electroluminescent elements which have been lighted up and the anode and cathode lines connected with the electroluminescent element to be lighted up to electrically connect together; and

switching the anode and cathode lines connected with the electroluminescent elements which have been lighted up and connected with the electroluminescent elements to be lighted up to connect to respective power sources or ground such that the electroluminescent elements to be lighted up are supplied with respective bias currents.

4. The driving method of claim 3, further comprising the step of switching each anode line connected with any electroluminescent elements to be lighted up to connect to a precharge voltage before switching it to receive a respective bias current.

* * * * *

专利名称(译)	用于电致发光显示器的驱动系统和方法		
公开(公告)号	[US20070052366A1](US20070052366A1)	公开(公告)日	2007-03-08
申请号	US11/510816	申请日	2006-08-28
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申请(专利权)人(译)	陈建CHUNG LIN HSAN-FONG 杨SHEI-CHIE		
当前申请(专利权)人(译)	立锜科技股份有限公司.		
[标]发明人	CHEN CHIEN CHUNG LIN HSAN FONG YANG SHEI CHIE		
发明人	CHEN, CHIEN-CHUNG LIN, HSAN-FONG YANG, SHEI-CHIE		
IPC分类号	G09G3/10		
CPC分类号	G09G3/3216 G09G2310/0256 G09G2310/0251		
优先权	094130146 2005-09-02 TW		
其他公开文献	US7808456		
外部链接	Espacenet USPTO		

摘要(译)

一种用于电致发光显示器的驱动系统和方法，通过将已被点亮的电致发光元件连接到要点亮的电致发光元件，使得元件之间共享电荷，从而增加电极的电压电平。要点亮的电致发光元件，从而降低功耗并提高响应速度。