



[54] **PASSIVE MATRIX LCD WITH DRIVE CIRCUITS AT BOTH ENDS OF THE SCAN ELECTRODE APPLYING EQUAL AMPLITUDE VOLTAGE WAVEFORMS SIMULTANEOUSLY TO EACH END**

4,427,997 1/1984 Hareng et al. 345/87
4,789,857 12/1988 Maurice 345/93
4,803,480 2/1989 Soneda et al. 345/100

FOREIGN PATENT DOCUMENTS

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[73] Assignee: **Seiko Epson Corporation**, Tokyo, Japan
[21] Appl. No.: **08/026,234**
[22] Filed: **Mar. 2, 1993**

0 197 551 10/1986 European Pat. Off. .
0 260 747 3/1988 European Pat. Off. .
36 30 012 4/1987 Germany .
2 081 018 2/1982 United Kingdom .
2 183 054 5/1987 United Kingdom .

Related U.S. Application Data

[63] Continuation of application No. 07/783,728, Oct. 28, 1991, abandoned, which is a continuation of application No. 07/391,593, Jul. 10, 1989, abandoned.

Foreign Application Priority Data

Nov. 10, 1987 [JP] Japan 62-284025
Oct. 27, 1988 [JP] Japan 63-271229
Nov. 9, 1988 [WO] WIPO PCT/JP88/01126

[51] **Int. Cl.⁷** **G09G 3/36; G09G 5/00**
[52] **U.S. Cl.** **345/100; 345/94; 345/204**
[58] **Field of Search** 345/211-214, 90, 345/87, 92, 93, 94, 97, 98, 99, 100, 204, 205, 206, 208; 359/85, 59

References Cited

U.S. PATENT DOCUMENTS

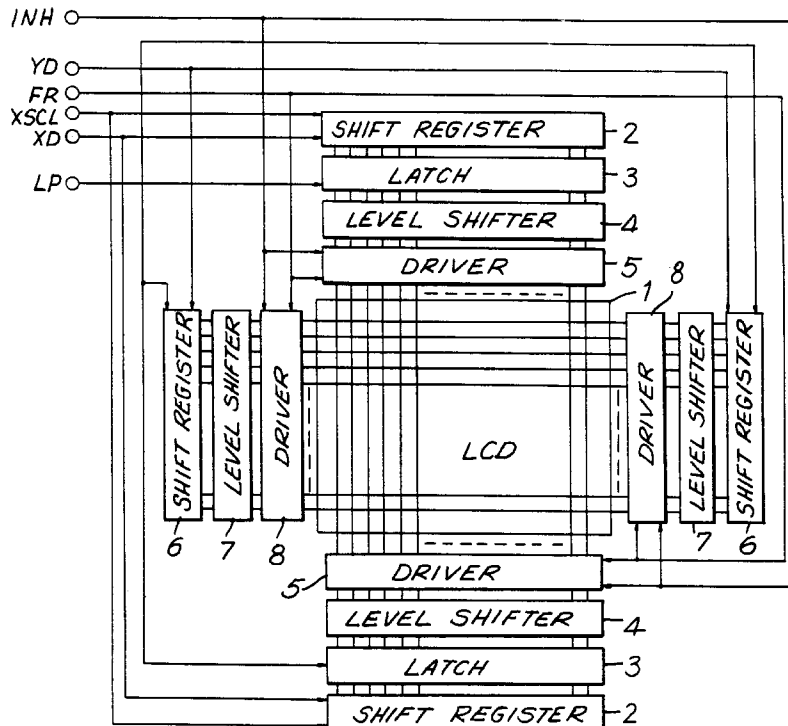
4,346,378 8/1982 Shanks 345/98

Primary Examiner—Jeffery Brier
Assistant Examiner—Paul A. Bell
Attorney, Agent, or Firm—Stroock & Stroock & Lavan LLP

[57] **ABSTRACT**

The present invention is directed to a flat display device and the driving method thereof having a plurality of display picture elements which are defined by liquid crystal cell portions formed between the scanning and the signal electrodes arranged in the form of a matrix wherein at least scanning electrodes of said scanning and signal electrodes are driven from both terminals of the electrodes by individual driving circuits. A circuit is also included that creates a short circuit across the electrode thus protecting the flat display panel from degradation due to excessive current flowing across the panel before the voltage waveform is stabilized.

14 Claims, 3 Drawing Sheets



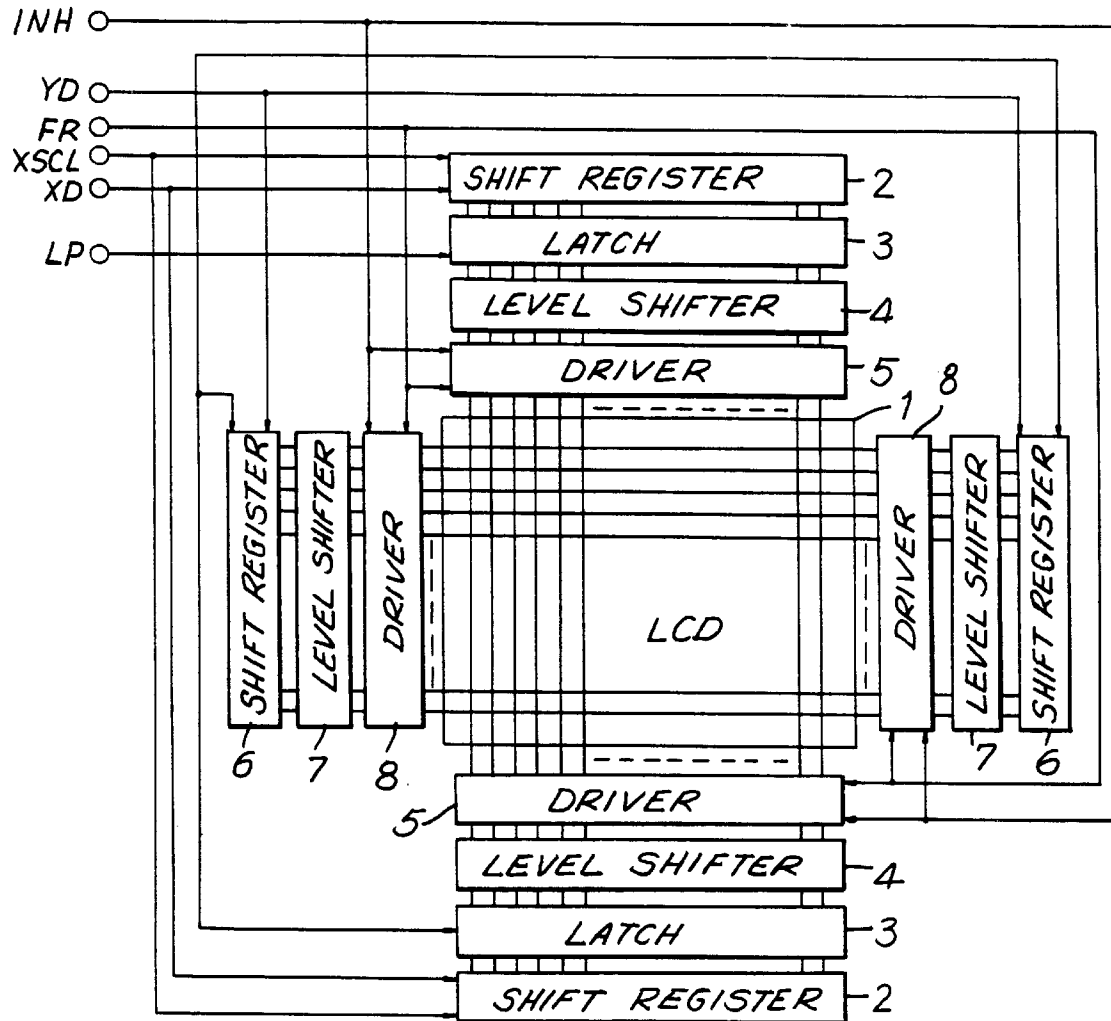


FIG. 1

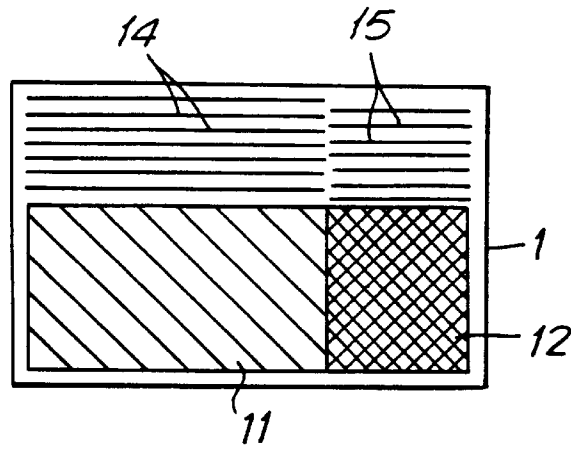


FIG. 2

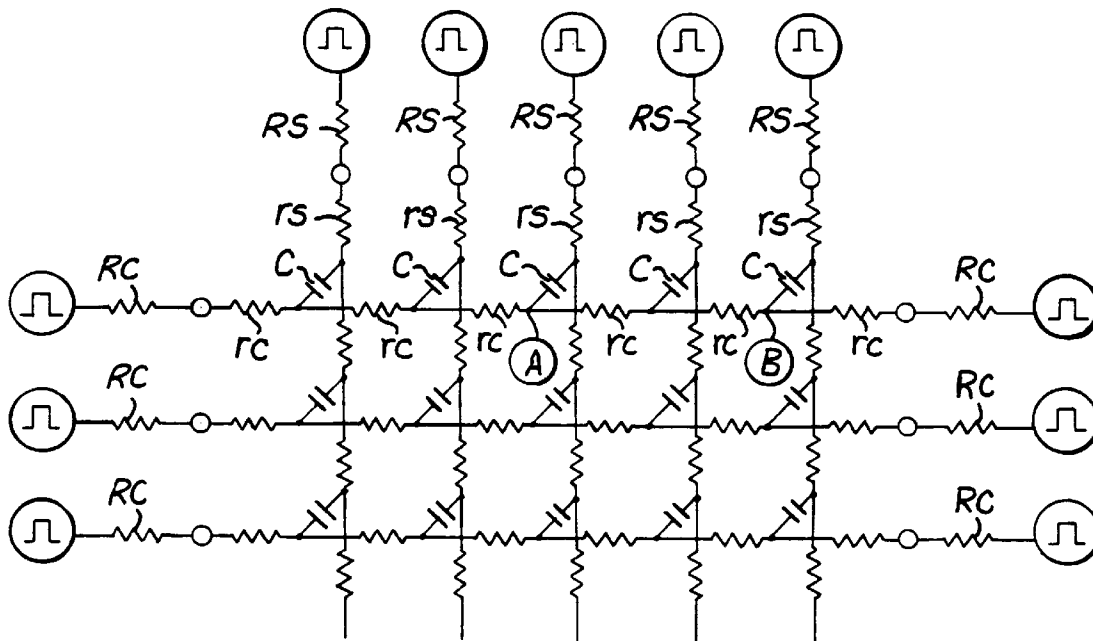


FIG. 3

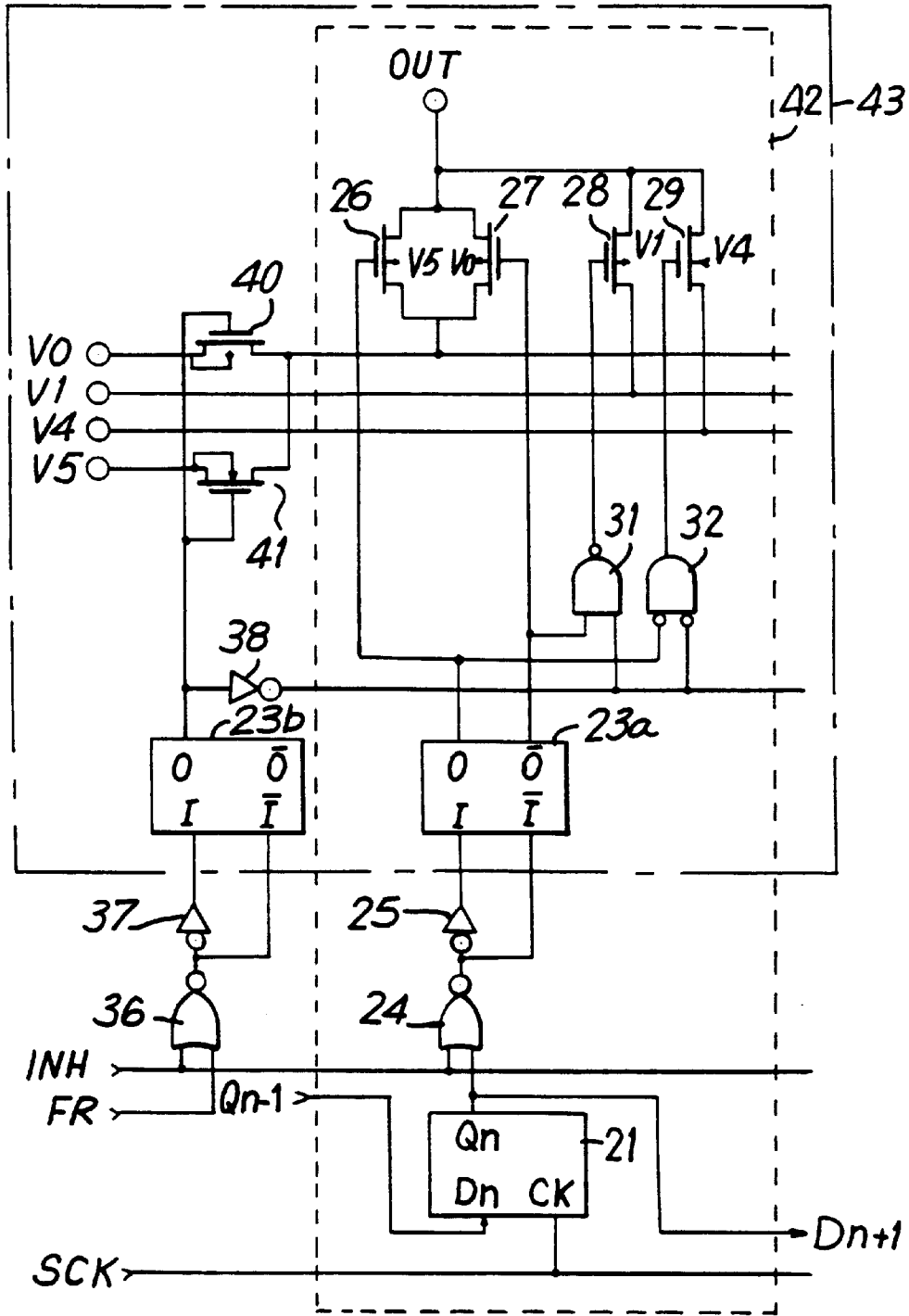


FIG. 4

**PASSIVE MATRIX LCD WITH DRIVE
CIRCUITS AT BOTH ENDS OF THE SCAN
ELECTRODE APPLYING EQUAL
AMPLITUDE VOLTAGE WAVEFORMS
SIMULTANEOUSLY TO EACH END**

This is a continuation of application Serial No. 07/783, 728, filed Oct. 28, 1991, now abandoned which, is a continuation of application Ser. No. 07/391,593, filed on Jul. 10, 1989, for FLAT DISPLAY DEVICE AND METHOD OF DRIVING THE SAME, and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to a flat liquid crystal display device, and more particularly to a flat display device having a plurality of display elements which are defined by liquid crystal cell portions formed between the scanning and the signal electrodes arranged in the form of a matrix and the method of driving the flat display device. In particular, the present invention-relates to a driving method which is effective for the improvement of the display quality in the flat display device.

One method for driving a flat display panel is shown in Japanese Patent Laid-Open No. 38935/78 and Japanese Patent Laid-Open No. 52686/83. This method discloses a driving circuit connected to one end of transparent electrodes in order to drive a display panel.

However, in the above-mentioned prior art, since large capacity dot matrix type liquid crystal panels are required in many applications, the transparent electrodes increase in length and width. The electrode resistance, R , and capacitance, C , across the terminal of the driving circuit to the end of the electrode increases. This increase results in degradation of the display. For example, when the liquid crystal panel has 640×400 dots and is driven at a duty ratio of $1/200$, $R=10^6$ K Ω , and $C=800$ ~ 2000 pF.

When the driving waveform changes, there is a delay period of up to several tens of μ sec. in which the display elements stabilize. This delay time is significant relative to one scanning period (60 ~ 80 μ s). Due to the delay time, the effective driving voltage applied to the respective display elements varies during stabilization from the predetermined value obtained by the voltage standard method. As a result, unevenness of color contrast occurs, as shown in FIG. 2. The quality of the display is reduced so much that it may be difficult to distinguish the non-selected and selected regions.

FIG. 2 shows one embodiment of the prior art wherein unevenness of color contrast is generated between the non-selected regions **11** and **12** when every other horizontal lines is ON. As shown in the upper side of the portion **11**, when there are a large number of signal electrodes **14** and every other horizontal line is in the ON state, the display is too light. In the upper side of the portion **12**, when there are fewer signal electrodes **15** and every other horizontal line is in the ON state, the display is too dark. The color contrast is likely to be more even when the resistance of the scanning electrodes is high.

Increasing the thickness of the electrodes in order to reduce the resistance is ineffectual because of the inferior alignment and increased cost of the panel due to the reduction of the throughput in the manufacturing. Therefore, there is a limit to the thickness of the transparent electrodes that can be achieved.

In order to eliminate the above problems, the object of the present invention is to drive the electrodes of the liquid crystal panel from both terminals thereof, thereby providing

a flat display device possessing a high quality display and little unevenness of contrast.

SUMMARY OF THE INVENTION

The flat display device and method of driving the same according to the present invention has a construction in which the scanning and signal electrodes are arranged in the form of a matrix. Display elements are formed at the crossing points therebetween. The scanning electrodes are driven from both terminals of the electrodes by driving circuits.

According to the above method of the present invention, the resistance of the transparent electrodes becomes approximately one quarter the resistance of the transparent electrodes when the electrodes are driven from only one side. The output resistance of the driving circuit become equivalently one half and the effect of the voltage variation of the display elements is also less because the electrode is being driven from both terminals. Therefore, elements are not likely to be affected by the varying voltage, so that the quality of display is improved over that of the prior art.

Accordingly, it is an object of this invention to provide an improved flat display device which substantially reduces contrast problems.

It is another object of the invention to provide an improved flat display device which applies a voltage to both scanning driving circuits to prevent current from flowing across the liquid crystal.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a perspective view of the flat display device in accordance with the present invention.

FIG. 2 is perspective view illustrating the problems with the prior art.

FIG. 3 is a schematic showing an electronic model of the flat display of FIG. 1.

FIG. 4 is a circuit diagram of the driving circuit utilizing short preventing circuitry in accordance with the present invention.

**DESCRIPTION OF THE PREFERRED
EMBODIMENT**

FIG. 1 shows a driving method according to one embodiment of the present invention. The display elements are formed on the crossing portions between the scanning and signal electrodes, arranged in the form of a matrix. The flat display device is driven by two segment and scanning side driving circuits of the transparent electrode (i.e. ITO (Indium Tin Oxide)). The amplitudes of the voltages simultaneously applied to the both ends of the scanning and signal side driving circuits are equal. A shift clock input, XSCL, is

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