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(54) BUMP STRUCTURE FOR TESTING LIQUID CRYSTAL DISPLAY PANEL AND METHOD OF FABRICATING THE SAME

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(52) **U.S. Cl.** **324/770**

(57) **ABSTRACT**

A bump structure for testing a liquid crystal display panel includes a plurality of pads arranged at a pad region along an edge portion of a liquid crystal display panel and connected to one of a gate line and a data line, a driver IC arranged to be electrically connected to the plurality of pads, and a test bump electrically connected to at least one of the plurality of pads and arranged at the pad region except within a region where the driver IC is mounted.

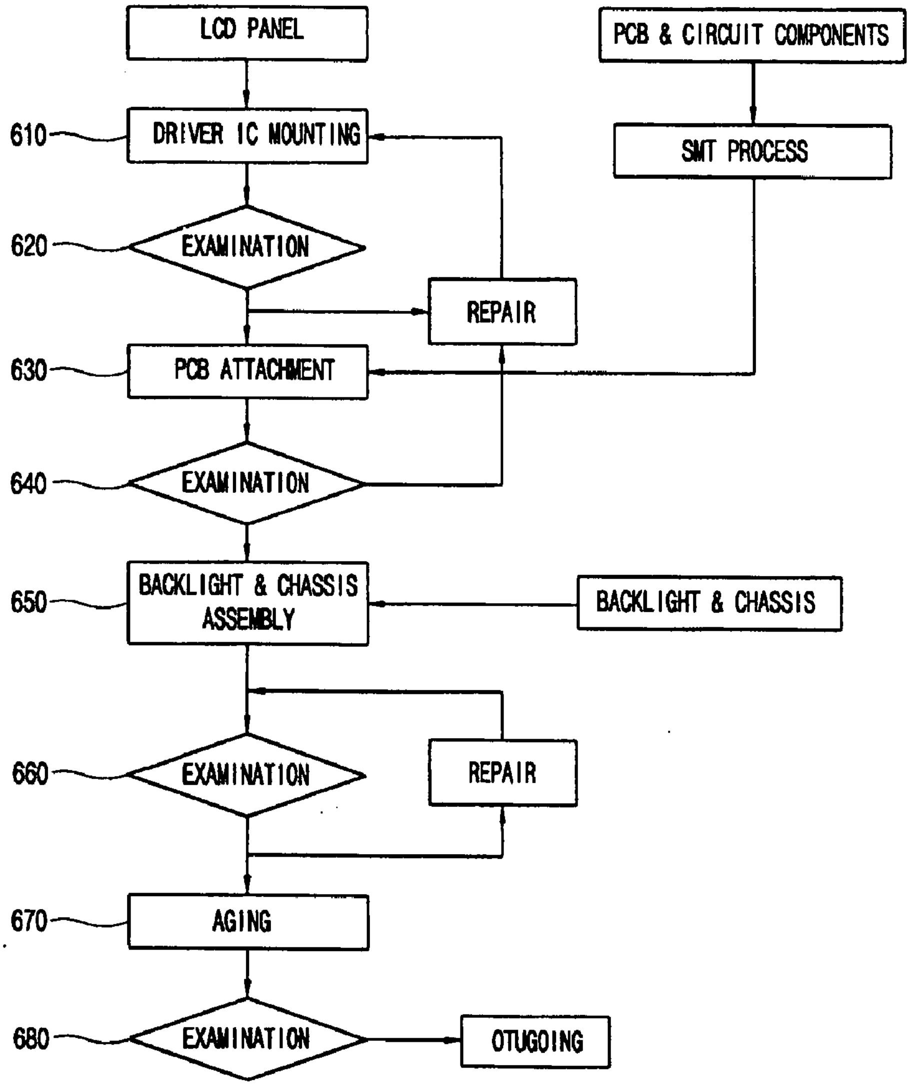


FIG. 1
RELATED ART

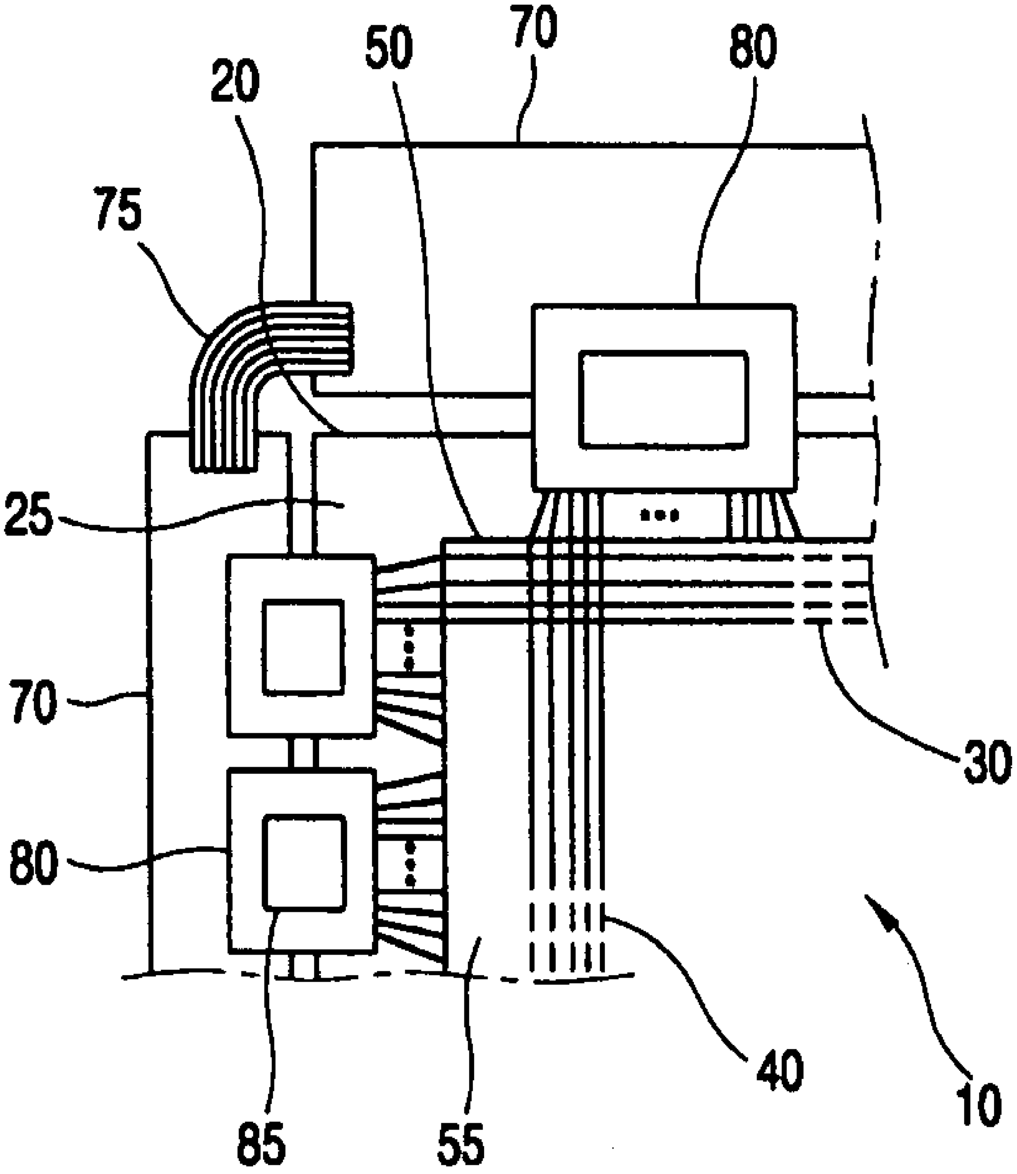


FIG. 2

RELATED ART

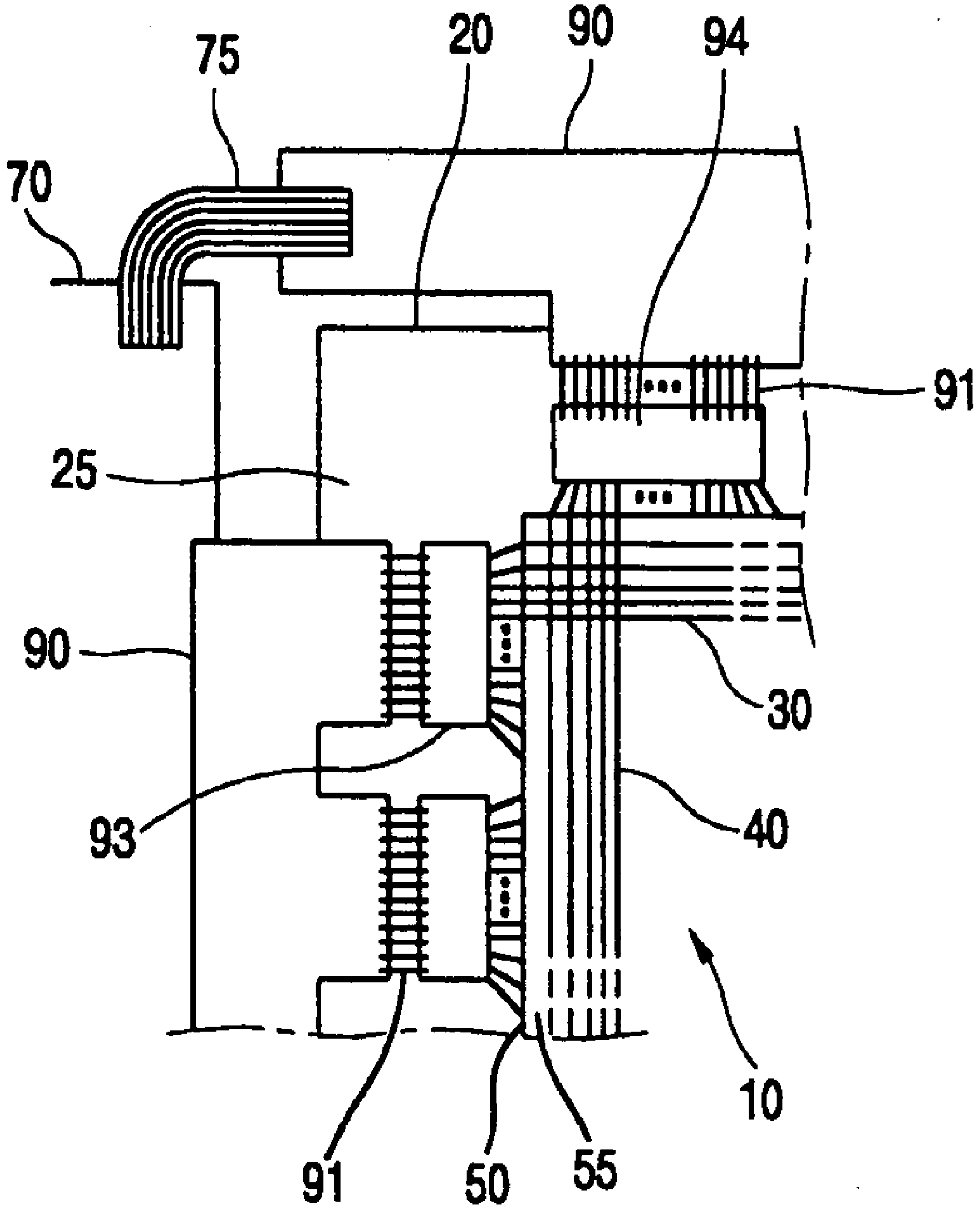


FIG. 3A

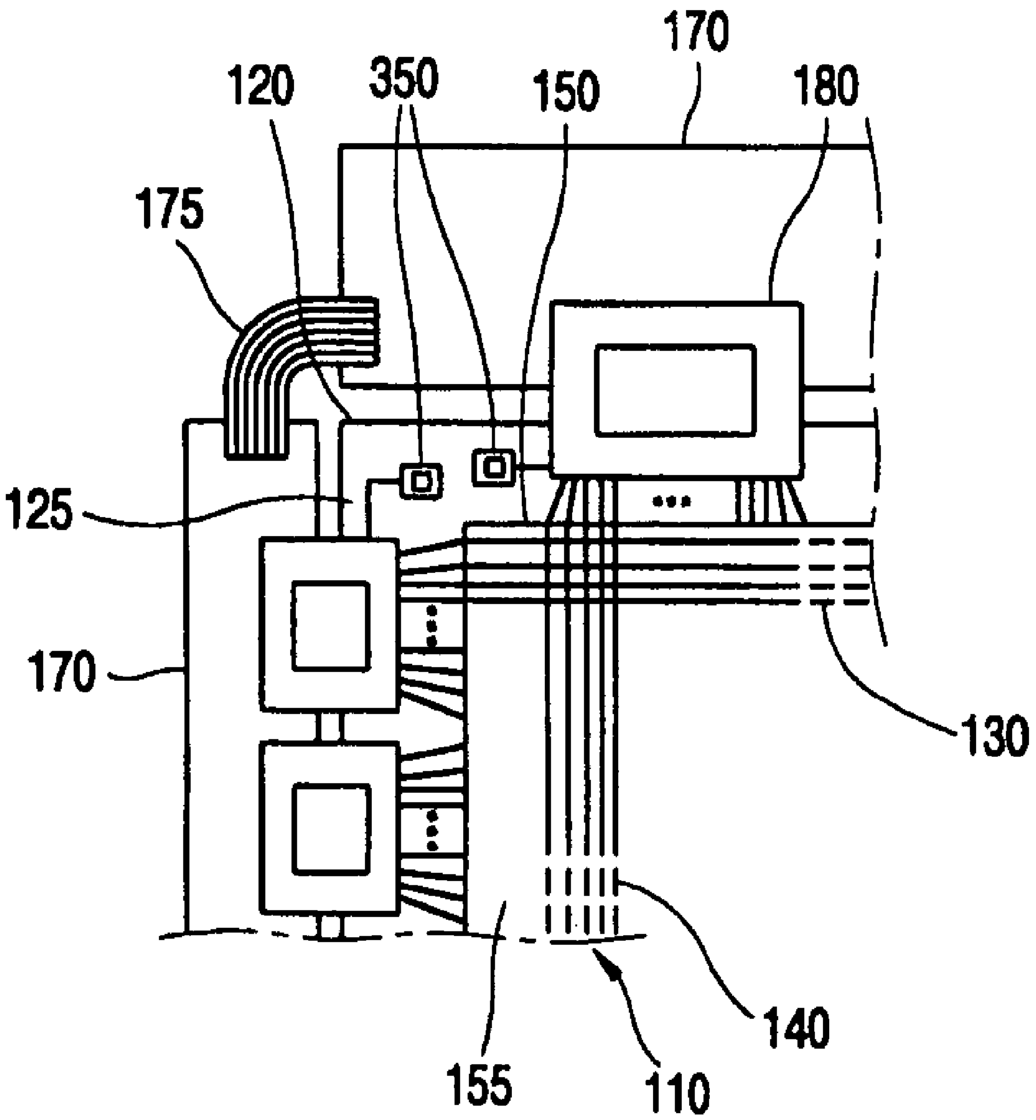


FIG. 3B

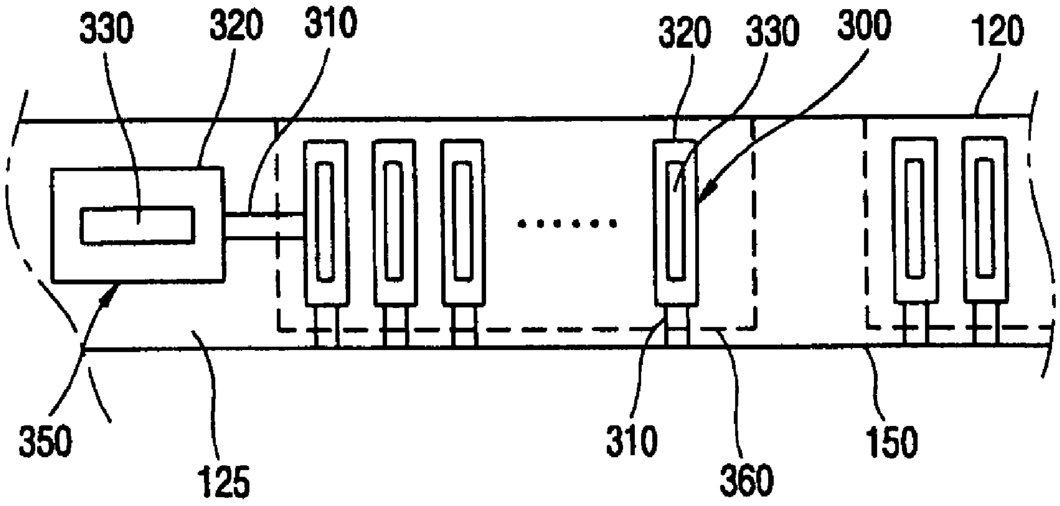


FIG. 4A

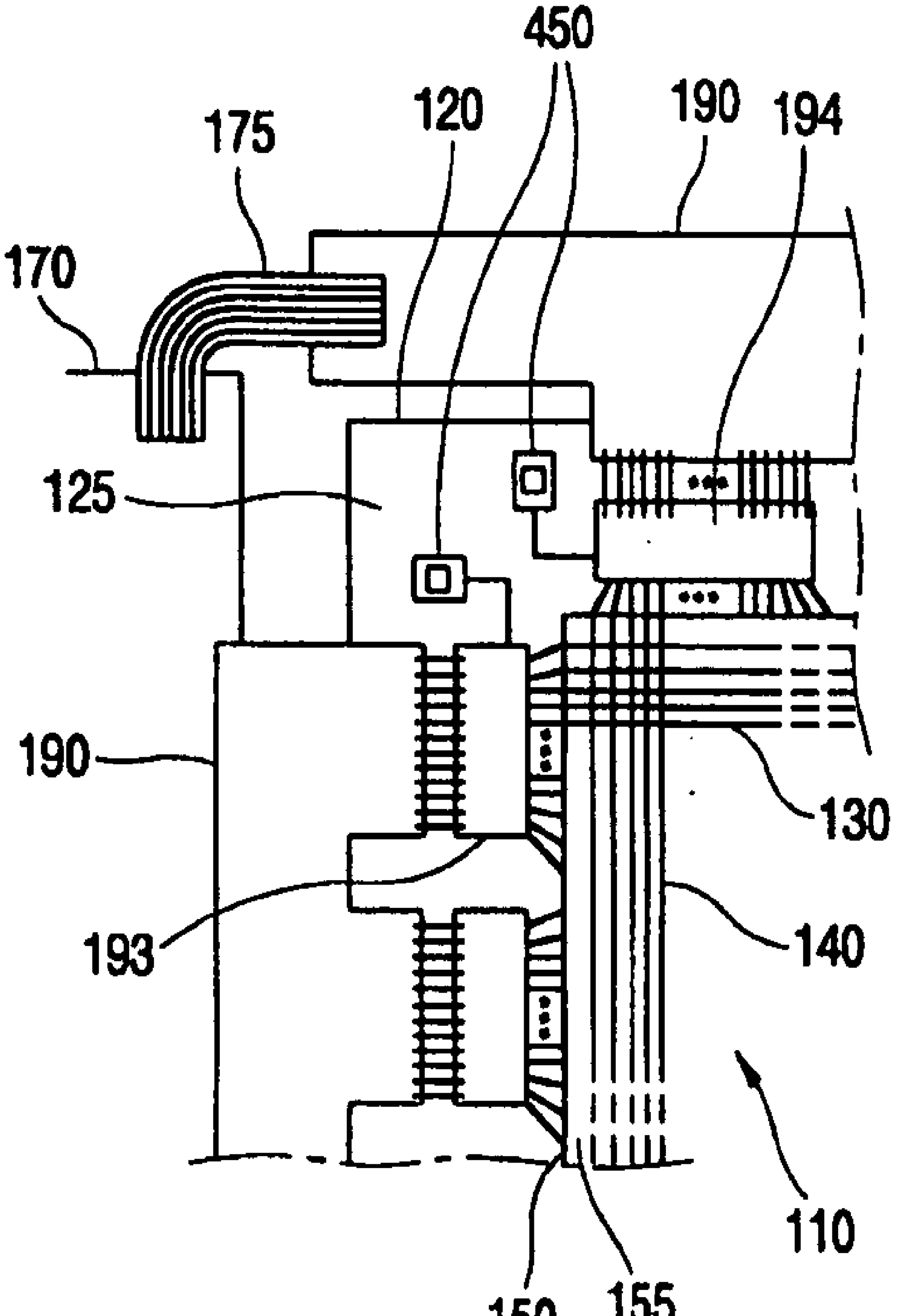


FIG. 4B

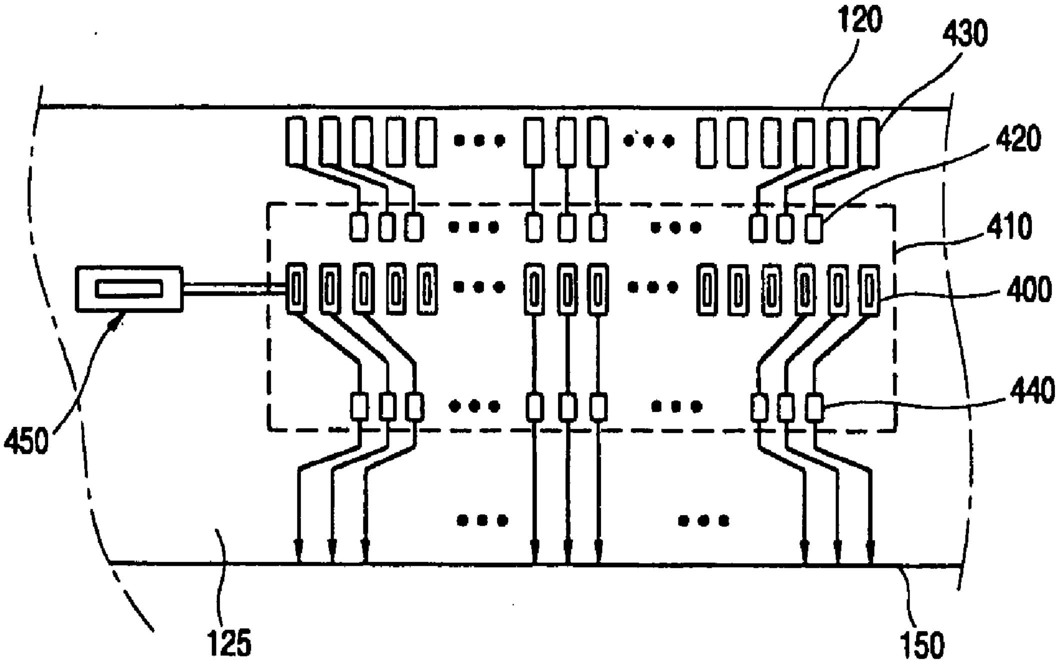


FIG. 5

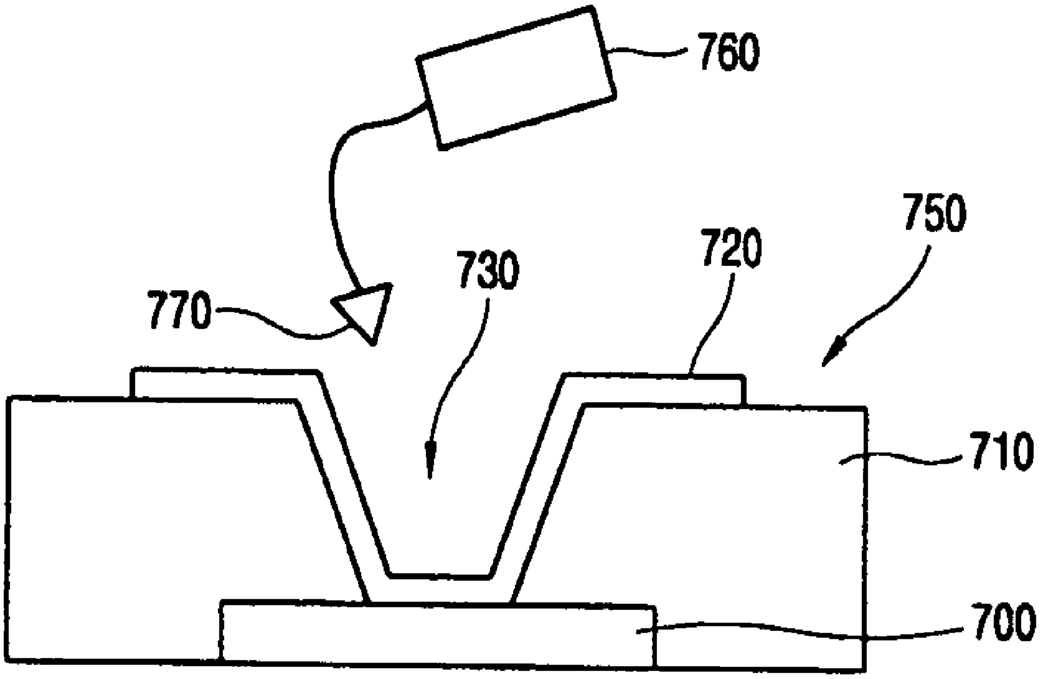
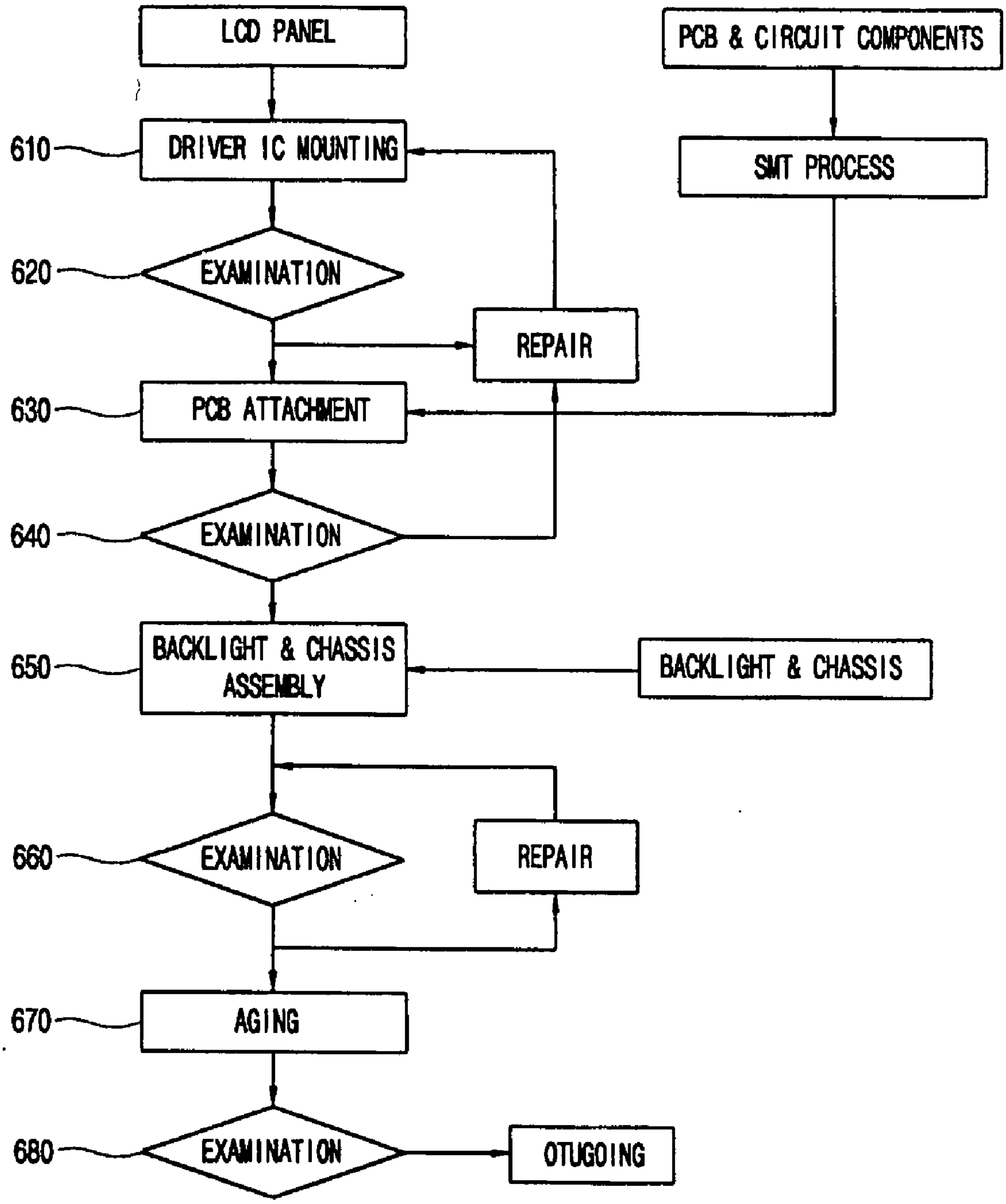


FIG. 6


LCD PANEL
PCB & CIRCUIT COMPONENTS
610
DRIVER IC MOUNTING
SMT PROCESS
620
EXAMINATION
REPAIR
630
PCB ATTACHMENT
640
EXAMINATION
650
BACKLIGHT & CHASSIS ASSEMBLY
BACKLIGHT & CHASSIS
660
EXAMINATION
REPAIR
670
AGING
680
EXAMINATION
OTUGOING

BUMP STRUCTURE FOR TESTING LIQUID CRYSTAL DISPLAY PANEL AND METHOD OF FABRICATING THE SAME

[0001] The present invention claims the benefit of Korean Patent Application No. 86065/2002 filed in Korea on Dec. 28, 2002, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a bump structure for testing a liquid crystal display panel and a method of fabricating a bump structure, and more particularly, to a bump structure for testing a liquid crystal display panel that can test the liquid crystal display panel after a driver integrated circuit (IC) is mounted.

[0004] 2. Description of the Related Art

[0005] In general, display devices need to have low power consumption, high picture quality, thin profile, and light weight. Presently, liquid crystal display (LCD) devices are replacing conventional cathode ray tubes (CRTs). The liquid crystal display devices display an image by making use of an optical anisotropy of liquid crystal molecules, and the devices include an upper substrate, a lower substrate, and a liquid crystal material layer formed therebetween. The upper substrate includes a color filter having sub-color filters R (red), G (green), and B (blue), a black matrix that divides the sub-color filters and shields light, and a transparent common electrode that supplies a voltage to a liquid crystal cell of the liquid crystal display device. In addition, the lower substrate includes a pixel region, a

[0006] The COG method includes direct mounting the driver IC on a glass substrate of the liquid crystal display panel using a bump technology that is significantly different from the TCP method for mounting the driver IC onto the conductive film. Thus, the COG method can reduce production costs since the TCP is not required. However, using the COG method increases a size of the glass substrate of the liquid crystal display panel.

[0007] **FIG. 1** is a partial plan view of a liquid crystal display panel of a TCP method according to the related art. In **FIG. 1, a** liquid crystal display panel **10** is formed by attaching an array substrate **20** and a color filter substrate **50**. The array substrate **20** is divided into a first region **55** that corresponds to the color filter substrate **50** and a second region **25** of an outer periphery of the array substrate **20** that does not correspond to the color filter substrate **50**. In addition, the array substrate **20** includes a gate line **30** and a data line **40** arranged along horizontal and vertical directions, respectively, and a switching device, such as a thin film transistor (not shown), is formed at an intersection region between the gate and data lines **30** and **40**.

[0008] Pads (not shown) are formed at end portions of the gate and data lines **30** and **40**, and are located at the second region **25** of the array substrate **20**. A horizontal pad constitutes a data pad that is connected to the data line **40**, and a vertical pad constitutes a gate pad that is connected to the gate line **30**. In addition, the array substrate **20** is formed to be a little larger than the color filter substrate **50** to accommodate the gate and data pads. Moreover, the liquid crystal display device includes a print circuit substrate **70**, a TCP **80** for connecting the print circuit substrate **70** to the liquid crystal display panel **10**, and a data transmitting line **75** for transmitting a gate signal to a gate driver IC.

[0009] **FIG. 2** is a partial plan view of a liquid crystal display panel of a COG method according to the related art. In **FIG. 2**, at the second region **25** of the periphery of the array substrate **20**, a gate driver IC chip **93** is connected to the gate line **30** and a data driver IC chip **94** is connected to the data line **40** are mounted. In addition, an input line is connected to input terminals of the data driver IC chip **94** and the gate driver IC chip **93** is formed on a flexible printed circuit (FPC) **90**.

[0010] With the COG method, an input pad and an output pad are formed at a region where the driver IC chips **93** and **94** are to be mounted. The input pad receives a driving signal from the FPC **90** that is connected to the liquid crystal display panel **10**, and the output pad outputs the driving signal to the gate line **30** or the data line **40**. In addition, the liquid crystal display panel of the COG method is provided with a pad for testing the liquid crystal display panel before the driver IC chips **93** and **94** are mounted.

[0011] In both the TCP method and the COG method, testing of the liquid crystal display panel is performed by using the pads. However, currently there are no methods for testing the liquid crystal display panel after the driver IC is mounted to the pads of the liquid crystal display panel.

SUMMARY OF THE INVENTION

[0012] Accordingly, the present invention is directed to a bump structure for testing a liquid crystal display panel that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[0013] An object of the present invention is to provide a structure for testing a liquid crystal display panel during each fabrication process after mounting of a driver IC.

[0014] Another object of the present invention is to provide a method for fabricating a structure for testing a liquid crystal display panel.

[0015] Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0016] To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, a bump structure for testing a liquid crystal display panel includes a plurality of pads arranged at a pad region along an edge portion of a liquid crystal display panel and connected to one of a gate line and a data line, a driver IC arranged to be electrically connected to the plurality of pads, and a test bump electrically connected to at least one of the plurality of pads and arranged at the pad region except within a region where the driver IC is mounted.

[0017] In another aspect, a bump structure for testing a liquid crystal display panel includes a plurality of pads arranged at a pad region along an edge portion of a liquid crystal display panel and connected to one of a gate line and a data line, a driver IC arranged to be electrically connected to the plurality of pads, and a test bump electrically connected to at least one of the plurality of pads and arranged at the pad region except within a region where the driver IC is not mounted.

[0018] In another aspect, a method of fabricating a bump structure for testing a liquid crystal display panel includes forming a plurality of pads arranged at a pad region along an edge portion of a liquid crystal display panel and connected to one of a gate line and a data line, mounting a driver IC to be electrically connected to the plurality of pads, and connecting a test bump to at least one of the plurality of pads and arranged at the pad region except within a region where the driver IC is mounted.

[0019] In another aspect, a method of fabricating a bump structure for testing a liquid crystal display panel includes forming a plurality of pads arranged at a pad region along an edge portion of a liquid crystal display panel and connected to one of a gate line and a data line, mounting a driver IC electrically connected to the plurality of pads, and connecting a test bump to at least one of the plurality of pads and arranged at the pad region including a region where the driver IC is mounted.

[0020] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention. In the drawings:

[0022] **FIG. 1** is a partial plan view of a liquid crystal display panel of a TCP method according to the related art;

[0023] **FIG. 2** is a partial plan view of a liquid crystal display panel of a COG method according to the related art;

[0024] **FIG. 3A** is a partial plan view of an exemplary liquid crystal display panel according to the present invention;

[0025] **FIG. 3B** is a partial enlarged plan view of an exemplary test bump and pad region of the liquid crystal display panel of **FIG. 3A** according to the present invention;

[0026] **FIG. 4A** is a partial plan view of another exemplary liquid crystal display panel according to the present invention;

[0027] **FIG. 4B** is a partial enlarged plan view of another exemplary test bump and pad region of the liquid crystal display panel of **FIG. 4A** according to the present invention;

[0028] **FIG. 5** is a cross sectional view of an exemplary test bump according to the present invention; and

[0029] **FIG. 6** is a flow chart of an exemplary fabrication process of a liquid crystal display device according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0031] **FIG. 3A** is a partial plan view of an exemplary liquid crystal display panel according to the present invention, and **FIG. 3B** is a partial enlarged plan view of an exemplary test bump and pad region of the liquid crystal display panel of **FIG. 3A** according to the present invention. In **FIG. 3B, a** TCP (not shown) may be attached at a position **360** and may be electrically connected to a pad **300**. The pad **300** may be formed along an edge portion of the liquid crystal display panel where an array substrate **120** does not correspond to a color filter substrate **150**. Hereinafter, the edge portion of the liquid crystal display panel where the pad **300** is formed will be referred to as a pad region.

[0032] The pad **300** may include a conductive layer **310** that may constitute one of a gate line **130** or a data line **140**, an insulating layer (not shown) formed on the conductive layer **310**; and a transparent electrode layer **320** formed on the insulating layer (not shown). In addition, a contact hole **330** may be formed in the insulating layer (not shown) to electrically interconnect the conductive layer **310** and the transparent electrode layer **320**.

[0033] A test bump **350** may be formed to protrude from the pad **300**, and may be formed outside a region **360** where the TCP may be attached. The test bump **350** may include the conductive layer **310**, the insulating layer (not shown), and the transparent electrode layer **320**. The test bump **350** may be formed at the pad region of the array substrate **120** without an additional processing of the array substrate **120**. Accordingly, the test bump **350** may be formed along the edge portion of the liquid crystal display panel **110** to provide for testing region.

[0034] **FIG. 4A** is a partial plan view of another exemplary liquid crystal display panel according to the present invention, and **FIG. 4B** is a partial enlarged plan view of another exemplary test bump and pad region of the liquid crystal display panel of **FIG. 4A** according to the present invention. For convenience, the same reference numerals will be used to denote the same components of **FIG. 3**.

[0035] In **FIG. 4B, a** driver IC chip (not shown) may be attached with a location **410**. In addition, an input terminal **420** of the driver IC chip (not shown) may be connected to a FPC pad **430** that is connected to an FPC, and an output terminal **440** of the driver IC chip (not shown) may be connected to a testing pad **400** for testing. The testing pad **400** may be used to test quality of the liquid crystal display panel **110** by applying a panel driving signal thereto before the driver IC chip is attached to the liquid crystal display panel **110**.

[0036] In the case of the TCP method, gate and data pads may be used as testing pads for testing, but in the case of the COG method, the testing pad **400** additionally may be formed inside the driver IC chip mounting region **410** in order to provide easy testing. In addition, an additional test bump **450** may be connected to the test pad **400**. Although not shown, the test bump **450** may include a conductive layer, an insulating layer, and an electrode layer similar to those used in the TCP method, and may be formed outside the region **410** to which the driver IC chip is attached. Moreover, the test bump **450** may be formed to extend from the output pad to which the output terminal of the driver IC chip is connected, and may be formed to protrude out from the driver IC to extend from the pad.

[**0037**] The test bumps **350** (in **FIGS. 3A and 3B**) and **450** (in **FIGS. 4A and 4B**) may be formed at a pad region of one of a first or last gate line **130** and a pad region of one of a first or last data line **140**. Accordingly, as resolution of the liquid crystal display panel **110** increases, an interval between adjacent pads formed at the pad regions may decrease. Thus, the test bumps **350** and **450** may be formed along the edge portion of the lower substrate **120** to provide maximum space.

[**0038**] **FIG. 5** is a cross sectional view of an exemplary test bump according to the present invention. In **FIG. 5, a** conductive layer **700**, an insulating layer **710**, and a transparent electrode layer **720** may be sequentially deposited onto a substrate (not shown) or another material layer (not shown). The transparent electrode layer **720** may be electrically connected to the conductive layer **700** through a contact hole **730** formed on the insulating layer **710**. The liquid crystal display panel tests whether the driver IC is normally mounted by using the test bump **750** after the driver IC is mounted. A probe of a test apparatus may be contacted to the transparent electrode layer **720** of the test bump **750** to supply a signal to the test bump **750**. The signal may be supplied to the test bump **750** through one of a gate or data line to drive a thin film transistor of a thin film transistor array.

[**0039**] When the signal is not supplied due to an open circuit condition of the data or gate lines of the thin film transistor array, a point defect or a line defect may be detected at a testing display screen. Similarly, when the signal is supplied to drive the thin film transistor array, the defects may not be generated. Accordingly, each data and gate line of the liquid crystal display panel may be examined.

[**0040**] **FIG. 6** is a flow chart of an exemplary fabrication processes of a liquid crystal display device according to the present invention. In **FIG. 6**, after a driver IC is mounted onto an LCD panel (step **610**), a print circuit substrate upon which circuit components are mounted may be attached to the LCD panel (step **630**). Then, a back light and a chassis are assembled (step **650**) and aging is performed (step **680**), thereby completing the liquid crystal display device. Whenever the respective processes are performed, the liquid crystal display panel may be examined using a test bump in accordance with the present invention (steps **620**, **640**, **660**, and **680**). Accordingly, defective parts, or part may be repaired during any one of the individual fabrication processes.

[**0041**] The test bump may be formed at any location as long as a space is formed at the pad region of the liquid crystal display panel. In addition, the test bump may be formed to extend from a pad to be tested except at both ends of the gate or data lines. Moreover, the test bump additionally may be formed outside the region where the driver IC is mounted, so that the liquid crystal display panel can be tested after the driver IC is mounted. Accordingly, even when the driver IC is incorrectly mounted, consecutive processes may be stopped and repair may be performed.

[**0042**] It will be apparent to those skilled in the art that various modifications and variations can be made in the bump structure for testing liquid crystal display panel and method of fabricating the same of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A bump structure for testing a liquid crystal display panel, comprising:

a plurality of pads arranged at a pad region along an edge portion of a liquid crystal display panel and connected to one of a gate line and a data line;

a driver IC arranged to be electrically connected to the plurality of pads; and

a test bump electrically connected to at least one of the plurality of pads and arranged at the pad region except within a region where the driver IC is mounted.

2. The bump structure according to claim 1, wherein the driver IC is mounted by a tape automated bonding method.

3. The bump structure according to claim 1, wherein the driver IC is mounted by a chip-on-glass method.

4. The bump structure according to claim 1, wherein the test bump is connected to one of the plurality of pads at one of a first and last gate line.

5. The bump structure according to claim 1, wherein the test bump is connected to one of the plurality of pads at one of a first and last data line.

6. The bump structure according to claim 1, wherein the test bump includes a conductive layer, an insulating layer formed on the conductive layer and having a contact hole, and a transparent electrode layer formed on the insulating layer and electrically connected to the conductive layer through the contact hole.

7. A bump structure for testing a liquid crystal display panel, comprising:

a plurality of pads arranged at a pad region along an edge portion of a liquid crystal display panel and connected to one of a gate line and a data line;

a driver IC arranged to be electrically connected to the plurality of pads; and

a test bump electrically connected to at least one of the plurality of pads and arranged at the pad region within a region where the driver IC is mounted.

8. A method of fabricating a bump structure for testing a liquid crystal display panel, comprising:

forming a plurality of pads arranged at a pad region along an edge portion of a liquid crystal display panel and connected to one of a gate line and a data line;

mounting a driver IC to be electrically connected to the plurality of pads; and

connecting a test bump to at least one of the plurality of pads and arranged at the pad region except within a region where the driver IC is mounted.

9. The method according to claim 8, wherein the step of mounting a driver IC includes tape automated bonding.

10. The method according to claim 8, wherein the step of mounting a driver IC includes a chip-on-glass method.

11. The method according to claim 8, wherein the step of connecting a test bump includes connection to one of the plurality of pads at one of a first and last gate line.

12. The method according to claim 8, wherein the step of connecting a test bump includes connection to one of the plurality of pads at one of a first and last data line.

13. The method according to claim 8, wherein the test bump includes a conductive layer, an insulating layer formed on the conductive layer and having a contact hole, and a transparent electrode layer formed on the insulating layer and electrically connected to the conductive layer through the contact hole.

14. A method of fabricating a bump structure for testing a liquid crystal display panel, comprising:

forming a plurality of pads arranged at a pad region along an edge portion of a liquid crystal display panel and connected to one of a gate line and a data line;

mounting a driver IC electrically connected to the plurality of pads; and

connecting a test bump to at least one of the plurality of pads and arranged at the pad region within a region where the driver IC is mounted.

* * * * *

专利名称(译)	用于测试液晶显示板的凸块结构及其制造方法		
公开(公告)号	US20040124868A1	公开(公告)日	2004-07-01
申请号	US10/419927	申请日	2003-04-22
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG.PHILIPS LCD CO. , LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	LIM JOO SOO		
发明人	LIM, JOO SOO		
IPC分类号	G02F1/1345 G02F1/13 G02F1/1362 G09G3/00 G01R31/00		
CPC分类号	G02F1/13452 G09G3/006 G02F2001/136254 G02F1/136259		
优先权	1020020086065 2002-12-28 KR		
其他公开文献	US6798232		
外部链接	Espacenet USPTO		

摘要(译)

一种用于测试液晶显示面板的凸块结构，包括沿着液晶显示面板的边缘部分设置在焊盘区域并连接到栅极线和数据线之一的多个焊盘，设置为电气的驱动器IC连接到多个焊盘，并且测试凸块电连接到多个焊盘中的至少一个焊盘并且布置在焊盘区域处，除了安装驱动器IC的区域之外。