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(54) **CAPACITIVE TOUCH SCREEN WITH A MESH ELECTRODE**

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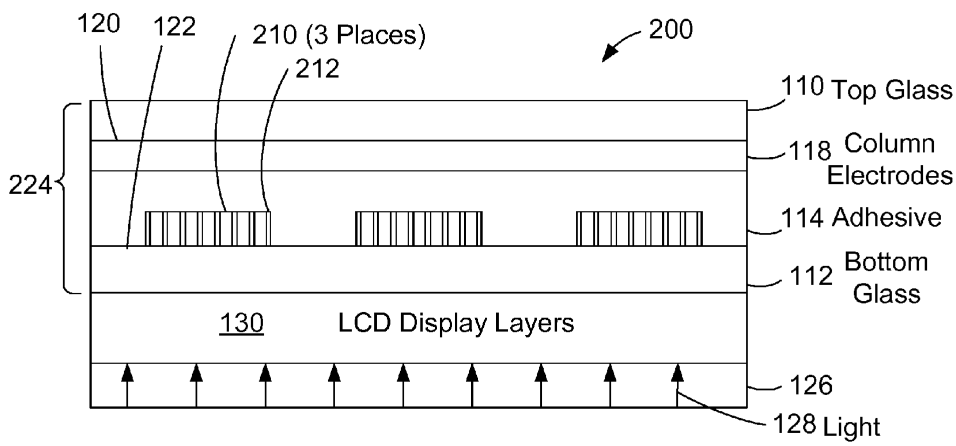
(57) **ABSTRACT**

An improved touch screen provides enhanced electrical performance and optical quality. The electrodes on the touch screen are made of a mesh of conductors to reduce the overall electrode resistance thereby increasing the electrical performance without sacrificing optical quality. The mesh electrodes comprise a mesh pattern of conductive material with each conductor comprising the mesh having a very small width such that the conductors are essentially invisible to the user of the touch screen.



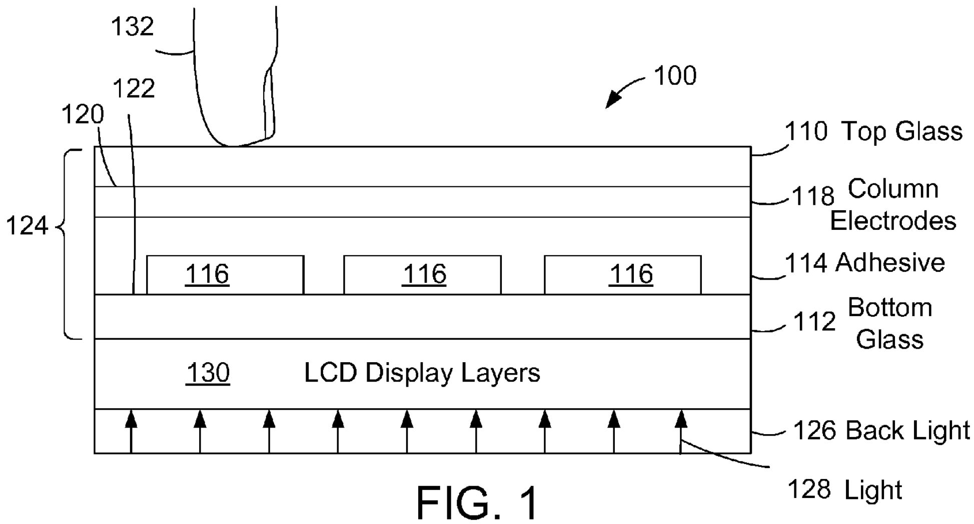


FIG. 1
(Prior Art)

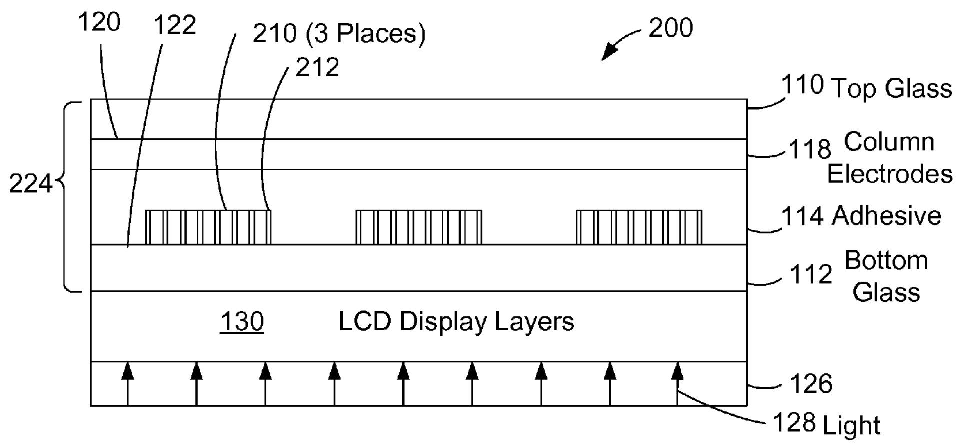


FIG. 2

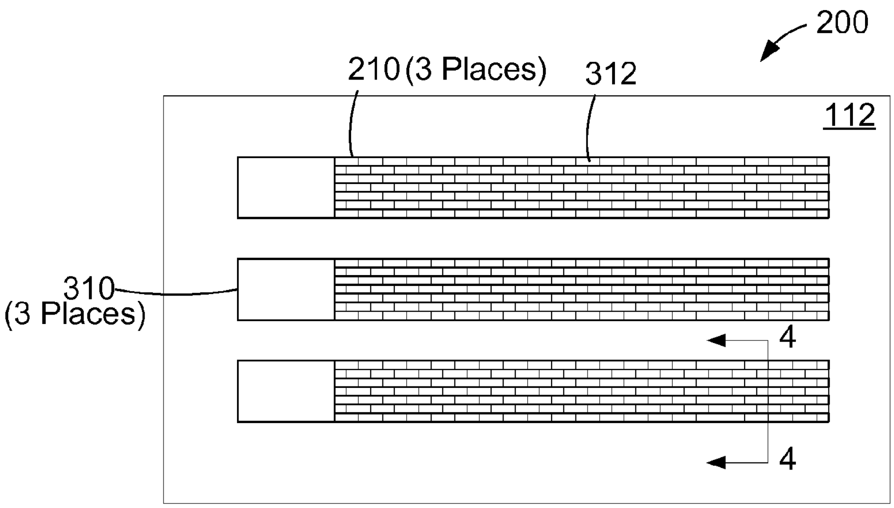


FIG. 3

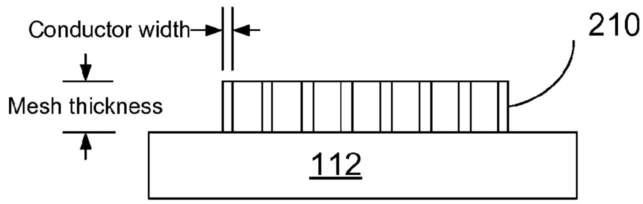


FIG. 4

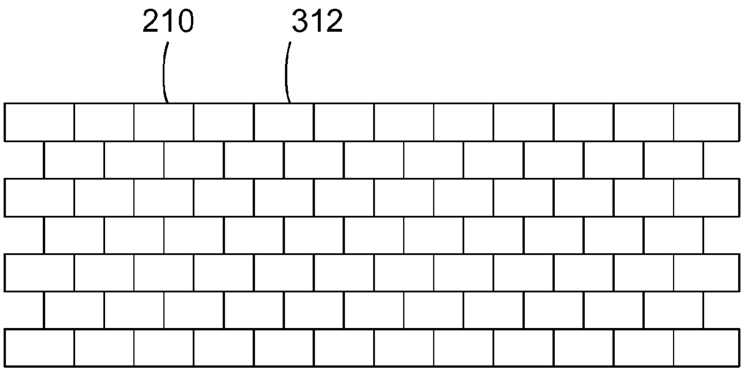


FIG. 5

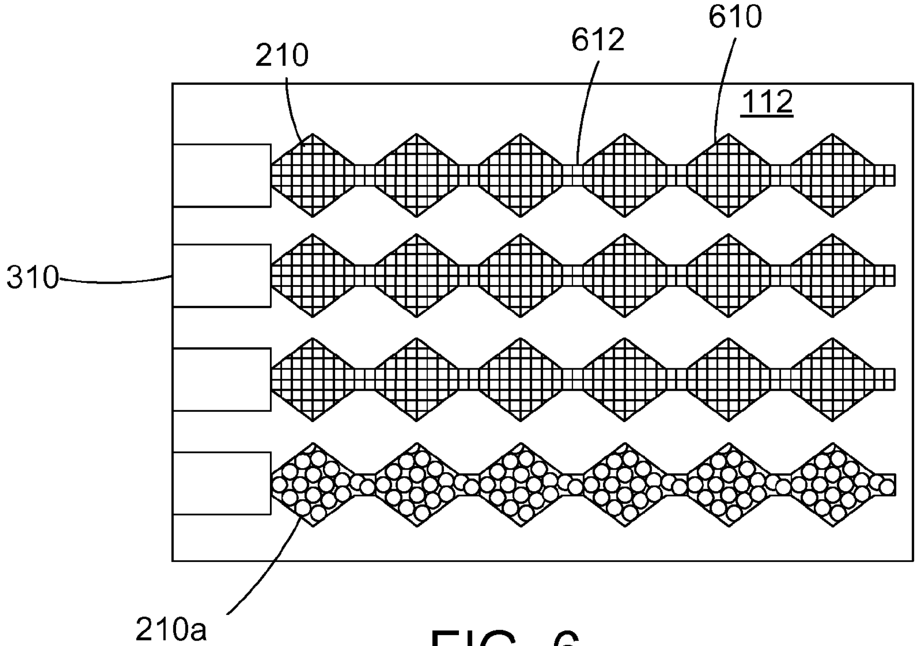


FIG. 6

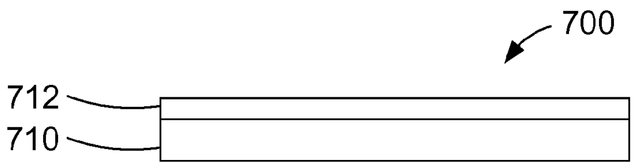


FIG. 7

CAPACITIVE TOUCH SCREEN WITH A MESH ELECTRODE

BACKGROUND

[0001] 1. Technical Field

[0002] The disclosure and claims herein generally relate to touch screens, and more specifically relate to a touch screen having low resistance mesh electrodes to improve the electrical characteristics of the touch screen without compromising the optical characteristics.

[0003] 2. Background Art

[0004] Touch screens have become an increasingly important input device. Touch screens use a variety of different touch detection mechanisms. One important type of touch screen is the capacitive touch screen. Capacitive touch screens are manufactured via a multi-step process. In a typical touch screen process, a transparent conductive coating, such as indium tin oxide (ITO) is formed into conductive traces or electrodes on two surfaces of glass. The conductive traces on the two surfaces of glass typically form a grid that can sense the change in capacitance when a user's finger or a pointer touches the screen near an intersection of the grid. Thus the capacitive touch screen consists of an array of capacitors, where a capacitor is created at each crossing of the x and y conductive traces or electrodes which are separated by a dielectric. These capacitors are charged and discharged by scanning electronics. The scanning frequency of the touch screen is limited by a resistance/capacitive (RC) time constant that is characteristic of the capacitors. As the resistance of the trace becomes larger and larger, scanning times become proportionately longer and longer. Longer scan times are even more problematic as the panel sizes get larger. The larger the panel size the longer the traces and the higher the resistance gets.

[0005] As mentioned above, in typical capacitive touch screens, the conductive traces or electrodes are formed with a layer of indium tin oxide (ITO). ITO is used because of its conductive and transparent qualities. However, the ITO traces are not completely transparent. The visibility of the electrode traces is distracting to the user. It is desirable for the touch screen to have the sense electrodes and other traces on the touch screen to be substantially invisible to the user, but it is also desirable to reduce the resistance of the traces to reduce the scan times and the performance of the touch screen. Increasing the thickness of the ITO layer can reduce the electrode trace resistance. However, increasing the thickness of the ITO layer sufficiently to decrease the electrode trace resistance results in reduced optical performance because the thicker ITO layer becomes more visible.

BRIEF SUMMARY

[0006] The application and claims herein are directed to an improved touch screen with enhanced electrical performance and optical quality. The electrodes on the touch screen are made of a mesh of conductors to reduce the overall electrode resistance thereby increasing the electrical performance without sacrificing optical quality. The mesh electrodes comprise a mesh pattern of conductive material with each conductor comprising the mesh having a very small width such that the conductors are essentially invisible to the user of the touch screen.

[0007] The description and examples herein are directed to capacitive touch screens with two substrates for the conductive sense electrodes, but the claims herein expressly extend to other arrangements including a single glass or plastic substrate.

[0008] The foregoing and other features and advantages will be apparent from the following more particular description, and as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0009] The disclosure will be described in conjunction with the appended drawings, where like designations denote like elements, and:

[0010] FIG. **1** is a cross-sectional side view of a capacitive touch screen according to the prior art;

[0011] FIG. **2** is a cross-sectional side view of a capacitive touch screen as described and claimed herein;

[0012] FIG. **3** shows a top view of mesh electrodes on a portion of the bottom glass of the touch screen shown in FIG. **2**;

[0013] FIG. **4** shows an enlarged view of the cross section of the mesh electrode taken on the lines **4-4** of the touch screen shown in FIG. **3**;

[0014] FIG. **5** shows an enlarged top view of the mesh conductors of the electrode shown in FIGS. **3** and **4**;

[0015] FIG. **6** shows an example of mesh electrodes with a diamond shape pattern; and

[0016] FIG. **7** shows an example of mesh electrodes with stacked layers.

DETAILED DESCRIPTION

[0017] As claimed herein, the electrodes on a touch screen are made of a mesh of conductors to reduce the overall electrode resistance thereby increasing the electrical performance without sacrificing optical quality. The mesh electrodes comprise a mesh pattern of conductive material with each conductor comprising the mesh having a very small width such that the conductors are essentially invisible to the user of the touch screen.

[0018] Touch Panel Transparency

[0019] The optical quality of a touch screen panel can be described in terms of transparency, where 100% transparent means 100% of the light transfers through the panel. A typical single layer of glass used in a touch screen panel has a transparency of about 97%. A typical optical adhesive has a transparency of about 99.5%. For a touch panel constructed out of two sheets of glass and a single layer of optical adhesive (No electrodes on the glass at all), the overall transparency of the panel can be calculated as follows:

$$\text{Total Panel transparency}=0.97*0.97*0.995=93.6\%$$

[0020] As described in the background, a typical touch screen panel has a layer of ITO on the glass to form electrodes for sensing the location where the screen is touched. The transparency of ITO coated glass with 100 ohm/square ITO is ~92%. A touch panel constructed out of 100 ohm ITO glass with the optical adhesive is therefore about 0.92*0.92*0.995=85%. Thinner layers of ITO can give a higher transparency, but as discussed above, it is advantageous to reduce the electrode resistance for better performance. Thus there is a tradeoff between transparency for better optical performance and resistance of the electrode for better touch performance.

[0021] In capacitive touch panels there are a different methodologies to measure the capacitive coupling effect when the panel is touched. Some methods use a separate sense line to sense the change in capacitance while the electrodes are being

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