

disposed in a matrix. The matrix portion of the vertical wiring lines 22 and the horizontal wiring lines 32 constitutes a sensor unit.

[0085] The capacitive sensor according to the fifth embodiment differs from the capacitive sensor according to the fourth embodiment in that the shield plate 100 (shield layer) on the horizontal wiring line 90 for noise detection is shaped like a comb having the same pitch as those of the vertical wiring lines 22 to make the horizontal wiring lines 32 shaped like the portion, at which the horizontal wiring lines 32 do not cross the vertical wiring 22, at the matrix of the horizontal wiring 32 and the vertical wiring 22, that is, to make the horizontal wiring lines 32 have the comb-like convex parts 100A having the same pitch as those of the vertical wiring lines 22, thereby the area corresponding to the detecting area of the horizontal wiring line 90 for noise detection is exposed. Since the rest structures are the same as those of the fourth embodiment, the descriptions thereabout will be omitted.

[0086] Therefore, according to the capacitive sensor of the embodiment, since the horizontal wiring line for noise detection is shaped very similar to each horizontal wiring, when the capacitive sensor is used as a fingerprint sensor, in addition to the effect obtained by the fourth embodiment, the manner of unevenness of the second substrate (film substrate) near the portion of the sensor, with which the finger comes in contact, becomes equal to the manner of unevenness at the other portions of the sensor unit, thereby the amount of noises delivered to the horizontal wiring lines (detecting wiring) becomes closer to the amount of noises delivered to the horizontal wiring line for noise detection, and thus the noise-reducing effect can be improved by means of signal processing of the detecting unit. In addition, no discomfort is felt when the sensor unit is pressed by the finger.

#### Sixth Embodiment

[0087] A pressure-sensitive capacitive sensor according to a sixth embodiment of the invention will be described with reference to FIGS. 10 to 12. In the pressure-sensitive capacitive sensor according to the first to fifth embodiments, the first substrate 20 where the vertical electrodes are formed and the second substrate 30 where the horizontal electrode for noise detection are disposed separately. However, in the pressure-sensitive capacitive sensor of the sixth embodiment, the first and second substrates are composed of a single flexible film substrate 200, and vertical wiring lines 201 and horizontal wiring lines 202 are formed on the flexible film substrate 200. In addition, the flexible film substrate is bent at a predetermined position to cross the horizontal wiring lines and the vertical wiring lines each other.

[0088] That is, in FIG. 10, in the capacitive sensor according to the embodiment, the single flexible film substrate 200 is divided into two areas 200A and 200B, and the vertical wiring lines 201 are formed on the upper area 200A, and the horizontal wiring lines 202 and the horizontal wiring line 210 for noise detection are formed on the lower area 200B. In addition, a circuit unit 220 including a driving circuit and a detecting circuit are formed on the lower area 200B.

[0089] The flexible film substrate 200 is a film disposed on a reinforcement plate 230 as shown in FIG. 12, and wiring

lines are formed on the film 231. In this case, FIG. 11 shows an enlarged A portion of FIG. 10, and FIG. 12 is a cross-sectional view taken along line G-G' of FIG. 11.

[0090] The vertical wiring 201 and the horizontal wiring are connected to an input and output terminal of the circuit unit 220 by the outlet wiring 211, and the horizontal wiring 202 and the horizontal wiring line 210 for noise detection are connected to the input and output terminal by the outlet wiring 212. A reference numeral 221 denotes wiring lines for the connection with an external circuit unit.

[0091] As described above, the vertical wiring lines 201 and the horizontal wiring lines 202 can cross each other by bending the flexible film substrate 200, where the vertical wiring lines 201, the horizontal wiring lines 202, and the horizontal wiring line 210 for noise detection are formed, at an almost central position of the substrate 200.

[0092] Accordingly, the pressure-sensitive capacitive sensor can be easily assembled, and the manufacturing cost thereof can be reduced.

[0093] In addition, it is desirable that the reinforcement plate composing the flexible film substrate 200 be made of a metal and connected to the ground of the circuit unit.

[0094] Accordingly, as shown in FIG. 12, noises can be prevented from being flowed in from the metal reinforcement plate 230 via the capacitances formed between the reinforcement plate 230 and each wiring.

[0095] When the metal reinforcement plate 230 is not connected to the ground of the circuit unit, it is desirable than an auxiliary electrode 203 be provided at the horizontal wiring lines 202 as shown in FIG. 11.

[0096] It is desirable that the area of the auxiliary electrode 203 be the area of the horizontal wiring line for noise detection and all wiring lines including the outlet wiring connected to the horizontal wiring or the like subtracted by the all areas of the horizontal wiring lines and the outlet wiring connected to the horizontal wiring lines or the like for the respective horizontal wiring lines. It is needless to say that the auxiliary electrode can be disposed at any position that is not the capacitance detecting area of the capacitive sensor and has no vertical wiring lines. For example, the auxiliary electrode can be provided at a pad connected to the circuit unit (composed of an IC).

[0097] In addition, instead of the auxiliary electrode, the thickness of the outlet wiring can be changed in the middle or the outlet wiring can be bypassed.

[0098] Accordingly, the capacitances formed between the metal reinforcement plate 230 and each wiring shown in FIG. 12 make the amount of noises delivered to each of the horizontal wiring lines 202 from the reinforcement plate 230 equal to the amount of noises flowed into the horizontal wiring line 210 for noise detection from the reinforcement plate 230, thereby noises can be easily removed at a detecting circuit in the subsequent stage.

[0099] In addition, it is needless to say that the same effect as that of the first embodiment can be obtained in the embodiment.

[0100] Next, an example the detecting circuit of the capacitive sensor according to the embodiments of the invention will be described. FIG. 13 shows the function of