[0036] **FIG. 8** is a plan view and a cross-sectional view illustrating a structure of the pressure-sensitive capacitive sensor according to a fourth embodiment of the invention;

[0037] **FIG. 9** is a plan view and cross-sectional view illustrating a structure of the pressure-sensitive capacitive sensor in accordance with a fifth embodiment of the present invention;

[0038] **FIG. 10** is a plan view and a cross-sectional view illustrating a structure of the pressure-sensitive capacitive sensor according to a sixth embodiment of the invention;

[0039] **FIG. 11** is view illustrating an enlarged A portion of **FIG. 10**;

[0040] **FIG. 12** is a cross-sectional view taken along G-G' wiring of **FIG. 11**;

[0041] **FIG. 13** is a view for explaining a basic characteristic of a current conveyor circuit;

[0042] **FIG. 14** is a circuit view illustrating a structure of a basic detecting circuit using the current conveyor circuit for signal detection;

[0043] **FIG. 15** is a circuit view illustrating an example of a detecting circuit of the capacitive sensor configured to use a current conveyor circuit according to embodiments of the invention;

[0044] **FIG. 16** is a circuit view illustrating another example of a detecting circuit of the capacitive sensor configured to use a current conveyor circuit according to the embodiments of the invention; and

[0045] **FIG. 17** is a cross-sectional view and a plan view illustrating a schematic structure of the fingerprint reading device of the related art.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0046] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings. The embodiments of the invention describe the pressure-sensitive capacitive sensor applied to a fingerprint sensor. An operation principle of the pressure-sensitive capacitive sensor according to the invention will be described with reference to FIGS. **1** to **4**. **FIG. 1** conceptually shows an electric structure of the pressure-sensitive capacitive sensor according to the invention. In **FIG. 1**, the capacitive sensor **1** according to the invention includes vertical wiring lines DL**1** to DLn, horizontal wiring lines SL**1** to SLn, a horizontal wiring line for noise detection DD, a driving circuit **10** for supplying a driving voltage to the vertical wiring lines DL**1** to DLn, and a detecting circuit **11** for detecting signal currents from the horizontal wiring lines SL**1** to SLn.

[0047] In addition, a capacitance CX is a capacitance for signal-detecting formed between the vertical wiring lines and the horizontal wiring lines, and a capacitance CS is a parasitic capacitance formed between a finger and a gap where the horizontal wiring and the vertical wiring do not cross each other when the fingerprint is scanned. In addition, a capacitance CN is a parasitic capacitance formed between the finger and the horizontal wiring line for signal-detection when the fingerprint is scanned.

[0048] **FIG. 2** shows a cross-sectional structure of the capacitive sensor **1**. In **FIG. 2**, the vertical wiring lines DL**1** to DLn correspond to vertical wiring lines **22**, and the horizontal wiring lines SL**1** to SLn correspond to horizontal wiring lines **32**. In addition, the horizontal wiring line for signal-detecting is not shown in **FIG. 2**.

[0049] The capacitive sensor **1** has a first substrate **20** (film substrate) where a plurality of vertical wiring lines **22** is formed on one surface of a film **21**, and a second substrate **30** where a plurality of horizontal wiring lines **32** is formed on a base **31**, and the first and second substrates face each other with a gap interposed therebetween. The vertical wiring lines **22** and the horizontal wiring **32** are disposed in a matrix, and the horizontal wiring line for signal-detecting (not shown) is disposed not to cross the vertical wiring lines on the base **31** of the second substrate **30** where the horizontal wiring lines **32** are formed. A reference numeral **33** denotes an insulating layer.

[0050] As shown in **FIG. 3**, when the finger **40** comes in contact with a surface of the first substrate **20** (film substrate) formed at an upper side of the capacitive sensor **1**, the first substrate **20** is deformed by an external force added according to the unevenness of the fingerprint of the finger **40**, and a space between the first substrate **20** and the second substrate **30** is changed. In addition, the pressure distribution appears as the changes in the capacitance at the intersections between the vertical wiring lines and the horizontal wiring lines, and is detected by the detecting circuit **11**.

[0051] In the meantime, when the finger **40** comes in contact with the first substrate, noises are flowed into the capacitive sensor **1** from a human body. **FIG. 4A** shows a state that the vertical wiring **22** and the horizontal wiring **32** are disposed in a matrix in the capacitive sensor **1**, and **FIGS. 4B and 4C** are cross-sectional views taken along line A-A' of **FIG. 4A**.

[0052] As shown in **FIG. 4B**, while the finger **40** comes in contact with the film **21** of the first substrate **20**, the capacitance for signal-detecting CX is formed between the vertical wiring **22** and the horizontal wiring **32**, and the parasitic capacitance CS is concurrently formed between the finger **40** and the gap, that is, the area where the corresponding horizontal wiring **32** of the horizontal wiring lines **32** and the vertical wiring **22** do not cross each other.

[0053] Next, while the finger **40** is pressed onto the first substrate **20** as shown in **FIG. 4C**, the space between the first substrate **20** and the second substrate **30** decreases, which in turn causes the space between the vertical wiring **22** and the horizontal wiring **32** and a distance between the finger **40** and the horizontal wiring **32** to decrease as compared to a case of not pressing the finger **40** onto the first substrate **20**, thereby the capacitance for signal-detecting and the parasitic capacitance increase to have values of CX' and CS', respectively. Accordingly, the amount of noises delivered from the human body further increase in a case of pressing the finger **40** onto the first substrate **20** as compared to a case of not pressing finger **40** onto the first substrate **20**.

[0054] In the capacitive sensor **1** of the invention, the horizontal wiring line for noise detection DD is formed not to cross the vertical wiring on the base **31** of the second substrate **30**, thereby only the noise delivered from the human body via the parasitic capacitance CN is sensed by the horizontal wiring line for noise detection.