

DESCRIPTION

Touch Panel with Adhesive Layer

Technical Field

5           The present invention relates to a touch panel with an adhesive layer, which is free from obstacles in electrical inspection process or appearance inspection process before shipping, and further free from occurrence of functional deteriorations due to bends of the product  
10   during the time before the shipping or during the time after the shipping and before it being mounted onto the display surface.

Background Art

15           Conventionally, touch panels have been widely used as an input device which is mounted at frontage of display-equipped portable electronic equipment such as cordless telephones, cellular phones, electronic calculators, subnotebook computers, PDAs (Personal Digital  
20   Assistants), digital cameras, video cameras, and business-use telecommunications equipment, or which is mounted at frontage of the monitor of a personal computer or the like, the input device there allowing various operations to be executed through the press of the surface of the screen by  
25   pen or finger or the like according to instructions from

the seen-through screen.

The touch panel includes an upper electrode plate which has an upper electrode 103 of a transparent conductive film formed on a lower surface of an upper  
5 insulating substrate 102 made of a transparent plastic film, and a lower electrode plate which has a lower electrode 105 of a transparent conductive film formed on an upper surface of a lower insulating substrate 104 made of a transparent glass plate or a transparent plastic film to construct a  
10 touch panel body 101, where the upper electrode plate and the lower electrode plate are disposed opposite to each other with an air layer 106 therebetween (see Fig. 2). Recently, as greater importance has been being placed on the thinning and lightening of products for the above-  
15 mentioned personal computers and the like, so there has been a growing demand for the thinning and lightening of the touch panel itself. Therefore, it is more often the case that film/film structure is selected rather than film/glass structure. Reference numeral 108 denotes a  
20 double-sided tape.

Then, the touch panel, which is adhesively bonded and fitted overall onto the display (not shown) surface, is so structured in its shipping form that the touch panel is further equipped with an adhesive layer 109 for bonding to  
25 the display as well as a separate sheet 110 (for example, a

thin and limp PET film sheet having about 50  $\mu\text{m}$ -thickness and flexural rigidity of about  $0.0038 \text{ kgf}\cdot\text{cm}^2$ ) therefor.

However, in the case where the touch panel is of the above-mentioned film/film structure, there have been  
5 some cases where various issues occur during the electrical inspection process and the appearance inspection process prior to shipping, and during the time until the touch panel is finally bonded to the display surface.

More specifically, since the touch panel of  
10 film/film structure becomes thin in its overall thickness, the touch panel as a whole tends to warp. In particular, when a hard coat layer is provided on top of the upper electrode plate, the warping becomes more likely to occur due to the heating during the manufacturing process. In an  
15 appearance inspection process performed with the whole touch panel warped, if the interelectrode distance is uniform, then the product would be determined as a conforming article involving no occurrence of Newton's rings, but mounting the touch panel onto the display with  
20 the lower electrode plate flat by means of an adhesive layer would cause the interelectrode distance to become nonuniform so that Newton's rings might occur in some cases. Conversely, if the interelectrode distance is nonuniform with the overall touch panel warped, indeed the product  
25 would be determined as a nonconforming article involving

occurrence of Newton's rings, but mounting the touch panel onto the display might make the interelectrode distance uniform so that Newton's rings do not occur. Thus, for the touch panel of film/film structure, there is an issue of a  
5 great difficulty of decision in the appearance inspection process for Newton's rings due to warpage and the like.

Also, in the electrical inspection process, because of a small total thickness of the lower insulating substrate 104 and the separate sheet 110 as described above  
10 and therefore a small overall thickness of the product, and because of a small flexural rigidity and therefore a large bendability of the touch panel, it would be difficult to automatize the inspection in the case of shared use of the cassette-rack type automatic inspection machine that has  
15 conventionally been used for touch panels of film/glass structure. That is, during the process that the touch panel with an adhesive layer, which is located at the lowermost stage of the cassette rack, is pushed out in the side-face direction by a pusher so as to be taken out, and  
20 during the process that the touch panel with the adhesive layer, which has been taken out from the cassette rack, is pushed in the side-face direction by a pusher so as to be positioned onto a jig, it may occur that the touch panel with the adhesive layer is bent or that the touch panel  
25 with the adhesive layer is disengaged from the jig.

Further, with automatic or semi-automatic electrical inspection machines of other systems, because of the small total thickness of the lower insulating substrate 104 and the separate sheet 110 as described above and because of the small flexural rigidity as well as the large bendability of the touch panel, the presence of foreign matters such as dust on the jig of the electrical inspection machine may cause occurrence of such deformation that the lower insulating substrate is locally protruded along the foreign matters toward the upper insulating substrate. As a result, even a conforming-article product might be determined as insulation failure due to contact between the lower electrode plate and the upper electrode plate, or might be determined as defective that the lower electrode plate and the upper electrode plate are so close to each other, although out of contact as it is, and thus an inspection of linearity performed by tracing the input surface with a pen or the like might cause an input to be executed near an input point. To reduce these occurrences, it may be conceivable to perform the electrical inspection process in a clean room. However, this would take cost, and yet still imperfect.

Furthermore, even if the product has successfully passed the electrical inspection process and the appearance inspection process, there is an issue that, because of the

product's small overall thickness, the small flexural rigidity, and the high bendability of the touch panel, some load may be applied to the touch panel during the time before shipping or during the time after the shipping and  
5 until the mounting onto the display surface, resulting in occurrence of cracks due to the bends of the product or functional deteriorations of the transparent conductive film or the like.

Accordingly, an object of the present invention  
10 is to provide a touch panel with an adhesive layer which solves the above-described issues, and which is free from any obstacles in the electrical inspection process or the appearance inspection process before shipping and moreover which is prevented from any occurrence of functional  
15 deteriorations due to bends of the product during the time before the shipping or during the time after the shipping and before its being mounted onto the display surface.

#### Disclosure Of Invention

20 In accomplishing these and other aspects, according to a first aspect of the present invention, there is provided a touch panel with an adhesive layer comprising:

a touch panel main body comprising an upper  
25 electrode plate which has an upper electrode constituted by

substrate constituted by a transparent plastic film, and a lower electrode film which has a lower electrode constituted by a transparent conductive film formed on an upper surface of a lower insulating substrate constituted by a transparent plastic film, and which is disposed opposite to the upper electrode film with an air layer interposed between the electrodes;

an adhesive layer for bonding the touch panel main body overall to a display; and

a separate support-plate member for being removed from the adhesive layer (9) and then being thrown away at using the touch panel,

wherein the separate support-plate member which will be removed and then thrown away is a transparent plastic sheet having a flexural rigidity at ordinary temperature of 0.3 to 40  $\text{kgf} \cdot \text{cm}^2$  on assumption that a rectangular cross-sectional width  $b$  of the separate support-plate member is 12 cm.

According to a second aspect of the present invention, there is provided a touch panel with an adhesive layer according to the first aspect, wherein the separate support-plate member which will be removed and then thrown away is a transparent plastic sheet having a flexural rigidity at ordinary temperature of 1.5 to 8.0  $\text{kgf} \cdot \text{cm}^2$  on assumption that a rectangular cross-sectional width  $b$  of the separate support-plate member is 12 cm.

According to a third aspect of the present invention,

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there is provided a touch panel with an adhesive layer according  
to the first or second aspect, wherein the

adhesive layer is constructed by an acrylic adhesive layer, a core member of polyethylene terephthalate, and a silicon-base self adhesive agent layer.

5      Brief Description Of Drawings

These and other aspects and features of the present invention will become clear from the following description taken in conjunction with the preferred embodiments thereof with reference to the accompanying  
10      drawings, in which:

Fig. 1 is a sectional view showing a touch panel with an adhesive layer according to an embodiment of the present invention;

Fig. 2 is a sectional view showing a touch panel  
15      with an adhesive layer according to the prior art;

Fig. 3 is a sectional view showing a state where the separate support-plate member of the touch panel with the adhesive layer according to the embodiment of the present invention is removed from the adhesive layer and  
20      then the adhesive layer is wholly attached to a display;

Fig. 4 is a sectional view showing a touch panel with an adhesive layer according to a modification of the embodiment of the present invention; and

Fig. 5 is a sectional view showing a touch panel  
25      with an adhesive layer according to another modification of

the embodiment of the present invention.

#### Best Mode for Carrying Out the Invention

Before the description of the present invention  
5 proceeds, it is to be noted that like parts are designated  
by like reference numerals throughout the accompanying  
drawings.

Hereinbelow, embodiments of the present invention  
are described in detail with reference to the accompanying  
10 drawings. There are shown, in the figures, reference  
numeral 1 denotes a touch panel main body, 2 denotes an  
upper insulating substrate, 3 an upper electrode arranged  
at an inner surface of the upper insulating substrate 2, 4  
a lower insulating substrate arranged so as to opposite to  
15 the upper insulating substrate 2, 5 a lower electrode  
arranged at an inner surface of the lower insulating  
substrate 4 to opposite to the upper electrode 3, 6 an air  
layer interposed between the upper electrode 3 and the  
lower electrode 5, 8 a double-sided tape for tightly  
20 bonding peripheries of the upper insulating substrate 2 and  
the lower insulating substrate 4 to each other, 9 an  
adhesive layer arranged at an outer surface of the lower  
insulating substrate 4, and 10 a separate support-plate  
member arranged on the adhesive layer 9, the separate  
25 support-plate member having both of a function of a

separate sheet and a function of a support plate.

Here, the general purpose-separate sheet of the adhesive layer only serves as an adhesive prevention before adhesion, and then it is unnecessary to have such a thickness as a plate-like-large thickness of the present invention, and thus, has no support function. Therefore, the separate sheet of the prior art is greatly different from the plate-like separate support-plate member of the present invention having the support function.

10 The touch panel with an adhesive layer shown in Fig. 1 is a touch panel with an adhesive layer a touch panel main body of which includes: an upper electrode plate which has an upper electrode 3 of a transparent conductive film formed on a lower surface of an upper insulating substrate 2 made of a transparent plastic film; a lower  
15 electrode plate 3 which has a lower electrode 5 of a transparent conductive film formed on an upper surface of a lower insulating substrate 4 made of a transparent plastic film, the lower electrode plate being disposed opposite to the upper electrode plate with an air layer provided  
20 between the electrodes; an adhesive layer 9 for bonding the touch panel main body 1 overall to the display 20 of Fig. 3; and a separate support-plate member 10 therefor, where the separate support-plate member 10 is a transparent  
25 plastic film having a flexural rigidity at ordinary

temperature of 0.3 to 40 kgf·cm<sup>2</sup> on condition that the cross-sectional width "b" is 12 cm.

Each of the upper insulating substrate 2 and the lower insulating substrate 4 of the touch panel main body 1 may be given by using a transparent plastic film of polyethylene terephthalate resin (PET), polycarbonate resin (PC), polyester sulfone resin (PES), polyarylate resin (PAR), norbornene resin, or the like. It is noted that the upper insulating substrate 2 and the lower insulating substrate 4 may be provided each in a multilayered structure. The upper insulating substrate 2 and the lower insulating substrate 4 may appropriately be set each to a thickness of 75 to 200 μm. Further, the upper insulating substrate 2 may have a hard coat layer formed on its top surface. Available for the hard coat layer are inorganic materials such as siloxane base resins, or organic materials such as acrylic-epoxy or urethane base thermosetting resins or acrylate base photocurable resins. The thickness of the hard coat layer is appropriately about 1 to 7 μm. Also, the upper insulating substrate 2 may be non-glare-treated at its top surface for prevention of optical reflection. The treatment is implemented, for example, by dip-and-bump machining a transparent insulating base material or a hard coat layer or by mixing extender pigments or fine particles of silica or alumina or the like

into the hard coat layer.

Materials to be used for the transparent conductive films to be used for the upper electrode 3 and the lower electrode 5 include: metal oxides such as tin oxide, indium oxide, antimony oxide, zinc oxide, cadmium oxide, or ITO; or metals such as gold, silver, copper, tin, nickel, aluminum, or palladium. The method for forming these transparent conductive films is given by the use of vacuum deposition process, sputtering process, ion plating process, CVD process, or the like.

Also, circuits of a specified pattern including bus bars, routing lines, or the like are formed on the electrode-side surfaces of the upper electrode plate and the lower electrode plate (not shown). Materials of the circuits may be given by, for example, pastes having electrical conductivity such as metals such as gold, silver, copper, or nickel, or carbon, or otherwise by already known materials. The method for forming these may be selected from among screen printing, offset printing, gravure print, flexographic printing or, other printing process; photoresist process; brush painting process; or the like.

It is noted that the upper electrode plate and the lower electrode plate are, generally, spaced from each other by spacers (not shown) formed on the surface of the upper electrode 3 or the lower electrode 5 so that the

upper electrode 3 and the lower electrode 5 will not make contact with each other to effectuate an input until a press by finger or pen or the like is exerted from on the upper electrode plate. The spacers can be obtained by  
5 forming a transparent photocurable resin into minute dots by photoprocess. Otherwise, the spacers may be given by forming numerous minute dots by printing process. The height of the spacer is, generally, 2 to 10  $\mu\text{m}$ .

The adhesive layer 9 for bonding the touch panel  
10 main body 1 overall to the display 20 may be given by an adhesive sheet formed of a multilayered body of silicon-base adhesive agent layer/polyethylene-terephthalate core member/acrylic adhesive agent layer (See Fig. 5 described later), or by a silicon-base adhesive agent layer alone, or  
15 by an acrylic adhesive agent layer alone, or the like. The thickness of the adhesive layer 9 may appropriately be set, usually, to 20 to 100  $\mu\text{m}$ . Also, the adhesive layer 9 has the separate support-plate member 10 therefor on its one surface that is to be bonded overall to the display 20.  
20 After the separate support-plate member 10 is removed from the adhesive layer 9, as shown in Fig. 3, the adhesive layer 9 is bonded overall to the display 20.

A characteristic of the embodiment of the present invention lies in that the separate support-plate member 10  
25 is a transparent plastic film having a flexural rigidity at

ordinary temperature of 0.3 to 40 kgf·cm<sup>2</sup> on condition that its cross-sectional width "b" is 12 cm. The flexural rigidity of the separate support-plate member 10 is expressed as modulus of elasticity in tension  $\times$  I (geometrical moment of inertia (cm<sup>4</sup>)), and, in the case of a rectangular-shaped cross section of the separate support-plate member 10, expressed as I (geometrical moment of inertia) =  $bh^3/12$ , where "b" is the width of the cross section (cm) and "h" is the height of the cross section (cm). The term, "ordinary temperature", refers to 20 to 25°C. In the embodiment of the present invention, it is assumed that even if the cross-sectional width "b" of the separate support-plate member 10 in actual use is not 12 cm, a flexural rigidity value is obtained according to the above-shown expression on the assumption that  $b = 12$  cm.

Here, the reason why the cross-sectional width "b" of the separate support-plate member 10 is 12 cm is for expressing the flexural rigidity of the separate support-plate member 10 by the thickness and the modulus of elasticity in tension of the material. The flexural rigidity of the separate support-plate member 10 is expressed as (flexural rigidity) = (modulus of elasticity in tension)  $\times$   $bh^3/12$ , where "b" is the width of the cross section and "h" is the height (thickness) of the cross section. Therefore, if it is fixedly set so that  $b=12$ cm in

accordance with 12 of the denominator value of the above expression, then the flexural rigidity of the separate support-plate member 10 can be expressed only by the thickness and the modulus of elasticity in tension of the material.

The reason of the ordinary temperature is that the examination environment and the removing operation environment for removal of the separate support-plate member 10 is ordinary environment (Please note that the modulus of elasticity in tension of the material of the separate support-plate member 10 and the flexural rigidity thereof are changed by environment temperature.).

It is more preferable that the separate support-plate member has a flexural rigidity at ordinary temperature of 1.5 to 8.0  $\text{kgf}\cdot\text{cm}^2$  under a condition that a cross-sectional width  $b$  is 12 cm.

If the flexural rigidity is below 0.3  $\text{kgf}\cdot\text{cm}^2$ , there is a possibility that the same defects as in conventional touch panels with adhesive layers might occur. Also, if the flexural rigidity is over 40  $\text{kgf}\cdot\text{cm}^2$ , there is a possibility that the touch panel main body 1 might be bent to a large extent in the separation of the separate support-plate member 10 from the adhesive layer 9, resulting in defects such as occurrence of cracks of the transparent conductive film or the like. In order to

surely ensure to remove the above issues, the more preferable range is 1.5 to 8.0 kgf·cm<sup>2</sup> as described above.

By setting the flexural rigidity of the separate support-plate member 10 to within the above-mentioned range, the touch panel with an adhesive layer becomes one which is free from the issues that would occur in the electrical inspection process and the appearance inspection process before shipping.

More specifically, in the electrical inspection process, since the use of the separate support-plate member 10 having a flexural rigidity within a specific range as described above enhances the rigidity of the product as a whole, it becomes simply achievable to automatize the inspection even in the case of shared use of the cassette-rack type automatic inspection machine that has conventionally been used for touch panels of film/glass structure. That is, during the process that the touch panel with an adhesive layer is pushed out in the side-face direction by a pusher, it never occurs that the touch panel with an adhesive layer is bent or disengaged from the jig, as might occur in the prior art.

Further, with automatic or semi-automatic electrical inspection machines of other systems, since the rigidity of the product as a whole is enhanced by the use of the separate support-plate member 10 having a flexural

rigidity within a specific range as described above, it never occurs that the presence of foreign matters such as dust on the jig of the electrical inspection machine causes the lower insulating substrate to be gently flexed with the result of occurrence of such deformation that the lower insulating substrate is locally protruded along the foreign matters toward the upper insulating substrate, as might occur in the prior art. As a result of this, mis-decisions as to the insulation or the linearity are eliminated, making it implementable to execute the electrical inspection process outside a clean room.

Also, since the rigidity of the product as a whole is enhanced by the use of the separate support-plate member 10 having a flexural rigidity within a specific range as described above, the whole touch panel is never warped even upon occurrence of a warp of the upper insulating substrate, as might occur in the prior art. Thus, also in the appearance inspection process of Newton's rings or the like, correct decisions as to conforming or nonconforming articles can be achieved.

Further, since the rigidity of the product as a whole is enhanced by the use of the separate support-plate member 10 having a flexural rigidity within a specific range as described above, cracks of the transparent conductive film or the like due to the bends of the product

never occur even with some load applied to the touch panel during the time before shipping or during the time after the shipping and until the mounting onto the display surface.

5           As the transparent plastic film to be used for the separate support-plate member 10, for example, polypropylene resin (PP), polyethylene terephthalate resin (PET), polycarbonate resin (PC), acrylonitrile resin (AC), methyl methacrylate - styrene copolymer resin, or the like  
10       are usable. Because the separate support-plate member 10 is finally removed and thrown away, low priced ones such as PET, PC, PMMA, or the like may appropriately be used. The thickness of the separate support-plate member 10 may be freely selected unless the flexural rigidity departs from  
15       the foregoing range.

          As one example of specified numerical values of the separate support-plate member 10, for example, a polycarbonate resin can be used which has a modulus of elasticity in tension of 2300MPa ( $23460\text{kgf/cm}^3$ ), a  
20       thickness of 0.025-0.12 cm, a flexural rigidity of about 0.37-40  $\text{kgf}\cdot\text{cm}^2$ . More preferably, the resin has a thickness of 0.04-0.07 cm, and a flexural rigidity of 1.5-8.0  $\text{kgf}\cdot\text{cm}^2$ . In addition, if the surface of the adhesive layer 9 to be bonded overall to the display 20 has a strong  
25       adhesive function (for example, if the acrylic adhesive

layer 9 is provided), as shown in Fig. 4, a separate support-plate member 10 having, for example, a silicone release layer 25 formed thereon for being treated for mold release is used.

5                Furthermore, as shown in Fig. 5, the adhesive layer 9 may be constructed by an acrylic adhesive layer 9a, a core member 9b, for example, of 38  $\mu\text{m}$ -thickness polyethylene terephthalate, and a silicon-base self adhesive agent layer 9c.

10                In such an arrangement, the use of the silicon-base self adhesive agent layer 9c allows re-release of the touch panel main body 1 from the display 20 for easy maintenance. In the above arrangement, the non-release acrylic adhesive layer 9a is included therein, so that  
15                either one face of the lower surface of the touch panel main body 1 or the upper surface of the display 20 can be specified as the re-release face.

                 The size of the touch panel with the adhesive layer constituted as described above is, for example, 100  
20                mm  $\times$  75 mm, 80 mm  $\times$  60 mm, 50 mm  $\times$  40 mm, or the like.

(Working Example 1)

                 With a 125  $\mu\text{m}$  thick PET film used as the lower insulating substrate, a lower electrode made of a 0.02  $\mu\text{m}$  thick ITO film was formed on a top surface of the PET film  
25                by sputtering, by which a lower electrode plate was

provided. On the other hand, with a 200  $\mu\text{m}$  thick PET film used as the upper insulating substrate, an upper electrode made of a 0.02  $\mu\text{m}$  ITO film was formed on a bottom surface of the PET film by sputtering, by which an upper electrode plate was provided. Further, the surface of the upper insulating substrate other than the surface on which the upper electrode had been formed was coated with an acrylate base photocurable resin by a roll coater to a coating thickness of 5  $\mu\text{m}$ , by which a hard coat layer was provided. Next, circuits of a specified pattern were formed by screen printing on the upper electrode plate and the lower electrode plate. Thereafter, the upper electrode plate and the lower electrode plate were disposed opposite to each other with an air layer interposed between the electrodes, and the two electrode plates were bonded together at their peripheral portions with a 50  $\mu\text{m}$  thick double-sided tape. Thus, an 80 mm x 60 mm sized touch panel main body was obtained.

While a PC film having a flexural rigidity at ordinary temperature of 2.9  $\text{kgf}\cdot\text{cm}^2$  under the conditions of a thickness of 500  $\mu\text{m}$  and a cross-sectional width "b" of 12 cm was used as a separate support-plate member, there was provided an adhesive layer made up by sequentially stacking on one surface thereof a 40  $\mu\text{m}$  thick silicon-base self adhesive agent layer, a core member made of 38  $\mu\text{m}$  thick

polyethylene terephthalate, and a 20  $\mu\text{m}$  thick acrylic adhesive agent layer (for example, see Fig. 5). This multilayered film was bonded overall to the lower surface of the lower electrode plate of the touch panel main body by means of the adhesive layer. Thus, a touch panel with

5 an adhesive layer was made up.

(Comparative Example 1)

A touch panel with an adhesive layer was made in the same manner as in Working Example 1 except that a PET

10 film whose flexural rigidity at ordinary temperature of 0.0038  $\text{kgf}\cdot\text{cm}^2$  under the conditions of a thickness of 50  $\mu\text{m}$  and a cross-sectional width "b" of 12 cm was used as the separate sheet.

The touch panel of this Comparative Example 1,

15 because of a small flexural rigidity of the separate sheet, showed occurrence of considerable problems in the electrical inspection process and the appearance inspection process before shipping, as well as functional deteriorations due to bends of the product during the time

20 before the shipping or during the time after the shipping and before its being mounted onto the display surface. In contrast to this, the touch panel of the foregoing Working Example 1, by virtue of a large flexural rigidity of the separate support-plate member, showed no problems like

25 those of Comparative Example 1.

The touch panel with the adhesive layer according to the present invention, having the constitution as described hereinabove, produces the following working effects.

That is, according to the present invention, since the separate support-plate member is given by the transparent plastic film having a flexural rigidity at ordinary temperature of 0.3 to 40  $\text{kgf}\cdot\text{cm}^2$  on assumption that a rectangular cross-sectional width "b" of the separate support-plate member is 12 cm, the rigidity of the product as a whole is enhanced by the use of the separate support-plate member having the flexural rigidity within the specific range as described above. Therefore, for the electrical inspection process, it becomes simpler to automatize the inspection even in the case of shared use of the cassette-rack type automatic inspection machine that has conventionally been used for touch panels of film/glass structure. That is, during the process that the touch panel with the adhesive layer is pushed in the side-face direction by a pusher, it never occurs that the touch panel with the adhesive layer is bent or disengaged from the jig, as has been the case in the prior art.

Further, with automatic or semi-automatic electrical inspection machines of other systems, since the rigidity of the product as a whole is enhanced by the use of the separate support-plate member having the flexural

rigidity within the specific range as described above, it never occurs that the presence of foreign matters such as dust on the jig of the electrical inspection machine causes the lower insulating substrate to be gently flexed with the result of occurrence of such deformation that the lower insulating substrate is locally protruded along the foreign matters toward the upper insulating substrate, as might occur in the prior art. As a result of this, mis-decisions as to the insulation or the linearity are eliminated, making it implementable to execute the electrical inspection process outside a clean room.

Further, since the rigidity of the product as a whole is enhanced by the use of the separate support-plate member having the flexural rigidity within the specific range as described above, it never occurs that occurrence of a warp of the upper insulating substrate causes the whole touch panel to be warped, as in the case of the prior art. Thus, also in the appearance inspection process of Newton's rings or the like, correct decisions as to conforming or nonconforming articles can be achieved.

Furthermore, since the rigidity of the product as a whole is enhanced by the use of the separate support-plate member having the flexural rigidity within the specific range as described above, it never occurs that cracks of the transparent conductive film or the like due

to the bends of the product never occur even with some load applied to the touch panel during the time before shipping or during the time after the shipping and until the mounting onto the display surface.

5           Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and  
10 modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.

CLAIMS

1(amended). A touch panel with an adhesive layer comprising:

a touch panel main body (1) comprising an upper electrode film which has an upper electrode (3) constituted by a transparent conductive film formed on a lower surface of an upper insulating substrate (2) constituted by a transparent plastic film, and a lower electrode film which has a lower electrode (5) constituted by a transparent conductive film formed on an upper surface of a lower insulating substrate (4) constituted by a transparent plastic film, and which is disposed opposite to the upper electrode film with an air layer (6) interposed between the electrodes;

an adhesive layer (9) for bonding the touch panel main body overall to a display (20); and

a separate support-plate member (10) for being removed from the adhesive layer (9) and then being thrown away at using the touch panel,

wherein the separate support-plate member which will be removed and then thrown away is a transparent plastic sheet having a flexural rigidity at ordinary temperature of 0.3 to 40 kgf·cm<sup>2</sup> on assumption that a rectangular cross-sectional width b of the separate support-plate member is 12 cm.

2(amended). A touch panel with an adhesive layer according to claim 1, wherein the separate support-plate member (10) which

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will be removed and then thrown away is a transparent plastic sheet having a flexural rigidity at ordinary temperature of 1.5 to 8.0 kgf·cm<sup>2</sup> on assumption that a rectangular cross-sectional width  $b$  of the separate support-plate member is 12 cm.

3. A touch panel with an adhesive layer according to claim 1 or 2, wherein the adhesive layer (9) is constructed by an acrylic adhesive layer (9a), a core member (9b) of polyethylene terephthalate, and a silicon-based self adhesive agent layer (9c).