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METHOD AND APPARATUS FOR INSPECTING DISPLAY BASE PLATE

BACKGROUND OF THE INVENTION

[0001] Field of the Invention

The present invention relates to a method and apparatus for inspecting a display base plate such as a liquid crystal display panel, a glass base plate, etc.

[0002] Description of Prior Art

A display base plate such as a liquid display panel undergoes a lighting inspect as to whether or not picture elements including liquid crystal elements are proper or not. As one of such methods and apparatus for automatic lighting inspect is known the technique described in the patent literature 1.

[0003]

[Patent Literature 1]

Japanese Patent Appln. Public Disclosure No. 10-160628

[0004] In this prior art, a polarizing filter (polar screen) capable of changing the polarization direction is disposed between a CCD camera and a display base plate, and when detecting a light having transmitted the display base plate with the CCD camera by leading the light through the polarizing filter to detect a light polarization-dependent portion of a projection or a foreign mater which becomes easily visible by sequentially changing the polarization direction with the polarizing filter.

[0005] According to this art, however, since the light having transmitted the display base plate should be always passed through the

polarizing filter, it is necessary to detect defects of the display base plate itself while changing a polarizing angle with the polarizing filter when obtaining image information by the CCD camera. Therefore, the structure of the polarizing filter itself or its drive mechanism is complicated and expensive.

[0006]] SUMMARY OF THE INVENTION

An object of the present invention is to enable to detect defects of the display base plate without using a complicated polarizing filter or drive mechanism.

[0007] The method of inspecting according to the present invention comprises a step of obtaining genuine defect information of the display base plate by using a first image signal by a first light heading from a display base plate to a light detecting means and a second image signal by a second light having passed a polarizing filter with a polarizing angle different by 90° from a polarizing angle by the display base plate.

[0008] The apparatus for inspecting according to the present invention comprises an image processor for obtaining genuine defective information of the display base plate by using: a chuck top for receiving a display base plate to be inspected; a probe unit with a plurality of probes for energizing the display base plate; light detecting means which detects a light from the display base plate; a polarizing filter disposed accessibly to a passage of the light heading from the display base plate to the light detecting means and having a polarizing angle different by 90° from a polarizing angle by the display base plate; the first image signal by the first light not led through the polarizing filter among the lights from the display base plate; and the second image signal by the second light led through the polarizing filter.

[0009] The first light can be obtained by displacing the polarizing filter to a position outside the passage of the first light. On the other hand, the second light can be obtained by displacing the polarizing filter to a position interrupting the passage of the first light. The first and second image signals can be obtained respectively by detecting the first and second lights with light detecting means such as a CCD camera.

[0010] The first image signal by the first light not led through the polarizing filter includes a base plate signal (including a genuine defect signal) showing a state of the display base plate itself, and a foreign matter signal showing an existence of a foreign matter such as dust and a scar which result in irregular polarization of light. However, the second image signal by the second light led through the polarizing filter includes the foreign matter signal but does not include the base plate signal.

[0011] For this reason, the genuine defect information of the display base plate can be obtained by using the foreign matter signal in the second image signal and removing the foreign matter signal in the first image signal.

[0012] According to the present invention, it suffices to displace the polarizing filter selectively between the position for the polarizing filter to be outside the passage of the first light and the position to interrupt the first light, so that it is possible to detect a genuine defect of the display base plate without using the polarizing filter or a driving mechanism with a complicated structure.

[0013] The genuine defect information can be obtained by a subtraction process by the first image signal and the second image signal. The display base plate may be one including a liquid crystal element or one including a glass base plate without a liquid crystal element as well as a polarization

plate opposed to the glass base plate.

[0014] The inspecting apparatus can further include a displacing mechanism for selectively displacing the polarizing filter between a first position where the polarizing filter is not located in the passage of the first light and a second position where it is located. Also, the chuck top may be provided with a back light for irradiating a light to the display base plate received thereon.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing an embodiment of the apparatus for inspection according to the present invention.

Fig. 2 is a schematic diagram illustrating a state of polarization.

Fig. 3 is another schematic diagram illustrating a state of polarization.

Fig. 4 is still another schematic diagram illustrating a state of polarization.

[0015] PREFERRED EMBODIMENTS OF THE INVENTION

Referring to Fig. 1, an inspection apparatus 10 uses a liquid crystal display panel enclosing a liquid crystal element as the display base plate 12. Though the display base plate 12 has a rectangular configuration in plane in the following explanation, it may have another configuration in plane. The display base plate 12 has a plurality of electrodes to be excited for driving in positions corresponding to at least two sides of the rectangle.

[0016] The inspection apparatus 10 comprises: a chuck top 14 for receiving the display base plate 12 to be inspected; an inspecting stage 16 for displacing the chuck top 14; a probe unit 18 for exciting the display base

plate 12 received; a photo detector 20 for detecting the light led through the display base plate 12 as an electric signal; a polarizing filter 22 disposed accessibly to an optical path between the display base plate 12 and the photo detector 20; a drive mechanism 24 which makes the polarizing filter 22 access an optical path between the display base plate 12 and the photo detector 20; an image processor 26 for obtaining the genuine defect information of the display base plate 12 by using an output signal of the photo detector 20; and a shielding case 28 housing the machinery.

[0017] The chuck top 14 is an existing one with a plurality of adsorbing grooves for adsorbing in a vacuum state the display base plate 12 received and houses a back light irradiating from below a white light to the display base panel 12 received.

[0018] The inspecting stage 16 is formed on the stages of X, Y, Z and θ for moving the chuck top 14 three- dimensionally in the directions X, Y and Z, and for angularly rotating about the axis θ extending in the vertical direction (Z direction).

[0019] The probe unit 18 disposes a plurality of probe blocks 32 having a plurality of contacts 30 to be pressed respectively by the electrodes of the display base plate 12 on the base plate 36 having a rectangular opening 34 corresponding to the configuration in plane of the display base plate 12 in the central area.

[0020] The contact 30, in the illustration, is a needle-type probe but may be of other types such as blade-, pogo pin-, bump types and others. Each probe block 32 is attached to the upper face of the base plate 36 such that the front end (needle point) of the contact 30 penetrate the opening 34 of the base plate 36 to project below the base plate 36.

[0021] The photo detector 20 is an existing camera such as a CCD

camera and a line sensor, detects the light which transmitted the display base plate 12, generates an electric signal showing an image of the display base plate 12 and outputs to the image processor 26.

[0022] The polarizing filter 22 has a polarizing angle different by 90° from the polarizing angle of the light passing the display base plate 12 (which prevents passing of the light vibrating in the same direction as the polarizing angle of the light by the display base plate 12) and passes the light vibrating in the direction different by 90° from the vibrating direction of the light led through the display base plate 12.

[0023] The polarizing filter 22 is moved by the drive mechanism 24 selectively between the first position which the polarizing filter 22 does not interrupt the first light heading from the display base plate 12 to the photo detector 20 and the second position which the polarizing filter 22 interrupts the first light.

[0024] When inspecting, the display base plate 12 is mounted on the chuck top 14, and each electrode is pressed by the contact 30 while the back light unit is maintained such that the light from the back light unit passes the display base plate 12. In this state, the polarizing filter 22 is displaced by the drive mechanism 24 selectively between the first and the second positions.

[0025] The image processor 26 generates the first and second image signals on the basis of the output signal of the photo detector 20 when the polarizing filter 22 is moved to the first position and the output signal of the photo detector 20 when it is moved to the second position, and obtains the genuine defect information of the display base plate 12 by using both image signals.

[0026] When the polarizing filter 22 is moved to the first position, the

first light heading from the display base plate 12 to the photo detector 20 enters the photo detector 20 without passing the polarizing filter 22. Therefore, the output signal of the photo detector 20 becomes the first signal by the first light not passing the polarizing filter 22, and the image processor 26 generates the first image signal corresponding to a first signal.

[0027] When the polarizing filter 22 is moved to the second position, the first light heading from the display base plate 12 to the photo detector 20 enters the polarizing filter 22, so that the second light having passed the polarizing filter 22 enters the photo detector 20. Therefore, the output signal of the photo detector 20 becomes a second signal by the second light, and the image processor 26 generates the second image signal corresponding to the second signal.

[0028] The first image signal by the first light not led through the polarizing filter 22 includes a base plate signal (including a genuine defect signal) showing a state of the display base plate 12 itself and a foreign matter signal showing existence of a foreign matter such as dust, a scar, etc., resulting in scattering or irregular reflection of light.

[0029] However, the second image signal by the second light led through the polarizing filter 22 permits passing of the light vibrating in the direction different by 90° from the vibrating direction of the first light but prevents passing of the light vibrating in the same direction as that of the first light, so that it includes the foreign matter signal due to the scattering or irregular reflection of the light but does not include the base plate signal including the genuine defect signal.

[0030] Concretely, as shown in Fig. 2, a case of the display panel 12 having two polarizing films 40 and 42, whose polarizing angles to permit

passing of the light differ by 90° from each other, disposed respectively on the lower face and the upper face of a liquid crystal element layer 44 is explained in the following.

[0031] Firstly, a light 46 from the back light unit inside the chuck top 14 is a white light and includes a photo component vibrating in the direction of 360° about an optical axis.

[0032] When this light 46 is passed through the polarizing film 40 which passes a photo component vibrating horizontally, the light passing the polarizing film 40 becomes a light of the component which vibrates in the horizontal direction.

[0033] Next, the light having passed the polarizing film 40 is polarized into the light vibrating in the vertical direction by passing the liquid crystal element layer 44.

[0034] Then, the light having passed the liquid crystal element layer 44 is passed the polarizing film 42 which makes the photo component vibrating in the vertical direction pass. By this, the light 48 having passed the display base plate 12 becomes a vertically vibrating light.

[0035] The light 48 having passed the display base plate 12 either directly enters the photo detector 20 or enters the photo detector 20 through the polarizing filter 22 which prevents passing of the light (led through the display base plate 12) vibrating in the vertical direction, depending on which of the first and second positions the polarizing filter 22 is displaced to.

[0036] If the polarizing filter 22 is displaced to the first position, the light 48 does not pass the polarizing filter 22, so that the light incident on the photo detector 20 includes a light showing a state of the display base plate 12 itself.

[0037] Also, if a foreign matter 50 such as dust, scar, etc., which results in irregular reflection of the light exists in the display base plate 12, the light which is to pass or has passed the display base plate 12 is scattered or irregularly reflected by the foreign matter 50. Because of this, the light scattered or irregularly reflected by the foreign matter 50 also enters the photo detector 20.

[0038] On the other hand, when the polarizing filter 22 is displaced to the second position, all the lights heading for the photo detector 20 enter the polarizing filter 22, and the polarizing filter 22 has a polarizing angle different by 90° from the polarizing angle made by the display base plate 12, so that the light 48 is prevented by the polarizing filter 22 from passing, but the light 54 of a horizontally vibrating component among the scattered or irregularly reflected light 52 passes the polarizing filter 22. Therefore, while the horizontally vibrating light enters the photo detector 20, the vertically vibrating light having passed the display base plate 12 does not enter the photo detector 20.

[0039] In view of the above, when the polarizing filter 22 is displaced to the first position, the image processor 26 generates a base plate signal showing a state of the display base plate 12 itself (including a genuine defect signal) and a first image signal including a foreign matter signal showing the presence of a foreign matter resulting in irregular reflection of light. On the other hand, when the polarizing filter 22 is displaced to the second position, the image processor 26 does not include any foreign matter signal, but the base plate signal generates a second image signal not including the base plate signal.

[0040] The image processor 26, using the foreign matter signal in the second image signal, removes the foreign matter signal in the first image

signal, thereby obtaining the genuine defect information of the display base plate 12. Concretely, the image processor 26 obtains the genuine defect information of the display base plate 12 by subtracting the second image signal from the first image signal, and stores the obtained defect information in a memory.

[0041] Namely, the light 52 directly incident from the foreign matter 50 on the photo detector 20 and the light 54 having passed the polarizing filter 22 in the light 52 exist at the same coordinate position within the inspecting apparatus 10 and both image signals. Consequently, by subtracting the second image signal from the first image signal, the foreign signal is removed, and the defect information showing the genuine defect position of the display base plate 12 can be obtained.

[0042] The obtained defect information is used to sort in an assortment equipment not shown into a normal display base plate without any defective area and a defective display base plate having a defective area.

[0043] According to such the inspecting apparatus 10 as mentioned above, the polarizing filter 22 is selectively displaced between the first position which is outside the light path from the display base place 12 to the photo detector 20 and the second position interrupting the light path, thereby obtaining the genuine defect information of the display base plate 12, so that the genuine defect information of the display base plate 12 can be detected without using any polarizing filter of a complicated structure and its drive mechanism.

[0044] As shown in Fig. 3, in the case of a display base plate having the polarizing film 40 only on one of the liquid crystal layers 44 (the underside in the illustration), the photo component vibrating vertically the light 46 vibrating in all directions is firstly removed by the polarizing film 40, and

the light of the photo component vibrating horizontally passes the polarizing film 40.

[0045] Then, the light having passed the polarizing film 40, polarized in the liquid crystal element layer 44 into a photo component vibrating vertically, is oriented from the display base plate 12 to the photo detector 20. Consequently, the polarizing filter 22, if moved to the first position, generates the first image signal but, if moved to the second position, generates the second image signal.

[0046] The present invention can obtain not only a foreign matter existing on the surface of the display base plate 12 but also the genuine defect information not influenced by a foreign matter existing in the interior of the display base plate 12 as shown in Fig. 4 and a photo detection element of the photo detector 20.

[0047] The present invention can be applied not only to an inspecting technique which uses a back light unit for irradiating the display base plate 12 but also to an inspecting technique which uses reflected light by disposing a reflecting mirror behind the display base plate 12.

[0048] The present invention can be variously modified without being limited to the foregoing embodiments and unless departing from the purport.

WHAT IS CLAIMED IS:

1. A method of inspecting a display base plate comprising a step of obtaining genuine defect information of said display base plate by using a first image signal by a first light heading for photo detection means from said display base plate and a second image signal by a second light which has passed said first light through a polarizing filter with a polarizing angle different by 90° from a polarizing angle by said display base plate.

2. A method of inspecting according to claim 1, for obtaining said genuine defect information by performing a subtraction process of said first and second image signals.

3. A method of inspecting according to claim 1 or 2, wherein said display base panel comprises a liquid crystal layer.

4. A method of inspecting according to any one of claims 1 through 3, wherein said display base plate comprises a glass base plate not including a liquid crystal element, and a polarization plate opposed to said glass base plate.

5. A method of inspecting according to any one of claims 1 through 4, further comprising a step of displacing said polarizing filter to a position outside an optical path of said first transmitted light to obtain said first image signal, and displacing said polarizing filter to a position interrupting the optical path of said first transmitted light to obtain said second image signal.

6. An apparatus for inspecting a display base plate, comprising:

a chuck top for receiving a display base plate to be inspected;

a probe unit provided with a plurality of probes for exciting said display base plate;

photo detecting means for detecting a light from said display base plate as an electric signal;

a polarizing filter disposed accessibly to a passage of the light heading for said photo detecting means from said display base plate and having a polarizing angle different by 90° from the polarizing angle by said display base plate; and

an image processor for obtaining genuine defect information of said display base plate by using the first image signal by the first light not passed through said polarizing filter and the second image signal by the second light passed through said polarizing filter.

7. An apparatus for inspecting a display base plate according to claim 6, further comprising a displacing mechanism for selectively displacing said polarizing filter between the first position where said polarizing filter is not located in said first light path and the second position where it is located.

8. An apparatus for inspecting according to claim 6 or 7, wherein said chuck top is provided with a back light for irradiating the display base plate received.