SUMMARY OF THE DISCLOSURE

A need exists for a system and a method for uniformly and safely heating an object during a laser shearography test. Further, a need exists for a system and a method for heating an object that reduce a potential of damage to the object during a laser shearography test. Further, a need exists for a system and a method that increase detection probability of far field irregularities by providing uniform excitation across an inspected part.

With those needs in mind, certain embodiments of the present disclosure provide a laser shearography testing system for non-destructively testing a component. The laser shearography testing system includes a component heating sub-system coupled to the component. The component heating sub-system excites the component into a loaded state by passing an electric current through the component. Resistivity of the component causes the component to internally and uniformly heat as the electric current passes through the component.

In at least one embodiment, the laser shearography testing system includes a laser-emitting device that is configured to emit a laser beam onto the component. In at least one embodiment, the laser beam emitted by the laser-emitting device passes through a beam expander before impinging on the component. A camera acquires at least one first image of the component in a neutral state, in which the component is not excited by the component heating sub-system, and at least one second image of the component in the loaded state. An image shearing device may be disposed between the component and the camera.

In at least one embodiment, the component heating sub-system includes a power source coupled to the component. For example, a first lead extends from the power source and couples to a first portion of the component, and a second lead extends from a second portion of the component and couples to the power source.

In at least one embodiment, the component heating sub-system includes a heating control unit that is operatively coupled to a power source. The heating control unit selectively activates the power source in order to selectively pass the electric current through the component.

In at least one embodiment, the component heating sub-system includes one or more heat sensors coupled to the component. The heat sensor(s) may be mounted on an outer surface of the component, and/or embedded within the component.

Certain embodiments of the present disclosure provide a laser shearography testing method for non-destructively testing a component. The laser shearography testing method includes coupling a component heating sub-system to a component, exciting the component into a loaded state with the component heating

sub-system, wherein the exciting includes passing an electric current through the component, and internally and uniformly heating an internal region of the component through the exciting due to a resistivity of the component.

In at least one embodiment, the laser shearography testing method includes emitting a laser beam onto the component by a laser-emitting device, passing the laser beam emitted by the laser-emitting device through a beam expander before impinging on the component, acquiring at least one first image of the component in a neutral state in which the component is not excited by the component heating sub-system, and acquiring at least one second image of the component in the loaded state.

In at least one embodiment, the coupling includes coupling a power source to the component. For example, the coupling includes extending a first lead from the power source to a first portion of the component, and extending a second lead from a second portion of the component to the power source.

In at least one embodiment, the laser shearography testing method includes operatively coupling a heating control unit to a power source, communicatively coupling one or more heat sensors coupled to the component with the heating control unit, and selectively activating the power source in order to selectively pass the electric current through the component.

Certain embodiments of the present disclosure provide a laser shearography testing system for non-destructively testing a component. The laser shearography testing system includes a laser-emitting device that is configured to emit a laser beam onto the component; a beam expander, wherein the laser beam emitted by the laser-emitting device passes through the beam expander before impinging on the component; a camera that acquires at least one first image of the component in a neutral state, in which the component is not excited, and at least one second image of the component in a loaded state; and a component heating sub-system coupled to the component, wherein the component heating sub-system excites the component into the loaded state by passing an electric current through the component, wherein a resistivity of the component causes the component to internally and uniformly heat as the electric current passes through the component. The component heating sub-system further includes a first lead that extends from a power source and couples to a first portion of the component; a second lead that extends from a second portion of the component and couples to the power source; a heating control unit that is operatively coupled to the power source, wherein the heating control unit selectively activates the power source in order to selectively pass the electric current through the component; and one or more heat sensors coupled to the component.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a schematic diagram of a laser shearography testing system, according to an embodiment of the present disclosure.

Figure 2 illustrates a perspective exploded view of the composite panel assembly, according to an embodiment of the present disclosure.

Figure 3 illustrates a flow chart of a laser shearography testing method for non-destructively testing a component, according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

The foregoing summary, as well as the following detailed description of certain embodiments, will be better understood when read in conjunction with the appended drawings. As used herein, an element or step recited in the singular and preceded by the word “a” or “an” should be understood as not necessarily excluding the plural of the elements or steps. Further, references to “one embodiment” are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly

CLAIMS:

1. A laser shearography testing system for non-destructively testing a component, the laser shearography testing system comprising:

a component heating sub-system coupled to the component, wherein the component heating sub-system excites the component into a loaded state by passing an electric current through the component, wherein a resistivity of the component causes the component to internally and uniformly heat as the electric current passes through the component.

2. The laser shearography testing system of claim 1, further comprising a laser-emitting device that is configured to emit a laser beam onto the component.

3. The laser shearography testing system of any of claims 1 to 2, further comprising a beam expander, wherein the laser beam emitted by the laser-emitting device passes through the beam expander before impinging on the component.

4. The laser shearography testing system of any of claims 1 to 3, further comprising a camera that acquires at least one first image of the component in a neutral state, in which the component is not excited by the component heating sub-system, and at least one second image of the component in the loaded state.

5. The laser shearography testing system of any of claims 1 to 4, further comprising an image shearing device disposed between the component and the camera.

6. The laser shearography testing system of claim 1, wherein the component heating sub-system comprises a power source coupled to the component.

7. The laser shearography testing system of claim 6, wherein the component heating sub-system further comprises:

a first lead that extends from a power source and couples to a first portion of the component; and

a second lead that extends from a second portion of the component and couples to the power source.

8. The laser shearography testing system of claim 1, wherein the component heating sub-system comprises a heating control unit that is operatively coupled to a power source, wherein the heating control unit selectively activates the power source in order to selectively pass the electric current through the component.

9. The laser shearography testing system of claim 1, wherein the component heating sub-system comprises one or more heat sensors coupled to the component.

10. The laser shearography testing system of claim 9, wherein the one or more heat sensors are mounted on an outer surface of the component.

11. The laser shearography testing system of claim 9, wherein the one or more heat sensors are embedded within the component.

12. A laser shearography testing method for non-destructively testing a component, the laser shearography testing method comprising:

coupling a component heating sub-system to a component;

exciting the component into a loaded state with the component heating sub-system, wherein the exciting comprises passing an electric current through the component; and

uniformly heating an internal region of the component through the exciting due to a resistivity of the component.

13. The laser shearography testing method of claim 12, further comprising emitting a laser beam onto the component by a laser-emitting device.

14. The laser shearography testing method of claim 13, further comprising passing the laser beam emitted by the laser-emitting device through a beam expander before impinging on the component.

15. The laser shearography testing method of claim 13, further comprising:

acquiring at least one first image of the component in a neutral state in which the component is not excited by the component heating sub-system; and

acquiring at least one second image of the component in the loaded state.

16. The laser shearography testing method of claim 15, further comprising disposing an image shearing device between the component and a camera that acquires the at least one first image and the at least one second image.

17. The laser shearography testing method of claim 12, wherein the coupling comprises coupling a power source to the component.

18. The laser shearography testing method of claim 17, wherein the coupling further comprises:

extending a first lead from the power source to a first portion of the component; and

extending a second lead from a second portion of the component to the power source.

19. The laser shearography testing method of claim 12, further comprising:

operatively coupling a heating control unit to a power source;

communicatively coupling one or more heat sensors coupled to the component with the heating control unit;

selectively activating the power source in order to selectively pass the electric current through the component.

20. A laser shearography testing system for non-destructively testing a component, the laser shearography testing system comprising:

a laser-emitting device that is configured to emit a laser beam onto the component;

a beam expander, wherein the laser beam emitted by the laser-emitting device passes through the beam expander before impinging on the component;

a camera that acquires at least one first image of the component in a neutral state, in which the component is not excited, and at least one second image of the component in a loaded state; and

a component heating sub-system coupled to the component, wherein the component heating sub-system excites the component into the loaded state by passing an electric current through the component, wherein a resistivity of the component causes the component to internally and uniformly heat as the electric current passes through the component, wherein the component heating sub-system further comprises:

a first lead that extends from a power source and couples to a first portion of the component;

a second lead that extends from a second portion of the component and couples to the power source;

a heating control unit that is operatively coupled to the power source, wherein the heating control unit selectively activates the power source in order to selectively pass the electric current through the component; and

one or more heat sensors coupled to the component.