

## **Method and device for detecting cracks in an aircraft component or gas turbine component**

The invention relates to a method for detecting cracks in an aircraft component or gas turbine component and to a device for detecting cracks in an aircraft component or gas turbine component.

During operation, aircraft components are subjected to a high stress. Apart from components consisting of composite materials, such as structural components or metallic components, such as undercarriage components, this can result, particularly in the case of aircraft engine components, in defective crack formation. Similar damage patterns are also present in the case of other gas turbines, for example stationary gas turbines. In gas turbines, combustion chamber components are affected particularly severely by crack formation.

Cracks are local material separations within a structure or within a component. The formation of a crack is usually a local event in the microstructure of the surface which is generally caused by lattice imperfections in the microstructure or by cyclic operational loads. Cracks generally spread out vertically to the effective normal stress. This spread is described as being controlled by normal stress.

In combustion chamber components, cracks are the result of a high thermal and mechanical stress. On the one hand, crack formation is caused due to the high temperatures which prevail and on the other hand, the vibrations transmitted onto the combustion chamber from the modules connected upstream and downstream, from the high-pressure compressor and from the high-pressure turbine further the formation and growth of cracks. In addition, short-term thermal material stresses during the start-up of the gas turbine and, if appropriate, during the take-off phase of the aircraft promote the formation of cracks. Solid particles which are sucked into the gas turbine, such as sand and dust, also make a significant contribution to the formation of cracks in combustion chamber components. Furthermore, the permanent thermal stresses during the operating phase of the gas turbine mean that the combustion chamber components undergo a change in geometric shape.

The main problem which arises during the maintenance of aircraft components and/or gas turbine components, particularly during maintenance of combustion chambers is of detecting the cracks and changes in shape which occur during operation and of repairing the components by suitable measures. This is often difficult due to the individually varying manifestation of cracks and damage.

by the human factor. Furthermore, the dye penetrant test method is a chemical, energy-intensive and thereby ecologically harmful test method.

Accordingly, the object of the invention is to provide an improved method and a corresponding device for detecting cracks in an aircraft component and/or gas turbine component.

The invention achieves this object by the features of the independent claims. Further preferred configurations of the invention are provided in the drawings, the subclaims and in the associated description.

To achieve the object, a method for detecting cracks in an aircraft component or a gas turbine component is proposed according to the invention, the method having at least the following steps:

- a) determination of geometric data of the component using an optical measurement method,
- b) evaluation of the geometric data by an electronic evaluation means, cracks and/or other damage being automatically detected and/or classified and the position of the cracks and/or of other damage being stored.

The method according to the invention allows the cracks and/or other damage of the aircraft component or gas turbine component to be automatically detected and identified, and allows the position of the cracks and/or of other damage to be stored with respect to the component coordinate system. According to the results, measures are then carried out, if appropriate, to repair the component. It is possible to dispense with complex test methods, in particular the very complex dye penetrant method. Consequently, during the crack detection, a manual inspection of the components is not needed and the omission of the high energy requirement, necessary for the dye penetrant method (heating of the cleaning baths and component drying) and of the chemical substances (penetrant, cleaning agent and developer) contributes to a reduction in environmental pollution. Overall, it is hereby possible to reduce the component processing time and furthermore, the process reliability and reproducibility is improved. The method is preferably carried out on dismantled components.

For example, during maintenance or servicing, engine components are dismantled from the

aircraft engine, are cleaned and then tested for cracks and/or other damage using the method according to the invention.

In this respect, optical measurement methods are, for example measurement methods based on visible light, infrared light, ultraviolet light or laser light. With regard to the small dimensions to be determined, measurement methods are preferred which make use of the wave characteristics of light, in particular interferometric methods, where coherent light is preferred. Methods which do not belong to optical measurement methods are, for example, methods which are based on electron beams or X-rays, ultrasound or eddy current.

The geometric data which is determined is preferably automatically compared with preferably mathematically predefined and stored features and/or set contours and/or tolerances and/or damage patterns. In this respect, discrepancies in the component can be detected and classified by the comparison of the geometric data with predefined set contours and/or determined component tolerances, or damage which has occurred can be detected by comparison with typical damage patterns and/or by comparison with presettings in the component maintenance documentation.

More preferably, prior information about the component, such as the nominal component geometry, can be used to provide the evaluation means with prior knowledge about the geometric data which is to be expected. In conjunction with a so-called "matching" process, the evaluation means is able to automatically decide whether or not damage in specific regions of the component can occur due to the shape of the component. For example, a drilled hole is not damage and is not to be classified as such.

The geometric data which is acquired is preferably additionally used for a measurement of the component. A measurement was usually made after the inspection of the component and implied an additional expense, due to a large number of measurement positions on the component. In this respect, the accuracy of the measurement results also depended significantly on the knowledge and diligence of the staff performing the measurement. As a result of using the geometric data for measuring the components, which data is in any case required for the crack test, the effort for the component maintenance can be further reduced and the quality can be increased.

The method according to the invention is well suited to aircraft components or gas turbine components which are used as combustion chamber components of an aircraft engine.

Combustion chamber components are subjected to high stresses and crack detection is

usually associated with a considerable expense which can be significantly reduced by the method according to the invention.

The geometric data is preferably determined by an interferometric method. In interferometry, a measurement is made using the interference effect of light. An interferometer, preferred in this respect, for the method is the Michelson interferometer, in which coherent light is split and is brought to interference with itself. The use of interferometry allows cracks and/or damage to be effectively detected.

The geometric data is preferably determined by white light interferometry. White light interferometry is preferred for the detection of cracks and other damage since it can test the surface of the components in a highly accurate manner.

The optical measurement method is preferably carried out with a distance in a range of between 1 and 100 mm, preferably in a range of between 10 and 50 mm from the surface of the component to an optical measurement device. According to the invention, a further preferred distance of 20 to 30 mm produces good results.

The evaluated geometric data is preferably used to establish the need for, and/or extent of, repairs of the component. Consequently, according to the test method, it can be immediately established which repairs and/or machining steps are necessary to process the component again to such an extent that it complies with the current requirements, for example of aviation law authorisation and/or with particular specifications by the engine manufacturer.

The evaluated geometric data is preferably used for a subsequent repair and/or machining of the component. For example, the geometric data can be used thus for an automated welding treatment. The positions of the cracks and/or of other damage in the coordinate system of the component are already known from the crack test, so that during the repair method, the appropriate areas can be welded or otherwise reworked in an automated manner. Additional programming expense and thereby undesired manual processing steps can be omitted during the course of a fully automated repair cycle, and the component can be reused relatively quickly.

To achieve the object, a device for detecting cracks in an aircraft component or gas turbine component is also proposed, the device comprising an optical measurement device and an electronic evaluation means and being configured to implement the described method.

The device can test the components in an advantageous manner according to the invention for cracks and other damage.

For this purpose, the device preferably comprises a manipulation device, by which the measurement device and the component can be moved relative to one another. In this respect, either the component can be stationary and the measurement device is moved on and/or around the component, or the measurement device is stationary and the component is moved. Finally, it is also possible for the component and the measurement device to move. Thus, the manipulation device preferably comprises a rotary table, on which the component can be rotated about its own axis for testing, and a robot which can move the measurement device in an automated manner into a position conducive to an optimum result. In this respect, the measurement device is preferably arranged such that it can be moved towards the component on a linear axis, for example realised by a linear unit. The linear unit can be configured, for example, as a linear adjuster. Precise height images can be produced by a displaceably arranged measurement device of this type.

Since the measurement device and the component can be moved relative to one another, the measurement device is also well suited to the detection of cracks in components of different sizes, because the optimal working distance can be adjusted in a component-specific manner.

During the test, the measurement device is preferably moved adaptively into the best possible measuring position. The path of the measurement device is corrected based on the geometric differences which vary for individual components. This path correction can be realised, for example, using a distance sensor and/or by a software path correction, i.e. by calibrating the actual geometry with the nominal geometry of the component. Preferably, an offline path correction is carried out by means of an initial measuring pass and/or an online path correction is carried out during the measuring procedure.

Thus, the optical measurement means preferably comprises a distance sensor which allows an automatic online-adaptive and/or offline-adaptive path correction of the manipulation device by means of the control device.

Furthermore, it is preferred that the evaluation means automatically evaluates the geometric information using predefined features and/or set contours and/or tolerances and/or damage patterns and/or learned rules and/or prior knowledge about the geometric information to be expected and uses the evaluated geometric information to detect and/or classify damage.

Fig. 1 is a schematic illustration of a crack test on a component using an interferometric method;

Fig. 2 is an illustration of the method according to the invention for crack detection and of a device according to the invention for implementing the method.

Fig. 1 shows an aircraft component 1 or a gas turbine component 1 which is arranged on a workpiece carrier 9. The component 1 can be, for example, a CFRP component, for example a structural component or a metallic component, for example an undercarriage component. Furthermore, the component 1 can also originate from a stationary gas turbine. In this embodiment, the component 1 is a component from the combustion chamber of an aircraft engine. The surface of the combustion chamber component is to be examined for the presence of possible defects, for example cracks 2, burns, deformations or other damage. An examination of this type is usually carried out as part of the maintenance of engine components. There are aviation law standards and requirements which apply to the quality of the components. Thus, for example, combustion chamber components can only have a limited extent of cracks 2. The permitted crack shape, for example the maximally admissible size of the cracks 2 is also prescribed. In order to comply with these requirements, a crack test is usually carried out by means of the dye penetrant method mentioned at the outset. However, the method is associated with the described disadvantages.

To be able to dispense with the complex dye penetrant method, according to the invention the crack test of the combustion chamber component is carried out using an optical measurement method, preferably an interferometric method. In this respect, white light interferometry is preferably used. As shown in Fig. 1, for this purpose a measurement device 20, in particular an interferometer is provided. The measurement device 20 comprises a coherent light source 8, in particular a laser with a collimator 7 to provide parallel coherent light. The measurement device 20 also comprises a beam splitter 4, a reference mirror 3 and a camera unit 6 with a lens unit 5.

The combustion chamber component to be tested and the reference mirror 3 are simultaneously illuminated by the coherent, broadband light from the light source 8. For this purpose, the light waves are split into two bundles of light in the beam splitter 4. The combustion chamber component and the reference mirror 3 reflect the light waves which, in turn, strike the camera unit 6 via the beam splitter 4. In this respect, interference patterns are then produced if the path length to component 1 is the same as the path length to the

reference mirror 3. These interference patterns or brightness fluctuations are detected by the camera unit 6. In-phase or correct order striking produces the maximum constructive interference. If the wave bundles converge in correct phase, but displaced in order and partly overlapping, a less pronounced constructive interference is obtained. If the wave bundles strike the detector one after another, no interference is produced.

The measured fluctuations in brightness are evaluated by software. In this respect, a means 14 used for evaluation can comprise the camera unit 6 and/or one or more computers. Using mathematical algorithms which allocate height values to the brightness fluctuations, geometric data is determined or generated by the measurement. One height value is allocated mathematically to each pixel, thereby producing a so-called "point cloud". As a result, the topography of the component surface can be determined with a resolution in the range of the surface roughness. The component surface can be examined for damage with a resolution of  $0.3\text{ }\mu\text{m}$  to  $130\text{ }\mu\text{m}$  and with a measurement field of  $0.3\text{ times }0.3\text{ mm}^2$  to  $130\text{ times }130\text{ mm}^2$ , and the examination is preferably carried out with a resolution in a range of between  $1$  and  $50\text{ }\mu\text{m}$ , more preferably in a range of  $5$  to  $30\text{ }\mu\text{m}$ , for example in a range of approximately  $10$  to  $20\text{ }\mu\text{m}$ . The measurement field is preferably within a range of between  $1$  to  $50\text{ times }1\text{ to }50\text{ mm}^2$ , more preferably within a range of  $5$  to  $25\text{ times }5\text{ to }25$ , for example within a range of approximately  $20\text{ times }20\text{ mm}^2$ . In this embodiment, the measurement field is within a preferred range of between  $0.25$  to  $50\text{ times }0.25\text{ to }50\text{ mm}^2$ , more preferably within a range of  $1$  to  $15\text{ times }1\text{ to }15$ , for example approximately  $3\text{ times }3\text{ mm}^2$ . Cracks 2 and/or other to some extent very small areas of damage can be detected and identified. The determined geometric data is preferably compared in an automated manner with set contours and/or tolerances and/or typical damage patterns which can be stored. These set contours and/or tolerances and/or typical damage patterns can be, for example old geometric data which originates from the same component 1 and was stored during the last maintenance procedure and crack test. The tolerances can be derived, for example, from aviation law specifications, as a result of which it is possible, subsequent to the method according to the invention, to have information immediately available as to whether the component 1 complies with the specifications, or whether repairs are required. In this respect, repairs can be, for example, the closure of cracks 2 by welding. The objective of the repairs is to mend the component 1 so that it complies with the safety provisions and is thereby fit for flight again.

During the course of the test process, the measured data is preferably evaluated in a connected cluster of computers which is preferably included in the evaluation means 14. In

this respect, the measured surface of the component is preferably initially transformed into a plane by mathematical conversions and the surface curvature is calculated therefrom. The computer or software which is used is preferably configured such that it allocates specific features or combinations of features or surface characteristics which satisfy specific predefined conditions, for example the characteristic "crack" or "damage", and stores the coordinates of these findings. As a result, the findings, also referred to as damage patterns, can be displayed on a computer screen for example, the information about the position, i.e. the absolute position in the coordinate system used, being stored. The component 1 together with the findings can preferably be presented on a computer screen and "critical" results, i.e. results which mean that reworking is required, are identified in particular. The determined geometric data is also used for a measurement of the component 1. According to current prior art, this measurement is usually carried out manually subsequent to the crack test and is a separate, time-consuming step. In contrast, due to the method according to the invention, an additional geometric measurement or an additional working step is no longer necessary.

The established geometric data and the findings, such as cracks 2, burns or other damage is preferably stored in the form of polygon courses and/or polygons. The geometric data which, as described, is initially present as a point cloud is transformed into a CAD model by a so-called "meshing" or "paving" process and by surface reconstruction. This model can be used for further automated, preferably adaptively automated machining steps.

Due to the optical measurement method, the relevant component measurements can already be (co-)detected during the crack test. Component measurements which are to be documented according to maintenance instructions are saved automatically and are preferably also available as a protocol. The measurements are preferably determined at predefined measurement positions, as a result of which a high reproducibility and process reliability of the measurement procedure can be achieved. The measured data is then forwarded to one or more connected computers. The computer or computers is/are configured to evaluate the measured data. The measured data is preferably stored in a database to allow a long-term documentation. Consequently, the change in the same component 1 over the life thereof can be observed. In their lifetime, the components 1 generally pass through the maintenance processes several times and the established data can thereby be compared with the data from the previous maintenance.

**Method and device for detecting cracks in an aircraft component or gas turbine component**

The invention relates to a method for detecting cracks in an aircraft component or gas turbine component and to a device or apparatus for detecting cracks in an aircraft component or gas turbine component.

During operation, aircraft components are subjected to a high stress. Apart from components consisting of composite materials, such as structural components or metallic components, such as undercarriage components, this can result, particularly in the case of aircraft engine components, in defective crack formation. Similar damage patterns are also present in the case of other gas turbines, for example stationary gas turbines. In gas turbines, combustion chamber components are affected particularly severely by crack formation.

Cracks are local material separations within a structure or within a component. The formation of a crack is usually a local event in the microstructure of the surface which is generally caused by lattice imperfections in the microstructure or by cyclic operational loads. Cracks generally spread out vertically to the effective normal stress. This spread is described as being controlled by normal stress.

In combustion chamber components, cracks are the result of a high thermal and mechanical stress. On the one hand, crack formation is caused due to the high temperatures which prevail and on the other hand, the vibrations transmitted onto the combustion chamber from the modules connected upstream and downstream, from the high-pressure compressor and from the high-pressure turbine further the formation and growth of cracks. In addition, short-term thermal material stresses during the start-up of the gas turbine and, if appropriate, during the take-off phase of the aircraft promote the formation of cracks. Solid particles which are sucked into the gas turbine, such as sand and dust, also make a significant contribution to the formation of cracks in combustion chamber components. Furthermore, the permanent thermal stresses during the operating phase of the gas turbine mean that the combustion chamber components undergo a change in geometric shape.

The main problem which arises during the maintenance of aircraft components and/or gas turbine components, particularly during maintenance of combustion chambers is of detecting the cracks and changes in shape which occur during operation and of repairing the components by suitable measures. This is often difficult due to the individually varying manifestation of cracks and damage.

by the human factor. Furthermore, the dye penetrant test method is a chemical, energy-intensive and thereby ecologically harmful test method.

Accordingly, the techniques disclosed herein may provide for an improved method and a corresponding device or apparatus for detecting cracks in an aircraft component and/or gas turbine component.

The invention is defined in the independent claims. Further preferred configurations of the invention are provided in the drawings, the subclaims and in the associated description.

One method for detecting cracks in an aircraft component or a gas turbine component has at least the following steps:

- a) determination of geometric data of the component using an optical measurement method,
- b) evaluation of the geometric data by an electronic evaluation means, cracks and/or other damage being automatically detected and/or classified and the position of the cracks and/or of other damage being stored.

The method allows the cracks and/or other damage of the aircraft component or gas turbine component to be automatically detected and identified, and allows the position of the cracks and/or of other damage to be stored with respect to the component coordinate system.

According to the results, measures are then carried out, if appropriate, to repair the component. It is possible to dispense with complex test methods, in particular the very complex dye penetrant method. Consequently, during the crack detection, a manual inspection of the components is not needed and the omission of the high energy requirement, necessary for the dye penetrant method (heating of the cleaning baths and component drying) and of the chemical substances (penetrant, cleaning agent and developer) contributes to a reduction in environmental pollution. Overall, it is hereby possible to reduce the component processing time and furthermore, the process reliability and reproducibility is improved. The method is preferably carried out on dismantled components. For example, during maintenance or servicing, engine components are dismantled from the

aircraft engine, are cleaned and then tested for cracks and/or other damage using the method.

In this respect, optical measurement methods are, for example measurement methods based on visible light, infrared light, ultraviolet light or laser light. With regard to the small dimensions to be determined, measurement methods are preferred which make use of the wave characteristics of light, in particular interferometric methods, where coherent light is preferred. Methods which do not belong to optical measurement methods are, for example, methods which are based on electron beams or X-rays, ultrasound or eddy current.

The geometric data which is determined is preferably automatically compared with preferably mathematically predefined and stored features and/or set contours and/or tolerances and/or damage patterns. In this respect, discrepancies in the component can be detected and classified by the comparison of the geometric data with predefined set contours and/or determined component tolerances, or damage which has occurred can be detected by comparison with typical damage patterns and/or by comparison with presettings in the component maintenance documentation.

More preferably, prior information about the component, such as the nominal component geometry, can be used to provide the evaluation means with prior knowledge about the geometric data which is to be expected. In conjunction with a so-called "matching" process, the evaluation means is able to automatically decide whether or not damage in specific regions of the component can occur due to the shape of the component. For example, a drilled hole is not damage and is not to be classified as such.

The geometric data which is acquired is preferably additionally used for a measurement of the component. A measurement was usually made after the inspection of the component and implied an additional expense, due to a large number of measurement positions on the component. In this respect, the accuracy of the measurement results also depended significantly on the knowledge and diligence of the staff performing the measurement. As a result of using the geometric data for measuring the components, which data is in any case required for the crack test, the effort for the component maintenance can be further reduced and the quality can be increased.

The method is well suited to aircraft components or gas turbine components which are used as combustion chamber components of an aircraft engine. Combustion chamber components are subjected to high stresses and crack detection is

usually associated with a considerable expense which can be significantly reduced by the method.

The geometric data is preferably determined by an interferometric method. In interferometry, a measurement is made using the interference effect of light. An interferometer, preferred in this respect, for the method is the Michelson interferometer, in which coherent light is split and is brought to interference with itself. The use of interferometry allows cracks and/or damage to be effectively detected.

The geometric data is preferably determined by white light interferometry. White light interferometry is preferred for the detection of cracks and other damage since it can test the surface of the components in a highly accurate manner.

The optical measurement method is preferably carried out with a distance in a range of between 1 and 100 mm, preferably in a range of between 10 and 50 mm from the surface of the component to an optical measurement device. A further preferred distance of 20 to 30 mm produces good results.

The evaluated geometric data is preferably used to establish the need for, and/or extent of, repairs of the component. Consequently, according to the test method, it can be immediately established which repairs and/or machining steps are necessary to process the component again to such an extent that it complies with the current requirements, for example of aviation law authorisation and/or with particular specifications by the engine manufacturer.

The evaluated geometric data is preferably used for a subsequent repair and/or machining of the component. For example, the geometric data can be used thus for an automated welding treatment. The positions of the cracks and/or of other damage in the coordinate system of the component are already known from the crack test, so that during the repair method, the appropriate areas can be welded or otherwise reworked in an automated manner. Additional programming expense and thereby undesired manual processing steps can be omitted during the course of a fully automated repair cycle, and the component can be reused relatively quickly.

A device for detecting cracks in an aircraft component or gas turbine component is also proposed, the device comprising an optical measurement device and an electronic evaluation means and being configured to implement the described method.

The device can test the components in an advantageous manner for cracks and other damage.

For this purpose, the device preferably comprises a manipulation device, by which the measurement device and the component can be moved relative to one another. In this respect, either the component can be stationary and the measurement device is moved on and/or around the component, or the measurement device is stationary and the component is moved. Finally, it is also possible for the component and the measurement device to move. Thus, the manipulation device preferably comprises a rotary table, on which the component can be rotated about its own axis for testing, and a robot which can move the measurement device in an automated manner into a position conducive to an optimum result. In this respect, the measurement device is preferably arranged such that it can be moved towards the component on a linear axis, for example realised by a linear unit. The linear unit can be configured, for example, as a linear adjuster. Precise height images can be produced by a displaceably arranged measurement device of this type.

Since the measurement device and the component can be moved relative to one another, the measurement device is also well suited to the detection of cracks in components of different sizes, because the optimal working distance can be adjusted in a component-specific manner.

During the test, the measurement device is preferably moved adaptively into the best possible measuring position. The path of the measurement device is corrected based on the geometric differences which vary for individual components. This path correction can be realised, for example, using a distance sensor and/or by a software path correction, i.e. by calibrating the actual geometry with the nominal geometry of the component. Preferably, an offline path correction is carried out by means of an initial measuring pass and/or an online path correction is carried out during the measuring procedure.

Thus, the optical measurement means preferably comprises a distance sensor which allows an automatic online-adaptive and/or offline-adaptive path correction of the manipulation device by means of the control device.

Furthermore, it is preferred that the evaluation means automatically evaluates the geometric information using predefined features and/or set contours and/or tolerances and/or damage patterns and/or learned rules and/or prior knowledge about the geometric information to be expected and uses the evaluated geometric information to detect and/or classify damage.

Fig. 1 is a schematic illustration of a crack test on a component using an interferometric method;

Fig. 2 is an illustration of the method for crack detection and of a device for implementing the method.

Fig. 1 shows an aircraft component 1 or a gas turbine component 1 which is arranged on a workpiece carrier 9. The component 1 can be, for example, a CFRP component, for example a structural component or a metallic component, for example an undercarriage component. Furthermore, the component 1 can also originate from a stationary gas turbine. In this embodiment, the component 1 is a component from the combustion chamber of an aircraft engine. The surface of the combustion chamber component is to be examined for the presence of possible defects, for example cracks 2, burns, deformations or other damage. An examination of this type is usually carried out as part of the maintenance of engine components. There are aviation law standards and requirements which apply to the quality of the components. Thus, for example, combustion chamber components can only have a limited extent of cracks 2. The permitted crack shape, for example the maximally admissible size of the cracks 2 is also prescribed. In order to comply with these requirements, a crack test is usually carried out by means of the dye penetrant method mentioned at the outset. However, the method is associated with the described disadvantages.

To be able to dispense with the complex dye penetrant method, the crack test of the combustion chamber component is carried out using an optical measurement method, preferably an interferometric method. In this respect, white light interferometry is preferably used. As shown in Fig. 1, for this purpose a measurement device 20, in particular an interferometer is provided. The measurement device 20 comprises a coherent light source 8, in particular a laser with a collimator 7 to provide parallel coherent light. The measurement device 20 also comprises a beam splitter 4, a reference mirror 3 and a camera unit 6 with a lens unit 5.

The combustion chamber component to be tested and the reference mirror 3 are simultaneously illuminated by the coherent, broadband light from the light source 8. For this purpose, the light waves are split into two bundles of light in the beam splitter 4. The combustion chamber component and the reference mirror 3 reflect the light waves which, in turn, strike the camera unit 6 via the beam splitter 4. In this respect, interference patterns are then produced if the path length to component 1 is the same as the path length to the

reference mirror 3. These interference patterns or brightness fluctuations are detected by the camera unit 6. In-phase or correct order striking produces the maximum constructive interference. If the wave bundles converge in correct phase, but displaced in order and partly overlapping, a less pronounced constructive interference is obtained. If the wave bundles strike the detector one after another, no interference is produced.

The measured fluctuations in brightness are evaluated by software. In this respect, a means 14 used for evaluation can comprise the camera unit 6 and/or one or more computers. Using mathematical algorithms which allocate height values to the brightness fluctuations, geometric data is determined or generated by the measurement. One height value is allocated mathematically to each pixel, thereby producing a so-called "point cloud". As a result, the topography of the component surface can be determined with a resolution in the range of the surface roughness. The component surface can be examined for damage with a resolution of  $0.3\text{ }\mu\text{m}$  to  $130\text{ }\mu\text{m}$  and with a measurement field of  $0.3\text{ times }0.3\text{ mm}^2$  to  $130\text{ times }130\text{ mm}^2$ , and the examination is preferably carried out with a resolution in a range of between  $1$  and  $50\text{ }\mu\text{m}$ , more preferably in a range of  $5$  to  $30\text{ }\mu\text{m}$ , for example in a range of approximately  $10$  to  $20\text{ }\mu\text{m}$ . The measurement field is preferably within a range of between  $1$  to  $50\text{ times }1\text{ to }50\text{ mm}^2$ , more preferably within a range of  $5$  to  $25\text{ times }5\text{ to }25$ , for example within a range of approximately  $20\text{ times }20\text{ mm}^2$ . In this embodiment, the measurement field is within a preferred range of between  $0.25$  to  $50\text{ times }0.25\text{ to }50\text{ mm}^2$ , more preferably within a range of  $1$  to  $15\text{ times }1\text{ to }15$ , for example approximately  $3\text{ times }3\text{ mm}^2$ . Cracks 2 and/or other to some extent very small areas of damage can be detected and identified. The determined geometric data is preferably compared in an automated manner with set contours and/or tolerances and/or typical damage patterns which can be stored. These set contours and/or tolerances and/or typical damage patterns can be, for example old geometric data which originates from the same component 1 and was stored during the last maintenance procedure and crack test. The tolerances can be derived, for example, from aviation law specifications, as a result of which it is possible, subsequent to the method, to have information immediately available as to whether the component 1 complies with the specifications, or whether repairs are required. In this respect, repairs can be, for example, the closure of cracks 2 by welding. The objective of the repairs is to mend the component 1 so that it complies with the safety provisions and is thereby fit for flight again.

During the course of the test process, the measured data is preferably evaluated in a connected cluster of computers which is preferably included in the evaluation means 14. In

this respect, the measured surface of the component is preferably initially transformed into a plane by mathematical conversions and the surface curvature is calculated therefrom. The computer or software which is used is preferably configured such that it allocates specific features or combinations of features or surface characteristics which satisfy specific predefined conditions, for example the characteristic “crack” or “damage”, and stores the coordinates of these findings. As a result, the findings, also referred to as damage patterns, can be displayed on a computer screen for example, the information about the position, i.e. the absolute position in the coordinate system used, being stored. The component 1 together with the findings can preferably be presented on a computer screen and “critical” results, i.e. results which mean that reworking is required, are identified in particular. The determined geometric data is also used for a measurement of the component 1. According to current prior art, this measurement is usually carried out manually subsequent to the crack test and is a separate, time-consuming step. In contrast, due to the method, an additional geometric measurement or an additional working step is no longer necessary.

The established geometric data and the findings, such as cracks 2, burns or other damage is preferably stored in the form of polygon courses and/or polygons. The geometric data which, as described, is initially present as a point cloud is transformed into a CAD model by a so-called “meshing” or “paving” process and by surface reconstruction. This model can be used for further automated, preferably adaptively automated machining steps.

Due to the optical measurement method, the relevant component measurements can already be (co-)detected during the crack test. Component measurements which are to be documented according to maintenance instructions are saved automatically and are preferably also available as a protocol. The measurements are preferably determined at predefined measurement positions, as a result of which a high reproducibility and process reliability of the measurement procedure can be achieved. The measured data is then forwarded to one or more connected computers. The computer or computers is/are configured to evaluate the measured data. The measured data is preferably stored in a database to allow a long-term documentation. Consequently, the change in the same component 1 over the life thereof can be observed. In their lifetime, the components 1 generally pass through the maintenance processes several times and the established data can thereby be compared with the data from the previous maintenance.