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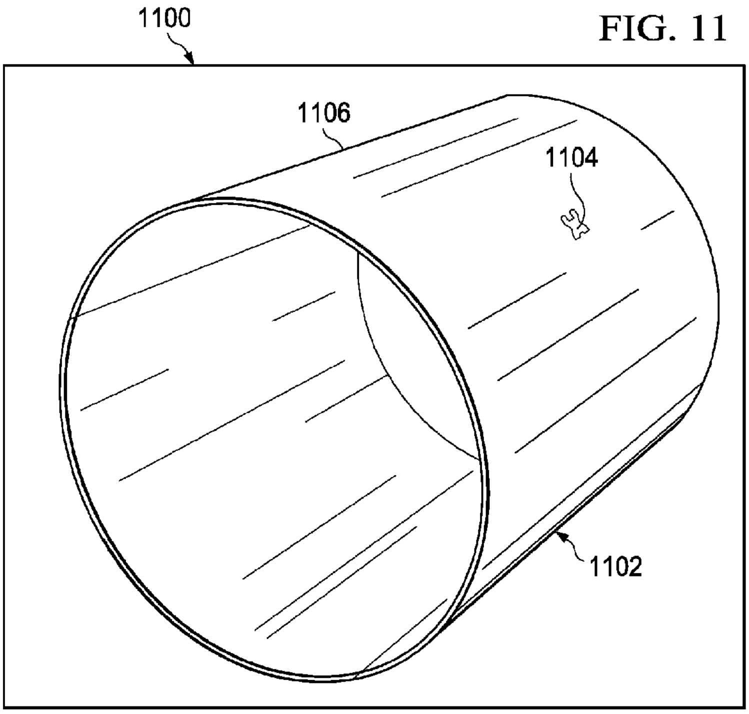
(54) Title: BONDED REWORK TEMPLATE SYSTEM

FIG. 11



(57) Abstract: A method and apparatus for processing an inconsistency. A shape of the inconsistency is identified in a location having layers of composite materials. A model of the location is created with a portion of a number of layers in the layers of composite materials removed to form a section based on the shape of the inconsistency and a policy for rework.

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BONDED REWORK TEMPLATE SYSTEM

BACKGROUND INFORMATION

1. Field:

The present disclosure relates generally to aircraft and, in particular, to a method and apparatus for performing rework on an aircraft. Still more particularly, the present disclosure relates to a method and apparatus for generating a template to form a scarf for bonded rework.

2. Background:

Aircraft are being designed and manufactured with greater and greater percentages of composite materials. Some aircraft may have more than 50 percent of their primary structure made from composite materials. Composite materials may be used in aircraft to decrease the weight of the aircraft. This decreased weight may improve payload capacities and fuel efficiencies. Further, composite materials may provide longer service life for various components in an aircraft.

Composite materials may be tough, light-weight materials created by combining two or more dissimilar components. For example, a composite may include fibers and resins. The fibers and resins may be combined to form a cured composite material.

Further, by using composite materials, portions of an aircraft may be created in larger pieces or sections. For example, a fuselage in an aircraft may be created in cylindrical sections that may be put together to form the fuselage of the aircraft. Other examples may include, without limitation, wing sections joined to form a wing, or stabilizer sections joined to form a stabilizer.

In forming these components, layers of composite materials may be laid up and cured to form structures for an aircraft. During manufacturing and/or use, inconsistencies may occur in various structures of the aircraft. These inconsistencies may be undesirable and/or may result in less than desired performance of the aircraft.

For example, inconsistencies may occur in composite structures. These inconsistencies may include, for example, without limitation, delamination, voids in or between layers of composite materials, cracks, deformations in the structure, and/or other types of inconsistencies.

When an inconsistency is identified on a composite structure in an aircraft, the structure may be reworked to remove the inconsistency. A rework may involve removing a portion of the composite materials in a section of the composite structure and placing new composite materials into that section. For example, a number of layers of composite material corresponding to the layers of composite material removed in the section may be used as a patch. This patch may be bonded to the section to perform the rework. These operations may be referred to as bonded rework for the aircraft.

Information is obtained about the layers of composite material in the location where the inconsistency is located. This information is obtained to identify layers of material for a patch. This patch is put in place of a section of layers of composite material containing the inconsistency that is removed from the structure. Obtaining this information is often time consuming. Further, identifying the portion of the composite materials to be removed to form a section for which the patch may be placed also may be more time consuming than desired.

Therefore, it would be advantageous to have a method and apparatus that takes into account one or more of the issues discussed above, as well as possibly other issues.

SUMMARY

In one illustrative embodiment, a method is provided for processing an inconsistency. A shape of the inconsistency is identified in a location having layers of composite materials. A model of the location is created with a portion of a number of layers in the layers of composite materials removed to form a section based on the shape of the inconsistency and a policy for rework. The method may further comprise creating a patch for bonding in the section. The patch may be a virtual patch in the model. The step of creating the model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework may comprise creating a three-dimensional model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework. The three-dimensional model may include the portion as a separate object.

In another illustrative embodiment, an apparatus comprises a computer system. The computer system is configured to identify a shape of an inconsistency in a location having layers of composite materials and create a model of the location with a portion of a number of layers in the layers of composite materials removed to form a section based on a shape of the inconsistency and a policy for rework. The apparatus in being configured to create the model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework, the computer system may be configured to create a two-dimensional top view of the section. Additionally, in being configured to create the model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework, the computer system may be configured to create a three-dimensional model of the layers of composite materials at the location; and remove the portion of the number of layers in the layers of composite materials in the three-dimensional model to form the section to form the model of the location with the portion of the number of layers in the layers of composite materials removed. The computer system may be further configured to identify information for a layup for the number of layers in the layers of composite materials based on the location of the inconsistency. In being configured to create the model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework, the computer system may be configured to create a three-dimensional model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for rework.

In yet another illustrative embodiment, a computer program product comprises a computer readable storage medium, first program code, and second program code. The first program code is for identifying a shape of an inconsistency in a location having layers of composite materials. The second program code is for creating a model of the location with a portion of a number of layers in the layers of composite materials removed to form a section based on the shape of the inconsistency and a policy for rework. The first program code and the second program code are stored on the computer readable storage medium.

The features, functions, and advantages can be achieved independently in various embodiments of the present disclosure or may be combined in yet other embodiments in which further details can be seen with reference to the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the illustrative embodiments are set forth in the appended claims. The illustrative embodiments, however, as well as a preferred mode of use, further objectives, and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment of the present disclosure when read in conjunction with the accompanying drawings, wherein:

Figure 1 is an illustration of an aircraft manufacturing and service method in accordance with an illustrative embodiment;

Figure 2 is an illustration of an aircraft in which an illustrative embodiment may be implemented;

Figure 3 is an illustration of a rework environment in accordance with an illustrative embodiment;

Figure 4 is an illustration of components in a rework tool in accordance with an illustrative embodiment;

Figure 5 is an illustration of a section in a skin panel for a wing in accordance with an illustrative embodiment;

Figure 6 is an illustration of layup information for layers of composite materials in accordance with an illustrative embodiment;

Figure 7 is an illustration of a two-dimensional top view of a section in a skin panel in accordance with an illustrative embodiment;

Figure 8 is an illustration of a section in an aft section of fuselage skin in accordance with an illustrative embodiment;

Figure 9 is an illustration of information for layers of composite material in accordance with an illustrative embodiment;

Figure 10 is a two-dimensional top view of a section of fuselage skin in accordance with an illustrative embodiment;

Figure 11 is an illustration of a section in the middle portion of a fuselage skin in accordance with an illustrative embodiment;

Figure 12 is an illustration of a display of layup information for layers of composite material in a fuselage in accordance with an illustrative embodiment;

Figure 13 is an illustration of a two-dimensional top view of a section of fuselage skin in accordance with an illustrative embodiment;

Figure 14 is an illustration of a flowchart of a process for processing an inconsistency in accordance with an illustrative embodiment;

Figure 15 is an illustration of a flowchart of a process for creating a model of a location with a section removed for an inconsistency in accordance with an illustrative embodiment;

Figure 16 is an illustration of a flowchart of a process for creating a template in accordance with an illustrative embodiment; and

Figure 17 is an illustration of a data processing system in accordance with an illustrative embodiment.

DETAILED DESCRIPTION

Referring more particularly to the drawings, embodiments of the disclosure may be described in the context of aircraft manufacturing and service method **100** as shown in **Figure 1** and aircraft **200** as shown in **Figure 2**. Turning first to **Figure 1**, an illustration of an aircraft manufacturing and service method is depicted in accordance with an illustrative embodiment. During pre-production, aircraft manufacturing and service method **100** may include specification and design **102** of aircraft **200** in **Figure 2** and material procurement **104**.

During production, component and subassembly manufacturing **106** and system integration **108** of aircraft **200** in **Figure 2** takes place. Thereafter, aircraft **200** in **Figure 2** may go through certification and delivery **110** in order to be placed in service **112**. While in service **112** by a customer, aircraft **200** in **Figure 2** is scheduled for routine maintenance and service **114**, which may include modification, reconfiguration, refurbishment, and other maintenance or service.

Each of the processes of aircraft manufacturing and service method **100** may be performed or carried out by a system integrator, a third party, and/or an operator. In these examples, the operator may be a customer. For the purposes of this description, a system integrator may include, without limitation, any number of aircraft manufacturers and major-system subcontractors; a third party may include, without limitation, any number of vendors, subcontractors, and suppliers; and an operator may be an airline, a leasing company, a military entity, a service organization, and so on.

With reference now to **Figure 2**, an illustration of an aircraft is depicted in which an illustrative embodiment may be implemented. In this example, aircraft **200** is produced by aircraft manufacturing and service method **100** in **Figure 1** and may include airframe **202** with a plurality of systems **204** and interior **206**. Examples of systems **204** include one or more of propulsion system **208**, electrical system **210**, hydraulic system **212**, and environmental system **214**. Any number of other systems may be included. Although an aerospace example is shown, different illustrative embodiments may be applied to other industries, such as the automotive industry.

Apparatuses and methods embodied herein may be employed during at least one of the stages of aircraft manufacturing and service method **100** in **Figure 1**. As used herein, the phrase “at least one of”, when used with a list of items, means that different combinations of one or more of the listed items may be used and only one of each item in the list may be needed. For example, “at least one of item A, item B, and item C” may include, for example, without limitation, item A, or item A and item B. This example also may include item A, item B, and item C, or item B and item C.

In one illustrative example, components or subassemblies produced in component and subassembly manufacturing **106** in **Figure 1** may be fabricated or manufactured in a manner similar to components or subassemblies produced while aircraft **200** is in service **112** in **Figure 1**. As yet another example, a number of apparatus embodiments, method embodiments, or a combination thereof may be utilized during production stages, such as component and subassembly manufacturing **106** and system integration **108** in **Figure 1**. A number, when referring to items, means one or more items. For example, a number of apparatus embodiments is one or more apparatus embodiments. A number of apparatus embodiments, method embodiments, or a combination thereof may be utilized while aircraft **200** is in service **112** and/or during maintenance and service **114** in **Figure 1**. The use of a number of the different illustrative embodiments may substantially expedite the assembly of and/or reduce the cost of aircraft **200**.

For example, one or more of the illustrative embodiments may be applied during component and subassembly manufacturing **106** to rework inconsistencies that may be found in composite structures. As yet another example, one or more of the illustrative embodiments may be used during maintenance and service **114** to rework inconsistencies that may have occurred during use of aircraft **200.**

The different illustrative embodiments recognize and take into account a number of different considerations. For example, without limitation, the different illustrative embodiments recognize and take into account that in performing rework on composite structures, a maintenance person may need to identify a portion of a number of layers in the layers of composite materials to remove to form a section. This section is also referred to as a scarf.

The section may have a stair-stepped cross section such that different layers are exposed when the area is viewed from a top view. The exposed layers may provide a surface for bonding a patch with layers in the section.

The different illustrative embodiments recognize and take into account that the shape for this section encompasses the inconsistency that is to be reworked to remove or reduce the inconsistency. The different illustrative embodiments also recognize and take into account that various policies may be present for which layers are to be removed for the layers of composite materials and the amount of each layer to be removed to form a section.

For example, the different illustrative embodiments recognize and take into account that an angle or ratio of layers may be required. For example, the section may require a ratio of about a 30 to 1 ratio. This ratio means that for every inch deep into the composite structure, the area should extend out about 30 inches.

The different illustrative embodiments recognize and take into account that various features or other structures around the inconsistency may make it difficult to obtain a desired ratio for the section. Further, the thickness of the composite materials may make obtaining a desired ratio difficult.

The different illustrative embodiments recognize and take into account that these variations and features in the structure and the thickness of the composite material may require additional research and time on the part of the maintenance person. The different illustrative embodiments also recognize and take into account that information about the different layers of composite material is not easily found.

For example, an identification of the layers may be found in a computer aided design model of the aircraft. The composition, orientation, and other information about the layers may be found in yet a different database or repository. This information may be located in a repository for computer numerical controlled machines that lay up composite materials. The different illustrative embodiments recognize and take into account that locating this information may be more time consuming than desired.

Therefore, the different illustrative embodiments provide a method and apparatus for processing an inconsistency. In one illustrative embodiment, a shape of the inconsistency in a location having layers of composite materials is identified. A model of the location is created with a portion of the number of layers in the layers of composite material removed to form a section based on the shape of the inconsistency and a policy for the rework.

Information for a layup for the layers of the composite materials may be identified based on the shape of the inconsistency and the location of the inconsistency. The model and this information may be used to generate information to perform the rework on the inconsistency. This type of information may be referred to as a template.

With reference now to **Figure 3,** an illustration of a rework environment is depicted in accordance with an illustrative embodiment. Rework environment **300** is an example of an environment in which rework may be performed on platform **302.** In this illustrative example, platform **302** may take the form of aircraft **304.** Aircraft **304** may be an example of aircraft **200** in **Figure 2.**

In this illustrative example, inconsistency **306** may be located in location **308** of aircraft **304.** Layers of composite materials **310** are present in location **308** in which inconsistency **306** is present. Inconsistency **306** has shape **312** in layers of composite materials **310.**

In performing rework **316** on inconsistency **306**, portion **318** of number of layers **320** within layers of composite materials **310** are removed. Portion **318** of number of layers **320** includes or substantially includes inconsistency **306.** By removing portion **318** of number of layers **320** in layers of composite materials **310,** inconsistency **306** may be removed and/or reduced. This removal of portion **318** of number of layers **320** forms section **314,** which may be referred to as a scarf.

Patch **324** is placed into section **314** after section **314** is formed. Patch **324** is bonded to section **314** as part of performing rework **316.**

Patch **324** may have number of layers **326** of composite material that corresponds to number of layers **320** of layers of composite materials **310.** In other words, a layer within number of layers **320** of layers of composite materials **310** may be the same type of layer in a layer within number of layers **320.** Further, in these illustrative examples, the orientation of the layers in patch **324** also may correspond to number of layers **320**.

The orientation of number of layers **320** removed to form section **314** may have different orientations. Each layer within number of layers **320** may have an orientation that is selected to obtain a particular property or properties. For example, the orientation may be selected to provide properties, such as a desired strength, durability, and other suitable features.

Depending on the orientation of the layer within number of layers **320**, different properties may be present. When rework **316** is performed, it is often desirable for number of layers **326** in patch **324** to have the same type of orientation as number of layers **320** in portion **318** that was removed to form section **314**. This matching of orientations for layers is performed to obtain the same properties as the layers that are removed.

When the layers are removed, some overlap between the original layers still remaining and the layers that are in patch **324** are desirable. In other words, each layer in number of layers **326** for patch **324** matches layers within number of layers **320** in section **314**. Further, a layer in number of layers **326** may partially overlap an original layer in number of layers **320** in section **314**. Thus, the layers have the same orientation, thickness, and materials as the layers removed in these illustrative examples.

Patch **324** has shape **328** that substantially corresponds to shape **330** of portion **318** that was removed. In other words, shape **328** may be substantially the same as shape **330.** Thus, shape **328** for patch **324** is selected to be substantially the same shape, shape **330**, as that of number of layers **320** that were removed to form section **314.**

In this manner, patch **324** may replace portion **318** of number of layers **320** in layers of composite materials **310** that was removed to form section **314.** Patch **324** may be bonded in place to perform rework **316** on inconsistency **306.** Rework **316** reduces or removes inconsistency **306.**

In these illustrative examples, number of structures **332** may be associated with location **308.** Number of structures **332** is considered to be associated with location **308** by including location **308,** being adjacent to location **308,** and/or being located within some distance of location **308** such that number of structures **332** may affect and/or be affected by bonding of patch **324** in section **314.** Number of structures **332** may affect the formation of section **314**.

In these illustrative examples, location **308** may be identified by operator **334.** Location **308** may take the form of coordinates, measurements, and/or other information used to identify location **308.** Operator **334** may be, for example, without limitation, a maintenance person, a technician, a pilot, or some other person. Operator **334** may input location **308** into computer system **336.**

Computer system **336** takes the form of number of computers **338** in these illustrative examples. When more than one computer is present in number of computers **338,** these computers may be networked or otherwise in communication with each other. In the illustrative examples, rework tool **340** runs on computer system **336.** Rework tool **340** may take the form of hardware, software, or a combination of the two.

Rework tool **340** uses location **308** and shape **312** of inconsistency **306** to identify information **342** for layup **344** for number of layers **320** of layers of composite materials **310.** Additionally, information **342** also may include other information. For example, information **342** may include information for other layers in layers of composite materials **310** in addition to number of layers **320**. As another illustrative example, information **342** may include information about number of structures **332.** Information **342** also may be used to design, select, and/or manufacture patch **324**.

Information **342** may be identified using platform database **346.** Platform database **346** may include, for example, without limitation, aircraft database **348.** Aircraft database **348** includes models **350.** Models **350** include engineering data **352** in the depicted examples. Models **350** may be, for example, computer aided designs and/or other types of models for aircraft **304** within aircraft database **348.**

Engineering data **352,** in these depicted examples, may include, for example, without limitation, information about number of structures **332,** layup **344,** and/or other suitable types of information. As another example, engineering data **352** may include information about platform **302** used to generate patch **324.**

In these illustrative examples, rework tool **340** creates model **354** of location **308**. Rework tool **340** removes portion **318** of number of layers **320** in layers of composite materials **310** in model **354** to form section **314.** Model **354** is generated based on shape **312** of inconsistency **306** and policy **356.**

As depicted, rework tool **340** identifies shape **358** and, in particular, one parameter for shape **358** is a configuration of perimeter **360** based on shape **312** of inconsistency **306** and policy **356**. Shape **358** of section **314** has perimeter **360** from a top view of section **314** in model **354.** Rework tool **340** also may select other parameters for shape **358**, such as a depth for section **314**.

Rework tool **340** may select shape **358** and, in particular, perimeter **360**, to have a form also based on number of structures **332** and their effect on forming section **314**. In other words, perimeter **360** may have an irregular shape rather than a regular or standard shape. This irregular shape may be referred to as an amoeba or random shape.

Perimeter **360** also may be defined for each layer in number of layers **320** that is removed to form section **314**. As a result, rework tool **340** may define a shape of perimeter **360** for each layer to be removed to be different from another layer in number of layers **320**. With this selection, the angle or ratio of layers may vary around perimeter **360** as selected for section **314**.

In this manner, a more effective form of patch **324** may be created. Thus, selection of shape **358** by rework tool **340** may allow for rework **316** to occur rather than replacing a component. For example, if too much material is removed from layers of composite materials, the component may have to be replaced instead of performing rework **316**. With an irregular shape, the amount of composite material removed may allow for rework **316** instead of replacing the component.

In the illustrative examples, an irregular shape for shape **358** may be present if the inconsistency is at a discrete location and no ply drops are in the area in which rework **316** is to occur. However, inconsistency **306** may vary in length and depth. Further, multiple inconsistencies may be present within a particular area in which different inconsistencies have different depths, shapes, and/or sizes. These types of inconsistencies may result in an irregular shape for shape **358**. Additionally, if ply drops are asymmetric in location **308**, shape **358** also may have an irregular shape.

Further, rework tool **340** also may identify where layers begin and end within layers of composite materials **310** in location **308**. For example, a layer may be on the same level as another layer within layers of composite materials **310**.

Further, with an irregular shape, more of the composite materials in layers of composite materials **310** may be left in place instead of being removed. In this manner, portion **318** of number of layers **320** may be made smaller as compared to using some regular shapes, such as a circle, a track, or some other type of shape.

Also, with an irregular shape, number of structures **332** associated with location **308** may be taken into account. For example, with a shape, such as a circle, number of structures **332** may be harder to take into account if the circle encompasses one or more of number of structures **332**. With the irregular shape, perimeter **360** may exclude number of structures **332** if needed.

Policy **356** comprises a number of rules and may also include data used to apply the number of rules. Policy **356** defines how section **314** is to be created. Policy **356** also may define how patch **324** is to be designed, selected, and/or manufactured.

For example, policy **356** may provide rules for shape **358** of section **314.** For example, without limitation, policy **356** may define how many layers are present in number of layers **320** and the size of each layer in number of layers **320** for removal from layers of composite materials **310.** The size is an area of a layer that is removed from the layer.

Additionally, policy **356** also may include rules that select parameters, such as, for example, without limitation, scarf ratio, variable scarf ratios in areas, and other suitable types of rules. For example, a scarf ratio of 30:1 is typically used for rework **316**. This type of ratio, however, may be impracticable for some areas. As a result, the scarf ratio may change from 30:1 from part of section **314** to 20:1 at another part of section **314**. This change or variation in the scarf ratio is referred to as a variable scarf ratio.

The change in the scarf ratio may allow removing less of number of layers **320** in forming section **314**. As a result, the size of section **314** may be reduced. Rework tool **340** may allow for this variable scarfing and better visualization of the scarfing in section

314 in a manner that may not be possible without rework tool **340**. These views may be provided in the displays described with respect to **Figures 5-13** below.

As another example, policy **356** may include rules that identify areas to avoid in removing number of layers **320**. These areas may include structures that should be avoided, such as number of structures **332**. With these types of rules, perimeter **360** of section **314** may have an irregular shape when avoiding those types of areas. Further, policy **356** also may define when replacement of a component should occur instead of rework **316**.

Additionally, policy **356** may identify a ratio and/or angle for a cross section of section **314.** As a further example, policy **356** also may identify exceptions or different configurations for shape **358** of section **314** based on number of structures **332** that may be associated with location **308.** These and other rules in policy **356** may be generated from at least one of regulations of a government or regulatory authority, guidelines from a manufacturer of aircraft **304,** and/or some other suitable source.

Rework tool **340** generates template **362.** Template **362** is generated by rework tool **340** using model **354**. Rework tool **340** also may use other information in creating template **362**. For example, information **342** for layup **344** for number of layers **320** may be used to form template **362**.

Template **362** is a data structure that includes the information used by operator **334** to perform some or all of rework **316** on inconsistency **306**. This data structure may be, for example, a file, a number of files, a database, a record in a database, or some other suitable data structure.

In these illustrative examples, template **362** may be viewed on computer system **336** by operator **334** to perform rework **316** on inconsistency **306**. In particular, template **362** may be displayed on display device **366** in computer system **336**.

In essence, template **362** is used by operator **334** to perform operations for rework **316** on inconsistency **306.** For example, template **362** provides information to remove portion **318** of number of layers **320** in layers of composite materials **310.** Further, template **362** also may provide information to form patch **324** and/or place patch **324** into section **314** to perform rework **316** on inconsistency **306** at location **308.**

In this manner, operator **334** may perform rework **316** in less time, as compared to current rework operations without one or more of the different illustrative embodiments. In this manner, time and expense for maintenance operations on aircraft **304** based on inconsistency **306** may be reduced.

The illustration of rework environment **300** in **Figure 3** is not meant to imply physical or architectural limitations to the manner in which different illustrative embodiments may be implemented. Other components in addition to and/or in place of the ones illustrated may be used. Some components may be unnecessary. Also, the blocks are presented to illustrate some functional components. One or more of these blocks may be combined and/or divided into different blocks when implemented in an illustrative embodiment.

For example, in different illustrative embodiments, additional inconsistencies in addition to inconsistency **306** may be present in location **308** or other locations. These inconsistencies may be processed in the same manner as inconsistency **306.** In yet another illustrative example, other operators in addition to operator **334** may be present. For example, operator **334** may locate inconsistency **306,** while another operator inputs the information into computer system **336.** In still other examples, another operator may perform rework **316** once template **362** has been generated. In yet another illustrative example, operator **334** may use model **354** instead of template **362**.

With reference now to **Figure 4,** an illustration of components in a rework tool is depicted in accordance with an illustrative embodiment. In this depicted example, components for rework tool **340** are depicted.

In this illustrative example, rework tool **340** includes client **400,** web server **402,** template module **404,** and design system **406.** All of these components may run on one or more computers within computer system **336** in **Figure 3.**

In this illustrative example, client **400** is a portion of rework tool **340** that receives user input **408** using graphical user interface **410.** Client **400** may be a browser application or some other suitable application.

User input **408** is entered by operator **334** in **Figure 3** using graphical user interface **410** in these depicted examples. In some examples, user input **408** may be sent to client **400** without graphical user interface **410** if user input **408** is sent by an application, computer, or other device.

User input **408** includes information used to define section **314** to perform rework **316** in **Figure 3**. Also, the information may include information needed to design, select, and/or manufacture patch **324** in **Figure 3**. The information may be, for example, location **308** and shape **312** for inconsistency **306.** Additionally, user input **408** may include an identification of aircraft **304** and other suitable information. This user input may take the form of text, values, images, and other types of input.

In this example, client **400** may take the form of a web-based client. For example, client **400** may be implemented using a browser on which web pages with forms and pages are displayed on display device **366** within computer system **336** in **Figure 3.** Graphical user interface **410** receives user input **408** and displays information to a user.

User input **408** may be formatted, processed, validated, and/or otherwise processed by client **400** to form rework input **412.** Client **400** sends rework input **412** to web server **402.**

Web server **402** is a process in computer system **336** that receives rework input **412** from clients, such as client **400.** Additionally, web server **402** may receive rework input **412** from other clients or the same client in computer system **336.** Rework input **412** is placed into in queue **414.** Additionally, web server **402** also may monitor status queue **416** for messages **444**. Any of messages **444** in status queue **416** may then be sent to client **400** for display in graphical user interface **410.**

In these illustrative examples, template module **404** monitors in queue **414** for rework input **412.** When rework input **412** is found in in queue **414**, rework input **412** is processed by template module **404** to generate template **362.**

In these illustrative examples, template module **404** sends requests **420** to design system **406** to access model **422.** Model **422** is a model for a platform for which rework input **412** is generated. Although requests **420** are plural, requests **420** also may refer to a single request. Design system **406** may be, for example, without limitation, a computer aided design application. For example, design system **406** may be Catia, which is available from Dassault Systemes. Of course, design system **406** may be implemented using any available design application or software.

Template module **404** sends requests **420** to design system **406** to load model **422.** After model **422** has been loaded, template module **404** sends requests **420** to design system **406** to identify layup information **424.** Layup information **424** may be returned to template module **404** in responses **426.** Layup information **424** is information about layup **344** for number of layers **320** in portion **318** removed to form section **314** in **Figure 3**.

Additionally, template module **404** may send requests **420** to design system **406** to generate model **354.** Model **354** is a model of layers of composite materials **310** in **Figure 3** in which inconsistency **306** is located.

Template module **404** sends requests **420** to design system **406** to remove portion **318** of number of layers **320** in layers of composite materials **310** from model **354.** In response, design system **406** modifies model **354.** Portion **318** and number of layers **320** are identified based on shape **312** of inconsistency **306** and the location of inconsistency **306** within location **308** and the use of policy **356.** Additionally, this removal of portion **318** also may take into account number of structures **332** associated with location **308.**

Template module **404** may then send requests **420** to design system **406** to create template **362** from model **354.** Template **362,** in this illustrative example, may be a form of model **354.** For example, without limitation, template **362** may include at least one of three-dimensional model **432,** two-dimensional top view **434,** removed portion model **436,** layup information **438,** patch model **440**, and/or other suitable models or information.

Three-dimensional model **432** is a model of location **308** with portion **318** of number of layers **320** and layers of composite materials **310** removed to form section **314.** In other words, three-dimensional model **432** is a model of a scarf that is formed. Two-dimensional top view **434** provides a top view of section **314** in these examples.

In this manner, a layup and orientation of layers may be seen. In some cases, the orientation of layers also may indicate two-dimensional top view **434**.

Removed portion model **436** is a model formed using number of layers **320** in layers of composite materials **310** removed to form section **314**. In other words, removed portion model **436** shows portion **318**. This model may also be a three-dimensional model. Layup information **438** may provide information about the different layers.

Patch model **440** may include a model of a patch for use in performing rework. Patch model **440** may be a model of patch **324** that is to be placed into section **314** in these illustrative examples. Patch model **440** illustrates virtual patch **442** that may be used to construct a physical patch, such as patch **324.**

Thereafter, when template **362** is complete, template module **404** stores template **362** in repository **446** in the depicted examples. Repository **446** is one or more storage systems in which one or more storage devices are present. Repository **446** may be a database or some other repository in which template **362** may be stored for access by client **400**.

Template module **404** then places messages **444** into status queue **416.** Messages **444** indicate that template **362** has been completed.

Web server **402** monitors status queue **416.** When messages **444** are detected in status queue **416**, web server **402** sends messages **444** to client **400.** Messages **444** indicate that template **362** is ready. Messages **444** may include, for example, a universal resource locator that points to a location of template **362.** The user may then retrieve template **362** for display on graphical user interface **410.** This retrieval may be directly from repository **446** in these examples.

The different components illustrated for rework tool **340** in **Figure 4** may be combined with components in **Figure 3,** used with components in **Figure 3,** or a combination of the two. Additionally, some of the components in the figure may be illustrative examples of how components shown in block form in **Figure 3** may be implemented.

The illustration of the components for rework tool **340** in **Figure 4** is not meant to imply architectural limitations to the manner in which an illustrative embodiment may be implemented. Other components in addition to and/or in place of the ones illustrated may be used. Some components may be unnecessary. Also, the blocks are presented to illustrate some functional components. One or more of these blocks may be combined and/or divided into different blocks when implemented in an illustrative embodiment.

For example, in some illustrative examples, the different processes illustrated for client **400,** web server **402,** and template module **404** may be implemented on more than one computer. In still other illustrative examples, the different operations performed by design system **406** may be performed directly by template module **404** instead. Of course, other combinations of components or division of operations may be implemented for an illustrative embodiment. In still other illustrative examples, the different operations performed by template module **404** may be integrated as part of design system **406**.

In the depicted examples, only client **400** is shown. In other examples, one or more additional clients may be used and may send rework input to web server **402**. As another illustrative example, three-dimensional model **432**, removed portion model **436**, and patch model **440** may all be a single model instead of three different models.

Figures 5-13 are illustrations of displays in graphical user interface **410**. These displays are examples of information from template **362** that may be displayed by graphical user interface **410** in client **400** in **Figure 4**. The different displays show information that may be used to perform rework **316** in **Figure 3**.

With reference first to **Figure 5**, an illustration of a section in a skin panel for a wing is depicted in accordance with an illustrative embodiment. In this illustrative example, display **500** is an example of a display in graphical user interface **410** for client **400**.

As depicted, skin panel **502** is used with a wing on an aircraft and is shown in display **500**. In this illustrative example, section **504** can be seen on surface **506** of skin panel **502**. In this example, skin panel **502** may be manipulated by a user in display **500**. For example, a user may rotate skin panel **502**, magnify skin panel **502**, and/or perform other manipulations of skin panel **502** within display **500**. In other words, skin panel **502** is displayed and may be manipulated as a three-dimensional object.

With reference now to **Figure 6**, an illustration of layup information for layers of composite materials is depicted in accordance with an illustrative embodiment. In this illustrative example, display **600** is an example of a display that may be generated by graphical user interface **410** for client **400** in **Figure 4**.

As depicted, display **600** includes table **602**. Table **602** is an example of layup information **424** in **Figure 4**.

Column **604** in table **602** identifies the name of the layer. Column **606** identifies the material in the layer. Column **608** identifies a thickness, column **610** identifies an orientation of the material in the layer, and column **612** identifies a sequence for the layer. Column **614** provides a rosette name. The rosette name is the identification of the axis system for the layer.

With reference now to **Figure 7**, an illustration of a two-dimensional top view of a section in a skin panel is depicted in accordance with an illustrative embodiment. In this illustrative example, display **700** is another example of the display in graphical user interface **410** for client **400**. In this illustrative example, section **702** is a two-dimensional view of section **504** in **Figure 5**. Section **702** is a top view from surface

506 of skin panel **502** in **Figure 5**. In this illustrative example, section **702** has a circular shape.

In the depicted examples, information in **Figures 5-7** may be linked to each other. For example, selection of an entry in table **602** in display **600** in **Figure 6** may cause graphical user interface **410** to show display **700** with an indication of the layer in section **702** that corresponds to the selected entry in table **602**. As another example, selection of a layer in section **702** may cause graphical user interface **410** to show display **600** and indicate the entry that corresponds to the selected layer.

The indications may occur in a number of different ways. For example, an indication may be made with a graphical indicator in association with the entry in table **602**. The graphical indicator may be at least one of highlighting the entry, bolding text, animation, color, and/or other suitable types of graphical indicators.

As another illustrative example, selection of a layer in section **702** may cause a window or some other graphical user interface element to be shown in display **700** with the information for the entry in table **602** that corresponds to the selected layer. This window, or graphic user interface element, also could be shown when a pointer is moved over a layer or remains over a layer for some selected period of time.

Although the information in **Figures 5, 6,** and **7** are illustrated as different displays, this information may be presented in a single display that may be continuous. For example, the information may be displayed as a single webpage or document.

With reference now to **Figure 8**, an illustration of a section in an aft section of fuselage skin is depicted in accordance with an illustrative embodiment. In this illustrative example, display **800** is an example of the display in graphical user interface **410** for client **400** in **Figure 4**.

In this illustrative example, fuselage skin **802** is displayed. In this illustrative example, section **804** can be seen on surface **806** of fuselage skin **802**. Fuselage skin **802** and display **800** also may be manipulated by a user in a similar fashion to skin panel **502** in **Figure 5**.

With reference now to **Figure 9**, an illustration of information for layers of composite material is depicted in accordance with an illustrative embodiment. In this illustrative example, display **900** is an example of a display in graphical user interface **410** in **Figure 4**.

In this illustrative example, display **900** includes table **902**. Table **902** is an example of layup information **424** in **Figure 4**. Table **902** identifies layers for section **804** of fuselage skin **802** in **Figure 8**.

In this illustrative example, column **904** is a name for a layer in the number of layers in section **804**. Column **906** identifies a material for the layer. Column **908** identifies a thickness for the layer, column **910** identifies an orientation for the column, and column **912** identifies a sequence for the layer. Column **914** is a rosette name for the layer.

In **Figure 10**, a two-dimensional top view of a section in a fuselage skin is depicted in accordance with an illustrative embodiment. In this illustrative example, display **1000** is an example of a display in graphical user interface **410** in **Figure 4**. In this example, section **1002** is a two-dimensional top view of section **804** in **Figure 8**. In this example, section **1002** is seen as a top view from surface **806** of fuselage skin **802** in **Figure 8**. Section **1002** may take into account a structure that may be located in fuselage skin **802**. As can be seen in this illustrative example, section **1002** has irregular shape **1004**. This situation may result in section **1002** having the irregular shape. Additionally, irregular shape **1004** may take into account the shape of the inconsistency to be reworked.

With reference now to **Figure 11**, an illustration of a section in the middle portion of a fuselage skin is depicted in accordance with an illustrative embodiment. In this illustrative example, display **1100** is an example of a display in graphical user interface **410** for client **400** in **Figure 4**. In this illustrative example, fuselage skin **1102** is displayed in display **1100**. Section **1104** is seen on surface **1106** of fuselage skin **1102** in this illustrative example. In a similar fashion, fuselage skin **1102** also may be manipulated by a user in a fashion similar to skin panel **502** in **Figure 5** and fuselage skin **802** in **Figure 8**.

With reference now to **Figure 12**, an illustration of a display of layup information for layers of composite material in a fuselage is depicted in accordance with an illustrative embodiment. In this illustrative example, display **1200** is an example of a display in graphical user interface **410** for client **400** in **Figure 4**.

In this example, table **1202** is present in display **1200**. Table **1202** is an example of layup information **424** in **Figure 4**. Column **1204** identifies the name of the layer, and column **1206** identifies a material for the layer. Column **1208** identifies a thickness for the layer, column **1210** identifies an orientation for the layer, and column **1212** identifies a sequence for the layer. Column **1214** includes a rosette name for each of the entries.

With reference now to **Figure 13**, an illustration of a two-dimensional top view of a section in a fuselage skin is depicted in accordance with an illustrative embodiment. In this illustrative example, display **1300** is an example of the display in graphical user interface **410** for client **400** in **Figure 4**. Section **1302** is seen in display **1300**. Section **1302** is a two-dimensional top view of section **1104** on surface **1106** of fuselage skin **1102** in **Figure 11**. Section **1302** also has an irregular shape.

The illustration of three-dimensional models, layup information for layers of composite material, and two-dimensional top views are presented for purposes of illustration for an illustrative embodiment and are not meant to imply limitations to the manner in which information from a template may be displayed to a user. In still other illustrative examples, other information may be displayed in addition to and/or in place of the information in these illustrative examples. For example, a model of the patch may be displayed. In still other illustrative examples, the materials removed to form the section also may be shown.

As another example, in some illustrative embodiments, cross-sectional side views may also be included in the displays in addition to the three-dimensional views, the two-dimensional views, and the tables illustrated in the examples above. These cross-sectional side views may include additional information about the section and the patch that may be placed in the section. For example, a cross-sectional side view may be included that provides layers that correspond to layers illustrated in table **602** in **Figure 6**, table **902** in **Figure 9**, and table **1202** in **Figure 12**. These cross-sectional views may correspond to different cross-sections taken of the two-dimensional top views. More than one cross-sectional view may be present, depending on the shape of the perimeter for each of the sections.

Although the different examples in **Figures 5-13** illustrate information for a skin panel on a wing and different parts of a fuselage skin, these different illustrative embodiments can be applied to other structures. These structures may include, for example, a frame in a fuselage, a bulk head, and/or other structures in an aircraft.

With reference now to **Figure 14**, an illustration of a flowchart of a process for processing an inconsistency is depicted in accordance with an illustrative embodiment.

This process may be implemented in computer system **336** and, in particular, the process may be performed by rework tool **340** in **Figure 3**.

The process begins by identifying a location of an inconsistency on a platform (operation **1400**). The identification in operation **1400** may be made through receiving user input **408** in graphical user interface **410** in **Figure 4** in these illustrative examples. The process then identifies a shape of an inconsistency in a location having layers of composite materials (operation **1402**). A shape also may be identified through user input **408** entered into graphical user interface **410** in these illustrative examples.

The process then identifies information for a layup for the layers of composite materials based on the shape of the inconsistency and the location of the inconsistency (operation **1404**). In operation **1404**, this information may be obtained from a cad bottle of the platform, a database of layup information used to manufacture the platform, and/or other suitable types of information. This information may be in different locations. Rework tool **340** may send requests to receive or access this information.

The process then creates a model of the location with a portion of the number of layers in the layers of composite materials removed to form a section based on the shape of the inconsistency and a policy for the rework (operation **1406**). In the illustrative examples, this policy may be, for example, policy **356** in **Figure 3**.

Additionally, in creating the model, policy **356** may take into account structures that may be associated with the location. Some of these structures may affect the shape or configuration of the perimeter defining the area for a portion of a layer in the number of layers. Further, the configuration of the perimeter and the area of each layer that is removed to form the section also may be customized for the shape of a particular inconsistency.

The process creates a template using the model of the location and the information for the layup of the layers of composite materials (operation **1408**). The template created in operation **1408** may be displayed to a user in displays, such as the displays in **Figures 5-13**. The process terminates thereafter.

In creating the model of the location, in addition to forming a section based on the shape of the inconsistency, rework tool **340** also may include a patch for bonding to the section in the model. Also, the portion of the number of layers removed to form the section also may be included in the model. In some illustrative examples, rather than including the patch in the portion of the number of layers of composite materials removed, these structures may be placed in separate models, depending on the particular implementation.

With reference now to **Figure 15**, an illustration of a flowchart of a process for creating a model of a location with a section removed for an inconsistency is depicted in accordance with an illustrative embodiment. The process illustrated in **Figure 15** is an example of one manner in which operation **1406** in **Figure 14** may be implemented.

In these illustrative examples, the different operations in **Figure 15** may be performed directly by rework tool **340** in **Figure 3** or by rework tool **340** sending requests to another application, such as a computer aided design system.

The process begins by obtaining a model of the platform (operation **1500**). The process then creates a model of the location using the model of the platform (operation **1502**). The model of the location may be created by selecting a section of a model of the platform. This section is a three-dimensional section in these illustrative examples. This section includes the location of the inconsistency. The model created in operation **1502** may be used to create template **362** in these illustrative examples.

The process identifies dimensions for the inconsistency from the information about the shape of the inconsistency (operation **1504**). The dimensions may be identified from user input providing the information about the shape of the inconsistency. This information may take the form of the dimensions being entered by the user, pictures, drawings, or other suitable information. For example, a picture of the inconsistency may be processed to identify dimensions for the inconsistency.

The process then selects an unprocessed layer from the layers in the location (operation **1506**). The process then selects a portion of the layer for removal using the policy (operation **1508**). This policy includes rules to identify the area that the portion encompasses, as well as the shape or configuration of the perimeter that defines the area.

In some cases, the selected portion of the layer for removal may include not removing any portion of the layer. For example, if the location at which the inconsistency is located has about 70 layers, the policy may only require removing some portion of those layers rather than all of the layers forming the section.

A determination is made as to whether structures associated with the location affect the portion selected (operation **1510**). If one or more structures is present in the location that affects the portion selected for removal from a layer, the process adjusts the portion based on each structure that is identified using the policy (operation **1512**). The policy may provide rules on adjustments to the portion that is selected for removal from a layer based on the structure location, shape, and other suitable information.

Next, the process removes the selected portion from the layer (operation **1514**). The process then adds the removed layer to a new structure (operation **1516**). This new structure in the model represents a structure comprised of the portions of the layers that are removed to form the section.

A determination is made as to whether another unprocessed layer is present (operation **1518**). If another unprocessed layer is present, the process returns to operation **1506** to select another unprocessed layer.

Otherwise, the process creates a patch based on the removed layers (operation **1520**). In operation **1520**, this patch may be created using a standard or pre-defined model. In some cases, operation **1520** may involve creating a patch based on the structure formed in operation **1516**. The creation of a patch in operation **1520** may be the same as the structure or may have different types of layers with the same general shape, depending on the particular implementation. The process terminates thereafter.

With reference again to operation **1510**, if the structures associated with the location do not affect the portion selected, the process proceeds to operation **1514** as described above.

With reference now to **Figure 16**, an illustration of a flowchart of a process for creating a template is depicted in accordance with an illustrative embodiment. The process illustrated in **Figure 16** is an example of one manner in which operation **1408** in **Figure 14** may be implemented.

The process begins by creating a data structure for the template (operation **1600**). This data structure may take different forms, depending on the particular implementation. For example, the data structure may be a portable document format file, a light-weight viewer document format for a computer aided design application, a computer aided design application file, or some other suitable type of data structure.

The process places a model of the location with the section into the data structure (operation **1602**). The model placed into the data structure in operation **1602** may be a model similar to those displayed in a display in **Figures 5**, **8**, and **11**.

This model also may include the patch that is to be bonded to the section that is to be created at the location in which the inconsistency is present. Additionally, this model may include the portions of the layers of composite materials removed to form the section. In placing the model into the data structure, the model may be reformatted for use in the particular data structure.

Next, the process creates a table of the layup of the composite materials (operation **1604**). This table, may be, for example, without limitation, tables such as those illustrated in **Figures 6**, **9**, and **12**.

A two-dimensional top view of the section is created (operation **1606**). This two-dimensional top view may be similar to the ones displayed in **Figures 7**, **10**, and **13**. The two-dimensional top view of the section is placed into the data structure (operation **1608**). Thereafter, a cross-sectional side view of the section and the patch is created (operation **1610**). This cross-sectional side view may be created using the model of the location and the patch. The cross-sectional side view of the section and the patch are then placed into the data structure (operation **1612**), with the process terminating thereafter.

The flowcharts and block diagrams in the different depicted embodiments illustrate the architecture, functionality, and operation of some possible implementations of apparatus and methods in an illustrative embodiment. In this regard, each block in the flowcharts or block diagrams may represent a module, segment, function, and/or a portion of an operation or step. For example, one or more of the blocks may be implemented as program code, in hardware, or a combination of the program code and hardware. When implemented in hardware, the hardware may, for example, take the form of integrated circuits that are manufactured or configured to perform one or more operations in the flowcharts or block diagrams.

In some alternative implementations of an illustrative embodiment, the function or functions noted in the block may occur out of the order noted in the figures. For example, in some cases, two blocks shown in succession may be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. Also, other blocks may be added in addition to the illustrated blocks in a flowchart or block diagram.

For example, in some illustrative examples, operation **1516** and operation **1520** may be omitted from the flowchart in **Figure 15**. These operations may be omitted when only the section is desired in the model. As another example, rather than placing a particular piece of information into the data structure each time the information is created, all of the information may be placed into the data structure as a final step. Further, depending on the particular implementation, some of the operations may be processed in parallel if multi-tasking or multiple computers are present for performing the different operations.

Turning now to **Figure 17**, an illustration of a data processing system is depicted in accordance with an illustrative embodiment. In this illustrative example, data processing system **1700** includes communications fabric **1702**, which provides communications between processor unit **1704**, memory **1706**, persistent storage **1708**, communications unit **1710**, input/output (I/O) unit **1712**, and display **1714**. Data processing system **1700** is an example of a data processing system that may be used to implement one or more computers in number of computers **338** in computer system **336**.

Processor unit **1704** serves to execute instructions for software that may be loaded into memory **1706**. Processor unit **1704** may be a number of processors, a multi-processor core, or some other type of processor, depending on the particular implementation. A number, as used herein with reference to an item, means one or more items. Further, processor unit **1704** may be implemented using a number of heterogeneous processor systems in which a main processor is present with secondary processors on a single chip. As another illustrative example, processor unit **1704** may be a symmetric multi-processor system containing multiple processors of the same type.

Memory **1706** and persistent storage **1708** are examples of storage devices **1716**. A storage device is any piece of hardware that is capable of storing information, such as, for example, without limitation, data, program code in functional form, and/or other suitable information either on a temporary basis and/or a permanent basis. Storage devices **1716** may also be referred to as computer readable storage devices in these examples. Memory **1706**, in these examples, may be, for example, a random access memory or any other suitable volatile or non-volatile storage device. Persistent storage **1708** may take various forms, depending on the particular implementation.

For example, persistent storage **1708** may contain one or more components or devices. For example, persistent storage **1708** may be a hard drive, a flash memory, a rewritable optical disk, a rewritable magnetic tape, or some combination of the above. The media used by persistent storage **1708** also may be removable. For example, a removable hard drive may be used for persistent storage **1708**.

Communications unit **1710**, in these examples, provides for communications with other data processing systems or devices. In these examples, communications unit **1710** is a network interface card. Communications unit **1710** may provide communications through the use of either or both physical and wireless communications links.

Input/output unit **1712** allows for input and output of data with other devices that may be connected to data processing system **1700**. For example, input/output unit **1712** may provide a connection for user input through a keyboard, a mouse, and/or some other suitable input device. Further, input/output unit **1712** may send output to a printer. Display **1714** provides a mechanism to display information to a user.

Instructions for the operating system, applications, and/or programs may be located in storage devices **1716**, which are in communication with processor unit **1704** through communications fabric **1702**. In these illustrative examples, the instructions are in a functional form on persistent storage **1708**. These instructions may be loaded into memory **1706** for execution by processor unit **1704**. The processes of the different embodiments may be performed by processor unit **1704** using computer-implemented instructions, which may be located in a memory, such as memory **1706**.

These instructions are referred to as program code, computer usable program code, or computer readable program code that may be read and executed by a processor in processor unit **1704**. The program code in the different embodiments may be embodied on different physical or computer readable storage media, such as memory **1706** or persistent storage **1708**.

Program code **1718** is located in a functional form on computer readable media **1720** that is selectively removable and may be loaded onto or transferred to data processing system **1700** for execution by processor unit **1704**. Program code **1718** and computer readable media **1720** form computer program product **1722** in these examples. In one example, computer readable media **1720** may be computer readable storage media **1724** or computer readable signal media **1726**.

Computer readable storage media **1724** may include, for example, an optical or magnetic disk that is inserted or placed into a drive or other device that is part of persistent storage **1708** for transfer onto a storage device, such as a hard drive, that is part of persistent storage **1708**. Computer readable storage media **1724** also may take the form of a persistent storage, such as a hard drive, a thumb drive, or a flash memory, that is connected to data processing system **1700**. In some instances, computer readable storage media **1724** may not be removable from data processing system **1700**.

In these examples, computer readable storage media **1724** is a physical or tangible storage device used to store program code **1718** rather than a medium that propagates or transmits program code **1718**. Computer readable storage media **1724** is also referred to as a computer readable tangible storage device or a computer readable physical storage device. In other words, computer readable storage media **1724** is a media that can be touched by a person.

Alternatively, program code **1718** may be transferred to data processing system **1700** using computer readable signal media **1726**. Computer readable signal media **1726** may be, for example, a propagated data signal containing program code **1718**. For example, computer readable signal media **1726** may be an electromagnetic signal, an optical signal, and/or any other suitable type of signal. These signals may be transmitted over communications links, such as wireless communications links, optical fiber cable, coaxial cable, a wire, and/or any other suitable type of communications link. In other words, the communications link and/or the connection may be physical or wireless in the illustrative examples.

In some illustrative embodiments, program code **1718** may be downloaded over a network to persistent storage **1708** from another device or data processing system through computer readable signal media **1726** for use within data processing system **1700**. For instance, program code stored in a computer readable storage medium in a server data processing system may be downloaded over a network from the server to data processing system **1700**. The data processing system providing program code **1718** may be a server computer, a client computer, or some other device capable of storing and transmitting program code **1718**.

The different components illustrated for data processing system **1700** are not meant to provide architectural limitations to the manner in which different embodiments may be implemented. The different illustrative embodiments may be implemented in a data processing system including components in addition to or in place of those illustrated for data processing system **1700**. Other components shown in **Figure 17** can be varied from the illustrative examples shown. The different embodiments may be implemented using any hardware device or system capable of running program code.

As one example, the data processing system may include organic components integrated with inorganic components and/or may be comprised entirely of organic components excluding a human being. For example, a storage device may be comprised of an organic semiconductor.

In another illustrative example, processor unit **1704** may take the form of a hardware unit that has circuits that are manufactured or configured for a particular use. This type of hardware may perform operations without needing program code to be loaded into a memory from a storage device to be configured to perform the operations.

For example, when processor unit **1704** takes the form of a hardware unit, processor unit **1704** may be a circuit system, an application specific integrated circuit (ASIC), a programmable logic device, or some other suitable type of hardware configured to perform a number of operations. With a programmable logic device, the device is configured to perform the number of operations. The device may be reconfigured at a later time or may be permanently configured to perform the number of operations. Examples of programmable logic devices include, for example, a programmable logic array, a programmable array logic, a field programmable logic array, a field programmable gate array, and/or other suitable hardware devices. With this type of implementation, program code **1718** may be omitted, because the processes for the different embodiments are implemented in a hardware unit.

In still another illustrative example, processor unit **1704** may be implemented using a combination of processors found in computers and hardware units. Processor unit **1704** may have a number of hardware units and a number of processors that are configured to run program code **1718**. With this depicted example, some of the processes may be implemented in the number of hardware units, while other processes may be implemented in the number of processors.

In another example, a bus system may be used to implement communications fabric **1702** and may be comprised of one or more buses, such as a system bus or an input/output bus. Of course, the bus system may be implemented using any suitable type of architecture that provides for a transfer of data between different components or devices attached to the bus system.

Additionally, a communications unit may include a number of devices that transmit data, receive data, or transmit and receive data. A communications unit may be, for example, a modem or a network adapter, two network adapters, or some combination thereof. Further, a memory may be, for example, memory **1706**, or a cache, such as found in an interface and memory controller hub that may be present in communications fabric **1702**.

Thus, the different illustrative embodiments provide a method and apparatus for processing an inconsistency. With an illustrative embodiment, a shape of the inconsistency is identified in the location having layers of composite materials. Information for a layup of the layers of composite materials is identified based on the shape of the inconsistency and the location of the inconsistency. A model of the location with a portion of the number of layers in the layers of composite material removed to form a section based on the shape of the inconsistency in a policy for rework is created.

With the different illustrative embodiments, a model of a section and information about the layup of the layers of composite materials in that location in which the section is present may be generated. This information may be created without requiring a user to search for information in various locations. Further, the creation of the section is based on the policy for rework. With the policy, the section may be an irregular shape rather than some standard shape that may be selected to encompass the inconsistency.

With these and other features in an illustrative embodiment, processing an inconsistency may take less time and expense. Time may be saved in identifying the layup of the materials and creating a section that is tailored to the shape of the inconsistency and a policy for performing rework on the inconsistency.

The description of the different illustrative embodiments has been presented for purposes of illustration and description and is not intended to be exhaustive or limited to the embodiments in the form disclosed. The embodiment or embodiments selected are chosen and described in order to best explain the principles of the embodiments, the practical application, and to enable others of ordinary skill in the art to understand the disclosure for various embodiments with various modifications as are suited to the particular use contemplated.

CLAIMS:

What is claimed is:

1. A method for processing an inconsistency, the method comprising:

identifying a shape of the inconsistency in a location having layers of composite materials; and

creating a model of the location with a portion of a number of layers in the layers of composite materials removed to form a section based on the shape of the inconsistency and a policy for rework.

2. The method of claim 1 further comprising:

identifying information for a layup for the number of layers in the layers of composite materials based on the location of the inconsistency.

3. The method of claim 2 further comprising:

forming a template using the model, wherein the template comprises at least one of a three-dimensional model of the location with the portion of the number of layers in the layers of composite materials removed to form the section, a two-dimensional top view of the section, layup information for the number of layers, a model of a patch for bonding in the section, and a model of the portion of the number of layers in the layers of composite materials removed to form the section.

4. The method of claim 3 further comprising:

performing the rework on the inconsistency using the template.

5. The method of claim 1, wherein the shape comprises at least one of dimensions for the inconsistency, a depth of the inconsistency, a size of the inconsistency, and an orientation of the inconsistency.

6. The method of claim 1, wherein the shape of the inconsistency is a first shape and the section has a second shape based on at least one of the first shape of the

inconsistency and a number of structures associated with the location.

7. The method of claim 1 further comprising:

creating a patch for bonding in the section.

8. The method of claim 1, wherein the step of creating the model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework comprises:

creating a three-dimensional model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework.

9. The method of claim 1, wherein the step of creating the model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework comprises:

creating a two-dimensional top view of the section.

10. The method of claim 1, wherein the step of creating the model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework comprises:

creating a three-dimensional model of the layers of composite materials at the location; and

removing the portion of the number of layers in the layers of composite materials in the three-dimensional model to form the section to form the model of the location with the portion of the number of layers in the layers of composite materials removed.

11. An apparatus comprising:

a computer system configured to identify a shape of an inconsistency in a location having layers of composite materials and create a model of the location with a portion of a number of layers in the layers of composite materials removed to form a section based on the shape of the inconsistency and a policy for rework.

12. The apparatus of claim 11, wherein the computer system is further configured to identify information for a layup for the number of layers in the layers of composite materials based on the location of the inconsistency.

13. The apparatus of claim 12, wherein the computer system is further configured to form a template using the model, wherein the template comprises at least one of a three-dimensional model of the location with the portion of the number of layers in the layers of composite materials removed to form the section, a two-dimensional top view of the section, layup information for the number of layers, a model of a patch for bonding in the section, and a model of the portion of the number of layers in the layers of composite materials removed to form the section.

14. The apparatus of claim 12 further comprising:

a client, on the computer system, configured to receive the information about the inconsistency;

a computer aided design system configured to access the information about the layup for the number of layers in the layers of composite materials and process models; and

a rework tool module, on the computer system, configured to identify the information for the layup for the number of layers in the layers of composite materials based on dimensions of the inconsistency and the location of the inconsistency; and create the model of the location with the portion of the number of layers in the layers of composite materials removed to form the section based on the shape of the inconsistency and the policy for the rework.

15. A computer program product comprising:

a computer readable storage medium;

first program code for identifying a shape of an inconsistency in a location having layers of composite materials;

second program code for creating a model of the location with a portion of a number of layers in the layers of composite materials removed to form a section based on the shape of the inconsistency and a policy for rework, wherein the first program code and the second program code are stored on the computer readable storage medium.

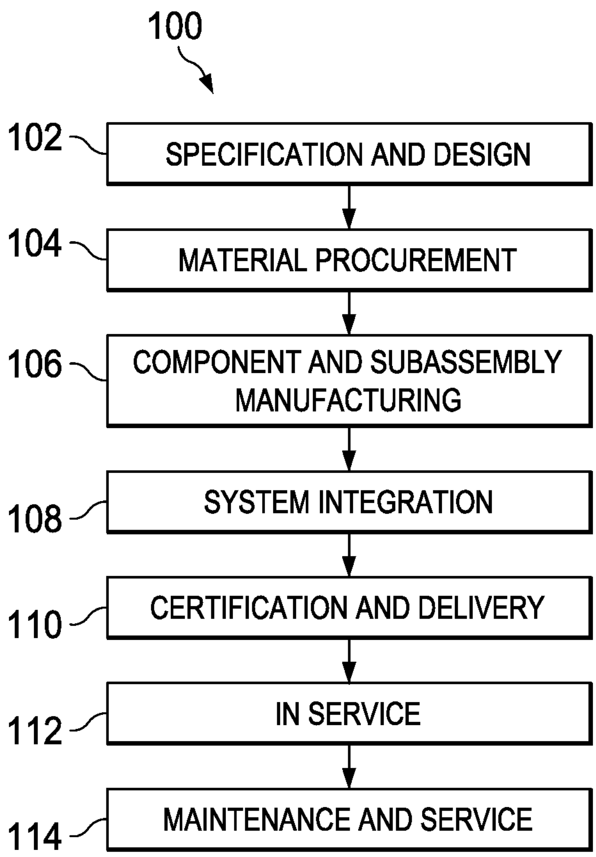

100
102
SPECIFICATION AND DESIGN
104
MATERIAL PROCUREMENT
106
COMPONENT AND SUBASSEMBLY MANUFACTURING
108
SYSTEM INTEGRATION
110
CERTIFICATION AND DELIVERY
112
IN SERVICE
114
MAINTENANCE AND SERVICE

FIG. 1

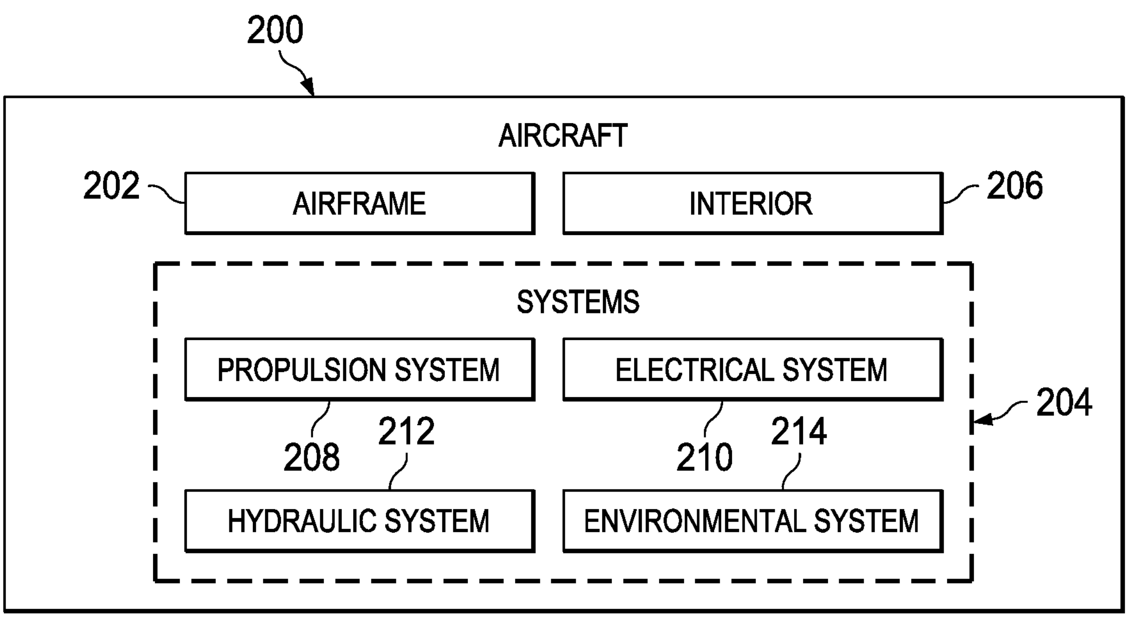
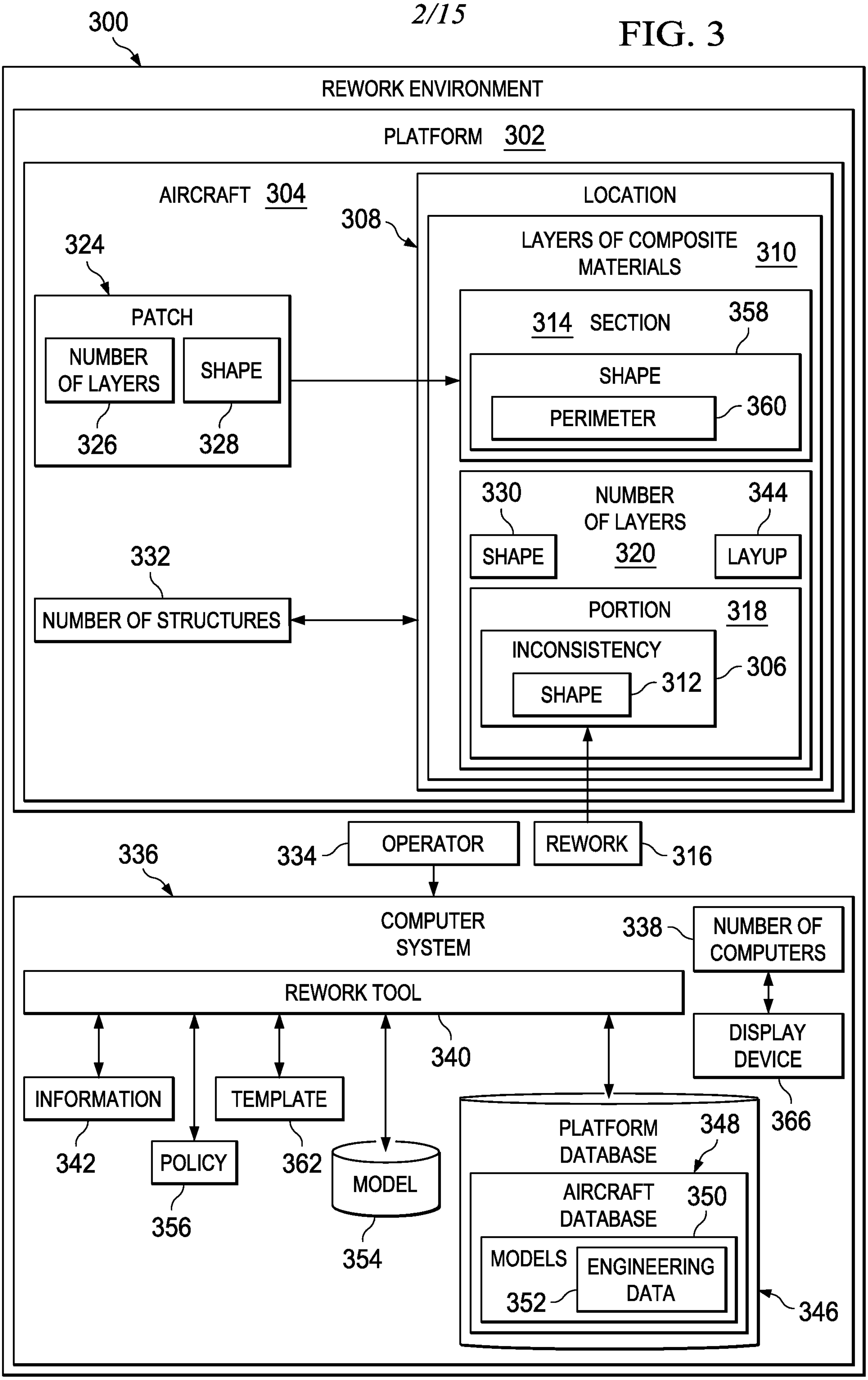

200
AIRCRAFT
202
AIRFRAME
INTERIOR
206
SYSTEMS
PROPULSION SYSTEM
ELECTRICAL SYSTEM
204
208
212
210
214
HYDRAULIC SYSTEM
ENVIRONMENTAL SYSTEM

FIG. 2

FIG. 3


300
REWORK ENVIRONMENT
PLATFORM 302
AIRCRAFT 304
LOCATION
308
LAYERS OF COMPOSITE MATERIALS 310
324
PATCH
NUMBER OF LAYERS
SHAPE
326
328
314 SECTION
358
SHAPE
PERIMETER
360
330
NUMBER OF LAYERS 320
344
SHAPE
LAYUP
332
NUMBER OF STRUCTURES
PORTION 318
INCONSISTENCY
306
SHAPE
312
336
334
OPERATOR
REWORK
316
COMPUTER SYSTEM
338
NUMBER OF COMPUTERS
REWORK TOOL
340
DISPLAY DEVICE
INFORMATION
TEMPLATE
366
342
POLICY
362
MODEL
PLATFORM DATABASE
348
356
354
AIRCRAFT DATABASE
350
MODELS
ENGINEERING DATA
352
346

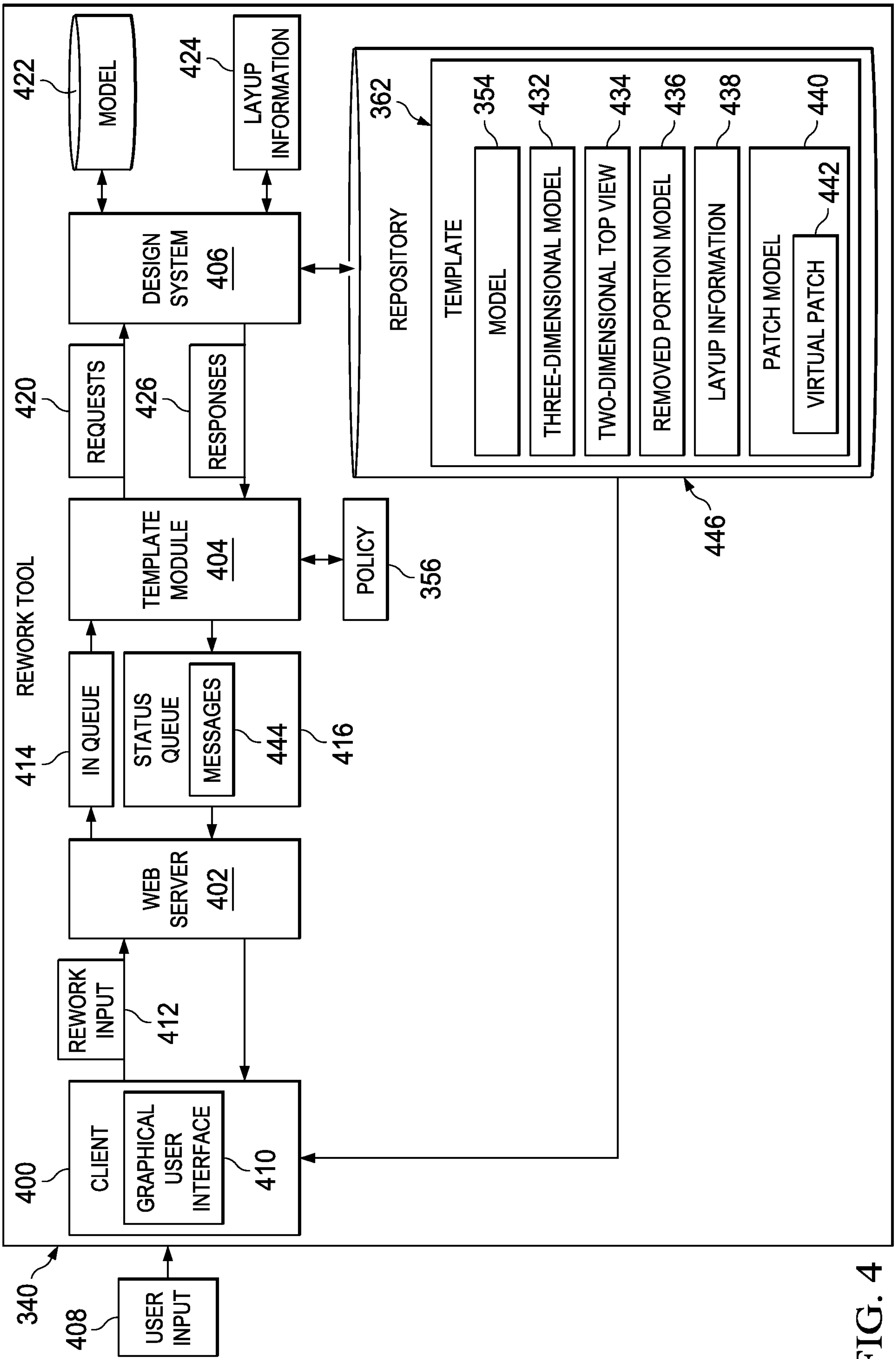

REWORK TOOL
340
CLIENT
400
GRAPHICAL USER INTERFACE
410
USER INPUT
408
REWORK INPUT
412
WEB SERVER
402
IN QUEUE
414
STATUS QUEUE
416
MESSAGES
444
TEMPLATE MODULE
404
POLICY
356
REQUESTS
420
RESPONSES
426
DESIGN SYSTEM
406
MODEL
422
LAYUP INFORMATION
424
REPOSITORY
362
TEMPLATE
354
MODEL
432
THREE-DIMENSIONAL MODEL
434
TWO-DIMENSIONAL TOP VIEW
436
REMOVED PORTION MODEL
438
LAYUP INFORMATION
440
PATCH MODEL
442
VIRTUAL PATCH
446

FIG. 4

FIG. 5

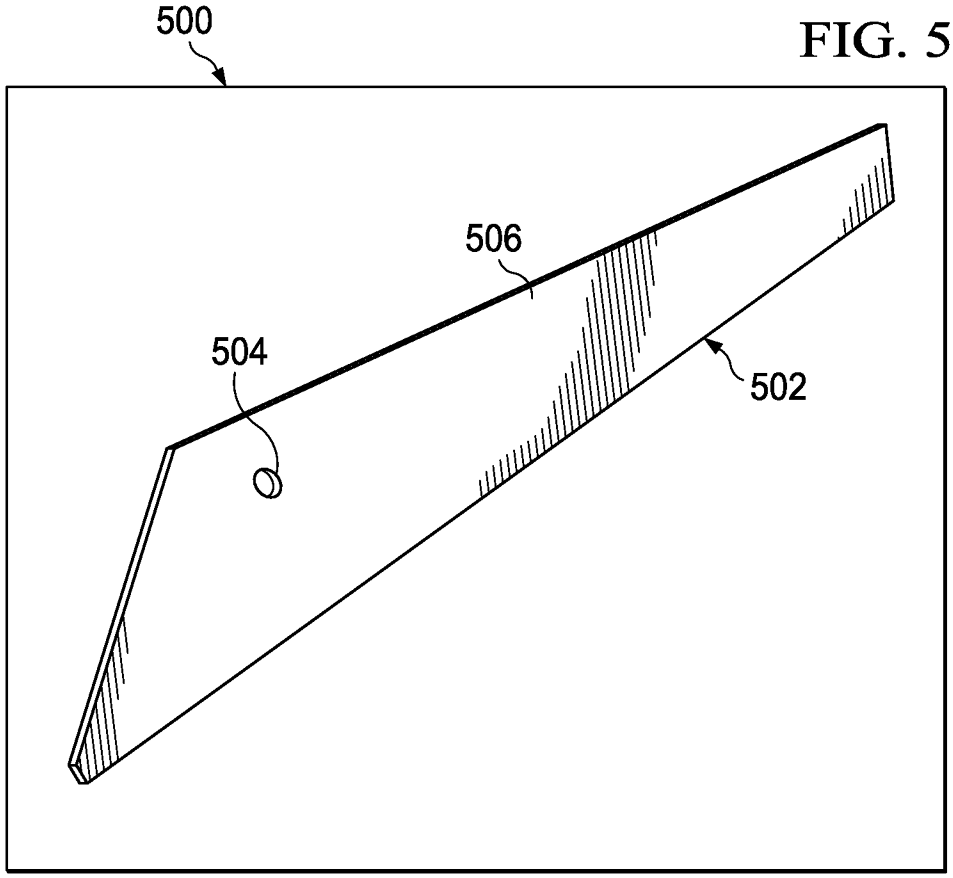
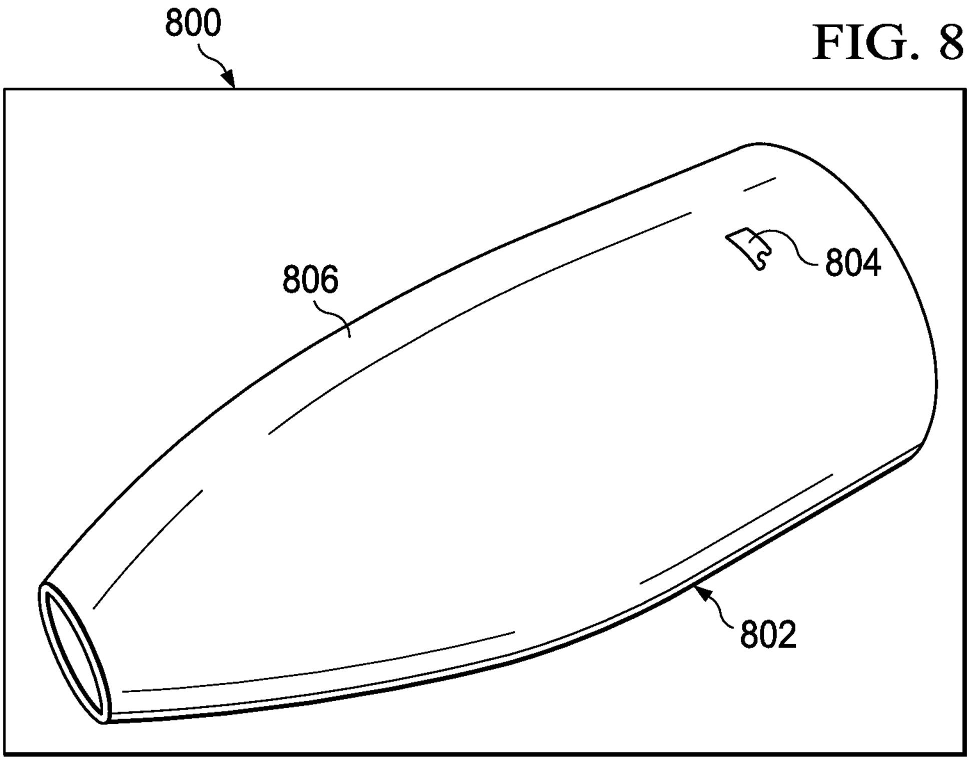


FIG. 8



600

604 PLYINSERT	602 606 MATERIAL	608 THICKNESS	610 ORIENTATION	612 SEQUENCE	614 ROSSETTENAME
PLY P105	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	-45.000000	SEQUENCE 700	ROSETTE-ROSETTE SKIN
PLY P107	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	0.000000	SEQUENCE 705	ROSETTE-ROSETTE SKIN
PLY P112	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	45.000000	SEQUENCE 720	ROSETTE-ROSETTE SKIN
PLY P113	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	90.000000	SEQUENCE 730	ROSETTE-ROSETTE SKIN
PLY P115	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	0.000000	SEQUENCE 735	ROSETTE-ROSETTE SKIN
PLY P118	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	0.000000	SEQUENCE 740	ROSETTE-ROSETTE SKIN
PLY P119	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	45.000000	SEQUENCE 750	ROSETTE-ROSETTE SKIN
PLY P120	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	-45.000000	SEQUENCE 760	ROSETTE-ROSETTE SKIN
PLY P130	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	0.000000	SEQUENCE 765	ROSETTE-ROSETTE SKIN
PLY P134	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	45.000000	SEQUENCE 770	ROSETTE-ROSETTE SKIN
PLY P135	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	90.000000	SEQUENCE 780	ROSETTE-ROSETTE SKIN
PLY P136	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	-45.000000	SEQUENCE 790	ROSETTE-ROSETTE SKIN
PLY P137	N0004763 | CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 11 GRADE 190 FORM 3 COMPOSITION LEVEL 2 |	0.0076	45.000000	SEQUENCE 800	ROSETTE-ROSETTE SKIN

FIG. 6

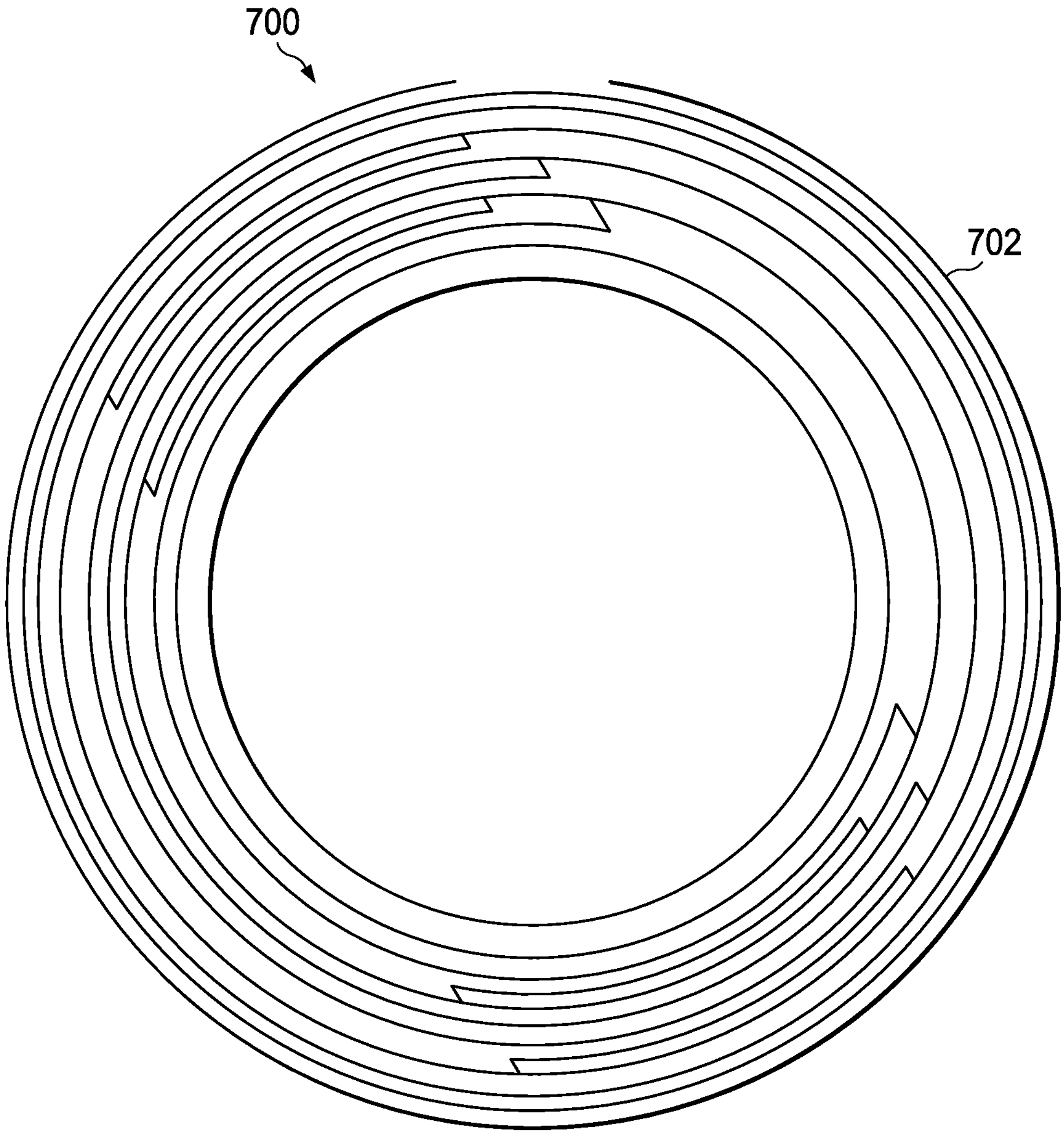


FIG. 7

FIG. 9

900

902

PLY NAME (904)	MATERIAL (906)	THICKNESS (908)	ORIENTATION (910)	SEQUENCE (912)	ROSSETTE (914)
PLY P011	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|	0.0076	45 DEGREES	SEQUENCE 8	ROSSETTE-Full_Barrel_Trans_Ros
PLY P050	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|	0.0076	90.000000 DEGREES	SEQUENCE 10	ROSSETTE-Full_Barrel_Trans_Ros
PLY P058	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|	0.0076	45.000 DEGREES	SEQUENCE 11	ROSSETTE-Full_Barrel_Trans_Ros
PLY P066	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|	0.0076	0.000 DEGREES	SEQUENCE 12	ROSSETTE-Full_Barrel_Trans_Ros
PLY P153	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|	0.0076	0.000 DEGREES	SEQUENCE 67	ROSSETTE-Full_Barrel_Trans_Ros
PLY P162	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|	0.0076	45.000 DEGREES	SEQUENCE 68	ROSSETTE-Full_Barrel_Trans_Ros
PLY P179	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|	0.0076	-45.000 DEGREES	SEQUENCE 70	ROSSETTE-Full_Barrel_Trans_Ros
PLY P225	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|	0.0076	-45.000 DEGREES	SEQUENCE 72	ROSSETTE-Full_Barrel_Trans_Ros
PLY P242	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|	0.0076	45.000 DEGREES	SEQUENCE 74	ROSSETTE-Full_Barrel_Trans_Ros
PLY P250	787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE	0.0076	0.000 DEGREES	SEQUENCE 75	ROSSETTE-Full_Barrel_Trans_Ros

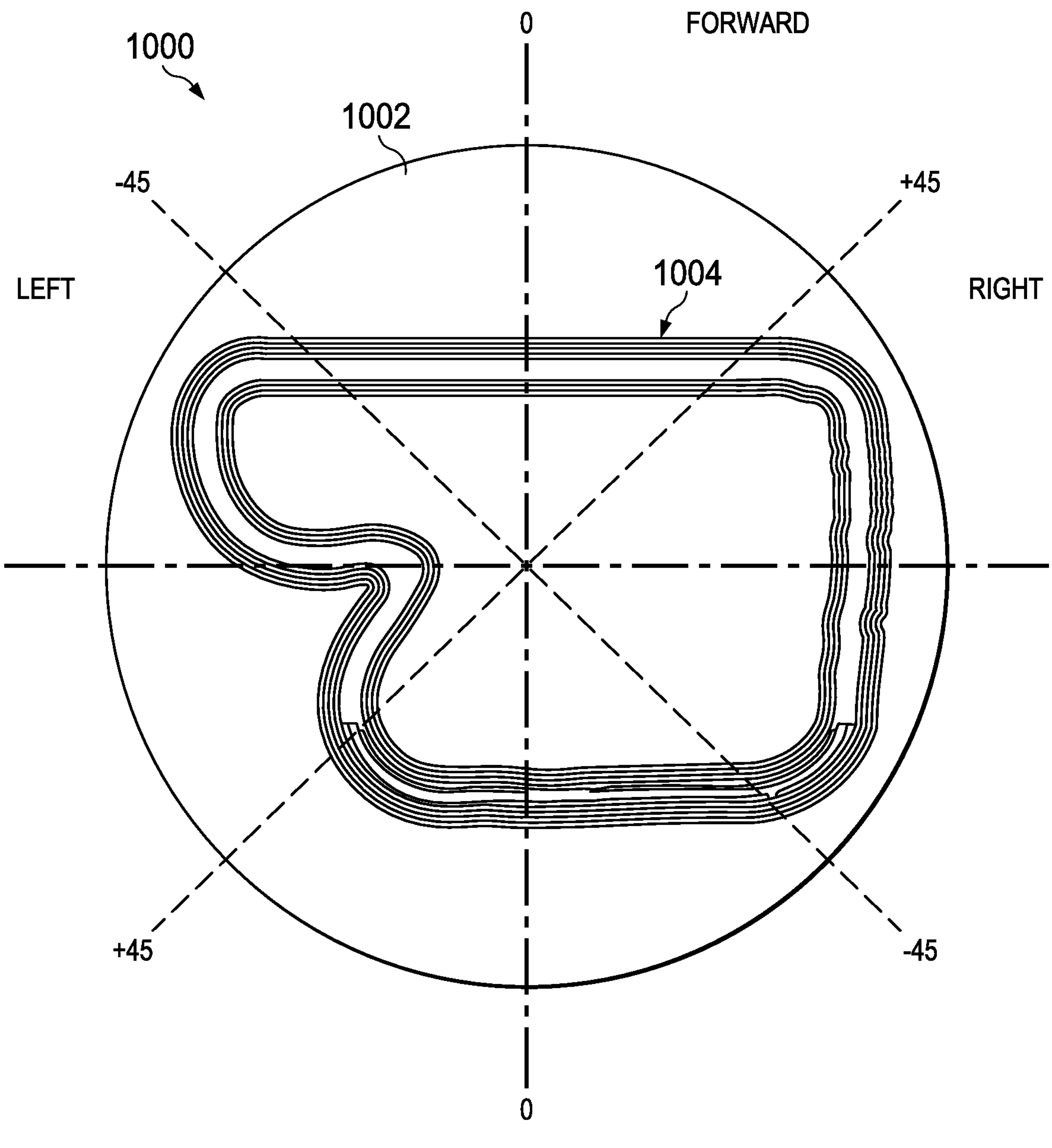


FIG. 10

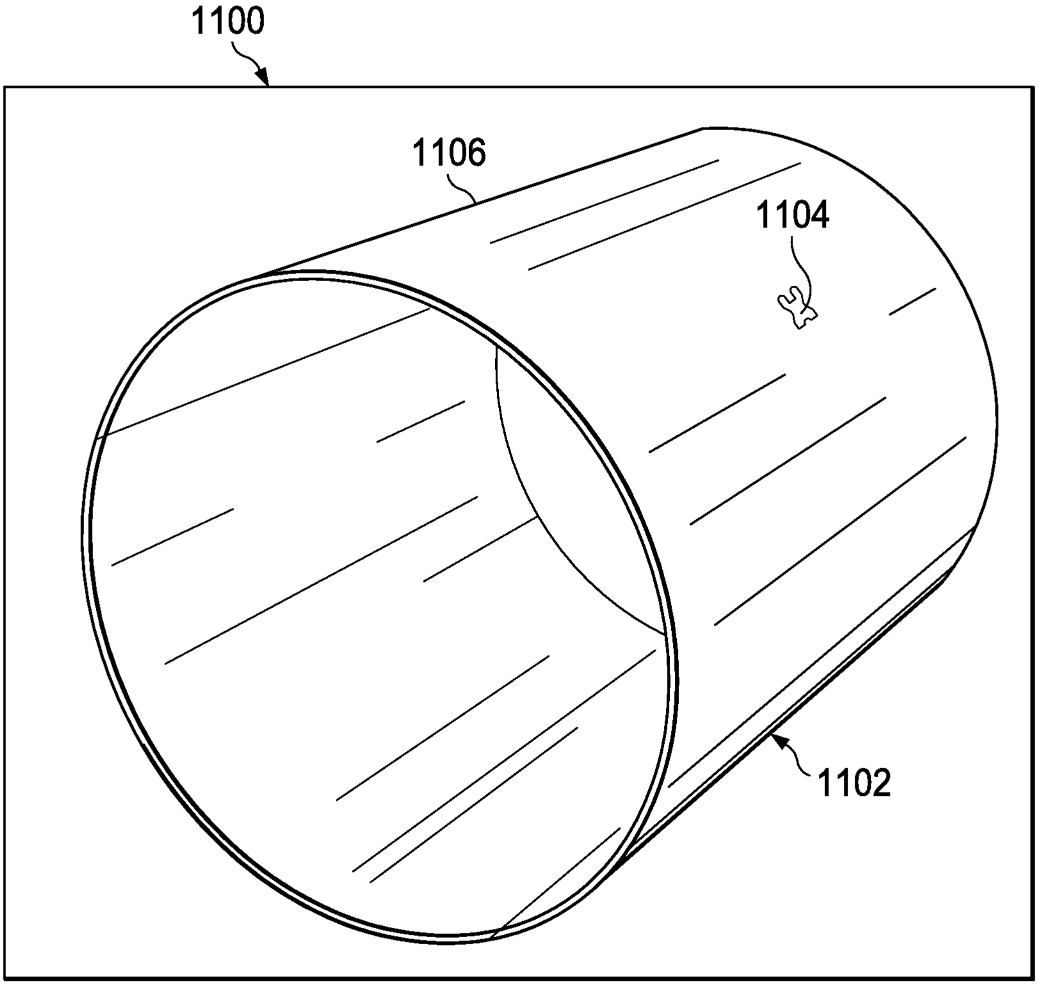


FIG. 11

1200

FIG. 12

1204 1202 1206 1208 1210 1212 1214

<table>
<tr><th>PLY NAME</th><th>MATERIAL</th><th>THICKNESS</th><th>ORIENTATION</th><th>SEQUENCE</th><th>ROSSETTE</th></tr>
<tr><td>PLY P011</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>45 DEGREES</td><td>SEQUENCE 8</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
<tr><td>PLY P050</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>90.000000 DEGREES</td><td>SEQUENCE 10</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
<tr><td>PLY P058</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>45.000 DEGREES</td><td>SEQUENCE 11</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
<tr><td>PLY P066</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>0.000 DEGREES</td><td>SEQUENCE 12</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
<tr><td>PLY P153</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>0.000 DEGREES</td><td>SEQUENCE 67</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
<tr><td>PLY P162</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>45.000 DEGREES</td><td>SEQUENCE 68</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
<tr><td>PLY P179</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>-45.000 DEGREES</td><td>SEQUENCE 70</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
<tr><td>PLY P225</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>-45.000 DEGREES</td><td>SEQUENCE 72</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
<tr><td>PLY P242</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>45.000 DEGREES</td><td>SEQUENCE 74</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
<tr><td>PLY P250</td><td>787 TOW (1/4)-N0004769|CARBON FIBER REINFORCED EPOXY SHEET PER BMS 8-276 TYPE 35 CLASS 7 GRADE 190 FORM 3 COMPOSITION LEVEL 2|</td><td>0.0076</td><td>0.000 DEGREES</td><td>SEQUENCE 75</td><td>ROSSETTE-Full_Barrel_Trans_Ros</td></tr>
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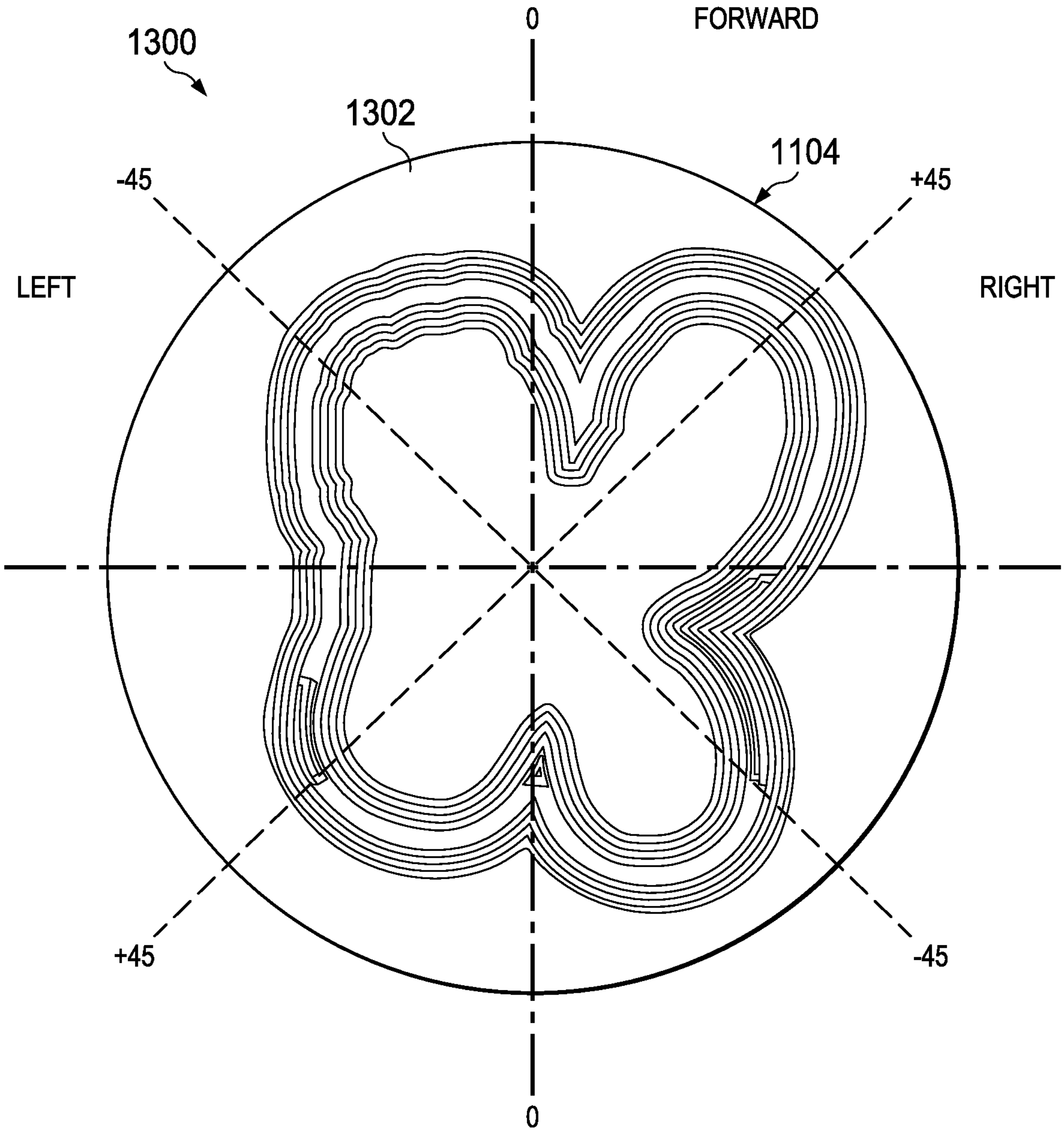


FIG. 13

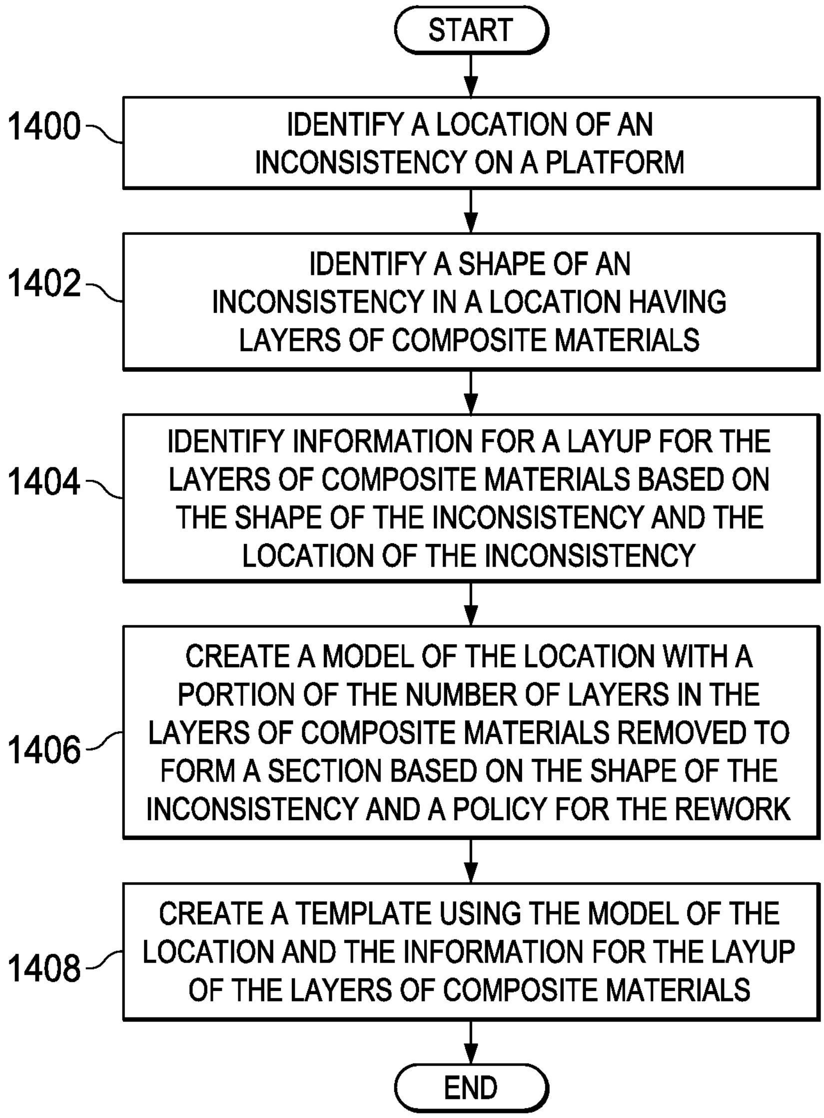

START
1400
IDENTIFY A LOCATION OF AN INCONSISTENCY ON A PLATFORM
1402
IDENTIFY A SHAPE OF AN INCONSISTENCY IN A LOCATION HAVING LAYERS OF COMPOSITE MATERIALS
1404
IDENTIFY INFORMATION FOR A LAYUP FOR THE LAYERS OF COMPOSITE MATERIALS BASED ON THE SHAPE OF THE INCONSISTENCY AND THE LOCATION OF THE INCONSISTENCY
1406
CREATE A MODEL OF THE LOCATION WITH A PORTION OF THE NUMBER OF LAYERS IN THE LAYERS OF COMPOSITE MATERIALS REMOVED TO FORM A SECTION BASED ON THE SHAPE OF THE INCONSISTENCY AND A POLICY FOR THE REWORK
1408
CREATE A TEMPLATE USING THE MODEL OF THE LOCATION AND THE INFORMATION FOR THE LAYUP OF THE LAYERS OF COMPOSITE MATERIALS
END

FIG. 14

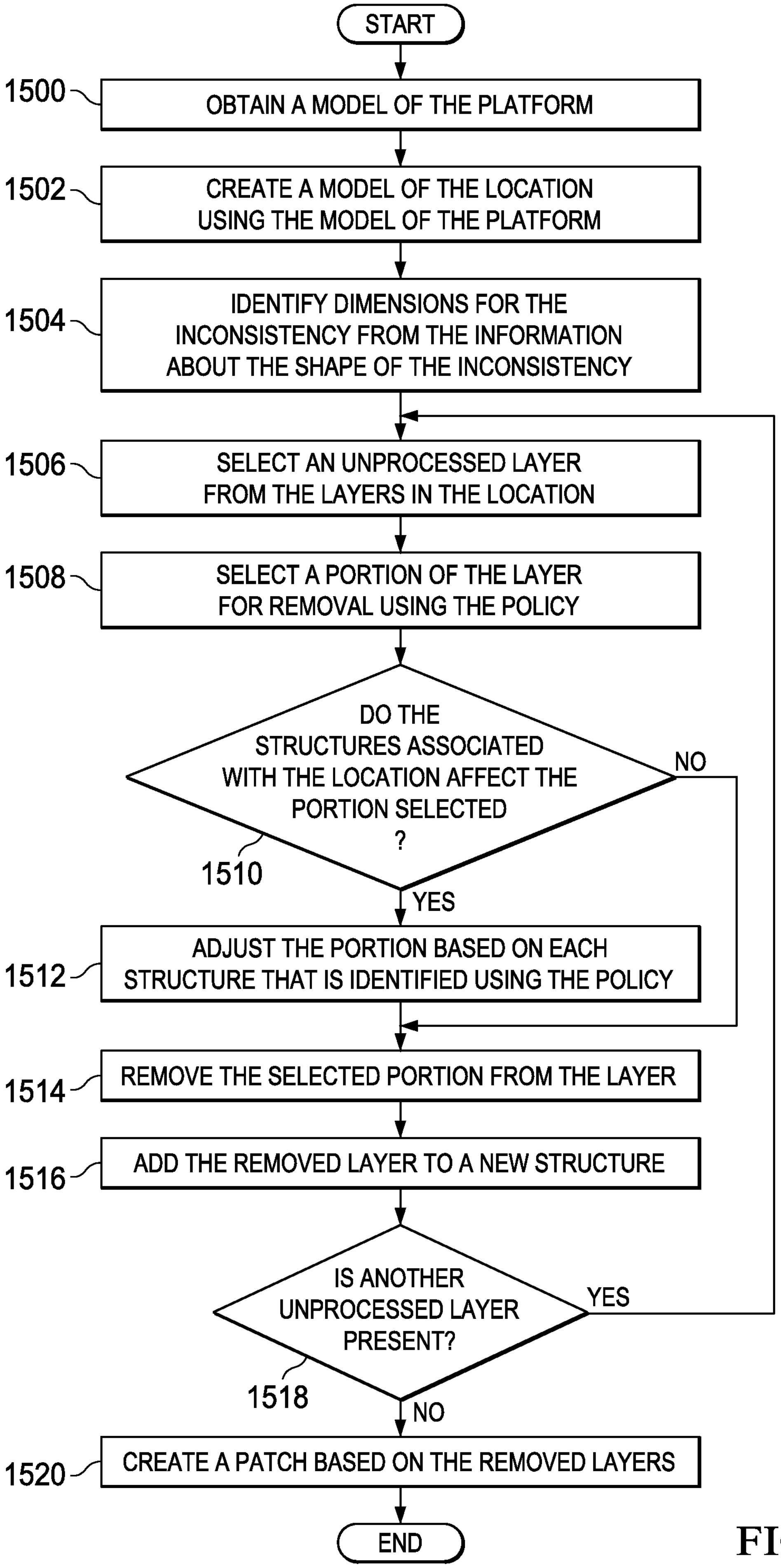

START
1500
OBTAIN A MODEL OF THE PLATFORM
1502
CREATE A MODEL OF THE LOCATION USING THE MODEL OF THE PLATFORM
1504
IDENTIFY DIMENSIONS FOR THE INCONSISTENCY FROM THE INFORMATION ABOUT THE SHAPE OF THE INCONSISTENCY
1506
SELECT AN UNPROCESSED LAYER FROM THE LAYERS IN THE LOCATION
1508
SELECT A PORTION OF THE LAYER FOR REMOVAL USING THE POLICY
DO THE STRUCTURES ASSOCIATED WITH THE LOCATION AFFECT THE PORTION SELECTED ?
1510
NO
YES
1512
ADJUST THE PORTION BASED ON EACH STRUCTURE THAT IS IDENTIFIED USING THE POLICY
1514
REMOVE THE SELECTED PORTION FROM THE LAYER
1516
ADD THE REMOVED LAYER TO A NEW STRUCTURE
IS ANOTHER UNPROCESSED LAYER PRESENT?
1518
YES
NO
1520
CREATE A PATCH BASED ON THE REMOVED LAYERS
END

FIG. 15

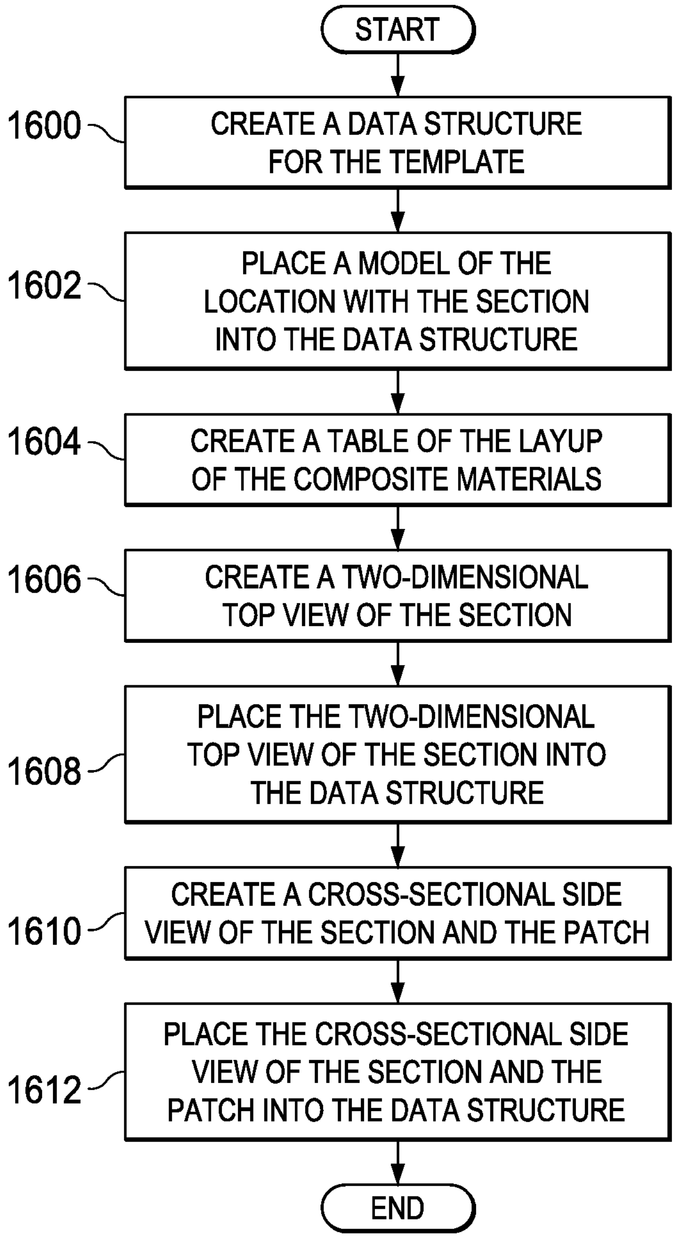
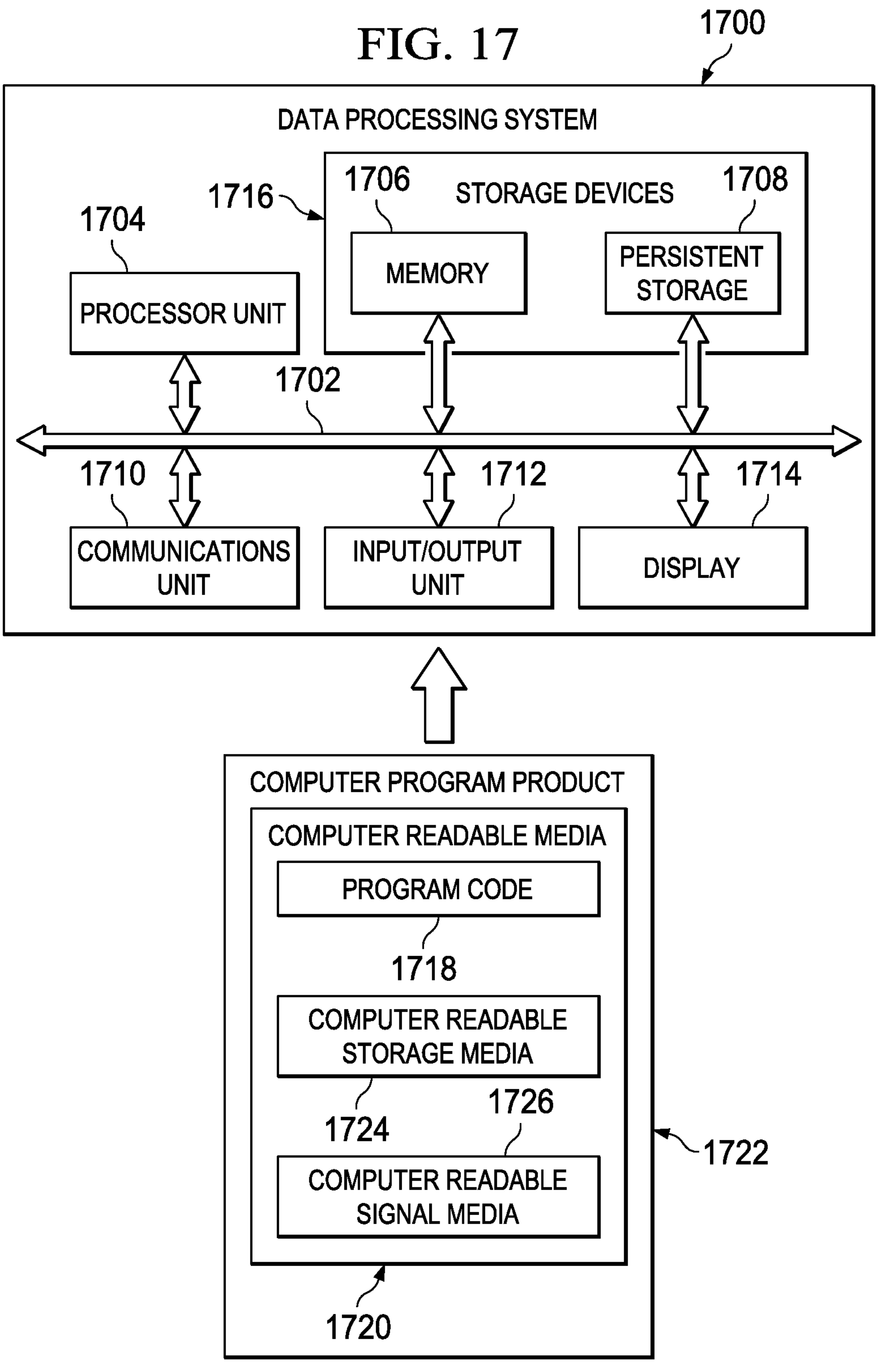

START
1600
CREATE A DATA STRUCTURE FOR THE TEMPLATE
1602
PLACE A MODEL OF THE LOCATION WITH THE SECTION INTO THE DATA STRUCTURE
1604
CREATE A TABLE OF THE LAYUP OF THE COMPOSITE MATERIALS
1606
CREATE A TWO-DIMENSIONAL TOP VIEW OF THE SECTION
1608
PLACE THE TWO-DIMENSIONAL TOP VIEW OF THE SECTION INTO THE DATA STRUCTURE
1610
CREATE A CROSS-SECTIONAL SIDE VIEW OF THE SECTION AND THE PATCH
1612
PLACE THE CROSS-SECTIONAL SIDE VIEW OF THE SECTION AND THE PATCH INTO THE DATA STRUCTURE
END

FIG. 16

FIG. 17


1700
DATA PROCESSING SYSTEM
1716
1706
STORAGE DEVICES
1708
1704
MEMORY
PERSISTENT STORAGE
PROCESSOR UNIT
1702
1710
1712
1714
COMMUNICATIONS UNIT
INPUT/OUTPUT UNIT
DISPLAY
COMPUTER PROGRAM PRODUCT
COMPUTER READABLE MEDIA
PROGRAM CODE
1718
COMPUTER READABLE STORAGE MEDIA
1724
1726
1722
COMPUTER READABLE SIGNAL MEDIA
1720

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/033004

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29C73/04
ADD. B29K105/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B29C B29K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 174 392 B1 (REIS CARL ANDREW [US]) 16 January 2001 (2001-01-16) figures 1-4,5A,5B column 1, line 10 - column 2, line 38 column 3, line 7 - column 4, line 13 -----	1-15
X	US 2010/316458 A1 (LINDGREN LAWRENCE S [US] ET AL) 16 December 2010 (2010-12-16) paragraphs [0005] - [0008], [0023], [0024], [0026], [0031], [0036], [0037], [0038] -----	1-15
A	US 2008/055591 A1 (WALTON STEVEN R [US]) 6 March 2008 (2008-03-06) paragraphs [0009], [0010], [0012], [0013], [0031], [0032], [0033], [0037], [0039], [0047], [0048] -----	1-15
	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 September 2012	24/09/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Jouannon, Fabien

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/033004

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008/135856 A2 (SPIRIT AEROSYSTEMES INC [US]; CORK GLEN PAUL [US]; BORGMAN MICHAEL D [) 13 November 2008 (2008-11-13) page 3 page 9, line 16 - page 10, line 32 -----	1-15

1

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2012/033004

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 6174392	B1	16-01-2001	NONE			
US 2010316458	A1	16-12-2010	NONE			
US 2008055591	A1	06-03-2008	EP	2062033	A1	27-05-2009
			US	2008055591	A1	06-03-2008
			WO	2008030297	A1	13-03-2008
WO 2008135856	A2	13-11-2008	CN	101939709	A	05-01-2011
			GB	2463385	A	17-03-2010
			US	2008281554	A1	13-11-2008
			WO	2008135856	A2	13-11-2008