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(54) MASKING SYSTEMS

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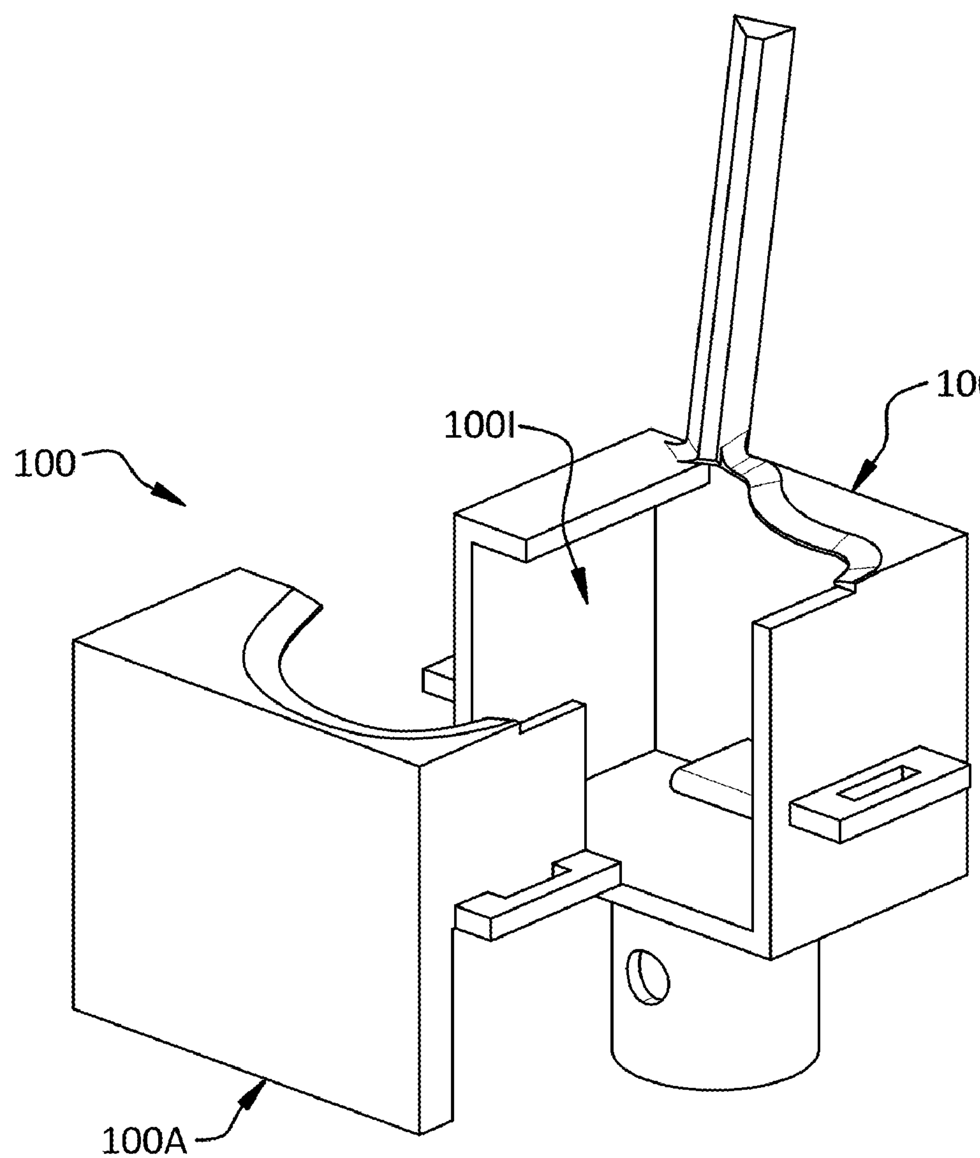
F01D 5/28	(2006.01)

(52) U.S. Cl.

CPC ***B05C 21/005*** (2013.01); ***C23C 16/042*** (2013.01); ***F01D 5/288*** (2013.01); *B33Y 80/00* (2014.12); *F05D 2230/90* (2013.01)

(57) **ABSTRACT**

A masking system for selectively masking a component includes a first shell half and a second shell half. The second shell half is configured to be secured to the first shell half such that at least a portion of the first shell half overlaps the second shell half when the component is retained by the masking system. A protrusion extends from one of the first shell half and the second shell half. The protrusion is configured to cover an edge of the component.



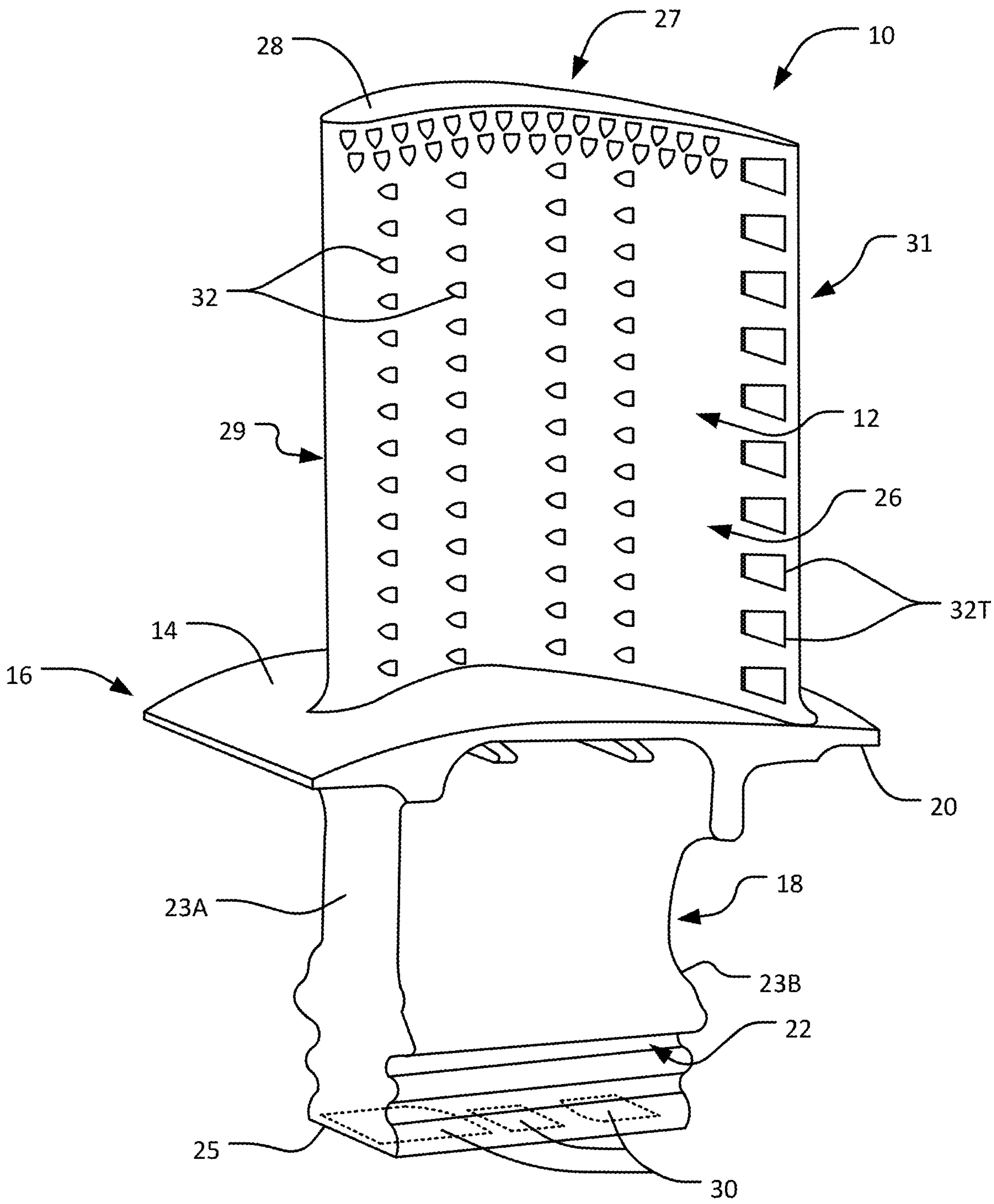


FIG. 1

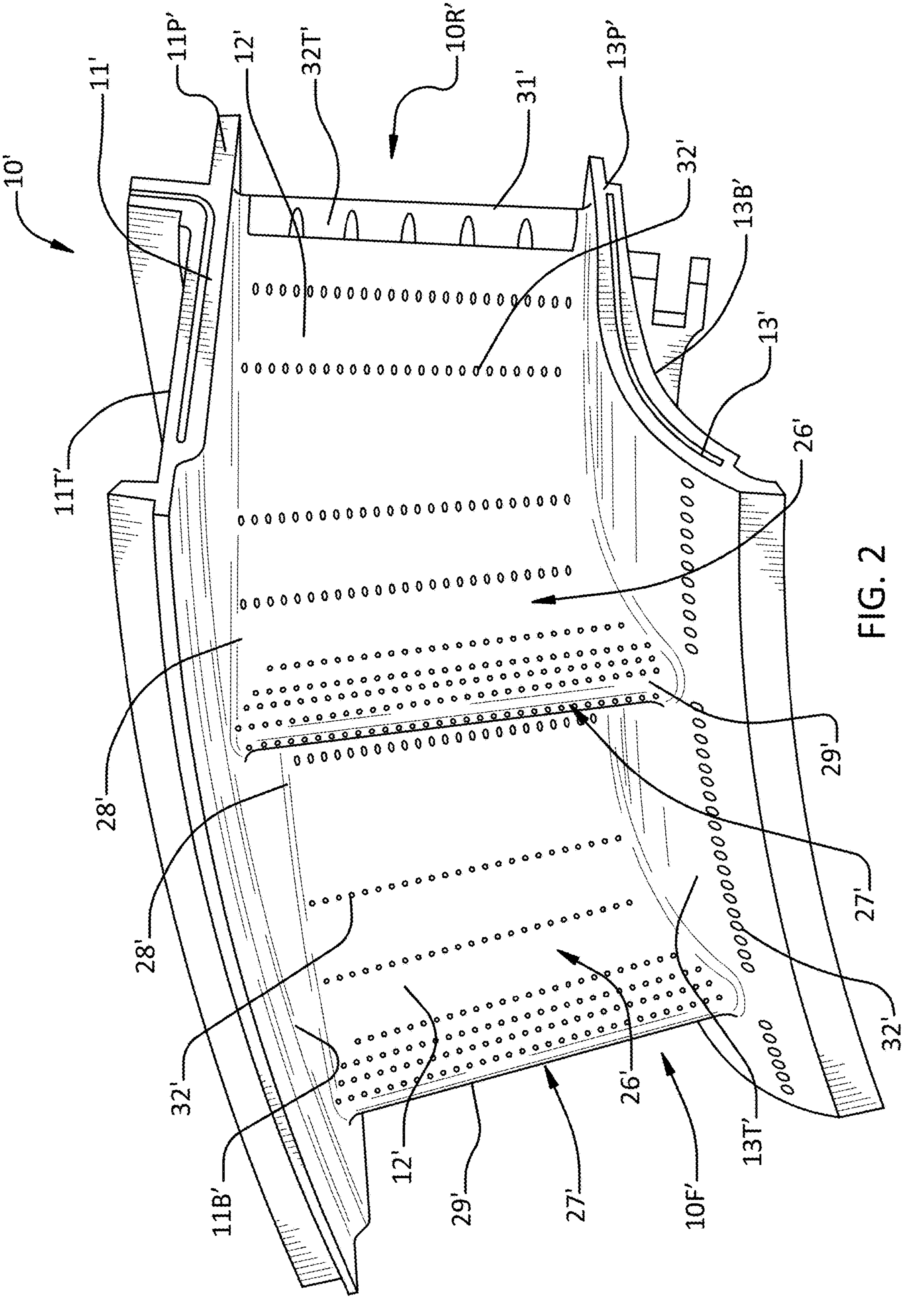

10'
11'
11P'
12'
32T'
10R'
31'
13P'
32'
32'
13B'
13'
26'
11T'
28'
29'
27'
28'
32'
32'
26'
12'
11B'
29'
27'
10F'
13T'

FIG. 2

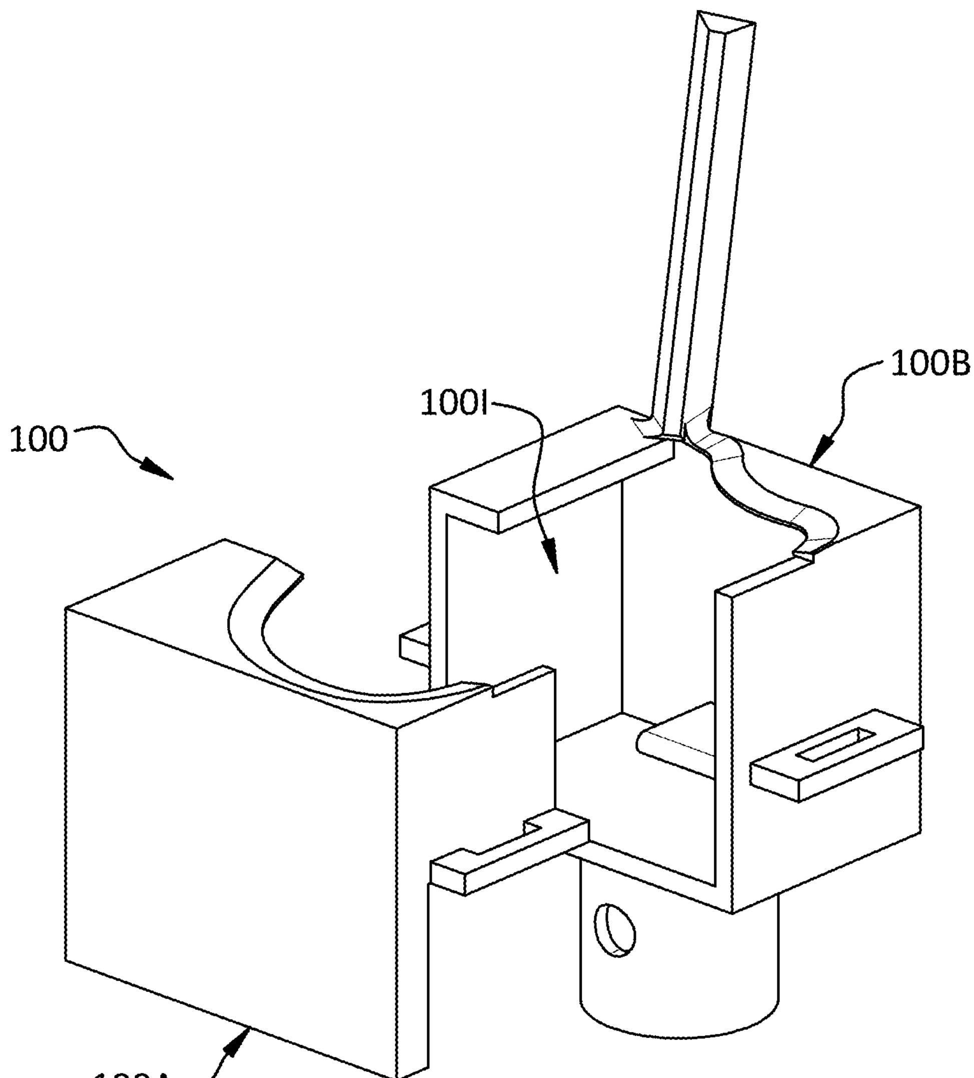
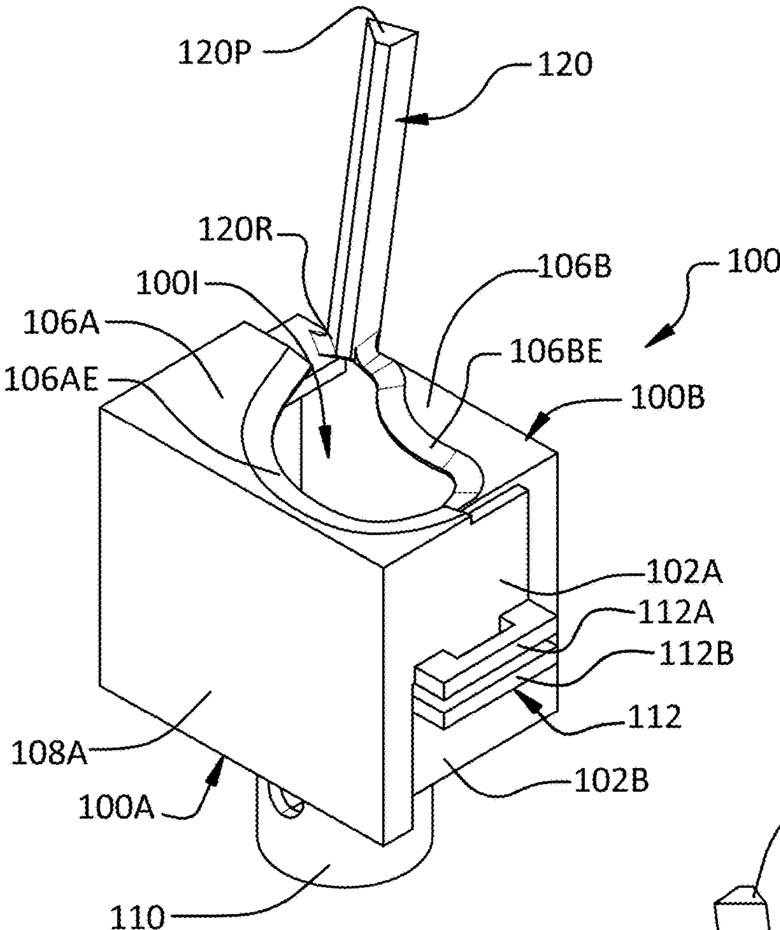
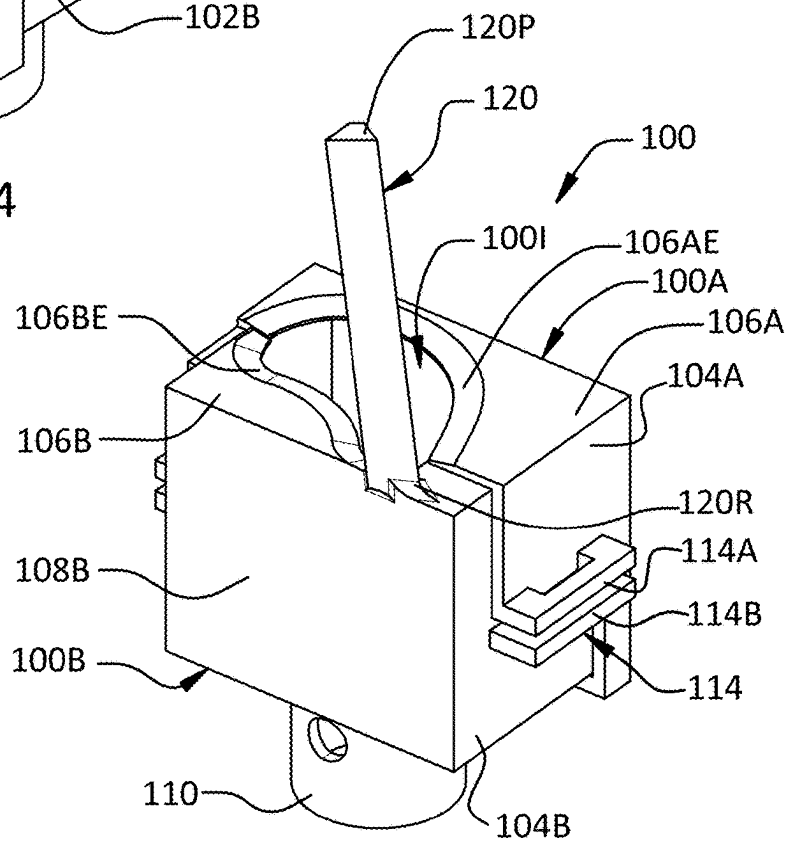


FIG. 3



120P
120
120R
100I
106B
100
106A
106BE
106AE
100B
102A
112A
112B
112
108A
102B
100A
110

FIG. 4



120P
120
100
100I
106AE
100A
106BE
106A
104A
106B
120R
114A
108B
114B
100B
114
110
104B

FIG. 5

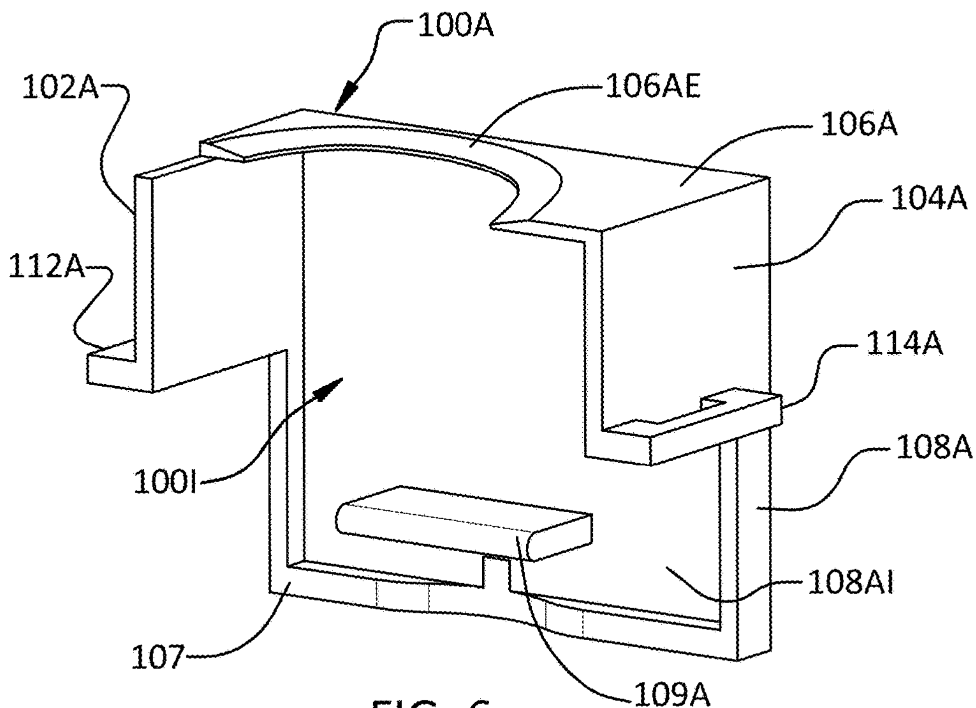

100A
102A
106AE
106A
104A
112A
114A
100I
108A
108AI
107
109A

FIG. 6

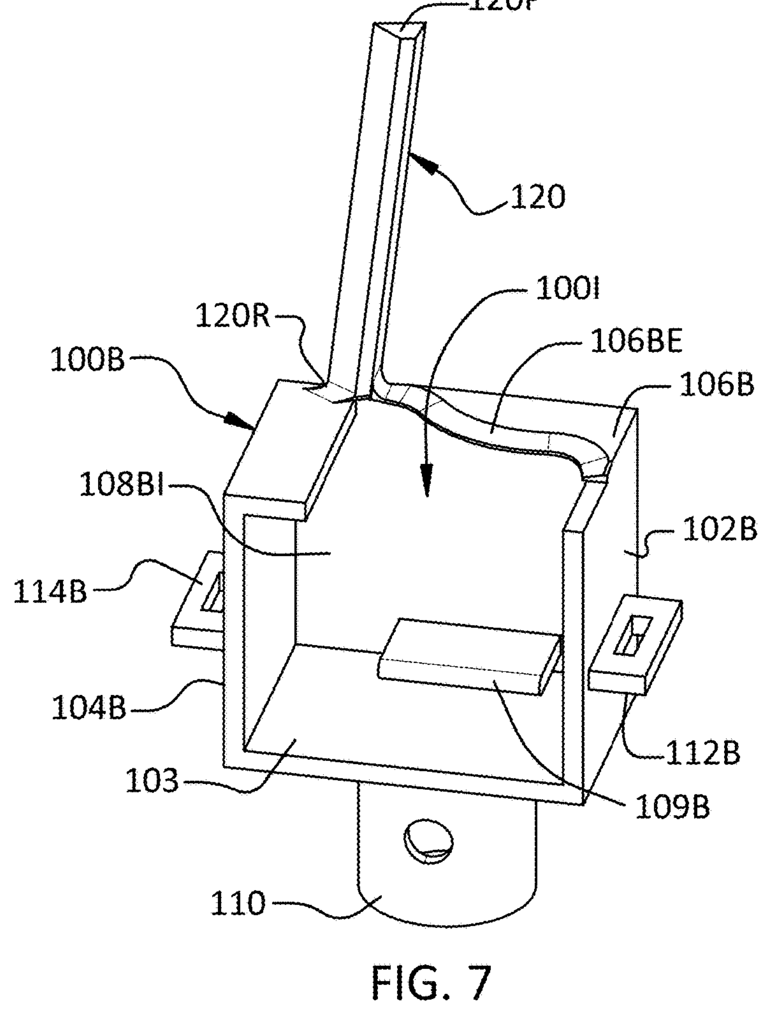

120P
120
100I
120R
106BE
100B
106B
108BI
102B
114B
104B
112B
103
109B
110

FIG. 7

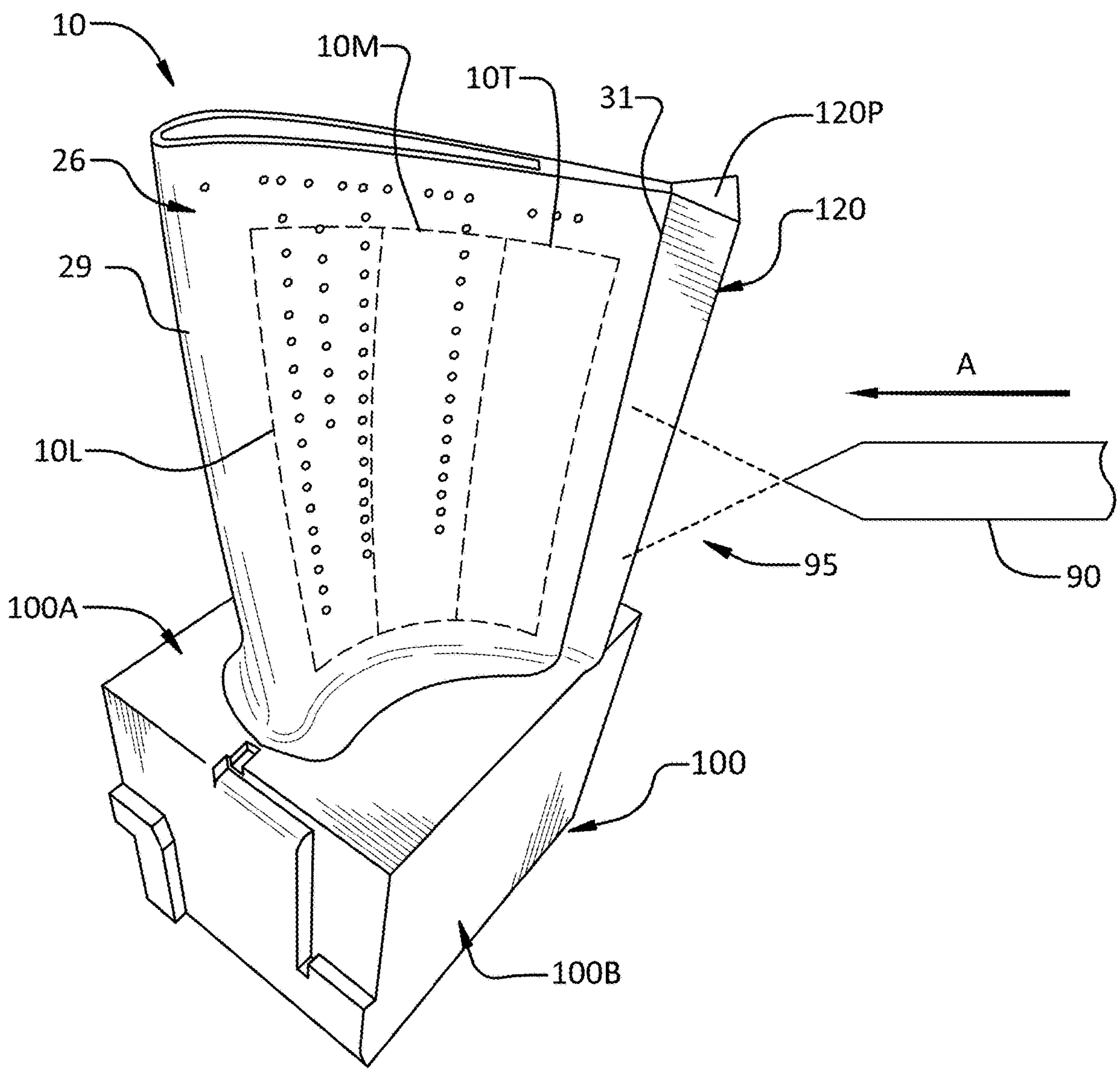


FIG. 8

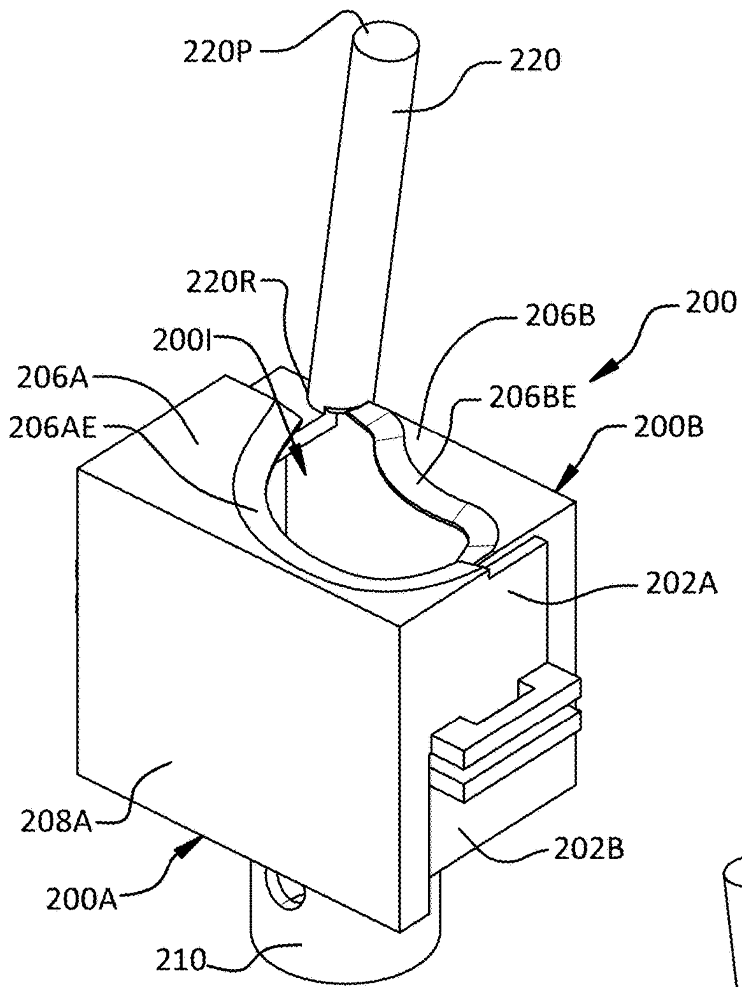

220P
220
220R
206B
200
200I
206A
206BE
206AE
200B
202A
208A
202B
200A
210

FIG. 9

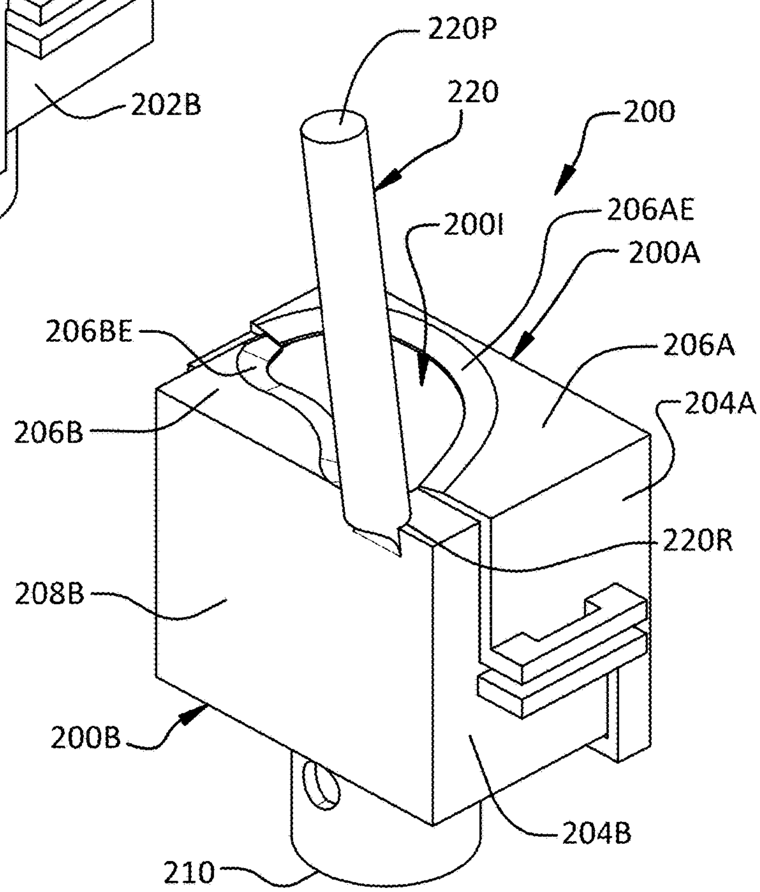

220P
220
200
206AE
200I
200A
206BE
206A
204A
206B
220R
208B
200B
204B
210

FIG. 10

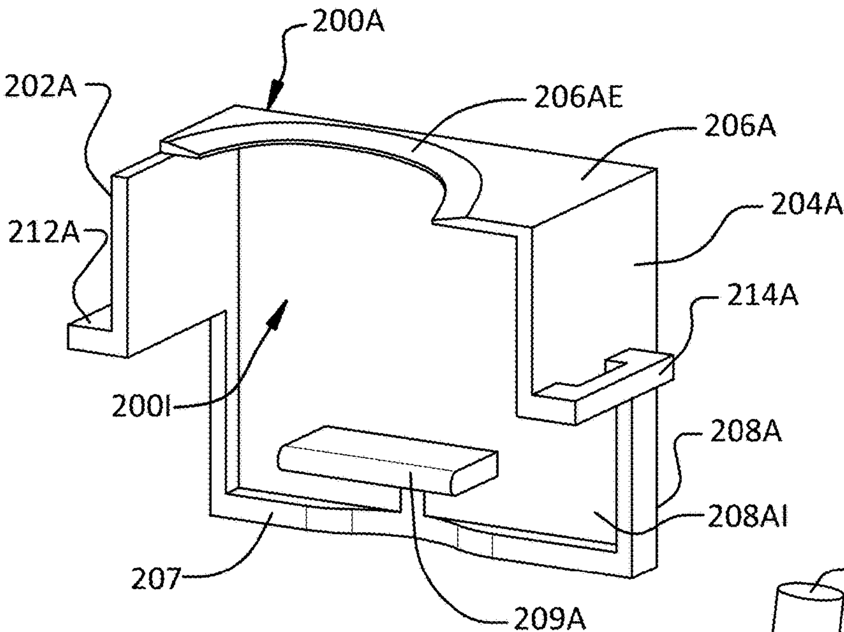

200A
202A
206AE
206A
212A
204A
214A
200I
208A
208AI
207
209A

FIG. 11

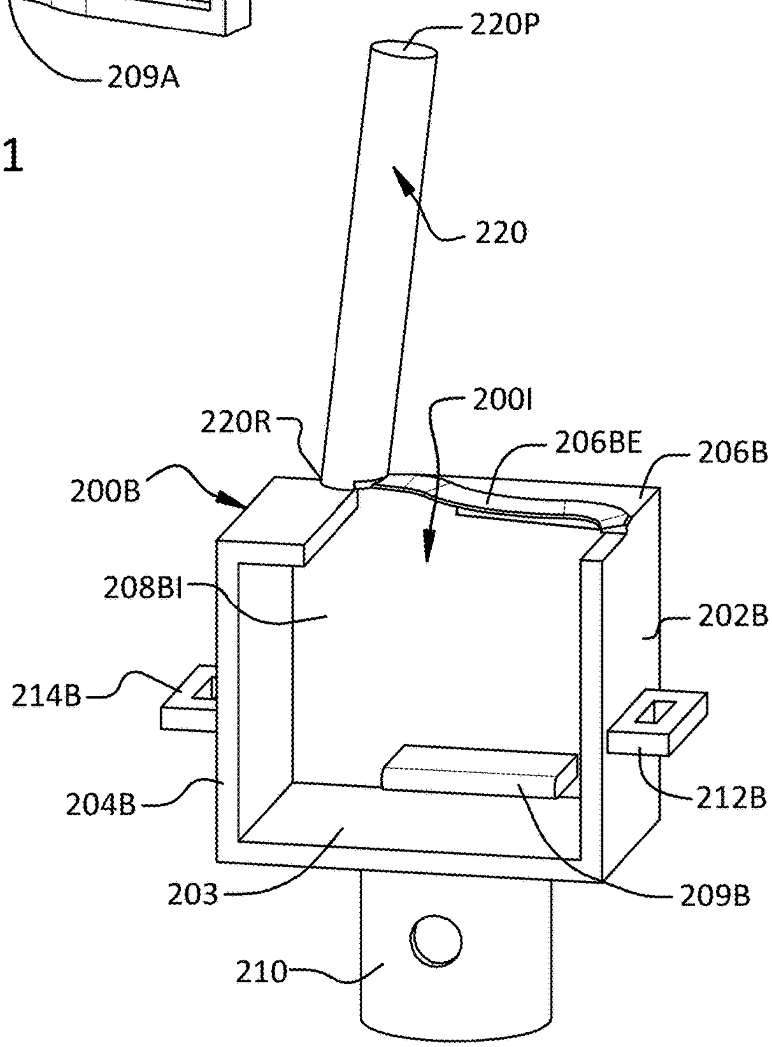
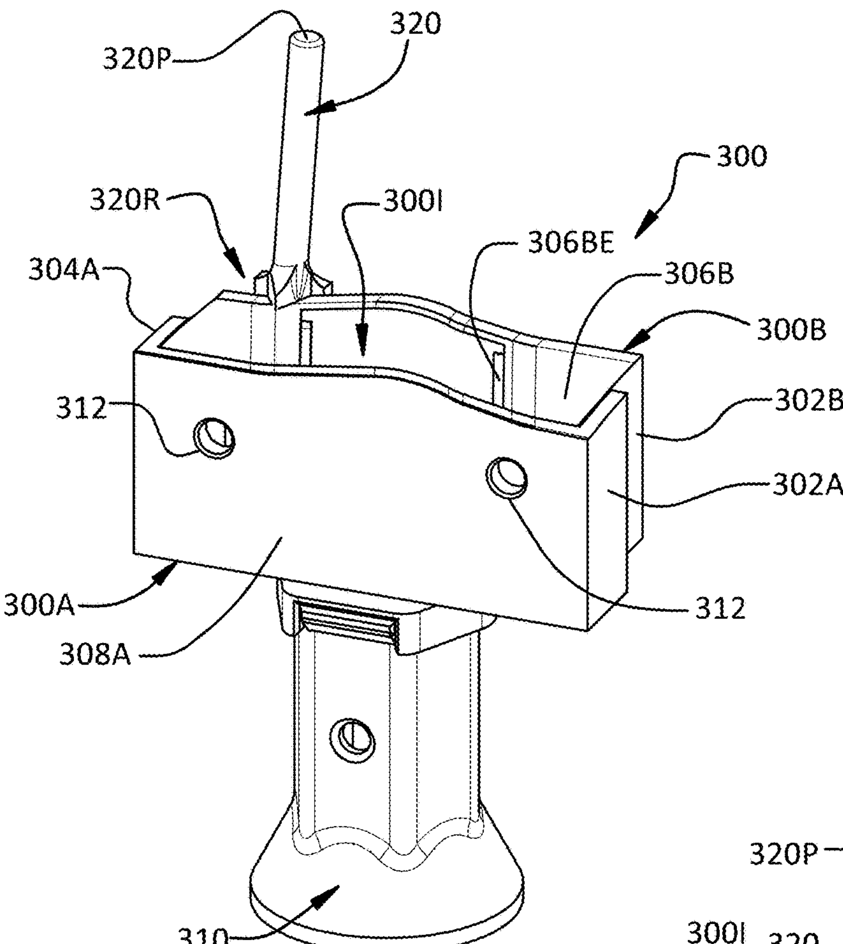
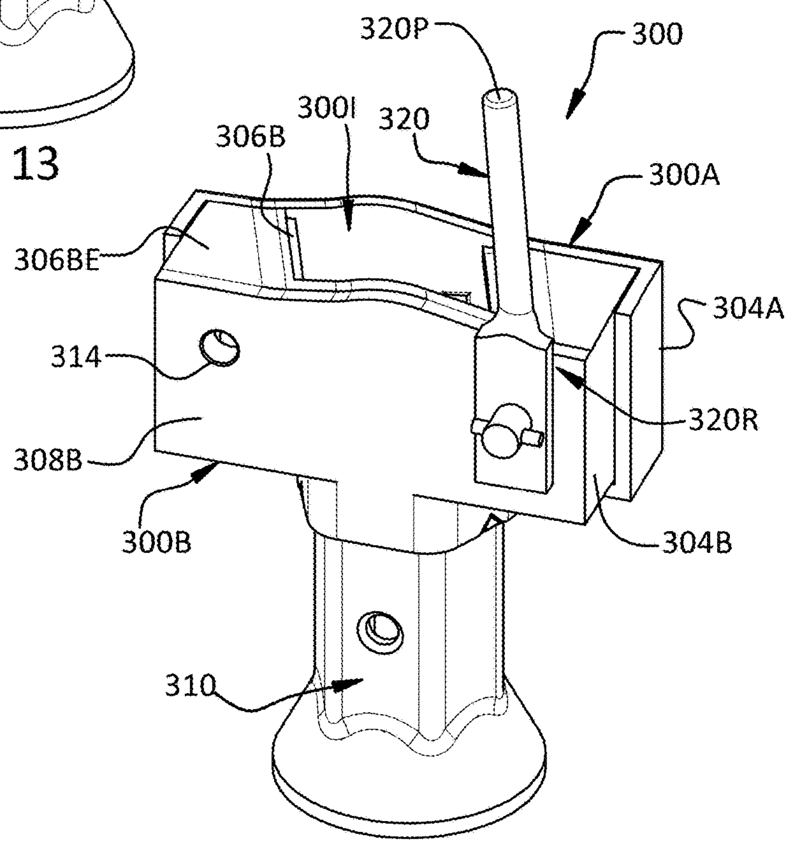

220P
220
200I
220R
206BE
206B
200B
208BI
202B
214B
212B
204B
203
209B
210

FIG. 12



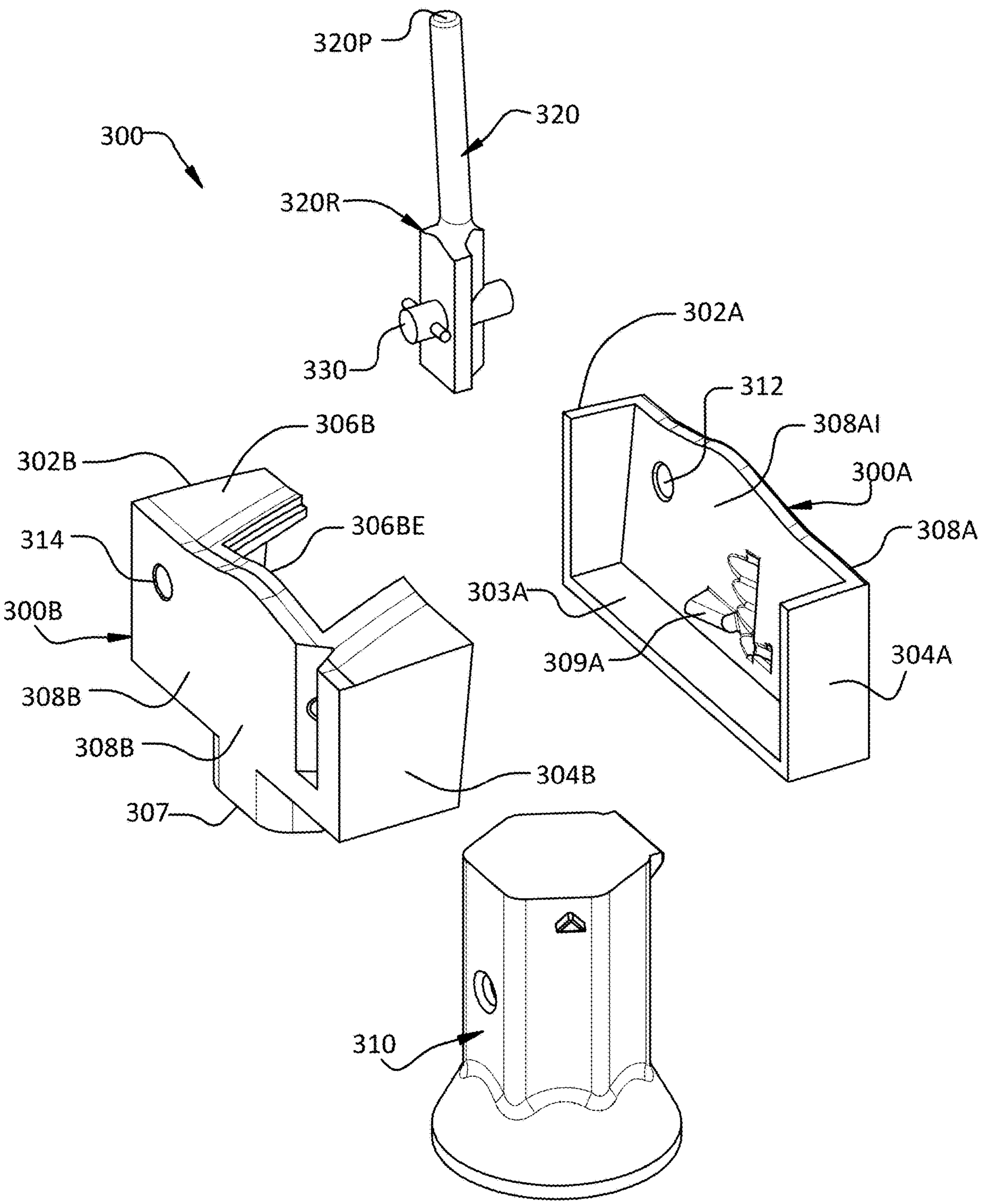
320P
320
300
320R
300I
306BE
306B
304A
300B
312
302B
302A
300A
312
308A
310

FIG. 13



320P
300
300I
306B
320
300A
306BE
304A
314
320R
308B
300B
304B
310

FIG. 14



320P
320
300
320R
330
302A
312
308AI
300A
308A
306B
302B
306BE
314
303A
300B
309A
304A
308B
308B
304B
307
310

FIG. 15

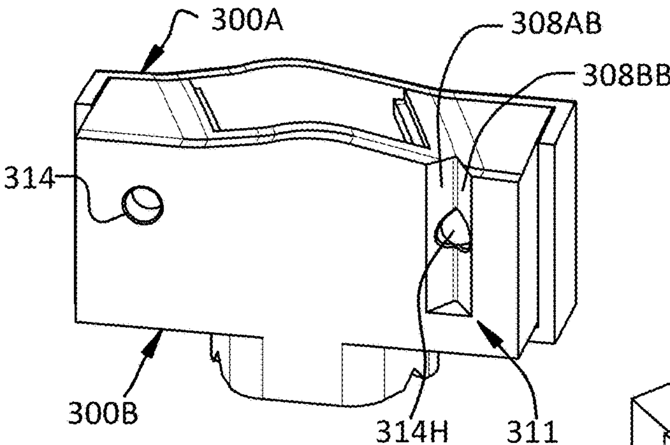


FIG. 16

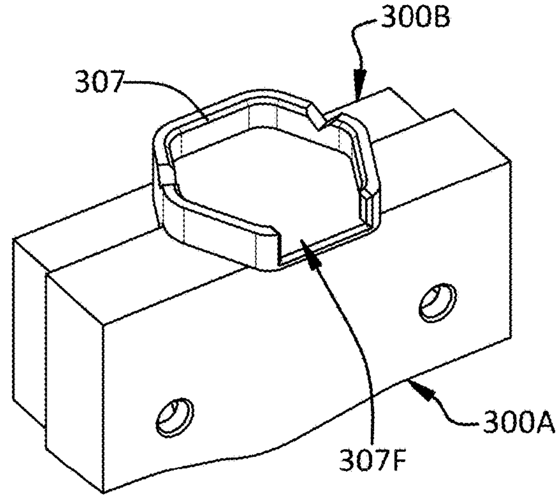


FIG. 17

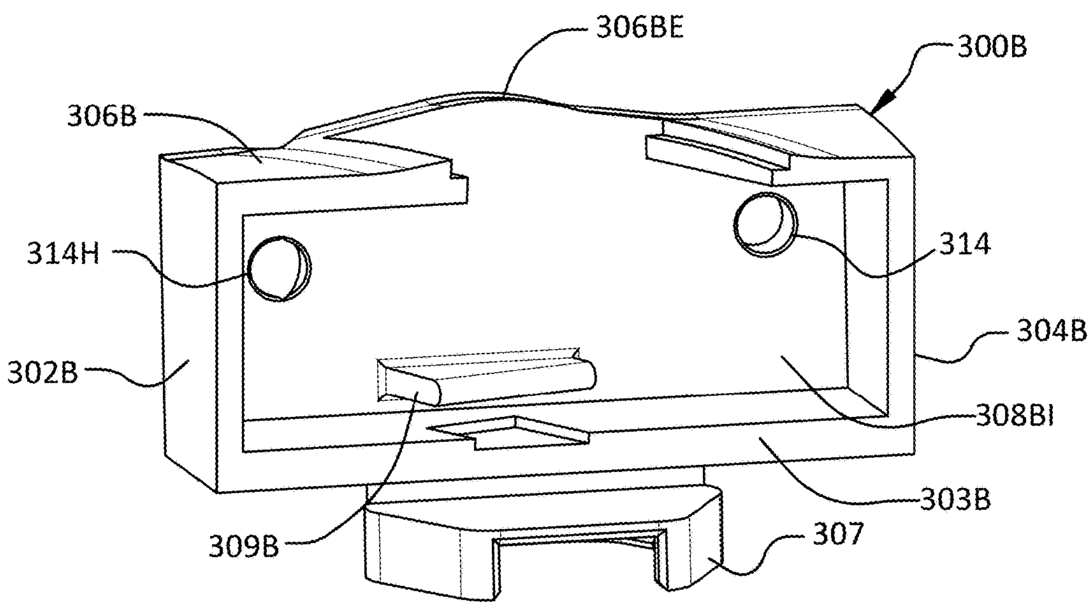


FIG. 18

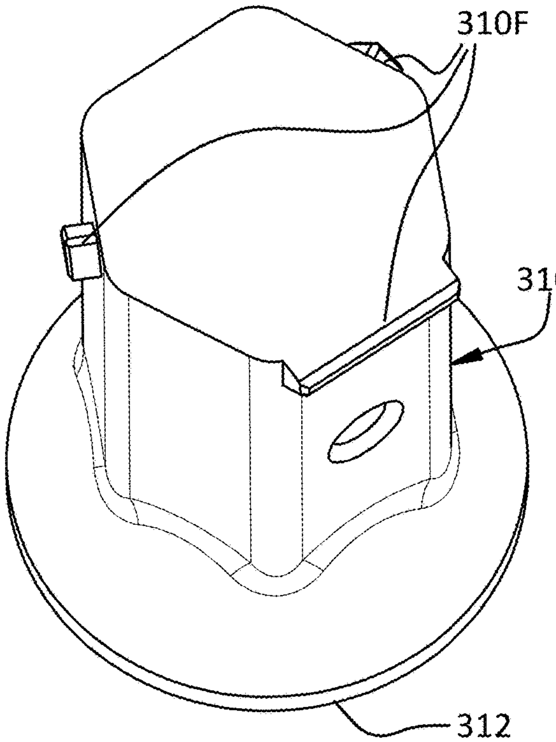


FIG. 19

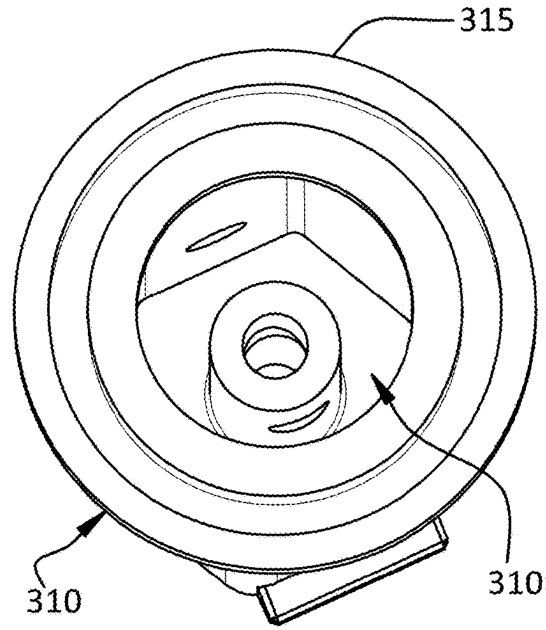


FIG. 20

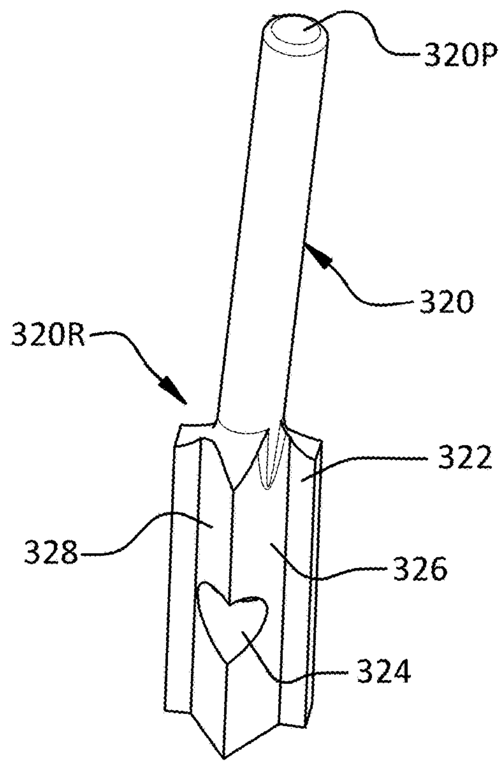


FIG. 21

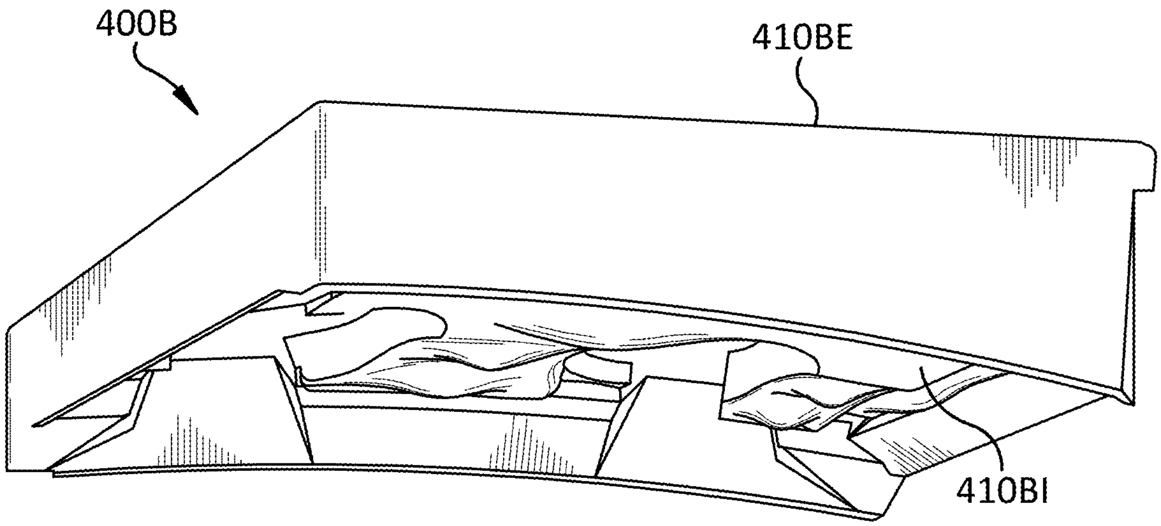


FIG. 22A

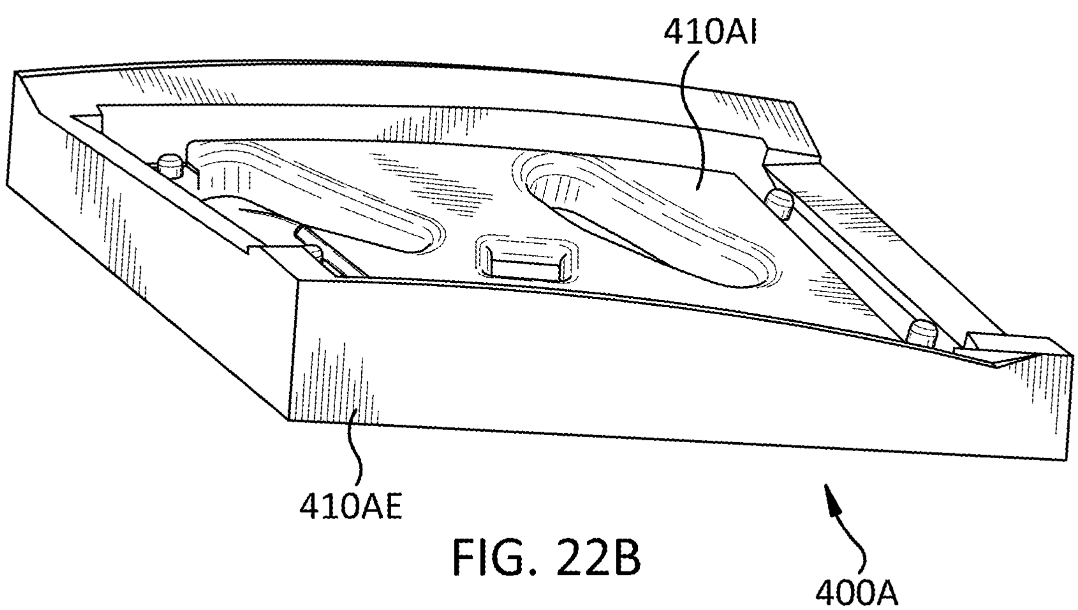


FIG. 22B

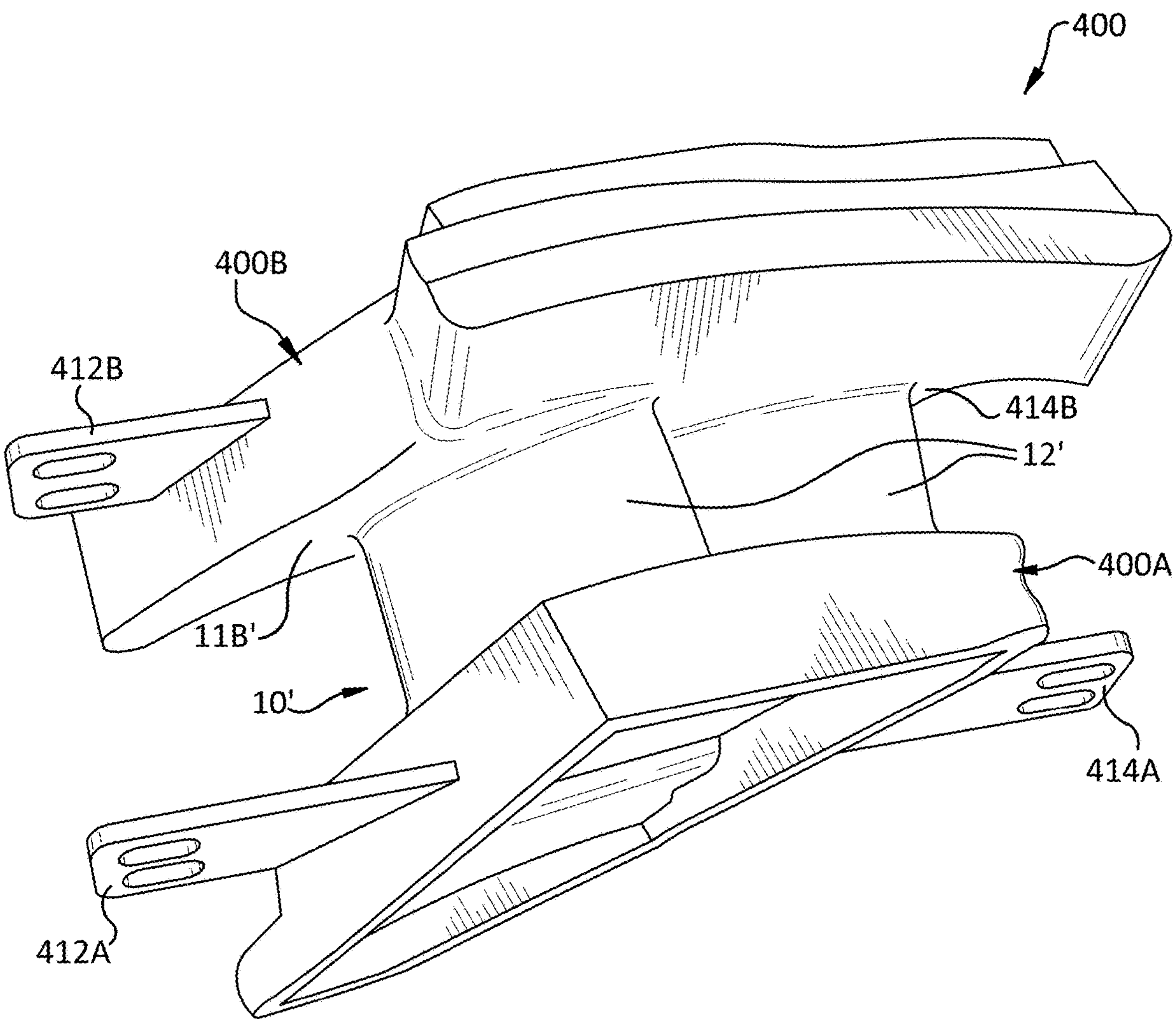


FIG. 22C

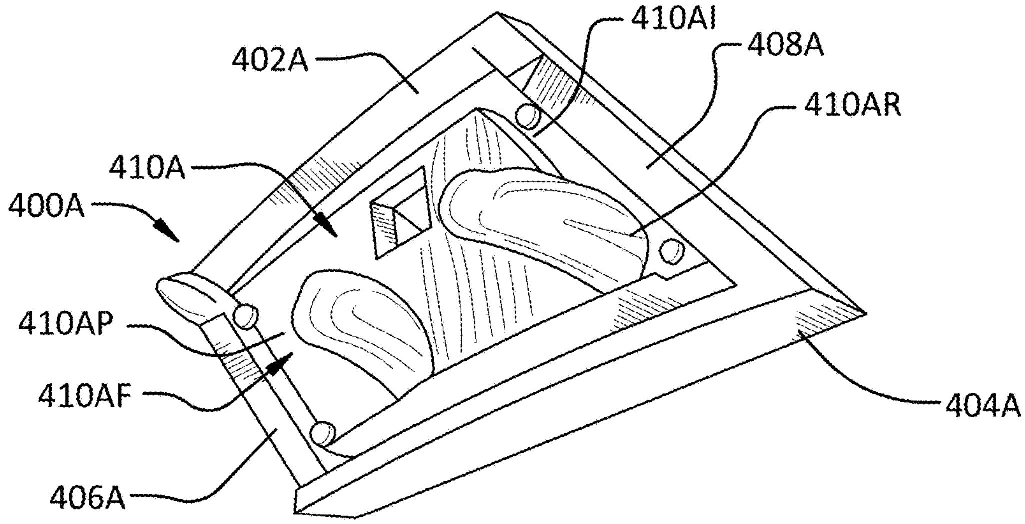


FIG. 23A

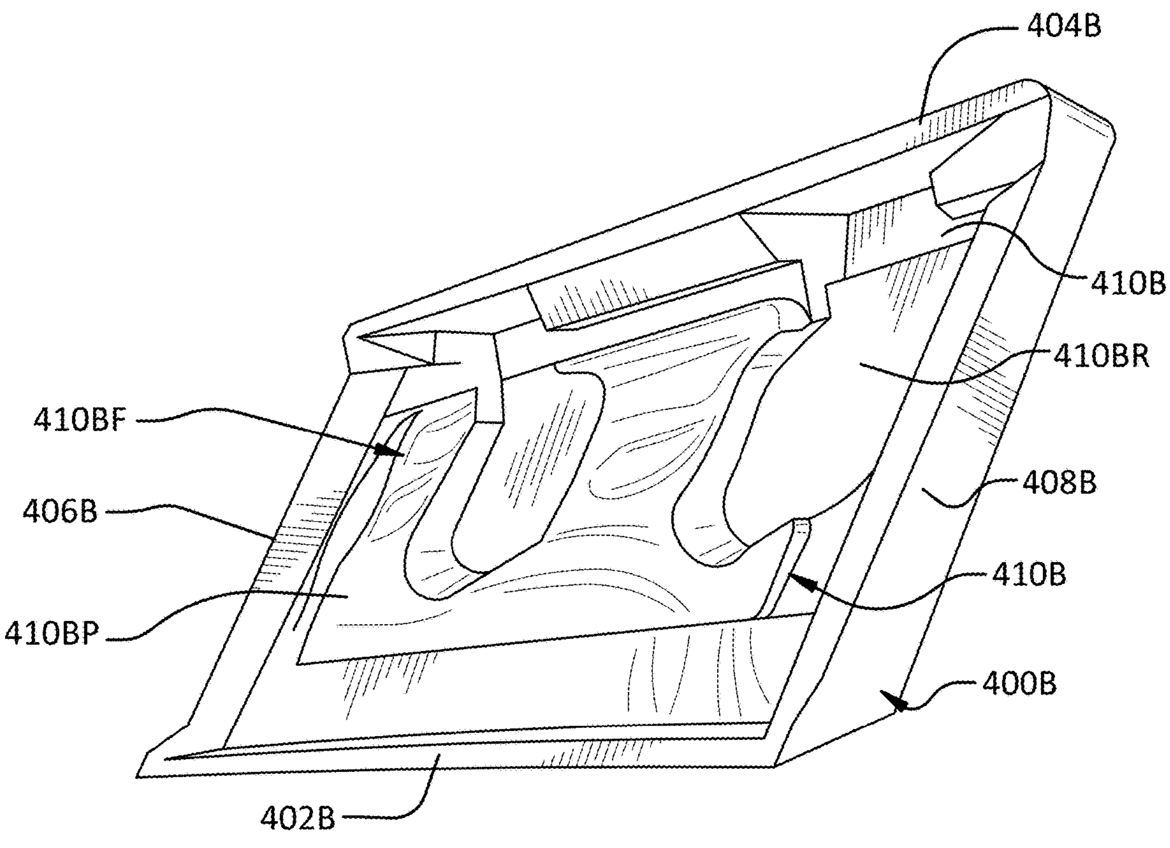


FIG. 23B

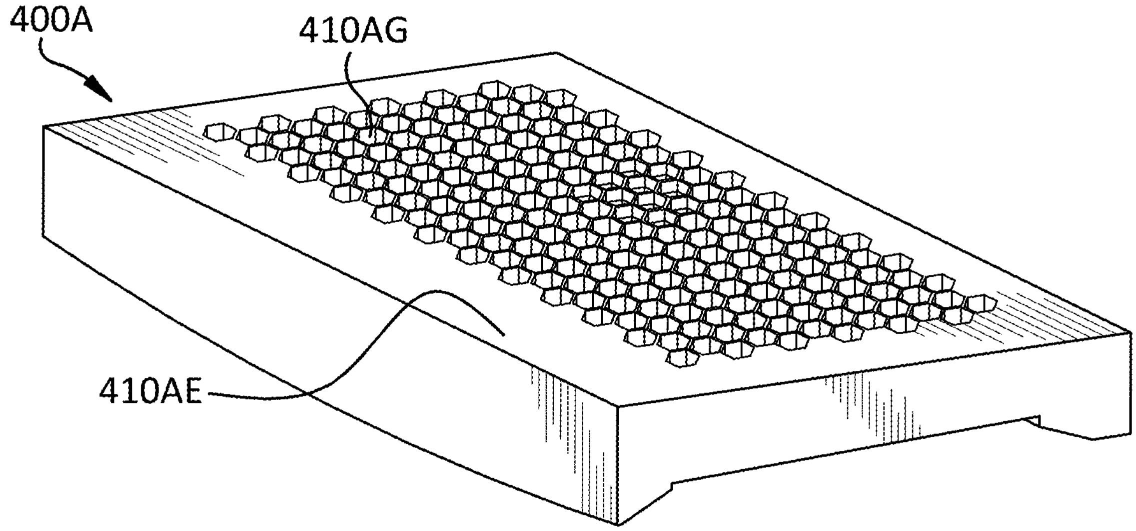


FIG. 24A

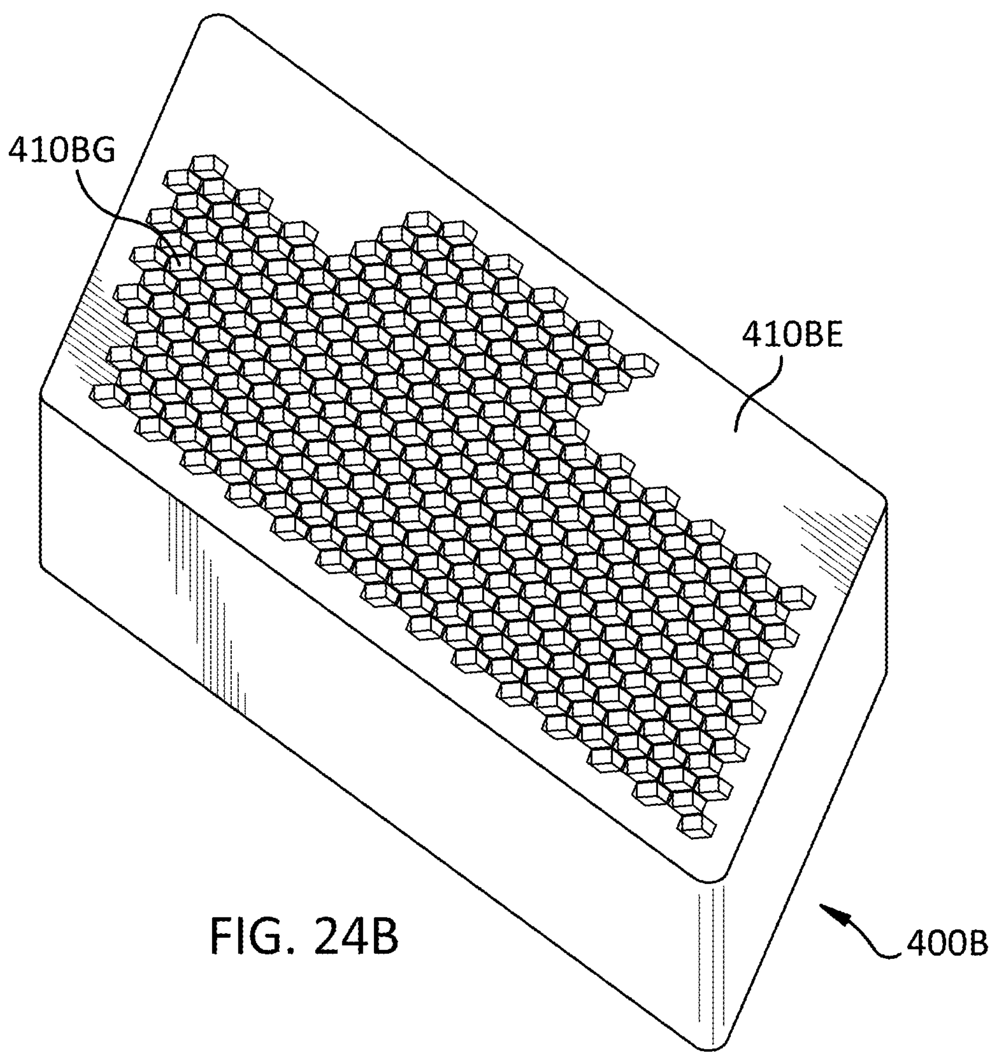


FIG. 24B

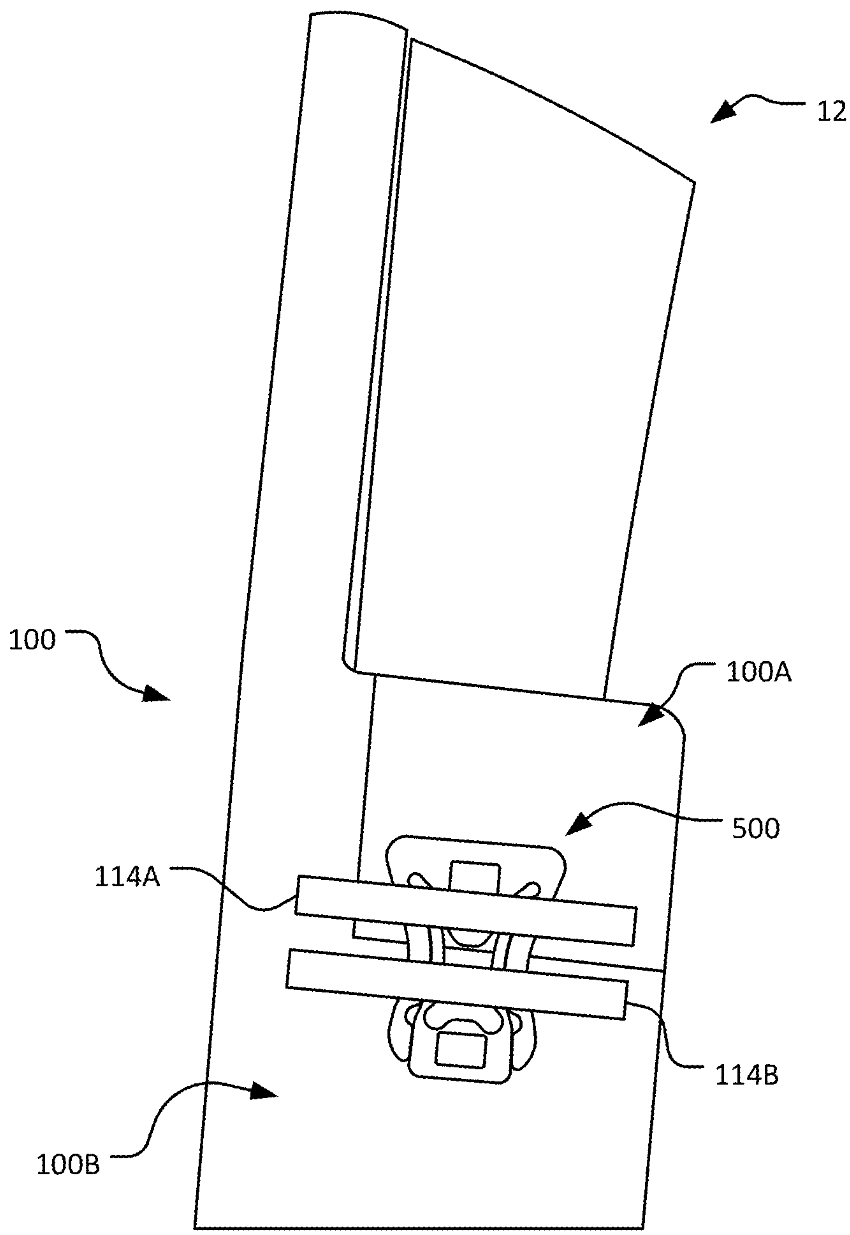


FIG. 25

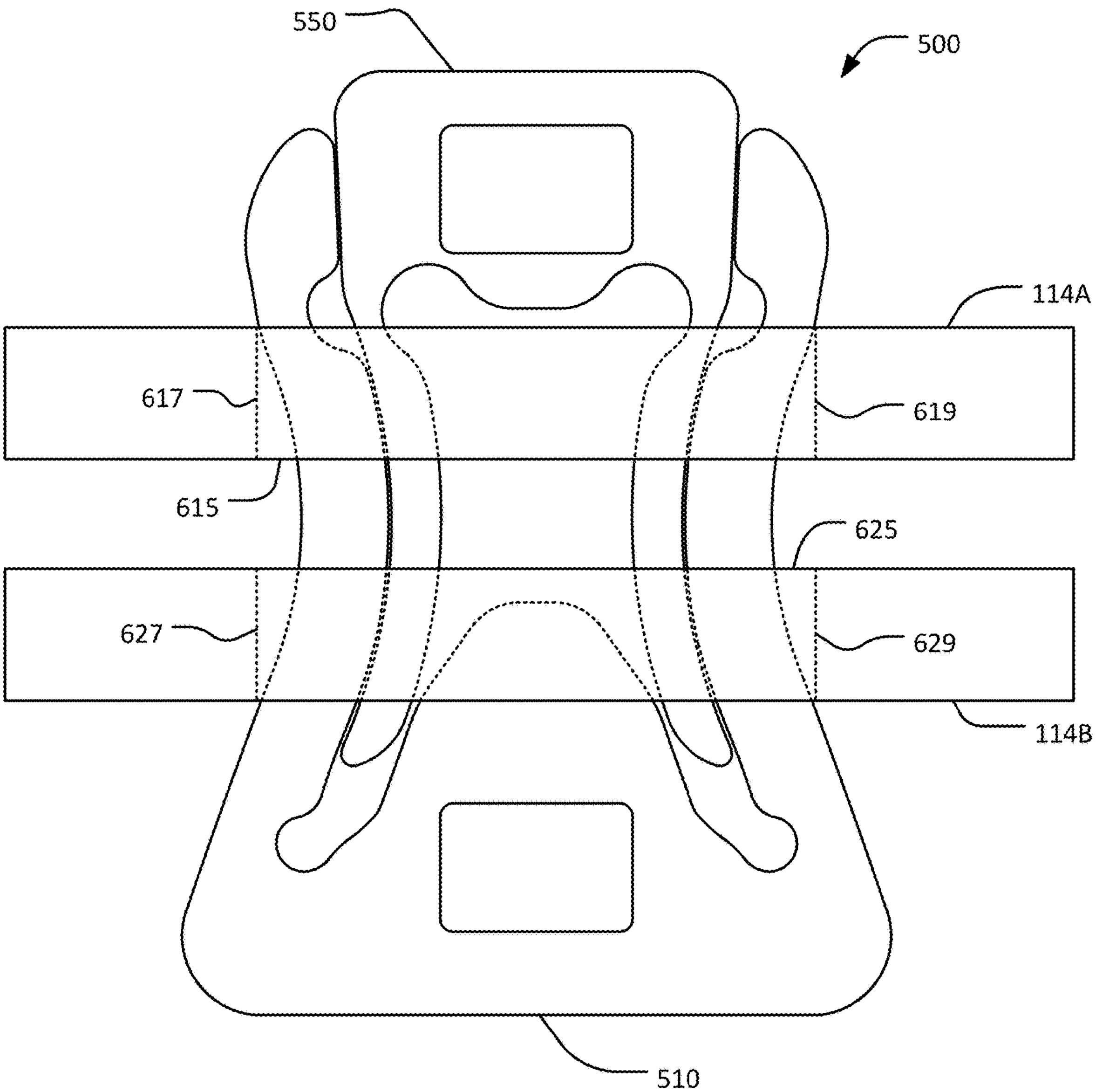


FIG. 26

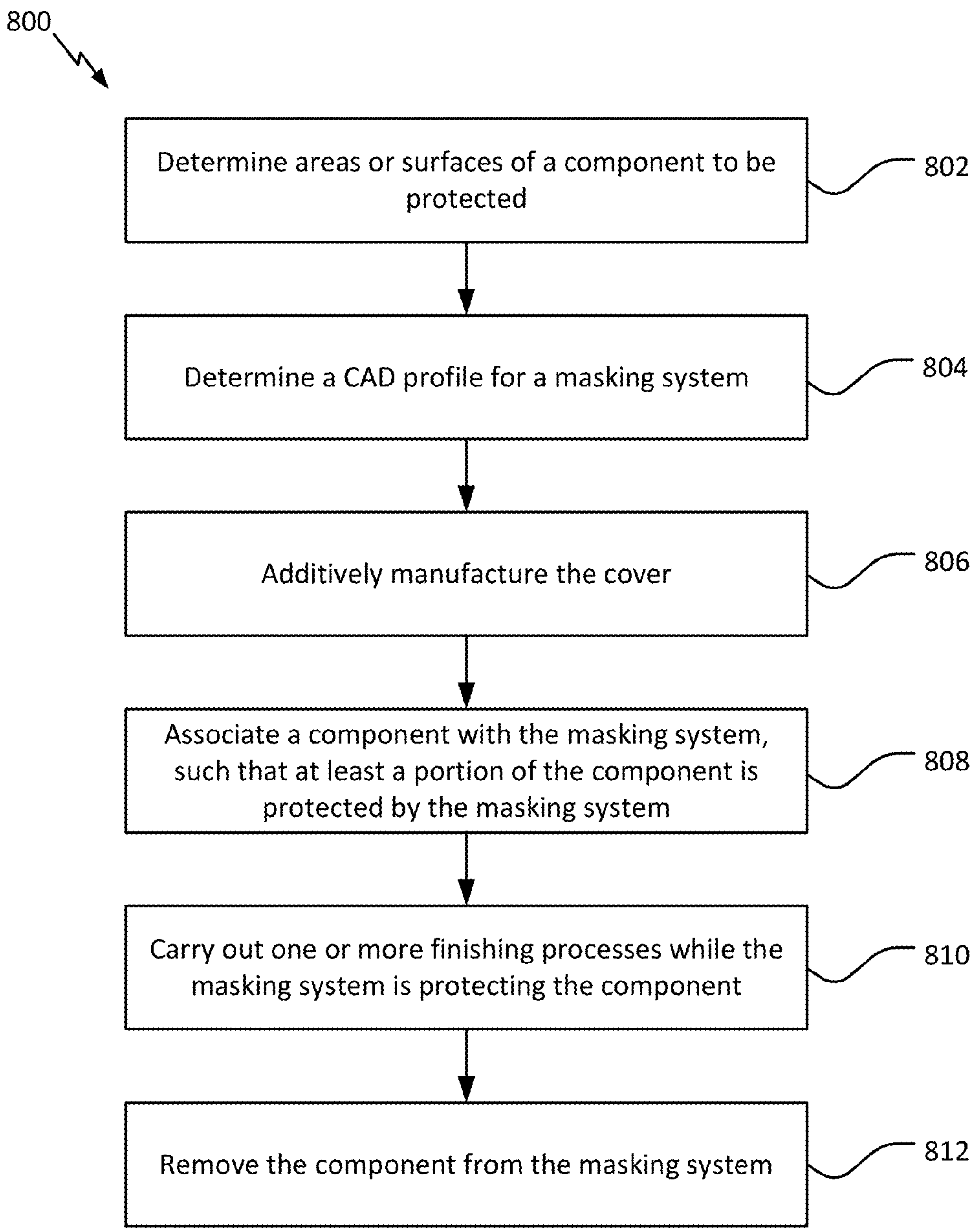

800
Determine areas or surfaces of a component to be protected
802
Determine a CAD profile for a masking system
804
Additively manufacture the cover
806
Associate a component with the masking system, such that at least a portion of the component is protected by the masking system
808
Carry out one or more finishing processes while the masking system is protecting the component
810
Remove the component from the masking system
812

FIG. 27

MASKING SYSTEMS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] None.

FIELD OF THE DISCLOSURE

[0002] The disclosure relates generally to the field of making systems. More specifically, the disclosure relates to multi-component masking systems for selectively masking a component.

SUMMARY

[0003] The following presents a summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the invention. It is not intended to identify critical elements of the invention or to delineate the scope of the invention. Its sole purpose is to present some concepts of the invention in a simplified form as a prelude to the more detailed description that is presented elsewhere herein.

[0004] In an aspect of the disclosure, a masking system for selectively masking a component is provided. The masking system has a first shell half and a second shell half. The second shell half is configured to be secured to the first shell half such that at least a portion of the first shell half overlaps the second shell half when the component is retained by the masking system. A protrusion extends from one of the first shell half and the second shell half. The protrusion is configured to cover an edge of the component.

[0005] In an aspect, according to any one of the preceding aspects, the protrusion is removable.

[0006] In an aspect, according to any one of the preceding aspects, the masking system is configured to retain the component for a coating process.

[0007] In an aspect, according to any one of the preceding aspects, a distribution of coating on the component is associated with a profile of the protrusion.

[0008] In an aspect, according to any one of the preceding aspects, the first shell half has a first tab, and the second shell half has a second tab that corresponds to the first tab when the first shell half is brought into contact with the second shell half.

[0009] In an aspect, according to any one of the preceding aspects, the masking system includes a fastener extending through each of the first tab and the second tab.

[0010] In an aspect, according to any one of the preceding aspects, the masking system includes interlocking clips extending through each of the first tab and the second tab.

[0011] In an aspect, according to any one of the preceding aspects, the masking system is additively manufactured.

[0012] In an aspect, according to any one of the preceding aspects, the component is a component of a gas turbine.

[0013] In an aspect, according to any one of the preceding aspects, the component is a gas turbine blade, and the edge is a trailing edge of the gas turbine blade.

[0014] In an aspect, according to any one of the preceding aspects, the masking system is configured to mask at least a dovetail of the gas turbine blade.

[0015] In an aspect, according to any one of the preceding aspects, the first shell half includes a first shelf, and the second shell half includes a second shelf. Each of the first shelf and the second shelf are configured to contact the component.

[0016] In an aspect, according to any one of the preceding aspects, the masking system includes a mounting portion for mounting the masking system to a surface.

[0017] In an aspect, according to any one of the preceding aspects, the mounting portion is removably coupled to one of the first shell half and the second shell half.

[0018] In an aspect of the disclosure, an additively manufactured masking system for selectively masking a blade of a gas turbine for a coating process is provided. The masking system includes a first shell half having a wall corresponding to a suction side of the blade. The masking system includes a second shell half having a wall corresponding to a pressure side of the blade. The masking system includes a protrusion extending from one of the first shell half and the second shell half. A distribution of coating on the blade is associated with a profile of the protrusion.

[0019] In an aspect, according to any one of the preceding aspects, the protrusion is removable.

[0020] In an aspect, according to any one of the preceding aspects, the protrusion has a generally spherical shape.

[0021] In an aspect, according to any one of the preceding aspects, the protrusion has a generally trapezoidal shape.

[0022] In an aspect of the disclosure, a masking system for selectively masking a component is disclosed. The masking system includes a first shell having a first cover and a first tab. The first cover has at least a first recess and a first peak. Each of the first recess and the first peak correspond to the component at a first side thereof. The masking system has a second shell having a second cover and a second tab. The second cover has at least a second recess and a second peak. Each of the second recess and the second peak correspond to the component at a second side thereof. The second side opposes the first side.

[0023] In an aspect, according to any one of the preceding aspects, the component is a gas turbine vane.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Illustrative embodiments of the present disclosure are described in detail below with reference to the attached drawing figures and wherein:

[0025] FIG. **1** is a perspective view of a turbine blade.

[0026] FIG. **2** is a perspective view of a turbine vane.

[0027] FIG. **3** is a perspective view of a masking system, according to an aspect of the disclosure.

[0028] FIGS. **4** and **5** are additional perspective views of the masking system of FIG. **3**.

[0029] FIG. **6** is a perspective view of a first shell half of the masking system of FIG. **3**.

[0030] FIG. **7** is a perspective view of a second shell half of the masking system of FIG. **3**.

[0031] FIG. **8** is a perspective view of a turbine blade seated within the masking system of FIG. **3**, according to an aspect of the disclosure.

[0032] FIGS. **9** and **10** are perspective views of a masking system, according an aspect of the disclosure.

[0033] FIG. **11** is a perspective view of a first shell half of the masking system of FIG. **9**.

[0034] FIG. **12** is a perspective view of a second shell half of the masking system of FIG. **9**.

[0035] FIGS. **13** and **14** are perspective views of a masking system, according to an aspect of the disclosure.

[0036] FIG. **15** is an exploded view of the masking system of FIG. **13**.
[0037] FIGS. **16** and **17** are perspective views of a first shell half and a second shell half of the masking system of FIG. **13**.
[0038] FIG. **18** is a perspective view of the second shell half of the masking system of FIG. **13**.
[0039] FIGS. **19** and **20** are perspective views of a mounting handle of the masking system of FIG. **13**.
[0040] FIG. **21** is a perspective view of a protrusion of the masking system of FIG. **13**.
[0041] FIG. **22**A is a perspective view of a second shell of a masking system of FIG. **22**C, according to an aspect of the disclosure.
[0042] FIG. **22**B is a perspective view of a first shell of the masking system of FIG. **22**C, according to an aspect of the disclosure.
[0043] FIG. **22**C is a perspective view of a turbine vane seated within a masking system, according to an aspect of the disclosure.
[0044] FIG. **23**A is another perspective view of the first shell of the masking system of FIG. **22**C.
[0045] FIG. **23**B is another perspective view of the second shell of the masking system of FIG. **22**C.
[0046] FIGS. **24**A and **24**B are perspective views of a top cover and a bottom cover of the masking system of FIG. **22**C, respectively.
[0047] FIG. **25** is a side view of interlocking clips with the turbine blade seated within the masking system of FIG. **3**.
[0048] FIG. **26** is a schematic view of the interlocking clips of FIG. **25**.
[0049] FIG. **27** is a flowchart illustrating a method of making and using the cover of FIG. **3**, FIG. **9**, FIG. **13**, and FIG. **22**C.

DETAILED DESCRIPTION

[0050] A gas turbine engine typically includes a multi-stage compressor coupled to a multi-stage turbine via an axial shaft. Air enters the gas turbine engine through the compressor where its temperature and pressure are increased as it passes through subsequent stages of the compressor. The compressed air is then directed to one or more combustors where it is mixed with a fuel source to create a combustible mixture. This mixture is ignited in the combustors to create a flow of hot combustion gases. These gases are directed into the turbine causing the turbine to rotate, thereby driving the compressor. The output of the gas turbine engine can be mechanical thrust via exhaust from the turbine or shaft power from the rotation of an axial shaft, where the axial shaft can drive a generator to produce electricity.

[0051] The compressor and turbine each include a plurality of rotating blades and stationary vanes having an airfoil extending into the flow of compressed air or flow of hot combustion gases. Each blade or vane has a particular set of design criteria which must be met to provide the necessary work to the flow passing through the compressor and the turbine. However, due to the severe nature of the operating environment, especially in the turbine, it is often necessary to cool these blades and vanes. The blades and vanes often utilize complex internal cooling passageways in order to maximize the efficiency of cooling fluid passing therethrough. The internal cooling passageways are often operably linked to external cooling holes in the blade or vane which, during gas turbine engine operation, expel the cooling fluid from the internal cooling passageway to cool the blade or vane.

[0052] FIG. **1** shows a gas turbine component that is a blade **10**. The blade **10** generally includes an airfoil **12** extending from a top or gas path side surface **14** of a platform **16** and a root fixing portion or "dovetail" **18** depending from an undersurface **20** of the platform **16**. The dovetail **18** may include one or more serrations or tangs **22** that extend laterally from one side **23**A of the dovetail **18** to an opposing side **23**B of the dovetail **18**. The dovetail **18** may terminate at a terminal or bottom wall **25** that may span between the dovetail sides **23**A and **23**B. The dovetail **18**, including the tangs **22** and the bottom wall **25** thereof, may be adapted for interlocking engagement in a corresponding slot defined in the periphery of a hub of a turbine rotor.

[0053] The airfoil **12** may have a pressure side **26**, a suction side **27** opposite the pressure side **26**, a tip **28**, a leading edge **29**, and a trailing edge **31**. The tip **28** may include or may be configured to interact with a shroud. The shroud may be provided at the tip **28** of each blade **10**, or may be a stationary ring including one or more circumferentially extending sections each connected to the gas turbine casing. The shroud(s) may be configured to seal the gap between the tip **28** of the blade **10** and stationary components (e.g., stators) of the turbine, and thereby, may reduce leakage flow between the rotating and stationary components. The airfoil **12**, e.g., the pressure side **26** thereof, may come into contact with combustion gases that are at an extremely high temperature. The airfoil **12** or portions thereof may therefore be coated with heat-resistant, wear-resistant, and/or other coatings. During operation, the tip **28** may rub against the tip shroud, and the tip **28** may therefore additionally or alternately be coated with wear-resistant coatings. In like fashion, one or more other portions of the blade **10** may be coated with different materials depending on the environment in which these portions are located and the stresses encountered thereby.

[0054] The bottom wall **25** of the dovetail **18** may include one or more air inlet apertures **30**. Further, one or more portions of the blade **10** may include cooling holes **32** for cooling the blade **10** during operation. The cooling holes **32** may be provided on one or more surfaces of the airfoil **12**, such as the pressure side **26**, the suction side **27**, the tip **28**, the leading edge **29**, the trailing edge **31**, or a combination thereof. The cooling holes **32** may be circular cooling holes, diffused (e.g., angled) cooling holes, cooling slots, or take on one or more other regular or irregular shapes. Cooling gas may pass through internal cooling channels (not illustrated for ease of description) in the blade **10** and emerge from the cooling holes **32** to create a blanket of thin film over the outer surface of the airfoil **12**, thus preventing direct contact of the hot gases and the surfaces of the blade **10**. For example, the illustrated blade **10** has air inlet apertures **30** in the bottom wall **25** of the dovetail **18** and cooling holes **32** on the pressure side **26** of the airfoil **12**. The blade **10**, including the airfoil **12** thereof, may include hollow interior passages for the passage of cooling air, for example, but not limited to, from air inlet apertures **30** to cooling holes **32**. Thus, cooling air may be bled from the compressor and channeled into the air inlet apertures **30**. This air may exit out the cooling holes **32** to cool one or more portions of the blade **10** during operation. One having skill in the art will understand that different blades may have differing cooling schemes and that the inlet apertures **30** and cooling holes **32** in FIG. **1** are merely exemplary and not intended to be independently limiting.

[0055] FIG. **2** shows a gas turbine vane **10'**. Where the blade **10** may be designed as a rotating or moving component of the gas turbine engine, the vane **10'** may be intended as a stationary component of the gas turbine engine. The vane **10'** generally includes one or more airfoils **12'** extending between a bottom surface **11**B' of a top platform **11'** and a top surface **13**T' of a bottom platform **13'**. The airfoils may generally extend from a front or leading end **10**F' of the top platform **11'** and bottom platform **13'** to a rear or trailing end **10**R' of the top platform **11'** and bottom platform **13'**. The top platform **11'** and bottom platform **13'** may be adapted for interlocking engagement with a corresponding portion of the gas turbine engine (e.g., a corresponding slot defined in an area of the gas turbine engine adjacent the area of the gas turbine engine where one or more blades **10** are located). The vane **10'** may include one or more non-gas path surfaces, such as a top surface **11**T' of the top platform **11'**, a perimeter **11**P' of the top platform **11'**, a bottom surface **13**B' of the bottom platform **13'**, and a perimeter **13**P' of the bottom platform **13'**. These non-gas path surfaces may, in some aspects, have features for securing the vane **10'** to other parts of gas turbine engine.

[0056] Each of the airfoils **12'** may have a pressure side **26'**, a suction side **27'** opposite the pressure side **26'**, a tip **28'** engaged with the bottom surface **11**B', a leading edge **29'**, and a trailing edge **31'**. The top platform **11'** and bottom platform **13'** may be a part of a stationary ring including one or more circumferentially extending sections each connected to the gas turbine casing. The airfoils **12'**, e.g., the pressure sides **26'** thereof, may come into contact with combustion gases that are at an extremely high temperature. The airfoils **12'** or portions thereof may therefore be coated with heat-resistant, wear-resistant, and/or other coatings. In like fashion, one or more other portions of the vane **10'** may be coated with different materials depending on the environment in which these portions are located and the stresses encountered thereby.

[0057] Like the blade **10**, one or more portions of the vane **10'** may include cooling holes **32'** for cooling the vane **10'** during operation. The cooling holes **32'** may be provided on one or more surfaces of the airfoils **12'**, such as the pressure side **26'**, the suction side **27'**, the leading edge **29'**, the trailing edge **31'** (e.g., cooling holes **32**T'), or a combination thereof. The cooling holes **32'** may alternately or additionally be located on other portions of the vane **10'**, such as along the top surface **13**T' of the bottom platform **13'**. The cooling holes **32'** may be circular cooling holes, diffused (e.g., angled) cooling holes, cooling slots, or take on one or more other regular or irregular shapes. Cooling gas may pass through internal cooling channels (not illustrated for ease of description) in the vane **10'** and emerge from the cooling holes **32'** to create a blanket of thin film over outer surfaces of the vane **10'**, e.g., over the airfoils **12'**, the bottom surface **11**B', the top surface **13**T', et cetera, thus preventing direct contact of the hot gases and those surfaces. For example, the illustrated vane **10'** may have air inlet apertures (not illustrated for ease of description) in the top platform **11'** and/or the bottom platform **13'**. The vane **10'**, including the airfoils **12'** thereof, may include hollow interior passages for the passage of cooling air, for example, but not limited to, to cooling holes **32'**. Thus, cooling air may be bled from the compressor and channeled through to the cooling holes **32'**. This air may exit out the cooling holes **32'** to cool one or more portions of the vane **10'** during operation. One having skill in the art will understand that different vanes **10'** may have differing cooling schemes and that the inlet apertures and cooling holes **32'** in FIG. **2** are merely exemplary and not intended to be independently limiting.

[0058] A gas turbine component, such as the blade **10** or the vane **10'**, may be manufactured using investment casting, also referred to in the art as lost-wax processing. The investment casting process may involve making a precise negative die of the blade shape that is filled with wax to form the blade or vane shape. If the component, such as the blade **10** or the vane **10'**, is hollow and has interior cooling passages, a ceramic core in the shape of the cooling passages may be inserted into the middle. The wax blade or vane may be coated with a heat-resistant material to make a shell, and then that shell may be filled with a metal alloy.

[0059] Once cast, the blade **10** or the vane **10'** may undergo one or more finishing processes to prepare the blade **10** or vane **10'** for operation. The finishing processes may ensure that the blade **10** or the vane **10'** has the required aerodynamic profile, which may impact engine efficiency and fuel consumption. The finishing processes may also make the blade **10** or vane **10'** more resistant to fatigue, and thereby increase the lifespan of the blade **10** or vane **10'**. Some finishing processes may reduce the maintenance requirements associated with the blade **10** or vane **10'**.

[0060] Finishing the blade **10** or vane **10'** may include coating one or more surfaces of the blade **10** or vane **10'**. For example, one or more surfaces of the blade **10** or vane **10'** may be blasted with abrasive media to configure these surfaces to accept coatings, and thereafter, heat-resistant, wear-resistant, and/or other coatings may be applied to these surfaces of the blade **10** or vane **10'**. Some non-limiting examples of coating methods which may be used in the finishing processes include low pressure plasma spraying methods, electron beam physical vapor deposition methods, pack aluminide methods, vapor phase aluminide methods, chromide coating methods, ceramic or metallic coating method et cetera. Finishing the blade **10** or vane **10'** may also include deburring and breaking sharp edges, polishing one or more surfaces of the blade **10** or vane **10'** to remove excess material, welding, brazing, or otherwise associating another feature with the blade **10** or vane **10'**, machining one or more surfaces of the blade **10** or vane **10'**, coating one or more surfaces of the blade **10** or vane **10'**, and so on. The term "finishing" and the phrase "surface finishing", as used herein, includes any one of the one or more processes that may be used to alter a manufactured component to cause it to achieve a certain property. For example, finishing the blade **10** or vane **10'** includes the one or more processes undergone by the blade **10** or vane **10'** (e.g., media blasting, brazing, coating, machining, et cetera) after it is cast to prepare the blade **10** or vane **10'** for operation in a gas turbine.

[0061] Many of the coatings applied in a finishing process are intended to cover only a specific part or portion of the gas turbine component. For example, for the blade **10**, a heat-resistant coating may be intended to cover the pressure side **26** of the airfoil **12** while avoiding cooling holes **32**T arranged near the trailing edge **31**. If the protective coating is unintentionally applied to cooling holes **32**T, the protective coating may clog the cooling holes **32**T and preclude cooling air from exiting cooling holes **32**T. Similarly, for the vane **10'**, a heat-resistant coating may be intended to cover some or all of the one or more airfoils **12'** while avoiding the top platform **11'** and bottom platform **13'**. As another example, a finishing process, such as a media blasting process, may only be intended to affect the airfoil **12** of blade **10**, and not to other portions thereof, such as the dovetail **18**, as media blasting these portions may negatively impact performance of blade **10**. To ensure that a process, such as a finishing process, impacts only a particular portion or portions of a component, such as blade **10** or vane **10'**, one or more masking systems may be used to mask, cover, or protect the portions of the component that are not intended to be impacted by the finishing process.

[0062] Some finishing processes involve diffusing a coating material into one or more surfaces of a component at a high temperature over an extended period of time, such as low-pressure plasma spray methods, electron beam physical vapor deposition methods, aluminum powder diffusion, et cetera. The medium used to coat the component may be a gas, and as such, any gap or opening between the masking system and the component may allow contact between the coating and the component. To prevent such gaps or openings from allowing the finishing process from unintentionally coating an area of the component, a slurry of material, e.g., an aluminum oxide material, may be packed in between the masking system and component. The slurry of material may deform to cover those areas of the component that would otherwise be exposed to the medium by the gaps or openings of the masking system. To be able to pack the slurry between the masking system and the component held therein, some masking systems may be designed specifically for the injection of slurry, e.g., include injection ports for the insertion of slurry into the masking system.

[0063] Some masking systems used to shield portions of components, e.g., gas turbine components such as the blade **10** or the vane **10'**, during a finishing process are constructed of a polymer-based material. Masking systems made of polymer-based material may be relatively cheap and may be easier to manufacture compared to metallic masking systems. However, polymer-based masking systems may be susceptible to damage when subjected to finishing processes involving high-temperatures, e.g., a high-temperature coating process. A high temperature coating process may involve heating one or more materials to temperatures of, for example, between about 260° C. to about 320° C., and up to about 1100° C. A masking system constructed of a polymer-based material, when heated to such temperatures, may deform, distort, or otherwise lose its shape during the high-temperature coating process, which may result in portions of the component undergoing the coating process to unintentionally receive the coating. For this reason, masking systems made of polymer-based materials are typically ruled out for high-temperature processes, including high-temperature coating processes.

[0064] To withstand the high temperatures that may be encountered during a finishing process, some masking systems are manufactured from metal. For example, masking systems may be manufactured using sheet metal fabrication techniques. It may be unduly laborious and time-consuming to fabricate a masking system using sheet metal fabrication techniques. In some cases, sheet metal fabrication of a masking system may take about two to four weeks. Furthermore, masking systems constructed from sheet metal may not be suitably durable, and may deform during the high-temperature process (e.g., a high-temperature coating process) and cause damage to the component undergoing the high-temperature process.

[0065] Masking systems may also be manufactured using investment casting techniques. Masking systems manufactured using investment casting techniques may be more durable than masking systems manufactured using sheet metal fabrication techniques, and may be reused for a plurality of finishing processes. Further, a large number of masking systems may be made using investment casting for relatively low cost after the initial casts have been formed. However, designing and constructing these casts is a lengthy process involving a long lead time, e.g., around twelve weeks or more. Furthermore, if a given design profile for a masking system is used and found to be inadequate, i.e., the masking system formed from that design profile does not properly shield the intended areas of the gas turbine component, then a large amount of time and effort must be expended to restructure the design profile and fabricate a new masking system.

[0066] FIGS. **3-23** show masking systems for masking components (e.g., gas turbine or other components) undergoing one or more finishing processes. The finishing process may be a high-temperature processes, such as a high-temperature coating process. Specifically, FIGS. **3-7**, **8-11**, and **12-20** respectively show a masking system **100**, a masking system **200**, and a masking system **300** for masking blade **10** undergoing a finishing process (e.g., a high-temperature coating process), and FIGS. **21-23** show a masking system **400** for masking vane **10'** undergoing a finishing process (e.g., a high-temperature coating process).

[0067] In aspects of the disclosure, one or more of masking system **100**, masking system **200**, masking system **300**, and masking system **400** may be additively manufactured as discussed herein. In some examples, one or more of the masking system **100**, masking system **200**, masking system **300**, and/or masking system **400** may be additively manufactured and employed to mask a component undergoing a high-temperature process. Alternately or in addition, one or more of the masking system **100**, masking system **200**, masking system **300**, and/or masking system **400** may be used as prototypes for masking systems that are subsequently investment casted or fabricated using other techniques. For example, a prototype of masking system **100** may be used to mask blade **10** undergoing a high-temperature process, and the protype may be tested, e.g., using spectrometer, blue light, or other methods now known or subsequently developed, to determine the viability of masking system **100**. One or more features of the protype may be redesigned to improve one or more characteristics (e.g., masking characteristics, durability, usability, et cetera) of masking system **100**. Once the design of an additively manufactured masking system **100** (and/or of the masking system **200**, masking system **300**, or masking system **400**) is finalized, the additively manufactured masking system **100** may be used to mask blade **10** undergoing one or more high-temperature processes and may also be used to facilitate fabrication of the masking system **100** using other techniques (e.g., investment casting or other methods now known or subsequently developed). For instance, a masking system **100** that is additively manufactured may be used to fabricate production tooling for manufacturing masking systems **100** using investment casting techniques.

[0068] Focus is directed to FIGS. **3-8** which show masking system **100** for selectively masking blade **10** undergoing a high-temperature process. In some examples, masking system **100** may shield or otherwise protect one or more non-gas path surfaces of blade **10**. In non-limiting aspects of the disclosure, masking system **100** may have a first shell half **100**A and a second shell half **100**B. First shell half **100**A and second shell half **100**B may be brought together and secured to each other to encapsulate a portion of the blade **10** (see FIG. **8**) within an interior **100**I of first shell half **100**A and second shell half **100**B. For example, a fastener may be inserted through tabs associated with the first shell half **100**A and second shell half **100**B as discussed herein to securely retain blade **10** within interior **100**I. One example of a fastener usable for securing first shell half **100**A and second shell half **100**B may be the interlocking clips **500** depicted in FIGS. **25** and **26**.

[0069] In some examples, first shell half **100**A and second shell half **100**B may overlap or cover each other when they are brought into contact with each other. For instance, first shell half **100**A may have a first side wall **102**A (see FIG. **4**) and a second side wall **104**A (see FIG. **5**) that respectively overlap a first side wall **102**B (see FIG. **4**) and a second side wall **104**B (see FIG. **5**) of the second shell half **100**B when first shell half **100**A and second shell half **100**B are brought into contact with each other. Overlapping side walls may provide for a suitable seal as the blade **10** retained within the masking system **100** undergoes a finishing process, such as a coating process. An improper seal may allow coating material to penetrate the masking system **100** and improperly coat portions of the blade **10**.

[0070] The masking system **100** may also have a protrusion **120**. The protrusion **120** may extend from the second shell half **100**B as illustrated and/or the first shell half **100**A. In the illustrated embodiment, the protrusion **120** may extend along and mask the trailing edge **31** of blade **10** while blade **10** is seated within masking system **100** (see FIG. **8**).

[0071] Focus is directed to FIGS. **4-7**, which show the masking system **100** in greater detail according to some aspects of the disclosure. The masking system **100** may cover (e.g., shield or envelope) one or more portions of a gas turbine component, such as the blade **10**, and protect the one or more portions of the blade **10** from inadvertently being impacted by a finishing process, such as coating. In the embodiment illustrated in FIG. **8**, the masking system **100** is shown covering and protecting the dovetail **18** and the trailing edge **31** of a blade **10**, while leaving the airfoil **12** thereof substantially exposed. In other examples of the disclosure, the masking system may protect one or more other surfaces of the blade **10** or another component (such as a gas turbine vane or other component).

[0072] As best shown in FIG. **6**, the first shell half **100**A may have the first side wall **102**A, the second side wall **104**A opposing first side wall **102**A, a top wall **106**A extending laterally between first side wall **102**A and second side wall **104**A, and an end wall **108**A extending vertically between first side wall **102**A and second side wall **104**A. The top wall **106**A may have an edge **106**AE. The shape of edge **106**AE may generally correspond to a profile of the airfoil **12**, e.g., on the suction side **27** of the blade **10**. In some aspects, edge **106**AE may be tapered.

[0073] The first shell half **100**A may include a lip **107** which extends from one or more of first side wall **102**A, second side wall **104**A, top wall **106**A, and/or end wall **108**A. The first shell half **100**A may further include a shelf **109**A that extends from an interior **108**AI of end wall **108**A. The shelf **109**A may assist in retaining the component within the masking system **100**. For example, the shelf **109**A may contact the dovetail **18** of a blade **10** seated in the interior **100**I.

[0074] The second shell half **100**B (see FIG. **7**) may have a first side wall **102**B, a second side wall **104**B opposing first side wall **102**B, a top wall **106**B, an end wall **108**B extending vertically between first side wall **102**B and second side wall **104**B, a bottom wall **103** extending laterally between first side wall **102**B and second side wall **104**B, and a mounting portion **110** extending from bottom wall **103**. The top wall **106**B may have an edge **106**BE that has a shape which generally corresponds to a profile of the blade **10**. For example, the shape of edge **106**BE may generally correspond to a profile of the airfoil **12**, e.g., on the pressure side **26** of the blade **10**. In some aspects, edge **106**BE may be tapered.

[0075] The second shell half **100**B may further include protrusion **120** having a profile **120**P. The protrusion **120** may extend from a protrusion base **120**R located on top wall **106**B. In some aspects, the protrusion base **120**R may be located proximate, at, or along the edge **106**BE. The second shell half **100**B may further include a shelf **109**B that extends from an interior **108**BI of end wall **108**A. The shelf **109**B may assist in retaining the component within the masking system **100**. For example, the shelf **109**B may contact the dovetail **18** of a blade **10** seated in the interior **100**I.

[0076] The mounting portion **110** may be usable for securing the masking system **100** to a stabilizing structure (not shown, e.g., a table, a tool, a vice, et cetera) to prevent motion of masking system **100** while the blade **10** retained therein undergoes a finishing process. The mounting portion **110** may have any suitable arrangement and number of openings, slots, apertures, et cetera, to allow for the masking system **100** to be coupled to the stabilizing structure.

[0077] Connecting members or tabs may be provided on each of the first shell half **100**A and second shell half **100**B to allow first shell half **100**A to be secured to second shell half **100**B while blade **10** is retained within masking system **100**. In some examples, first shell half **100**A may have a first tab **112**A (FIG. **6**) that extends from first side wall **102**A and the second shell half **100**B may have a third tab **112**B (FIG. **7**) that extends from first side wall **102**B. First tab **112**A of first shell half **100**A may correspond to third tab **112**B of second shell half **100**B when first shell half **100**A and second shell half **100**B are brough into contact with each other. In some examples, first shell half **100**A may further include a second tab **114**A that extends from second side wall **104**A, and the second shell half **100**B may have a fourth tab **114**B that extends from second side wall **104**B. The second tab **114**A of first shell half **100**A may correspond to fourth tab **114**B of second shell half **100**B when first shell half **100**A and second shell half **100**B are brough into contact with each other. Each of first tab **112**A, third tab **112**B, second tab **114**A, and fourth tab **114**B may have an opening therein for the reception of a fastener, e.g., one or more interlocking clips **500** (see FIGS. **25-26**). For instance, at least one interlocking clip **500** may be inserted within each of first tab **112**A and third tab **112**B, and at least one interlocking clip **500** may be inserted within each of second tab **114**A and fourth tab **114**B. In this manner, the first shell half **100**A and the second shell half **100**B may be locked and relative movement therebetween may be mitigated or precluded. In some aspects, first tab **112**A, third tab **112**B, second tab **114**A, and fourth tab **114**B may be manufactured using techniques other than additive manufacturing techniques, such as water jet cutting techniques, and may be secured to first shell half **100**A and second shell half **100**B using welding, adhesive, or other suitable techniques.

[0078] FIG. **8** illustrates a device **90**, e.g., a nozzle, an electron beam, et cetera, applying a coating **95** in direction A to certain portions of blade **10**. In some cases, and as depicted in FIG. **8**, the protrusion **120** may directionally shield one or more sections of the blade **10**, e.g., the trailing edge **31**, during the coating process. The profile **120**P of protrusion **120** may be configured to selectively shield certain portions of the blade **10** (e.g., may be configured to fully or partially shield trailing edge **31** of blade **10**) from coating **95**, and may also be configured to selectively direct or redirect coating **95** to other portions of blade **10**. The profile **120**P of the protrusion **120** may therefore allow a user to define and control the coating distribution pattern (i.e., the density and location of the coating **95**) applied to the blade **10**.

[0079] FIG. **8** shows the pressure side **26** of airfoil **12** divided into three regions-a trailing region **10**T, a middle region **10**M, and a leading region **10**L. In an example, the profile **120**P of protrusion **120** may be designed to allow for coating **95** to be applied by device **90** such that trailing region **10**T receives less coating **95** than the leading region **10**L. In some examples, the profile **120**P of the protrusion **120** may be designed to allow for coating **95** to be applied such that trailing region **10**T receives less coating **95** than the middle region **10**M and the leading region **10**L. Coating **95** may be selectively applied to various regions of the blade **10**, and the amount of coating **95** applied to various regions of the blade **10** may be controlled. The distribution of coating **95** on various portions (e.g., leading region **10**L, middle region **10**M, and trailing region **10**T) of the blade **10** may therefore be defined and controlled by altering the profile **120**P of protrusion **120**.

[0080] FIG. **8** shows the profile **120**P of protrusion **120** has a generally trapezoidal shape. Such may allow for a particular distribution of coating **95** on the blade **10**. The shape of the protrusion **120** may be changed to effectuate coating **95** having a different distribution or pattern. For example, the protrusion **120** may be made semi-circular, elliptical, polygonal, cylindrical, et cetera, as desired, to selectively apply coating **95** to blade **10** in the desired distribution. In some examples, the location and/or size of the protrusion **120** may also be altered in line with the desired distribution of the coating **95**.

[0081] To determine a profile **120**P of protrusion **120** that yields the desired coating distribution, a user may manufacture and test masking systems **100** having protrusions **120** with different profiles. This prototyping process may be arduous and costly when the masking systems **100** are manufactured using legacy manufacturing techniques (e.g., injection molding, sheet metal fabrication, investment casting, et cetera). Manufacturing the masking systems **100** using additive manufacturing techniques as discussed herein may allow for differently configured protrusions **120** to be tested quickly, cheaply, and efficiently to determine the profile **120**P of protrusion **120** that is optimal for the application at hand.

[0082] While the masking system **100** depicted herein uses the protrusion **120** to mask or cover trailing edge **31** of blade **10**, in some examples, the protrusion **120** may alternately or additionally be configured to mask or cover the leading edge **29** of blade **10**. In some examples, a protrusion (e.g., protrusion **120**) may selectively mask or cover each of the leading edge **29** and trailing edge **31**, and these two protrusions may collectively control the distribution pattern of the coating **95** on the various surfaces of blade **10**. Further, while the figures show the protrusion **120** disposed on second shell half **100**B, one or more protrusions may likewise extend from first shell half **100**A or another portion of masking system **100**.

[0083] FIGS. **9-12** show a masking system **200** in another aspect of the disclosure. The masking system **200** may be similar to masking system **100**, except as noted and/or shown. Corresponding parts may be denoted with corresponding reference numerals, though with any noted deviations. One difference between masking system **200** and masking system **100** may be that masking system **200** may have a protrusion **220** having a profile **220**P that differs from the profile **120**P of protrusion **120** of masking system **100**. In the example illustrated in FIG. **9**, the profile **220**P of protrusion **220** is shown to be spherical. As discussed, protrusion **220** with a spherical profile **220**P may result in a coating gradient or distribution that is different from a coating gradient or distribution produced by the protrusion **120** having the profile **120**P.

[0084] In non-limiting aspects of the disclosure, masking system **200** may have a first shell half **200**A and a second shell half **200**B. First shell half **200**A and second shell half **200**B may be brought together to encapsulate a portion of the blade **10** within an interior **200**I of first shell half **200**A and second shell half **200**B. First shell half **200**A and second shell half **200**B may be secured to each other to retain a component therein. The masking system **200** may further include a protrusion **220** that extends from one of the first shell half **200**A and the second shell half **200**B. The masking system **200** may be configured to selectively shield, cover, or protect one or more portions of the blade **10**.

[0085] In the embodiment illustrated in FIGS. **11** and **12**, the first side wall **202**A and second side wall **204**A of first shell half **200**A may extend over and overlap one or more portions of the second shell half **200**B. For example, first side wall **202**A of first shell half **200**A may extend over and overlap first side wall **202**B of second shell half **200**B, and second side wall **204**A of first shell half **200**A may extend over and overlap second side wall **204**B of second shell half **200**B, when first shell half **200**A and second shell half **200**B are brought into contact with each other. Overlapping side walls may provide for a suitable seal as the blade **10** retained within the masking system **200** undergoes a finishing process, such as a coating process. An improper seal may allow coating material to penetrate the masking system **200** and improperly coat portions of the blade **10** not intended to be coated.

[0086] The first shell half **200**A may have a first side wall **202**A, a second side wall **204**A opposing first side wall **202**A, a top wall **206**A extending laterally between first side wall **202**A and second side wall **204**A, and an end wall **208**A extending vertically between first side wall **202**A and second side wall **204**A. The top wall **206**A may have an edge **206**AE that has a shape which generally corresponds to a profile of the blade **10**, e.g., the shape of edge **206**AE shape may generally correspond to a profile of airfoil **12** (e.g., on the suction side **27**) of blade **10**. In some aspects, edge **206**AE may be tapered.

[0087] The first shell half **200**A may include a lip **207** which extends from one or more of first side wall **202**A, second side wall **204**A, top wall **206**A, and/or end wall **208**A. The first shell half **200**A may further include a shelf **209**A that extends from an interior **208**AI of end wall **208**A. The shelf **209**A may assist in retaining the component within the masking system **200**, e.g., by contacting the dovetail **18** of a blade **10** seated in the interior **200**I.

[0088] The second shell half **200**B (see FIGS. **10** and **12**) may have a first side wall **202**B, a second side wall **204**B opposing first side wall **202**B, a top wall **206**B, an end wall **208**B vertically extending between first side wall **202**B and second side wall **204**B, a bottom wall **203** extending laterally between first side wall **202**B and second side wall **204**B and opposing top wall **206**B, and a mounting portion **210** extending from bottom wall **203**. The top wall **206**B may have an edge **206**BE that has a shape which generally corresponds to a profile of the blade **10**. For example, the shape of edge **206**BE may generally correspond to a profile of the airfoil **12** (e.g., on the pressure side **26**) of the blade **10**. In some aspects, edge **206**BE may be tapered.

[0089] The second shell half **200**B may further include protrusion **220** having profile **220**P. The protrusion **220** may extend from a protrusion base **220**R located on top wall **206**B. In some aspects, the protrusion base **220**R may be located at or along edge **206**BE. The second shell half **200**B may further include a shelf **209**B that extends from an interior **208**BI of end wall **208**B. The shelf **209**B may assist in retaining the blade **10** within the masking system **200**, e.g., by contacting dovetail **18** of the blade **10** seated in interior **200**I.

[0090] The mounting portion **210** may be usable for securing the masking system **200** to a stabilizing structure (not shown, e.g., a table, a tool, a vice, et cetera) to prevent undue motion of masking system **200** during operation, such as while performing a finishing process on the blade **10** retained within masking system **200**. The mounting portion **210** may have any suitable arrangement and number of openings, slots, apertures, et cetera, to allow for the masking system **200** to be coupled to the stabilizing structure.

[0091] To allow for securement of second shell half **200**B to first shell half **200**A, the first shell half **200**A may have a first tab **212**A (FIG. **11**) that extends from first side wall **202**A and the second shell half **200**B may have a third tab **212**B (FIG. **12**) that extends from first side wall **202**B. The first tab **212**A of first shell half **200**A may correspond to third tab **212**B of second shell half **200**B when first shell half **200**A and second shell half **200**B are brought into contact with each other. In some examples, the first shell half **200**A may further include a second tab **214**A extending from second side wall **204**A, and the second shell half **200**B may have a fourth tab **214**B extending from second side wall **204**B. The second tab **214**A of first shell half **200**A may correspond to fourth tab **214**B of second shell half **200**B when first shell half **200**A and second shell half **200**B are brought into contact with each other. Each of first tab **212**A, third tab **212**B, second tab **214**A, and fourth tab **214**B may have an opening therein for the reception of a fastener, e.g., one or more interlocking clips **500** (see FIGS. **25-26**). For instance, at least one interlocking clip **500** may be inserted within each of first tab **212**A and third tab **212**B, and at least one interlocking clip **500** may be inserted within each of second tab **214**A and fourth tab **214**B. In this manner, the first shell half **200**A and the second shell half **200**B may be locked and relative movement therebetween may be mitigated or precluded. In some aspects, first tab **212**A, third tab **212**B, second tab **214**A, and fourth tab **214**B may be manufactured using techniques other than additive manufacturing techniques, such as water jet cutting techniques, and may be secured to first shell half **200**A and second shell half **200**B using welding.

[0092] As shown in FIG. **8** with respect to masking system **100**, the masking system **200** may likewise house blade **10** such that protrusion **220** selectively masks trailing edge **31** of blade **10**. In some examples, the protrusion **220** may alternately or additionally be configured to mask or cover the leading edge **29** of blade **10**. In some examples, a protrusion (e.g., protrusion **220**) may selectively mask or cover each of the leading edge **29** and trailing edge **31**, and these two protrusions may collectively control the distribution pattern of the coating **95** on the various surfaces of blade **10**. Further, while the figures show the protrusion **220** disposed on second shell half **200**B, one or more protrusions may likewise extend from first shell half **200**A or another portion of masking system **200**. The profile **220**P of protrusion **220** of masking system **200** may provide for a different coating distribution on blade **10** as compared to profile **120**P of protrusion **120** of masking system **100**.

[0093] FIGS. **13-21** show a masking system **300** or components thereof in another aspect of the disclosure. The masking system **300** may be similar to masking system **100**, except as noted and/or shown. Corresponding parts may be denoted with corresponding reference numerals, though with any noted deviations. One difference between masking system **300** and masking system **100** may be that masking system **300** may have a protrusion **320** having a profile **320**P that differs from the profile **120**P of protrusion **120** of masking system **100**. In the example illustrated in FIG. **13**, the profile **320**P may be spherical. As discussed, a protrusion **320** with a spherical profile **320**P may result in a coating gradient or distribution that is different from a coating gradient or distribution produced by protrusion **120** having profile **120**P. Another difference between masking system **300** and masking system **100** may be that masking system **300** may have one or more detachable parts. For example, masking system **300** may have a mounting handle **310** that may be readily detachable from the rest of masking system **300**, e.g., a second shell half **300**B thereof. Further, protrusion **320** may also be readily detachable from the rest of masking system **300**, e.g., a second shell half **300**B thereof. The detachability of parts of masking system **300**, such as the mounting handle **310** and the protrusion **320**, may allow for these parts to be readily replaced, e.g., when they are in need of repair, without having to fabricate an entirely new masking system **300**. Furthermore, protrusion **320** may be readily replaced with another protrusion **320** having a different profile than the profile **320**P, and therefore, the distribution of coating on the blade **10** may be changed without having to replace the entire masking system **300**.

[0094] In the embodiment illustrated in FIGS. **13** and **14**, a first side wall **302**A and a second side wall **304**A of first shell half **300**A may extend over and overlap one or more portions of the second shell half **300**B. One or more first apertures **312** for the reception of fasteners, e.g., a pin, may be arranged at or on first shell half **300**A, and one or more second apertures **314** for the reception of fasteners, e.g., a pin, may be arranged on second shell half **300**B. The apertures **312** and **314** may be usable with one or more fasteners to secure the first shell half **300**A and the second shell half **300**B together during a finishing process to prevent motion of the first shell half **300**A relative to the second shell half **300**B.

[0095] As shown in FIGS. **13-18**, masking system **300** may have a first shell half **300**A and a second shell half **300**B. First shell half **300**A (see FIGS. **13-17**) may have a first side wall **302**A, a second side wall **304**A opposing first side wall **302**A, a bottom wall **303**A extending laterally between first side wall **302**A and second side wall **304**A, and an end wall **308**A extending vertically between first side wall **302**A and second side wall **304**A. The first shell half **300**A may further include a shelf **309**A that extends from an interior **308**AI of end wall **308**A. The shelf **309**A may assist in retaining the component within masking system **300**, e.g., by contacting the dovetail **18** of a blade **10** seated in interior **300**I.

[0096] The second shell half **300**B (see FIGS. **15** and **18**) may have a first side wall **302**B, a second side wall **304**B opposing first side wall **302**B, a top wall **306**B extending laterally between first side wall **302**B and second side wall **304**B, an end wall **308**B extending vertically between first side wall **302**B and second side wall **304**B, a bottom wall **303**B extending laterally between first side wall **302**B and second side wall **304**B, and a mounting portion **307** extending from bottom wall **303**B. The top wall **306**B, in some aspects, may have an edge **306**BE that has a shape which generally corresponds to the blade **10**, e.g., the shape of the edge **306**BE may generally correspond to a profile of the platform **16** of the blade **10**. The second shell half **300**B may include a shelf **309**B (FIG. **18**) that extends from an interior **308**BI of end wall **308**B. The shelf **309**B may assist in retaining the component within the masking system **300**, e.g., by contacting dovetail **18** of a blade **10** seated in the interior **300**I.

[0097] In some examples, the second shell half **300**B may include a notch **311** (see FIG. **16**) having a first face **308**AB and a second face **308**BB forming a generally V-shape and configured to receive protrusion **320**. A hole **314**H may be extend through first face **308**AB and second face **308**BB for the reception of a fastener, e.g., a pin **330** (FIG. **15**).

[0098] The mounting portion **307** may be usable for securing masking system **300** to a mounting handle **310** to prevent motion of masking system **300** during operation. The mounting handle **310** and the mounting portion **307** may have any suitable arrangement and number of openings, slots, apertures, tabs, et cetera, to allow the mounting handle **310** to be coupled to the mounting portion **307**. For example, the mounting portion **307** may have features **307**F (FIG. **17**), e.g., slots, depressions, et cetera, which correspond to features **310**F (FIG. **19**), e.g., tabs, extensions, et cetera, of the mounting handle **310** for operable coupling therebetween. The mounting handle **310** may, in some examples, include a flared base **315** (FIG. **20**). In some examples, as depicted in FIG. **20**, the mounting handle **310** may have a hollow interior **310**I. The mounting handle **310** may be detachable from the rest of masking system **300** such that the mounting handle **310** may be readily replaced, e.g., in case mounting handle **310** is damaged.

[0099] The protrusion **320** (FIG. **21**) may be a detachable, replaceable part which may be coupled to a portion of masking system **300**, e.g., to the second shell half **300**B. The protrusion **320** may have profile **320**P, and may extend from a protrusion base **320**R of the protrusion **320**. A mountable base **322** may extend from protrusion base **320**R opposite protrusion **320**. The mountable base **322** may have faces **326** and **328** and an aperture **324** extending through the faces **326** and **328**. Collectively, the faces **326** and **328** may generally form a shape (e.g., a V-shape) corresponding to the V-shape formed by first face **308**AB and second face **308**BB (FIG. **16**) of the second shell half **300**B. The aperture **324** may be configured to receive a fastener, e.g., a pin **330** (see FIG. **15**), such that the fastener may operable secure the protrusion **320** to the rest of masking system **300**. The mountable base **322** may be mounted to second shell half **300**B, e.g., may be disposed within notch **311**, such that aperture **324** of mounting base **322** aligns with hole **314**H in second shell half **300**B. A fastener, e.g., pin **330**, may be removably inserted through aperture **324** and hole **314**H to secure mountable base **322** to second shell half **300**B. The mountable base **322** may be disassociated from second shell half **300**B by removing pin **330**. The removable mountable base **322** may allow for different protrusions **320** having disparate profiles to be associated with masking system **300**.

[0100] As shown in FIG. **8** with respect to masking system **100**, masking system **300** may encapsulate blade **10** such that protrusion **320** masks trailing edge **31** of blade **10** and controls the distribution of coating **95** on blade **10**. In some examples, the protrusion **320** may alternately or additionally be configured to mask or cover the leading edge **29** of blade **10**. In some examples, protrusions may selectively mask or cover each of the leading edge **29** and trailing edge **31**, and these two protrusions may collectively control the distribution pattern of the coating on the various surfaces of blade **10**. Further, while the figures show the protrusion **320** disposed on second shell half **300**B, one or more protrusions may likewise extend from first shell half **300**A or another portion of masking system **300**.

[0101] Focus is now directed to FIGS. **22A-24**B, which depict a masking system **400** or portions thereof for covering or protecting one or more surfaces, e.g., non-gas path surfaces, of a vane **10'** during a finishing process. In some aspects, the masking system **400** may include a first shell **400**A (FIG. **22**B) configured to shield the top surface **11**T' (FIG. **2**) and perimeter **11**P' of top platform **11'**, and a second shell **400**B (FIG. **22**A) configured to shield the bottom surface **13**B' and perimeter **13**P' of the bottom platform **13'**. FIG. **22**C shows the masking system **400**, i.e., the first shell **400**A and second shell **400**B thereof, covering non-gas path surfaces of vane **10'** such that airfoils **12'** of vane **10'** are exposed.

[0102] The first shell **400**A may include a first side wall **402**A (FIG. **23**A), a second side wall **404**A opposing first side wall **402**A, a first end wall **406**A, a second end wall **408**A opposing first end wall **406**A, and a cover **410**A extending between each of first side wall **402**A, second side wall **404**A, first end wall **406**A, and second end wall **408**A. The first side wall **402**A, second side wall **404**A, first end wall **406**A, and second end wall **408**A may extend out from cover **410**A and may be configured to shield the perimeter **11**P' of the top platform **11'** of vane **10'**. The cover **410**A may have an interior surface **410**AI that has features **410**AF corresponding to top surface **11**T' of the top platform **11'**. For example, the features **410**AF may include one or more peaks **410**AP and one or more recesses **410**AR that correspond to the geometry of the top surface **11**T' of the top platform **11'** such that the interior surface **410**AI may mate with the top surface **11**T' of the top platform **11'**.

[0103] The first shell **400**A may further include an exterior surface **410**AE (FIG. **24**A) opposing the interior surface **410**AI. The exterior surface **410**AE may, in some aspects of the disclosure, have a grid **410**AG formed therein. The grid **410**AG formed in the first shell **400**A may reduce the weight of the first shell **400**A. The grid **410**AG may be, but is not limited to, a hex grid pattern.

[0104] In some aspects, first shell **400**A may further include a first tab **412**A (FIG. **22**C) and second tab **414**A extending from first side wall **402**A, second side wall **404**A, first end wall **406**A, and/or second end wall **408**A. The first tab **412**A and second tab **414**A may be usable with one or more fasteners, e.g., wire tires, for the securement of the first shell **400**A to the second shell **400**B such that the vane **10'** is securely retained within the masking system **400**.

[0105] The second shell **400**B (FIG. **23**B) may include a first side wall **402**B, a second side wall **404**B opposing first side wall **402**B, a first end wall **406**B, a second end wall **408**B opposing first end wall **406**B, and a cover **410**B extending between each of first side wall **402**B, second side wall **404**B, first end wall **406**B, and second end wall **408**B. The first side wall **402**B, second side wall **404**B, first end wall **406**B, and second end wall **408**B may extend out from the cover **410**B and may be configured to shield the perimeter **13**P' of the bottom platform **13'** when secured to vane **10'**. The cover **410**B may have an interior surface **410**BI that has features **410**BF corresponding to the bottom surface **13**B' of the bottom platform **13'**. For example, the features **410**BF may include one or more peaks **410**BP and one or more recesses **410**BR that correspond to a geometry of the bottom surface **13**B' of vane **10**.'

[0106] The second shell **400**B may further include an exterior surface **410**BE (FIG. **24**B) opposing the interior surface **410**BI that, in some aspects, may have a grid **410**BG formed therein. The grid **410**BG may be a pattern formed in the second shell **400**B that reduces the weight of second shell **400**B. The grid **410**BG may be, but is not limited to, a hex grid pattern. In some aspects, the second shell **400**B may further include third tab **412**B and fourth tab **414**B (FIG. **22**C) extending from first side wall **402**B, second side wall **404**B, first end wall **406**B, and/or second end wall **408**B. The third tab **412**B and fourth tab **414**B may be usable with one or more fasteners, e.g., wire tires, for the securement of the masking system **400** during the finishing process. For example, a wire tie or other fastener may be used to secure each of first tab **412**A and third tab **412**B, and another wire tie or fastener may be used to secure each of second tab **414**A and fourth tab **414**B, to secure vane **10'** to masking system **400**.

[0107] In some aspects, the masking system, e.g., the masking system **100**, **200**, **300**, and **400**, may be additively manufactured. Additive manufacturing, also referred to as **3**D printing, may be performed by dividing the shape of a three-dimensional object, e.g., the masking system **100**, **200**, **300**, or **400**, into a number of two-dimensional cross sections having a uniform or variable thickness, and forming the two-dimensional cross sections to be stacked one by one. For example, the masking systems **100**, **200**, **300**, or **400**, or portions thereof, may be additively manufactured using binder jetting, sheet lamination, direct metal laser sintering (DLS), metal digital light processing (DLP), powder bed fusion method, directed energy deposition (DED), et cetera. Any one or more of these methods, or any other additive manufacturing method, now known or hereinafter developed, may be employed to manufacture masking systems **100**, **200**, **300**, and/or **400**. The material used for the additive manufacturing process may be any suitable material, now known or subsequently developed, that can withstand a high-temperature process reaching temperatures above about 260° C., and in some examples, up to about 1100° C. In some non-limiting examples, the masking systems **100**, **200**, **300**, and/or **400** described herein may be manufactured using materials such as an alloy, e.g., a nickel-based super alloy or other alloy. One example of a nickel-based super alloy that may be used in the additive manufacturing process may be Hastelloy® X produced by Haynes international, based in Kokomo, Indiana, or other suitable materials.

[0108] In some non-limiting examples, masking system **100**, masking system **200**, masking system **300**, and/or masking system **400** may be manufactured using laser powder bed fusion. The laser powder bed fusion method may involve using an energy beam, e.g., a laser, on specific points of a bed of metal powder. The energy beam may heat the metal powder until the metal powder reaches or exceeds a melting temperature of the metal powder. The metal powder may then melt and fuse into the desired shape. Once a layer is complete, the bed in which the metallic powder is deposited on may be moved, e.g., lowered, to create room for additional material to be placed on the previously melted layers (e.g., on the already fused portions) for the next layer of the design. The energy beam may be directed through the use of a CAD or other computer design file.

[0109] Additively manufacturing masking systems described herein may provide several benefits. For example, additive manufacturing may be more efficient and cost-effective relative to conventional manufacturing techniques (e.g., injection molding, sheet metal fabrication, et cetera). Further, additive manufacturing may allow for complex shape geometries such as curves, contours, and fillets to be readily manufactured, and the additively masking systems may therefore suitably cover those portions of components (e.g., the blade **10**, vane **10'**, or other components) that are not intended to undergo the finishing process (e.g., high-temperature finishing process). Furthermore, since the additively manufactured masking systems may better fit the components they are intended to selectively cover, the need for the use of an additional slurry injection when shielding the component may be circumvented.

[0110] Further, additive manufacturing, because of its efficiency and cost-effective nature, may allow a user to readily reconfigure and optimize the masking systems **100**, **200**, **300**, and/or **400**. For example, several different protrusions **120** having different shapes and sizes may be readily additively manufactured to achieve different distributions of coating **95** on blade **10**.

[0111] FIGS. **25** and **26** show the interlocking clips **500** in more detail. The interlocking clips **500** may be used to secure together, for example, the first shell half **100**A and the second shell half **100**B of masking system **100**. The interlocking clips **500** may include an outer clip **510** and an inner clip **550** which are both inserted into, for example, the second tab **114**A and fourth tab **114**B of the masking system **100**, as depicted in FIG. **25**. When the interlocking clips **500** are inserted in this fashion, they may serve to lock the first shell half **100**A to the second shell half **100**B such that there is no relative movement therebetween.

[0112] The second tab **114**A and fourth tab **114**B of masking system **100** are shown in more detail in FIG. **26**. The second tab **114**A may include a first slot (or opening) **615** defined by walls **617** and **619**, and fourth tab **114**B may include a second slot (or opening) **625** defined by walls **627** and **629**. As discussed herein, the interlocking clips **500**, i.e., each of the outer clip **510** and the inner clip **550**, may be passed through each of first slot **615** and second slot **625** to temporarily secure first shell half **100**A and second shell half **100**B. Once the finishing process is completed, a user may extract the interlocking clips **500** from the first slot **615** and second slot **625** to release the first shell half **100**A from the second shell half **100**B and liberate the component therein.

[0113] In more detail, the outer clip **510** may be inserted into the first slot **615** and second slot **625** of the tabs, e.g., the second tab **114**A and fourth tab **114**B, such that the outer clip **510** contacts the walls **617** and **619** of the second tab **114**A and walls **627** and **629** of the fourth tab **114**B. The outer clip **510** may be configured to matingly accept the inner clip **550**. The inner clip **550** may be received by the outer clip **510** therein and the inner clip **550** may push the outer clip **510** outwards against the walls **617** and **619** of the second tab **114**A and the walls **627** and **629** of the fourth tab **114**B. In implementations, a tool, such as a vice grip, may be used to further push the outer clip **510** and the inner clip **550** towards the walls **617** and **619** of the second tab **114**A and the walls **627** and **629** of the fourth tab **114**B to cause the tabs of the masking system to be secured to each other such that there is minimal or no relative movement between the tabs. When the finishing process is complete, outer clip **510** and inner clip **550** may be disassociated from each other and second tab **114**A and fourth tab **114**B using, e.g., a pair of pliers or other tool. For instance, outer clip **510** and inner clip **550** may be collectively pulled out of first slot **615** and second slot **625**, and outer clip **510** and inner clip **550** may be disassociated from each other. This unlocking of interlocking clips **500** may be non-destructive and clips **510** and **550** may be reused to subsequently lock the same or a different masking system.

[0114] FIG. **27** shows a flowchart illustrating a method **800** of making and using a masking system, such as the masking system **100**, **200**, **300**, or **400**. At step **802**, the areas or surfaces of a component to be covered during a finishing process are determined. For example, at step **802**, it may be determined that all of the non-gas path surfaces of a gas turbine component are to be covered. In some examples, where the finishing process is a coating process, a desired distribution of coating on the component may also be determined.

[0115] At step **804**, a design profile of the masking system, e.g., the masking system **100**, **200**, **300**, or **400**, may be developed using, for example, CAD software. At step **806**, the masking system, e.g., masking system **100**, **200**, **300**, or **400**, may be additively manufactured. At step **808**, a component, e.g., a gas turbine component, may be associated with the masking system such that at least a portion of the component is protected by the masking system. For example, the dovetail **18** of the blade **10** may be placed inside the masking system **100**, **200**, or **300** for protection from coating **95**. At step **810**, one or more finishing processes may be used to impact exposed portions of the component while the remainder of the component is protected by the masking system. For example, the exposed airfoil **12** of the blade **10** may be coated, machined, deburred, or otherwise finished while the dovetail **18** is shielded by the masking system **100**, **200**, or **300**. Once the finishing is complete, the component (e.g., blade **10**) may be disassociated from the masking system at step **812**. If required, the portion of the component that was shielded by the masking system may now be finished to prepare the component for operation.

[0116] Thus, as has been described, masking system **100**, masking system **200**, masking system **300**, and masking system **400** may protect one or more portions of a component, e.g., a gas turbine component, while one or more exposed portions of the component undergo one or more finishing processes, e.g., a high temperature finishing process. While the masking system embodiments described herein are depicted as being used with a component that is a gas turbine component, e.g., the blade **10** and the vane **10'**, the artisan would understand the masking systems disclosed herein may be readily adapted for use with other components that are to be selectively masked, e.g., when undergoing a finishing process such as a high-temperature coating process.

[0117] Many different arrangements of the various components depicted, as well as components not shown, are possible without departing from the spirit and scope of the present disclosure. Embodiments of the present disclosure have been described with the intent to be illustrative rather than restrictive. Alternative embodiments will become apparent to those skilled in the art that do not depart from its scope. A skilled artisan may develop alternative means of implementing the aforementioned improvements without departing from the scope of the present disclosure.

[0118] It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations and are contemplated within the scope of the claims. Not all steps listed in the various figures need be carried out in the specific order described.

The disclosure claimed is:

1. A masking system for selectively masking a component, the masking system comprising:
- a first shell half;
- a second shell half configured to be secured to the first shell half such that at least a portion of the first shell half overlaps the second shell half when the component is retained by the masking system; and
- a protrusion extending from one of the first shell half and the second shell half, the protrusion configured to cover an edge of the component.

2. The masking system of claim **1**, wherein the protrusion is configured to be removable.

3. The masking system of claim **1** configured to retain the component for a coating process.

4. The masking system of claim **3**, wherein a distribution of coating on the component is defined via a profile of the protrusion.

5. The masking system of claim **3**, wherein the first shell half has a first tab, and the second shell half has a second tab that corresponds to the first tab when the first shell half is brought into contact with the second shell half.

6. The masking system of claim **5**, including a fastener extending through each of the first tab and the second tab.

7. The masking system of claim **5**, including interlocking clips extending through each of the first tab and the second tab.

8. The masking system of claim **1**, wherein the masking system is additively manufactured.

9. The masking system of claim **8**, wherein the component is a component of a gas turbine.

10. The masking system of claim **9**, wherein:

the component is a gas turbine blade; and

the edge is a trailing edge of the gas turbine blade.

11. The masking system of claim **10**, wherein the masking system is configured to mask at least a dovetail of the gas turbine blade.

12. The masking system of claim **1**, wherein the first shell half includes a first shelf, and the second shell half includes a second shelf, each of the first shelf and the second shelf configured to contact the component.

13. The masking system of claim **1**, wherein the masking system further includes a mounting portion for mounting the masking system to a surface.

14. The masking system of claim **13**, wherein the mounting portion is removably coupled to one of the first shell half and the second shell half.

15. An additively manufactured masking system for selectively masking a blade of a gas turbine for a coating process, the masking system comprising:

a first shell half having a wall corresponding to a suction side of the blade;

a second shell half having a wall corresponding to a pressure side of the blade; and

a protrusion extending from one of the first shell half and the second shell half;

wherein, a distribution of coating on the blade during the coating process is defined via a profile of the protrusion.

16. The additively manufactured masking system of claim **15**, wherein the protrusion is removable.

17. The additively manufactured masking system of claim **15**, wherein the protrusion has a generally spherical shape.

18. The additively manufactured masking system of claim **15**, wherein the protrusion has a generally trapezoidal shape.

19. A masking system for selectively masking a component, the masking system comprising:

a first shell having a first cover and a first tab, the first cover having at least a first recess and a first peak, each of the first recess and the first peak corresponding to the component at a first side thereof; and

a second shell having a second cover and a second tab, the second cover having at least a second recess and a second peak, each of the second recess and the second peak corresponding to the component at a second side thereof, the second side opposing the first side.

20. The masking system of claim **19**, wherein the component is a gas turbine vane.

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