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(12) **United States Patent**
Fastabend et al.

(10) **Patent No.: US 9,914,229 B2**
(45) **Date of Patent: Mar. 13, 2018**

(54) **PRODUCE SLICER**

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(73) Assignee: **Prince Castle LLC**, Carol Stream, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 238 days.

(21) Appl. No.: **14/833,744**

(22) Filed: **Aug. 24, 2015**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 62/043,918, filed on Aug. 29, 2014, provisional application No. 62/117,222, filed on Feb. 17, 2015.

(51) **Int. Cl.**
B26D 1/02 (2006.01)
B26D 7/22 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***B26D 1/03*** (2013.01); ***B26D 3/185*** (2013.01); ***B26D 7/0608*** (2013.01); ***B26D 7/225*** (2013.01); *B26D 5/10* (2013.01)

(58) **Field of Classification Search**
CPC B26D 1/03; B26D 7/0608; B26D 7/225; B26D 2007/0018; B26D 2210/02;
(Continued)

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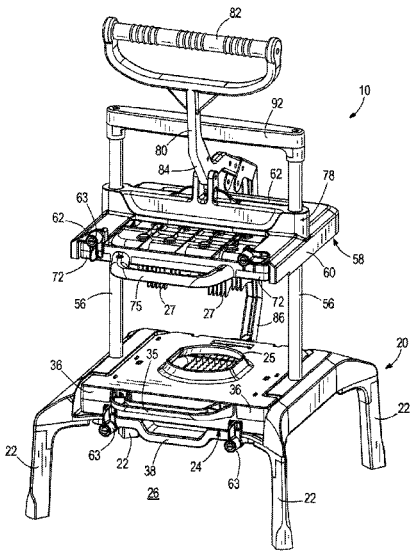
(57) **ABSTRACT**

Produce slicers for slicing produce include a frame. A blade assembly is removably and interchangeably received within the frame. A pusher head is removably and interchangeably received within the frame. The produce slicer includes a cover, at least one target ring in the cover defines a first target area. The blade assembly includes at least one blade set with a first frame bar and a second frame bar and a plurality of blades extend therebetween. The pusher head includes a pusher head body and at least one produce pusher with a plurality of fins extending in a direction away from the pusher head body.

15 Claims, 21 Drawing Sheets



(51) **Int. Cl.**

B26D 7/06	(2006.01)
B26D 1/03	(2006.01)
B26D 3/18	(2006.01)
B26D 5/10	(2006.01)

(58) **Field of Classification Search**

CPC .. B26D 3/185; B26D 5/10; B26D 3/26; Y10T 83/8831

USPC 83/422, 437, 407, 662, 431, 467, 425, 83/425.3, 425.2, 651.1, 404, 404.1, 404.3, 83/408, 858, 932; 99/495, 537, 538, 547, 99/567, 588

See application file for complete search history.

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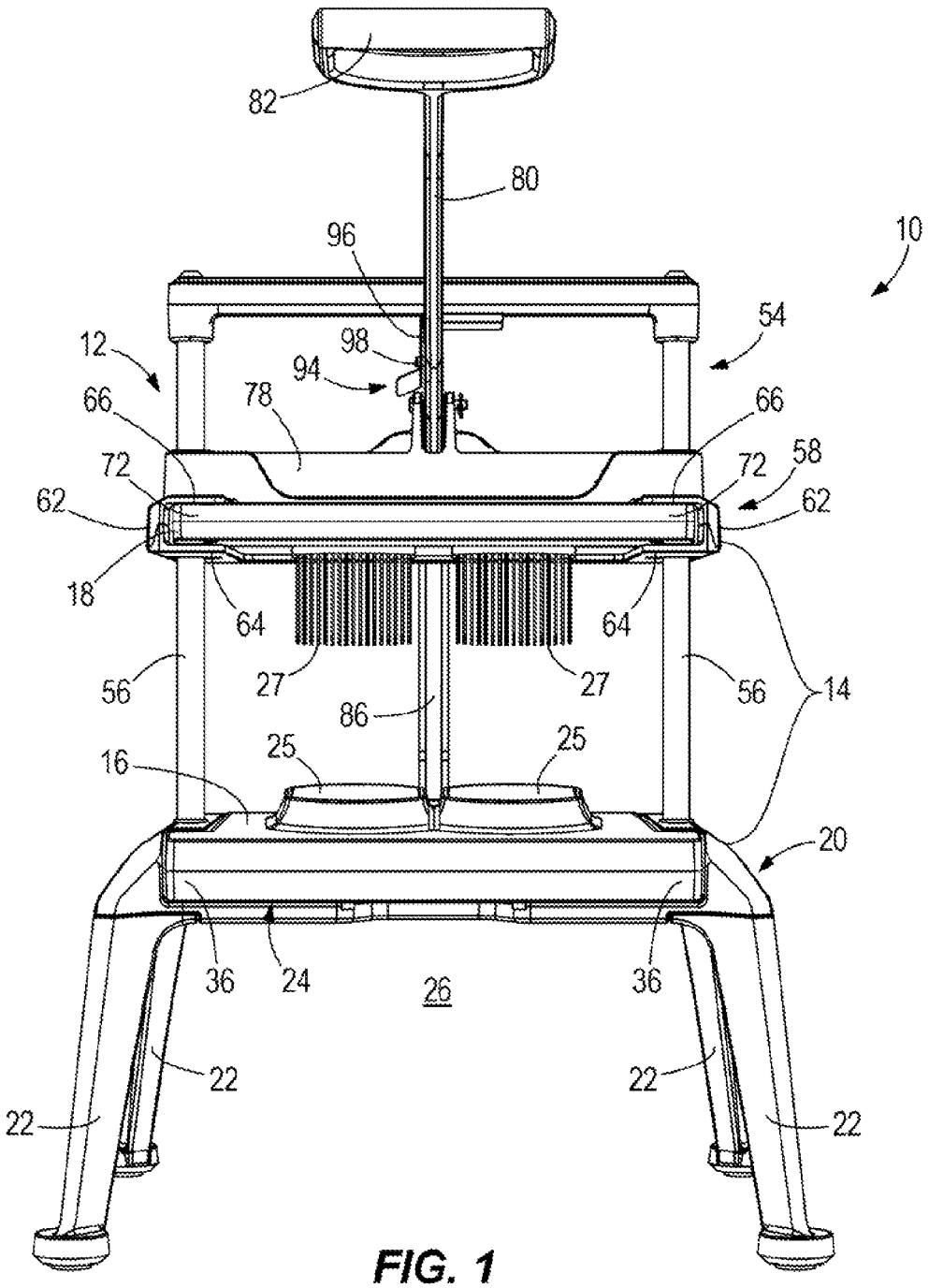
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FIG. 1

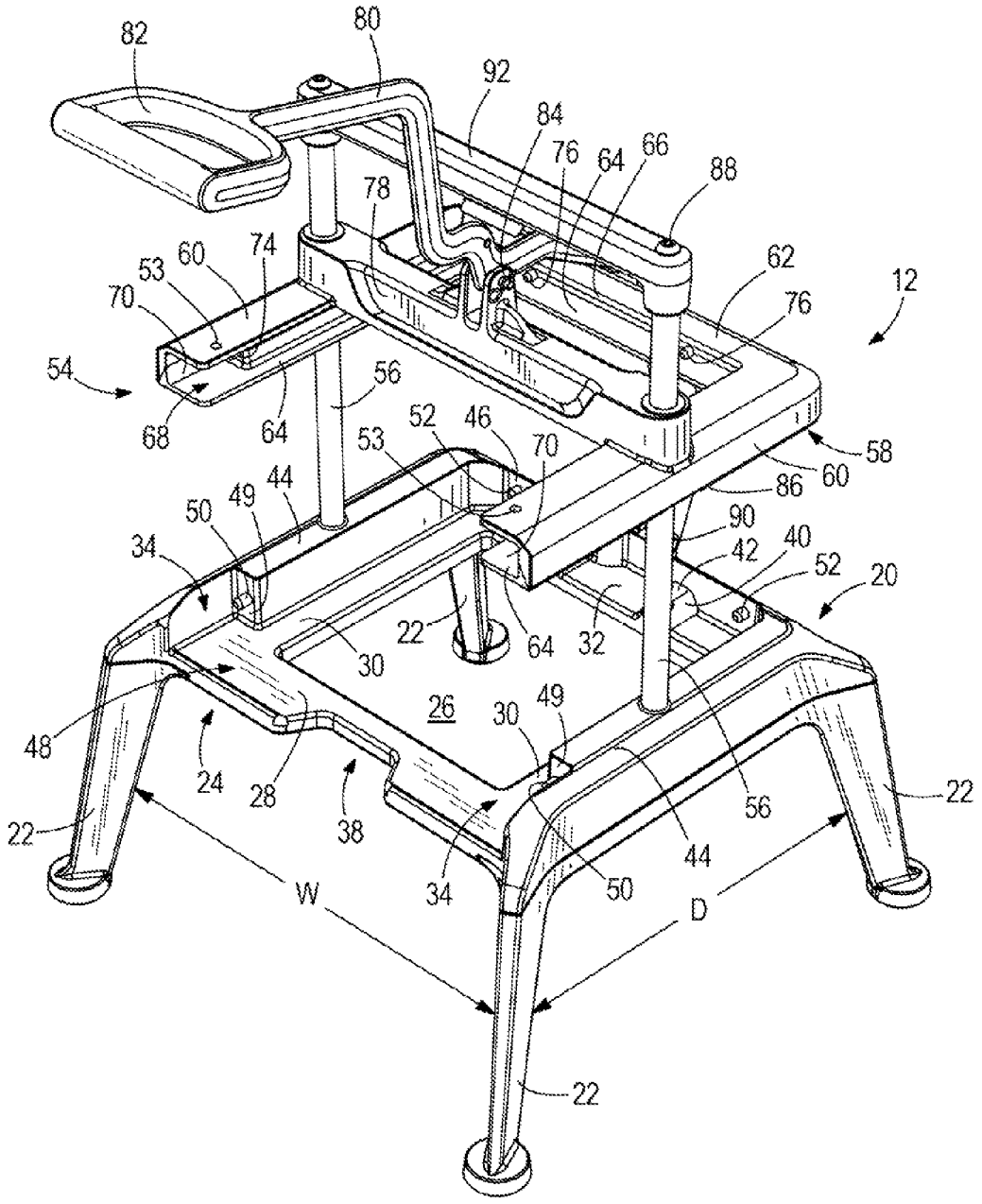
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FIG. 2

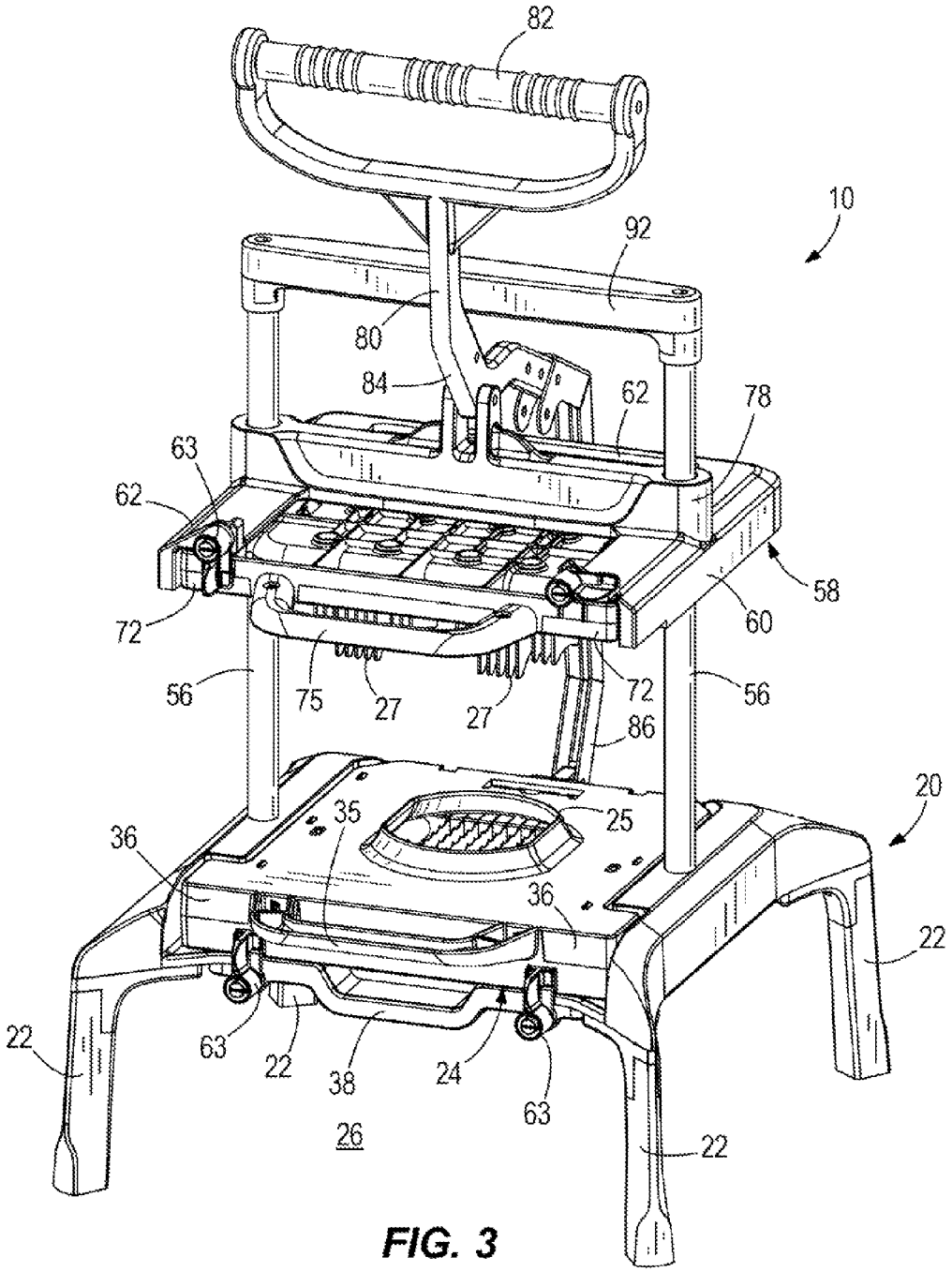
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FIG. 3

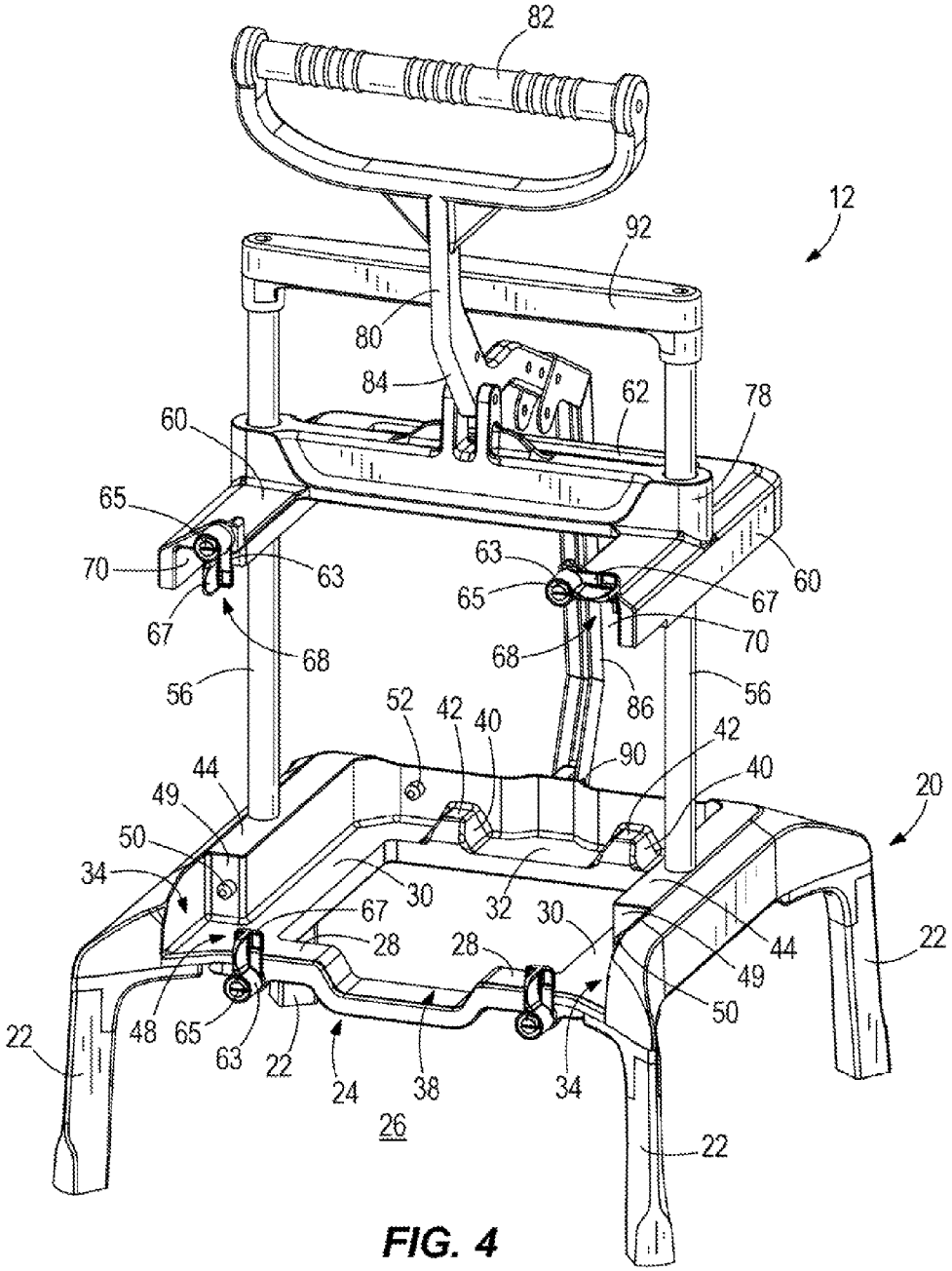
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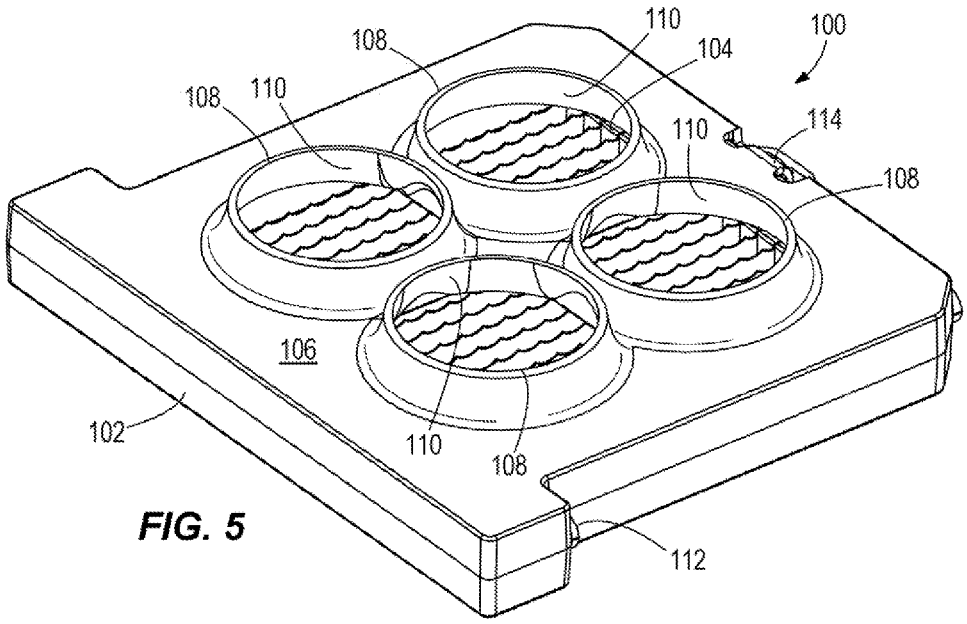
FIG. 4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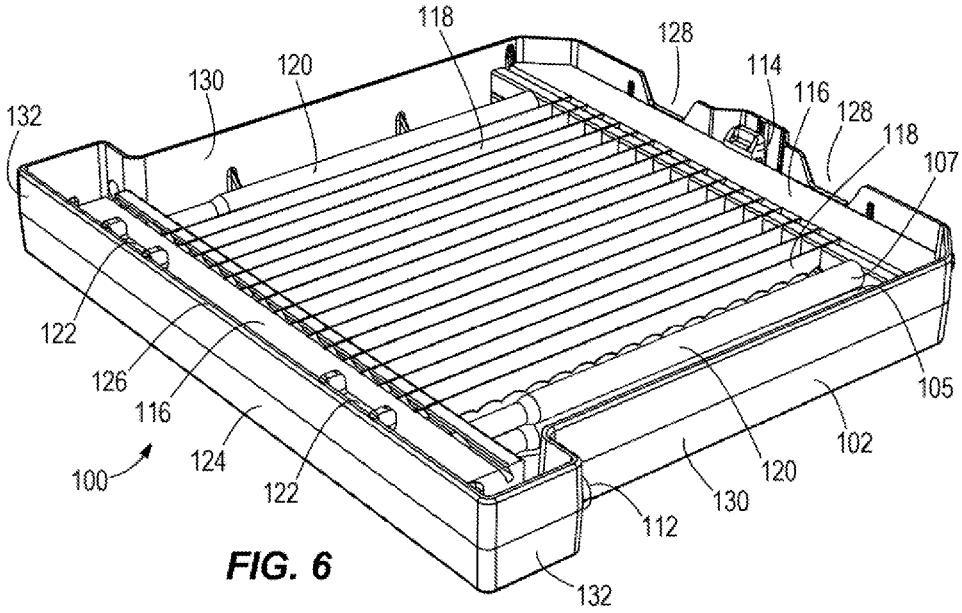
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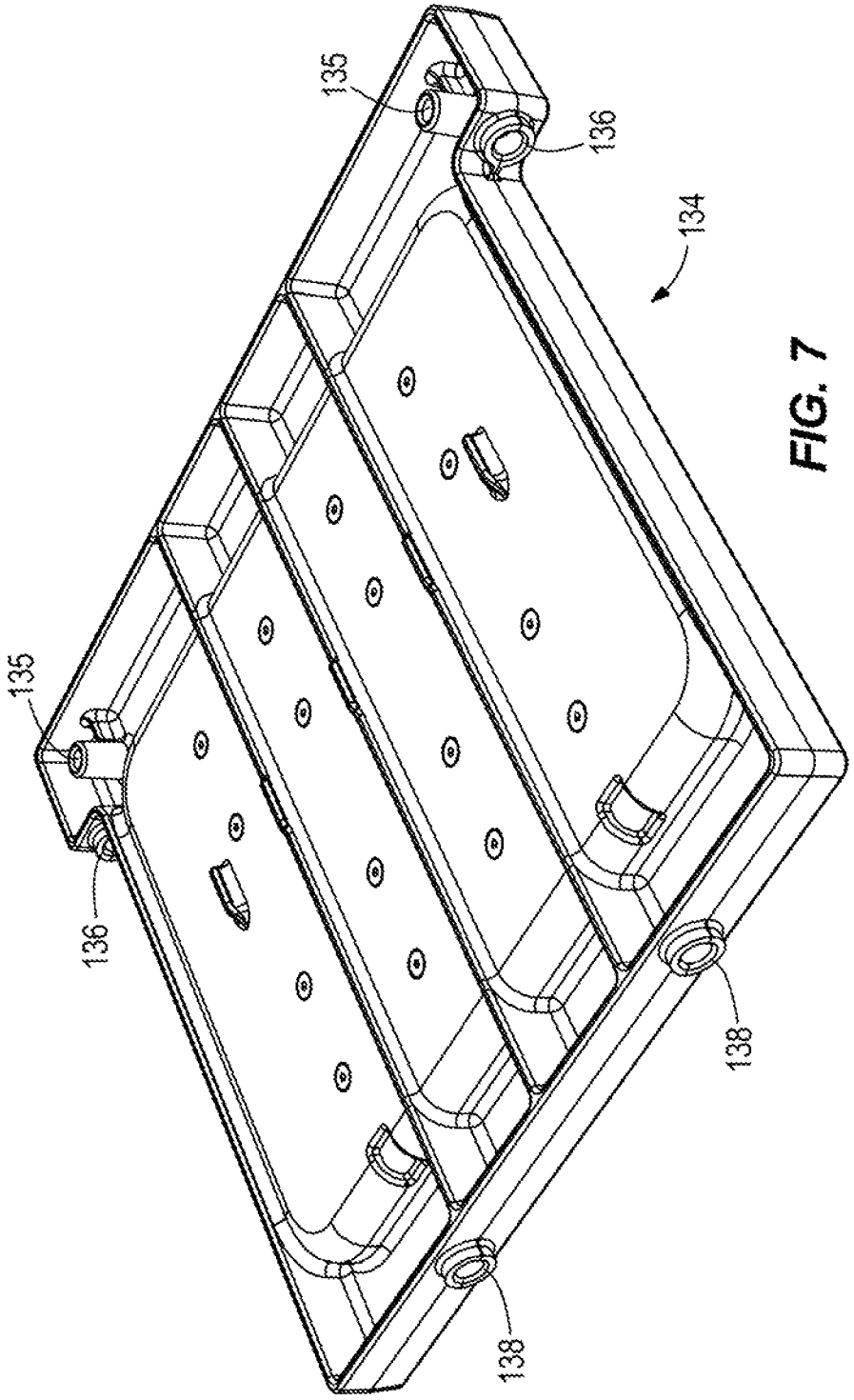
FIG. 6



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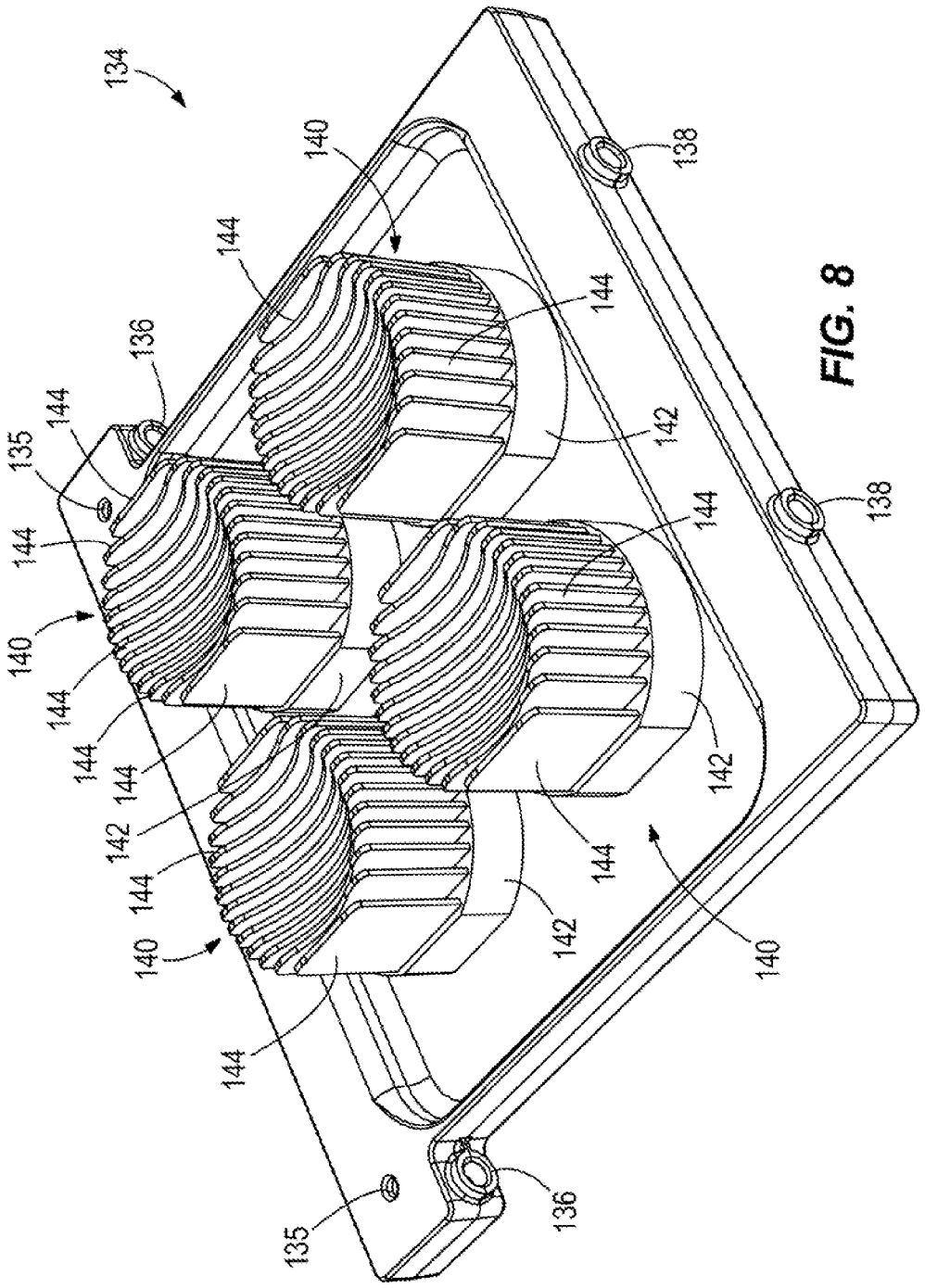

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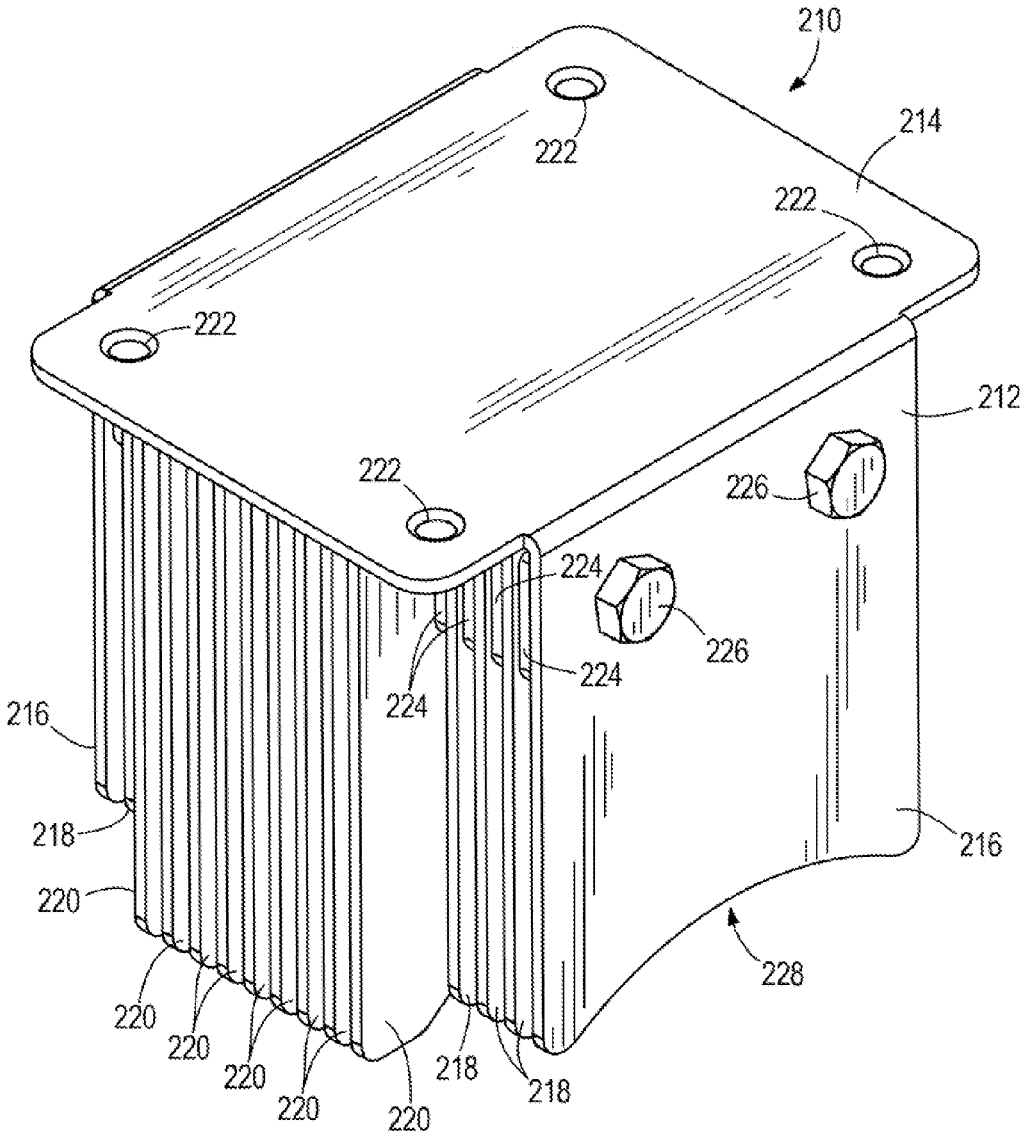
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FIG. 9

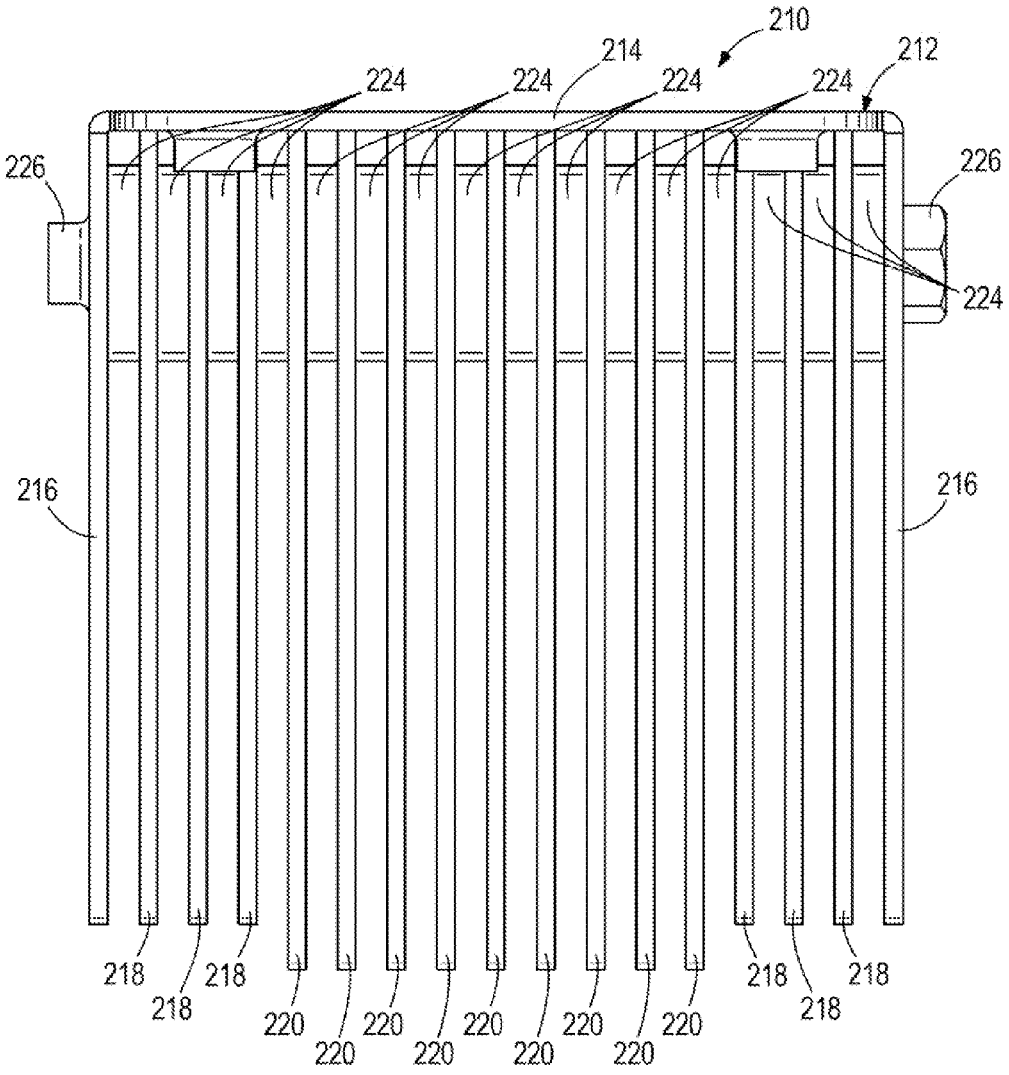
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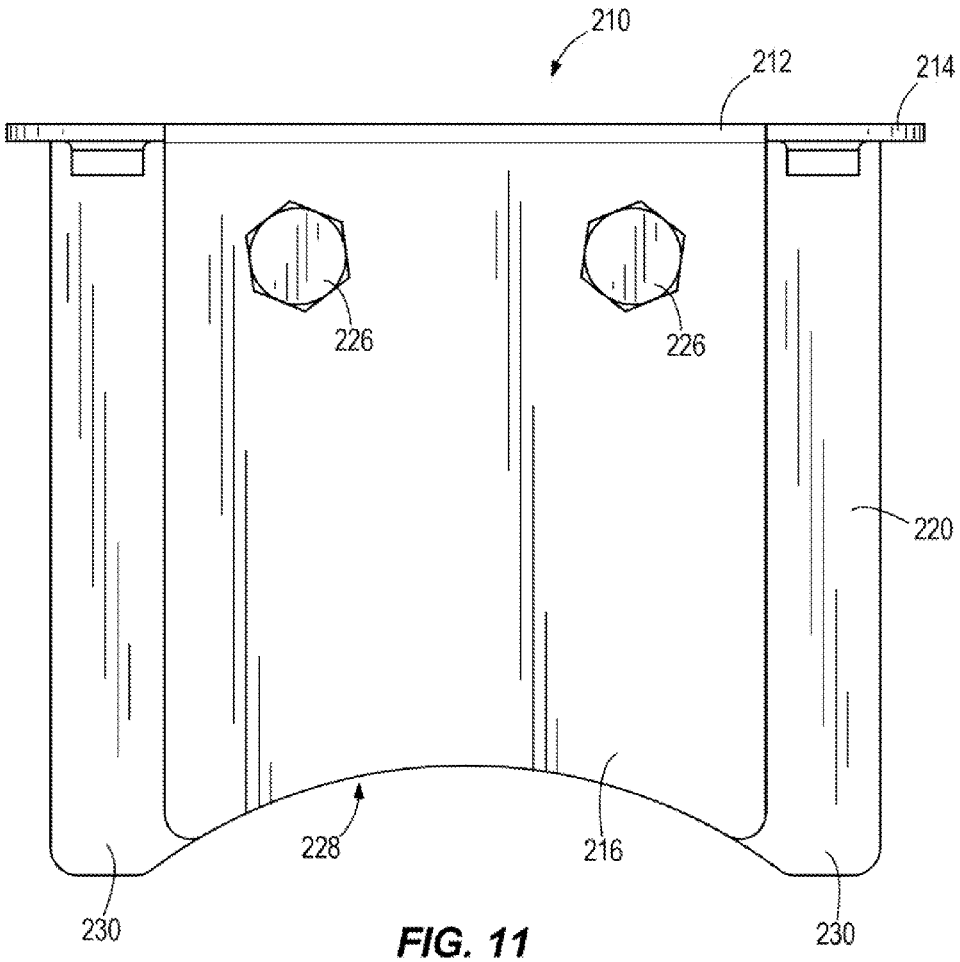
FIG. 10



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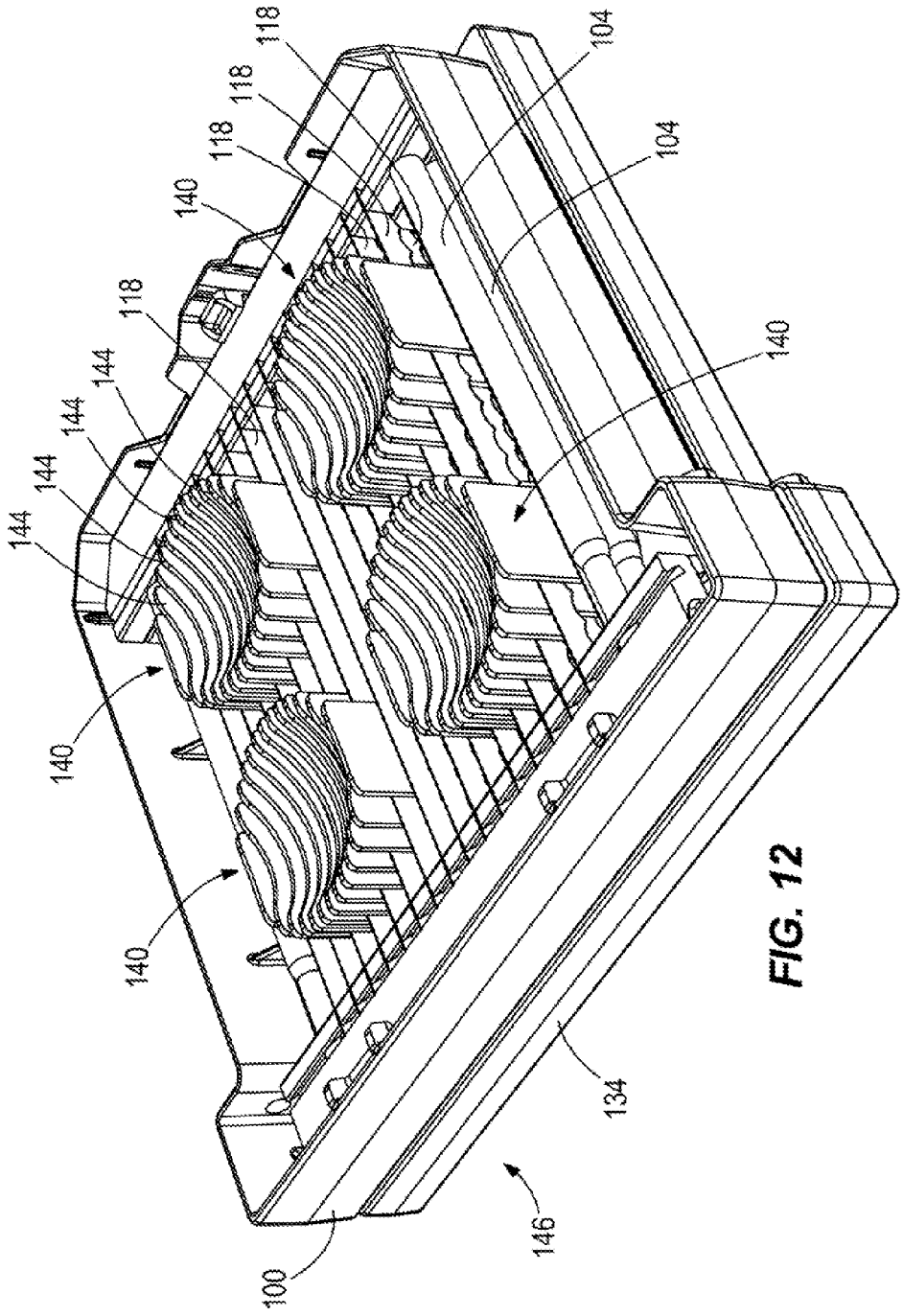
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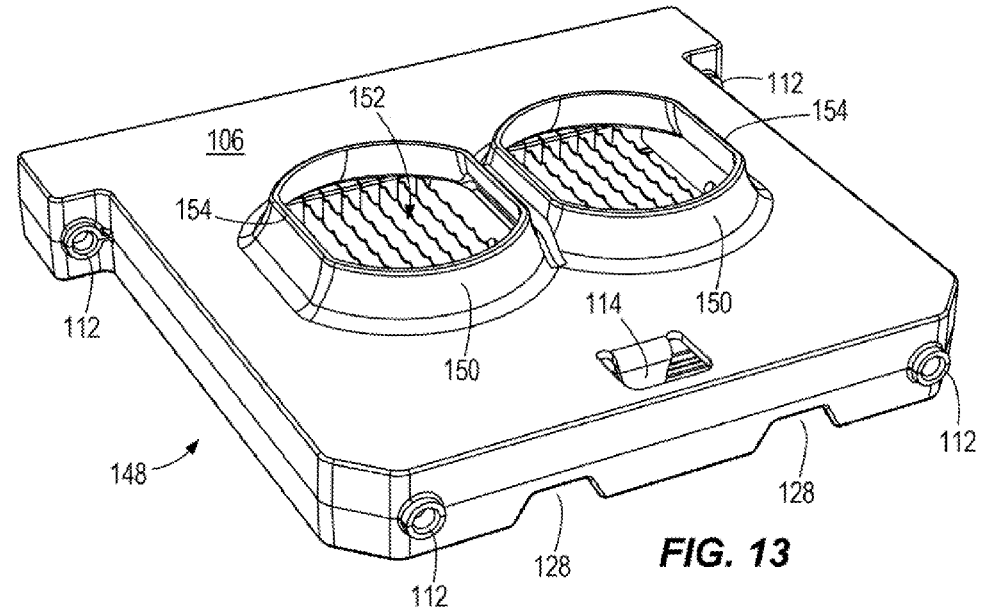
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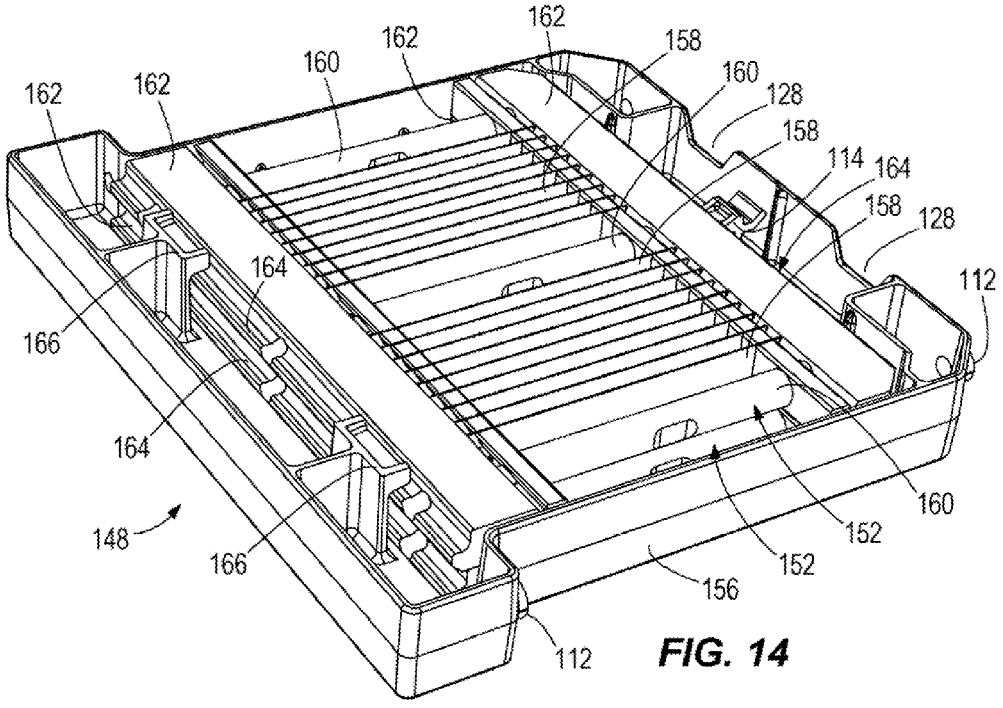
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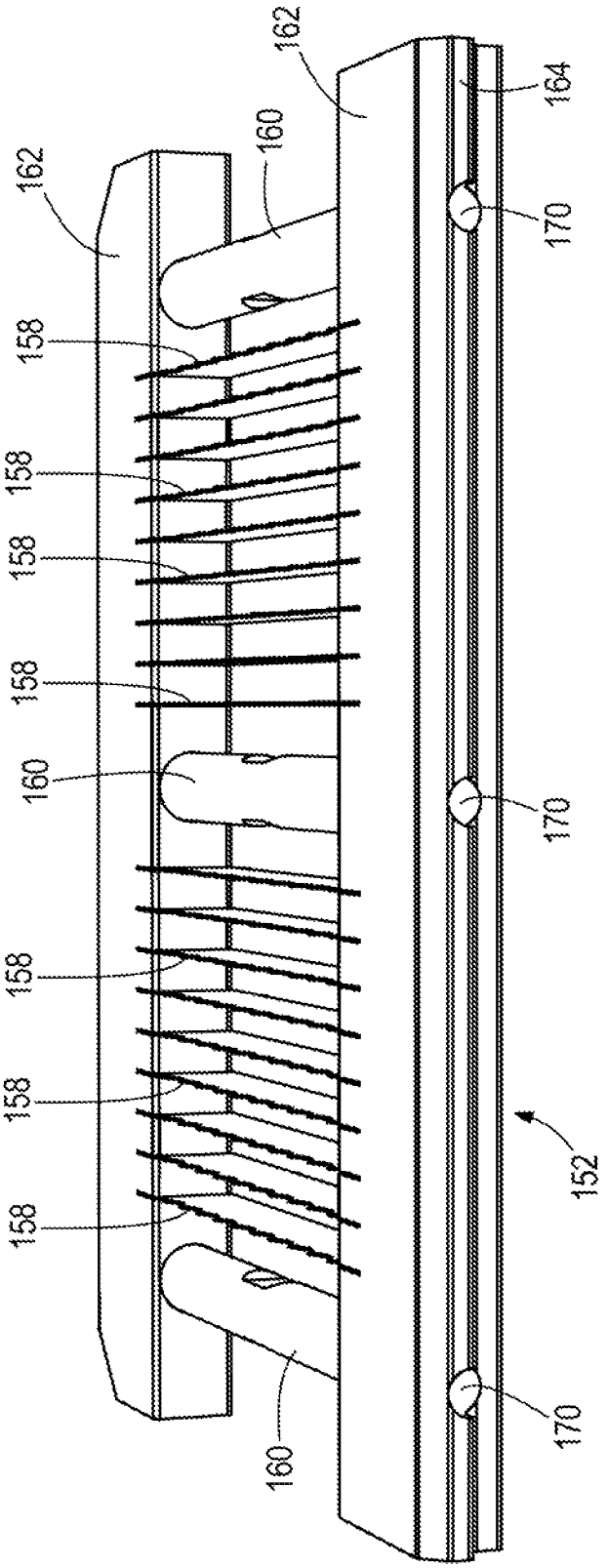
FIG. 14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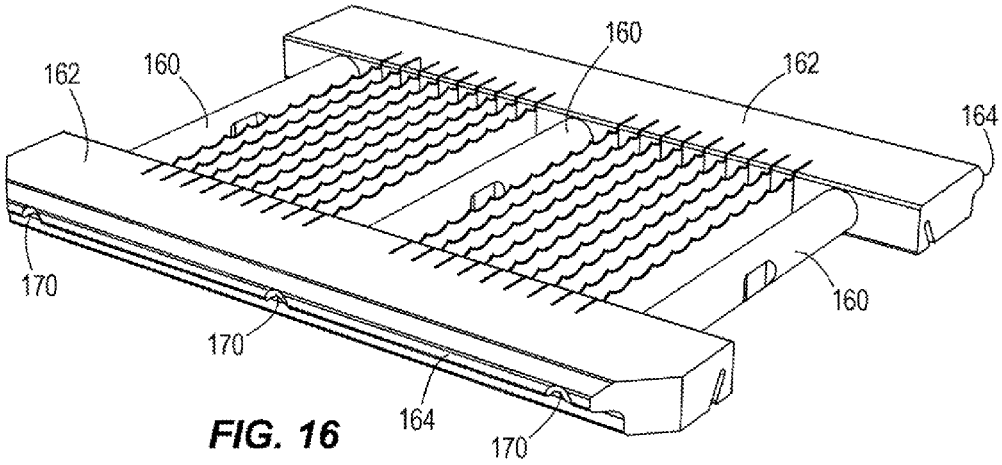
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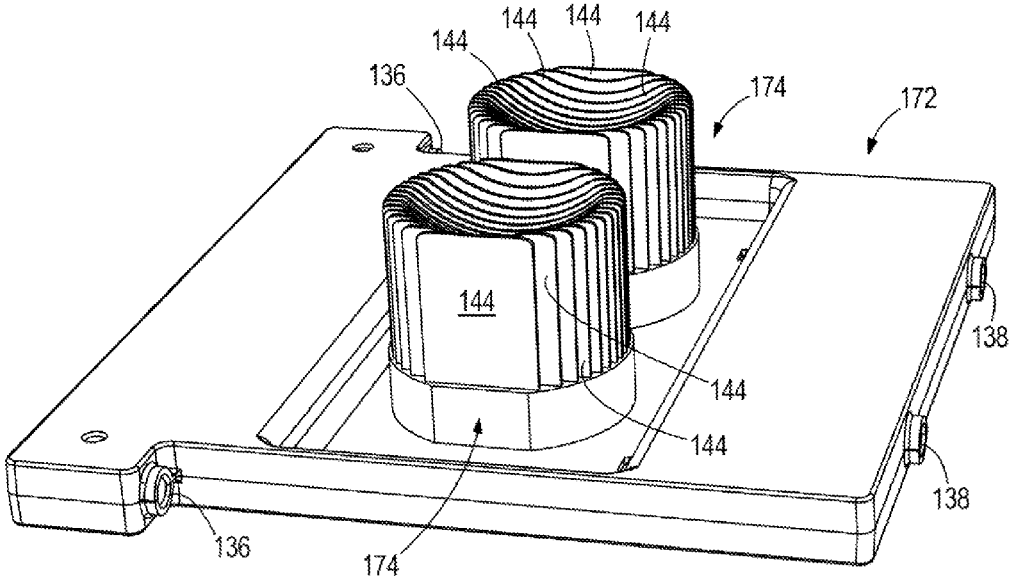
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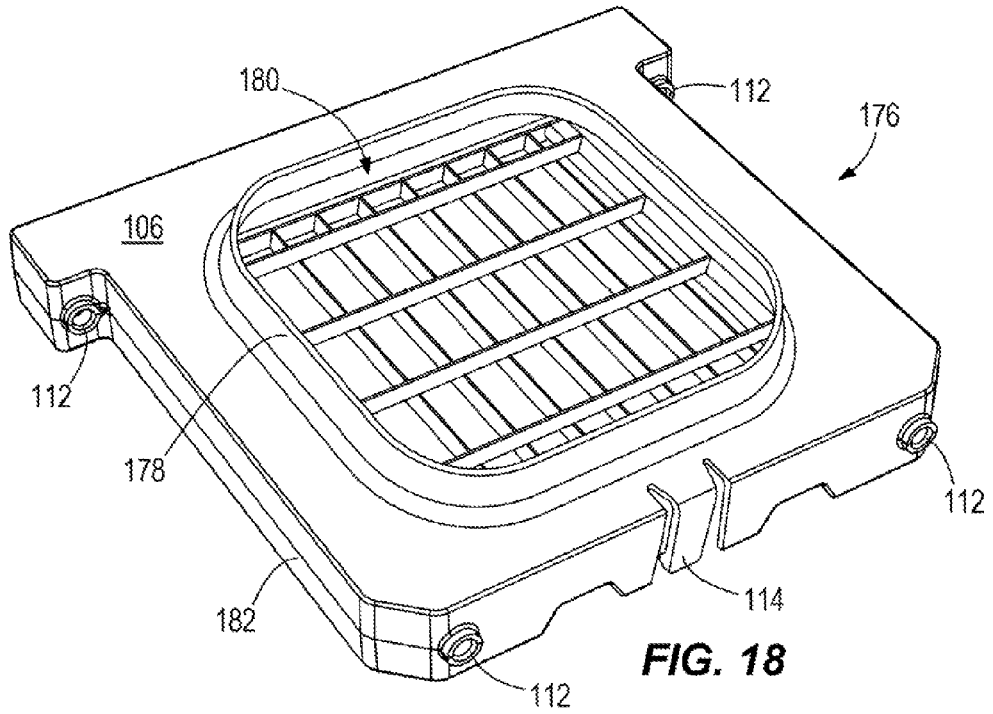
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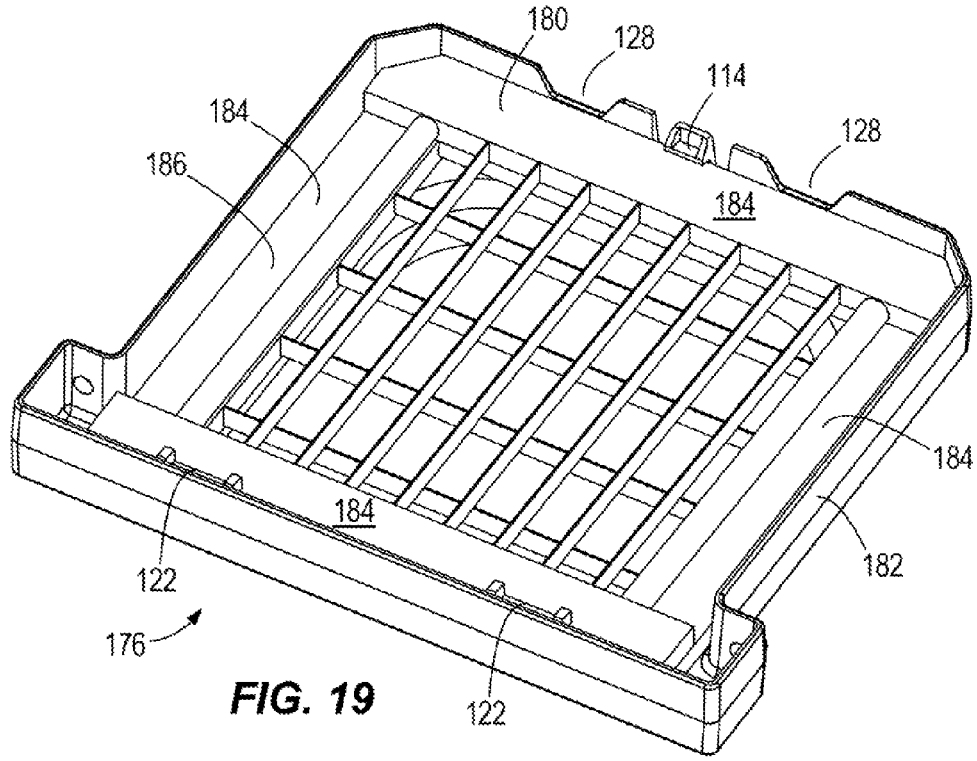
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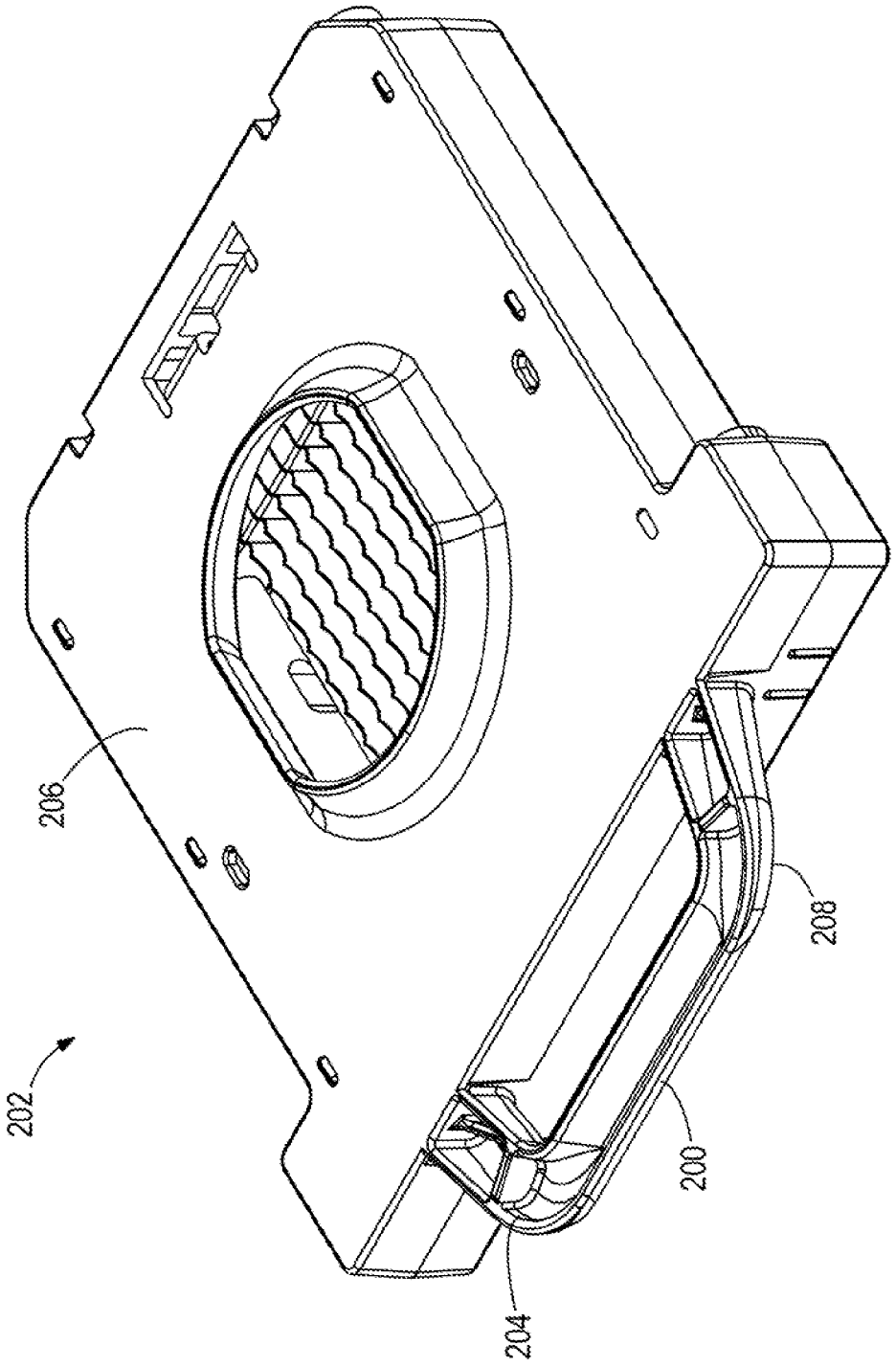

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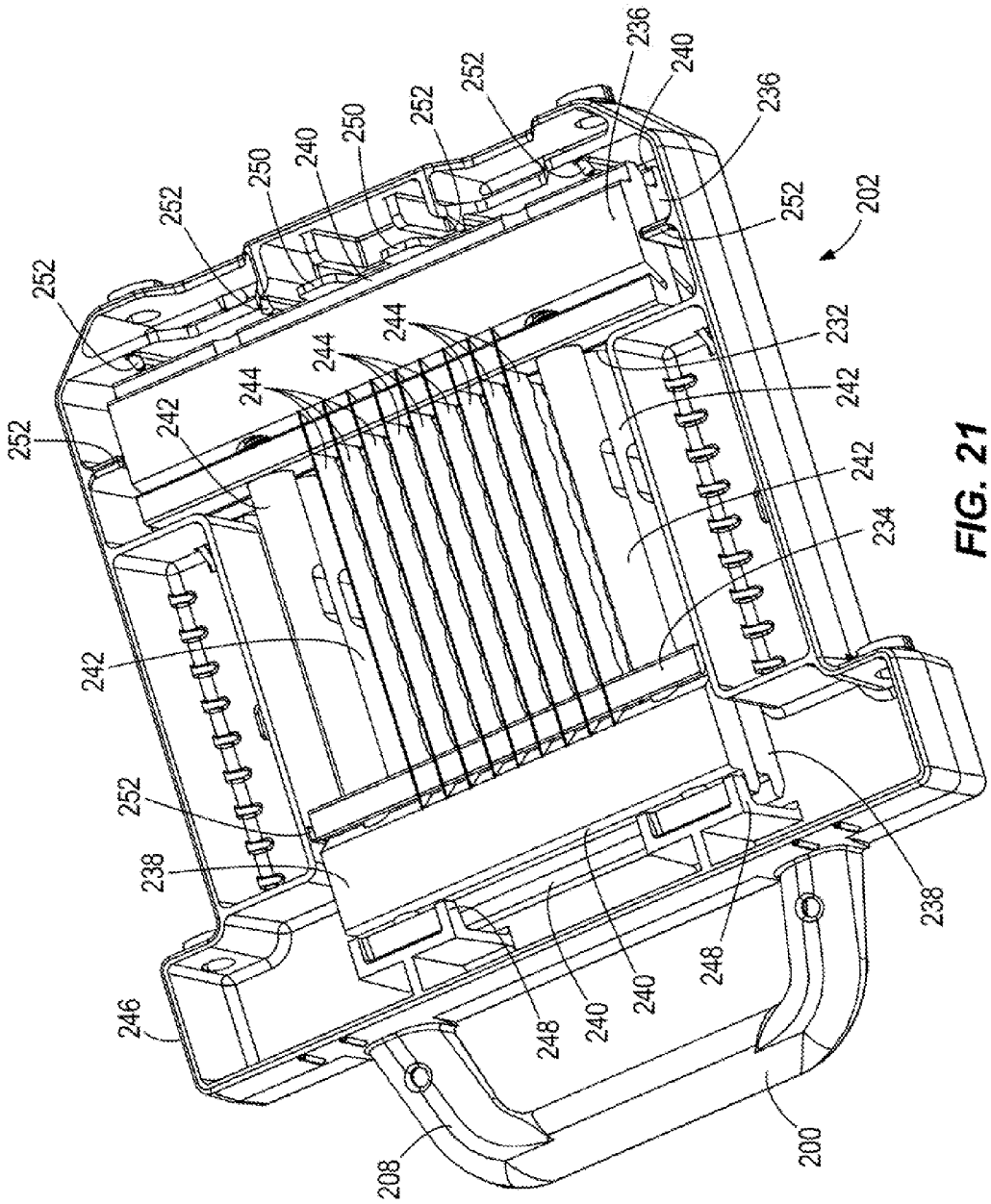

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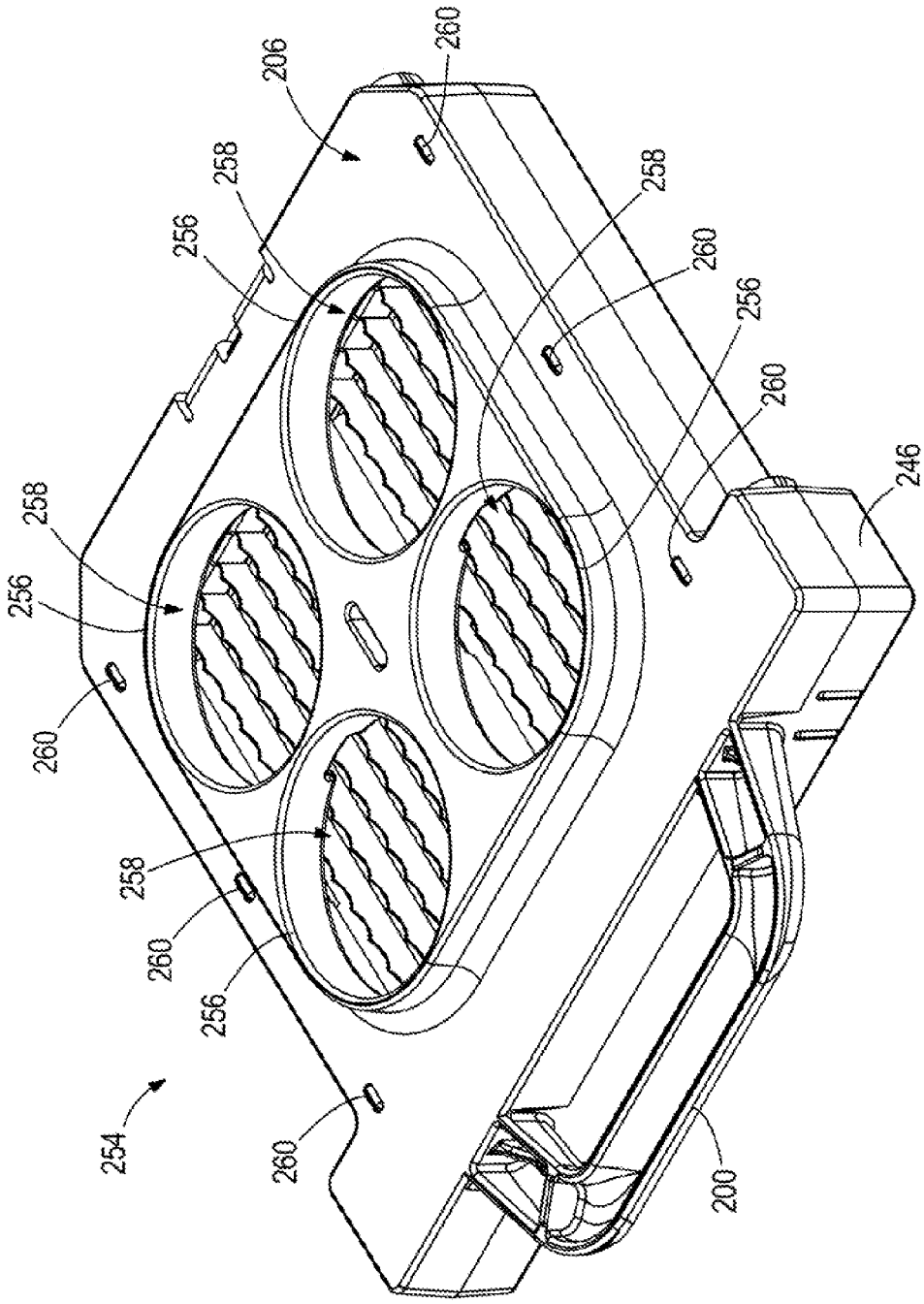
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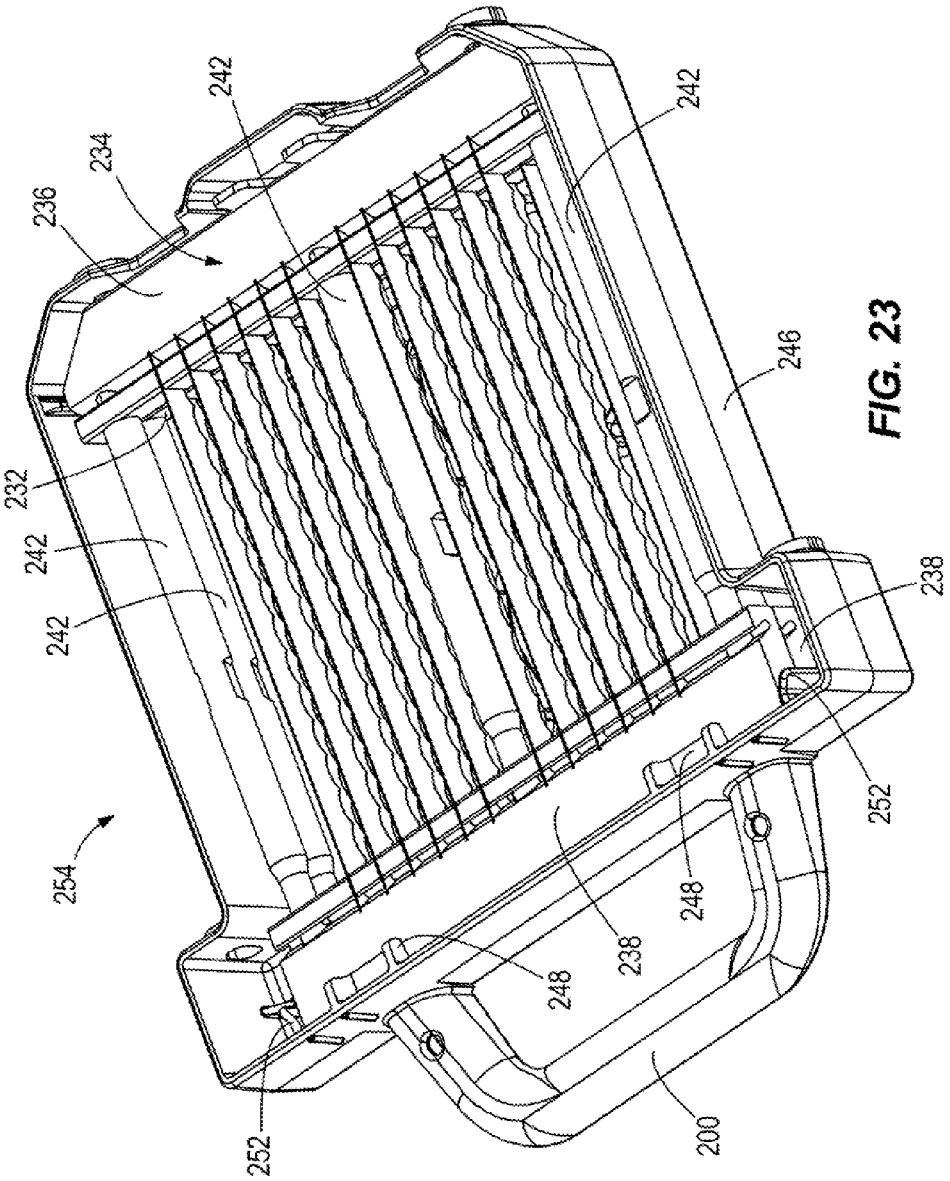

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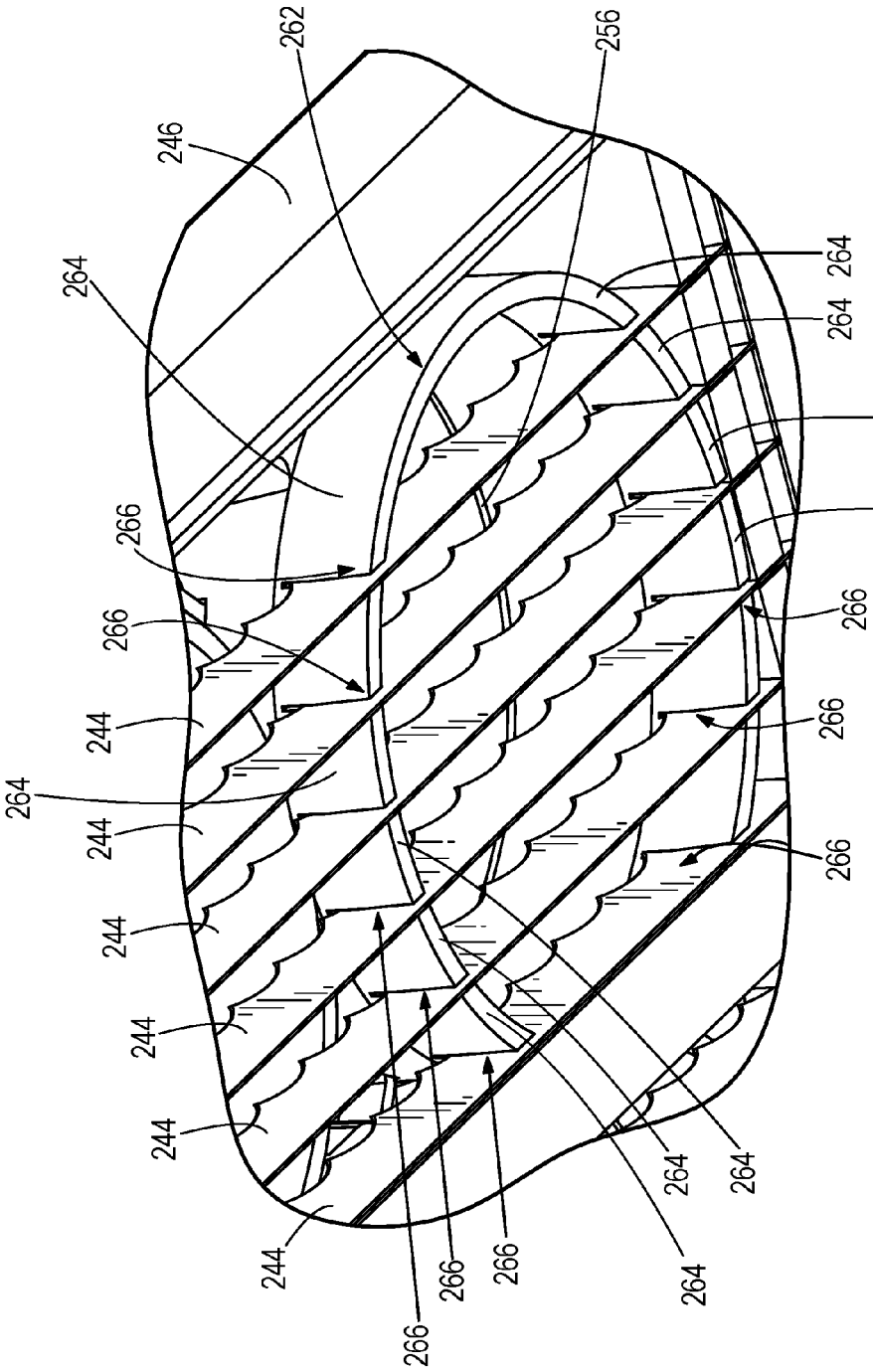
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FIG. 24

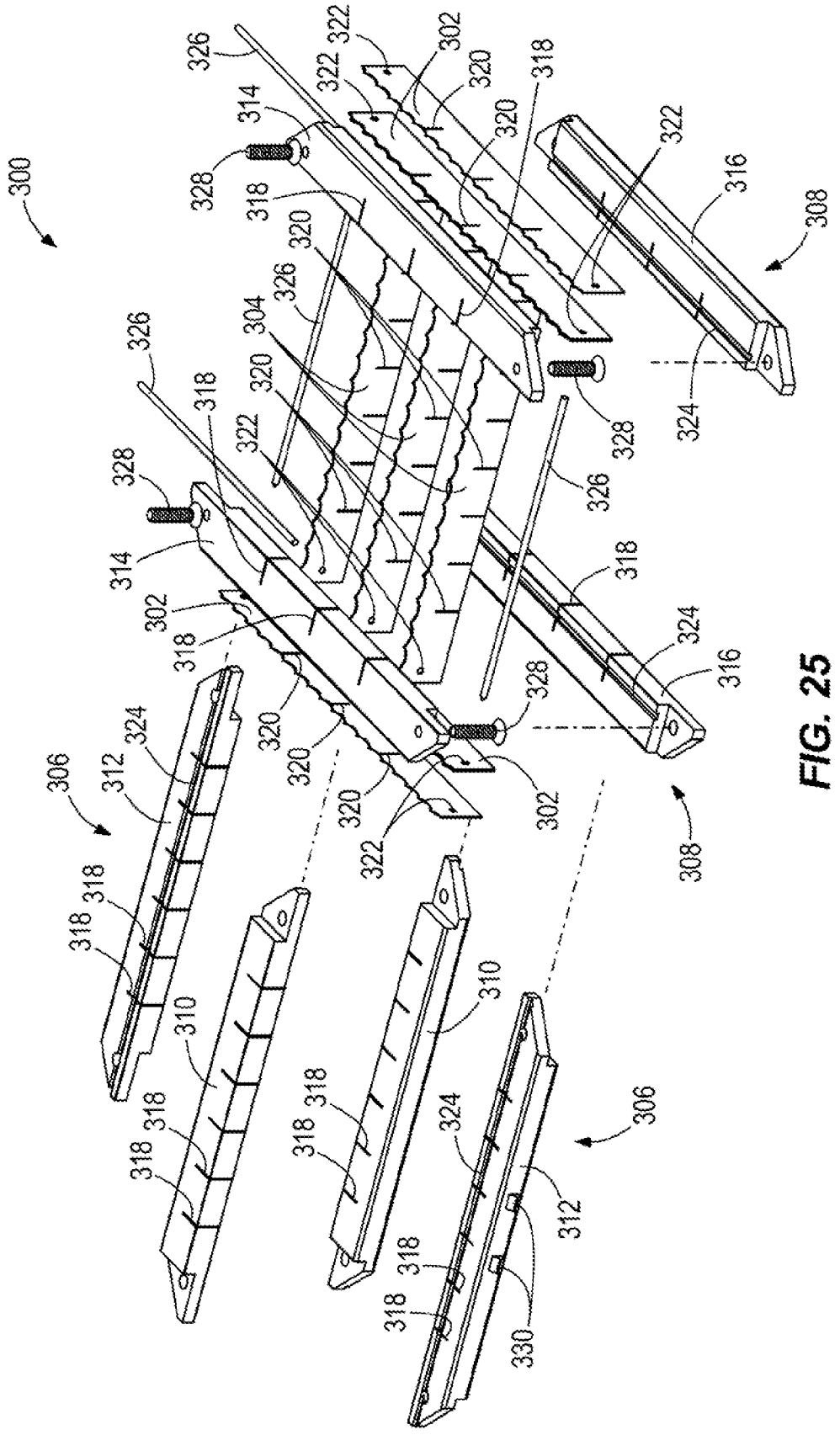

FIG. 25

PRODUCE SLICER

CROSS REFERENCE TO RELATED APPLICATION

The present application claims priority of U.S. Provisional Patent Application No. 62/043,918, filed on Aug. 29, 2014 and U.S. Provisional Patent Application No. 62/117,222, filed on Feb. 17, 2015, the contents of which are hereby incorporated herein by reference in their entireties.

FIELD OF THE DISCLOSURE

The present disclosure is related to the field of slicing. More specifically, the present application is related to a produce slicer and blade cartridges therefor.

BACKGROUND

Restaurant and food preparation industries require a large volume of produce to be processed such as by slicing so that the sliced produce can be used in food preparation and assembly. In addition to rapid slicing of produce, food preparation requires consistently sliced produce such that the food prepared with that produce is consistent in appearance, taste, texture, portion size, and cooking qualities between servings prepared.

Produce slicing is typically a manually performed task due to the aforementioned desire for consistency. As slicing necessarily requires some form of blade or cutting surface, this naturally involves a desire to seek solutions to improve safety for food preparation workers. Currently available slicing solutions have exposed blade sets which can present a risk to users during set up and operation. Currently available slicing solutions are limited to slicing a single piece of produce at a time.

Areas that are designated for food preparation often have limited space. With currently available slicing solutions, separate devices are used with each device configured to slice different produce. The need to store and maintain multiple devices adds further expense and use of already limited food preparation space.

BRIEF DISCLOSURE

An exemplary produce slicer includes a frame which includes a blade assembly receiving area and a head receiver. A blade assembly is removeably received within the blade assembly receiving area. The produce slicer further includes a cover. The cover includes a first target ring. The first target ring defines a first target area configured to receive a piece of produce to be sliced. A first blade set includes a first frame bar and a second frame bar. A plurality of blades extend between the first frame bar and the second frame bar. A pusher head is removably received within the head receiver. The pusher head includes a pusher head body and a first produce pusher. The first produce pusher includes a plurality of fins extending in a direction away from the pusher head body. The first produce pusher is aligned with the first target ring.

An exemplary produce slicing system is configured for slicing multiple types of produce. The produce slicing system includes a frame which includes a blade assembly receiving area. A pusher assembly includes at least one rail and a head receiver moveably mounted to the at least one rail. A handle is moveably connected to the pusher assembly. The handle is operably configured to move the pusher assembly along the at least one rail. A first blade cartridge is configured for interchangeable engagement with the frame and includes the first blade assembly. The first blade assembly is configured to removably engage the blade assembly receiving area of the frame. The first blade cartridge includes a first cover with a top portion and a plurality of sides extending away from the top portion to define an open interior. At least one target ring extends away from the top portion in a direction opposite the open interior. The at least one target ring defines at least one target area configured to receive produce to be sliced. First and second blade sets each include a first frame bar and a second frame bar. A plurality of blades extend between the first and second frame bars. The first and second blades sets are retained within the open interior of the first cover. A first pusher head is configured to removeably engage the head receiver of the frame. The first pusher head further includes a pusher head body and at least one produce pusher with a plurality of fins extending in a direction away from the pusher head body. The at least one produce pusher is aligned with the at least one target ring. A second blade cartridge, including a second blade assembly and a second pusher head, is configured for interchangeable engagement with the frame. The second blade assembly is configured to removably engage the blade assembly receiving area of the frame. The second blade assembly includes a second cover with a top portion and a plurality of sides extending away from the top portion to define an open interior. At least one target ring extends away from the top portion in a direction opposite the open interior. The at least one target ring defines at least one target area configured to receive produce to be sliced. Third and fourth blade sets each include a first frame bar and a second frame bar. A plurality of blades extend between the first and second frame bars. The first and second blade sets are retained within the open interior of the second cover. The second pusher head is configured to removeably engage the head receiver of the frame. The second pusher head further includes a pusher head body and at least one produce pusher with a plurality of fins extending in a direction away from the pusher head body. The at least one produce pusher is aligned with the at least one target ring.

An exemplary blade cartridge for use in slicing produce includes a pusher head comprising a pusher head body and at least one produce pusher with a plurality of fins extending in a direction away from the pusher head body. A first handle extends from the pusher head body. A blade assembly includes a blade cover having a planer top portion and a plurality of sides extending away from the planar top portion. The planer top portion in the plurality of sides define an open interior. At least one target ring defines a target area configured to receive a piece of produce to be sliced. At least one blade set includes a first frame bar and a second frame bar with a plurality of blades extending therebetween. A second handle extends away from a side of the plurality of sides of the blade cover in a direction away from the open interior. The second handle corresponds with the first handle.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front view of an exemplary embodiment of a slicing system.

FIG. **2** is a perspective view of an exemplary embodiment of a frame for a slicing system.

FIG. **3** is a perspective view of an additional exemplary embodiment of a slicing system.

FIG. **4** is a perspective view of an additional embodiment of a frame.

FIG. **5** is a perspective top view of a first embodiment of a blade assembly.

FIG. **6** is a perspective bottom view of the first embodiment of the blade assembly.

FIG. **7** is a perspective top view of a first embodiment of a pusher head.

FIG. **8** is a bottom perspective view of the first embodiment of the pusher head.

FIG. **9** is a perspective view of an additional exemplary embodiment of a produce pusher.

FIG. **10** is a front view of the additional exemplary embodiment of the produce pusher.

FIG. **11** is a side view of the additional exemplary embodiment of the produce pusher.

FIG. **12** is a bottom perspective view of a first embodiment a blade cartridge.

FIG. **13** is a top perspective view of an exemplary second embodiment of a blade assembly.

FIG. **14** is a bottom perspective view of the exemplary second embodiment of the blade assembly.

FIG. **15** is a front perspective view of an exemplary embodiment of a blade set for use with a blade assembly.

FIG. **16** is top perspective view of the exemplary embodiment of the blade set for use with a blade assembly.

FIG. **17** is a bottom side perspective view of an exemplary second embodiment of a pusher head.

FIG. **18** is a top perspective view of an exemplary third embodiment of a blade assembly.

FIG. **19** is a bottom perspective view of the exemplary third embodiment of the blade assembly.

FIG. **20** is a top perspective view of an exemplary fourth embodiment of a blade assembly.

FIG. **21** is a bottom perspective view of the exemplary fourth embodiment of the blade assembly.

FIG. **22** is a top perspective view of an exemplary fifth embodiment of a blade assembly.

FIG. **23** bottom perspective view of the exemplary fifth embodiment of the blade assembly.

FIG. **24** is a bottom perspective view of an exemplary embodiment of a portion of a blade assembly.

FIG. **25** is an exploded view of an exemplary embodiment of a blade set.

DETAILED DISCLOSURE

FIG. **1** is an exemplary embodiment of a produce slicer **10**. The produce slicer **10** includes a frame **12**. A blade cartridge **14** is received within the frame **12**. The blade cartridge **14** includes a blade assembly **16** and a pusher head **18**. In an exemplary and non-limiting embodiment, the blade assembly **16** and the pusher head **18** of the blade cartridge **14** are slidingly received into the frame **12**. The frame **12** facilitates movement of the pusher head **18** relative to the blade assembly **16** such that the pusher head **18** is partially received within the blade assembly **16**. The frame **12** will be described in further detail herein, with respect to the perspective view of the frame **12** depicted in FIG. **2** and the produce slicer **10** depicted in FIG. **1**. The produce slicer **10** as well as other embodiments as described herein may exemplarily be used to cut any of a variety of produce, including, but not limited to: fruits, vegetables, meats, seafood, tofu, cheese and other foods. While embodiments are exemplarily described in further detail herein with specific reference to tomatoes, onions, and lettuce, it will be recognized that the range of available foods to be cut are not so limited.

The frame **12** includes a frame base **20** which itself may include at least one leg **22**. In an exemplary embodiment, the frame base **20** includes four legs, each extending from a corner of the frame base **20**. In a still further exemplary embodiment, a width dimension W between adjacent legs **22** and a depth dimension D between adjacent legs **22** are both at least 13 inches apart such that standard size food preparation containers may be inserted below the frame **12** from any of the front, rear, right, and left sides. This facilitates flexibility in placement of the produce slicer **10** within the food preparation area of a kitchen as well as to promote flexibility in work flows within the produce preparation area by food preparation workers. In a still further embodiment, one or more lower support bars (not depicted) extend between adjacent legs **22**. In use, these lower support bars help to stabilize the device in the event that one of the legs inadvertently slides off of the work surface.

The frame base **20** further includes a support surface **24**. The support surface **24** as described in further detail herein supports the blade assembly **16**. The base **20** therefore defines a product receiving area **26** between the legs **22** and below the support surface **24** wherein the aforementioned, but not depicted, produce receiving container may be positioned below the support surface **24** to receive the sliced produce after operation of the produce slicer **10**. In an exemplary embodiment, the support surface **24** includes a front support **28**, opposed lateral supports **30**, and a rear support **32**. In the exemplary embodiment depicted in FIG. **2**, the support surface **24** includes all of the front supports **28**, lateral supports **30**, and rear supports **32** and such supports form a continuous support surface **24** around and above the produce receiving area **26**. It will be recognized that in alternative embodiments, the front support **28**, lateral supports **30**, or rear support **32** may be separate components of the frame base **20**, or that the support surface **24** may be implemented with more or fewer support areas as disclosed. In still further embodiments, the frame base may include other numbers of legs, including three-legged versions. In another embodiment, the frame base and or support surface may be a cantilevered construction, for example with base plate (not depicted) forming the product receiving area and the support surface cantilevered over the base plate. Such a construction facilitates open access to the product receiving area exemplarily from the front and sides. In a still further embodiment, the frame base may be constructed with no or limited legs and configured to be secured to or positioned over the produce receiving container.

The front support **28** further includes support cut-outs **34** which are configured to receive arms **36** of the blade assembly **16**, as will be described in further detail herein. The base assembly **16** includes one or more target areas **25**, as will be described in further detail herein. Additionally, embodiments of the front support **28** may include a finger cut-out **38** which facilitates insertion and removal of the blade assembly **16** with the frame **12**. The finger cut-out **38** may exemplarily extend in a depth dimension as exemplarily depicted in FIG. **2** or in a height dimension as exemplarily depicted in FIG. **4**. The inventors have discovered that in some embodiments, the cut-out **38** in the height dimension facilitates removal of the pusher head when the frame is in a down position. This facilitates simultaneous removal of the blade assembly and pusher head while engaging one another, further covering the blades of the blade assembly during removal.

In further exemplary embodiments, the rear support **32** includes one or more support structures **40**, which define at least one elevated support surface **42**.

As will be described in further detail herein, the frame base **20** is configured to receive, hold, and support the blade assembly **16**. The frame base **20** further includes lateral walls **44** and a rear wall **46** that may extend vertically from the support surface **24**. The lateral walls **44** and the rear walls **46**, together with the support surface **24** and cut-outs **34**, define a blade assembly receiving area **48**. In an exemplary embodiment, front alignment structures **50** are located in the cut-outs **34** of the lateral walls **44**. Rear alignment structures **52** are exemplarily located on outward faces **49** of the rear wall **46**. In embodiments as will be described in further detail herein, the front alignment structures **50** and rear alignment structures **52** matingly engage alignment structures located on the blade assembly **16** as will be described in further detail herein in order to align and secure the blade assembly **16** in the blade assembly receiving area **48**. In an exemplary embodiment, the front alignment structures **50** are bodies (e.g. pins) that project from the outward faces **49** of respective lateral walls **44**, and the rear alignment structures **52** are bodies (e.g. pins) that project from the rear wall **46**. The front alignment structures **50** and the rear alignment structures **52** are matingly received by corresponding alignment holes located in the blade assembly **16** and described in further detail herein. It will be recognized by a person of ordinary skill in the art that a variety of other alignment structures may be used, including, the reverse of the embodiment depicted (e.g. alignment holes in the outer faces **49** of lateral walls **44** and rear wall **46**) or other geometric shapes of mating structures.

The frame **12** further includes a pusher assembly **54** at least partially movably secured to the frame base **20**. The pusher assembly **54** includes rails **56** which extend from the frame base **20**. The pusher assembly **54** further includes a head receiver **58**. The head receiver **58** is exemplarily slidingly secured to the rails **56** and is configured as described in further detail herein to receive a pusher head **18** of a blade cartridge **14**. The head receiver **58** includes laterally opposed guide arms **60** and a rear guide **62**. The guide arms **60** and rear guide **62** include lower plates **64** and upper plates **66**. The lower plates **64** and upper plates **66** of the guide arms **60** and rear guide **62** define a pusher head receiving area **68** configured to receive a pusher head **18**, and is exemplarily configured to slidingly receive a pusher head **18**. The pusher head **18** is configured with one or more pushers **27** that correspond to a target area **25** of the blade assembly **16**. The head receiver **58** may further include one or more holes **53** which are configured to receive a respective one or more pin (not depicted) to secure through corresponding holes (e.g. **135** in FIGS. **7-8**) through the pusher head **18**. The pins therefore may further facilitate to secure the pusher head **18** within the head receiver **58**. A similar construction may also be used to secure the blade assembly **16** within the blade assembly receiving area **48**.

The guide arms **60** further include cut-outs **70** that are configured to receive respective arms **72** of the pusher head **18**. The head receiver **58** further includes front alignment structures **74** located on the guide arms **60**, and particularly exemplarily in the cut-outs **70** of the guide arms **60**, as well as rear alignment structures **52** located in the rear guide **62** exemplarily between the lower plates **64** and the upper plates **66** of the rear guide **62**. The front alignment structures **74** and rear alignment structures **76** are configured to matingly engage corresponding alignment structures as disclosed in further detail herein located on the pusher head **18** in order to facilitate alignment and engagement between the pusher head **18** and the head receiver **58**. It will be recognized that the alignment structures **74** and **76** of the head receiver **58** are corresponding alignment structures of the pusher head **18** may exemplarily be the same as or in accordance with the disclosure above regarding the alignment structures **50** and **52** of the frame base **20** and alignment structures of the blade assembly **16**.

The head receiver **58** further includes a force bar **78** that extends between the laterally opposed guide arms **60**. The force bar **78** operates to translate force from an arm **80** connected to a handle **82** which movably engages the force bar **78**. In an exemplary embodiment, the arm **80** has an inverted "L" shape to generally orient the handle **82** in a horizontal orientation, while it will be recognized that other orientations may be used including a more vertical arm **80**, resulting in a vertically-oriented handle **82**. In the exemplary embodiment depicted in FIGS. **1** and **2**, the arm **80** is pivotably secured to the force bar **78** at an arm pivot **84**. The arm pivot **84** translates generally downward force applied to the handle **82** by a user to the force bar **78** to direct the head receiver **58** downward towards the frame base **20** during operation of the produce slicer **10**. In an exemplary embodiment, the arm **80** is further secured to a body **86** by a body pivot **88** and the body **86** is secured to the base **20** at a base pivot **90**. The pivoted connection of the body **86** between the base **20** at the base pivot **90** and the arm **80** at the body pivot **88** reduces the overall operable footprint of the device such that the arm **80**, body **86**, or body pivot **88** do not extend laterally past the rear leg **22** of the base **20**. In exemplary embodiments, this enables the produce slicer **10** to be positioned with the rear legs **22** engaging a wall or kitchen station divider enabling efficient use of workstation counter space. Embodiments of the combination of arm **80**, arm pivot **84**, body **86**, body pivot **88**, and base pivot **90** further limit the extent to which the handle **82** extends beyond the lateral dimension of the front legs **22** during operation of the produce slicer **10** and such that embodiments of the produce slicer **10** may be operated by a food preparation worker with minimized impact to the movement of other workers past the worker operating the produce slicer.

Embodiments of the frame **12** further include a rail crossbar **92** which extends between the laterally opposed rails **56**. At least a portion of a latch **94** extends from the rail crossbar **92**. The latch **94** may include a detent portion **96** which extends from the rail crossbar **92** and an engagement portion **98**, which extends from the arm **80**. However, it will be recognized by a person of ordinary skill in the art that the latch **94** as disclosed herein may be carried out through alternative implementations. These alternatives may include a reversal of the detent and engagement portions, or other releaseably engageable configurations of corresponding structures. In the embodiment depicted, the detent portion **96** comprises a metal plate which includes a receiving portion or at least one cut-out that receives the engagement portion **98**. The plate of the detent portion **96** is configured to be deformable away from the arm **80** and engagement portion **98**, such that the engagement portion **98** moves past a front end of the detent portion **96** before engaging in the cut-out portion. In operation, this creates a passively automated latch that is biased to secure the head receiver **58** in the open or "up" position. In a still further embodiment, this operates as a safety mechanism as it creates a two-handed operation of the produce slicer, such that the food preparation worker must place one hand on the rail crossbar **92** in order to release the latching mechanism **94**, exemplarily with the worker's thumb, while the worker operates the handle **82**

with the worker's other hand to slice the produce. This creates a mechanical safety feature whereby the worker removes both hands from the cutting area before operating the produce slicer, promoting worker safety.

FIGS. **3** and **4** depict an additional configuration of the produce slicer **10**. It will be recognized that FIGS. **3** and **4** use similar reference numbers as the description above with respect to FIGS. **1** and **2**. This exemplarily indicates similar structures and the description thereof with respect to any of FIGS. **1-4** may similarly apply in various combinations and embodiments. It is understood by a person of ordinary skill in the art that additional combinations of the features disclosed herein apart from the specific exemplary embodiments depicted in the drawings are contemplated within the scope of the present disclosure. The produce slicer **10** includes a frame **12**, exemplarily described above. A blade assembly **16** is exemplarily received in the frame **12**. A pusher head **18** is exemplarily received within the frame **12**. Embodiments of the blade assembly **16** and pusher head **18** may include many features as described herein with respect to embodiments of the blade assembly and pusher head. Embodiments of the produce slicer **10** may further include additional features as will be described in detail herein.

The produce slicer **10** exemplarily includes at least one lock **63** configured to secure the blade assembly **16** to the frame **12**. The produce slicer **10** further includes at least one lock **63** configured to secure the pusher head **18** to the frame **12**.

In embodiments, the at least one lock **63** may be a plurality of rotational locks pivotably secured to the frame **12**. Such locks **63** may include a pivot pin **65** and a rotating arm **67** secured by the pivot pin **65** to the frame **12**. Exemplary embodiments of the at least one lock **63** may be manually actionable, such that a worker using a produce slicer **10** manually operates the at least one lock **63** between a first position extending across at least a portion of the blade assembly **16** and/or pusher head **18** and a second position where the blade assembly **16** and/or pusher head **18** is moveable with respect to the frame **12**. The second position of the at least one lock **63** opens the frame **12** to receive or remove the respective blade assembly **16** and/or pusher head **18**. The first position of the at least one lock **63** secures the blade assembly **16** and/or pusher head **18** to the frame **12** after installation of the respective blade assembly **16** and/or pusher head **18** into the frame **12**. In still further embodiments, the at least one lock **63** may be used in addition to or in connection with the alignment structures, as previously described, which may be located on both the frame **12** and a respective blade assembly **16** or pusher head **18**. In one exemplary embodiment, one or more of the locks **63** are positioned on the frame such as to be in alignment with the respective arms **36** of the blade assembly **16** and/or the arms **72** of the pusher head **18**. In another embodiment, the at least one lock **63** is aligned with another portion of the respective blade assembly **16** and/or pusher head **18**. Exemplarily, the at least one lock **63** is aligned interior of the arms **36** of arms **72**. It will be recognized that other implementations of locks may be used in additional embodiments including, but not limited to latches, clasps, and mated configurations.

FIG. **4** is a perspective view of an additional configuration of the frame **12**. FIG. **4** exemplarily further depicts the at least one lock **63**. As will be seen from FIG. **4**, an embodiment of the frame **12** may include four locks **63**, exemplarily one lock **63** associated with each lateral side of a respective blade assembly **16** and pusher head **18**. The finger cutout **38** as shown in FIGS. **3** and **4** exemplarily extends in the vertical dimension in contrast to the finger cut-out **38** shown in FIGS. **1** and **2** which extends in the horizontal dimension. It will be recognized that other configurations of finger cut-outs **38** may also be used as previously described.

The produce slicer **10** depicted in FIGS. **3** and **4** further includes a blade assembly **16** with a handle **35** and a pusher head **18** with a handle **75**. The respective handles **35**, **75** will be described in further detail herein, but it is to be recognized that they facilitate insertion, removal, and transport of the pusher head **18** and blade assembly **16** by a user while keeping the user's hands and fingers away from the blades (described herein) of the blade assembly **16**. In an exemplary embodiment, as depicted, the handle **35** of the blade assembly **16** and the handle **75** of the pusher head are exemplarily "D" shaped in cross section such that flat portions of the respective handles **35**, **75** correspondingly engage or align to facilitate grasping both handles with one hand.

As best seen in FIG. **4**, in exemplary embodiments, the frame **12** may be configured without lower plates **64** (FIG. **2**). In such an embodiment, the elimination of the lower plates facilitates access for placing and removing the pusher head **18** (FIG. **3**). In such embodiments, the placing/removing motion becomes more similar to that of the blade assembly **16** (FIG. **3**) whereby both pusher head **18** and the blade assembly may be placed or removed with an angled motion. In such an embodiment, the pusher head **18** (FIG. **3**) is retained within the frame **12** by the engagement of the alignment structures **74**, **76** with the pusher head **18** and engagement of the lock **63** within the pusher head **18**. However, it will be understood that the frame as depicted in FIG. **4**, may alternatively be constructed to include the lower plates **64** as depicted in FIG. **2** without departing from the scope of the present disclosure.

In another embodiment, the blade assembly **16** and the pusher head **18** nestingly engage each other, exemplarily by receiving the pushers(s) of the pusher head within the target ring(s) of the blade assembly. The handles **35**, **75** of each of the blade assembly **16** and the pusher head **18** generally correspond to facilitate grasping and handling of both parts of the entire blade cartridge **14** as a single unit. The frame **12** may be configured, exemplarily as described above, such that when the frame and handle are moved into the lower position, the blade cartridge **14** including the blade assembly **16** and the pusher head may be inserted into the frame **12** as a single unit. Exemplarily, the blade assembly **16** and the pusher head **18** will engage the respective alignment structures and locks **63** moved into position to secure the blade assembly **16** and the pusher head **18** to the frame **12** before raising the handle to the raised position.

FIG. **5** depicts an exemplary embodiment of a blade assembly **100** which may be used in conjunction with a frame **12** in a produce slicer **10**. The blade assembly **100** includes a blade cover **102** and at least one blade set **104**, both of which will be described in further detail herein. The blade assembly **100** is exemplarily configured to slice soft produce quickly. The embodiment of the blade assembly **100** depicted in FIG. **3** is exemplarily configured to slice four tomatoes or cucumbers. Various embodiments of blade assemblies **100** may be configured to receive different types of produce within the produce slicer **10**. As will be described in further detail, the blade cover **102** includes multiple features that facilitate operation of embodiments of the produce slicer. The blade cover **102** includes a top portion **106** which is generally flat and extends across at least a portion of the at least one blade set **104** contained within the blade cover **102**. The top portion **106** includes at least one target ring **108**. In an embodiment, at least one of the target rings **108** extend upward from the top portion **106**. In

embodiments, the target rings **108** define a target area relative to the blades within which the produce is placed. The target rings therefore may define the target area without extending upward from the blade cover **102**. In the exemplary embodiment depicted in FIG. **3**, four target rings **108** extend from the top portion **106** to facilitate slicing of four tomatoes (or other produce) during a single actuation of the produce slicer **10**.

The target rings **108** serve multiple functions. First, the target rings **108** generally define the shape of the produce to be sliced by the blade assembly **100**. This limits the exposed portions of the blade set **104** to only the area of the blades needed to slice the produce. Additionally, the target ring **108** may extend vertically upward from the top portion **106** such as to further define a retaining lip **110** that holds the produce in place in the blade assembly **100**. This retaining lip **110** helps to maintain alignment of the produce with the underlying at least one blade set **104**. In addition to speed of slicing the produce, accuracy in slicing produce is also desirable as food preparation and restaurant standards often require that the produce be sliced in a particular orientation relative to the physical structure of the produce itself. Therefore, it is desirable for the produce to be sliced to be held in a position relative to the blade set between placement and slicing of the produce with the produce slicer **10**. In still further embodiments, the target ring **108** may further facilitate this orientation of the produce relative to the at least one blade set by corresponding the shape of the target ring to any generalized features of the shape of the produce to be sliced when placed in the desired orientation.

In an embodiment, the retaining lip **110** defines a distance above the top portion **106** which a corresponding portion of the pusher head, as will be disclosed in further detail herein, cannot engage thereby defining a gap generally between components of the blade assembly **100** and the pusher head when the pusher head is in the closed position. In an embodiment, if an operator's fingers are positioned on the top portion **106** when the pusher assembly **54** is lowered to the closed or lowered position, the worker's fingers will not be pinched between the components of the blade assembly **100** and the pusher head. In another embodiment, the pusher head is configured such that the blade assembly **100** and pusher head nestingly engage to minimize storage space required for the whole blade cartridge.

In a still further function, the target rings **108**, and the retaining lip **110** further protect fingers of workers when inserting food into the target ring **108** by creating a still further barrier between fingers and the blades within the blade cover. In use, the worker must release the food before the retaining lip **110**.

The blade cover **102** further includes alignment structures **112** which are configured to matingly engage the exemplary front and/or rear alignment structures found on the frame base and the pusher assembly. Embodiments of the blade cover **102** further include a resilient finger **114** which can facilitate connection and removal of the at least one blade set **104** to the blade cover **102**.

FIG. **6** is a bottom perspective view of an exemplary embodiment of the blade assembly **100** as depicted in FIG. **5**. From the bottom view of the blade assembly **100** depicted in FIG. **4**, two blade sets **104** can be seen stacked upon one another within the blade cover **102**. In other embodiments of the blade assembly, other numbers of blade sets, including but not limited to one blade set or three blade sets, may be used. In an exemplary embodiment, the blade set **104** includes two opposed frame bars **116** across which a plurality of blades **118** are secured. In exemplary embodiments. In embodiments, the frame bars may be constructed as extrusions, cast, machined, or milled. It will be recognized that other manufacturing techniques may be used while remaining within the scope of the present disclosure. While the blade set **104** is depicted with two frame bars **116**, it is understood that more or fewer frame bars may be used in embodiments. In an embodiment the two or more frame bars may be portions of a continuous structure such as a frame. In embodiments such a frame may be milled from a single piece of material or cast as a unitary structure. In a still further embodiment, the frame bars may be portions of a ring, oval, rectangular, square, or other shaped frame within which the blades are secured. In still further embodiments as described herein, the frame bars may be constructed of multiple pieces secured together and secured to the blades.

The blades **118** are may be serrated in order to reduce the surface area of the blades that engage the produce at any one time, exemplarily such as to be able to cut through the tough skin of a tomato as compared to a head of lettuce, or the meat of the tomato. It will be recognized that other types of blades may be used as well. One or more tensioning rods **120** extend between the opposed frame bars **116**. Embodiments of the tensioning rods **120** may include a tensioning screw (not depicted), which is operated in order to achieve a desired tension on the plurality of blades **118**. It will be noted from the embodiments depicted in FIGS. **6** and **9**, the blades **118** of the two blade sets **104** are offset from one another. It will be recognized that the distance between adjacent offset blades corresponds to a desired thickness of the sliced produce, while offsetting of the blades further reduces the surface area engaged by the skin or surface of the produce at one time which promotes produce slicing. Still further embodiments may use a variety of other blade sets and include a blade cover **102** configured in the manners as disclosed herein to receive those other blade sets. Non-limiting exemplary embodiments of other blade sets which may be used include the **908**, **910**, **912**, **925**, and **943** series of blade sets all currently available from Prince Castle LLC.

As previously disclosed, in an embodiment, two blade sets **104** are secured within the blade cover **102**. In an embodiment, the blade sets **104** are secured within the open interior of the blade cover **102** defined by the top portion **106** and the sides **130**. The two blade sets **104** are exemplarily a top blade set **105** and a bottom blade set **107**. In an embodiment, one or more support ledges **122** extend from the interior of the front side **124** of the blade cover **102**. The front side **124** terminates in a front lip **126**. The support ledges **122** engage a bottom blade set **107** of the at least one blade set at the front end of the blade cover **102** and the aforementioned finger **114** extending from the rear end of the blade cover **102** engages the bottom blade set **107** at the rear end of the blade assembly **100**. Therefore, the combination of the support ledges **122** and the finger **114** hold the at least one blade set **104** within the blade cover **102** to form the blade assembly **100**. In an embodiment as depicted that uses two or more blade sets, the support ledges **122** and finger **114** are located such that engagement between the support ledges **122**, finger **114**, and bottom blade set **107**, also retains the top blade set **105** within the blade cover **102**.

In other embodiments, the blade sets may be secured within the blade cover in a variety of other ways. One or more cross-pins may extend along the bottom of the blade cover below the blade sets to retain the blade sets within the cover. Fasteners, including screws, pins, or rivets may extend through the sides of the blade cover into one or more of the blade sets, exemplarily into the frame bars. Fasteners may extend into one or more of the blade sets through the top

surface of the blade cover. In one exemplary embodiment, the blade cover may include limited or no side walls and the planar top portion of the blade cover is secured to the blade sets. The blade cover may extend at least partially around the blade sets by including a bottom side opposite the top surface. In a modified embodiment, the blade cover may at least partially surround the blade sets on top, bottom, and sides, and the blade cover comprises at least two pieces that may be secured to one another to locate and retain the blade sets therein. In a still further embodiment, the blade cover may be independently fixable to the frame from one or more blade set.

In use, when the blade assembly **100** is inserted into the blade assembly receiving area **48** of the frame **12**, the support ledges **122** engage the front support **28** such that the slicing force against the at least one blade set **104** is transferred through the support ledges **122** to the front support **28** of the support surface **24**. The blade cover **102** further includes cut-outs **128** that are configured such that support structure **40** can pass through the wall of the blade cover **102** at the rear of the blade cover **102** and the elevated support surfaces **42** of the support structures **40** directly engage the bottom blade set **107**. Thus, the blade set, which must resist the slicing force placed on the blade set through the produce and the pusher head are supported by the support surface of the frame **12**.

Embodiments of the blade assembly **100** further facilitate worker safety as the blade cover defines spaces for the worker to grab and hold the blade assembly **100** when placing and removing the blade assembly from the produce slicer. For example, the worker can grip over the front lip **126** and the worker's fingers will touch either the frame bar **116** or the non-cutting side of the blades **118**. The worker may also grip the blade assembly **100** from the blade cover sides **130** where the worker's fingers will engage a space between the sides **130** and the tension rods **120** therefore away from the blades **118**. Still further, the worker may grip the arm **132** of the blade assembly, where the worker may either grip the arms **132** of the blade cover **102** or within a region interior to the arms **132** between the sides **130** and the frame bar **116**. In each of these cases, the worker's fingers are naturally located at positions removed from the blade and the cutting surfaces of the blades **118** are interior to the blade assembly **100** and away from general access by the worker.

FIG. **7** depicts an exemplary top perspective view of a pusher head **134** as will be received within the pusher head receiving area **68** of the frame **12**. The pusher head **134** exemplarily includes front alignment structures **136** and rear alignment structures **138** which are configured to engage and secure to the front alignment structures **74** and rear alignment structures **76** of the head receiver **58**.

FIG. **8** depicts an exemplary bottom perspective view of the pusher head **134** which is exemplarily configured for operation with the blade assembly **100** as depicted in FIGS. **5** and **6**. Exemplarily, the pusher head **134** is configured for use in slicing multiple pieces of soft produce, for example, but not limited to, four tomatoes or cucumbers, and in the embodiment depicted, slicing four tomatoes simultaneously by actuation of the pusher assembly **54** of the produce slicer **10**. The pusher head **134** therefore exemplarily includes four produce pushers **140**. Each produce pusher **140** includes a base **142** from which extends a plurality of fins **144** a few of which are exemplarily labeled in FIG. **8** for identification purposes, although it will be recognized that far more fins **144** exist in the embodiment depicted in FIG. **6** than are specifically labeled with reference numbers. In an exemplary embodiment, the fins **144** are exemplarily constructed of aluminum or stainless steel and the bases **142** are injection molded around the fins **144**. This contour serves to create the produce pushers **140**. It will be recognized that the fins **144** are exemplarily contoured such as to generally define the shape of the surface of the produce to which the fins **144** will engage in order to maximize the distribution of the slicing force applied to the top of the produce when the pusher assembly **54** including the pusher head **134** is lowered against produce held in the target rings **108** of the blade assembly **100**. It will be recognized that in the embodiment depicted, the contours are exemplarily in two dimensions, width and depth to form a bowl or dish shaped contour. It will be recognized that the fins **144** are positioned and oriented such that each of the fins **144** will pass through a respective target ring **108** and between adjacent blades in the blade assembly **100**. It will further be recognized that in an embodiment wherein two or more blade sets **104** are used in the blade assembly **100**, that the adjacent blades may be comprised of blades from two different blade sets in the blade assembly **100**.

FIGS. **9-11** depict an additional exemplary embodiment of a produce pusher **210**. FIG. **9** is a perspective view of the produce pusher **210**. FIG. **10** is a front view of the produce pusher **210**. FIG. **11** is a side view of the produce pusher **210**. The produce pusher **210** may exemplarily be secured to the previously described pusher head **134**.

The produce pusher **210** can include a generally U-shaped frame **212** and the U-shaped frame **212** is constructed of a base plate **214** which is configured to be secured to the pusher head and a pair of opposed side fins **216** extending from the base plate **214**. The U-shaped frame **212** is exemplarily unitary in construction. The side fins **216** exemplarily provide the outer most fins (**218**, **220**) of the produce pusher **210**, as previously described above. As best depicted in the front view of FIG. **10**, the side fins **216** form the outermost fins of the produce pusher **210** and a plurality of intermediate fins, (**218**, **220**) are secured between the two opposed side fins **216**. In an exemplary embodiment, the intermediate fins (**218**, **220**) include intermediate end fins **218** and intermediate center fins **220**. However, it will recognized that in other embodiments, the intermediate fins (**218**, **220**) may all be of a similar construction or in still further embodiments, that still further different types of intermediate fins may be used.

In the exemplary embodiment of the produce pusher **210**, the intermediate center fins **220** exemplarily extend wider and longer than the intermediate end fins **218**. In some embodiments, this may be a practical distinction as described in further detail herein. In still other embodiments the additional length and width of the intermediate center fins **220** promote centering and alignment of the produce pusher **210** on a piece of produce placed in the produce slicer for cutting.

As best depicted in FIG. **11**, the fins (**216**, **218**, **220**) may include a contour or depression **228** further configured to generally match a contour of an outer surface of a specific type of produce to be cut using the produce pusher **210**. Such a contour **228** further promotes even application of cutting force by the produce pusher **210** to the piece of produce by increasing the surface area of each of the fins in contact with the piece of produce to be cut. It will be noted that the contour **228** is in a single dimension, exemplarily the same (depth) dimension within which the fins (**216**, **218**, **220**) and the blades (not depicted) extend. This contour **228**, along with the elongated portions **230** of the intermediate center

fins **220** helps to maintain positioning of the produce in this dimension, which facilitates cutting of the produce.

In an embodiment, the base plate **214** includes through holes **222** configured to receive at least one fastener (not depicted), which may exemplarily be a bolt, rivet, screw, or other type of fastener to secure the produce pusher **210** to the pusher head **134**. In an exemplary embodiment, a difference in dimensions between the intermediate end fin **218** and the intermediate center fins **220** provide a space or region about the through holes **222** to promote access thereto for assembly and/or disassembly of the pusher head **134**.

As best seen depicted in FIG. **10**, a plurality of spacers **224** are located exemplarily between each of the fins (**216**, **218**, **220**). Exemplarily, the spacers **224** may be of an elastomeric or plastic construction although other polymers, exemplarily including, although not limited to nylon may be used. The spacers **224** define the distance between each of the respective fins (**216**, **218**, **220**). Each of the fins are associated with one slice of the produce cut by the produce slicer. As described above, a blade of the blade assembly **202** will correspondingly pass between each of the fins of the produce pusher **210** as the piece of produce is pushed by the produce pusher **210** through the blades of the blade assembly **202**. The produce pusher **210** is exemplarily constructed by at least one fastener **226**, exemplarily one or more bolts **226**. The bolts **226** extend through corresponding holes (not depicted) in the side fins **216**, intermediate end fins **218**, intermediate center fins **220**, and spacers **224** before the fastener **226** is tightened against the spacers **224** to secure the assembly of the produce pusher **210** together.

As previously described, embodiments of produce pushers **210** may include fins constructed of stainless steel; however, it will recognized that, while strong and durable, stainless steel is also heavy and expensive. Therefore, in embodiments promoted by the configuration of the produce pusher **210**, the U-shaped frame **212** may exemplarily be constructed of stainless steel while the intermediate end fins **218** and intermediate center fins **220** are exemplarily constructed of another material including, but not limited to aluminum. Such an embodiment may exemplarily reduce a weight and a cost of the produce pusher **210**, while retaining the strength and durability benefits of stainless steel embodiments by providing support and a strong exterior of the produce pusher **210** with the stainless steel U-shaped frame **212**.

While not depicted in FIG. **8**, it will be recognized that in an alternative embodiment, the fins **144** of different produce pushers **140** may be of different lengths such that the fins **144** of different produce pushers **140** engage the produce positioned within the target rings of the blade assembly at different relative positions of the pusher head **134** above the blade assembly **100**. In such an exemplary embodiment, this focuses the slicing force generated by the pusher assembly **54** against less than all of the produce at the same time which can facilitate slicing of multiple pieces of produce with a lower overall required slicing force, as will be needed to slice all of the multiple pieces of produce simultaneously.

FIG. **12** is a bottom perspective view of an exemplary embodiment of the blade cartridge **146** including the blade assembly **100** depicted in FIGS. **5** and **6** and the pusher head **134** depicted in FIGS. **7** and **8** although it will be recognized that a pusher head using the produce pushers **210** depicted and described above with respect to FIGS. **9-11** may similarly be used. As can be seen in FIG. **12**, when the blade assembly **100** and the pusher head **134** are in engagement with one another, the fins **144** of the produce pushers **140** extend in between adjacent blades **118** of the blade set **104**. In an exemplary embodiment, the blade cartridge **146** in an arrangement wherein the blade assembly **100** engages the pusher head **134** may comprise an arrangement in which the blade cartridge **146** is stored, exemplarily when not in use.

As will be described in further detail herein, embodiments of the produce slicer **10** are configured to be operable with multiple configurations of blade cartridges, each blade cartridge specifically configured for optimal slicing of different types of produce, and, depending upon the produce, slicing multiple produce items simultaneously, such as with the blade cartridge just described with respect to FIGS. **5-12**, which is exemplarily configured to slice four tomatoes or cucumbers with a single operation of the produce slicer **10**. Embodiments of the blade cartridges are further configured, for example by arrangement of the one or more blade sets and/or pusher head, to execute different types of food preparation cuts, including but not limited to slicing, cubing, dicing, or wedging.

FIG. **13** is a top perspective view of a blade assembly **148** exemplarily configured to slice harder produce that requires more slicing force, for example slicing at least one onion or beet with a single operation of the produce slicer. The example depicted in FIG. **13** is configured to slice two pieces of produce. In an effort to promote clarity and conciseness between the description, like reference numerals between embodiments of the disclosed blade cartridges will be used to identify like structures between the embodiments.

It will be noted that the blade assembly **148** includes a top portion **106** as previously described and two target rings **150** that extend upward from the top portion **106** which are configured to receive produce (e.g. onions) positioned therein. In another aspect of embodiments as disclosed herein, it will be noted that the target rings **150** have a generally oblong configuration. This further facilitates the aforementioned desire to properly orient the produce relative to the underlying blade set **152**. It will be exemplarily noted that in one dimension (e.g. looking top down) of an onion, and the onion is generally circular, while from another dimension (e.g. from the side), the onion is exemplarily oblong, particularly if the onion has received some form of pre-processing exemplarily as to remove the skin and/or topmost and bottommost ends of the onion. It is further noted that exemplarily in the food service industry, it is desirable to slice an onion in order to form onion rings and therefore to achieve this orientation of produce slice, the onion must be sliced through the oblong dimension. Therefore, the shape of the target rings **150** facilitate proper orientation of the onion produce relative to the blades of the underlying blade set. The retaining lip **154** of the target rings **150** also serve to hold the onions in this orientation as the produce is sliced. The target rings may also have flat surfaces or walls to further define and facilitate produce product alignment within the blade assembly. Additionally, since the blade assembly is exemplarily configured to slice a specific type of produce, spacing between adjacent blades of the blade set(s) may be specific to the produce to be sliced with that blade assembly. For example, onion spacing may be 3/16 inch, while tomato spacing may be ¼ inch. It will be recognized that if more than one blade set is used in a staggered configuration, then the distance is greater between adjacent blades within the same blade set. This may exemplarily be double the desired slice thickness, if two blade sets are used.

FIG. **14** is a bottom perspective view of an exemplary embodiment of the blade assembly **148**. As previously mentioned, the blade assembly **148** is exemplarily configured to slice two pieces of produce (e.g. onions) with a

single operation of the produce slicer. As can be seen from a comparison of FIG. **14** to FIG. **6** different configurations of the blade sets **152** and the blade cover **156** are presented. This different configuration presents improved blade tension and strength and support of the blade sets while being configured for use in the same frame **12** of the produce slicer **10**. It will be recognized that the blade sets **152** are arranged to include shorter blades **158** and the blade sets **152** include three tensioning rods **160** with a tensioning rod disposed in the center of the blade set **152**. The frame bars **162** of the blade set **152** include elongated lips **164**. The lips **164** are configured to be engaged by the support ledges **166** at the front end of the blade assembly **148** and a similar elongated lip engaged by the finger **114** at the rear end of the blade assembly **148**. These modifications facilitate the holding of the lowermost of the one or more blade sets **152** in a plane even with the lower edge **168** of the blade cover **156**. Thus, in operation, the lowermost of the one or more blade sets **152** is directly supported by the support surface **24** of the frame base **20** of the produce slicer. In an exemplary embodiment, the ends of the frame bar **162** are supported on the lateral support **30** of the support surface **24**. In order to accommodate the onion slicing blade assembly **148** in the frame **12** configured to receive multiple configurations of blade cartridges for slicing different types of produce, the blade cover **156** includes the cut-outs **128** at the rear end of the blade assembly **148**; however, the respective support structures **40** of the frame **12** do not support the one or more blade sets **152**, and rather, the support structures **40** are arranged adjacent to the rearmost frame bars **162** when the blade assembly is positioned within the frame **12**, so that the lower most blade set **152** can engage the support surface **24**.

FIGS. **15** and **16** depict exemplary embodiments of blade sets **152** and exemplarily may be used in connection with embodiments of the blade assembly **148** described above with respect to FIGS. **13** and **14**. As can best be seen in FIG. **15**, the frame bars **162** include through-holes **170** within which tensioning screws that extend through tensioning rods **160** are disposed and the tensioning screws in the through-holes are adjusted in order to achieve the required blade tension on the blades **158** of the blade set **152**.

Due to the challenges of achieving a slicing force suitable to slice multiple pieces of hard produce (e.g. onions or beets) with a single actuation of the produce slicer while also slicing more delicate produce such as tomatoes and lettuce with the same produce slicer, still further embodiments of the blade set used in the blade assembly to cut onions may employ more than two blade sets such that the onions are held within the target ring at different heights relative to one another against the uppermost blade set associated with each onion by staggering the relative heights of the onion as positioned within the blade assembly. The pusher head as will be described in further detail herein applies the slicing force against the individual produce objects at different times thereby lowering the overall slicing force required through a single operation of the produce slicer to slice multiple pieces of produce.

In still another embodiment, the blade sets may hold the blades **158** at angles relative to each other as the angled blades reduce the blade surface engaging the produce at the start of the slicing operation thereby facilitating the initiation of the slicing of the produce. In one embodiment, the blades may be angled within a single blade set. In another embodiment, if two or more blade sets are used, blades may extend at angles between blade sets to create additional angulation of the blades in the blade assembly. In a still further embodiment, the blades are held straight by the blade sets, but held at one or more angles within the blade cover. This may exemplarily be achieved by adjusting a relative position between the finger and the support ledges. In another embodiment, if the blades within the blade assembly are angled sufficiently, then the produce may also be held at different heights relative to each other. As described above, this would result in application of the slicing force by the pusher head to each of the individual produce objects at different times in a single operation of the produce slicer.

FIG. **17** depicts an exemplary embodiment of a pusher head **172** as may exemplarily be used with embodiments of the blade assembly **148** described above with respect to FIGS. **13** and **14**. As will be recognized, the pusher head **172** includes two pusher assemblies **174** configured to apply the slicing force from the pusher assembly through the onion produce against the one or more blade sets of the blade assembly. As described above, in an alternative embodiment, the fins **144** of the respective pusher assemblies **174** may be of different relative heights such that the different pusher assemblies **174** engage the respective produce at different positions of separation between the pusher head **172** and the blade assembly **148** thereby focusing the slicing force from the pusher assembly against one of the pieces of produce first, thereby starting or completing slicing of one piece of produce before starting or completing slicing of another piece of produce with the other pusher assembly **174**.

FIGS. **18** and **19** respectively depict top and bottom perspective views of an exemplary embodiment of a blade assembly **176**. The blade assembly **176** may exemplarily be used to slice a single head of lettuce produce. Due to the relatively larger size of lettuce produce compared to other forms of produce (e.g. onions and tomatoes) a single target ring **178** defines a space to receive a single head of lettuce against an uppermost of the at least one blade set **180**.

Viewing the blade assembly **176** from the bottom, in FIG. **19**, the configuration of the blade cover **182** is more similar to that of the blade assembly configured for slicing the tomatoes described above with respect to FIGS. **5** and **6** than to the blade cover for the blade assembly configured for slicing onions described with respect to FIGS. **13** and **14**. Due to the lower slicing force required to cut the head of lettuce as opposed to multiple onions, the blade cover arrangement wherein support ledges **122** engage the frame bar **184** of the bottom blade set **180** and similarly cut-outs **128** enables the support of the lowermost blade set **180** by the support structure **40** of the frame.

The blade assembly **176** further exemplarily discloses that the bottom blade set **180** and top blade set **186** may be oriented and held within the blade cover **182** at different orientations to one another rather than the offset orientation as described above with respect to the blade assembly configured to slice tomatoes and/or onions. Depending upon food processing requirements, lettuce is designed to be cut with a cross cut processing and therefore, the blade sets **180** are arranged within the blade cover **182** perpendicular to each other to achieve this desired slicing. As depicted in FIG. **19**, the top blade set **186** is oriented perpendicular to the bottom blade set **180**. The top blade set **186** is therefore supported by engagement with the bottom blade set **180** at respective ends of the frame bars **184**, generally at the corners of the blade assembly **176**. In a still further embodiment, due to the slicing requirements of a relatively soft piece of produce like lettuce, the blades of the blade sets **180**, **186**, may be flat and not serrated, and further may be untensioned, or held to a lower degree of tension than other embodiments. It will be recognized that other types of

produce may also be processed with a cubing or dicing cut using such a configured blade assembly. It will be recognized that other angulations of blades may be used in other embodiments, for example to make wedge cuts.

In still further embodiments, each of the pusher head and blade assembly may include a handle that extends from the front side thereof. The handles can further facilitate the safe assembly and removal of the components of the blade cartridge into and from the frame of the produce slicer. In a still further embodiment, a handle link may be securable between the pusher head handle and the blade assembly handle. The handle link may rigidly define a distance between the blade assembly and the pusher head such that the blade assembly and pusher head are spaced apart at a predetermined distance for installation and removal of the blade cartridge from the frame of the produce slicer. In a still further embodiment, the predetermined distance established between the pusher head and the blade assembly can dispose the fins of the pusher head at least partially within the at least one blade set of the blade assembly to further block worker access to the blades during storage and/or cleaning of the blade cartridge. Additionally, by holding the pusher head and the blade assembly apart at a predetermined distance, cleaning of the component may further be facilitated.

An exemplary embodiment of a handle **200** is depicted on a blade assembly **202**. In an embodiment, the handle **200** is D-shaped with a flat side **204** coplanar with the top portion **206** of the blade assembly **202**. The handle **200** further includes a curved side **208** opposite the flat side **204**. It will be recognized that a corresponding pusher head of a blade cartridge may similarly include a handle as described herein (e.g. as depicted in FIG. **3**). In such an embodiment, when the pusher head is received within the blade assembly **202**, corresponding flat sides of the handles are positioned in close proximity to one another such unitary handle is constructed with both curved sides of the respective handle.

FIGS. **20** and **21** exemplarily depict a blade assembly **202** that is configured to slice a single piece of produce, which as non-limiting examples may include an onion or a beet. FIG. **21** is a bottom perspective view of the blade assembly **202**. Similar to that as described above with respect to FIG. **14**, the blade assembly **202** includes a top blade set **232** and a bottom blade set **234**. The top blade set **232** and bottom blade set **234** are both generally constructed of an interior frame bar **236** and an exterior frame bar **238**. Both the interior frame bar **236** and the exterior frame bar **238** include a lip **240**. Tensioning rods **242** and blades **244** extend between the interior frame bar **236** and the exterior frame bar **238**. The blade cover **246** includes a pair of support ledges **248** which engage a lip **240** of the exterior frame bar **238** of the bottom blade set **234** and a pair of fingers **250** that engage a lip **240** of the interior frame bar **236** of the bottom blade set **234**. Thus, the top blade set **232** and bottom blade set **234** are retained within the blade cover **246** by the support ledges **248** and the fingers **250**. The bottom blade set **234** is held in the position flush with the bottom of the blade cover **246** such that the interior frame bar **236** can exemplarily engage the sides of the support surface of the frame of the produce slicer while the exterior frame bar can engage the front supports of the support surface.

It will further be recognized that one or more projections **252** of the blade cover **246** extend from an interior of the blade cover **246** to engage the interior frame bar **236** or exterior frame bar **238**. These projections **252** further distinctly define and locate the position of the top blade set **232** and the bottom blade set **234** within the blade cover **246** such as to achieve a proper positioning between the blade sets **232**, **234**, and the blade cover **246**.

FIG. **22** is a perspective view of an additional exemplary embodiment of a blade assembly **254**. Similar in construction to the blade assembly **202** depicted in FIGS. **20** and **21**, the blade assembly **254** is exemplarily configured with four target rings **256**, defining four target areas **258**, exemplarily configured to receive a piece of produce within each of the target areas **258**. Exemplarily, the piece of produce may be a tomato, while it will be recognized that other embodiments, as disclosed above, may be configured to slice one or more types of other forms of produce, including, but not limited to cucumbers or onions. In an embodiment, the blade assembly **254** may be used to simultaneously cut pieces of produce of two or more types of produce with similar physical properties, for example tomatoes and cucumbers. In that embodiment, the blades may all have similar qualities (e.g. tension, serration, support). In another embodiment the blade assembly **254** may be configured to simultaneously cut pieces of produce of two or more types of produce with different physical properties, for example tomatoes and onions. In that embodiment, different blades in the blade assembly may have different qualities (e.g. tension serration, support). Different qualities may be provided by providing a plurality of blade sets within the blade assembly **254** with different blade sets oriented relative to particular target areas **258** configured to receive a type of produce. The blade assembly **254** further includes a handle **200** that, as described above, is exemplarily configured to facilitate the transfer, storage, insertion, and/or removal of the blade assembly and/or the entire blade cartridge (not depicted) of the produce slicer.

As described above, in exemplary embodiments, a blade assembly and a pusher head may be configured to nestingly engage one another for common transport, cleaning, and/or storage. In an exemplary embodiment wherein the produce pusher of the pusher head is configured to be entirely received within the target ring **256**, a top portion **206**, or a cover surface of the blade cover **246** may engage a similar cover surface of a pusher head (not depicted). Exemplary embodiments of the blade cover **246** may include a plurality of spacers **260** extending upwards from the cover surface **206**. This can limit the actual engaged surface area between the blade assembly and the pusher head when the two components are held together exemplarily for transport, cleaning, or storage. A reduction in engaged surface area promotes cleaning and drying of the cover surfaces as well as reduces adhesion between cover surfaces in the event of a moisture build up there between.

As discussed previously above, one or more blade sets may be used in an exemplary embodiment of a blade assembly. In embodiments of the blade set, the blades of the blade set are held in tension which enable the operation of the produce slicer by pushing the pieces of produce through the blade sets by a force applied by the produce pushers of the pusher head. However, forces on the blades during the cutting process may cause deflections or bending in the blades that over time reduce the tension in the blade set that worsens over time, reducing a useful life of the blade set. Therefore, in exemplary embodiments, the target rings **256** extend below a level of the cover surface **206** into the open interior of the blade cover **246** to produce one or more blade supports **262** which will be described in further detail herein, with respect to FIG. **24**.

FIG. **24** is a bottom perspective view of a portion of an exemplary embodiment of a blade set and a blade cover with a blade support **262**. The blade support **262** is exemplarily

constructed of a plurality of fingers **264** separated by blade slots **266**. The blade supports **262** include a series of pairs of blade slots **266** each aligned to receive a single blade **244** of a blade set there between. Exemplarily, the blade slots **266** may be configured to receive only blades of a top blade set **232**, as these are closest to the blade cover **246** and initiate cutting of the produce. In other embodiments, the blade support **262** includes slots for the blades of both a top blade set and a bottom blade set. It will be recognized that embodiments may include blade supports **262** associated with each of the plurality of target rings **256** in the blade cover **246**. In such embodiments, blade slots **266** may be aligned between adjacent blade supports **262**. In such an exemplary embodiment, each blade **244** of a blade set may therefore be supported by blade slots **266** of blade supports **262** at four locations across the length of the blade. The blade slots **266** are constructed within a sufficient manufacturing tolerance of the width of the respective blades so that the blades held in the blade slots **266** are supported from bending or rotation during the cutting process. This is exemplarily depicted in FIG. **24** in which a plurality of blades **246** can be seen supported by a plurality of blade slots **266** of the blade support **262**. In still further embodiments, the blade supports **262** may be independent structures apart from the target rings **256**. The blade supports may be secured to the blade set, or extend to the blades from another portion of the cover, for example the top portion or one or more of the sides.

FIG. **25** is an exploded view of an additional exemplary embodiment of a blade set **300** as may exemplarily be used with embodiments of the blade assembly as disclosed herein. The blade set **300** may exemplarily be used to slice lettuce, although it will be recognized that such blade set **300** may be used to slice any of the other food as disclosed herein as well. Additionally, the blade set **300** may exemplarily be used in applications wherein a cut other than slicing may be desired, exemplarily, but not limited to shredding or cubing. This may be due to the fact that embodiments of the blade set **300** include at least two blades oriented in different directions to one another.

In FIG. **25**, the blade set **300** includes at least one vertical blade **302** and at least one horizontal blade **304**. The vertical blade **302** exemplarily extend between the horizontal frame bars **306** and the horizontal blade **304** exemplarily extend between the vertical frame bars **308**.

The horizontal frame bars **306** are exemplarily constructed of top horizontal frame bars **310** and bottom horizontal frame bars **312**. The vertical frame bars **308** are exemplarily constructed of top vertical frame bars **314** and bottom vertical frame bars **316**.

A plurality of slots **318** in the frame bars are configured to respectively receive ends of the vertical blade **302** or horizontal blade **304**. The vertical blades **302** and horizontal blades **304** further include slots **320** partially therethrough and configured to engage one another. Exemplarily in the embodiment depicted in FIG. **25**, the vertical blades **302** and horizontal blades **304** are generally perpendicularly aligned.

The vertical blades **302** and horizontal blades **304** include holes **322** at respective ends. When the vertical blades are inserted within the slots **318** of the horizontal frame bars, the holes **322** of the vertical blades align with a groove **324** located through portions of both the top horizontal frame bar **310** and bottom horizontal frame bar **312**. Similarly, when the horizontal blades **304** are located in the slots **318** of the vertical frame bars **308**, the holes **322** of the horizontal blades **304** are aligned with grooves **324** located in the top vertical frame bar **314** and bottom vertical frame bar **316**. Retaining rods **326** positioned through the holes **322** and arranged within the grooves **324** operate to retain the respective blades between the top and bottom portions of the frame bars when the blade set **300** is assembled.

When the blade set **300** is assembled, the retaining rods **326** are fully enclosed within the mating groove **324** of the respective top and bottom portions of the respective frame bars. This prevents removal of the blade from the respective slots **318** of the frame bars. Depending upon a dimensioning of the blades, grooves, and/or retaining rods, such tensioning may be applied to the blades during assembly of the blade set **300**, although in other embodiments, the blades are generally untensioned.

In the embodiment depicted in FIG. **25**, the blade set **300** is assembled by first orienting the bottom portions of the frame bars, then inserting the blades and the respective retaining rods into the slots **318** and grooves **324** before locating the top portions of the frame bars, enclosing the retaining rods **326** and the ends of the blade within the frame bars. Screws **328** exemplarily threadingly extend through the corners of all four portions of the frame bars where the structures over lap in the corners.

In an exemplary embodiment, at least one frame bar portion may include projections **330** which are configured to engage a blade cover as previously described. It will be recognized that, as described above, a variety of manners of connection between the blade set and the blade cover may be used and this embodiment may not be limited to the projections as shown in FIG. **25**.

In an additional embodiment, the blade support is a separate structure (not depicted) apart from the blade cover. In an embodiment, the blade support comprises a plurality of fingers connected together to define a series of blade slots. This blade support embodiment may be placed in engagement with the blade set to receive a blade of the blade set into each of the blade slots. In an embodiment, the blade support or blade supports are configured with at least one mating feature or locking feature that engages a corresponding feature in the blade cover to secure the blade support thereto. In an embodiment, one or more blade supports may be secured to a blade set with the blades in engagement in the blade slots before the blades of the blade set are tensioned. In such an embodiment, the tension placed on the blades in the completed blade set secures the blade support in engagement with the blades of the blade set while the blade support strengthens the blades against twisting and/or bending during use.

Still further exemplary embodiments, it will be recognized that a blade assembly and a corresponding pusher head forming a blade cartridge may be configured for the simultaneously slicing of two different pieces of produce. As a non-limiting example, a blade cover of such a blade cartridge may be configured exemplarily with half of the blade cover as exemplarily depicted in FIG. **13** and the other half of the blade cover as exemplarily depicted in FIG. **5** to create a blade cover configured to receive one onion and two tomatoes for simultaneous slicing. The underlying blade sets of such a blade assembly may be constructed exemplarily as depicted in FIGS. **14-16** or FIG. **23** where the blades on either sides of the center tension rod are configured to different specification. Exemplarily, the spacing between the blades on either side of the center tension rod may be different to accommodate for exemplarily different widths of onion rings versus tomatoes slices. In still further embodiments, different features such as different blade tensioning and/or blade supports as described above may be used on

either sides of the center tension rod to achieve different cutting qualities for use in slicing the different types of produce.

As previously described above, while not depicted herein, it is recognized that blade cartridges may be configured to perform other types of produce slicing, including, but not limited to dicing, cubing, slicing, or wedging. In an exemplary embodiment, a blade cartridge configured to perform a wedge cut, may include exemplarily six or eight angled blades radially extending from a central alignment rod with corresponding wedge-shaped fins on the pusher head. In such an embodiment, the central alignment rod and an exemplary support ring may form the frame for the blade set received in the blade assembly receiving area of the frame. In exemplary embodiments, the blades of the wedging blade set may exemplarily be located at different heights relative to the cover of the blade assembly as described above which may be achieved by two separate blade sets, or a single blade set with blades on different height levels. A non-limiting example of an exemplary construction of a wedging blade and a wedging produce pusher is exemplarily found in the 908-A series of heavy-duty wedges available from Prince Castle LLC.

In still further exemplary embodiments, the cover may comprise the top portion and be independently positioned relative to one or more blade sets positioned in the blade assembly receiving area of the frame. In one exemplary embodiment the cover may be directly secured to the one or more blade sets. In another example the cover may engage the frame, for example by sliding or pivotable attachment, such that one or more blade sets can be positioned within the blade assembly receiving area and the cover, with the target rings pivoted or otherwise moved into a position relative to the blade sets.

It will be recognized that the present disclosure has made reference to a plurality of exemplary embodiments. It will be recognized by a person of ordinary skill in the art in view of the present disclosure that various features and components as described in connection with one embodiment may be similarly applied or incorporated with the features of another embodiment disclosed herein, while remaining within the scope of the present disclosure.

Therefore, an embodiment of the produce slicer as disclosed herein, a single frame enables space-efficient storage and use within a confined food processor or preparation area. The frame of the produce slicer is configured to accept multiple different blade cartridges which include a blade assembly and a pusher head configured to slice different specific types of produce. While a single purpose slicer can be maximized to the specific slicing force and desired processed produce shape, the specific requirements of slicing each different type of produce present challenges when incorporating these features into a single produce slicer. Therefore, by making the adjustments relative to the specific produce within the blade cartridges and configuring the blade cartridges to be accepted within the single common slicer frame, the food processing worker can quickly and efficiently reconfigure the produce slicer for the type of produce to be processed. Additionally, the incorporation of the blade cover safely and securely retains the blade set for slicing each of the different types of produce in a manner that reduces accident risk to the worker thereby promoting a safer work environment while providing a blade assembly that is easily disassembled and cleaned to promote sanitation.

This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to make and use the invention. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

The invention claimed is:

1. A produce slicing system for slicing multiple types of produce, the produce slicing system comprising:

a frame comprising:

a frame base comprising a blade assembly receiving area;

a pusher assembly comprising at least one rail and a head receiver movably mounted to the at least one rail; and

a handle movably connected to the pusher assembly and configured to move the pusher assembly along the at least one rail;

a first blade cartridge configured for interchangeable engagement with the frame, comprising:

a first blade assembly configured to removably engage the blade assembly receiving area of the frame base, comprising:

a first cover with a first cover top portion and a plurality of sides extending away from the first cover top portion defining an open interior;

at least one first cover target ring defined in the first cover top portion, the at least one first cover target ring defining at least one target area configured to receive produce to be sliced; and

first and second blade sets, each comprising first frame bar and second frame bar, and a plurality of blades extending therebetween, the first and second blade sets retained within the open interior of the first cover; and

a first pusher head configured to removably engage the head receiver of the frame, and comprising a first pusher head body and at least one produce pusher of the first pusher head with a plurality of fins extending in a direction away from the first pusher head body, the at least one produce pusher of the first pusher head aligned with the at least one first cover target ring; and

a second blade cartridge configured for interchangeable engagement with the frame, comprising:

a second blade assembly configured to removably engage the blade assembly receiving area of the frame base, comprising:

a second cover with a second cover top portion and a plurality of sides extending away from the second cover top portion defining an open interior;

at least one second cover target ring defined in the second cover top portion, the at least one second cover target ring defining at least one target area configured to receive produce to be sliced; and

third and fourth blade sets, each comprising a third frame bar and a fourth frame bar, and a plurality of blades extending therebetween, the third and fourth blade sets retained within the open interior; and

a second pusher head configured to removably engage the head receiver of the frame, and comprising a second pusher head body and at least one produce pusher of the second pusher head with a plurality of fins extending in a direction away from the second

pusher head body, the at least one produce pusher of the second pusher head aligned with the at least one second cover target ring.

2. The system of claim **1**, wherein the first blade cartridge is configured to slice a first type of produce and the second blade cartridge is configured to slice a second type of produce.

3. The system of claim **2**, further comprising:

wherein the frame base comprises a front support, lateral supports and at least one elevated support;

wherein the first frame bar of the first blade set engages the at least one elevated support and first cover further comprises at least one support ledge that engages the front support; and

wherein the third frame bar of the third blade set engages the lateral supports and the fourth frame bar of the third blade set engages the front support.

4. The system of claim **1**, wherein the frame further comprises at least one alignment structure located in the blade assembly receiving area and the first and second blade assemblies each comprise at least one alignment structure configured to matingly engage the at least one alignment structure of the blade receiving area, and the head receiver further comprises at least one alignment structure and the first and second pusher heads each comprise at least one alignment structure configured to matingly engage the at least one alignment structure of the head receiver.

5. The system of claim **4**, wherein the first cover and the second cover further comprise laterally extending arms that engage the front support surface, each of the laterally extending arms comprising an alignment structure configured to matingly engage an alignment structure of the frame.

6. The system of claim **1**, wherein the frame comprises:

a support surface and lateral walls defining the blade assembly receiving area in the frame base;

a first lock movably mounted to the frame base and configured to releasably retain the first blade assembly or the second blade assembly in engagement with the support surface and the lateral walls; and

a second lock movably mounted to the head receiver and configured to releasably retain the first pusher head or the second pusher head in engagement with the head receiver.

7. The system of claim **1**, further comprising:

a first handle extending away from the first blade assembly;

a second handle extending away from the first pusher head, wherein the first and second handles align when the first pusher head is engaged with the first blade assembly;

a third handle extending away from the second blade assembly;

a fourth handle extending away from the second pusher head, wherein the third and fourth handles align when the second pusher head is engaged with the second blade assembly.

8. The produce slicing system of claim **1**, wherein the first blade set and the second blade set further each comprise three tension rods extending between the respective first and second frame bars of the first blade set and the first and second frame bars of the second blade set.

9. The produce slicing system of claim **1**, wherein the at least one first cover target ring extends away from the first cover top portion in a direction away from the first blade set, and the first blade assembly further comprises a second target ring extending away from the first cover top portion in a direction away from the first blade set, the second target ring defining a second target area configured to receive a piece of produce to be sliced, and wherein the first pusher head further comprises a second produce pusher of the first pusher head with a plurality of fins extending in a direction away from the first pusher head body, the second produce pusher of the first pusher head aligned with the second target ring.

10. The produce slicing system of claim **1**, wherein the at least one first cover target ring extends away from the first cover top portion in a direction opposite the open interior.

11. The produce slicing system of claim **10**, further comprising a first handle extending away from the first blade assembly and a second handle extending away from the first pusher head, wherein the first and second handles align when the first pusher head is engaged with the first blade assembly.

12. The produce slicing system of claim **1**, wherein the first cover further comprises at least one first cover support ledge and at least one finger extending into the open interior; and

wherein the first frame bar and the second frame bar of the first blade set both comprise lips, the at least one support ledge engages a lip of the second frame bar and the at least one finger engages the lip of the first frame bar and the first frame bar further engages the lateral supports of the support surface and the second frame bar engages the front support.

13. The produce slicing system of claim **1**, wherein the first cover further comprises an intermediate blade support that extends between and engages at least some blade of the plurality of blades.

14. The produce slicing system of claim **1**, wherein the frame further comprises:

at least one rail, extending above the frame base, and the head receiver movably mounted to the at least one rail;

a handle and at least one arm movably connected between the frame base, head receiver and the handle, the handle operably configured to move the head receiver along the at least one rail between an elevated position and a lowered position; and

a latch configured to passively engage when the head receiver is in the elevated position, the latch requiring an active disengagement to move the head receiver to the lowered position.

15. The produce slicing system of claim **1**, further comprising:

wherein the at least one produce pusher comprises a base plate;

wherein the plurality of fins of the at least one produce pusher comprises side fins extending from the base plate, and a plurality of intermediate fins disposed between the plurality of side fins; and

wherein the at least one produce pusher comprises a plurality of spacers disposed between each of the side fins and intermediate fins, and the spacers and intermediate fins are held under compression between the side fins.

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