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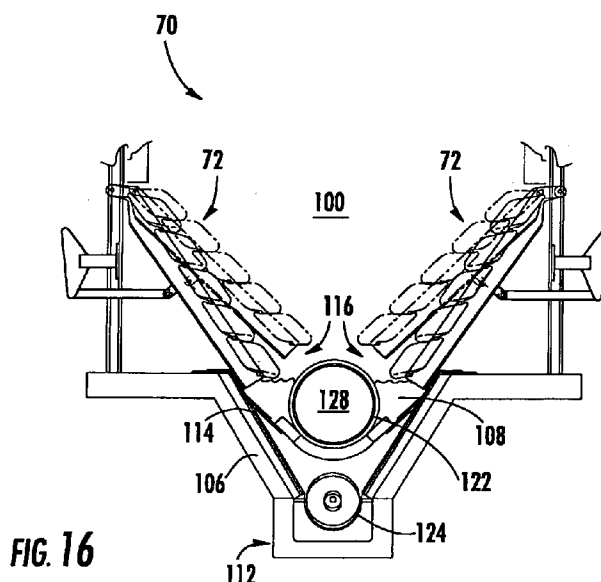
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(54) Title: INCINERATOR WITH PIVOTING GRATING SYSTEM



(57) Abstract: Aspects of the invention are directed to an incinerator and ash removal system. The incinerator includes a grating system, which has pair of grating panels arranged in a V-shaped configuration. The panels can be independently pivotable from each other. Pivoting the panels during incineration can aerate the garbage being burned and can provide a stoking effect. Each panel includes a support rack on which a plurality of bricks is removably connected. The bricks can be configured with a plurality of channels that can deliver pre- heated air to the combustion chamber. The v-shaped grating can be directly above an ash removal system, which includes a first auger and a second auger. Generally, the first auger can break up the products from combustion, and the second auger can transport these products out of the combustion chamber.

INCINERATOR WITH PIVOTING GRATING SYSTEM

FIELD OF THE INVENTION

[0001] The invention relates in general to waste disposal and, more particularly, to waste disposal by incineration.

BACKGROUND OF THE INVENTION

[0002] In a traditional incinerator system, waste is moved into a furnace where it is burned at high temperatures. The furnace includes a grate on which the garbage is supported while it is burned. To facilitate combustion, air is supplied from below the grate. The air travels up through openings in the grate.

[0003] During the incineration process, some materials, such as glass and plastic, may melt before they burn. Some of the melted material collects on the grate. Over time, the amount of material that collects on the grate begins to appreciably inhibit airflow, which in turn adversely affects the combustion process. If the amount of airflow blockage becomes too great, then the grate must be replaced or cleaned. Both of these options are time consuming, labor intensive and expensive.

[0004] Thus, there is a need for an incineration system that can minimize such concerns.

SUMMARY OF THE INVENTION

[0005] In one respect, aspects of the invention are directed to an incinerator system. The system includes a combustion chamber and a grating system. The grating system includes a first panel and an opposite second panel. Each of the first and second panels supports a plurality of bricks. At least a portion of each panel is housed within the combustion chamber.

The first panel and the second panel are angled relative to each other so as to be arranged in a generally v-shaped configuration.

[0006] Each of the first and second panels are pivotable. The first and second panels can be independently pivotable. The first panel can include an associated pivot point, and the second panel includes an associated pivot point. The pivot point of the first panel and/or the pivot point of the second panel can be located in an upper end region of each panel. The first panel and/or the second panel can be pivotably mounted to any suitable structure, including structure located outside of the combustion chamber. In such case, a portion of the first panel and/or second panel can extend outside of the combustion chamber.

[0007] An arm can be operatively connected to each of the first and second panels. Pivoting movement of the first and second panels can be achieved by movement of the arm. The arm can be a hydraulic arm. In one embodiment, a timer can be operatively associated with the hydraulic arm. Thus, the panels can be pivoted on a predetermined timed basis.

[0008] At least one of the bricks can have a channel extending therethrough. Each channel can be fluidly connected to an air source. As a result, air can enter and flow along the channel.

[0009] In another respect, aspects of the invention are directed to an ash removal system. The system can include a first auger and a second auger. The second auger can be located below the first auger. The first auger can have a rib that can break up combustion products, such as ash. The first auger can include a plurality of passages therein to deliver dense air to the combustor to help in the final burning of the garbage. The second auger can be used to transport the products of the incineration process out of the combustor for disposal. The first auger and/or the second auger can rotate at a variable speed. The direction of rotation of the

first auger and/or the second auger can be reversible. The first and second augers can be at least partially submerged in a fluid, such as water.

[0010] In another respect, aspects of the invention related to a method of incinerating garbage. Garbage can be supplied to a combustion chamber which can include a grating system with a first panel and an opposite second panel arranged in a generally v-shaped configuration. Each of the first and second panels can support a plurality of bricks. Each of the first and second panels can be pivotably mounted in the combustion chamber. According to the method, garbage can be supplied to the combustion chamber and supported on the grating system. The garbage can be burned. To facilitate burning, the garbage can be agitated by pivotally moving the first panel and/or the second panel, thereby allowing air to mix with the garbage. To further facilitate burning, pre-heated air can be added to the combustion chamber by passing air in heat exchanging relation through a channel in one or more of the bricks.

[0011] In still another respect, aspects of the invention can be directed to a brick for an incinerator. The brick can be made of a refractory material. The brick can provide one or more planar regions for engagement with other bricks. One or more channels can extend through the brick. The brick can be positioned so that a portion of the brick overhangs an exit end of each channel.

[0012] In yet another respect, aspects of the invention are directed to a grating panel for an incinerator. The panel can include a support rack formed by frame members connected by a plurality of rods. A plurality of bricks can be removably mounted on the support rack. The bricks can be arranged in a cascading manner on the support rack.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a perspective view of a brick in accordance with aspects of the invention.

[0014] FIG. 2 is a cross-sectional side view of a brick in accordance with aspects of the invention, showing a channel provided in the brick.

[0015] FIG. 3 is a cross-sectional side view of an alternative configuration for a brick in accordance with aspects of the invention, showing a first channel and a second channel formed in the brick.

[0016] FIG. 4 is a bottom view of a pair of bricks in accordance with aspects of the invention, showing the bricks separated from each other.

[0017] FIG. 5 is a bottom view of a pair of bricks in accordance with aspects of the invention, showing the bricks in abutment.

[0018] FIG. 6 is a perspective bottom view of a pair of bricks in accordance with aspects of the invention, showing the bricks in abutment.

[0019] FIG. 7 is an exploded perspective view of a support rack in accordance with aspects of the invention.

[0020] FIG. 8 is a perspective view of a support rack in accordance with aspects of the invention.

[0021] FIG. 9 is an exploded view of a grating panel in accordance with aspects of the invention.

[0022] FIG. 10 is a perspective view of a support rack in accordance with aspects of the invention, showing the support rack being made of more than two frame members and showing in phantom a pair of bricks removably installed thereon.

[0023] FIG. 11 is a side elevation view of a panel in accordance with aspects of the invention, in which a portion of the structure of the support rack has been removed to show the interaction between each row of bricks with other rows of bricks as well as with the rods and mounting rods of the support rack.

[0024] FIG. 12 is a side elevation view partially diagrammatic of a combustor in accordance with aspects of the invention, showing a pivotable grating system with panels arranged in a V-shaped configuration.

[0025] FIG. 13 is a side elevation view of an ash removal system in accordance with aspects of the invention.

[0026] FIG. 14 is a top plan view of an incineration system in accordance with aspects of the invention.

[0027] FIG. 15 is a side elevation view of a feeder and combustor in accordance with aspects of the invention.

[0028] FIG. 16 is a side elevation view of a combustor in accordance with aspects of the invention, showing the pivoting movement of the grating system.

[0029] FIG. 17 is a cross-sectional side view of a panel in accordance with aspects of the invention, in which a portion of the structure of the support rack has been removed to show the flow of molten garbage along the bricks of the panel.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0030] Aspects of the present invention relate to incinerator components, systems and associated methods that can enhance the performance of an incinerator. Embodiments according to aspects of the invention are shown in FIGS. 1 – 17, but the present invention is not limited to the illustrated structure or application. Further, the following detailed description is intended only as exemplary.

[0031] In one respect, aspects of the invention are directed to bricks for an incinerator. The brick can be a part of an improved grating system. Referring to FIG. 1, a brick 10 according to aspects of the invention can have a body 12. The body 12 can have any suitable shape and can be configured for the particular type of garbage that will be burned. In one embodiment, the body 12 can be generally diamond-shaped or generally parallelogrammatic, as shown in FIGS. 1 and 2. The brick 10 can be made of any material suited to withstand high temperature environments, such as a refractory material. One example of a suitable refractory material is silicon carbide. In one embodiment, the brick 10 can be made of a material that can withstand at least about 3000 degrees Fahrenheit. The brick 10 can be formed by any suitable casting process.

[0032] The following description of the brick 10 includes several relative terms, including, for example, "inner," "outer," "upper," and "lower." These terms refer to the relative position of the brick 10 when it is installed in its operational position. It will be understood that these terms are used to facilitate the description and are not intended to be limiting.

[0033] The body 12 can include an inner lateral side 14 and an outer lateral side 16. A substantial portion of the inner and outer lateral sides 14, 16 can be substantially planar. The term "substantially planar," as used here and in other places herein, is intended to mean true

planar and slight variations therefrom. In one embodiment, the inner lateral side 14 can be substantially parallel to the outer lateral side 16. The term "substantially parallel," as used here and in other places herein, is intended to mean true parallel and slight variations therefrom. The thickness of the brick 10 can be defined as the distance between the inner and outer lateral sides 14, 16. In one embodiment, the thickness of the brick 10 can be about 9 inches.

[0034] The brick 10 can also include an outer peripheral surface 18. Generally, the outer peripheral surface 18 can be divided into an outer portion 20 and an inner portion 22. The outer portion 20 can have any suitable contour. In one embodiment, the outer portion 20 can include a first upper planar region 24 and a first lower planar region 26 with an upper transition region 28 therebetween. It should be noted that the term "planar" can include a single continuous surface as well as a plurality of surfaces that collectively define a plane. The upper transition region 28 can have any suitable form. For instance, the upper transition region 28 can be generally rounded. Alternatively, the upper transition region 28 can be angular.

[0035] The inner portion 22 of the outer peripheral surface 18 can have any suitable contour. For instance, the inner portion 22 can include a second upper planar region 30 and a second lower planar region 32 with a lower transition region 34 therebetween. The lower transition region 34 can have any suitable form. For instance, the lower transition region 34 can be generally rounded. Alternatively, the lower transition region 34 can be angular. The lower transition region 34 can be contoured so that a lower trench 38 is formed. In one embodiment, the lower trench 38 can be formed by one or more wave-like contours 36 in the outer peripheral surface 18. The first upper planar region 24 can be substantially parallel to the second lower planar region 32. Alternatively or in addition, the first lower planar region

26 can be substantially parallel to the second upper planar region 30.

[0036] There can also be an upper end region 40 between the first upper planar region 24 and the second upper planar region 30. In the upper end region 40, the outer peripheral surface 18 can be contoured, such as by providing an upturn portion 42, so that an upper trench 44 is formed. Similarly, there can be a lower end region 46 between the first lower planar region 26 and the second lower planar region 32. In the lower end region 46, the outer peripheral surface 18 can have any suitable conformation, including, for example, a rounded end (as shown in FIG. 2) or an angular end.

[0037] Referring to FIG. 2, the brick 10 can include one or more channels 48. The channels 48 can be formed in the brick by any suitable process, including during the casting process or in a subsequent operation, such as drilling. The channels 48 can have any suitable conformation. For instance, the channels 48 can be generally circular, semi-circular, rectangular, triangular, oval, semi-oval, polygonal, trapezoidal, V-shaped or U-shaped in cross-sectional shape. The channels 48 can have any suitable cross-sectional size. The size and/or shape of each channel 48 may or may not be substantially uniform along its length. The term "substantially uniform" includes true uniform and slight variations therefrom. Each channel 48 can have any suitable length. In one embodiment, it is preferable if the ratio of the channel's diameter to the length is at least about 1:4. The channels 48 can be substantially straight or can include one or more non-straight features. The term "substantially straight" is intended to mean truly straight and slight variations therefrom.

[0038] The channels 48 can be provided in any suitable location. In one embodiment, one or more first channels 50 can be formed in the body so that each first channel 50 opens to the inner portion 22 of the outer peripheral surface 18. The channels 50 can have an inlet end 52 and an exit end 54. When a plurality of first channels 50 is provided, the first channels 50

can be substantially identical to each other. The term "substantially identical," as used here and in other places, is intended to mean exactly identical and slight variations therefrom.

Alternatively, at least one of the first channels 50 can differ from the other first channels 50 in at least one respect, including, for example, size, shape, cross-sectional area, length or any other respect described herein. Further, the plurality of first channels 50 can be substantially parallel to each other. Alternatively, at least one of the first channels 50 can be non-parallel to the other first channels 50. The first channels 50 can be recessed from the end of the lower end region 46 when the brick 10 is installed in the operational position, which can result in a portion of the brick 10 overhanging the exit end 54 of each first channel 50.

[0039] In one embodiment, the brick 10 can have a full first channel 50a and a partial first channel 50b, as shown in FIG. 4. The full channel 50a can be generally centrally located. The full channel 50a can open to the inner portion 22 of the outer peripheral surface 18. At least a portion of the full channel 50a can be in the second lower planar region 32. The partial channel 50b can be any portion of a full channel. For instance, the partial channel 50b can be a quarter, one third, one half, two third or three quarter channel. In one embodiment, the partial channel 50b can open to the inner lateral side 14 as well as the inner portion 22 of the outer peripheral surface 18.

[0040] Alternatively or in addition to the first channels 50, one or more second channels 56 can extend through the body 12 of the brick 10. The second channels 56 can have an inlet end 58 and an exit end 60. One example of such an arrangement is shown in FIG. 3. When the brick 10 is installed in its operational position, the second channels 56 are disposed at a higher elevation than the first channels 50. There can be any suitable spatial relationship between the first and second channels 50, 56. In one embodiment, the first channels 50 can be generally parallel to the second channels 56. When the brick 10 includes second channels

56, the outer peripheral surface 18 of the brick 10 can be adapted so that the outer peripheral surface 18 overhangs the exit end 60 on each of the second channels 56, as is shown in FIG. 3.

[0041] The brick 10 can include one or more features to facilitate installation and assembly. For example, the brick 10 can include one or more recesses 62 in the outer lateral side 16 of the brick 10. Each recess 62 can have any suitable shape and size. Examples of the use of such recesses 62 will be described in more detail below.

[0042] In one embodiment, the bricks 10 can be provided in pairs, which includes a first brick 10a and a second brick 10b, as shown in FIG. 4. The above description concerning brick 10 is equally applicable to the first and second bricks 10a, 10b. The second brick 10b can be substantially the mirror image of the first brick 10a. The term "substantially the mirror image" includes the true mirror image as well as slight variations therefrom. However, in some instances, the first and second bricks 10a, 10b can be different. The inner lateral side 14 of the first brick 10a and the inner lateral side 14 of the second brick 10b can be adapted for substantial mating engagement.

[0043] The first and second bricks 10a, 10b can be arranged so that the inner lateral side 14 of the first brick 10a is substantially adjacent to the inner lateral side 14 of the second brick 10b, as is shown in FIGS. 5 and 6. The term "substantially adjacent" can include actual abutment of the inner lateral sides 14 and a slight spacing between the inner lateral sides 14. When arranged in such a manner, only the outer lateral side 16 of the first and second bricks 10a, 10b may be visible. The partial channel 50b in the first brick 10a and the partial channel 50b in the second brick 10b can collectively define a full channel 50c.

[0044] Instead of providing a pair of bricks 10a, 10b, a single brick with all of the above features can be provided. However, depending on the material selection and other

considerations, such a brick may not be feasible at least from a weight standpoint during transportation and/or installation.

[0045] In another respect, aspects of the invention are directed to a grating system 70. The grating system 70 can be formed by opposing panels 72 arranged in a V-shaped configuration, as is shown in FIG. 12. Each panel 72 can include a support rack 74 on which a plurality of bricks 10, such as those described above, can be supported. An example of a support rack 74 is shown in FIG. 9. Each of the components of the grating system 70 and its assembly will be described in detail below.

[0046] Referring to FIGS. 7 and 8, the rack 74 can have any suitable configuration. The rack 74 can include a plurality of elongated frame members 76. The following description will describe a rack having two frame members 76: a first frame member 76a and a second frame member 76b. However, it will be understood that this description is not intended to be limiting, as there can be any number of frame members, depending on the desired size of a panel 74. The frame members 76a, 76b can be made of any suitable material. In one embodiment, the frame members 76a, 76b can be made of boiler plate steel. The frame members 76a, 76b can be substantially identical; that is, the frame members 76a, 76b can be exactly identical or there can be slight variations between them, including, for example, the pivoting features described below. The first and second frame members 76a, 76b can be spaced from each other so as to receive a pair of bricks 10a, 10b, as described above. In one embodiment, the frame members 76a, 76b can be spaced about 18 inches apart.

[0047] The frame members 76a, 76b can include a series of protrusions 78. The protrusions 78 can be substantially identical to each other. Alternatively, at least one of the protrusions 78 can be different from the other protrusions 78 in one or more respects. Each of the frame members 76a, 76b can include a first set of passages 80; each of the first set of

passages 80 can be provided in a respective protrusion 78 on the frame members 76a, 76b.

The first set of passages 80 can be substantially aligned along the length of each frame member 76a, 76b. The term "substantially aligned," as used here and in other places, means true alignment and slight variations therefrom. However, in one embodiment, at least one of the passages of the first set of passages 80 can be offset from the other passages 80 in the respective frame member 76a or 76b. Each of the frame members 76a, 76b can also include a second set of passages 82 and a third set of passages 84. The second set of passages 82 can be substantially aligned along the length of each frame member 76a, 76b. Likewise, the third set of passages 84 can be substantially aligned along the length of each frame member 76a, 76b. However, in one embodiment, at least one of the passages of the second set of passages 82 and/or in the third set of passages 84 can be offset from the other passages 82 or 84 in the frame members 76a, 76b.

[0048] The first and second frame members 76a, 76b can be positioned so that each of the first set of passages 80 in the first frame member 76a is substantially aligned with a respective one of the first set of passages 80 in the second frame member 76b. Similarly, each of the second set of passages 82 in the first frame member 76a can be substantially aligned with a respective one of the second set of passages 82 in the second frame member 76b. Each of the third set of passages 84 in the first frame member 76a can be substantially aligned with a respective one of the third set of passages 84 in the second frame member 76b.

[0049] The frame members 76a, 76b can be structurally connected together in any suitable manner. In one embodiment, the frame members 76a, 76b can be structurally connected by a plurality of rods 86. The rods 86 can be made out of any suitable material, such as steel. The rods 86 can have any suitable cross-sectional shape, including substantially circular, rectangular, triangular and polygonal, just to name a few possibilities.

The rods 86 can have any suitable size. In one embodiment, the rods 86 can have a diameter of about 1 inch. At least one of the plurality of rods 86 can be different from the other rods 86 in one or more respects, including any of those described above.

[0050] Each rod 86 can be passed through aligned a pair of passages in the frame members 76a, 76b. For instance, one rod 86 can be passed through one of the second plurality of passages 82 in the first frame member 76a and an aligned one of the second plurality of passages 82 in the left frame member 76b. Similarly, one rod 86 can be passed through one of the third plurality of passages 84 in the first frame member 76a and an aligned one of the third plurality of passages 84 in the second frame member 76b. The rods 86 can be secured to the frame members 76a, 76b in any suitable manner, including by welding, interference fit, mechanical engagement, fasteners, or adhesives. The frame members 76a, 76b and the rods 86 can cooperate to form the structural support for the panel 72.

[0051] At least one of the frame member members 76a, 76b can include one or more features to allow the panel 72 to be pivoted in it its operational position. For instance, at least one of the frame members 76a, 76b can include a pivot protrusion 88 having a cutout 90 formed therein, as shown in FIG. 7. Such pivoting features can be provided in any suitable location on the frame members 76a, 76b. In one embodiment, the pivoting features can be provided in an upper end region of at least one of the frame members 76a, 76b. Any suitable number of pivot points can be provided.

[0052] Bricks 10 in accordance with aspects of the invention can be removably installed on the support rack 74 to form a grate panel 72. The bricks 10 installed on the support rack 74 can be substantially identical to each other, or at least one of the bricks 10 can be different. The support rack 74 can provide one or more features to facilitate such mounting. For instance, a mounting rod 94 can be passed through each of the first set of passages 80 in the

first frame member 76a and through an aligned one of the first plurality of passages 80 in the second frame member 76b. In one embodiment, the mounting rod 94 can be undersized relative to the passages 80 so that there is clearance therebetween. In one embodiment, there can be about 1/8 inch clearance. Such clearance can allow for thermal expansion and contraction of the mounting rod 94 during incinerator operation. In such case, the ends of each mounting rod 94 can be held in place by any suitable retainer. In one embodiment, the retainer can be a fastener, such as a cotter pin.

[0053] In one embodiment, a first pair of first and second bricks 10a, 10b, as described above, can be received in between the frame members 76a, 76b, as shown in FIG. 9. The first and second bricks 76a, 76b can be positioned so that the upper trench 44 (collectively formed by the upper trench 44 in the first brick 10a and the upper trench 44 in the second brick 10b) engages a respective first mounting rod 94 and so that the lower trench 38 (collectively formed by the lower trench 38 in the first brick 10a and the lower trench 38 in the second brick 10b) engages a respective second mounting rod 94, as shown in FIG 11. The second mounting rod 94 can be below the first mounting rod 94.

[0054] It should be noted that the upper end region 40 of each brick 10 can be proximate one of the rods 86. In some instances, a brick 10 may contact one of the rods 86. Alternatively, the upper end region 40 of each brick 10 can be spaced from one of the rods 86. In one embodiment, there can be a clearance of about 3/16 inch between the upper end region 40 of a brick 10 and the rod 86. The rods 86 can act as a stop to help prevent the bricks 10 from falling out of place if a brick 10 should become loose.

[0055] The outer lateral sides 16 of each brick 10a, 10b can abut a respective one of the frame members 76a, 76b. A second pair of bricks 10a, 10b can be installed in a similar manner, as described above in connection with the first pair of bricks 10a, 10b. It should be

noted that the collective upper trench 44 formed by the second pair of bricks 10a, 10b can engage the second mounting rod 94. As a result, the second mounting rod 94 can be substantially surrounded by the upper trench 44 formed by the second pair of bricks 10a, 10b and the lower trench 38 formed by the first pair of bricks 10a, 10b, as is shown in FIG. 11. Similar engagements with the other mounting rods 94 can occur if additional rows of bricks are provided. In the case of the uppermost row of bricks 10, the mounting rod 94 may only be engaged by the upper trench 44 of the uppermost row of bricks 10, as is shown in FIG. 11. Likewise, in the case of the lowermost row of bricks 10, the mounting rod 94 may only be engaged by the lower trench 38 of the lowermost row of bricks 10, as is shown in FIG. 11.

[0056] It should also be noted that the second lower planar region 32 formed by the first pair of bricks 10a, 10b can engage the first upper planar region 24 formed by the second pair of bricks 10a, 10b. The second lower planar region 32 and the first upper planar region 24 can be adapted for substantial mating engagement.

[0057] It will be appreciated that the bricks 10 can be held in place by their engagement with the support rack 74 and neighboring bricks 10 and by gravity. The bricks 10 can be mounted without the use of mortar or other bonding agent. Further, each of the protrusions 78 on the frame members can be received in a respective recess 62 in the outer lateral side of a brick 10, as is shown in FIG. 9. As a result, the support rack 74 can be substantially shielded by the bricks 10. Such an arrangement can protect the support rack 74 from being exposed to the high temperature operational environment of the incinerator.

[0058] The grate panel 72 can be as long and as wide as desired. In order to make the grate panel 72 longer, the length of the frame members 76a, 76b can be increased. If a wider grate panel 72 is desired, additional frame members 76 can be added to the support rack 74 in any of the manners described above. An example of a wider grate formed by additional

frame members 76 is shown in FIG. 10. In one embodiment, the grate panel 72 can be about 14 feet wide. When additional frame members 76 are used, one or more of these additional frame members 76 can be equipped with features to facilitate the pivoting of the panel 72 in operation, such as those discussed above. Any suitable quantity of such pivoting features can be provided. In one embodiment, the pivoting features can be provided on every other frame member 76.

[0059] The grate panel 72 can be pivotably mounted on any suitable structure. In one embodiment, a portion of the grate panel 72, such as pivot protrusion 88, can extend outside of the combustion section of the incinerator system, as is generally shown in FIG. 12. This portion of the grate panel 72 can be pivotably mounted to any suitable structure, including an outside wall of the combustor section. In another embodiment, the grate panel 72 can be pivotably mounted to structure inside the combustor section of the incinerator system.

[0060] Each of the grate panels 72 can be operatively associated with any suitable device or structure that can cause the grate panels 72 to pivot, including, for example, a hydraulic arm 96. The hydraulic arm 96 or other suitable structure can be operatively connected with any portion of the grate panel 72. Each grate panel 72 can be independently pivotable from the other grate panels 72. A timer 98 can be operatively associated with each hydraulic arm 96 or other structure so that the grate panel 72 can be pivoted on a predetermined timed basis at any desired interval. Alternatively, the hydraulic arm 96 or other structure can be manually operated.

[0061] In a grating system 70 according to aspects of the invention, a pair of grate panels 72 can be arranged in a combustion chamber 100 in a generally V-shaped configuration, as shown in FIG. 12. The grate panels 72 can be disposed at any suitable angle. In one embodiment, each of the grate panels 72 can be arranged at about 45 degrees relative to

horizontal in their non-pivoted position. The grate panels 72 can have any suitable range of motion. The range of motion of one grate panel 72 may or may not be the same as the opposing grate panel 72. In one embodiment, the lower end 166 of at least one of the grate panels 72 can have a range of pivoting motion of about 1 foot.

[0062] The incinerator system 102 according to aspects of the invention can also include an ash removal system 104, as shown in FIG. 12. The ash removal system 104 is generally located in the region directly below the grating system 70 according to aspects of the invention. While referred to as an ash removal system herein, it will be understood that the ash removal system 104 is not limited to removing ash, as it can be used to remove any products and leftover materials of the incineration process.

[0063] The ash removal system 104 includes a reservoir 106 filled with a fluid, such as water 108. The fluid level can be adjustable so that the fluid can be selectively added or removed as needed. The supply of new water to the reservoir can help keep the water at a relatively cool temperature. In an upper region 110, the reservoir 106 can include one or more slanted walls 114. The slanted walls 114 can help to minimize the likelihood of ash and other combustion products sticking to the walls of the reservoir 106. The reservoir can be made out of any suitable material, including, for example, stainless steel.

[0064] In its non-pivoted position, a lower end portion 116 of each grate panel 72 can directly contact a portion of the reservoir 106. In such a position, a chamber 118 can be formed behind each panel 72. The chamber 118 can be in fluid communication with an air supply device, such as a blower 120 or vents. Preferably, the air supply device can deliver air to the chamber 118 at variable rates. The chamber 118 can be in fluid communication with the channels 50, 56 in the bricks 10, thereby allowing any air received in the chamber 118 to enter and flow through the channels 50, 56.

[0065] The ash removal system 104 can also include a first auger 122 and a second auger 124, as is shown in FIG. 13. A portion of each auger 122, 124 can pass through the reservoir 106. Generally, as will be explained in greater detail later, the first auger 122 can be used to break up garbage and combustion products as well as to help in the final burn of the garbage. The second auger 124 can be used to transport the products of the incineration process out of the reservoir 106.

[0066] The first auger 122 can be disposed at a higher elevation than the second auger 124. The first auger 122 can be at least partially submerged in the water 108. The second auger 124 can be completely submerged in the water 108. The first auger 122 can have a larger diameter than the second auger 124. The first and second augers 122, 124 can be substantially parallel to each other. Further, the first and second augers 122, 124 can be substantially aligned in the vertical direction.

[0067] The first auger 122 can have an outer peripheral surface 126 and a hollow interior 128 (FIG. 12). The first auger 122 can have any suitable size. In one embodiment, the first auger 122 can be about 28 inches in diameter. A rib 130 can extend helically along the outer peripheral surface 126 of the first auger 122. The rib 130 can have any suitable size or cross-sectional geometry. For instance, the rib 130 can have a square cross-sectional shape. In one embodiment, the rib 130 can be about 1 inch high. A plurality of passages 132 can extend through the wall 134 of the first auger 122. The passages can be distributed along the first auger 122 in any suitable manner. In one embodiment, the passages 132 can be distributed helically along the outer peripheral surface 126 of the first auger 122. The passages 132 can have any suitable spacing. There can be any suitable quantity of passages 132. The passages 132 can have any suitable size and shape. In one embodiment, the passages 132 can be substantially identical to each other. In another embodiment, at least one of the passages 132

can be different from the other passages 132 in one or more respects, including those described above.

[0068] A gas, such as air, can be supplied to the hollow interior 128 of the first auger 122. The air can be supplied in any suitable manner. In one embodiment, a blower 136 can be in fluid communication with the hollow interior 128 of the first auger 122. The blower 136 can be a variable speed blower. The blower 136 can supply ambient air to the hollow interior 128. As will be explained in greater detail later, the air supplied to the hollow interior 128 can be kept relatively cool due to the at least partial submergence of the first auger 122 in the water 108. The air can be expelled through at least the passages 132 that are above the water 108.

[0069] The first auger 122 can be rotatably mounted in the reservoir 106 in any suitable manner. The first auger 122 can be rotated in any suitable manner, including, for example, by a motor, hydraulics and/or gear reduction. In one embodiment, the speed of rotation of the first auger 122 can be varied. In one embodiment, the first auger 122 can turn at about one revolution per minute. The first auger 122 can be run continuously during incinerator operation. The direction of rotation of the first auger 122 can be reversible. Reversing of the direction of rotation during operation can help to dislodge any materials that may build up on the rib 130 and/or outer peripheral surface 126 of the first auger 122. In one embodiment, the first auger 122 can be rotated in a first direction for a first period of time, and then rotated in a second opposite direction for a second period of time. Such cycling between the direction of rotation can be repeated as needed.

[0070] The second auger 124 can have an outer peripheral surface 138. The second auger 124 can have any suitable size. In one embodiment, the diameter of the second auger 124 can be about $\frac{1}{4}$ the size of the diameter of the first auger 122. A rib 140 can extend helically

along the outer peripheral surface 138 of the second auger 124. The rib 140 can have any suitable size or cross-sectional geometry. The second auger 124 can be rotatably mounted in the reservoir 106 in any suitable manner. The second auger 124 can be rotated in any suitable manner, including, for example, by a motor, hydraulics and/or gear reduction. In one embodiment, the speed of rotation of the second auger 124 can be varied. The second auger 124 can be run continuously during incinerator operation.

[0071] The ash removal system 104 can also include a conveyor 142. The conveyor 142 can be operatively positioned relative to the second auger 124 to receive any materials transported by the second auger 124. The materials can be removed from the conveyor 142 and disposed of in any suitable manner. The conveyor 142 is located in a chamber 144 that is filled with water 146. The chamber 144 can capture water from the reservoir 106, at least some of which can be transported out of the reservoir 106 by the second auger 124. A portion of the second auger 124 can extend into the chamber 144.

[0072] The conveyor 142 can include an exit end 148 that has a hook-like shape or includes a hook attached thereto. As a result, the exit end 148 can facilitate engagement by a front end loader, which can position its blade under the exit end 148 and lift up the exit end 148 of the conveyor 142. The front end loader can back up so as to pull the conveyor out of the chamber 144. To facilitate removal of the conveyor 142, a roller 150 can be provided on underside of the conveyor 142. Such features can avoid the need for providing a crane, thereby minimizing expense and downtime.

[0073] Having described the various individual components of an incinerator system according to aspects of the invention, one manner of using the system will now be described. It will be understood that the following description is illustrative and is not intended to be limiting.

[0074] FIG. 14 shows an incineration plant 102 according to aspects of the invention. Garbage can be brought to the incineration plant. A scale 152 can be provided to weigh the garbage. The garbage can be removed from the truck and transported to a crusher 154. In one embodiment, such transport can be achieved by loading the garbage onto a conveyor 156. The conveyor 156 can be surrounded by V-shaped walls to capture any garbage that may fall off of or that may otherwise miss the conveyor, thereby aiding cleanup. The conveyor 156 can deliver the garbage to the crusher 154, which can crush and separate the garbage.

[0075] From the crusher 154, the crushed garbage can be transported on a conveyor 160. On this conveyor 160, the crushed garbage can be observed or tested to detect the presence of valuables and/or other desired materials. Such things can be removed by hand or other suitable means. For example, certain metals can be removed by the use of magnets. The conveyor 160 can transport the crushed garbage over a wall 162 and can drop the crushed garbage onto a first location 164 on the plant floor. A mound of crushed garbage 166 can collect on the floor. Garbage from this mound 166 can be transferred to a second location 168 on the plant floor 164. Such transfer can be achieved by a skid loader, other suitable machinery or a shovel, just to name a few possibilities.

[0076] At this second location 168, an overhead loader 170, such as a crane or gantry can pick up the garbage. The overhead loader can be slidably mounted on a wall 172 of the plant. In one embodiment, the loader can be adapted to pick up from about 600 to about 800 pounds of garbage per grab. A second overhead loader (not shown) can be slidably mounted on the wall 172 as a backup to the other overhead loader.

[0077] The loader 170 can transport the garbage to one or more feeders 174. An operator can select the feeder 174 into which the garbage will be deposited based on the content of the garbage. For instance, one of the feeders 174 can be dedicated to receiving rubber and

another can be reserved for household products. The overhead loader 170 can include systems to weigh the garbage it transfers to each feeder 174. Such a measurement can be used to verify the weight of garbage measured earlier on the scales 152.

[0078] In one embodiment, there can be three feeders 174a, 174b, 176c (collectively referred to as feeders 174). Each of the feeders 174 can be connected to a respective combustion chamber 176a, 176b, 176c (collectively referred to as combustion chambers 176). However, it will be understood that there can be any number of feeders 176. Referring to FIG. 15, each feeder 176 can include an inlet 178 which can be closed by an inlet door 180. Each feeder 176 can also include an exit 182 which can be closed by an exit door 184. The inlet door 180 can be opened so that the respective feeder 176 can receive garbage 188 from the overhead loader 170. The operator can pick one of the feeders 176, based at least in part on the type of garbage being burned. Once the garbage 188 is deposited inside the selected feeder 176, the inlet door 180 can be closed. Preferably, the inlet door 180 and the exit door 184 are not opened at the same time.

[0079] With the inlet door 180 closed, the exit door 184 can be opened so as to permit communication with the combustion chamber 176. The garbage 188 can be supplied to the combustion chamber 176 by any suitable means, including, for example, by being pushed by a ram 186. The garbage 188 can be selectively pushed into the combustion chamber 176 at different speeds, which can be selected by an operator depending on the type of garbage being burned. For wet garbage, the garbage can be moved into the combustion chamber 176 relatively slowly. By doing so, the high temperatures of the combustion chamber 176 can flash evaporate moisture out of the garbage. As a result, the garbage will be substantially dry as it enters the combustion chamber 176, allowing it to be burned more easily. On the other

hand, dry waste can be moved into the combustion chamber 176 relatively rapidly in order to keep it from burning too quickly, which can create fly ash.

[0080] When it exits the feeders 174, the garbage 188 can fall into the combustion chamber 176 and is supported by the grating system 70. Initially, the grate panels 72 can be arranged in their most horizontal position when the garbage 188 enters and can be slowly lowered thereafter. Exposure to the high temperatures in the combustion chamber 176 can cause the garbage to burn.

[0081] The burning of the garbage 188 can be facilitated by air exiting the channels 48 in the bricks 10, as shown in FIG. 17. The air can be delivered to the combustion chamber 176 preheated because the air passes in heat exchanging relation with the brick as it travels through the channels 48 in the relatively hot bricks 10. As a result, the air can be heated to a high temperature. As the air enters the combustion chamber 176 it can ignite the burnable material on and near the brick 10, which, in turn, further heats the air from the bricks. Because of the supply of pre-heated air, an incinerator system according to aspects of the invention may not require the use of a burner. However, during startup, an initial load of garbage may need to be ignited by a flame source, such as a match, igniter or burner.

[0082] As the garbage 188 burns, the grating system 70 according to aspects of the invention is configured to minimize the problem of air blockage associated with previous incinerator systems. In particular, the fact that a portion of lower end region 46 of each brick 10 overhangs the channels 48 can minimize the possibility of blockage. The overhanging portion and the generally downward angle of the bricks 10 can ensure that the molten materials, such as glass 190, plastic or non-ferrous metals, will fall off the lower end region 46 of one brick 10 and onto the brick below, as is generally shown in FIG. 17, thereby leaving the channels 48 unimpeded. The process can continue with the molten material cascading

down the grate panel 72 and ultimately into the ash removal system 104. Further, because the channels 48 deliver pre-heated air, the area near the exit end of the 54 channels 48 will be hotter, helping to burn away any materials that may otherwise collect in the area.

[0083] During incineration, the grate panels 72 can be moved in a pivoting manner, as shown in FIG. 16. As noted above, each grate panel 72 can be moved independently of the other grate 72. Movement of the grate panels 72 can agitate the garbage supported thereon. Such agitation can help to aerate the garbage 72 and can create a stoking effect, both of which can facilitate the process of burning the garbage.

[0084] Incineration can further be fostered by the first auger 122. As noted above, air can be supplied to the hollow interior 128 of the first auger 122. The pressure at which the air is supplied can be varied as needed. In one embodiment, the pressure of the air can be sufficient to prevent any appreciable quantity of air from exiting the passages 132 that are submerged in the water 108. The pressure of the air can be sufficient to prevent water 108 from entering the hollow interior 128 of the first auger 122.

[0085] This air can be kept at a relatively cool temperature because of the water 108 surrounding at least a portion of the first auger 122. The temperature of the air can be regulated at least in part by the depth of the water 108 and/or the temperature of the water 108. Because this air is at a relatively cool temperature compared to the air in the combustion chamber 100, the air in the first auger 122 is denser than the relatively hot air in the combustion chamber 100. Such air can supply a sufficient amount and/or concentration of oxygen to help complete the final burn before the ash falls into the water 108. Depending on the material being burned, more or less time may be needed to complete the final burn. To provide sufficient time for the final burn, the water level in the reservoir 106 can be selectively adjusted accordingly by adding or removing water from the reservoir 106.

[0086] Once the garbage is burned, the combustion products, such as ash, can rise to the stack where they can be treated, or they can fall into the ash removal system 104. The combustion products can be quenched when they drop into the water 108 in the reservoir 106. Larger pieces of material, including large pieces of glass and/or metal sometimes referred to as "clinkers," can be broken up or torn apart by the rib 130 on the first auger 122. After passing the first auger 122, the materials can fall down further in the reservoir 106 to the second auger 124. In the lower region 112 surrounding the second auger 124, the reservoir 106 can narrow to ensure that a substantial portion of the combustion products are engaged by the second auger 124.

[0087] The second auger 124 can transport the combustion products to a conveyor 142 located in an adjacent chamber 144, as shown in FIG. 13. The conveyor 142 can transport the ash to a disposal truck or any suitable ash disposal means. It should be noted that, when the system includes a plurality of combustion chambers 176, the first and second augers 122, 124 can extend through each combustion chamber, delivering the ash from each combustion chamber 176 to a single conveyor 142. Alternatively, each combustion chamber can have a dedicated first auger, second auger and conveyor.

[0088] The incineration and ash removal system according to aspects of the invention can provide numerous advantages. The system can efficiently burn waste and collect and dispose of ash. In many cases, additional pollution control measures may not be necessary to meet the legally mandated standards. The system can provide great flexibility. For instance, the system can burn several different types of waste in parallel. The system can handle new garbage or old waste, wet or dry. The grating system is configured so that the panels can readily accommodate different types or combinations of bricks to improve efficiency. Because the bricks are removably installed on the support rack, the system can be relatively

easy to service. These and other advantages can be realized with a system in accordance with aspects of the invention.

[0089] It will be understood that the invention is not limited to the specific details described herein, which are given by way of example only, and that various modifications and alterations are possible within the scope of the invention as defined in the following claims.

What is claimed is

1. A incinerator system comprising:
a combustion chamber; and
a grating system including a first panel and an opposite second panel, each of the first and second panels supporting a plurality of bricks, at least a portion of each panel being housed within the combustion chamber, the first panel and the second panel being angled relative to each other so as to be arranged in a generally v-shaped configuration, each of the first and second panels being pivotable.
2. The incinerator system of claim 1 wherein the first and second panels are independently pivotable.
3. The incinerator system of claim 1 wherein the first panel includes an associated pivot point and the second panel includes an associated pivot point, wherein the pivot point of at least one of the first and second panels is located in an upper end region thereof.
4. The incinerator system of claim 1 wherein at least one of the bricks has a channel extending therethrough.
5. The incinerator system of claim 4 wherein each channel is fluidly connected to an air source, whereby air flows along the channel.
6. The incinerator system of claim 1 further including an arm operatively connected to each of the first and second panels, whereby pivoting movement of the first and second panels is achieved by movement of the arm.
7. The incinerator system of claim 6 wherein the arm is a hydraulic arm.
8. The incinerator system of claim 7 further including a timer operatively associated with the hydraulic arm, whereby the panels can be pivoted on a predetermined timed basis.

9. The incinerator system of claim 1 wherein at least one of the first and second panels is pivotably mounted to a structure outside of the combustion chamber.
10. In a combustion chamber housing a grating system comprising a first panel and an opposite second panel, each of the first and second panels hosting a plurality of bricks, the first panel and the second panel being angled relative to each other so as to be arranged in a generally v-shaped configuration, each of the first and second panels being pivotably mounted in the combustion chamber, a method of incinerating garbage comprising the steps of:
- supplying garbage to the combustion chamber, wherein the garbage is supported on the grating system;
- agitating the garbage by pivotally moving at least one of the first and second panels, whereby air can mix with the garbage; and
- burning the garbage.
11. The method of claim 10 wherein the agitation step includes:
- pivotally moving the first panel at a first time;
- pivotally moving the second panel at a second time; and
- pivotally moving the first and second panels together at a third time.
12. The method of claim 10 further including the steps of:
- determining the content of the garbage; and
- selecting a speed at which garbage is supplied to the combustion chamber based on the content of the garbage.
13. The method of claim 10 further including the steps of:
- pivotally moving the panels toward a horizontal pivotal position during the supply step; and

gradually moving the panels toward a vertical pivotal position during the burning step.

14. The method of claim 10 further including the step of supplying pre-heated air to the combustion chamber, whereby burning is facilitated by the pre-heated air.

15. The method of claim 14 wherein at least one of the bricks includes a channel extending therethrough, and wherein the step of supplying pre-heated air is performed by passing air in heat exchanging relation through the channel in each brick.

16. A brick for an incinerator comprising:

a brick having a body made of a refractory material, said body including an outer peripheral surface including a top, bottom, front and rear, said front including a planar region defining a front face along which material to incinerate can flow, said front face turning inwardly towards the body and away from the material flow along a lower edge, said body providing a channel from the rear towards the front but terminating rearward of the lower edge so that the front face overhangs the opening on the channel, whereby air can be supplied through the channel towards the material and the material can flow along the front face and drop from the overhang without clogging the channel.

17. A brick assembly for an incinerator comprising:

at least two bricks, each brick having a body made of a refractory material, said body including an outer peripheral surface including a top, bottom, front and rear, said front including a planar region defining a front face along which material to incinerate can flow, said front face turning inwardly towards the body and away from the material flow along a lower edge, said body providing a channel from the rear towards the front but terminating rearward of the lower edge so that the front face overhangs the opening on the channel, whereby air can be supplied through the channel towards the material and the material can flow along the front face and drop from the overhang without clogging the channel;

one of the bricks being positioned above the other brick with their front faces aligned so that material flowing along the front face of the first brick drops from the overhang and transfers to the front face of the second brick.

18. The brick assembly of claim 17 wherein the channel is formed along the bottom of the first brick so that the channel is open along its bottom, and the open bottom is enclosed by the top of the second brick

19. The brick assembly of claim 17 wherein at two of the channels are provided by the brick body.

20. The brick assembly of claim 17 wherein the channel is formed through the body below the top and above the bottom. further including a first channel extending through the body, wherein the first channel has an inlet end and an exit end, wherein at least a portion of the body overhangs the exit end of the first channel.

21. The brick of claim 20 wherein the first channel is open along its length to the inner portion of the outer peripheral surface.

22. An incinerator grating panel comprising:

a first frame member;

a second frame member;

a plurality of rods structurally connecting the first and second frames;

a plurality of mounting rods extending between and into engagement with each of the first and second frame members; and

a first brick having an outer peripheral surface, an inner lateral side and an outer lateral side, wherein the outer peripheral surface includes an outer portion and an inner portion, the outer portion having a first upper planar region and being contoured so that an upper trench is formed, the inner portion having a second lower planar region and being

contoured so that a lower trench is formed, wherein the second lower planar region is substantially parallel to the first upper planar region,

wherein the first brick is received between the first and second frame members such that the outer lateral side is substantially adjacent one of the first and second frame members and such that the upper trench engages an upper one of the plurality of mounting rods and such that the lower trench engages a lower one of the plurality of mounting rods.

23. The incinerator grating panel of claim 22 further including a second brick having an outer peripheral surface, an inner lateral side and an outer lateral side, wherein the outer peripheral surface includes an outer portion and an inner portion, the outer portion having a first upper planar region and being contoured so that an upper trench is formed, the inner portion having a second lower planar region and being contoured so that a lower trench is formed, wherein the second lower planar region is substantially parallel to the first upper planar region, wherein the second brick is substantially the mirror image of the first brick, wherein the second brick is received between the first and second frame members such that the outer lateral side is substantially adjacent the other one of the first and second frame members and such that the upper trench engages the upper one of the plurality of mounting rods and such that the lower trench engages the lower one of the plurality of mounting rods and further such that the inner lateral side of the second bricks is substantially adjacent the inner lateral side of the first brick.

24. The incinerator grating panel of claim 23 further including:
a first partial channel extending through the first brick, wherein the first partial channel is open along its length to the inner lateral side; and
a second partial channel extending through the second brick, wherein the second partial channel is open along its length to the inner lateral side,

wherein the first and second bricks are positioned such that the first partial channel and the second partial channel collectively form a full channel.

25. An ash removal system comprising:

a combustion chamber;

a reservoir defining a lower region of the combustion chamber, the reservoir being at least partially filled with a fluid;

a rotatable first auger, at least a portion of the first auger extending through the reservoir, the first auger having an outer peripheral surface and a hollow interior, the first auger having a rib extending helically along the outer peripheral surface, the first auger further including a plurality of passages distributed helically along the outer peripheral surface; and

a rotatable second auger, at least a portion of the second auger extending through the reservoir, the second auger being located below the first auger, the second auger having an outer peripheral surface and a rib extending helically along the outer peripheral surface.

26. The ash removal system of claim 25 wherein the reservoir is defined by a plurality of walls, wherein the reservoir has an upper region and a lower region, wherein at least one of the walls in the upper region is slanted.

27. The ash removal system of claim 25 further including an air supply device in fluid communication with the hollow interior of first auger.

28. The ash removal system of claim 24 further including a conveyor operatively positioned proximate an end of the second auger, whereby materials transported by the second auger are delivered to the conveyor.

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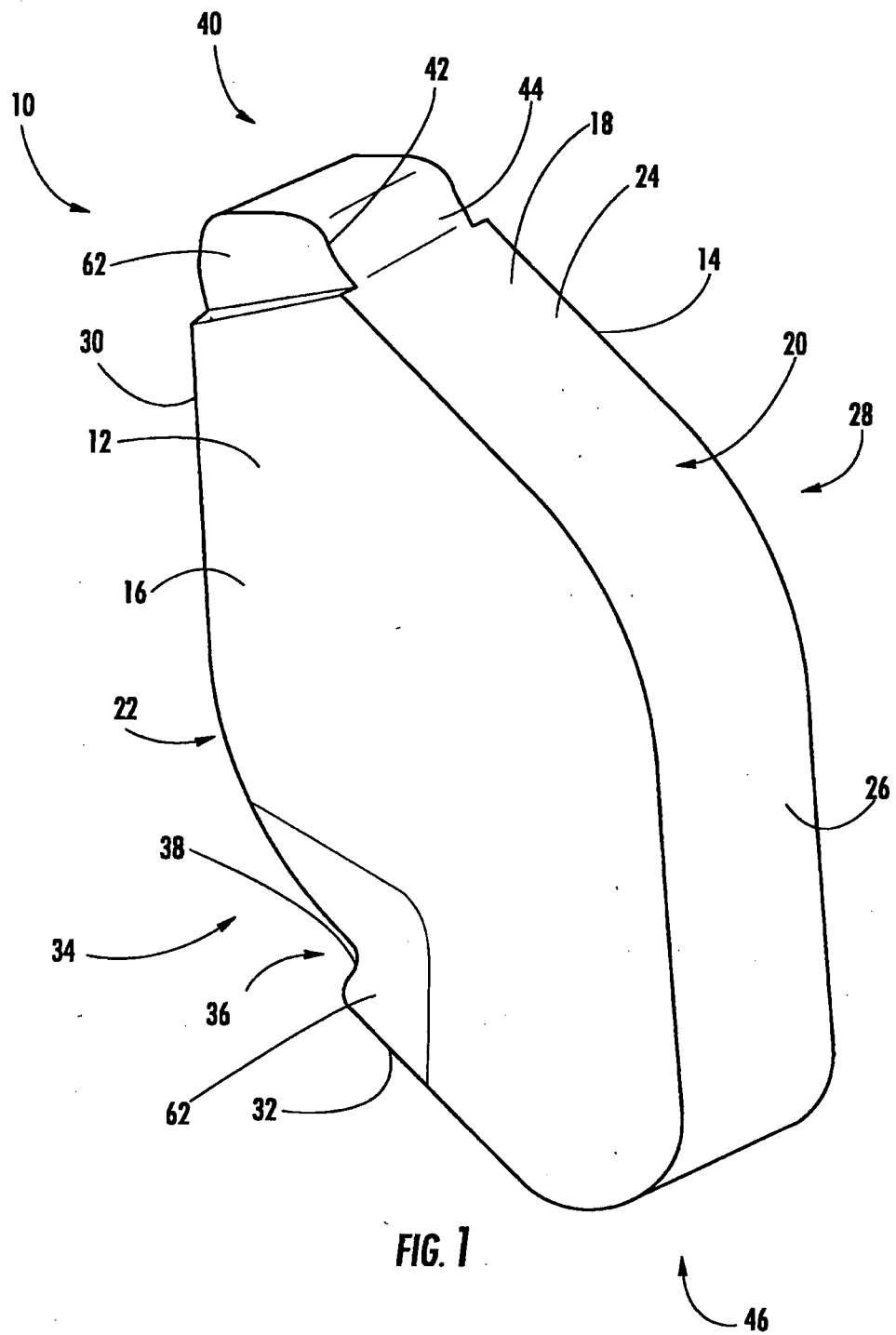
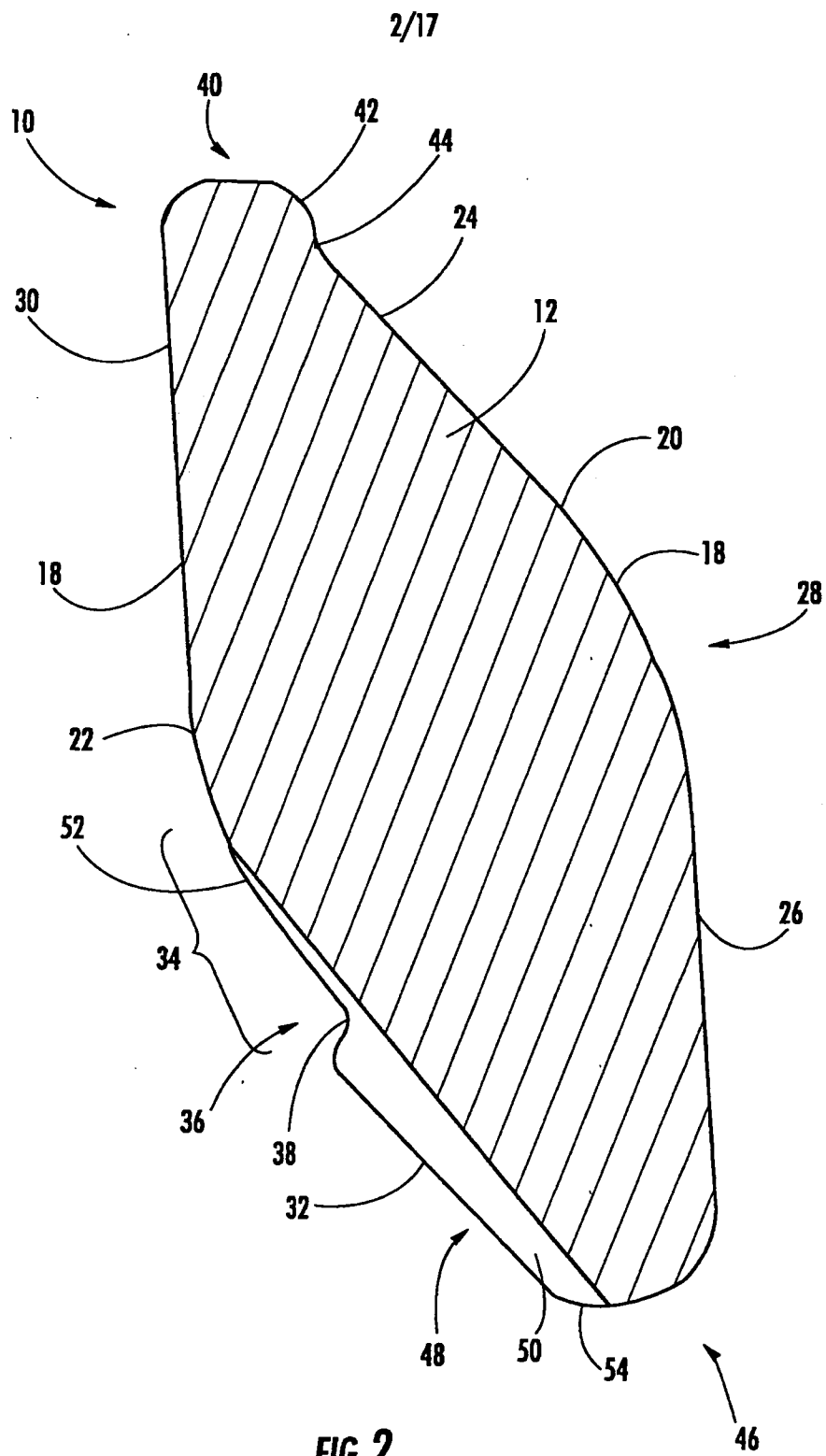
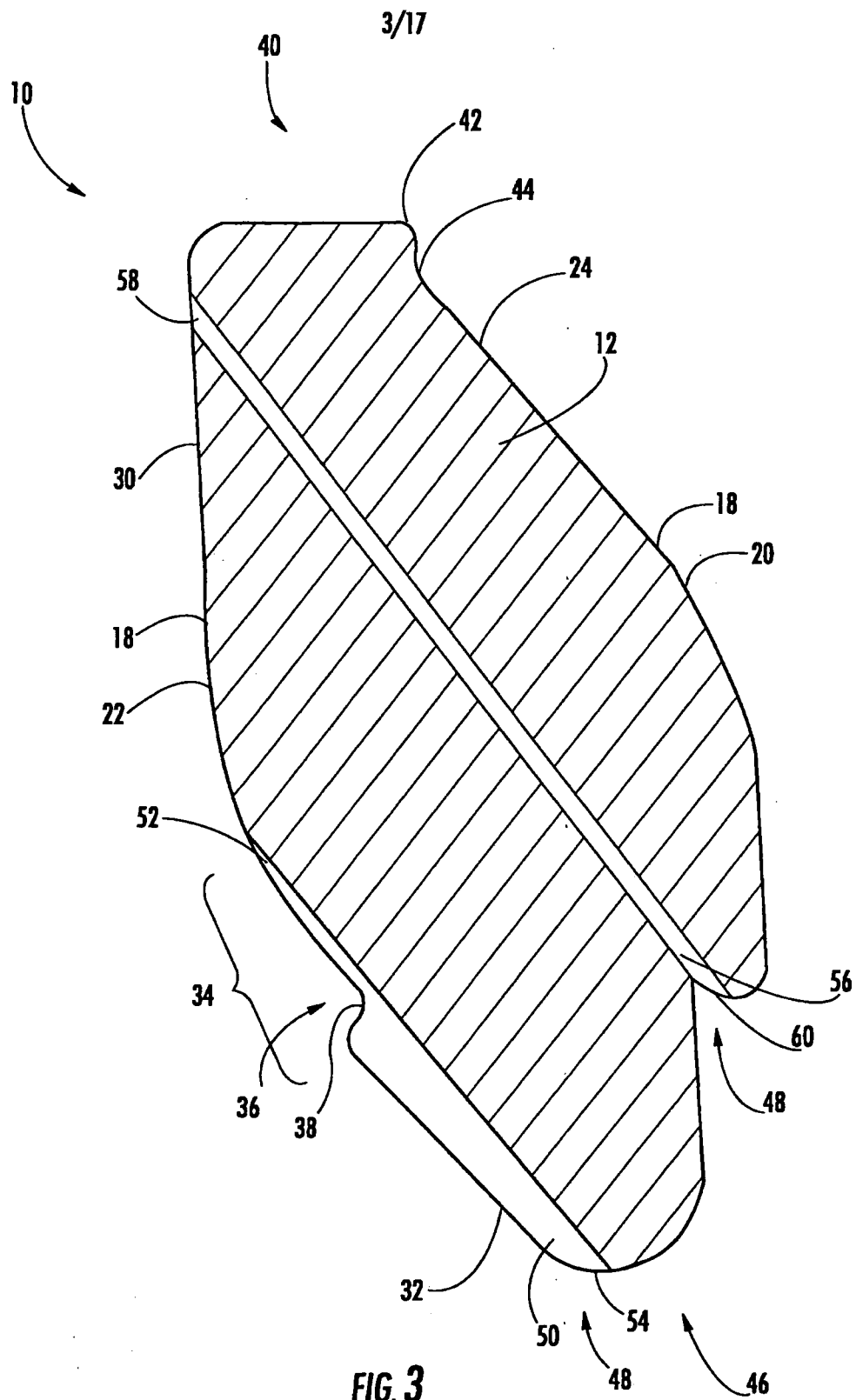


FIG. 1





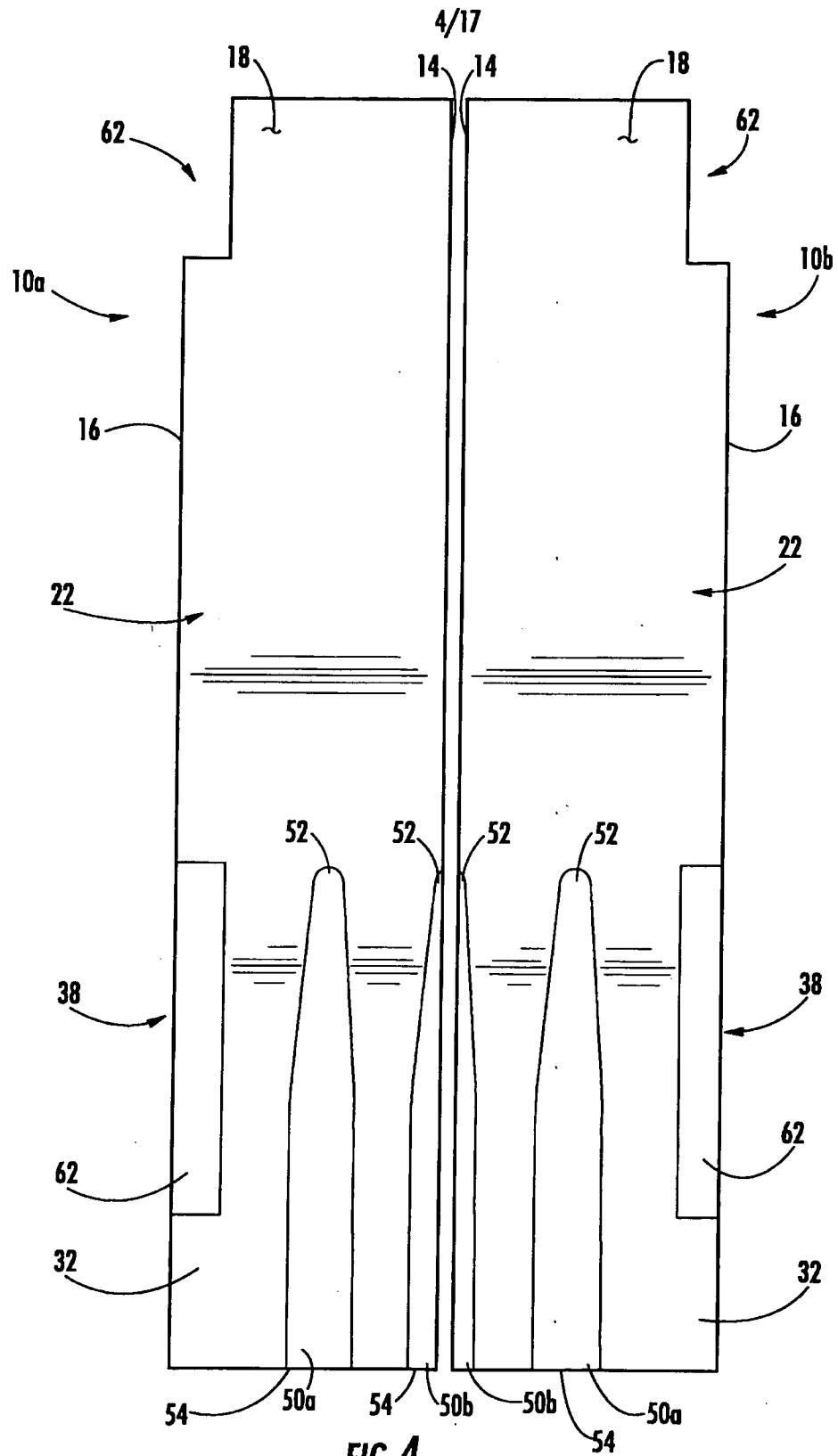
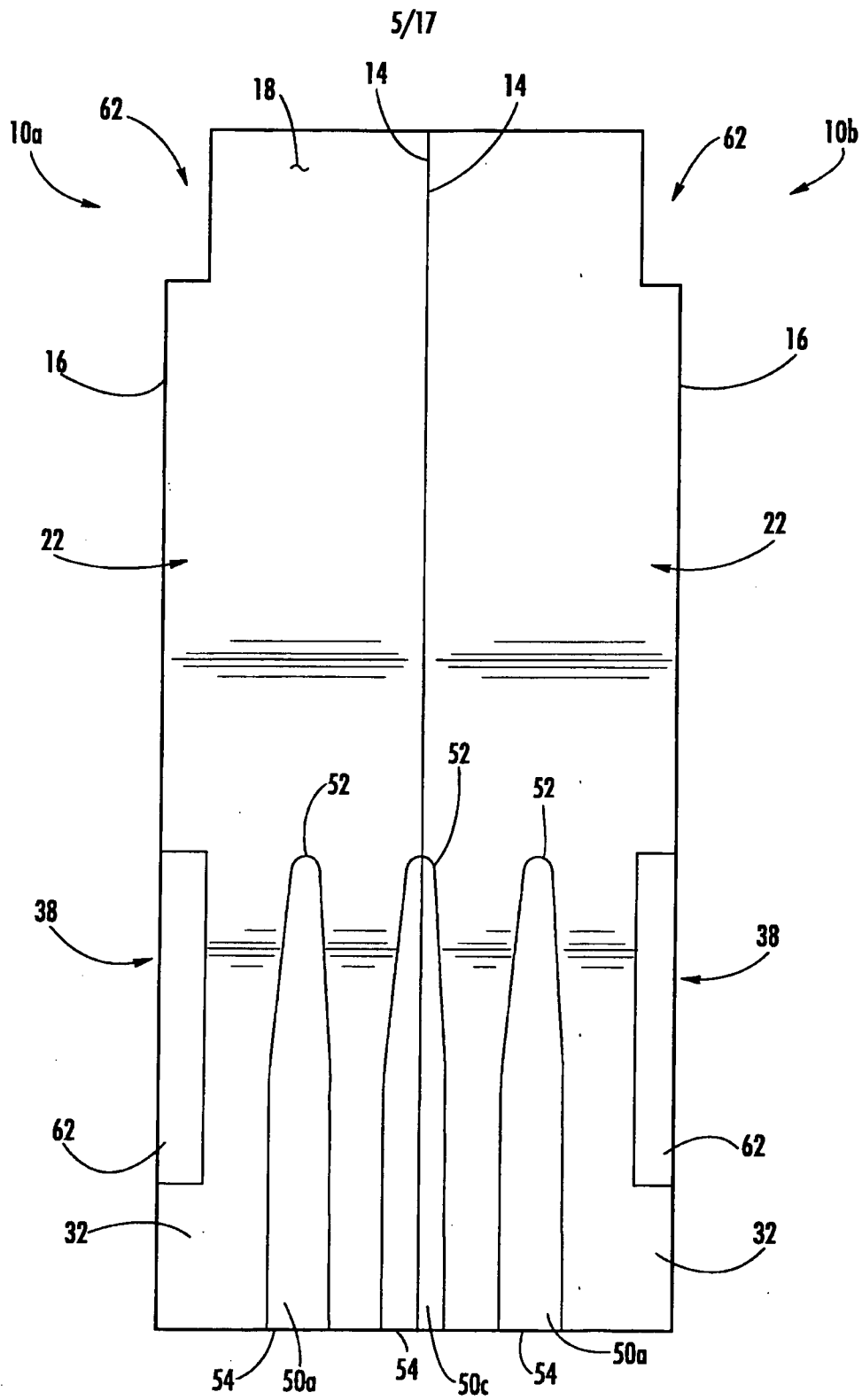


FIG. 4



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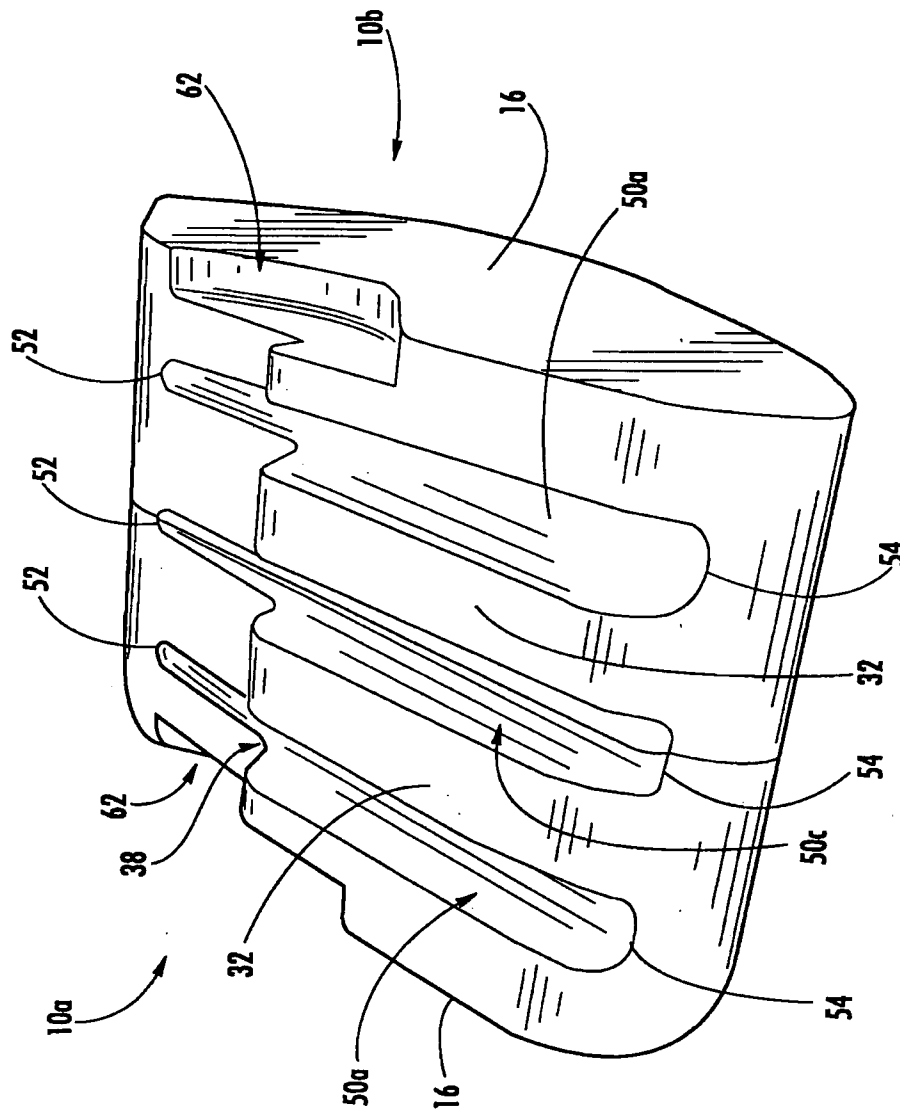


FIG. 6

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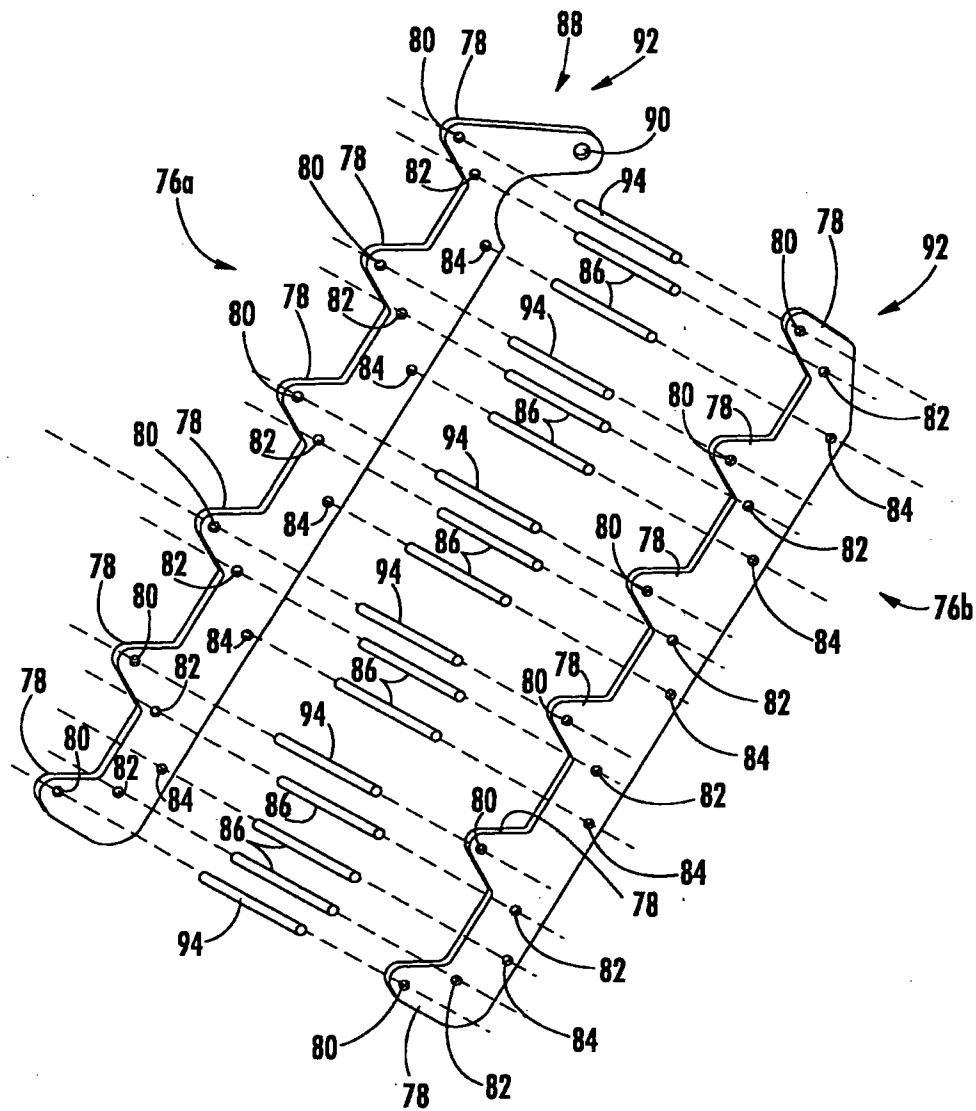
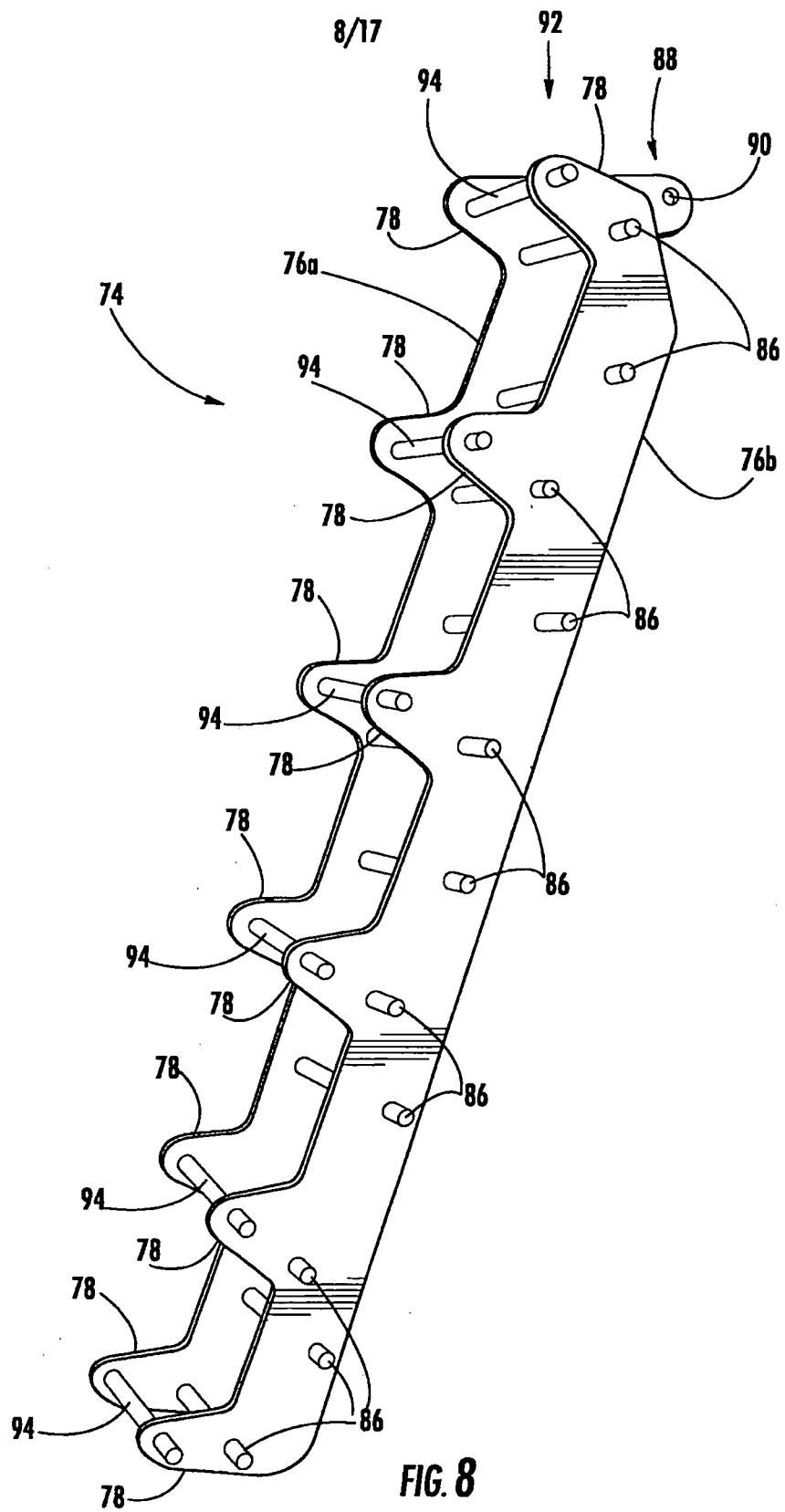


FIG. 7



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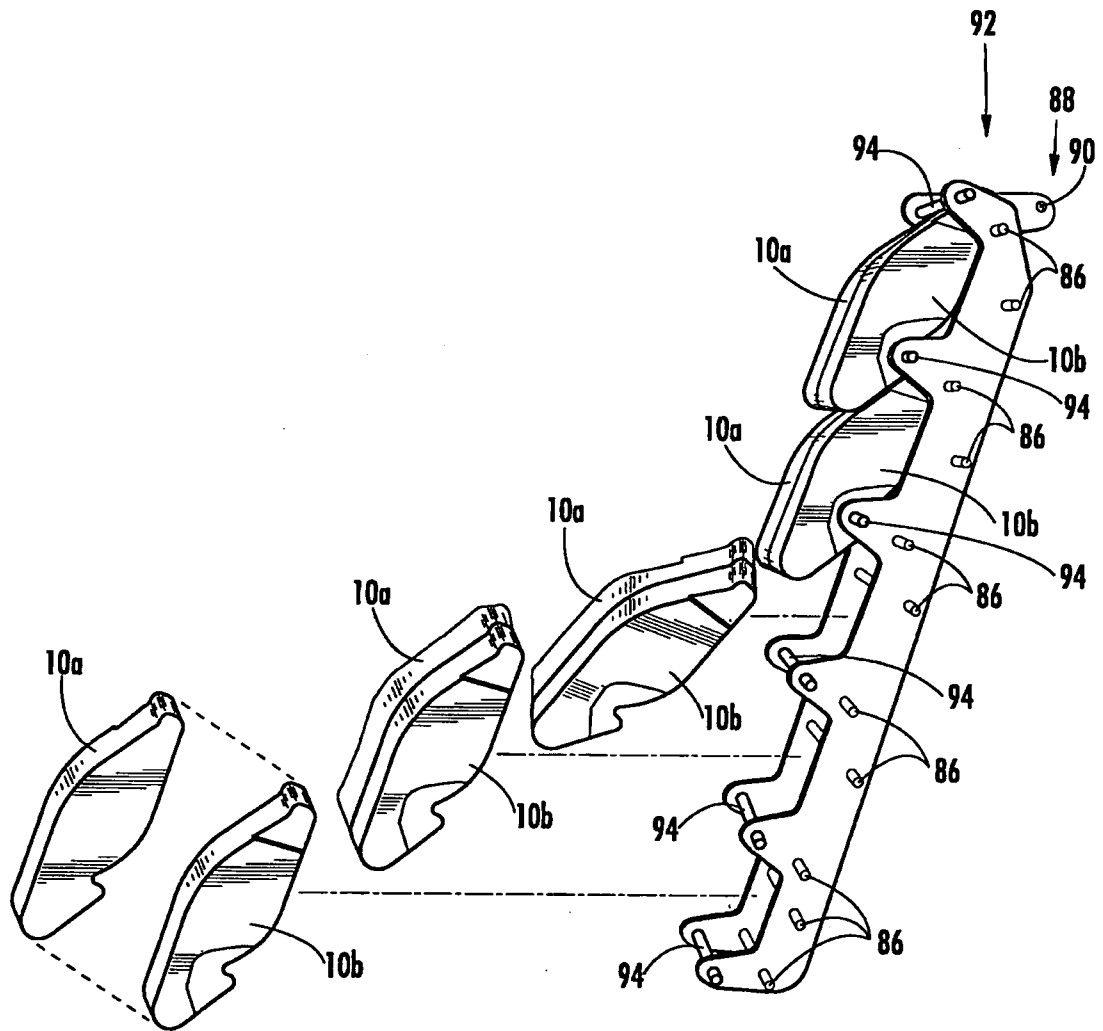
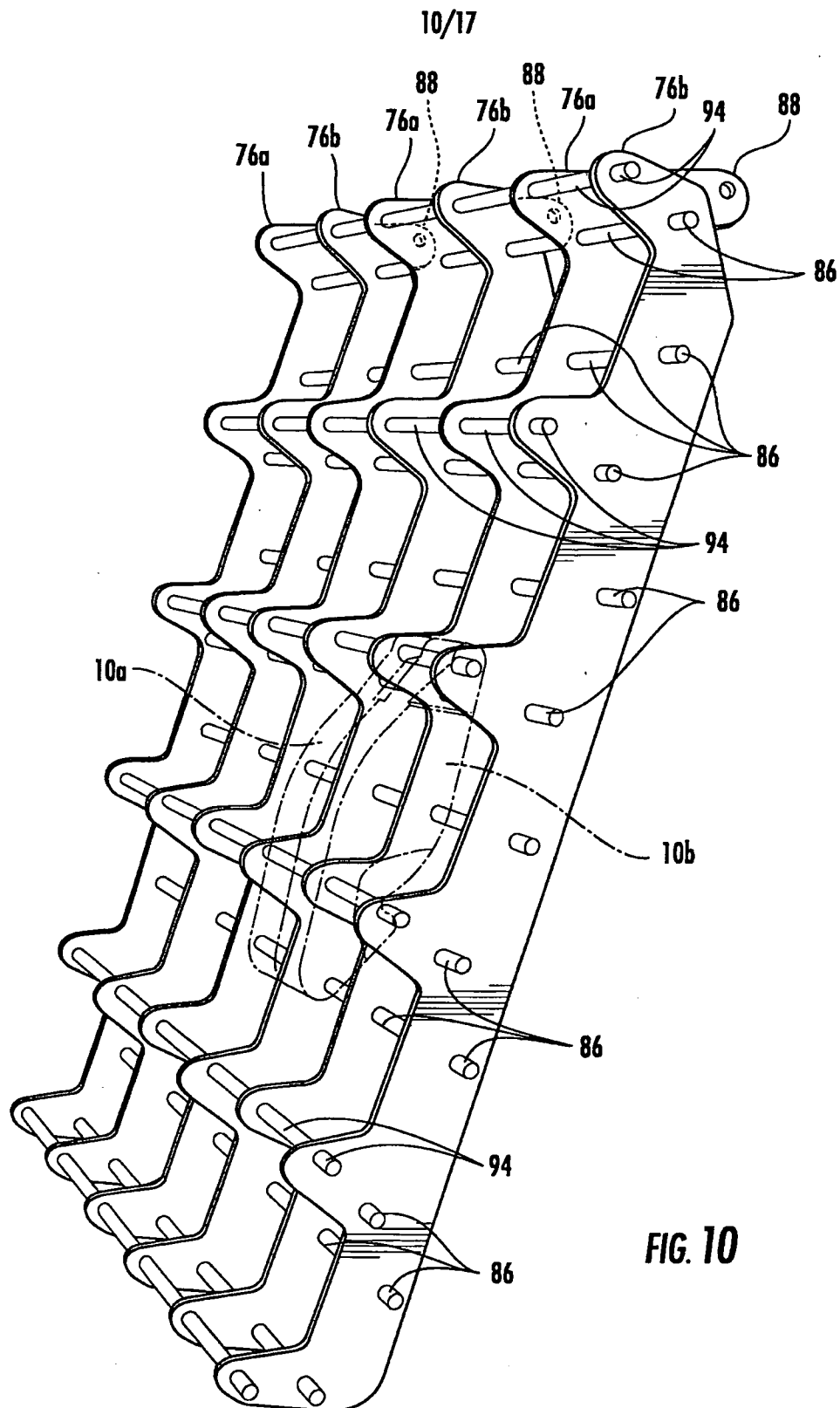


FIG. 9



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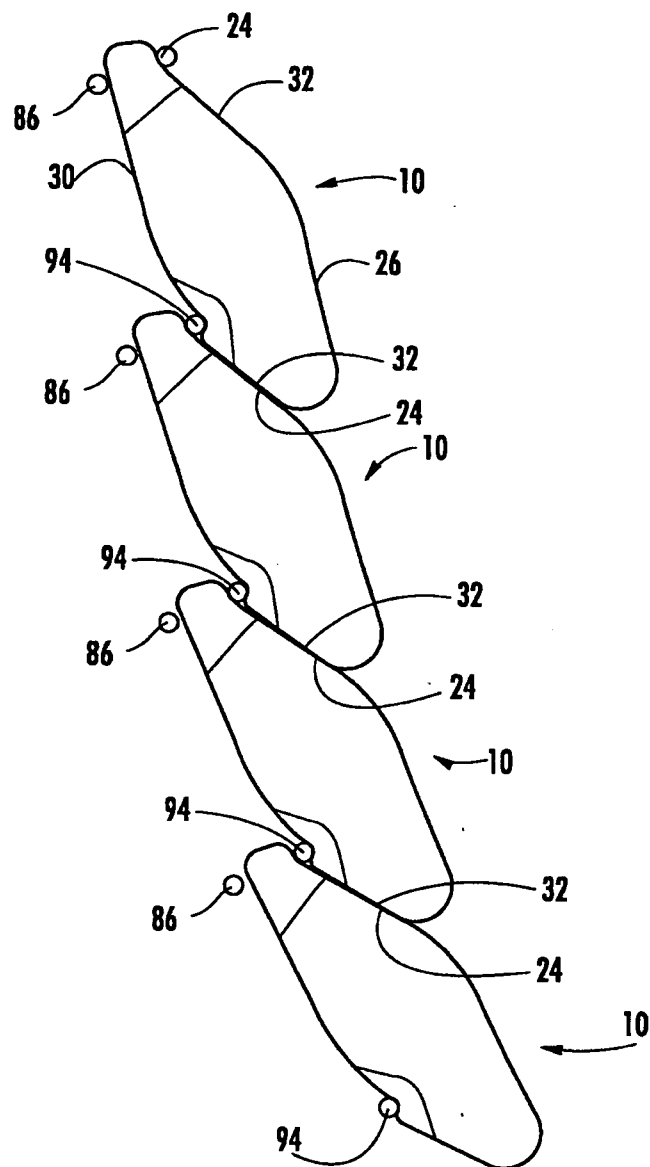


FIG. 11

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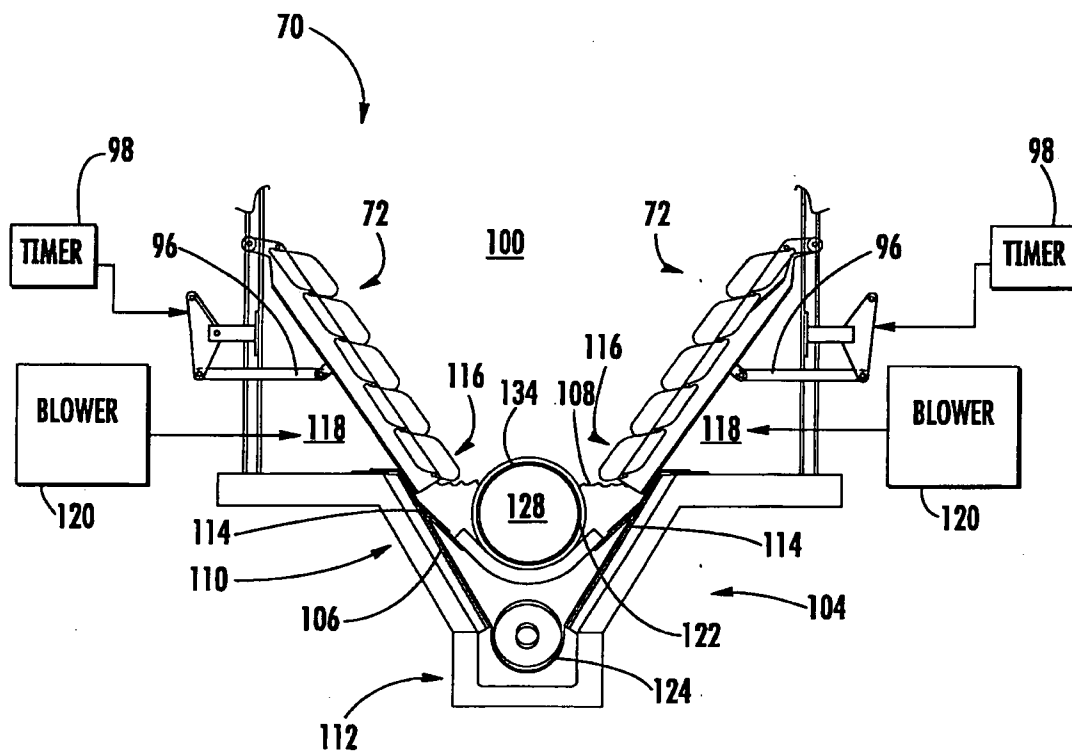


FIG. 12

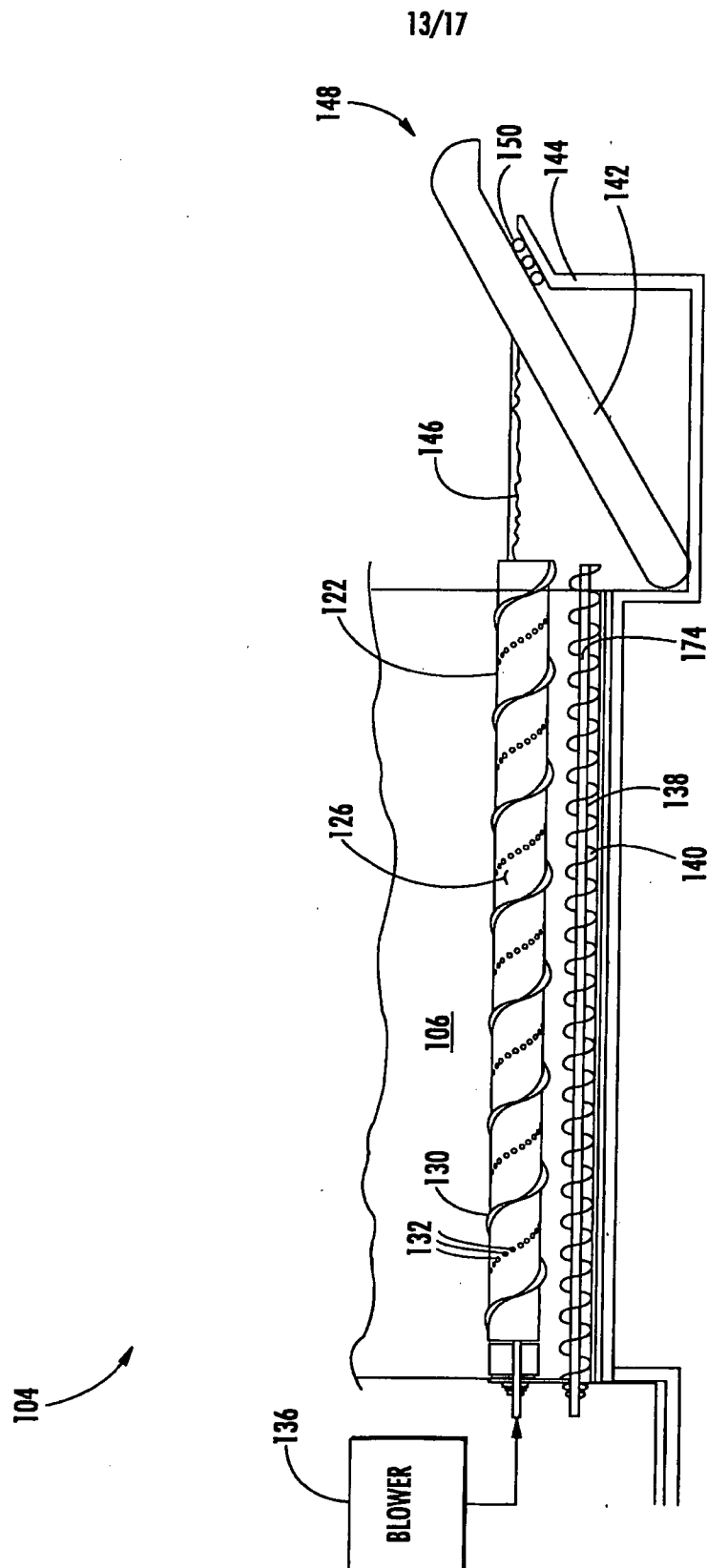


FIG. 13

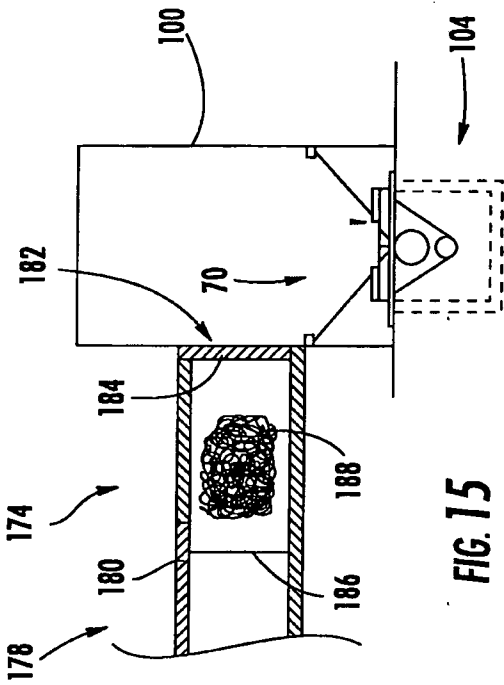


FIG. 15

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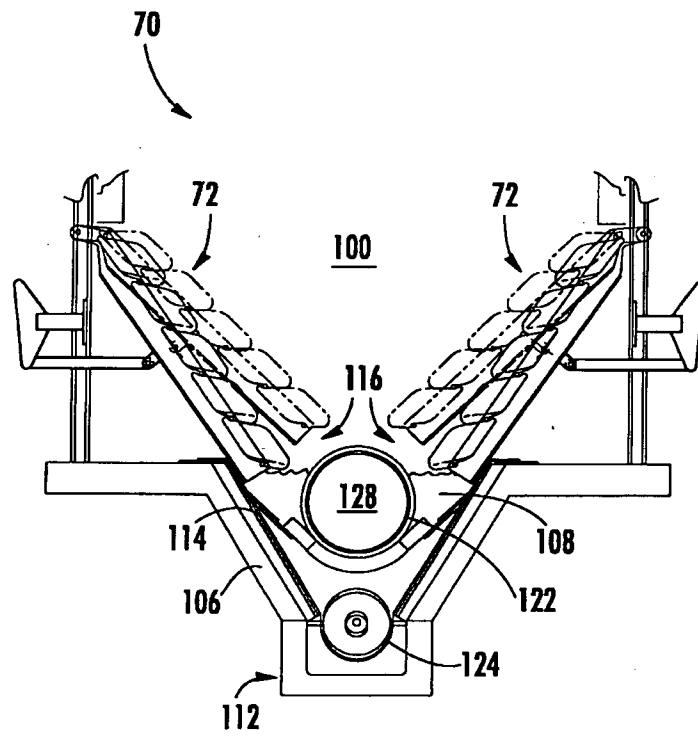


FIG. 16

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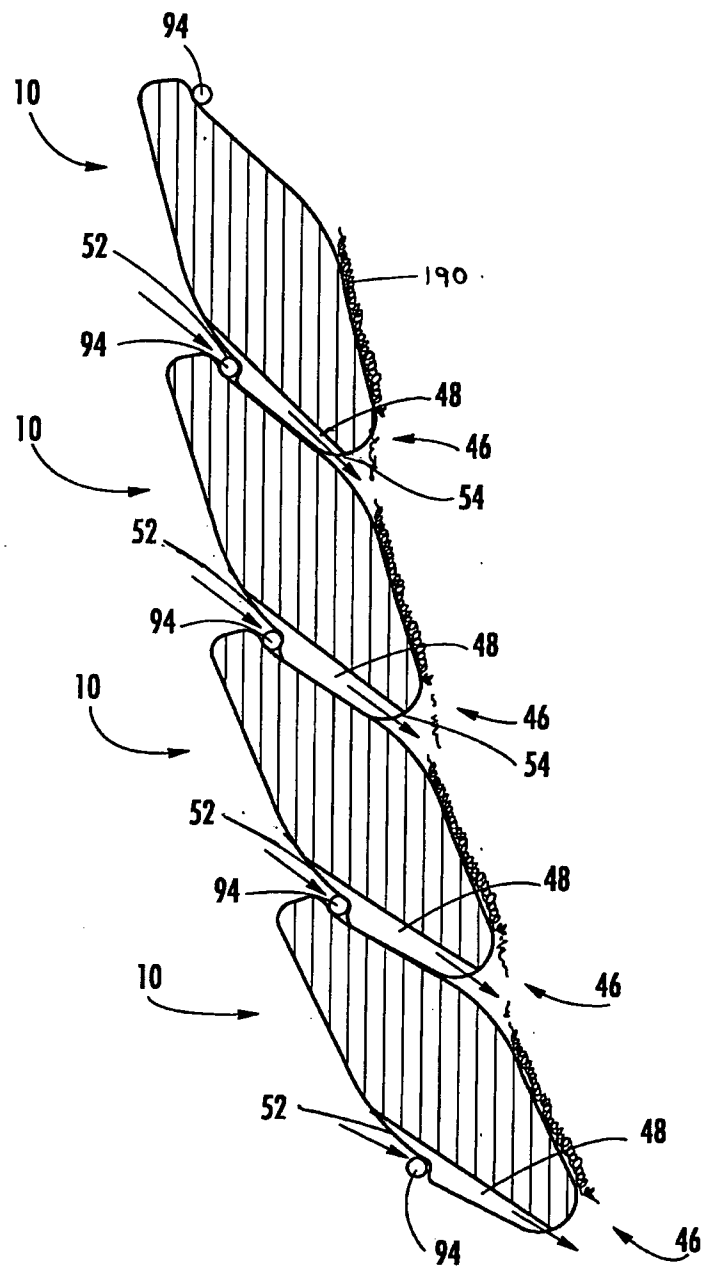


FIG. 17