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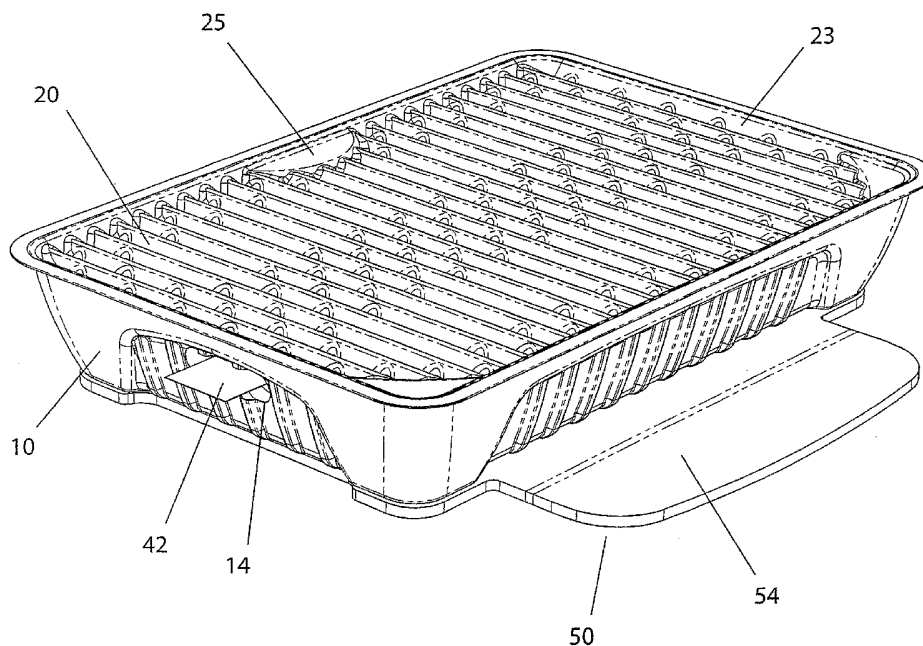
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(54) Title: INCLUSIVE SINGLE-USE COOKING APPARATUS



(57) Abstract: A single-use cooking apparatus utilizing a non-charcoal fuel source that is all-inclusive in nature; providing all tools, accessories and ignition means necessary for a complete cooking session. The cooking apparatus may be suitably fueled with a semi-solidified or gelled alcohol fuel, which provides immediate and controlled heat, a finite and predictable cooking time period, and rapid cool-down due to the invention's minimal mass and high material efficiency. The device is manufactured with sufficient economy to justify complete discard at the conclusion of the cooking session.

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INCLUSIVE SINGLE-USE COOKING APPARATUS**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This application claims the benefit of the priority date of U.S. Provisional Patent Application No. 60/668,380, filed April 5, 2005, and U.S. Provisional Patent Application No. 60/697,216, filed July 6th, 2005, the applications incorporated by reference in their entireties.

BACKGROUND OF THE INVENTION

[0002] The barbeque grill has become about as ubiquitous as the kitchen stove in modern American households. Today, about 76% of United States households own a barbeque grill and over 66 million Americans grill per year, according to the Barbecue Industry Association (2001). It is conservatively estimated that in the U.S. alone, there are over three billion "grilling events" per year.

[0003] Despite the broad appeal and general advantages of grilling, there remain some inherent shortcomings within certain niches of this multi-billion dollar industry. Grilling requires a fair amount of planning and relies on a variety of support accessories and other essential items. For instance, to effectively grill with a charcoal grill, the following items are needed: a functional charcoal grill; a suitable quantity of charcoal briquettes (usually between 2-5 lbs); cooking utensils (such as tongs, forks or spatula); ignition source (such as a match or butane lighter); a suitable quantity of lighter fluid (usually between ½ -1 cup); food to be grilled (typically meat). Due to the breadth of required items, grilling is not particularly feasible for last-minute planners or those that want to impulsively grill.

[0004] This invention relates to portable cooking apparatuses fueled by gelled alcohol or other alternate fuel means and intended to be used one time, thus disposable in a nature.

SUMMARY OF THE INVENTION

[0005] The present invention provides a single-use cooking apparatus and elements of that apparatus. The cooking apparatus is all-inclusive in nature, requiring no additional components beyond food for a complete cooking session.

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[0006] In one aspect, the invention provides a cooking assembly comprising a main housing, a fuel vessel assembly containing fuel and a cooking grate. The main housing has side walls, a bottom wall, an outer rim and an inside and outside. The cooking grate comprises a metal sheet that has a top side, a bottom side, a plurality of grate peaks and grate valleys and a plurality of apertures. Grease drip initiation tabs can broaden the apertures of the cooking grate to prevent grease from wicking to the underside of the cooking grate and dropping on the flames of the fuel. The cooking grate can also contain a thermal feedback label, which can be affixed to a thermal insulator positioned between the label and the metal sheet. The thermal feedback label can indicate to the user the temperature of the grill in operation. In one embodiment the cooking grate rests on the outer rim of the main housing. The cooking assembly can also have an insulating wrap, suitably cardboard, that connects to the main housing. The insulating wrap can have grip sections that allows the user to position the cooking assembly.

[0007] The inside of the main housing contains the fuel vessel assembly.

[0008] In one embodiment, the fuel vessel assembly comprises a fuel vessel having side walls and a bottom, the side walls defining an opening. In this opening the fuel is held by the fuel vessel. In one embodiment the fuel vessel also has a lip, on which a combustible sealing film is attached. This combustible sealing film covers the opening of the fuel vessel and is suitably impervious to vapor loss to prevent loss of the fuel. In another embodiment, the opening of the fuel vessel is covered by a removable sealing film. This sealing film is also suitably impervious to vapor loss to prevent loss of the fuel. The fuel vessel assembly can also contain a porous membrane that can be positioned between the fuel and the sealing film. The fuel vessel assembly can also contain a combustion enhancing strip that is in contact with the combustible sealing film. Additionally, the fuel vessel assembly can also include a restrictor plate that has a top side, a bottom side and an aperture. The restrictor plate is positioned over the top side of the sealing film of the fuel vessel. The restrictor plate can be connected directly to the fuel vessel, or can be supported by the main housing. Suitably the aperture of the restrictor plate is narrower than the width of the opening of the fuel vessel. This arrangement can help in controlling the combustion rate of the fuel. The restrictor plate can also contain a pair of legs located on the end sides of the plate. In one embodiment

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the legs are attached to the bottom of the main housing. In another embodiment the legs can be attached to the outer rim of the main housing. The length of the support legs in either of these embodiments can be such that when the restrictor plate is attached to the fuel vessel, the bottom of the fuel vessel is suspended off of the bottom of the main housing, providing an insulating air gap between the bottom of the fuel vessel and the bottom of the main housing. When the legs of the restrictor plate are attached to the bottom of the main housing, the legs should be longer than the side walls of the fuel vessel to provide this air gap.

[0009] In another embodiment, the fuel vessel assembly comprises a pouch formed from a sheet, the pouch having an inside and an outside. Attached to the pouch are spring strips. The pouch is filled with a fuel and the top of the pouch is sealed. In one embodiment the seal is comprised of adhesive portions on the pouch. An ignition strip is placed adjacent or connected to the seal of pouch. When the ignition strip is ignited, the seal of the pouch is opened, and the spring strips open the pouch and allow the fuel contained inside to burn .

[0010] In other embodiments of the invention, the cooking assembly further comprises an ignition sheet which is positioned between the fuel vessel or vessels, and the cooking grate. This ignition sheet can have a tab that can extend outwardly from the main housing by way of an air ventilation aperture in the side wall of the housing. The tab allows for a user to ignite the ignition sheet, which in turn ignites the combustible sealing film, and in turn the fuel of the fuel vessel assembly. By this design a user can ignite the fuel of the cooking assembly without having to remove the cooking grate and directly accessing the fuel vessel of vessels.

[0011] Suitably the fuel used in the cooking assembly is a clean-burning fuel and does not require the use of any intermediate tinder material to achieve self-sustaining combustion. Suitable fuels include gelled alcohol.

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BRIEF DESCRIPTION OF THE DRAWINGS

- [0012] FIG. 1 is an assembled perspective view of one embodiment of the cooking assembly;
- [0013] FIG. 2 is an exploded perspective view of one embodiment of the cooking assembly;
- [0014] FIG. 3A is an exploded isometric view of one embodiment of the fuel vessel assembly;
- [0015] FIG. 3B is an assembled isometric view of one embodiment of the fuel vessel assembly;
- [0016] FIG. 4A is an exploded isometric view of one embodiment of the assembled fuel vessel assembly and a fuel vessel support restrictor;
- [0017] FIG. 4B is an assembled isometric view one embodiment of the fuel vessel assembly, the vessel support restrictor mated together and crimped to the fuel vessel;
- [0018] FIG. 5 is a lengthwise cross-sectional view of one embodiment of the cooking assembly;
- [0019] FIG. 6 is a widthwise cross-sectional view of one embodiment the filled and sealed fuel vessel;
- [0020] FIG. 7A is an orthogonal end-view of one embodiment of the cooking assembly with the grip sections of the insulating wrap folded up in their packaging configuration;
- [0021] FIG. 7B is an orthogonal end-view of one embodiment of the cooking assembly with the grip sections of the insulating wrap folded down in their in-use configuration;
- [0022] FIG. 7C is an orthogonal end-view of one embodiment of the cooking assembly with the grip sections of the insulating wrap folded up in their packaging configuration;

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[0023] FIG. 8 is an assembled perspective view of one embodiment of the cooking assembly;

[0024] FIG. 9 is a top view of one embodiment of the cooking grate indicating the aperture pattern relative to the position of the underlying fuel vessel assemblies (indicated with dashed lines);

[0025] FIG. 10 is a widthwise cross-sectional view of one embodiment of the cooking grate;

[0026] FIG. 11 is a perspective view of one embodiment of the underside of the cooking grate;

[0027] FIG. 12 is an isometric exploded view of one embodiment of the cooking grate further comprising the thermal feedback label and the thermal insulator;

[0028] FIG. 13 is an isometric exploded view of one embodiment of the cooking assembly showing it primarily assembled with the main housing in an uncrimped state just prior to installation of the cooking grate;

[0029] FIG. 14A is an isometric view of one embodiment of the fuel vessel assembly, the pouch in its sealed state;

[0030] FIG. 14B is an isometric view of one embodiment of the fuel vessel assembly, the pouch in its opened state;

[0031] FIG. 15 is an isometric view of one embodiment of the fuel vessel assembly, the pouch installed into the pouch restraining support;

[0032] FIG. 16A is an isometric view of one embodiment of the fuel vessel having a removable sealing film, in the sealed state;

[0033] FIG. 16B is an isometric view of the one embodiment of the fuel vessel having a removable sealing film, with the sealed film strip partially removed to expose fuel;

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[0034] FIG. 17A is a lengthwise cross-sectional view of one embodiment of the cooking grate;

[0035] FIG. 17B is a detailed view of the cross-section of one embodiment of the cooking grate;

[0036] FIG. 17C is a detailed view of the cross-section of one embodiment of the cooking grate supporting food;

[0037] FIG. 18 is an isometric exploded view of one embodiment of the fuel vessel assembly that includes a porous membrane;

[0038] FIG. 19 is an isometric exploded view of one embodiment of the fuel vessel assembly that includes a combustion enhancing strip;

[0039] FIG. 20 is an orthogonal view of one-half of the cooking utensil;

[0040] FIG. 21A is an isometric view of the unassembled cooking utensil

[0041] FIG. 21B is an isometric view of the fully assembled cooking utensil;

[0042] FIG. 22A is an exploded isometric view of one embodiment of the fuel vessel assembly;

[0043] FIG. 22B is an isometric view of one embodiment of the assembled fuel vessel assembly;

[0044] FIG. 23A is an exploded perspective view of one embodiment of the cooking assembly and one embodiment of the fuel vessel assembly;

[0045] FIG. 23B is a perspective view of one embodiment of the cooking assembly and one embodiment of the fuel vessel assemblies;

[0046] FIG. 24 is a chart showing the average burn rate of the fuel in comparison to the width of the aperture of the restrictor plate;

[0047] FIG. 25 is a graph showing the effect of varying the vessel-grate gap on combustion performance;

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[0048] FIG. 26 is a chart showing the effect of the diameter and quantity of apertures in the cooking grate on the combustion rate;

[0049] Before the embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or being carried out in various ways. Also, it is understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. The use of “including”, “having” and “comprising” and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items and equivalents thereof.

[0050] It also is understood that any numerical value recited herein includes all values from the lower value to the upper value. For example, if a concentration range is stated as 1% to 50%, it is intended that values such as 2% to 40%, 10% to 30%, or 1% to 3%, etc., are expressly enumerated in this specification. These are only examples of what is specifically intended, and all possible combinations of numerical values between the lowest value and the highest value enumerated are to be considered to be expressly stated in this application.

DETAILED DESCRIPTION OF THE INVENTION

[0051] The present invention provides a single-use cooking assembly that utilizes a non-charcoal fuel source and is all-inclusive in nature. Suitably, the cooking assembly requires no additional components beyond food for a complete cooking session. Suitably, the fuel utilized is a gelled alcohol, which is clean-burning, inexpensive and requires the use of no intermediate tinder material to achieve self-sustaining combustion. In this way, the user may directly ignite the base fuel and does not have to wait for the heat source to reach a suitable temperature to begin cooking, which is otherwise typical with more traditional wood or charcoal fuels. This allows the user to experience very little delay between ignition and actual cooking.

[0052] In one embodiment, the fuel is housed within two thin-gauge metal fuel vessel assemblies. Each assembly comprises a fuel vessel, each fuel vessel being sealed

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with a metallized combustible and impermeable polymer film, referred to as the combustible sealing film. A separate ignition sheet can be attached to the fuel vessel assemblies to assist in the uniform and robust combustion of the combustible sealing film and the subsequent ignition of the fuel. The ignition sheet can have an integral ignition tab as one of its features, which can protrude from the exterior of the main housing and can be readily accessible by the user with a common ignition means, such as a match or butane lighter. This approach requires no disassembly or reassembly of the cooking assembly to prepare the device for food grilling and can be done with minimal effort by the user. In this way, the present invention has been devised to require only a single step for proper function: the user merely removes the device from any packaging that may be present and ignites the protruding ignition tab, which is clearly indicated and obvious.

[0053] Due to the homogeneous nature of the chosen fuel, and the geometric design features described in detail herein, the present invention operates with remarkable uniformity of heat across the entire cooking surface and over the cooking duration.

[0054] The present invention consumes the fuel in its entirety, leaving only trace levels of residue or ash, and therefore exhibits very low thermal inertia upon extinguishment. This feature, in conjunction with a material efficient design, renders the device very low in mass upon conclusion of the cooking session. The device cools rapidly at the end of the cooking session through mere exposure to ambient air and does not require the use of any water or other dousing means to accelerate its cool-down. This aspect makes it particularly well suited for safe and easy disposal.

[0055] Suitably, the cooking grate in is fabricated from a thin-gauge aluminum sheet into a specialized accordion form. Exposure holes are created in the surface of the grate, in the valleys of selected bends, to provide a pathway for accumulated grease to exit the grilling surface. Exposure holes are expressly omitted directly above the fuel cells to avoid any interaction between cooking byproducts (grease) and the combustion of the fuel. The accordion shape utilized in the cooking grate provides excellent material efficiency while preserving needed strength to resist deformation by normal cooking activities, such as depressing the meat with a spatula to excrete grease or cutting into meat to see if it is sufficiently cooked.

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[0056] The present invention features an air-gap between the enclosed fuel vessel assemblies and the bottom of the main housing, which serves as an effective thermal barrier. This method eliminates the need for any legs, or other features, that the user may need to otherwise erect off of the main housing for safe and undamaging operation. The main housing of the cooking assembly may be supported by any common surface while in use including: wood, plastic, vinyl, concrete or metal without causing thermal damage to the supporting surface.

[0057] An insulating wrap having a handle, suitably constructed of cardboard or other inexpensive thermally insulating material, may be fastened to the exterior underside of the main housing and serves a number of purposes. First, its extended wings provide the user with a convenient means to securely grasp the hot device while in use. This is useful for moving the device or securing it when repositioning food. Secondly, the insulating handle provides an added layer of thermal insulation between the device and the supporting surface. Thirdly, the bend lines of the insulating handle are aptly chosen to "square" the product and provide shipping strength in the vertical axis and render the package less prone to tipping when merchandized on-edge. Lastly, the chosen material used in the integral handle allows for vivid exterior color printing, which can assist in the communication of important directions, cautions or other marketing messages.

[0058] A specialized cooking utensil can be provided with the cooking assembly which allows two primary functions in a single tool: flipping food and grabbing food. The design can also be easily made to also pierce food. This singular specialized cooking utensil serves the same function as a spatula, fork and tongs do when used in their discrete equivalents. The inclusion of the cooking utensil and ignition means (matches) allows the entire cooking apparatus to be completely self-supporting and does not require any additional components or materials to complete a full grilling session.

[0059] The cooking assembly is best shown in FIGS. 1-23. One embodiment of the present invention is shown in FIG. 1 and FIG. 2. The cooking assembly is principally composed of a cooking grate 20, a main housing 10, an ignition sheet 40, a plurality of fuel vessel assemblies 30 and an insulating wrap 50 held together with staples 52 or other means. The cooking grate 20 provides support to the cooked food 80. The ignition sheet

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40 provides a means to transfer combustion from the end of the product to the fuel vessel assemblies 30. The fuel vessel assemblies 30 contain the fuel 35 and provide the heat source to the invention. The main housing 10 contains the fuel vessel assemblies 30 and provides structure and a safety thermal barrier to the user from the hot combustion. The insulating wrap 50 provides further thermal insulation and a means to secure the invention while flipping or repositioning food 80.

[0060] The cooking grate 20 is best shown in FIG. 9-FIG. 12 and FIG. 17A-17C. The cooking grate 20 is fabricated from a piece of thin gauge metal sheet. The metal sheet has a top side 19 and a bottom side 29. Suitably the metal sheet is 3003 alloy aluminum with thickness of 0.012 inches. The use of aluminum is uncommon for typical grilling apparatus because of its lower melting point and lower durability relative to stainless steel or porcelain alternatives. However, for the present invention's single-use application, it is both fitting and desirable. An aluminum cooking grate 20 permits the entire device, excluding the insulating wrap 50, to be made from a homogenous material and thus highly recyclable. Aluminum also has a very high heat conductivity rating and is therefore very conducive to heat transfer from the heat source to the food 80. Rapid heat up times and uniform heat across the cooking grate 20 result. Lastly, the cooking grate does not need to be plated, painted or oiled to prevent corrosion. This ensures safe interaction between the cooking grate 20 and the food 80 while maintaining the manufacturing economy necessary to profitably deliver a single-use device. For equivalent strength, aluminum is also much lighter than steel, which further bolsters the invention's portability and low overall weight. While aluminum is a suitable material for the cooking grate 20, the cooking grate 20 can be also be made from other formable metallic materials such as steel, stainless steel or tin-plated steel.

[0061] In one embodiment, the cooking grate 20 is asymmetric about one axis to establish a front and a back to the invention, which is analogous to a typical propane gas grill. The cooking grate 20 is symmetric about the other axis to achieve a balanced and pleasing aesthetic that is still highly functional and space efficient.

[0062] The fabrication of the cooking grate 20 is suitably performed by a two-step manufacturing process whereby the profile is stamped first, and then secondly a pattern of apertures 22 are punched. An integral food retaining lip 23 can be provided.

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Such a lip 23 provides lateral resistance to food 80 when the user is flipping or moving food 80, which prevents it from falling off of the cooking grate 20.

[0063] The geometry of the cooking grate 20 can feature a uniform pattern of grate peaks 24 and grate valleys 26. The grate peaks 24 serve to support the cooking food 80, while the grate valleys 26 serve to allow grease 21 to accumulate and escape from the cooking food 80. The angled ridges in the cooking grate 20 profile provide very high bending strength while maintaining economy of material consumption, and important aspect to preserve needed strength to resist common cooking activities such as degreasing the food with a spatula or cutting the food to check its doneness. The bend radius and waveform spacing of the grate peaks 24 can be chosen to provide highly desirable and marketable sear marks on the cooked food 80.

[0064] A pattern of apertures 22 can be punched into the grate valleys 26 at selected locations, such that grease 21 cannot escape the cooking grate directly above fuel vessel assemblies 30. This design prevents direct interaction between the combustion process and escaping grease 21. The grease drip initiation tabs 28, best shown in FIG. 17A-17C, are positioned adjacent to the apertures 22. The grease drip initiation tabs 28 provide a pointed tip that grease 21 is naturally drawn to and concentrated about. This local concentration of grease 21 accelerates the rate at which its own weight exceeds the surface tension of the grease 21 and increases the rate at which grease is drawn from the cooking grate 20. The position of the apertures 22 and the accompanying grease drip initiation tabs 28 also control the precise position by which the grease 21 accumulates into the bottom of the main housing 10.

[0065] The presence of food 80 can impact the air ventilation of the device, therefore impacting combustion rates. Food 80 can have the effect of slowing the combustion rate due to it blocking or constricting the ability for the device to expel updraft exhaust gases. The angular formation of the cooking grate 20 allows gases to escape around the food 80 along the air pathway formed by the gap between the food 80 and the grate valley 26, therefore muting its effect on the combustion rate. As a result of this design element, the grill becomes more stable across a broader range of food 80 types and quantity.

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[0066] The apertures 22 can provide the opportunity for intermittent flame exposure between the food 80 and the combustion, thus inducing a true “grilled” or “flame broiled” effect, another highly marketable trait.

[0067] In one embodiment, the cooking grate 20 features an applied thermal feedback label 25 on the top surface, which contains thermochromic ink technology that activates at a preset temperature threshold (FIG. 12). It is available from a variety of manufacturers, including Chromatic Technologies, Inc. of Colorado Springs, Colorado.

[0068] As the combustion of the fuel 35 occurs within the interior of the device and is largely not visible to the user, it is not visually obvious to the user when the product is ready to begin cooking or when the cooking grate 20 is too hot to safely touch. The thermal feedback label 25 addresses this issue by providing a thermally activated visual indication to the user. For example, the label could indicate “the cooking grate is sufficiently hot to begin cooking” or “the cooking grate is too hot to safely touch (safety warning).” The specific message and exact temperature threshold is chosen according to the desired function of the thermal feedback label 25. Thermochromic ink has a characteristic activation temperature, and is normally within the range of 15° C - 45° C; however custom formulations are available ranging between -5° C - 65° C. A 45° C threshold temperature is regarded as a “high temperature” thermochromic ink and is used to indicate the threshold where painful temperature for the human skin is approached and is commonly used on safety labels and hot beverage containers. However, if the thermal feedback label 25 is to be utilized to indicate adequate cooking temperature, the temperature threshold is much higher and in the range of 200° C. Activating at a higher temperature to indicate readiness to cook is desirable because of the present invention’s remarkably fast warm-up time relative to more typical charcoal grills. For this application, the thermal insulator 27 can be used. The thermal insulator 27 can be made out of any material, such as cardstock, that has thermal insulating properties. The thermal insulator 27 material and thickness are chosen to “tune” the interaction of the thermal feedback label 25 with the cooking grate 20 so that it activates at the correct time. In this way, the thermal insulator 27 raises the effective activation temperature of the thermal feedback label 25 without having to change the chemical composition of the label itself.

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[0069] The main housing 10, best shown in FIG. 1-2, FIG. 8 and FIG. 13 has side walls 11, a bottom 13, an inside 9 and an outside 15. The main housing is suitably formed from a medium-weight aluminum foil, but can be made from any metal material. In the embodiment shown in FIG. 13 the main housing also has an outer rim 16. The outer rim 16 can serve as a support ledge for the mating cooking grate 20. Discrete openings can be added to the side walls of the main housing 10, which comprise the side air ventilation apertures 14. The side air ventilation apertures 14 serve a dual role by providing ample oxygen availability to the interior of the device to sustain steady combustion of the fuel 35, and secondly provide convenient exposure for the tab 42 to protrude from the device and be readily accessible to the user.

[0070] As shown in the embodiment depicted in FIG. 2, the interior of the main housing 10 can contain two fuel vessel assemblies 30, each fastened to the floor of the main housing 10 with heavy-duty staples 52 on either end. The ignition sheet 40, suitably custom waxed-paper that is die cut to fit within the interior of the device, mates with the ignition sheet holding tabs 104 on the fuel vessel assembly 30. Once assembled, the ignition sheet holding tabs 104 are bent over, securing the ignition sheet 40 in place. The ignition sheet stand-off tabs 106 are similar in profile to the ignition sheet holding tabs 104; however, are shorter in height and do not protrude through the ignition sheet 40. The ignition sheet stand-off tabs 106 serve the function of maintaining a small air gap between the ignition sheet 40 and the combustible sealing film 33, a measure that dramatically improves the combustion characteristics of the ignition sheet 40.

[0071] In one embodiment, as shown in FIG. 3, the fuel vessel assembly 30 is comprised of a vessel support restrictor 100, a fuel vessel 32, the fuel 35 and the combustible sealing film 33. In one embodiment the fuel vessel 32 has side walls 31, a lip 34 and a bottom 36. The side walls define an opening 402 having a width 404. The fuel vessel 32 can be manufactured by a smooth-wall draw process from thin gauge aluminum. By utilizing a metal in the fuel vessel's 32 fabrication, there exists no chance of melting or combustion of the fuel vessel 32 and renders the fuel vessel assembly 30 highly conducive to safe direct food preparation.

[0072] The fuel vessel 32 can be designed and fabricated to be slightly oversized relative to the quantity of fuel 35 that needs to be accommodated, which forms a fuel

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clearance gap 39 (shown in FIG. 6). The fuel clearance gap 39 provides a margin for error in the fuel filling process and helps protect against unwanted residue from being deposited on the lip 34. This gap 39 also reduces the amount of direct contact between the fuel 35 and the combustible sealing film 33. As indicated above, such contact can have an adverse impact on the start-up characteristics of the device. When the combustible sealing film 33 is in direct contact with the fuel 35, the combustible sealing film 33 is inhibited from combusting because its kindling point is significantly greater than the vaporization temperature of the fuel 35. The fuel clearance gap 39, if properly maintained until use of the device, eliminates this problem and allows the combustible sealing film 33 to robustly and quickly burn away.

[0073] The fuel 35 suitably is a gelled alcohol, such as a gelled ethanol manufactured by FancyHeat Corporation of Newark, New Jersey. Many available substitutes are available in both ethanol and methanol varieties, from a wide array of competitive manufacturers. The fuel 35 is deposited in the fuel vessel 32. In one embodiment, the quantity of fuel 35 dispensed is suitably 140 grams, but could be more or less depending on specific performance targets. With the fuel 35 dispensed within the fuel vessel 32, a heat sealing process can be used to mate the combustible sealing film 33 to the fuel vessel 32 along the surface of the lip 34.

[0074] Suitably, the combustible sealing film 33 is an aluminum metallized polyester lidding film, a packaging material available from a variety of manufacturing sources. Alcan, Inc. of Chicago, Illinois is one such source of this material. The lidding material in one preferred embodiment is suitably of a 1 mil. thickness. While aluminum metallized polyester lidding film can be used, other materials are also suitable, such as metallized polyethylene. Suitably, the combustible sealing film 33 possesses the simultaneous requirements of a) impermeability to alcohol losses, which allows the device to achieve long shelf-life requirements, and b) capability of simple single-point ignition of the invention by being fully consumable, which negates the need to otherwise require the user to partially disassemble the device to remove a metal lid or some other packaging means more typically found with gelled alcohol applications. Suitably, the combustible sealing film 33 combusts with little or no residue and is completely incinerated prior to the user cooking, therefore it is a safe and simple means to offer these tremendous conveniences. The thickness of the metallized aluminum layer is aptly

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chosen to provide enough impermeability to alcohol vapor losses while still being readily degraded in the presence of flame.

[0075] In one embodiment, shown in FIG. 18, the fuel vessel assembly 30 further includes a porous membrane 300 having a top side 301 and a bottom side 302. The porous membrane can be positioned between the fuel 35 and the combustible sealing film 33. The porous membrane 300 is any material that prevents direct physical contact between the fuel 35 and the combustible sealing film 33, yet is porous enough to allow the fuel 35 vapors to escape and ignite above. The porous membrane 300 can be either a combustible or noncombustible material, and its function is not reliant on it degrading during the invention's use. In this way, the porous membrane 300 can remain substantially intact throughout the invention's use and ride down on the top surface of the fuel 35 until the fuel 35 has been fully consumed. One material that has been used with a high degree of success is a single ply of common toilet paper. The porous membrane 300 prevents direct contact between the combustible sealing film 33 and the fuel 35. It has been noted that when the fuel clearance gap 39 is not properly maintained and direct contact occurs between the fuel 35 and the combustible sealing film 33, complete and rapid degradation of the combustible sealing film 33 can be inhibited by the fuel 35. This is because the temperature of the fuel 35 in the liquid or gelled state is substantially below the kindling point temperature of the combustible sealing film 33. Since the porous membrane 300 provides a physical barrier between the fuel 35 and the combustible sealing film 33, the combustible sealing film 33 readily degrades when the ignition sheet 40 combusts in close proximity. The porous membrane 300 is placed on top of the fuel 35 after the filling process, but before the combustible sealing film 33 is hermetically sealed to the fuel vessel 32.

[0076] Another embodiment of the fuel vessel assembly 30 that addresses the issue of fuel 35 being in direct contact with the combustible sealing film 33 involves the addition of a combustion enhancing strip 310 to the exterior of the fuel vessel assembly 30 (See FIG.19). Suitably, the combustion enhancing strip 310 is placed in between the ignition sheet 40 and the combustible sealing film 33. The combustion enhancing strip 310 suitably can be a die cut piece of material with an embedded chemical oxidizer within its make-up that induces much hotter and robust combustion than the ignition sheet 40, which relies on ambient oxygen for combustion oxidation. Suitable oxidizers

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include potassium chlorate. Nitrocellulose, a chemical commonly found in “flash paper,” is another material candidate that provides extremely robust, odorless and ashless combustion that could serve as the combustion enhancing strip 310. The combustion of the ignition sheet 40 ignites the combustion enhancing strip 310 and locally generates a rapid combustion blitz near the combustible sealing film 33 that is sufficiently high temperature to breach the film and induce ignition of the underlying fuel 35. Rapid high heat output has been proven through experimentation to mitigate the adverse consequences described above with fuel 35 being in direct contact with the combustible sealing film 33.

[0077] In yet another embodiment, the fuel vessel assembly 30 can have a removable sealing film 92 (See FIG. 16A-16B). In this embodiment, the vessel assembly 30 is comprised of the fuel vessel 32, the fuel 35 and a sealed film strip 92. Suitably the sealed film strip 92 is impermeable and non-combustible. A common example of this type of material is an aluminum foil polyethylene laminate. Such materials are not suitable for low temperature open air combustion, but exhibit exceptional chemical resistance and vapor barrier properties. They are also accompanied with a substantially thicker aluminum layer than their metallized equivalents. In this embodiment, the fuel vessel assembly 30 can be fabricated by filling the fuel vessel 32 with a predefined quantity of fuel 35. A fuel clearance gap 39 is purposely present in the peel-away fuel vessel assembly 90 to decrease the amount of direct contact the sealed film strip 92 will have with the fuel 35 during storage and transportation. Once filled, the fuel vessel 32 is sealed with the sealed film strip 92, which suitably longer than necessary to cover the top surface of the exposed fuel 35. This allows the sealed film strip 92 to be folded back upon itself and exited to the opposing end of the invention through the side air ventilation aperture 14. This configuration provides an exposed tab at the non-secured end of the sealed film strip 92, whereby the user may grasp the sealed film strip 92 and remove causing the fuel 35 to become exposed to the air and ready for ignition.

[0078] Once the fuel vessel 32 is filled and sealed, a vessel support restrictor 100 can be mated to the fuel vessel 32 to complete the fuel vessel assembly 30. The vessel support restrictor 100 is shown in FIGS. 2, 4A, 4B, 18, 19, 22A, 22B and 23A-23B, and best shown in FIG. 4A-4B. In one embodiment, the vessel support restrictor 100 is comprised of a restrictor plate 110, which is a metal sheet having a top side 111, a

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bottom side 112, two end edges 103, two side edges 101 and an aperture 102. The aperture 102 has a width 406. The restrictor plate 110 can be fabricated from a single piece of metal in a progressive stamping operation. The restrictor plate 110 helps throttle the combustion of the fuel 35. The chosen value for the width 406 of the aperture 102 has a defining role in governing the combustion rate of the fuel 35. The restrictor plate 110 can also have means of securing the ignition sheet 40 in close proximity to the combustible sealing film 33 via ignition sheet holding tabs 104 that are deformed after installation of the ignition sheet 40. Additionally, the restrictor plate can have means of offsetting the ignition sheet 40 from the combustible sealing film 33 via ignition sheet stand-off tabs 106 to ensure an air-gap that induces consistent and robust combustion of the ignition sheet 40.

[0079] Along with the restrictor plate 110, the vessel support restrictor 100 can also comprise of a pair of support legs 108 having top ends 109 and bottom ends 107. The legs can be attached, or integral to, the end edges 103 of the restrictor plate 110. The vessel support restrictor 100 can also have a holding flange 105 that is attached, or integral to, the side edges 101 of the restrictor plate 110. The holding flange 105 can be crimped around the lip 34 on the fuel vessel 32 to secure the vessel support restrictor 100 to the fuel vessel 32 and provide a fuel vessel assembly 30. This design allows for the vessel support restrictor 100 to be secured to the main housing 10, which in turn allows for the positing of the fuel vessel 32 within the main housing 10. The vessel support restrictor 100, therefore, allows for lateral registration of the fuel vessel 32 relative to the cooking grate 20 and secures the fuel vessel 32 during shipping, storage and consumer use.

[0080] In one embodiment of the fuel vessel assembly 30, shown in FIG. 5, the bottom ends 107 of the support legs 108 are connected, or integral to, the bottom 13 of the main housing. The length of the support legs 108 in this embodiment are longer than the side walls 31 of the fuel vessel. This design allows for an air gap 38 to be created between the fuel vessel 32 and the cooking grate 20 and an insulating air gap 18 to be created between the fuel vessel 32 and the bottom 13 of the main housing 10. In this embodiment, by changing the sizing of the support legs 108 allows for the adjustment of the air gap 38 between the fuel vessel 32 and the cooking grate 20. This distance of the air gap 38 can effect combustion and the overall temperature of the cooking grate 20 in

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use. Furthermore, the creation of air gap 18 dramatically reduces the maximum temperature of the underside of the device and makes it suitable for operation over a wide assortment of support surface materials.

[0081] In another embodiment, shown in FIG. 22A-23B, the fuel vessel assembly 30 has a vessel support restrictor 100 with support legs 108, where the bottom 107 of the support legs 108 are attached, or integral to, the end edges 103 of the restrictor plate. The top ends 109 of the support legs 108 are in turn attached, or integral to, the side walls 11 of the main housing 10. Suitably, the top ends 109 of the support legs 108 can be attached, or integral to the outer rim 16 of the main housing 10. Again, by changing the sizing and positioning of the support legs 108, the air gaps 38 and 18 can be optimized depending on the desired result.

[0082] In another embodiment, the fuel vessel assembly is a self-opening combustion activated fuel package comprising a pouch 200 formed from a sheet 202 (See FIG. 14-15). The pouch 200 has an inside 205, an outside 207 and one or more spring strips 206. The inside of the pouch 200 is filled with fuel 35 and the pouch is hermetically sealed to prevent fuel vapor losses or any other gas exchange. In one embodiment, the pouch 200 can be sealed by adhesive portions 204 on, or attached, to the sheet 202. An ignition strip 208 is placed in proximity to the pouch 200. Upon lighting the ignition strip 208 by the user, the pouch 200 automatically mechanically opens by its own force and simultaneously ignites the freshly exposed fuel 35 within the device, which continues to be substantially contained by the sheet 202. The mechanical actuation of the pouch 200 to the open state is assisted by the inclusion of spring strips 206, which have a relaxed state when the package is fully opened and are under mechanical stress when the package is closed prior to use. The pouch 200 can be suitably fabricated from an aluminum foil/kraft paper laminate material, of which many variants are widely available in the packaging industry. The aluminum foil provides both a vapor barrier and chemical barrier for the housed fuel 35 and the paper provides a cost effective way to add structure to the assembly. The combustible ignition strip 208 can be suitably fabricated from paraffin-coated kraft paper or equivalent, which provides the right combination of combustion rate, combustion heat generation, mechanical structure and surface adhesion properties. The spring strip 206 may be suitably fabricated from blue-tempered spring steel of 4 mil thickness.

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[0083] The pouch 200 can be constructed by forming the sheet 202 with integral spring strips 206 into a U-shaped profile. The ends are heat sealed and fuel 35 is dispensed evenly along the length of the interior of the sheet 202. The top-edge of the pouch 200 is then heat-sealed by activating the adhesive portions 204 with a high-temperature heat sealing apparatus. Lastly, the ignition strip 208 is added to the assembly, which may be either glued or taped in place if secure attachment is desired or left merely in close proximity with the major seal 203 on the pouch 200. It has been determined through experimentation that a physical connection between the ignition strip 208 and the major seal 203 is unnecessary for proper function, so-long-as they are within close proximity of one another.

[0084] The adhesive portions 204 on the sheet 202 can be a variety of readily available polyester or polyethylene polymer films that possess the simultaneous attributes of: chemical resistance and insolency when exposed to the fuel 35, sufficient impermeability to the fuel 35 so that vapor losses through the thin adhesive portions 204 are negligible, sufficiently high melt temperature to ensure robust seal when resulting pouch 200 is stored in high temperature settings, sufficiently low melt temperature to significantly weaken when exposed to an adjacent high temperature flame from the combustion of the ignition strip 208, and does not emit any harmful byproducts of combustion or other gases when heated to elevated temperature due to adjacent combustion.

[0085] The pouch 200 is self-opening upon ignition, triggered by the combustion of the ignition strip 208. The ignition strip 208 is lit by the user with the ignition means 70, which is made easily accessible by the geometry of the ignition strip 208 that protrudes from the side air ventilation aperture 14.

[0086] As the ignition strip 208 continues to burn on both sides of the major seal 203, heat transfer from the combustion of the ignition strip 208 to the major seal 203 causes the adhesive portions 204 to soften, which in turn causes the major seal 203 to decouple and subsequently open. This function is caused by the spring strips 206 that are seeking their original unstrained and flattened state. In addition to providing necessary heat to decouple the major seal 203, the ignition strip 208 also ignites the escaping fuel 35 vapor that is released from the package upon opening. Once the ignition strip 208 has

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been fully consumed, the exposed fuel 35 continues combustion and provides the heat source to the device.

[0087] In one embodiment the sheet 202 of the pouch 200 can be made from an aluminum foil/kraft paper co-laminate material. This material has the benefit of introducing two materials that have two different coefficients of linear thermal expansion (CTE). After the two dissimilar materials are laminated together at ambient temperatures, large changes in temperatures cause one side of the laminate to expand or contract at a faster rate than the opposing material. This principle causes the co-laminate to curl outward towards the material side that has the lower of the two CTE. As noted above, the fuel package described herein may be constructed such that the aluminum foil/paper material is oriented so the paper is outward facing (aluminum foil is correspondingly inward facing). When subjected to elevated temperatures from the adjacent combustion of the ignition strip 208, the two layers of material that form the major seal 203 have a natural tendency to curl away from each other as the flame propagates and the internal ambient temperatures rise. This mechanical movement is consistent with the relaxed state of the spring strips 206 so these two methods for opening the package may work in concert to fully open the pouch 200. Since the spring strips 206 are placed in the assembly at discrete points, the curling effect from heating of the aluminum foil/paper material helps open the pouch 200 over regions not immediately adjacent to the spring strips 206. In this way, the spring strips 206 can be used for their considerably stronger applied force to initiate decoupling of the adhesive portions 204 and the natural tendency for the aluminum foil/paper material to curl open can be used to continue the propagation of decoupling the major seal 203 over regions between the spring strips 206. It is possible through optimization of this principle and appropriate material selection that use of dissimilar layers within the packaging material could render the need for the spring strips 206 unnecessary.

[0088] Only part of the major seal 203 must decouple while the ignition strip 208 is actively combusting. Once a portion of the major seal 203 has decoupled and the underlying fuel 35 has ignited, the remainder of the major seal 203 will decouple regardless of the combustion status (or further contributing effects) of the ignition strip 208 because the enclosed fuel 35 will provide ample heat output to soften the remaining

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portion of the major seal 203 that may not yet be decoupled causing the remainder of the pouch 200 to propagate until fully open.

[0089] The attachment of the ignition strip 208 can be done as a subsequent step to the sealing of the pouch 200, rather than made as an integral part of the major seal 203. This approach allows direct foil-to-foil adhesion via the adhesive portions 204. Suitably, the adhesive portions 204 are considerably less than 1 mil in thickness, and therefore provides a near perfect hermetic seal that is fully impermeable to gas or fuel 35 vapor exchange. Inclusion of the ignition strip 208 within the major seal 203 would provide the opportunity for significant vapor path, due to the relatively porous properties of paper and a material thickness that could easily exceed 2 mil.

[0090] In this embodiment, the fuel vessel assembly can also comprise a pouch restraining support 209 (See FIG. 15) that is used to house the pouch 200 so that it is secured during transportation and use and confined to opening no further than the defined boundaries of the pouch restraining support 209. The pouch restraining support 209 has two vertical walls 211 that the pouch 200 is housed within. The vertical walls 211 may be bent at some angle other than 90°, which governs the width of the combustion limiting gap 210. The combustion limiting gap 210 serves to restrict the availability of oxygen and throttle the combustion of the fuel 35 upon use.

[0091] As indicated above, the cooking assembly can also contain an ignition sheet 40 (See FIG. 13). The ignition sheet 40 can be made from die-cut waxed kraft paper and secured to the interior of the device by the ignition sheet holding tabs 104 that are attached or are integral to the vessel support restrictor 100. The ignition sheet 40 can feature two tabs 42 that are located on opposing ends and protrude from the main housing 10 through side air ventilation apertures 14. The ignition sheet 40 provides the primary function of transferring combustion from the readily accessible tabs 42 to the interior of the grill directly above the combustible sealing film 33. The heat generated by the combustion of the ignition sheet 40 breeches the seal of the combustible sealing film 33 and ignites the enclosed fuel 35. Once the fuel 35 is ignited along any portion of the fuel vessel 32, the flame will eventually propagate along the entire length of the fuel vessel 32 and ignite the device in its entirety. This process is aided and accelerated by the ignition sheet 40, which covers the entire surface of the fuel vessel assembly 30.

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[0092] In another embodiment, the ignition sheet 40 can be eliminated from the design. In this embodiment a portion of the combustible sealing film 33 is accessible to the ignition means 70. This can be achieved by positioning the end of the fuel vessel assembly 30 sufficiently close to the side air ventilation aperture 14. Once the combustible sealing film 33 is breached by the ignition means' 70 flame and the fuel 35 is ignited, combustion will propagate across the entire surface of the fuel vessel assembly 30.

[0093] The cooking assembly can also comprise of an insulating wrap 50 that has grip sections 54. The insulating wrap 50 can be secured to the underside of the main housing 10. In one embodiment, the insulating wrap 50 is connected to the main housing 10 with four staples 52 that can also secure the fuel vessel assembly 30 to the interior floor of the main housing 10. The insulating wrap 50 is suitably fabricated from die-cut $\frac{1}{4}$ inch thick cardboard. The cardboard may be either rendered nonflammable with a commonly available flame retardant or can be left untreated without a significant risk of unintended combustion. The insulating wrap 50 can be bent along two principal bend lines 56 that are slightly outboard relative to the geometry of the main housing 10, allowing the insulating wrap 50 to fulfill a dual purpose by squaring an otherwise trapezoidal profile, which aids in the merchandizing of the product when stored on-edge. (See FIG. 7C.)

[0094] The insulating wrap 50 can fulfill a number of simultaneous functions. First the cardboard material provides an inexpensive and effective thermal insulator between the underside of the main housing 10 and the supporting surface. The overall thermal properties of the underside of the device are governed primarily by the dimension of the thermal insulating air gap 18 and the thickness of the insulating wrap 50. The insulating wrap 50 further provides the ability for the user of the device to safely and securely flip or reposition food 80 by grabbing on to the grip section 54, which acts as a counterforce to activities performed by the user. The two grip sections 54 can also be gripped at the same time by the user if the device needs to be moved to a different location while in use. Finally, the insulating wrap 50 can serve as a printable means to communicate important warnings, instructions and branding messages to the user. Either surface of the grip section 54 can provide an excellent surface to print these messages.

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[0095] The cooking assembly of the present invention has been developed to be completely all-inclusive, providing everything the user needs to execute a successful grilling occasion without needing to gather a wide assortment of discrete items, as is typically the case with a grilling event. Consistent with this goal, in one embodiment a cooking utensil 60 and an ignition means 70 can be included in the product offering and can be housed in the accessory cavity 12 of the main housing 10 (See FIG. 8).

[0096] The cooking utensil 60, shown in FIG. 20-21B is a tong like implement made from two pieces. Each piece makes up one half of the cooking utensil 60 when assembled and are dimensionally identical to one another. This design aspect allows a single mold to be used for both halves of the cooking utensil 60 and further simplifies manufacturing component inventories. The user simply removes both halves from the product offering upon unwrapping the packaging and mates the components together with a "snap fit" at the hinge point 62. The resulting geometry is spring-biased to the open-state and functions like a pair of tongs. High material efficiency has been achieved through the extensive use of "ribbing" to provide suitable bending strength along the length of the cooking utensil 60 without needing a lot of material, as would be the case in a uniform wall thickness approach. When used unassembled, the cooking utensil 60 can be used similar to a spatula for flipping hamburgers or other food items.

[0097] The cooking assembly can also include an ignition means 70 (see FIG. 8) that can be a simple book of matches, but could be any low cost means to generate a kindling flame. "Strike anywhere" matches or a disposable butane lighter could easily serve as a functional substitute.

[0098] The assembly of the cooking assembly, in one embodiment, can be done as follows. The main housing 10, fuel vessel assembly 30, and insulating wrap 50 are first secured together with four staples 52, one each through the feet of the support legs 108 on the vessel support restrictor 100. Rivets or other fasteners may also be used other than staples. Next, the ignition sheet 40 is placed on top of the fuel vessel assembly 30 and secured by either twisting or bending the ignition sheet holding tabs 104 after they have been fed through the respective holes die-cut for this purpose. The tabs 42 on either end of the ignition sheet 40 are fed out the ends of the main housing 10 through the side air ventilation aperture 14. The cooking grate 20 is installed onto the outer rim 16 of the

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main housing 10, and secured in place by bending over the grate securing crimp flange 17. The ignition means 70 and cooking utensil 60 are placed in the accessory cavity 12.

[0099] Different parameters and parts of the cooking assembly can be adjusted to achieve a very wide range of performance targets. The primary performance metrics are the duration of the device's burn time, the average cooking grate temperature and the average combustion rate of the fuel. These performance metrics can be interrelated. For instance, there is a direct positive relationship between combustion rate of the fuel 35 (units in grams/minute) and the average cooking grate temperature (units in degrees Celsius); the higher the combustion rate, the higher the average cooking grate temperature. Also, for a finite and controlled quantity of fuel, a faster average combustion rate of the fuel leads to a shorter duration of the device's burn time.

[00100] Some of the features of the cooking assembly that can have an effect on these performance metrics include the width of the aperture 102 of the restrictor plate 110; the height of the vessel-grate gap 38; the diameter and number of apertures 22 in the cooking grate 20; the quantity of fuel 35; the type of fuel 35; the size and placement of the side ventilation opening 14 on the main housing 10; and the aspect ratio of the fuel vessel 32.

[00101] With respect to the width of the aperture 102 on the restrictor plate, there is a non-linear positive correlation between the width of the aperture 102 and the combustion rate of the fuel 35. FIG. 24 shows that as the width of the aperture 102 gets smaller, the burn rate of the fuel goes down.

[00102] With respect to the distance of the vessel-grate gap 38, this gap acts as a virtual "vertical choke," constricting availability of oxygen to the combustion zone. Smaller values for vessel-grate gap 38 generally lead to slower combustion rates (See FIG. 25). At high values for vessel-grate gap 38 (greater than 20 mm), there appears to be a much weaker negative correlation between the height of the vessel-grate gap 38 and the resulting combustion rate. As the vessel-grate gap 38 approaches infinity, it begins to approximate the "open air" scenario that would be present if the fuel 35 was being burned without a cooking grate 20.

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[00103] With respect to the diameter and quantity of apertures 22 in the cooking grate 20, there is a positive correlation between the diameter and quantity of apertures 22 and the combustion rate of the fuel (See FIG. 26). Higher ventilation through the top of the device impacts updraft air currents and has the effect of speeding the vaporization, mix rate and combustion of the fuel 35 vapor.

[00104] While the present invention has now been described and exemplified with some specificity, those skilled in the art will appreciate the various modifications, including variations, additions, and omissions that may be made in what has been described. Accordingly, it is intended that these modifications also be encompassed by the present invention and that the scope of the present invention be limited solely by the broadest interpretation that lawfully can be accorded the appended claims.

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CLAIMS

What is claimed is:

1. A fuel vessel assembly comprising:
a fuel vessel having side walls, a lip and a bottom, the side walls defining an opening having a width; the fuel vessel containing a fuel;
a combustible sealing film having a top side and a bottom side, wherein the bottom side of the film contacts the lip of the fuel vessel and covers the opening of the fuel vessel.
2. The fuel vessel assembly of claim 1 further comprising a restrictor plate having a top side, a bottom side and an aperture, wherein the bottom side of the restrictor plate is positioned over the top side of the combustible sealing film.
3. The fuel vessel assembly of claim 1 wherein fuel is gelled alcohol.
4. The fuel vessel assembly of claim 1 wherein the combustible sealing film is an aluminum metallized polymer film.
5. The fuel vessel assembly of claim 1 further comprising a porous membrane having a top side and a bottom side, the bottom side of the porous membrane covering the fuel.
6. The fuel vessel assembly of claim 4 wherein the porous membrane is paper.
7. The fuel vessel assembly of claim 1 further comprising a combustion enhancing strip in contact with the combustible sealing film.
8. The fuel vessel assembly of claim 7 wherein the combustion enhancing strip is positioned between the top side of the combustible sealing film and the bottom side of the restrictor plate.
9. The fuel vessel assembly of claim 2 wherein the aperture of the restrictor plate has a width narrower than the width of the fuel vessel opening.
10. A fuel vessel assembly comprising a pouch formed from a sheet, the pouch having an inside and an outside; a spring strip attached to the pouch; and an ignition strip attached to the pouch; wherein fuel is located in the inside of the pouch and the pouch is closed and sealed.
11. The fuel vessel assembly of claim 10 wherein the pouch has adhesive portions and the pouch is closed and sealed by the adhesive portions.

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12. The fuel vessel assembly of claim 10 wherein the sheet is made of laminated paper.
13. The fuel vessel assembly of claim 10 wherein the sheet is made of aluminum foil.
14. The fuel vessel assembly of claim 10 wherein the fuel is gelled alcohol.
15. A cooking grate comprising a metal sheet having a top side, a bottom side, a plurality of grate peaks and grate valleys, a plurality of apertures, and a plurality of grease drip initiation tabs adjacent to each aperture.
16. The cooking grate of claim 15 further comprising a thermal feedback label affixed to the top side of the metal sheet.
17. The cooking grate of claim 15 further comprising a thermal insulator in contact with the top side of the metal sheet, and a thermal feedback label affixed to the thermal insulator.
18. The cooking grate of claim 15 wherein the metal sheet further comprises a food lip which is positioned higher than the grate peaks.
19. A cooking assembly comprising:
 - a main housing having side walls, a bottom, an outer rim, and inside and an outside;
 - a fuel vessel assembly located in the inside of the main housing comprising:
 - a fuel vessel having side walls, a lip and a bottom, the side walls defining an opening having a width; the fuel vessel containing a fuel;
 - a combustible sealing film having a top side and a bottom side, wherein the bottom side of the film contacts the lip of the fuel vessel and covers the opening of the fuel vessel;
 - a cooking grate comprising a metal sheet having a top side, a bottom side, a plurality of grate peaks and grate valleys and a plurality of apertures; wherein the bottom of the cooking grate is in contact with the outer rim of the main housing.
20. The cooking assembly of claim 19 further comprising a restrictor plate having a top side, a bottom side and an aperture, wherein the bottom side of the restrictor plate is positioned over the top side of the combustible sealing film.
21. The cooking assembly of claim 19 wherein the main housing further has a side air ventilation aperture in a side wall of the housing.
22. The cooking assembly of claim 21 wherein the assembly further comprises an ignition sheet which has a tab, wherein the ignition sheet is positioned between the fuel

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vessel assembly and the cooking grate, and the ignition tab protrudes from the air ventilation aperture.

23. The cooking assembly of claim 20 wherein the restrictor plate further has two end edges, two side edges and a pair of support legs having a top and bottom ends, one leg being attached at the top end to one end edge of the restrictor plate, and the other leg being attached at the top end to the other end edge of the restrictor plate; the bottom ends of the support legs being connected to the bottom plate of the main housing.

24. The cooking assembly of claim 23 wherein the restrictor plate is secured to the fuel vessel, and the side walls of the fuel vessel have a height less than the height of the support legs.

25. The cooking assembly of claim 20 wherein the restrictor plate further has two end edges, two side edges and a pair of support legs having a top and bottom ends, one leg being attached at the bottom end to one end edge of the restrictor plate, and the other leg being attached at the bottom end to the other end edge of the restrictor plate; the top ends of the support legs being connected to the outer rim of the main housing.

26. The cooking assembly of claim 19 wherein the fuel the bottom of the fuel vessel assembly is integral with the bottom of the main housing.

27. A cooking assembly comprising:

- a main housing having side walls, a bottom wall, an outer rim, and inside and an outside;

- a fuel vessel assembly located in the inside of the main housing;

- a cooking grate comprising a metal plate having a top side, a bottom side, a plurality of grate peaks and grate valleys and a plurality of apertures; wherein the bottom of the cooking grate is in contact with the outer rim of the main housing.

28. The cooking assembly of claim 27 further comprising an insulating wrap, wherein the wrap is connected to at least a portion of the outside of the main housing.

29. The cooking assembly of claim 27 wherein the insulating wrap has grip sections.

30. The cooking assembly of claim 27 wherein the main housing further has a side air ventilation aperture in a side wall of the housing.

31. The cooking assembly of claim 30 wherein the assembly further comprises an ignition sheet which has a tab, wherein the ignition sheet is positioned between the fuel vessel assembly and the cooking grate, and the ignition tab protrudes from the air ventilation aperture.

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32. The cooking assembly of claim 27 wherein the fuel vessel assembly comprises:
a fuel vessel having side walls, a lip and a bottom, the side walls defining an opening having a width; the fuel vessel containing a gelled alcohol;
a combustible sealing film having a top side and a bottom side, wherein the bottom side of the film contacts the lip of the fuel vessel and covers the opening of the fuel vessel.
33. The cooking assembly of claim 32 further comprising a restrictor plate having a top side, a bottom side and an aperture, wherein the bottom side of the restrictor plate is positioned over the top side of the combustible sealing film and wherein the aperture of the restrictor plate has a width narrower than the width of the fuel vessel opening.
34. The fuel vessel assembly of claim 32 wherein the combustible sealing film is an aluminum metallized polyester film.
35. The fuel vessel assembly of claim 32 further comprising a porous membrane having a top side and a bottom side, the bottom side of the porous membrane covering the fuel.
36. The fuel vessel assembly of claim 35 wherein the porous membrane is paper.
37. The fuel vessel assembly of claim 32 further comprising a combustion enhancing strip in contact with the combustible sealing film.
38. The cooking assembly of claim 27 wherein the fuel vessel assembly comprises a pouch formed from a sheet, the pouch having an inside and an outside; a spring strip attached to the pouch; and an ignition strip attached to the pouch; wherein fuel is located in the inside of the pouch and the pouch is closed and sealed.
39. The fuel vessel assembly of claim 38 wherein the pouch has adhesive portions and the pouch is closed and sealed by the adhesive portions.
40. A cooking assembly kit comprising:
a cooking assembly comprising:
a main housing having side walls, a bottom wall, an outer rim, and inside and an outside;
a fuel vessel assembly located in the inside of the main housing comprising:
a fuel vessel having side walls, a lip and a bottom, the side walls defining an opening having a width; the fuel vessel containing a fuel;

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a combustible sealing film having a top side and a bottom side, wherein the bottom side of the film contacts the lip of the fuel vessel and covers the opening of the fuel vessel;

a restrictor plate having a top side, a bottom side, two end edges; two side edges; and an aperture, wherein the bottom side of the restrictor plate is positioned over the top side of the combustible sealing film;

a cooking grate comprising a metal plate having a top side, a bottom side, a plurality of grate peaks and grate valleys and a plurality of apertures; wherein the bottom of the cooking grate is in contact with the outer rim of the main housing;

an insulating handle wrap, wherein the wrap is connected to at least a portion of the outside of the main housing

a cooking utensil.

41. A fuel vessel assembly comprising:

a fuel vessel having side walls and a bottom, the side walls defining an opening having a width; the fuel vessel containing gelled alcohol;

a combustible sealing film substantially impervious to vapor loss, the sealing film covering the opening of the fuel vessel.

42. The fuel vessel assembly of claim 41 wherein the combustible sealing film is an aluminum metallized polymer film.

43. The fuel vessel assembly of claim 42 wherein the aluminum metallized polymer film is an aluminum metallized polyethylene film.

44. A fuel vessel assembly comprising a fuel vessel having side walls and a bottom, the side walls defining an opening having a width; the fuel vessel containing gelled alcohol;

a removable sealing film substantially impervious to vapor loss, the sealing film covering the opening of the fuel vessel.

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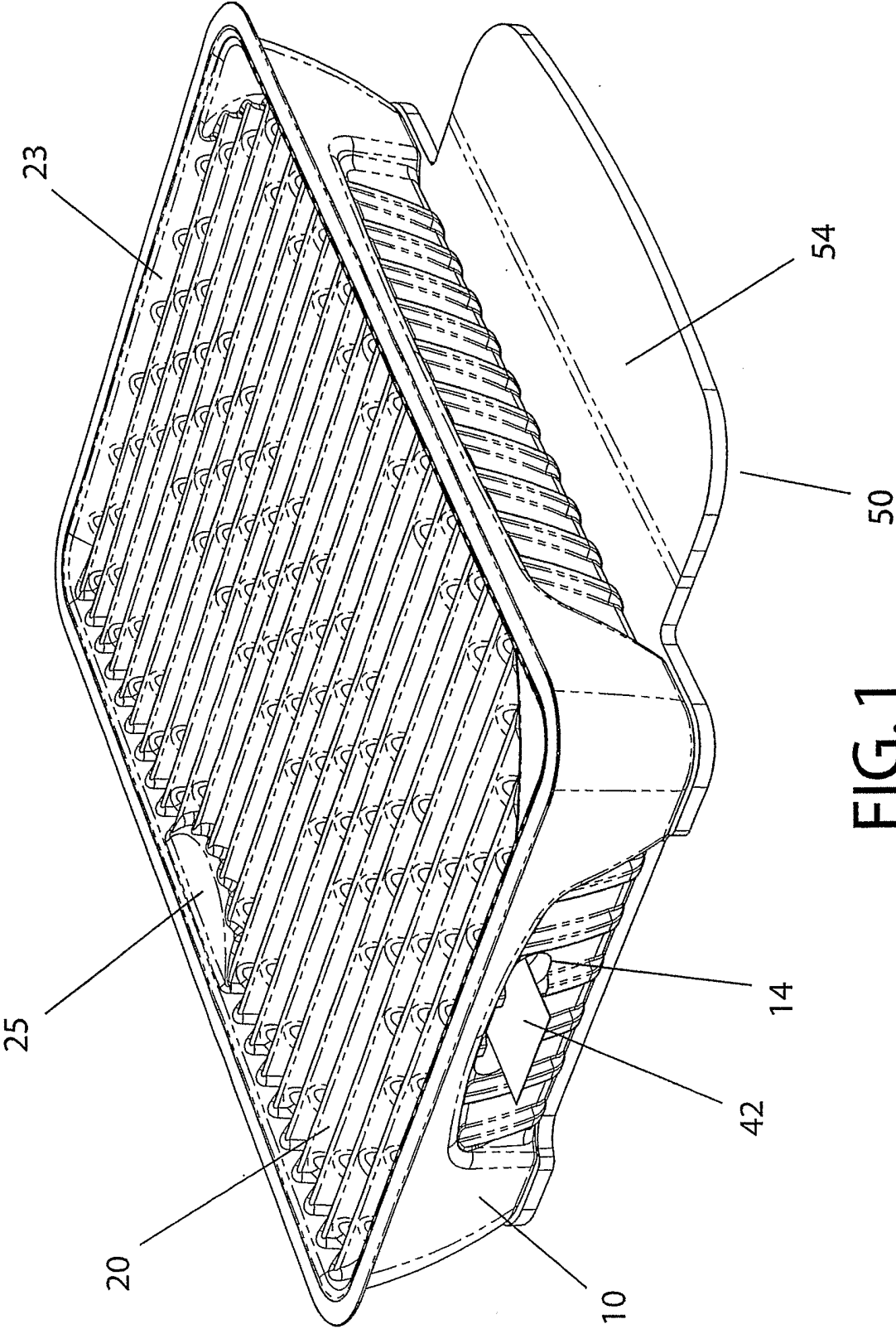


FIG. 1

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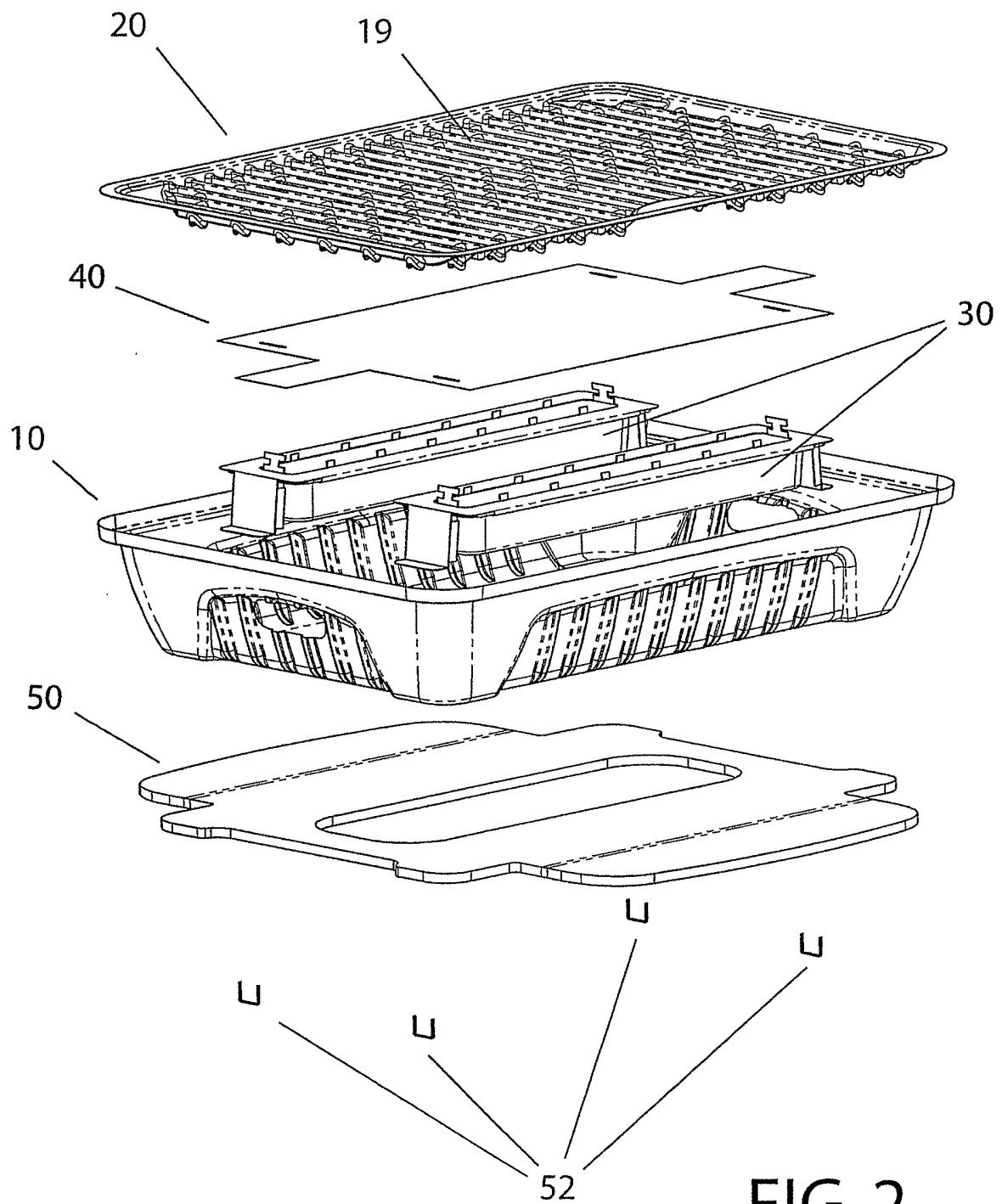
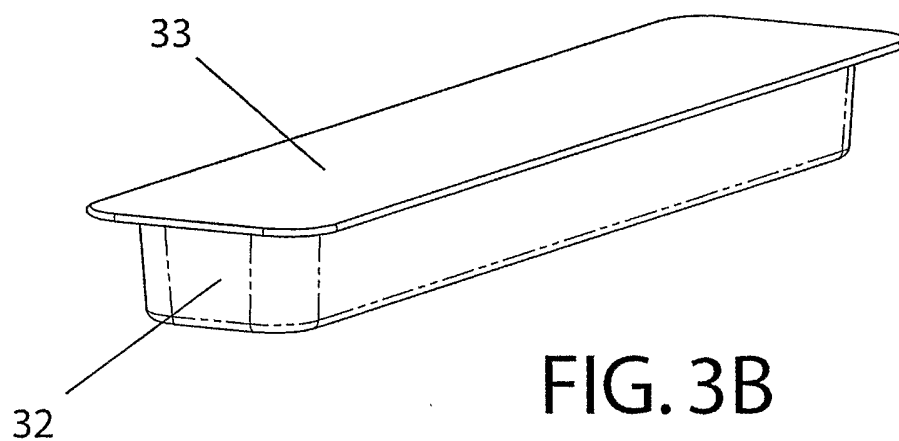
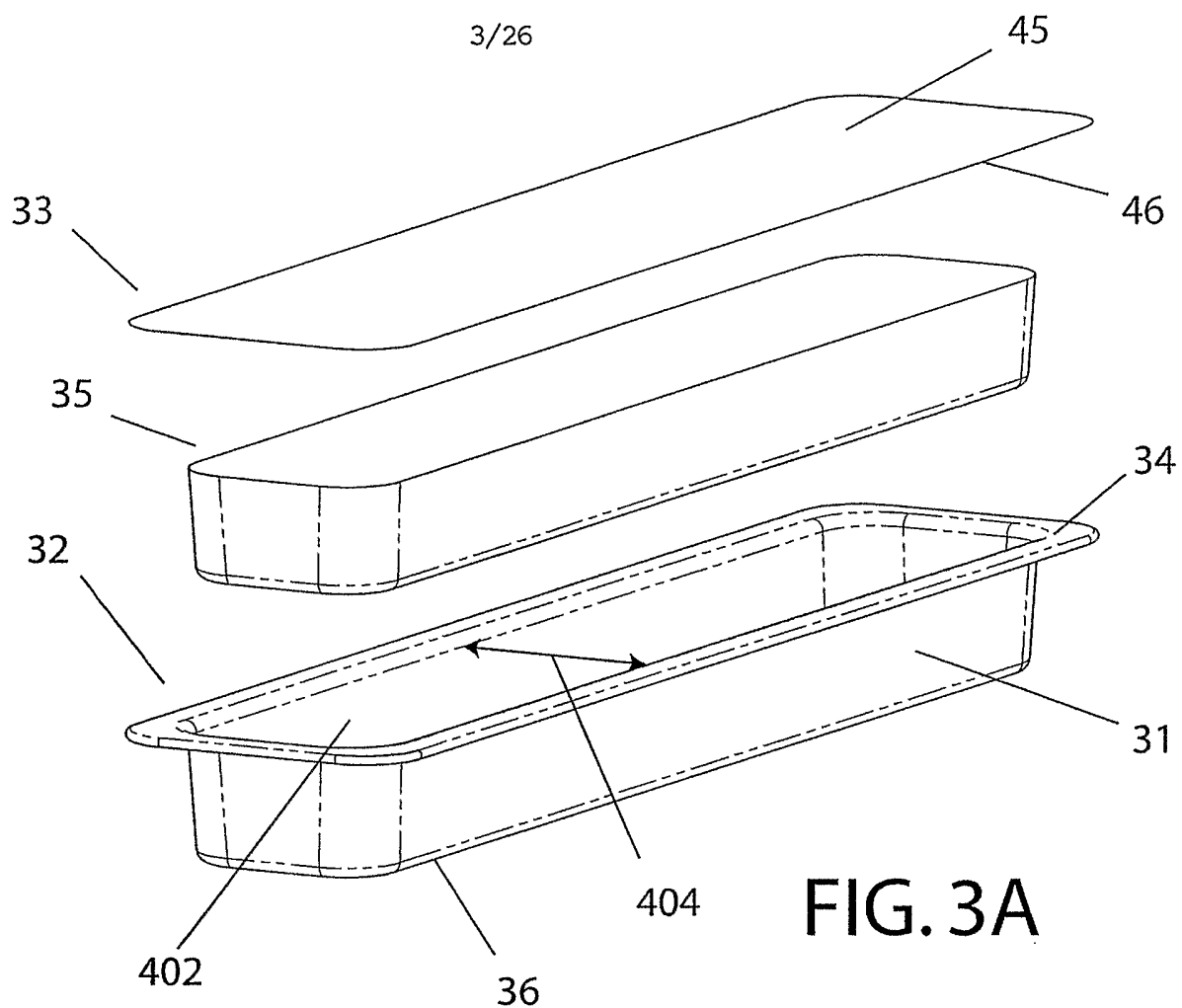
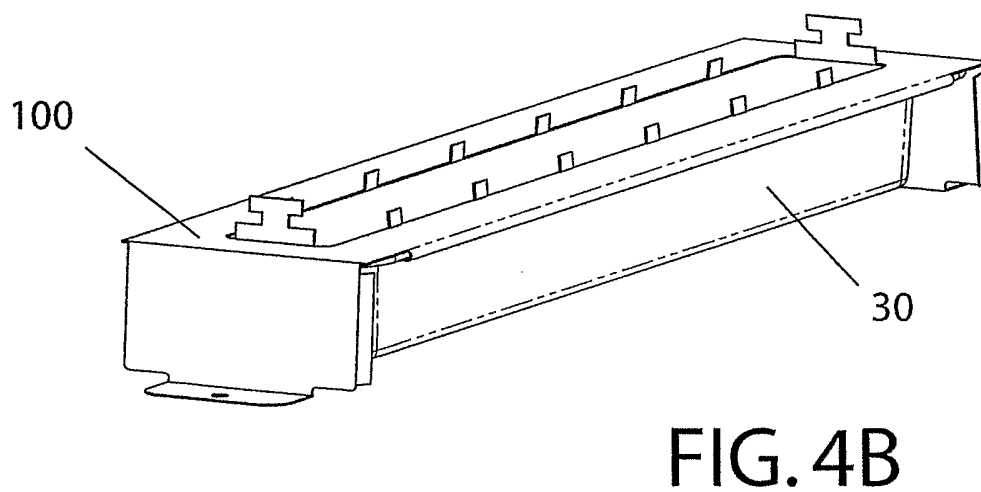
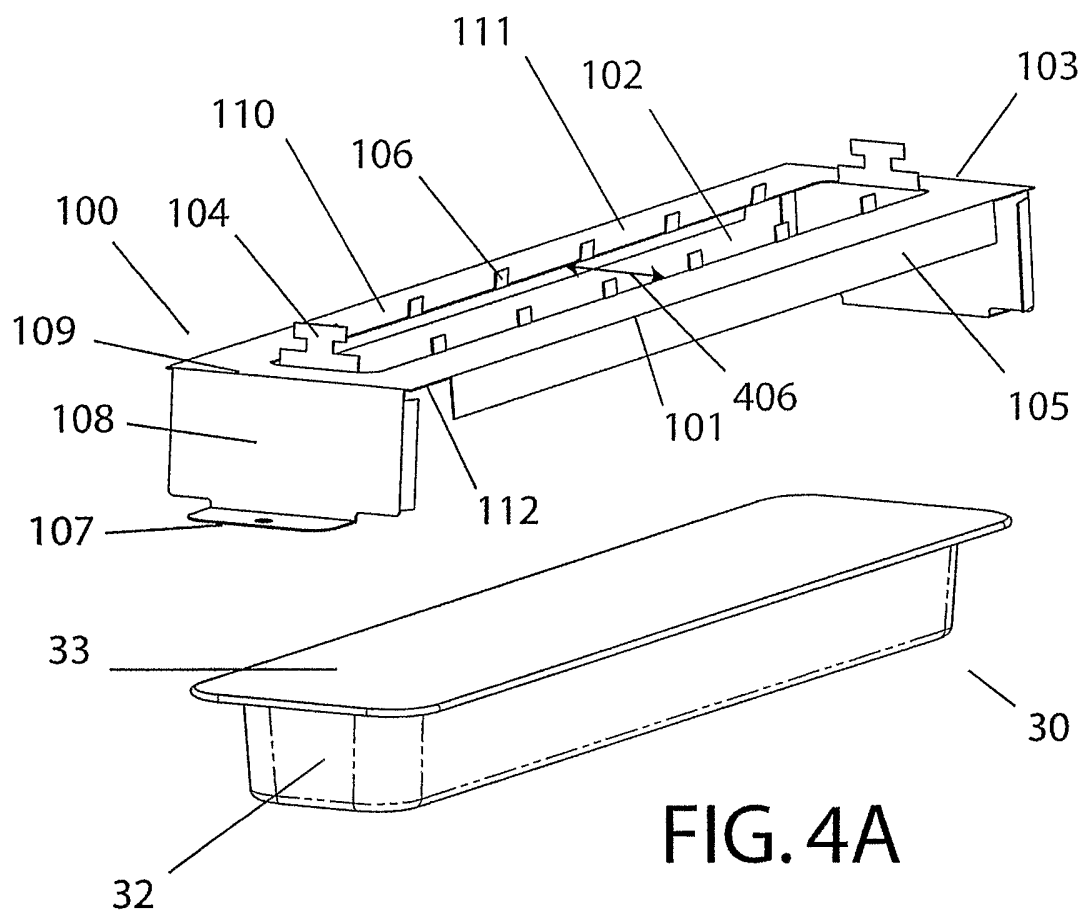


FIG. 2





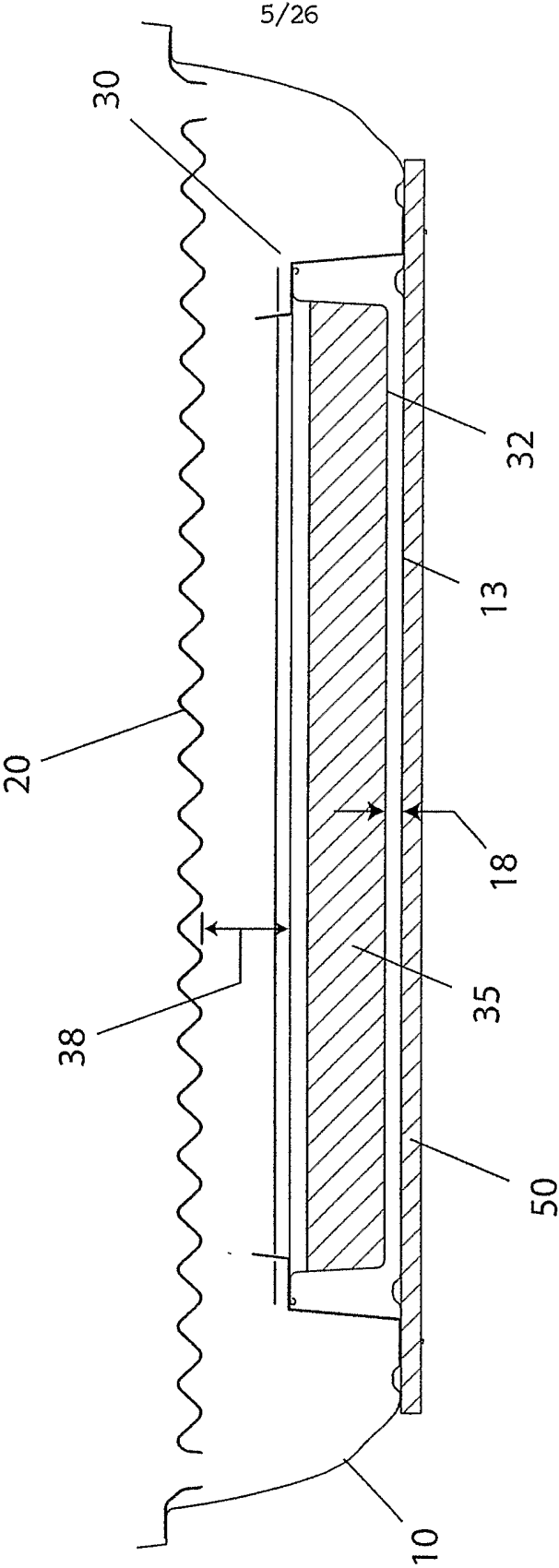


FIG. 5

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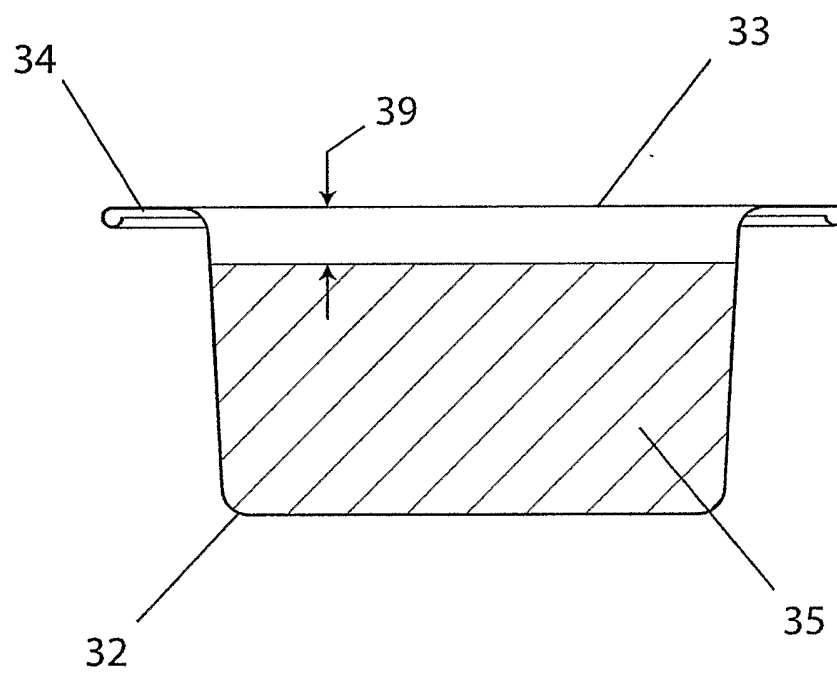


FIG. 6

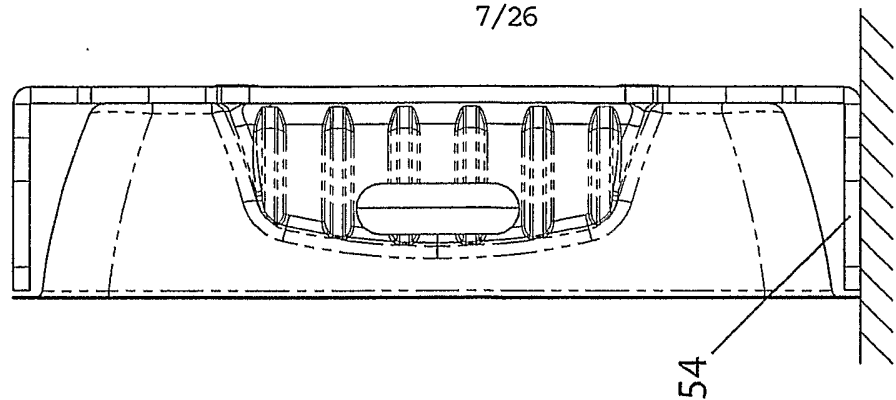


FIG. 7C

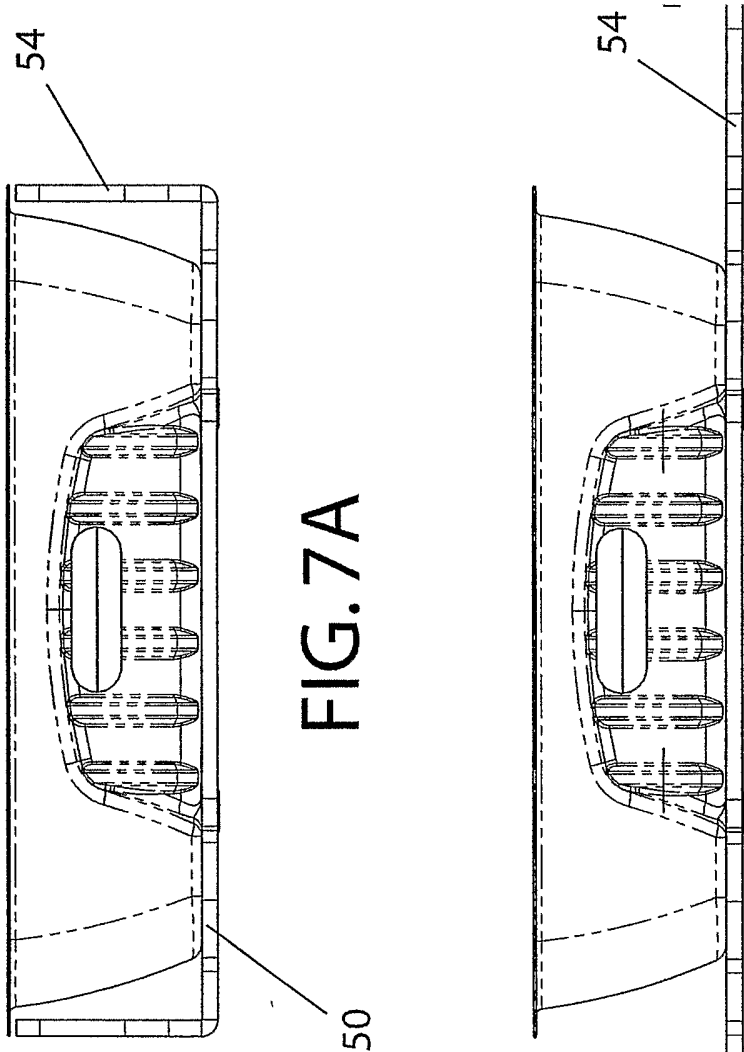


FIG. 7A

FIG. 7B

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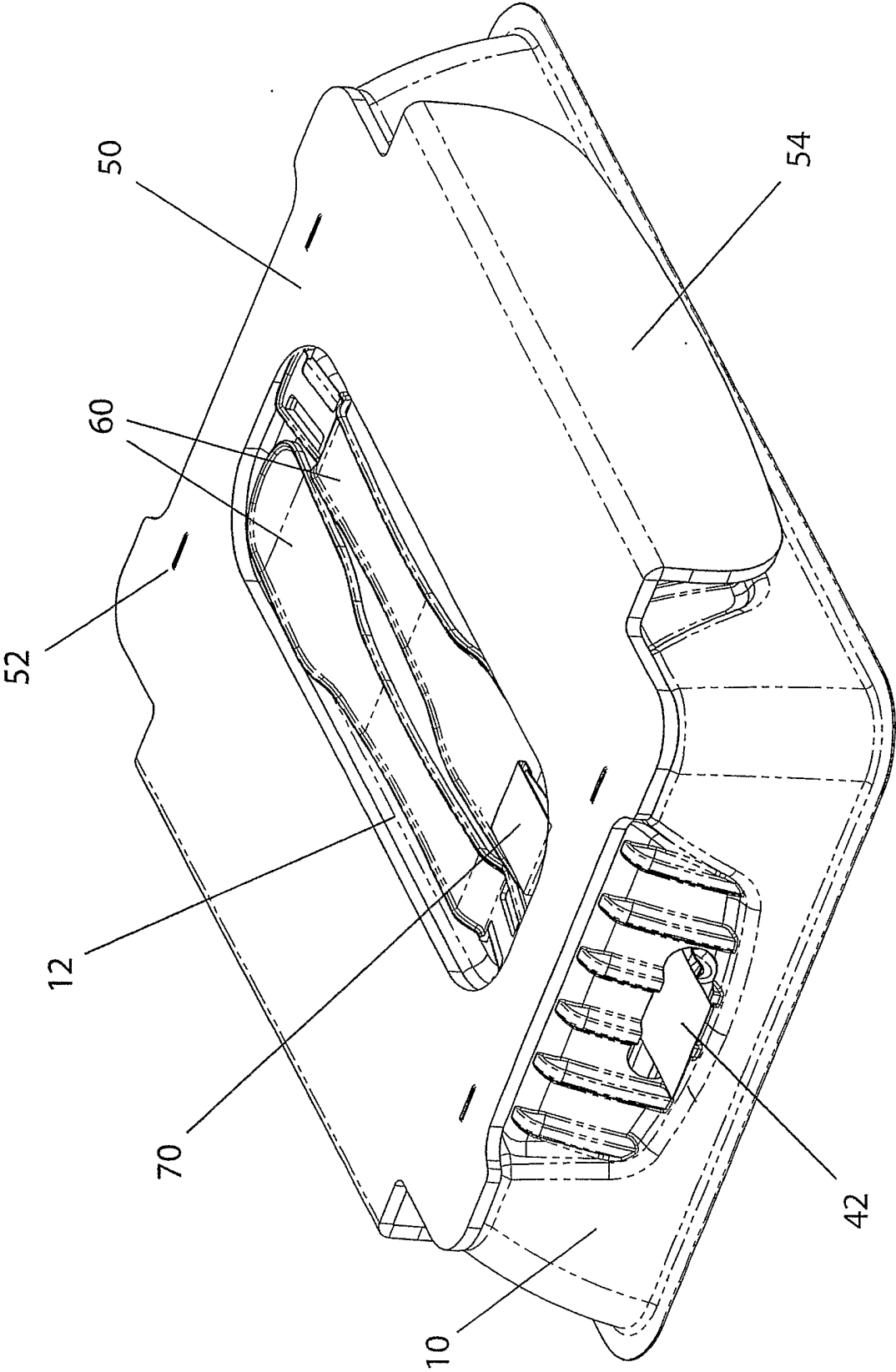


FIG. 8

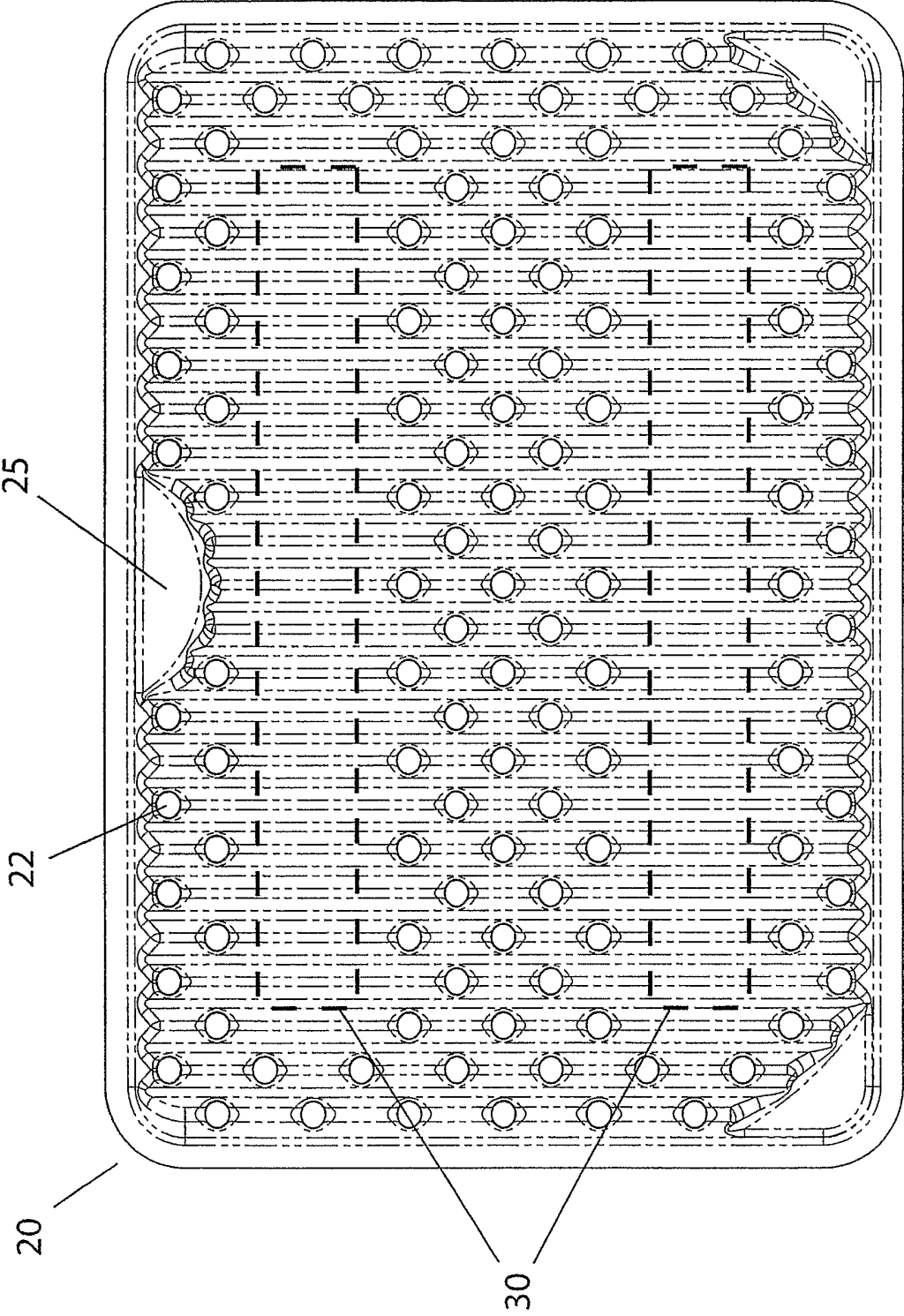


FIG. 9

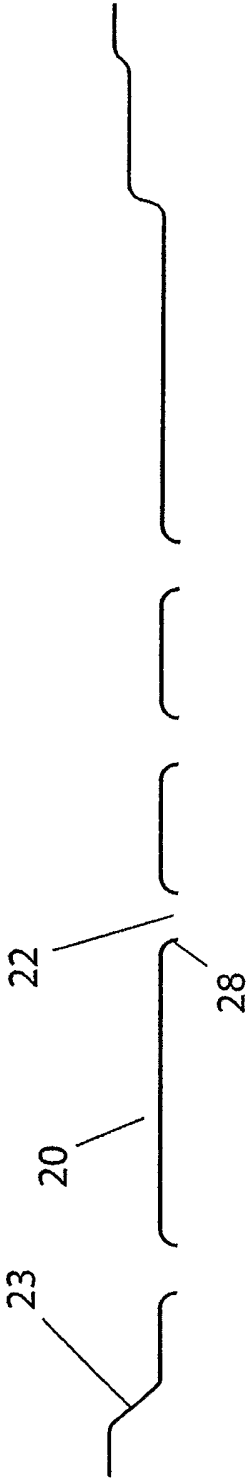


FIG. 10

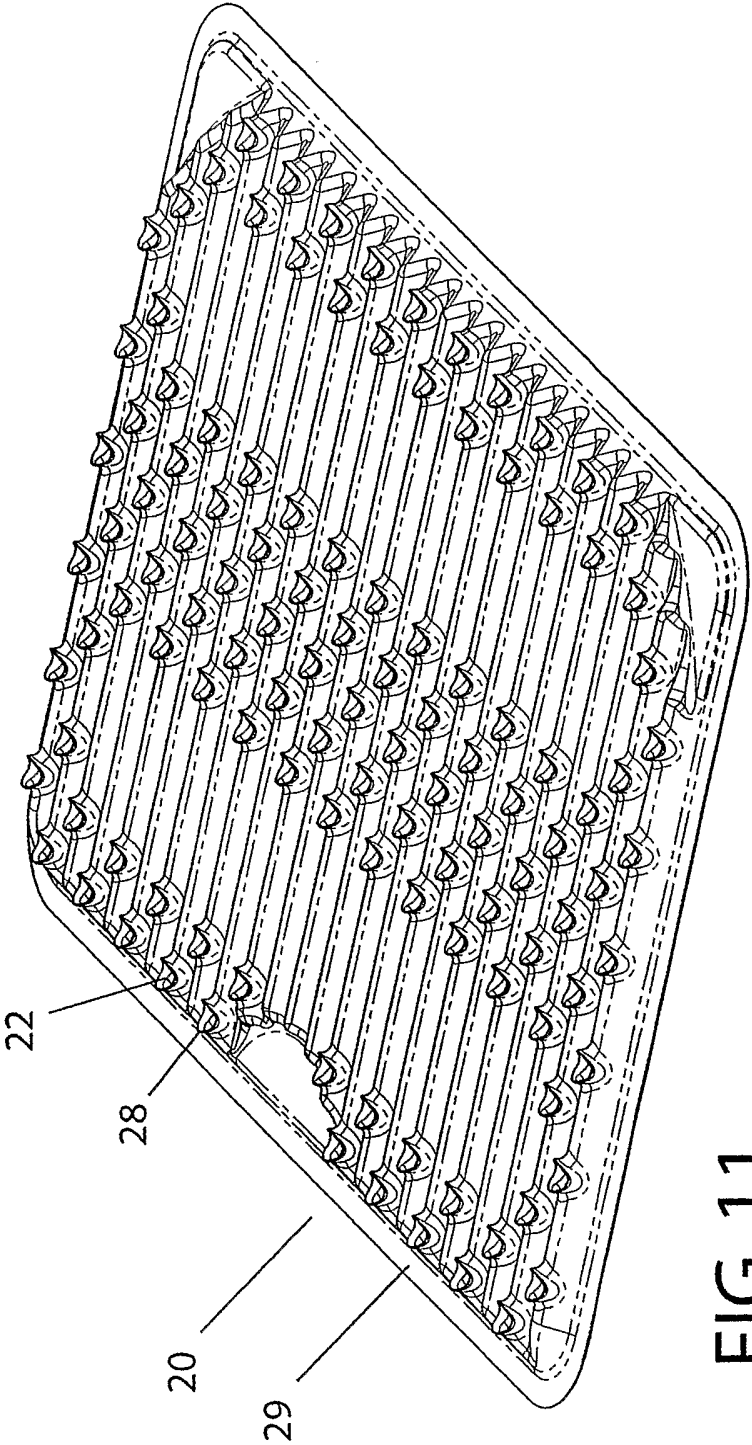


FIG. 11

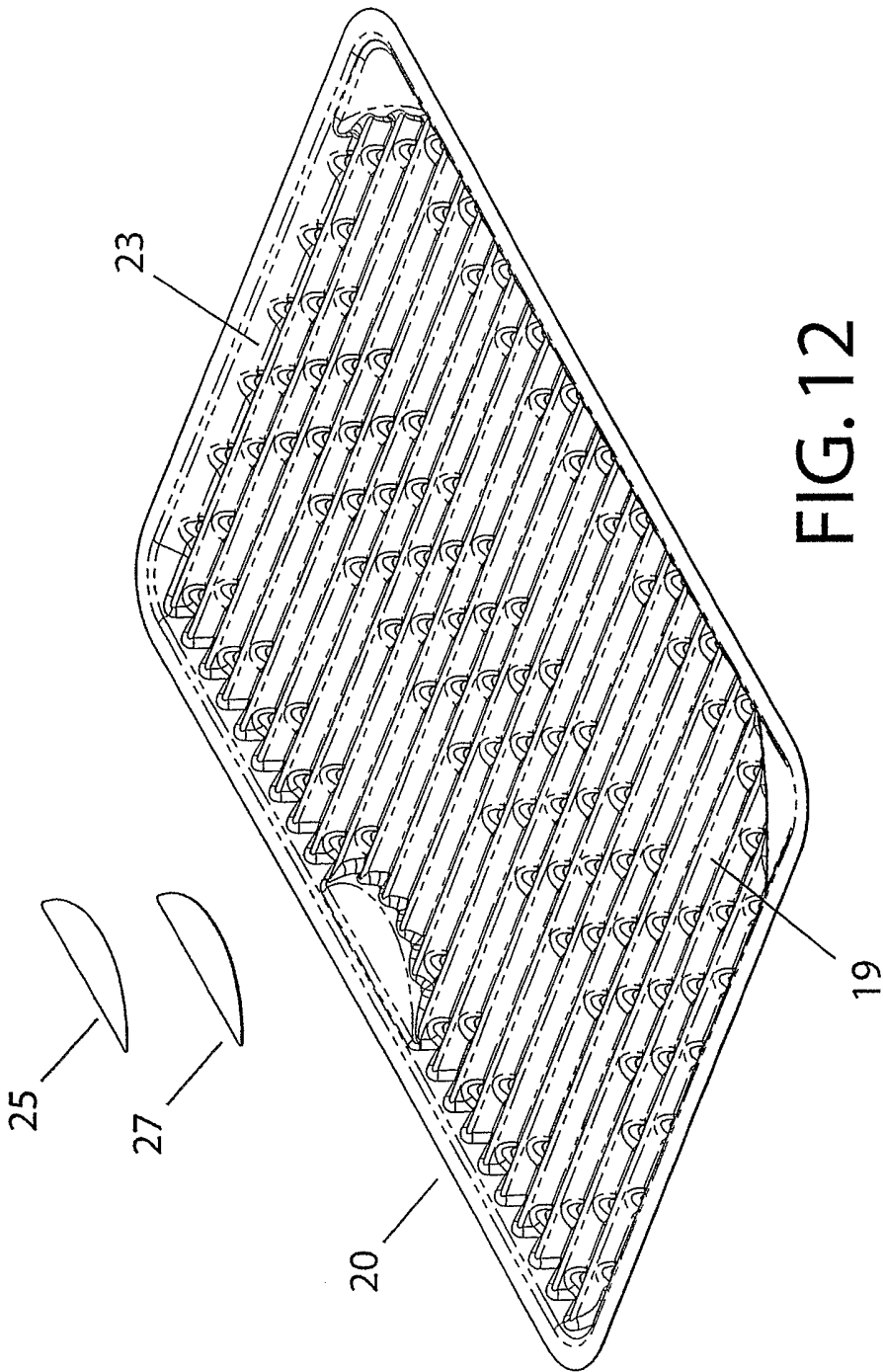


FIG. 12

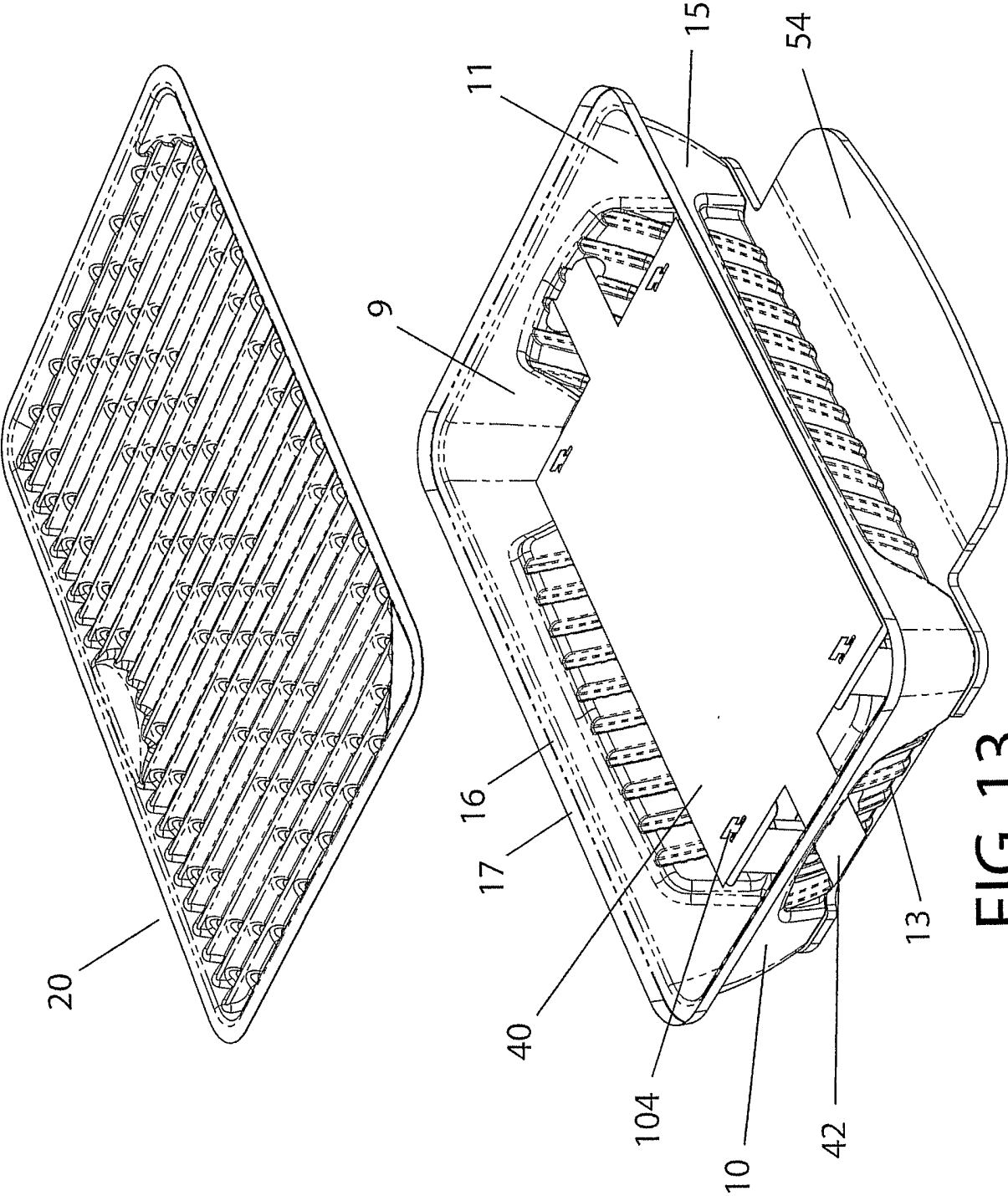
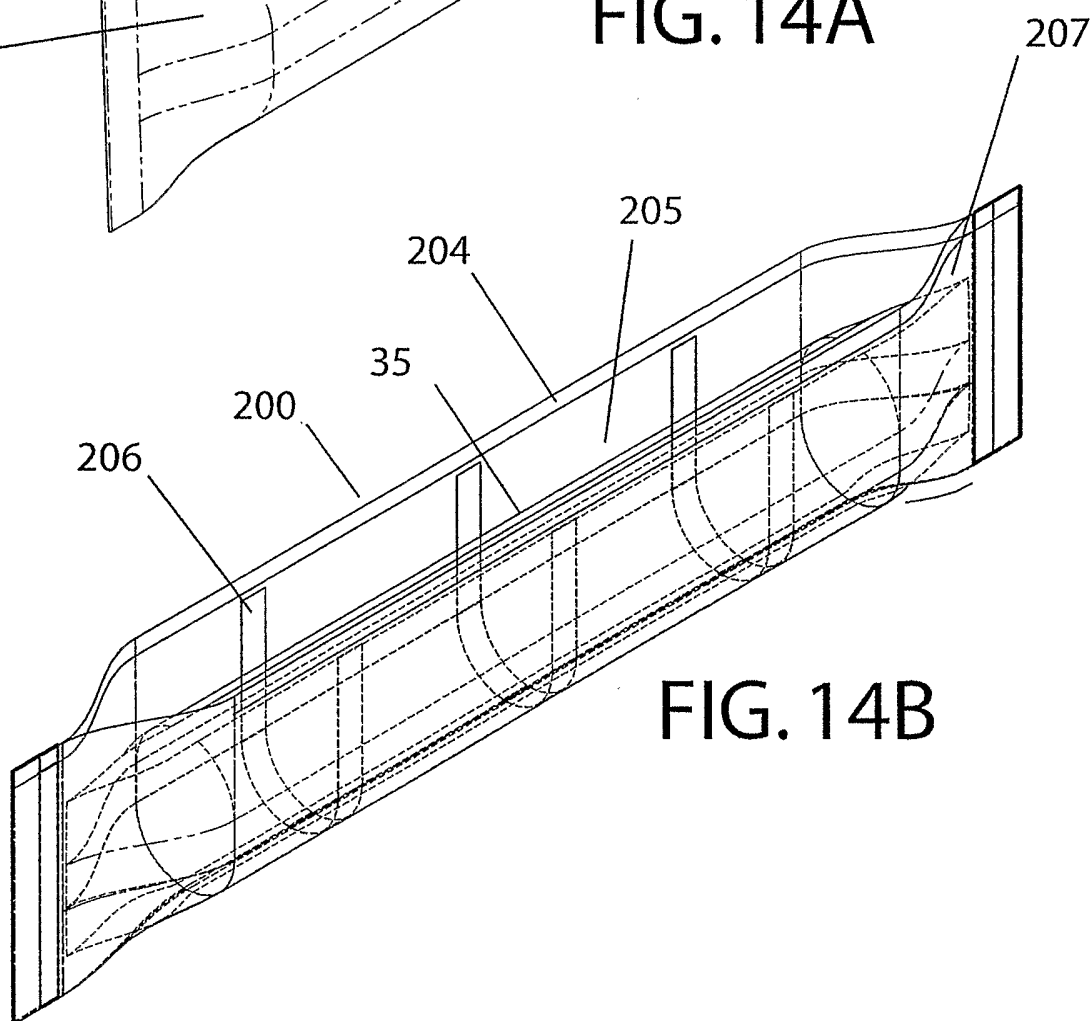
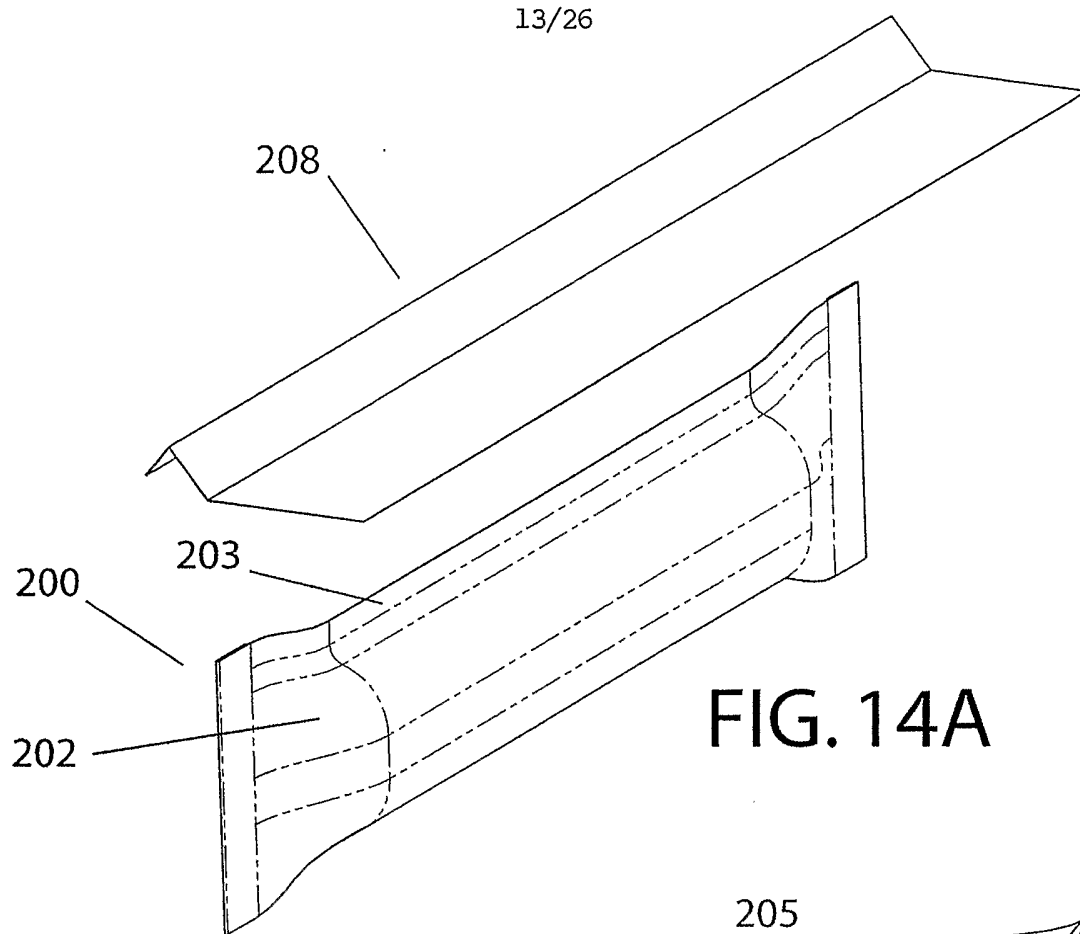
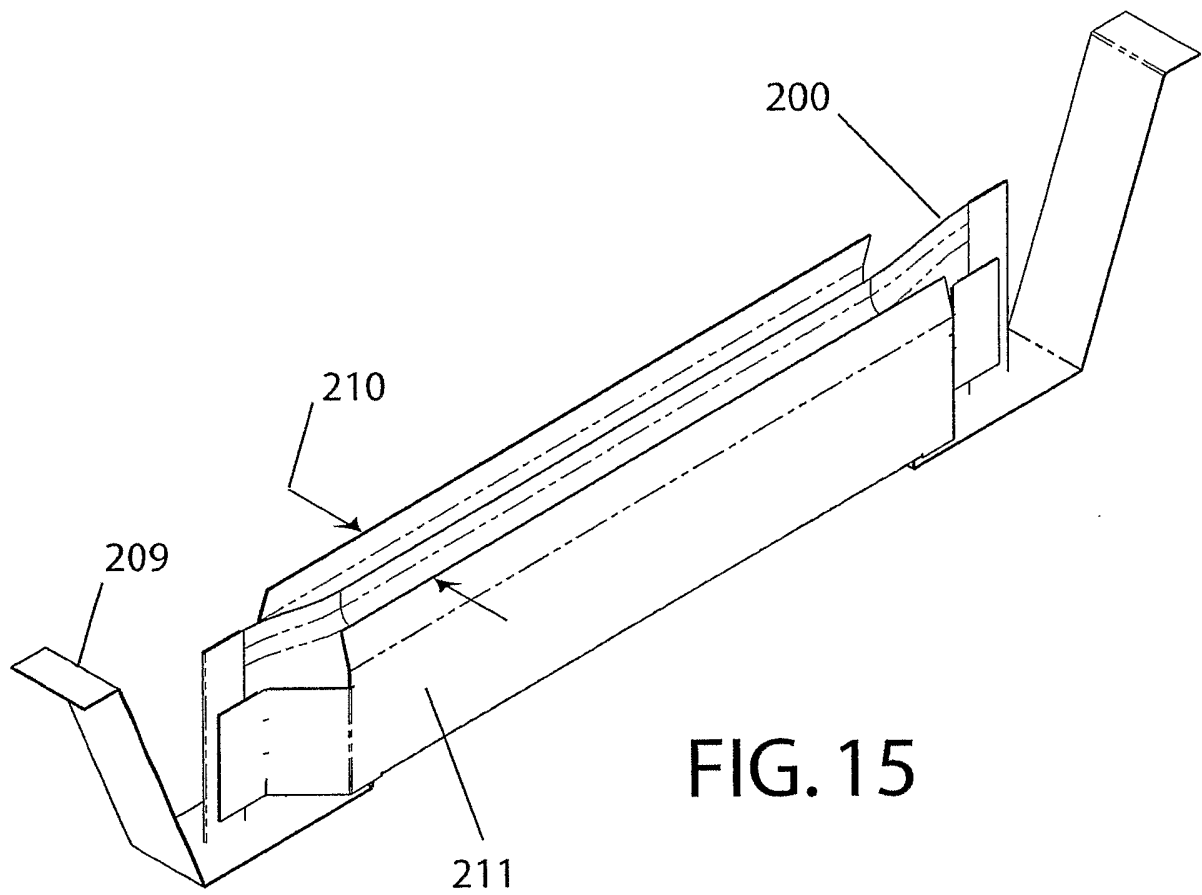


FIG. 13

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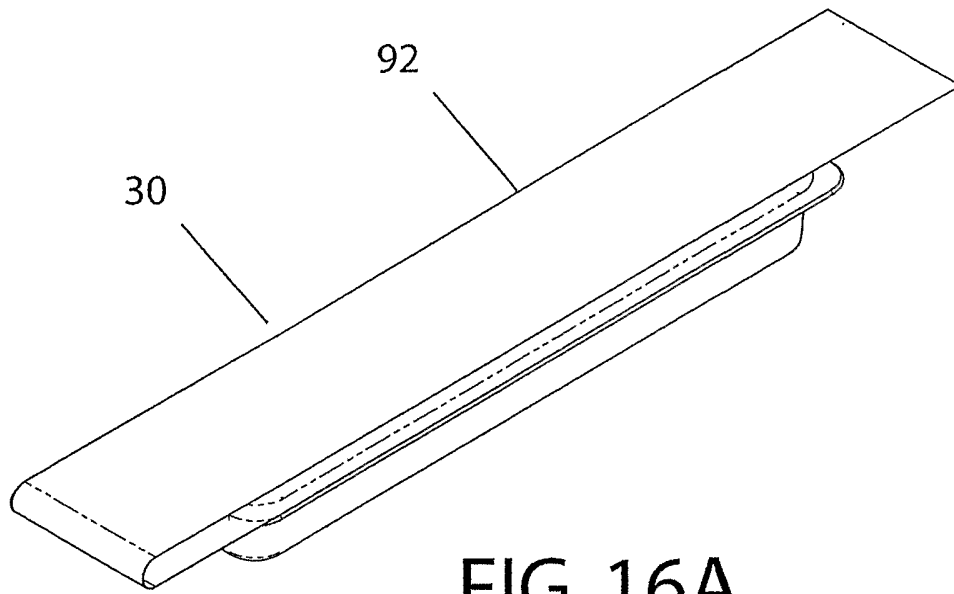


FIG. 16A

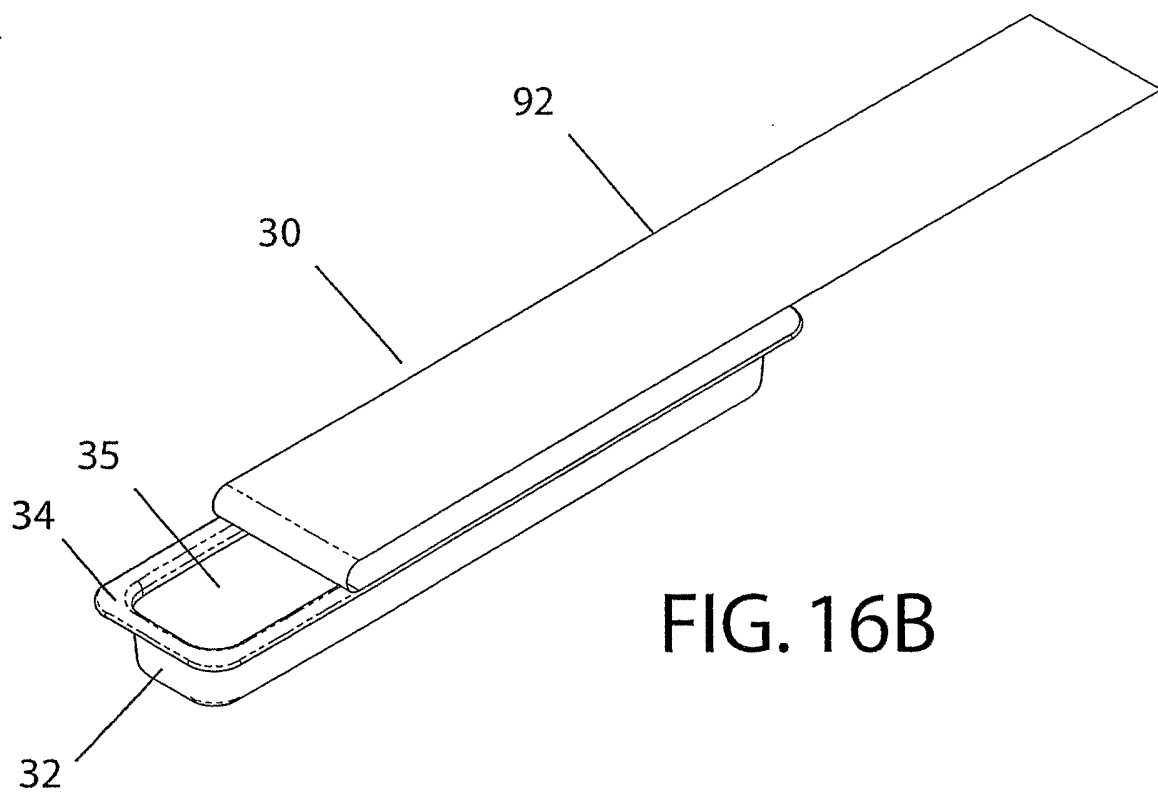


FIG. 16B

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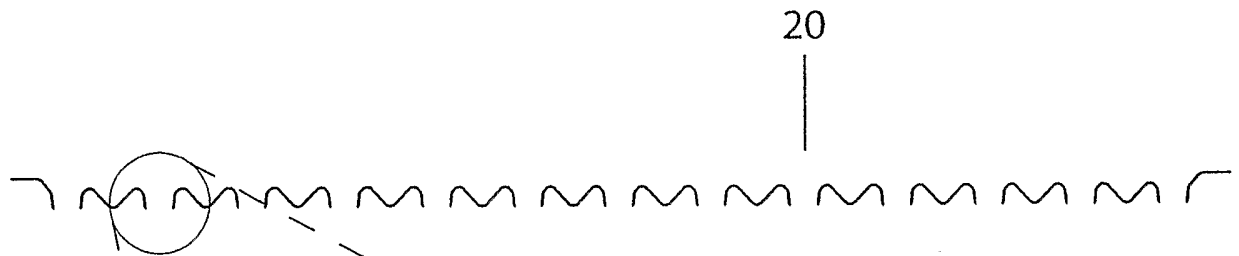


FIG. 17A

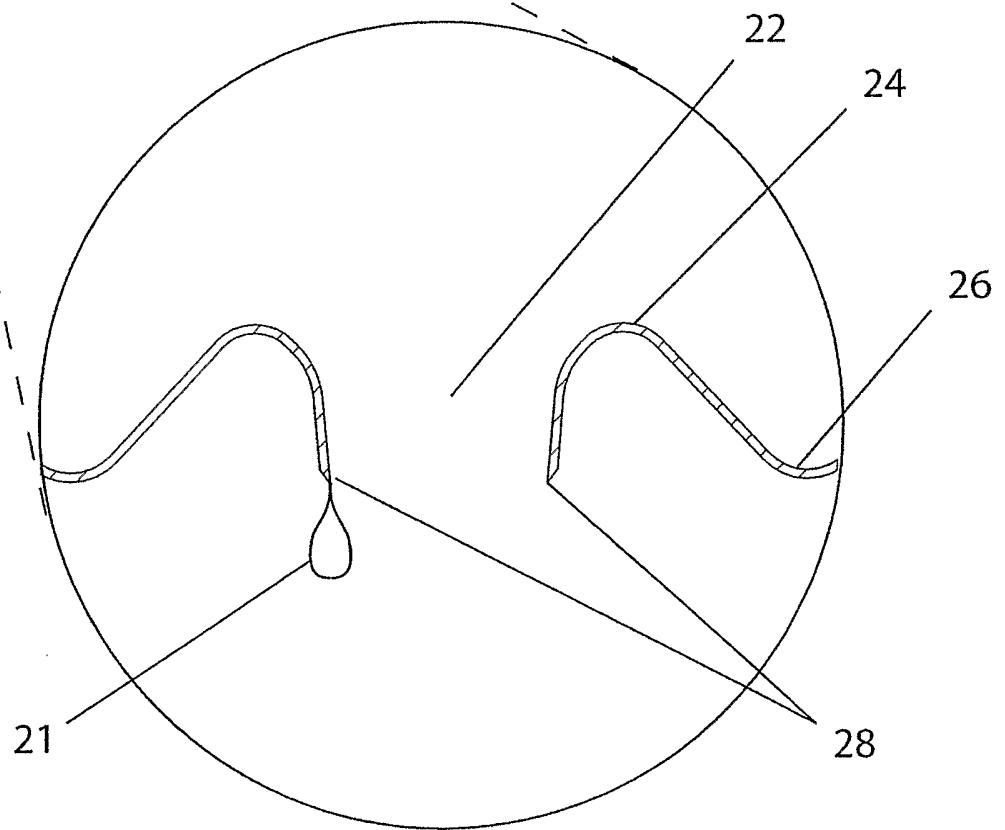
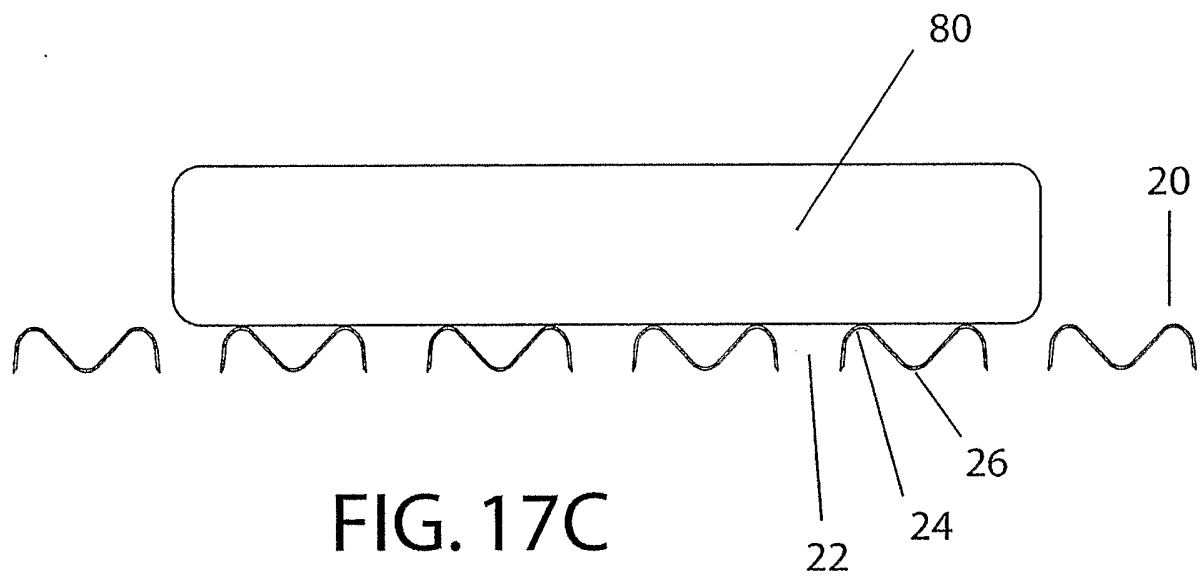


FIG. 17B

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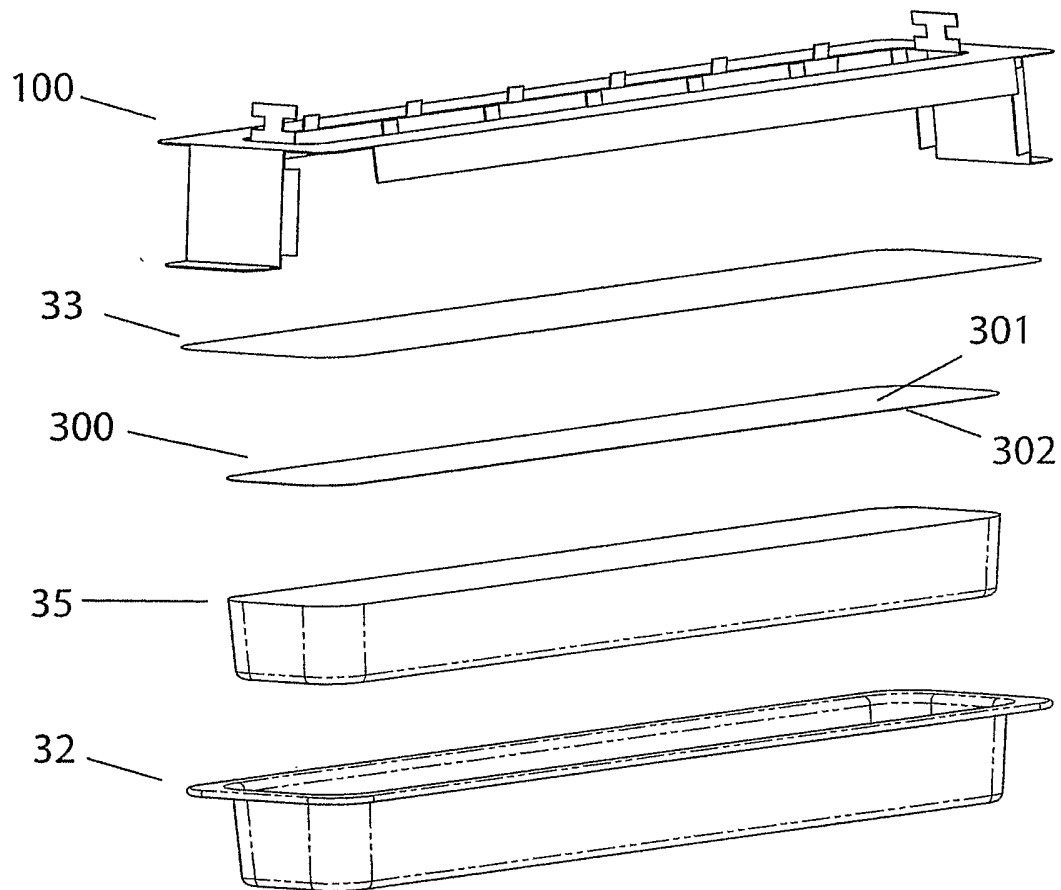


FIG. 18

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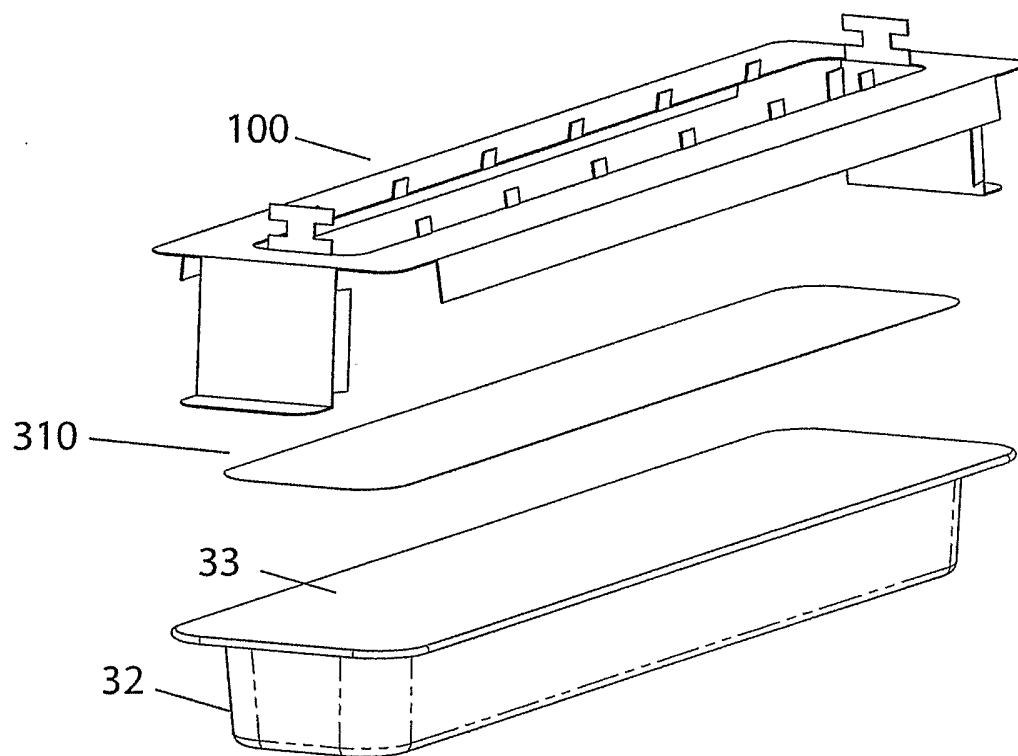


FIG. 19

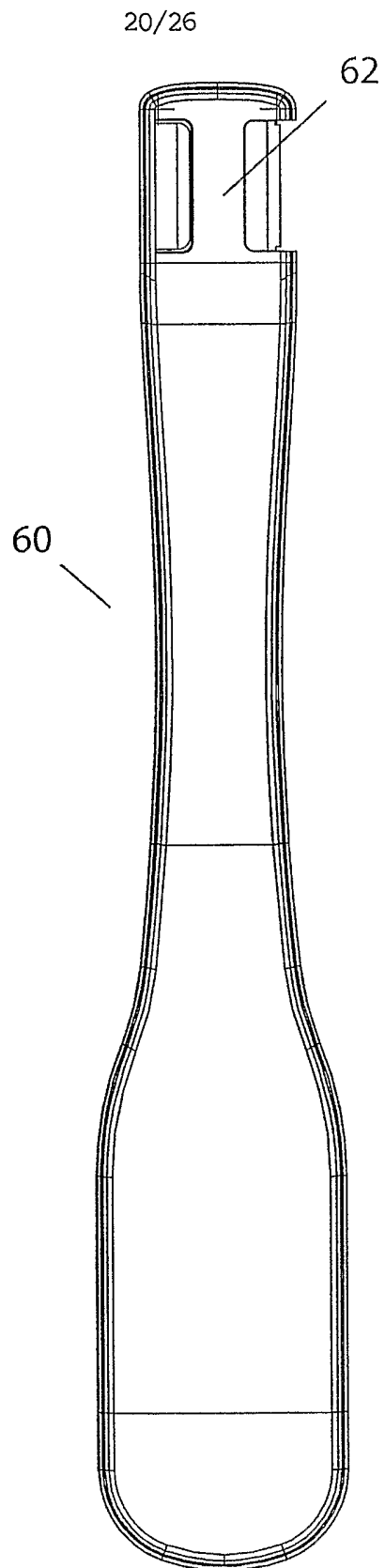


FIG. 20

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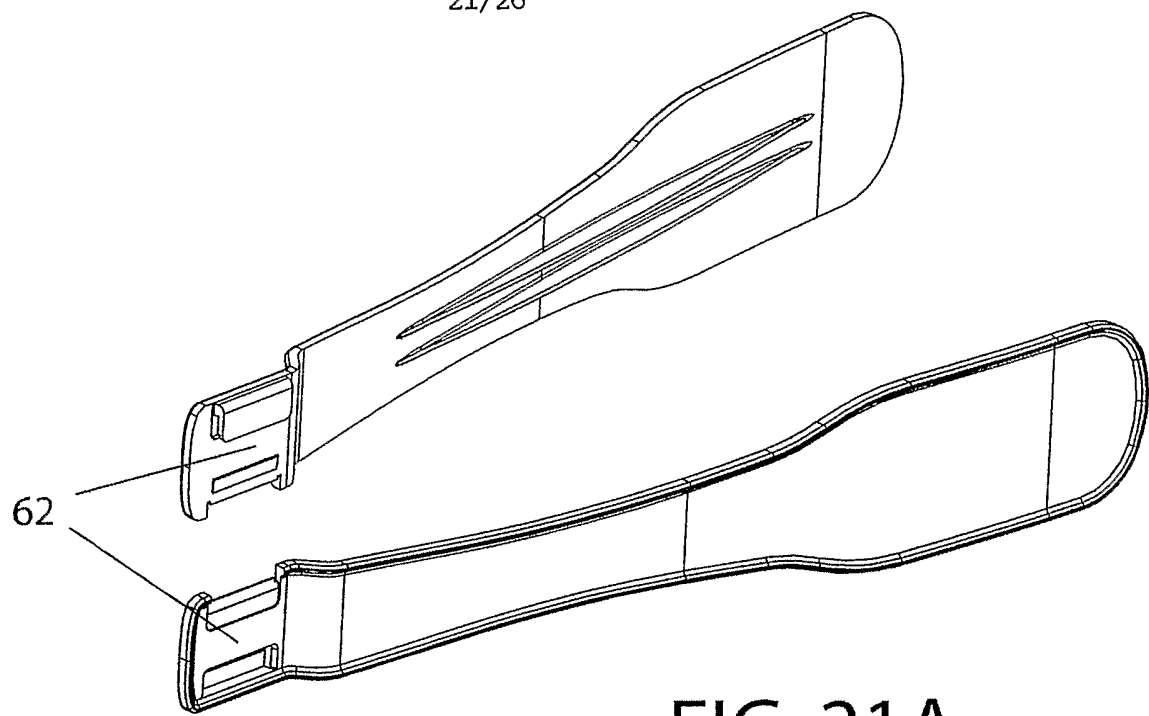


FIG. 21A

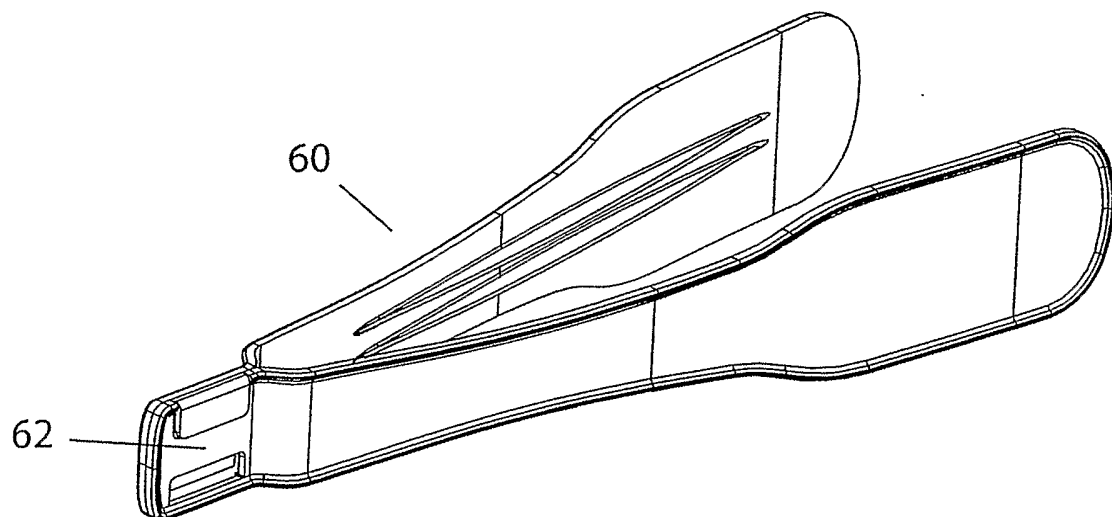


FIG. 21B

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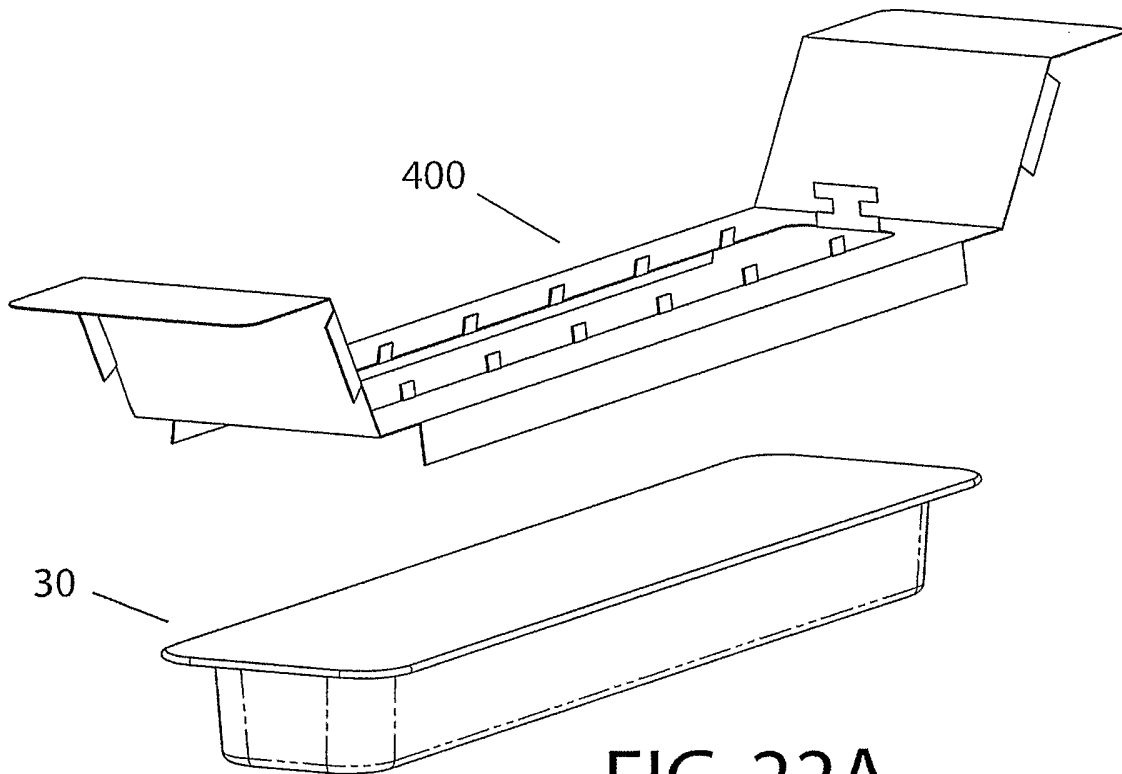


FIG. 22A

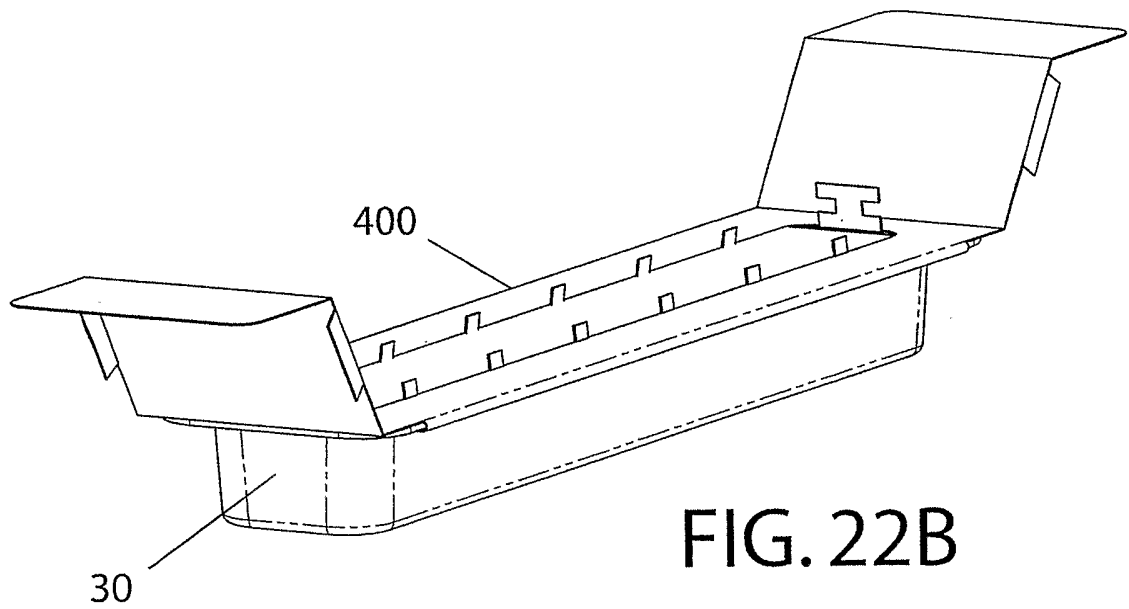


FIG. 22B

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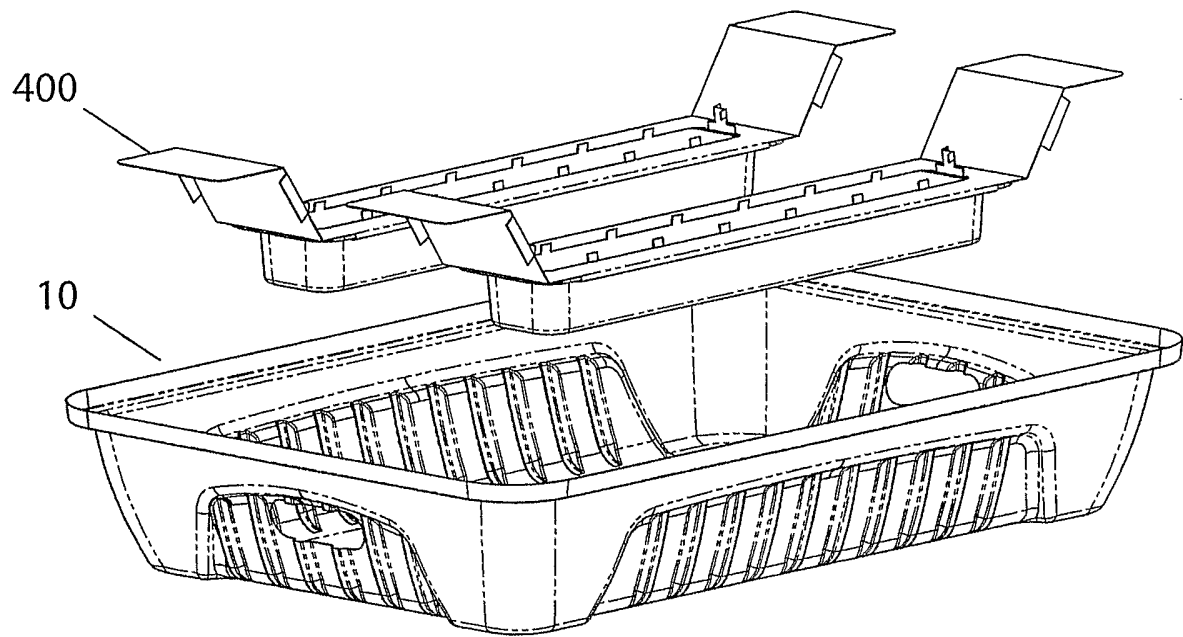


FIG. 23A

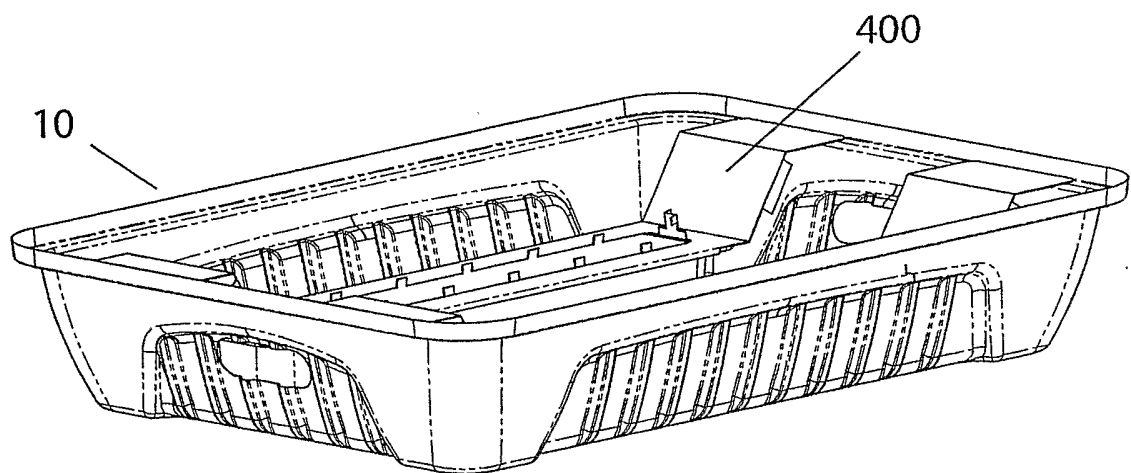


FIG. 23B

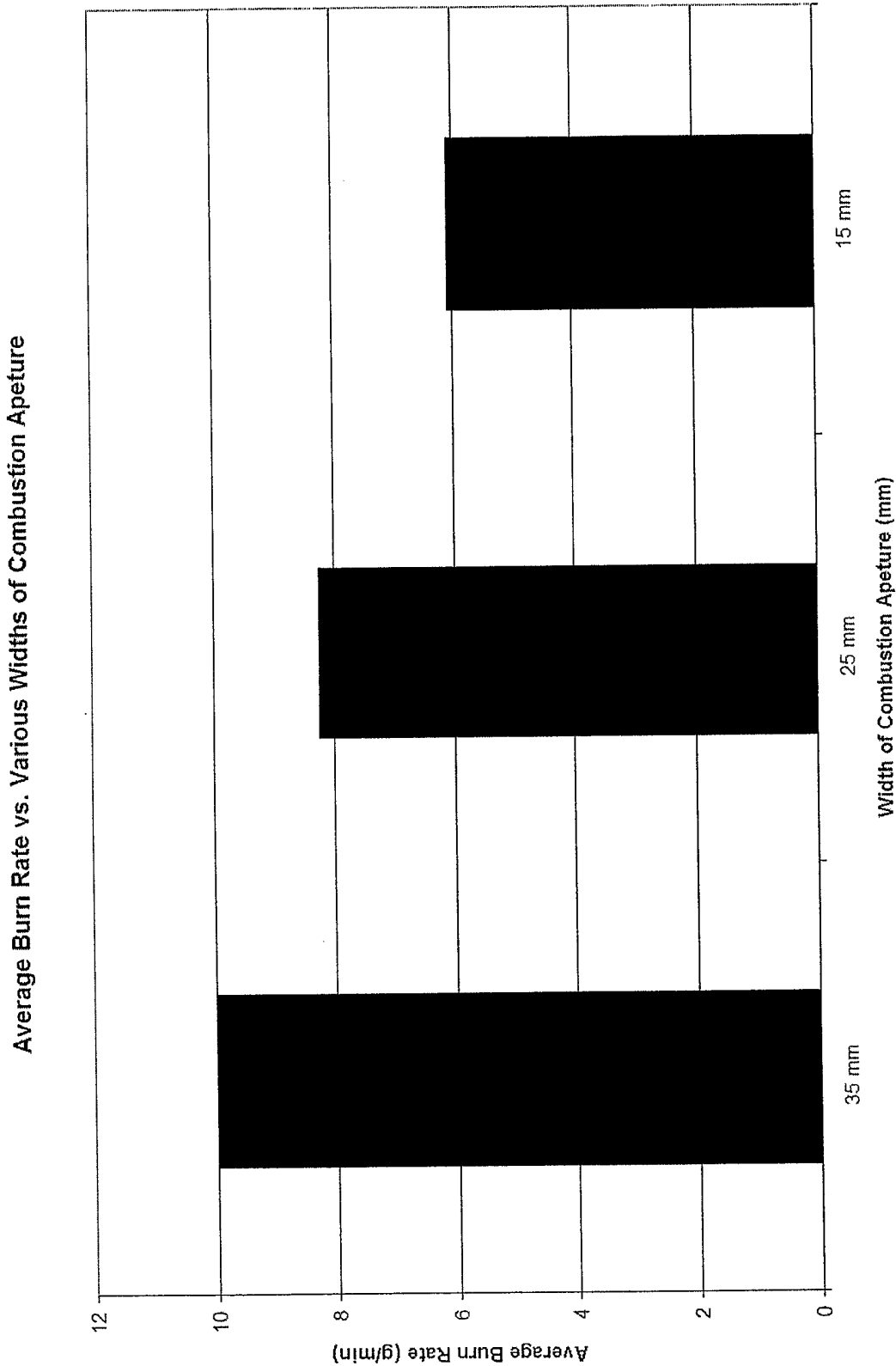


FIG. 24

Effect of Varying Vessel-Grate Gap on Combustion Performance

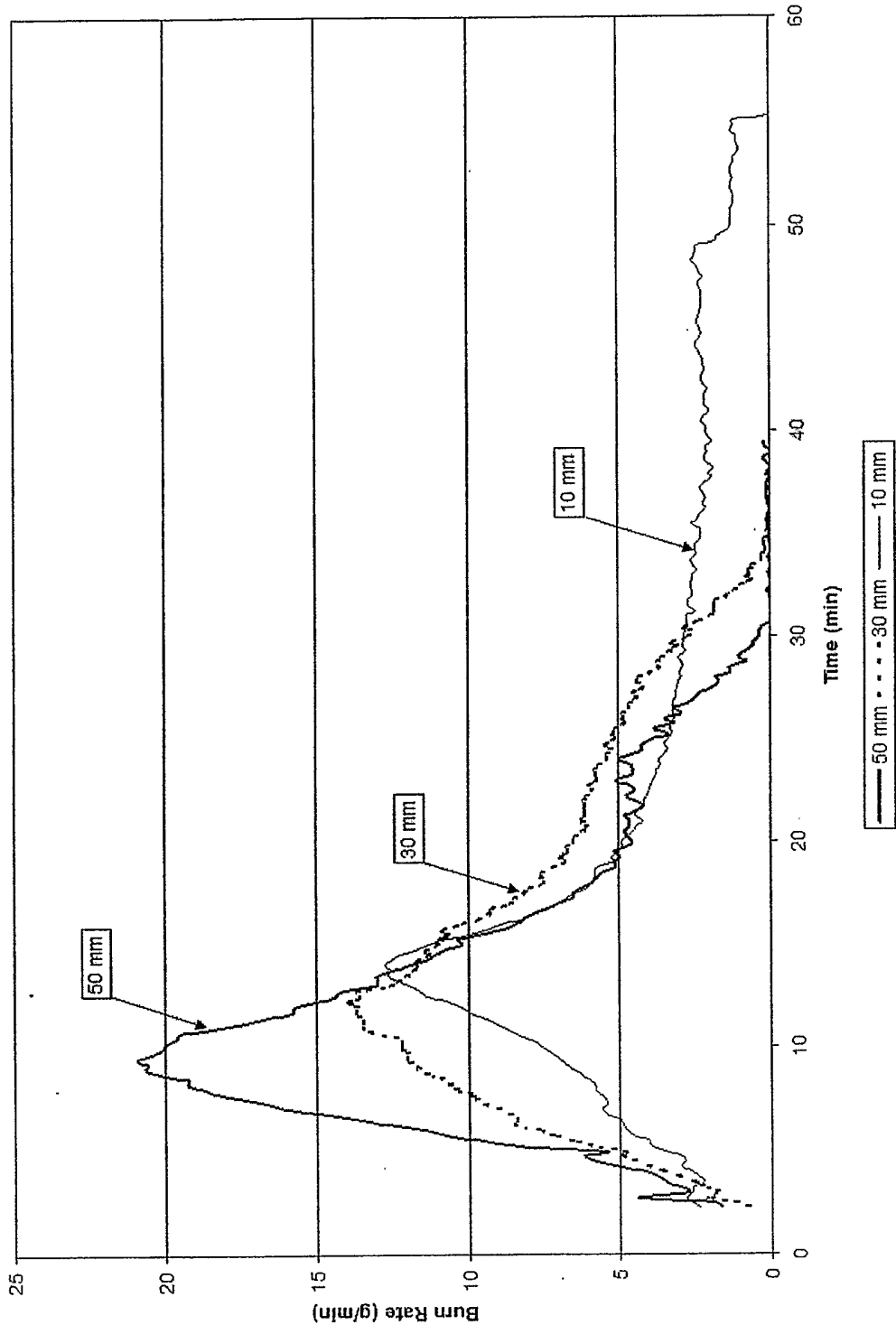


FIG. 25

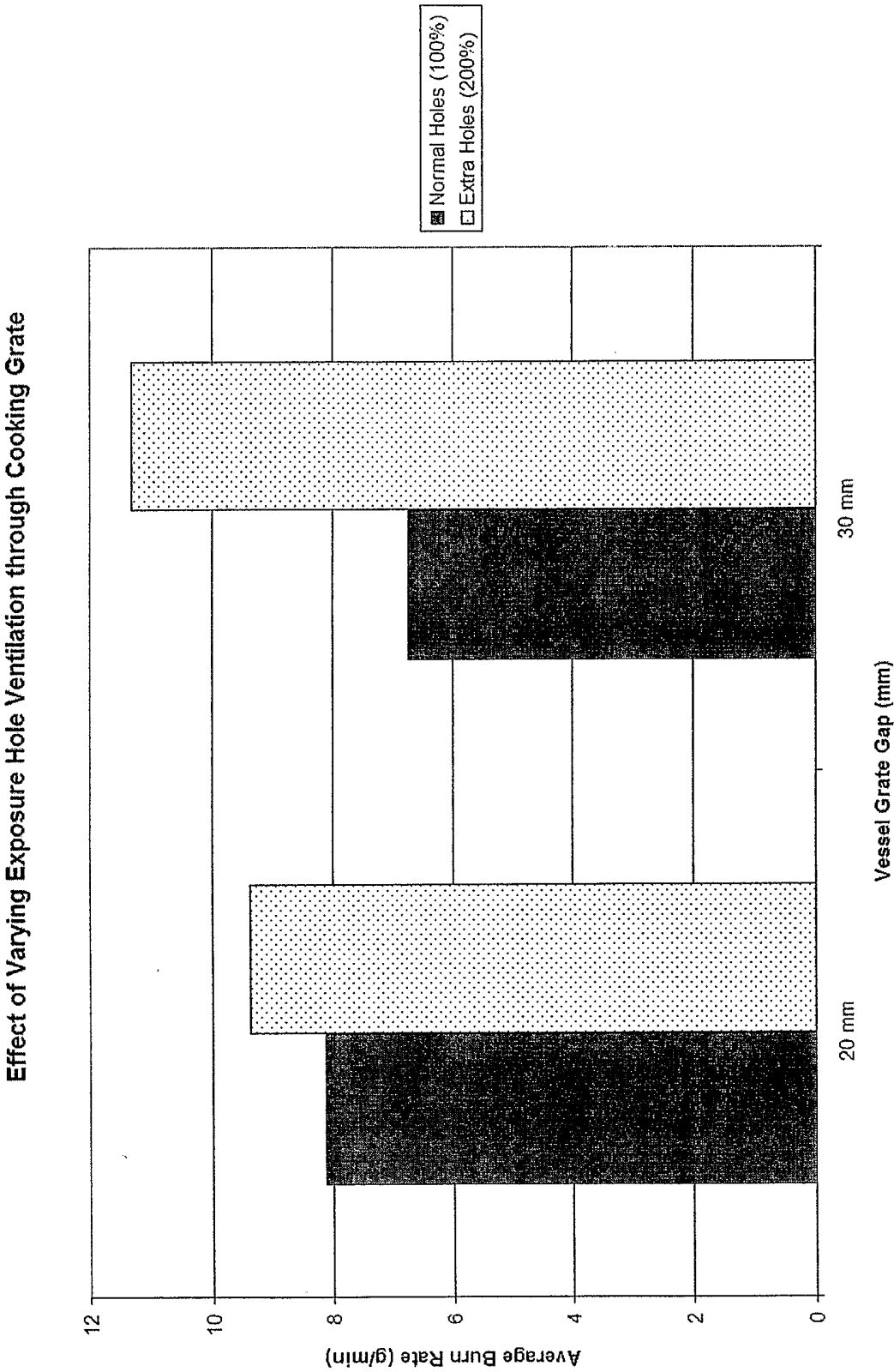


FIG. 26