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(19) **United States**(12) **Patent Application Publication****Basham et al.**(10) **Pub. No.: US 2024/0263778 A1**(43) **Pub. Date: Aug. 8, 2024**(54) **BURNER ACCESS HATCH**(71) Applicant: **Weil-McLain**, Michigan City, IN (US)(72) Inventors: **Tod Basham**, Valparaiso, IN (US);
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William Nanny, Valparaiso, IN (US)(21) Appl. No.: **18/434,503**(22) Filed: **Feb. 6, 2024****Related U.S. Application Data**

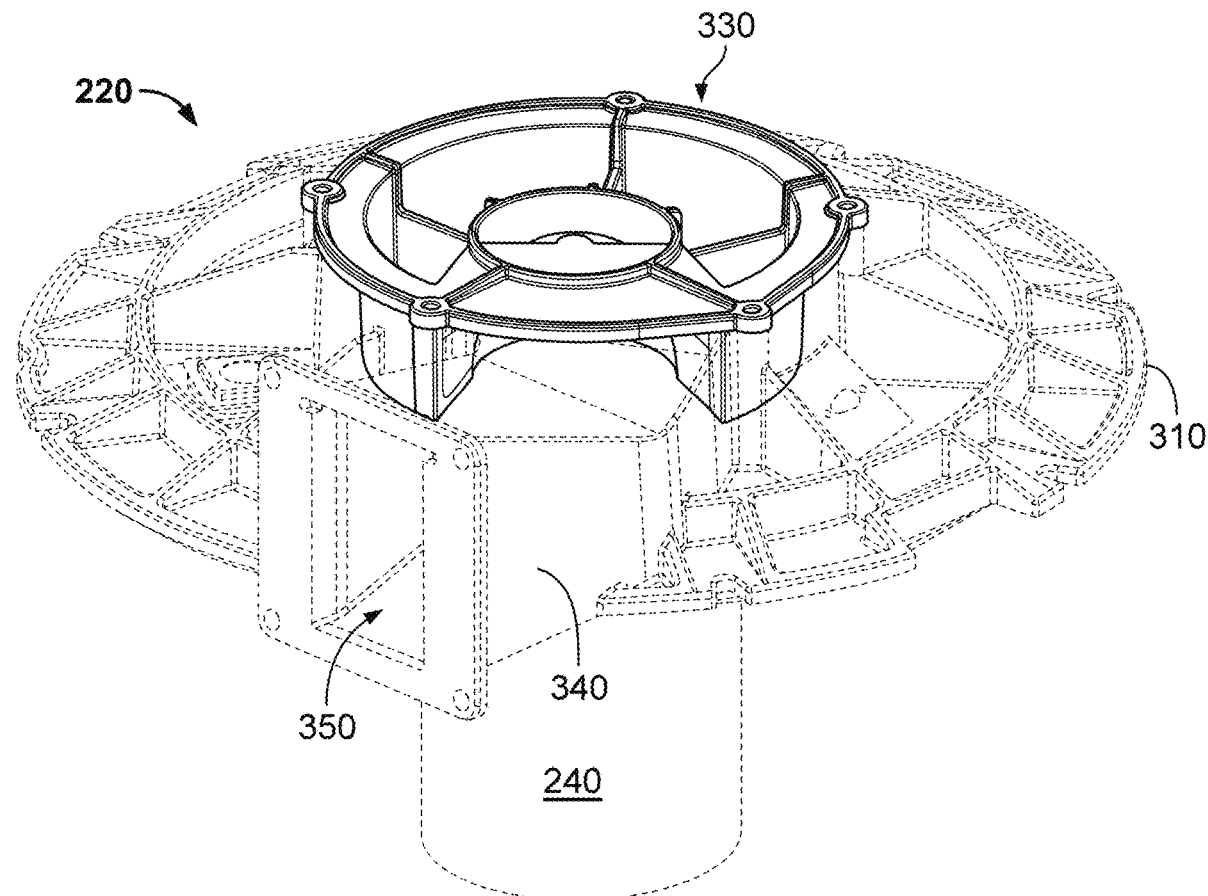
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(57)

ABSTRACT

A cover plate assembly for use with a furnace system is provided. The cover plate assembly includes a plate, a central opening formed within the plate, a hatch lid positioned at least partially within the central opening and the hatch lid having a body with a baffle area. The cover plate assembly further includes an inlet structure designed to direct a fluid fuel source towards the central opening. The baffle area is positioned towards the inlet structure forming a fluid pathway between the inlet structure and the baffle area. In some instances, the hatch lid is removable such that internal components of the furnace system can be accessed without having to remove the entire cover plate assembly. Also, the cover plate assembly provided herein is designed to distribute a fuel source evenly into a combustion chamber and reduce noise-producing harmonic effects in the furnace system.



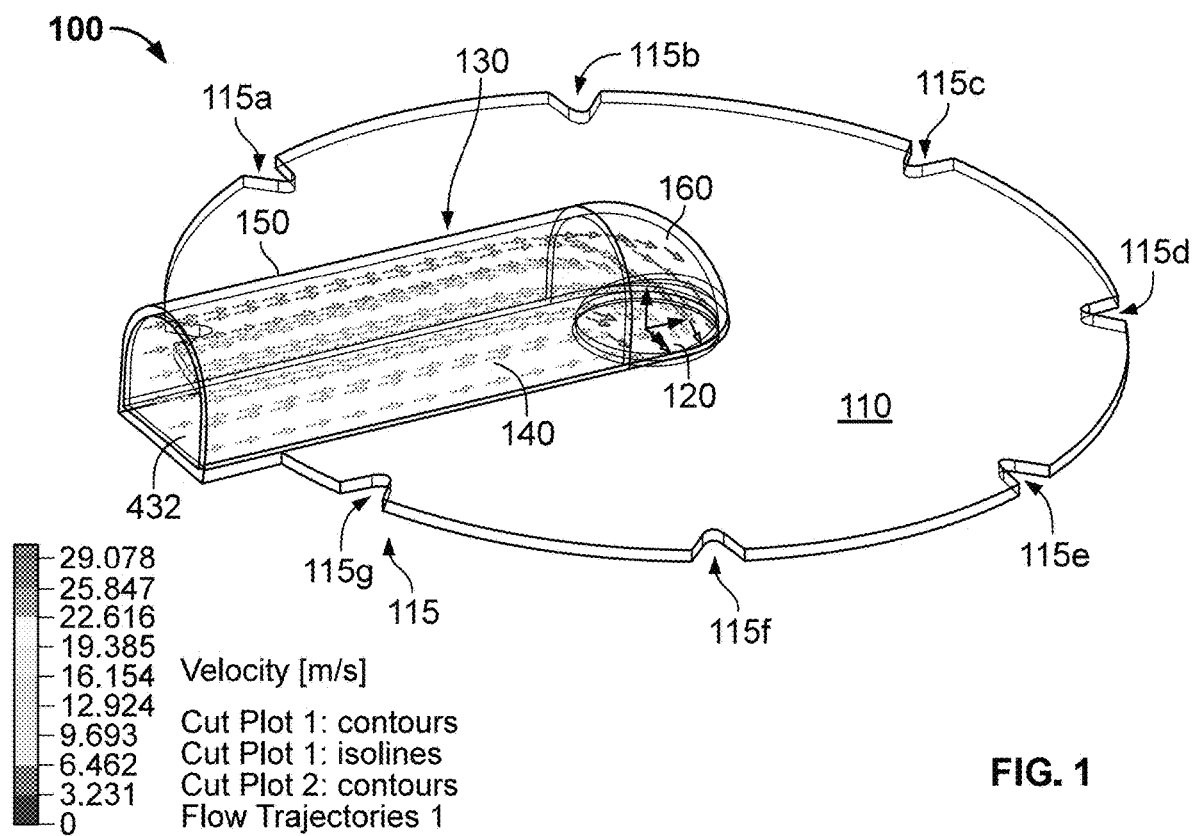


FIG. 1

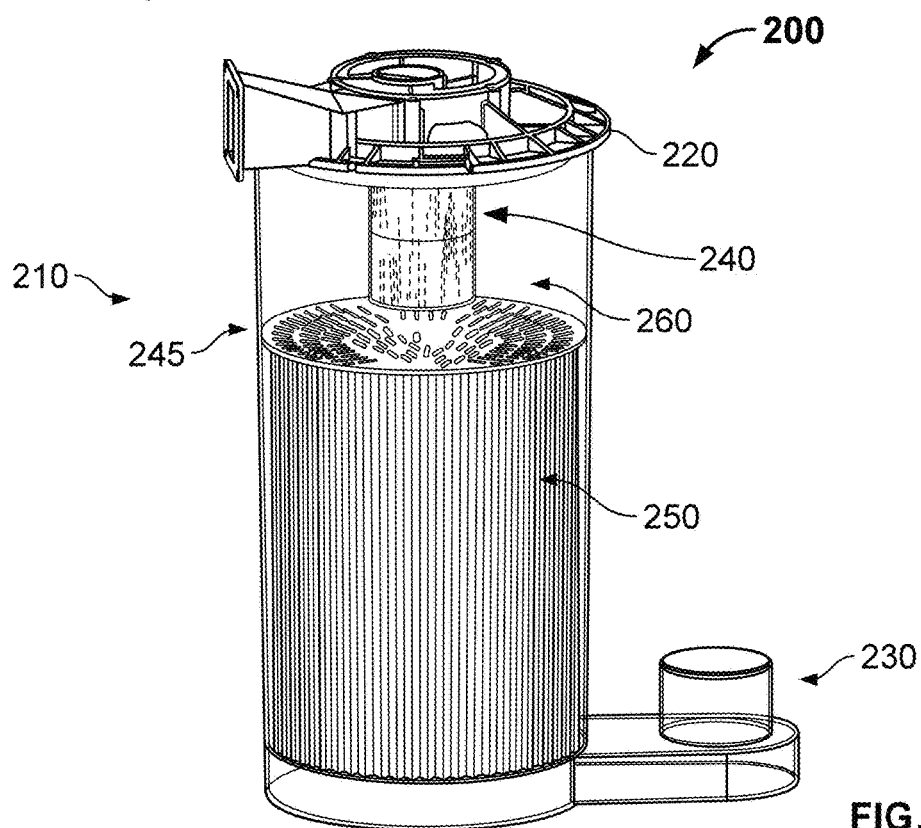


FIG. 2A

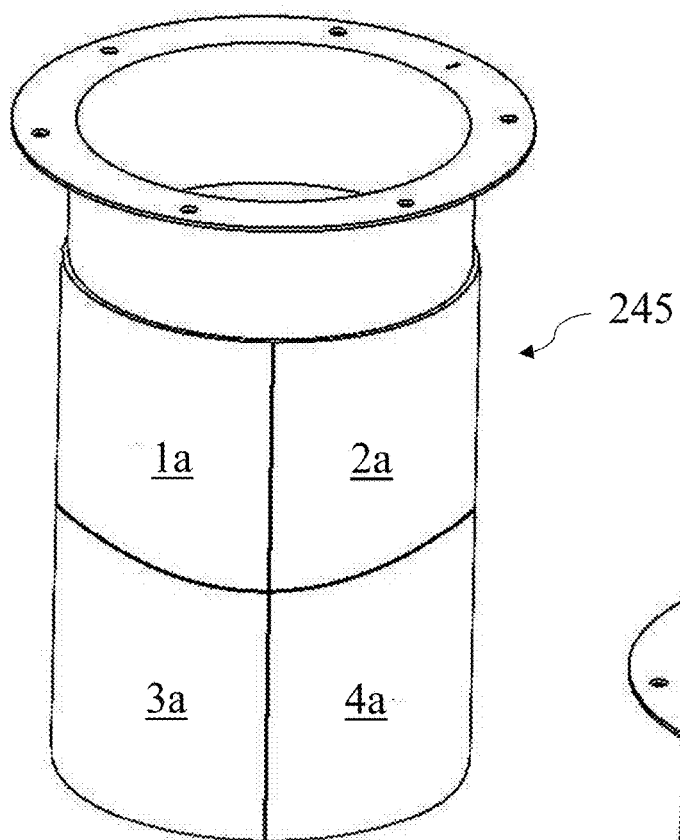


FIG. 2B

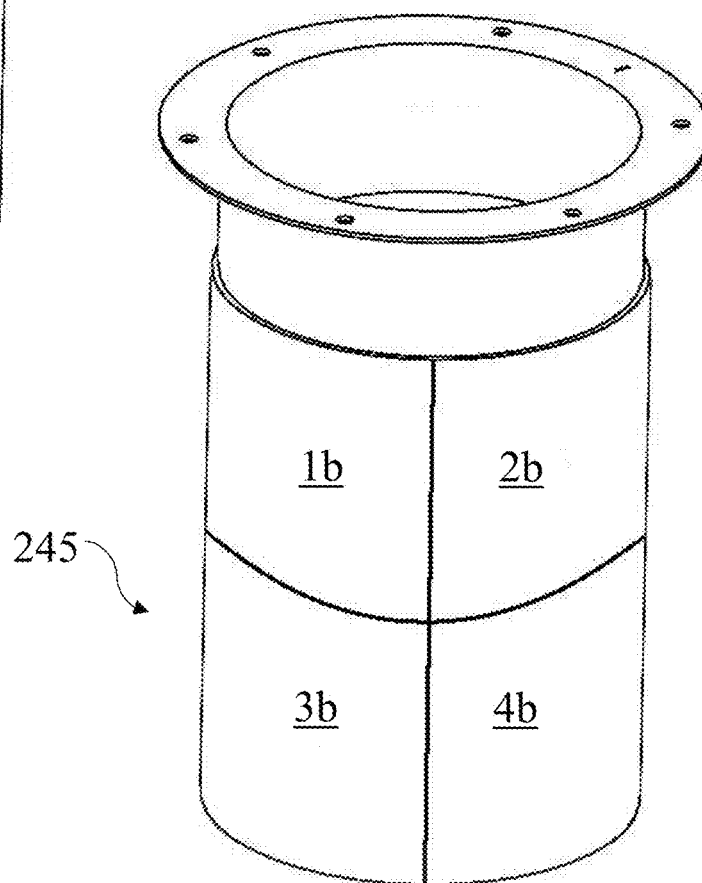


FIG. 2C

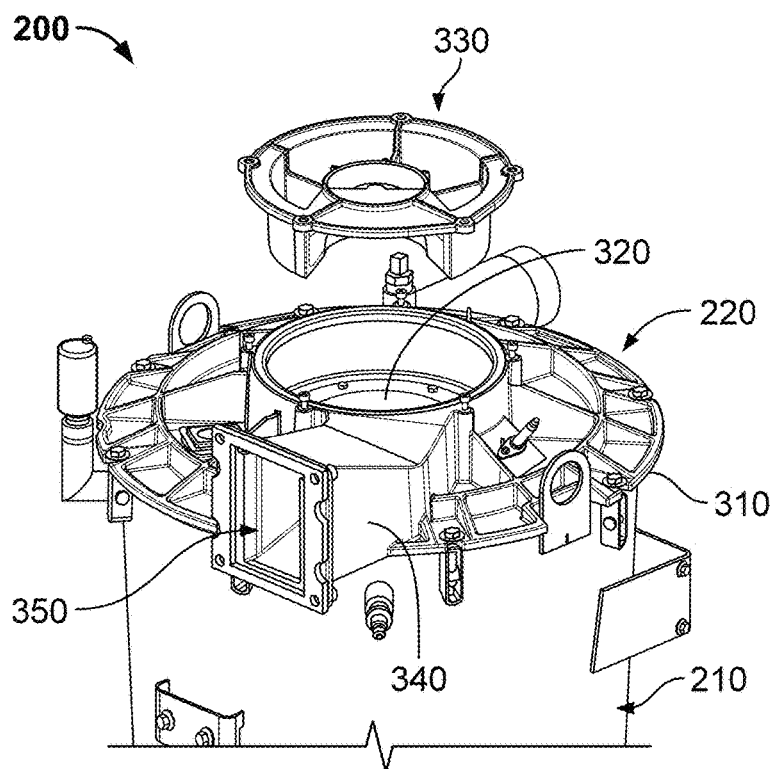


FIG. 3

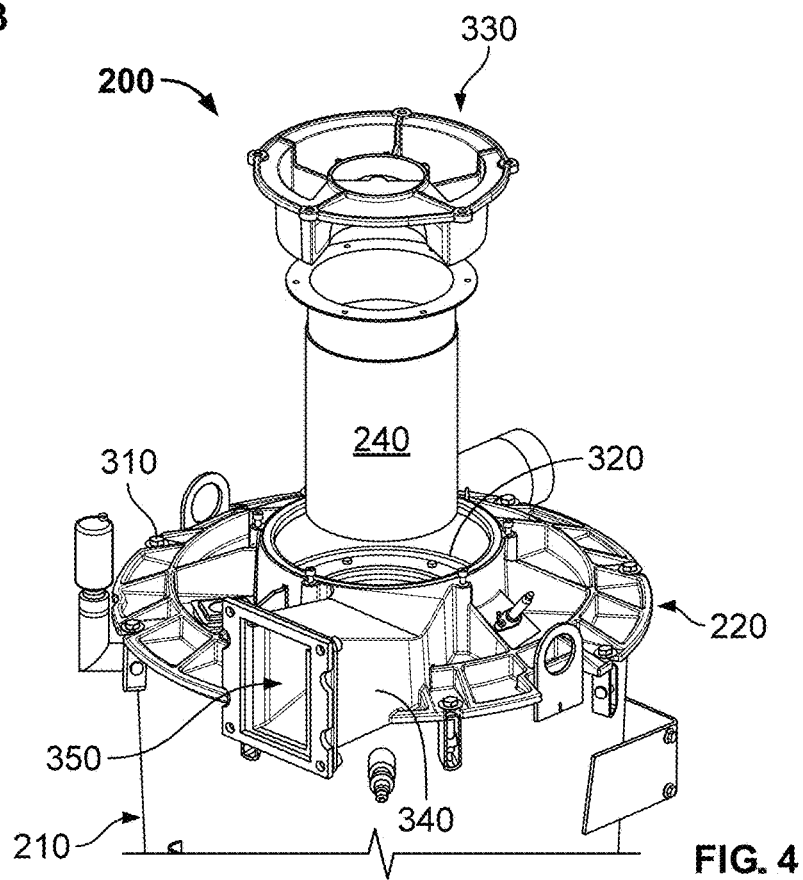
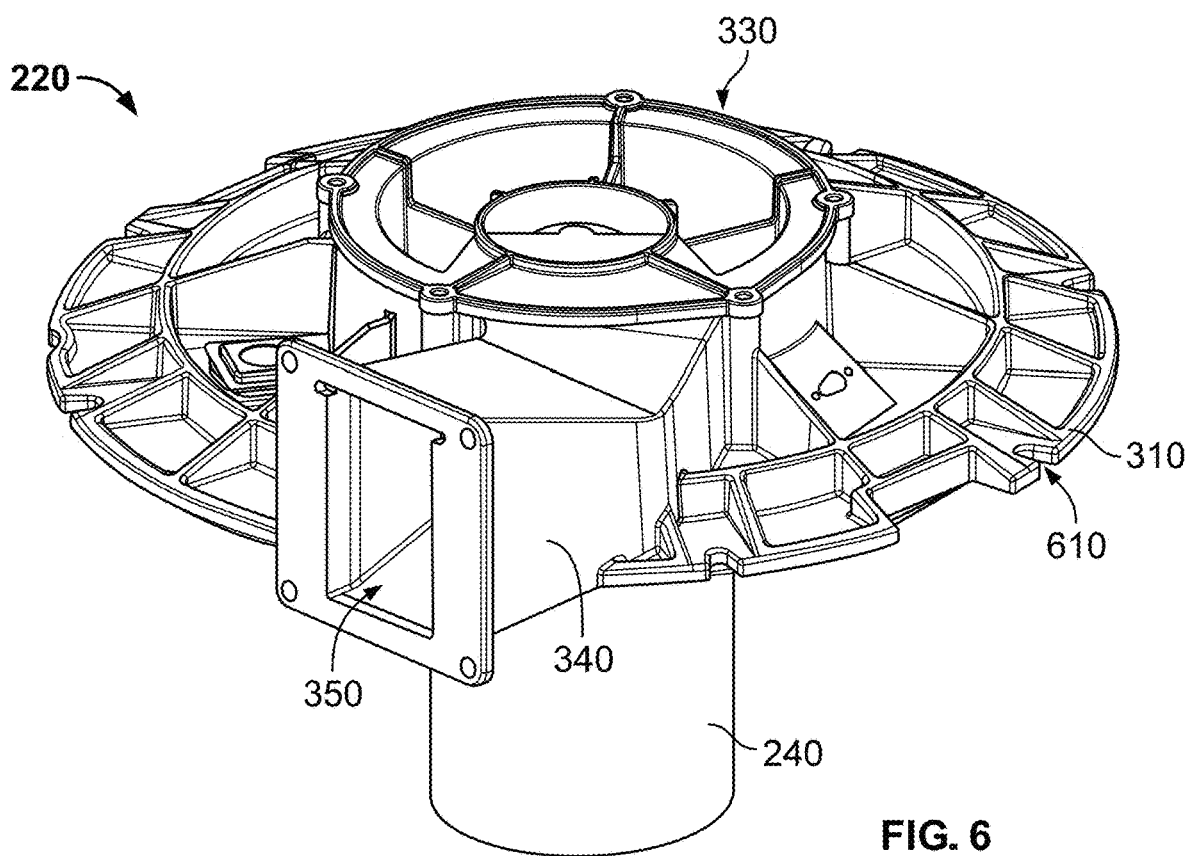
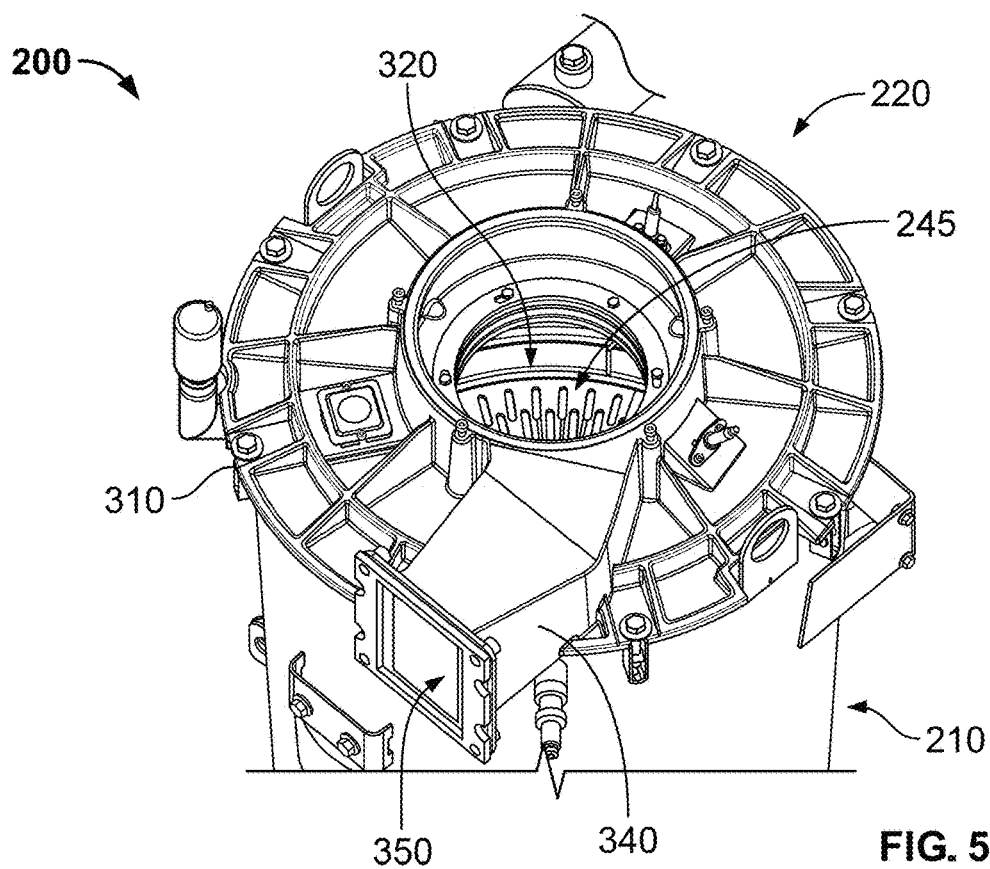
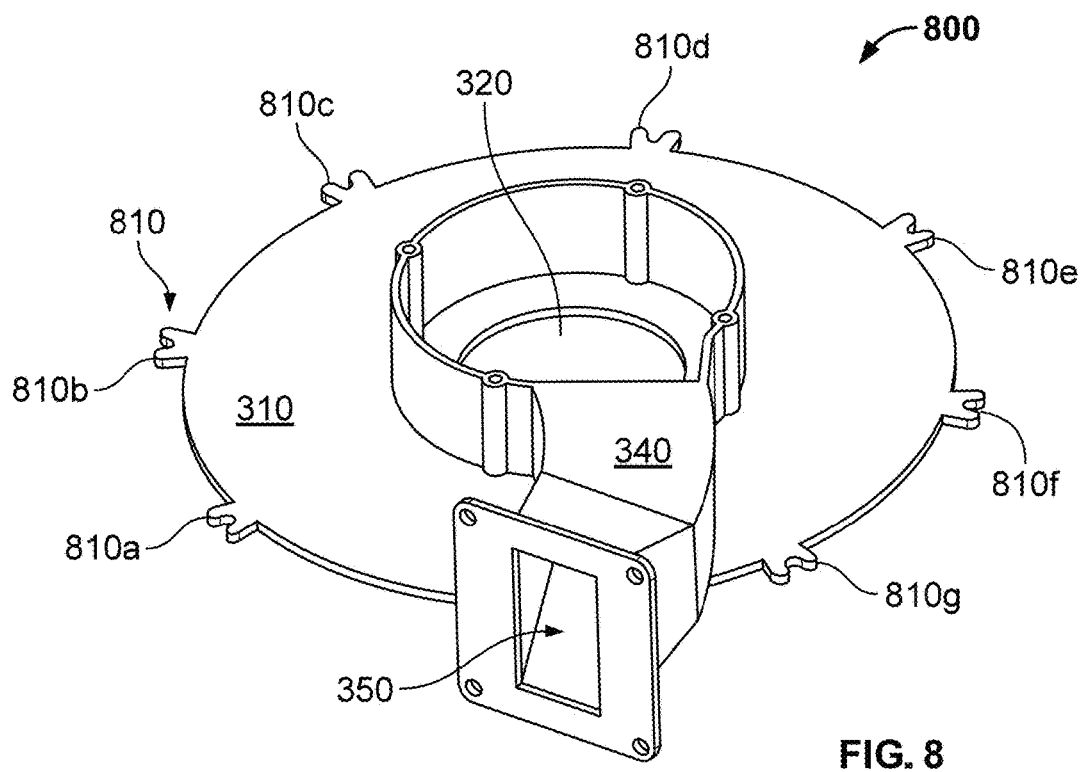
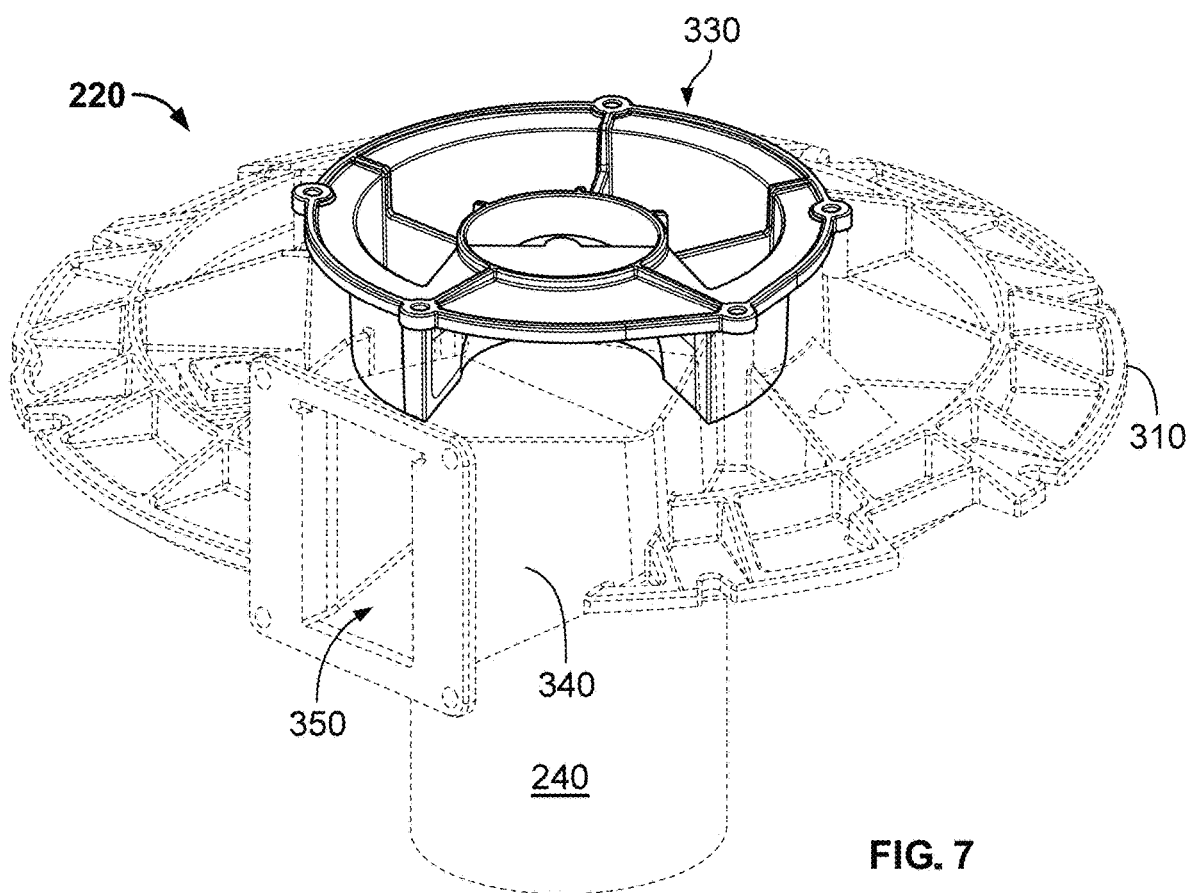
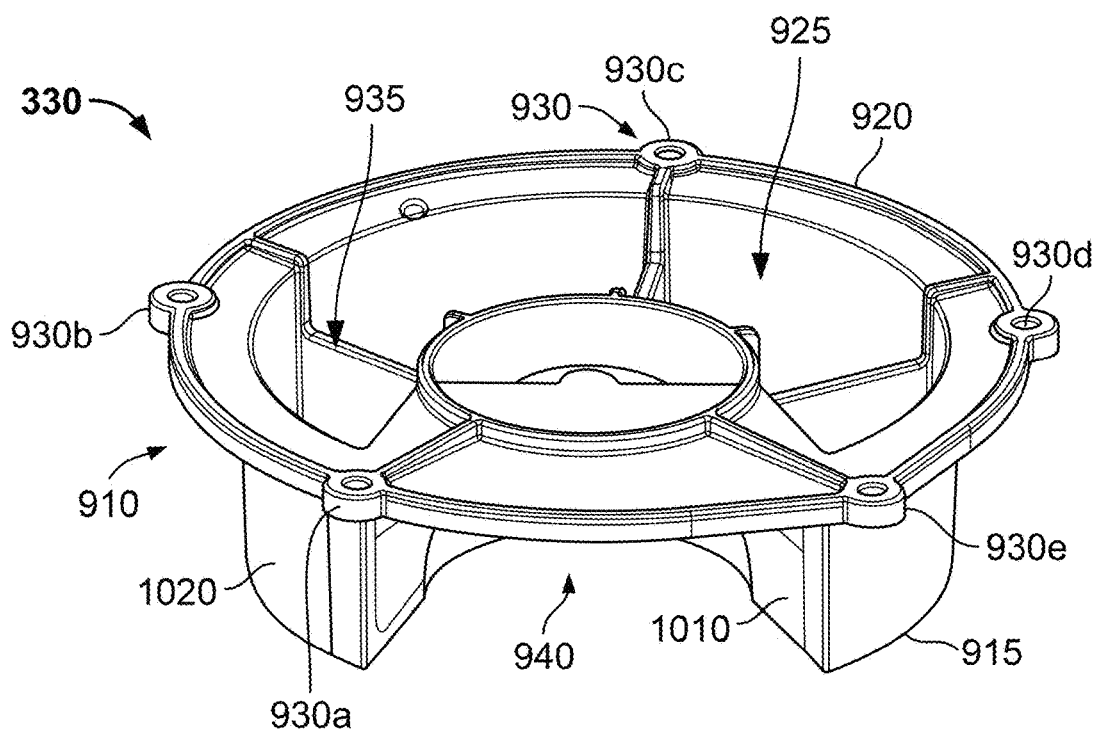
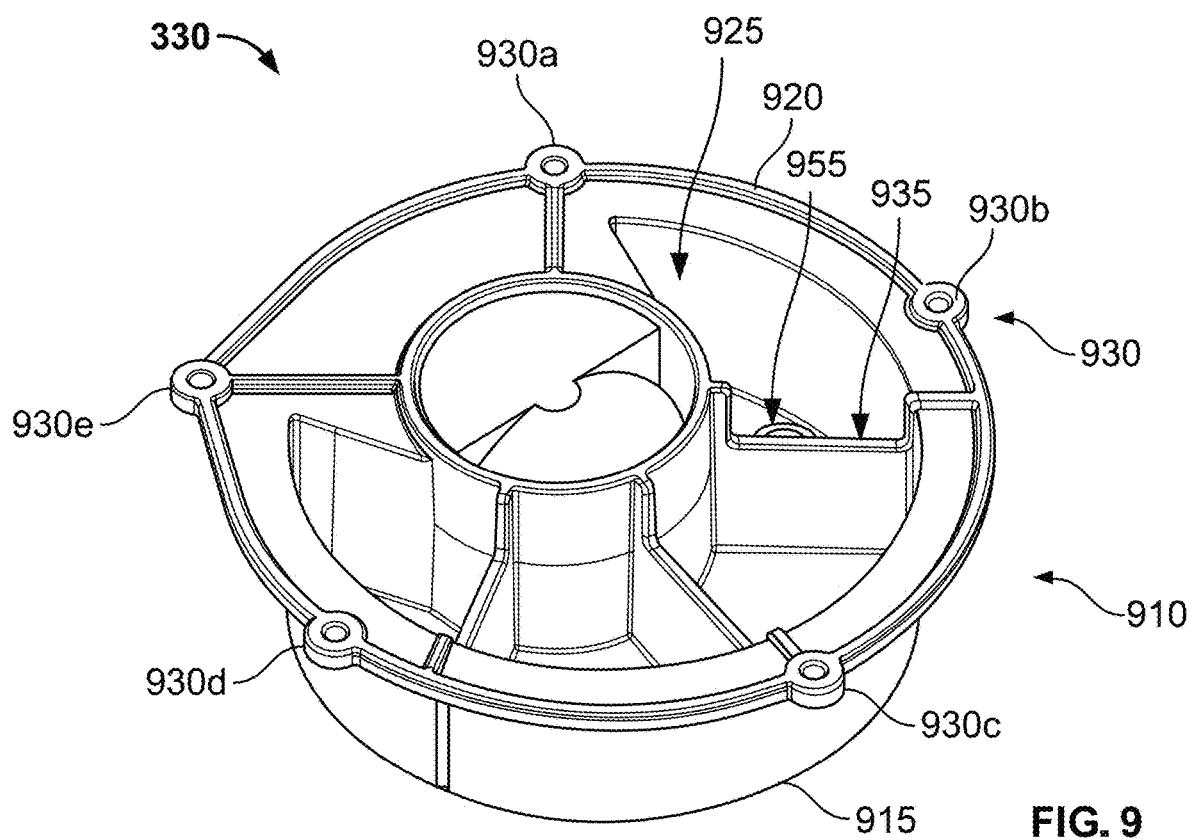


FIG. 4







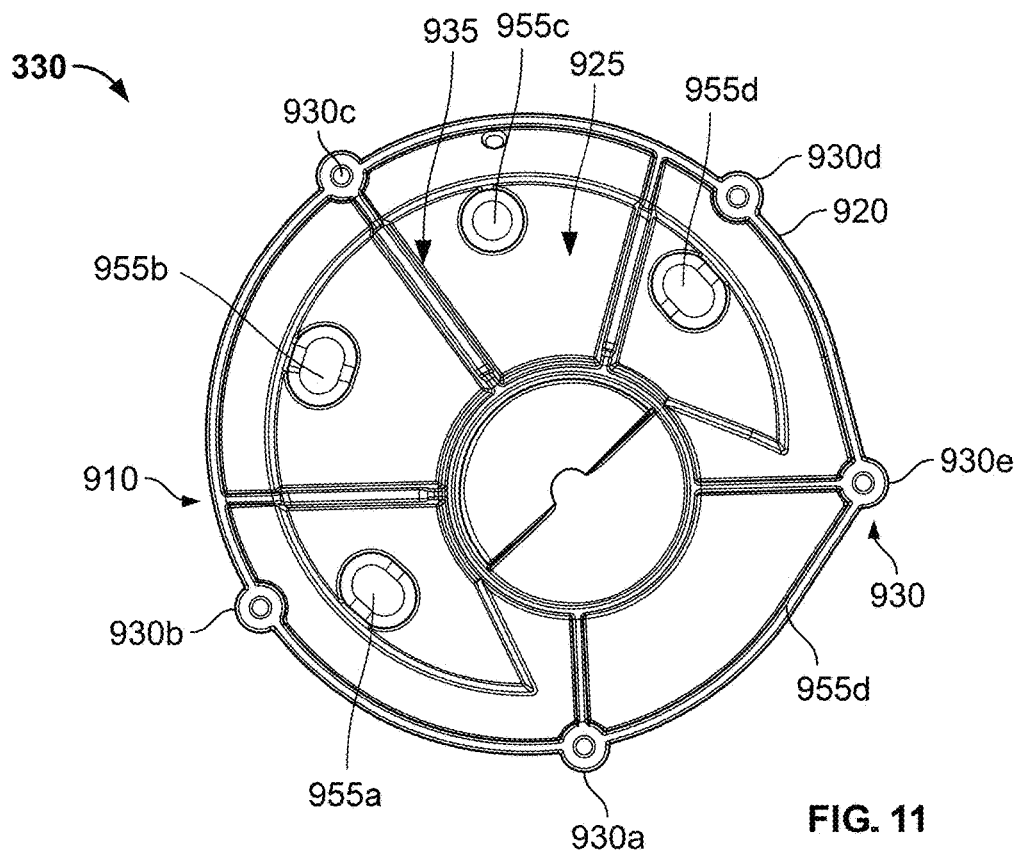


FIG. 11

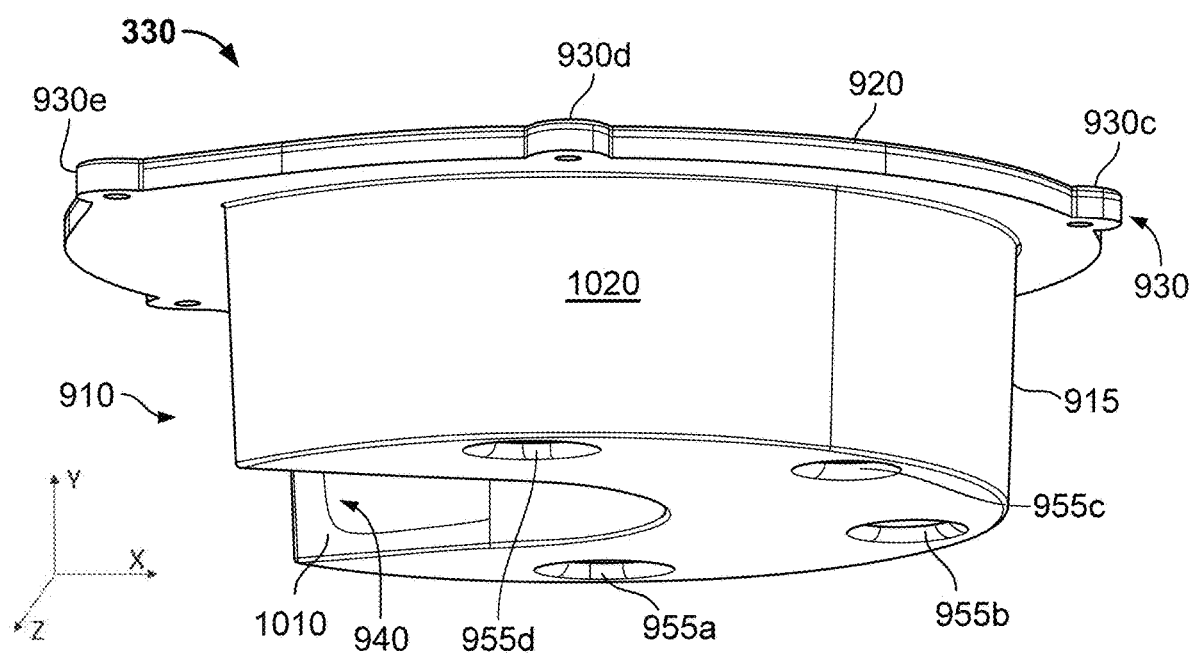
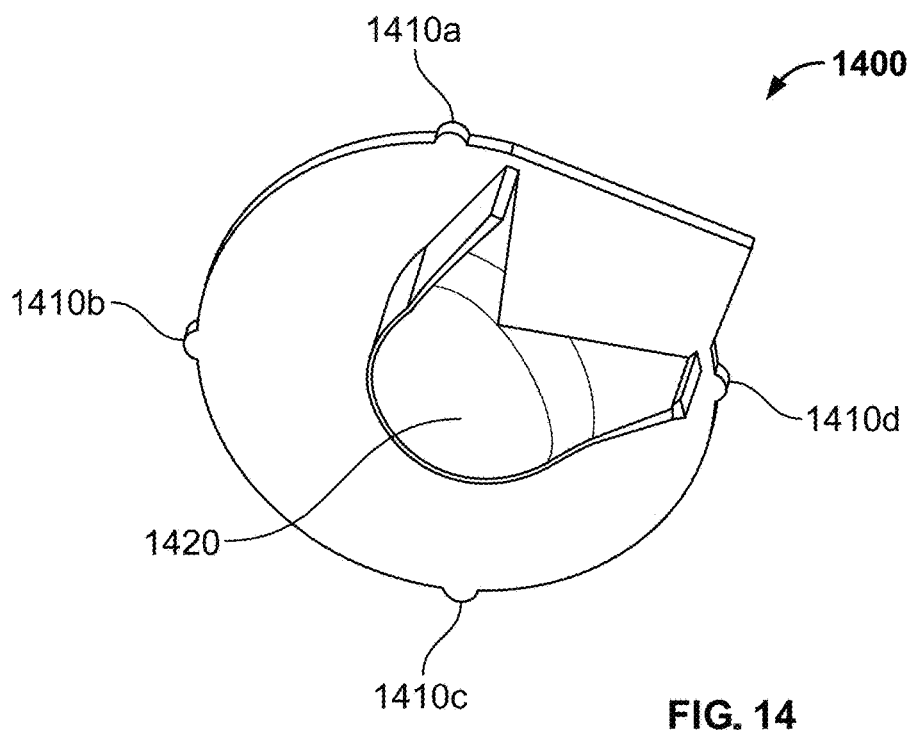
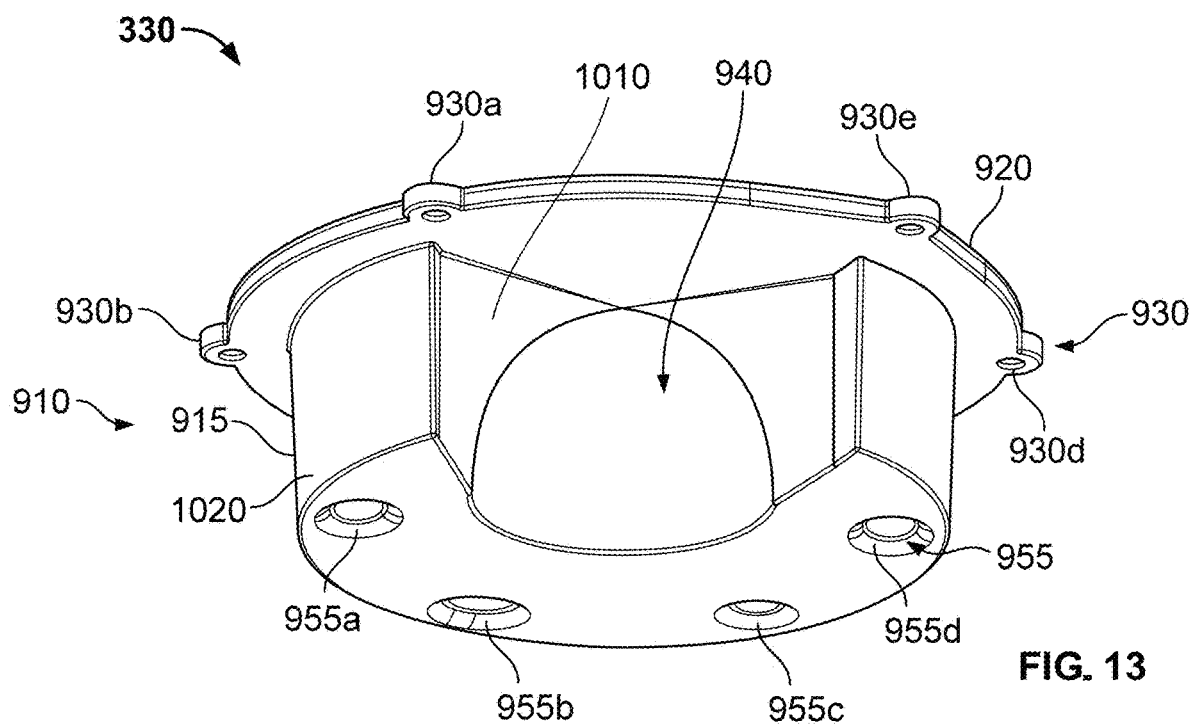


FIG. 12



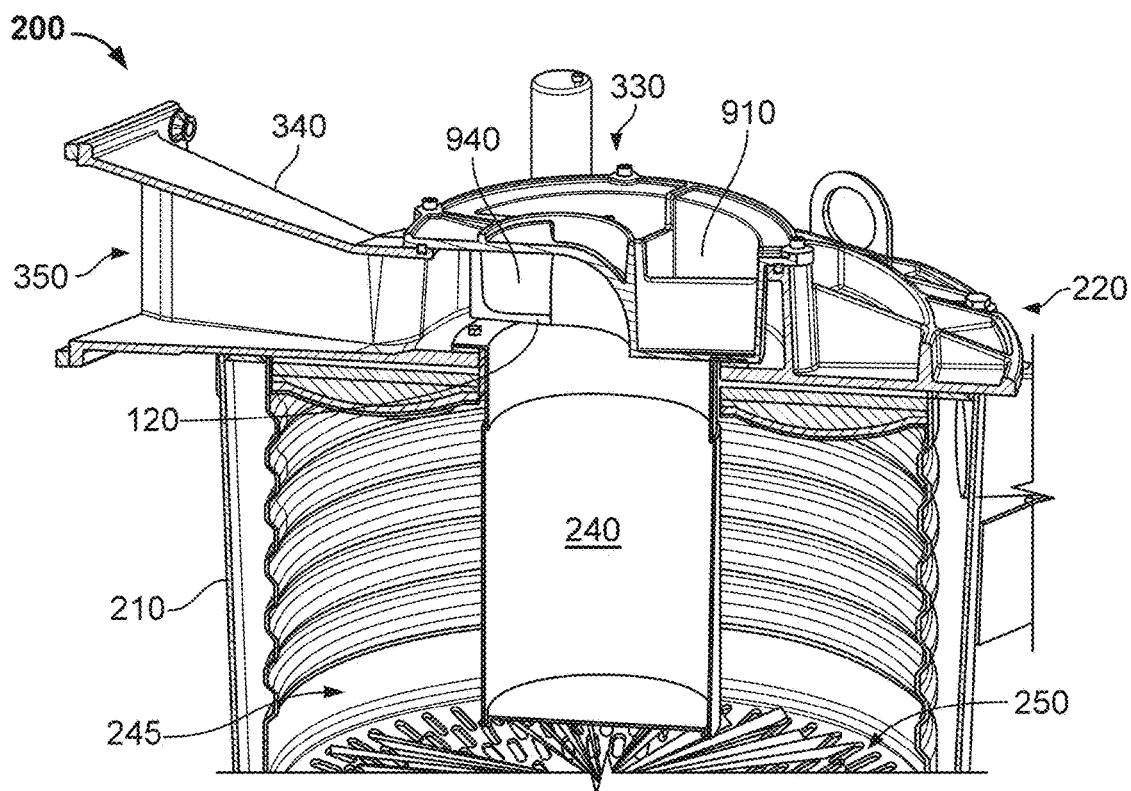


FIG. 15

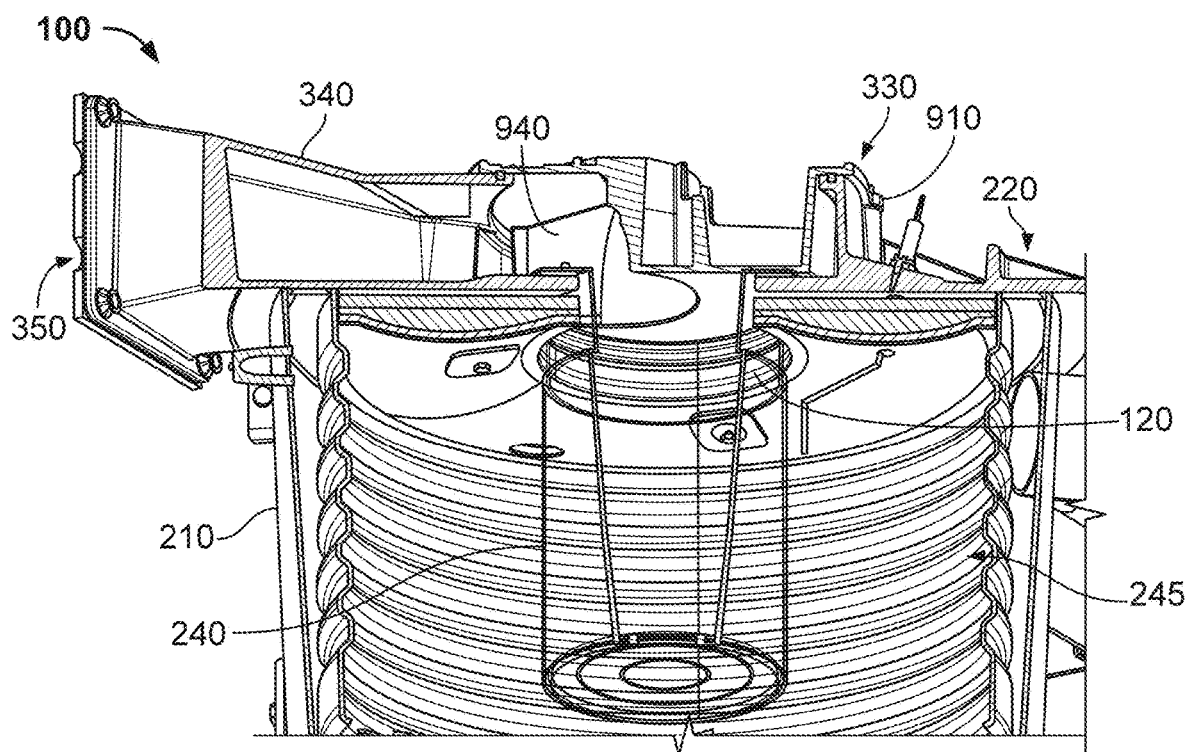
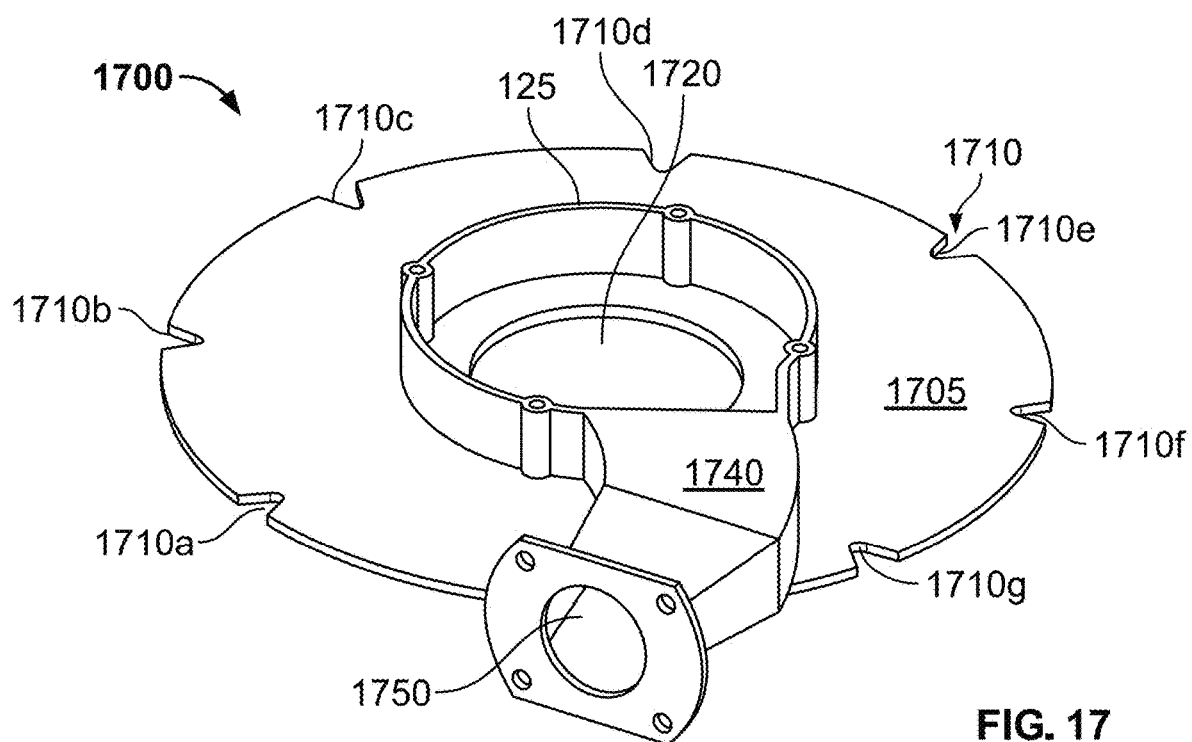
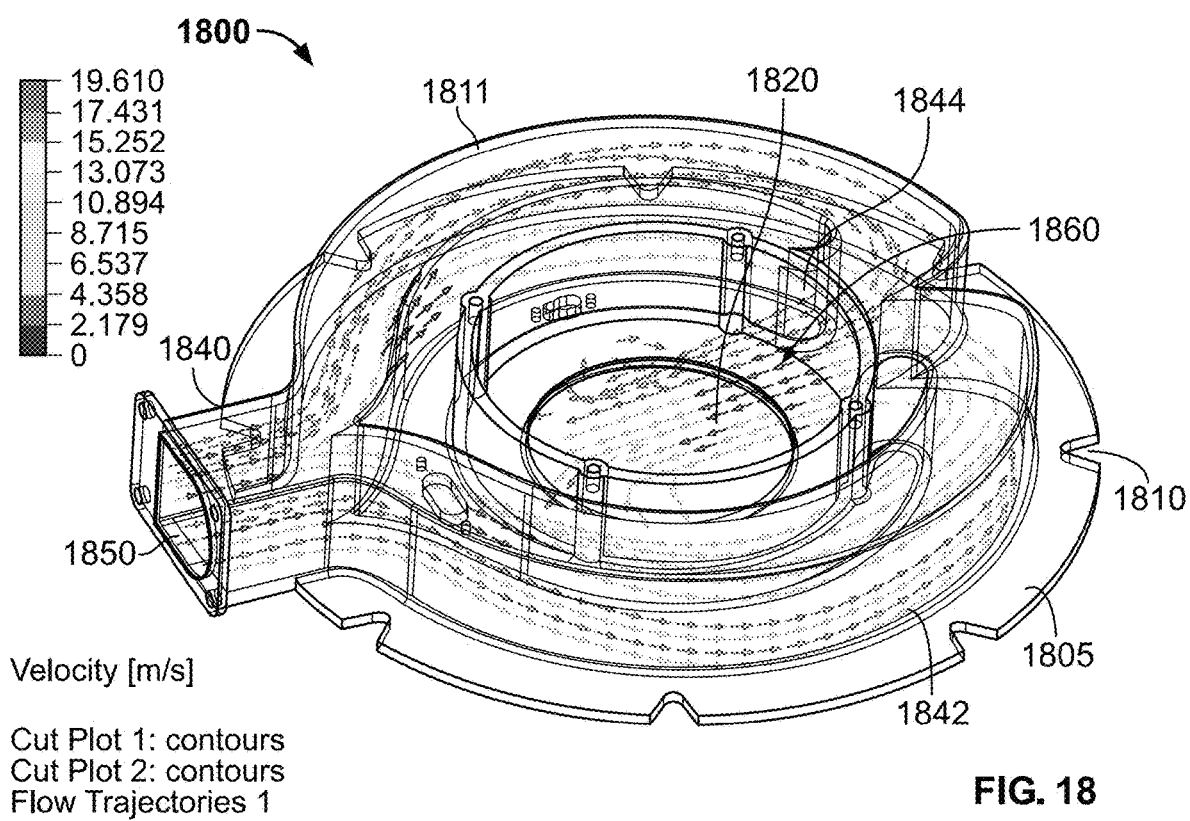


FIG. 16





BURNER ACCESS HATCH

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 63/483,371, filed Feb. 6, 2023, entitled BURNER ACCESS HATCH, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] This disclosure generally relates to a cover plate hatch for a burner. More specifically, the disclosure relates to a cover plate hatch with an air baffle for evenly distributing air into the burner and reducing combustion harmonics in the burner.

BACKGROUND

[0003] Heat transfer systems can be used in industrial, commercial, and residential settings to provide heating. Some common heat transfer systems can include a furnace system. Furnace systems can provide heat by using a burner in a combustion chamber to ignite a fuel source, such as a gas and air mixture. A cover plate, sometimes referred to as a burner access hatch, can be designed to direct the fuel source into the combustion chamber. The heat generated in the combustion chamber can be transferred to a heat exchanger, which, in turn, can provide heating to air and/or water.

[0004] However, some conventional burner access hatches may not evenly distribute the fuel source into the combustion chamber. Uneven fuel distribution can result in incomplete combustion of the fuel source, leading to a potential leak. Further, uneven fuel distribution can reduce the furnace system's efficiency because an unstable flame can create hotspots and cold spots. Hotspots can cause damage to the furnace system and reduce the furnace system's reliability. Additionally, some conventional furnaces with conventional burner access hatches can produce undesirable noise due to excess space at the top of the combustion chamber above the burner. The excess space can cause noise due to harmonic effects.

[0005] Therefore, there is a need for a heat transfer system, including a burner access hatch designed to distribute a fuel source evenly into a combustion chamber and reduce noise-producing harmonic effects in the furnace system.

SUMMARY

[0006] In one instance, a hatch lid for use with a furnace system is provided. The hatch lid has a body having an upper portion, and a lower portion extending outwardly from the upper portion. The body forms a baffle area designed to direct a fluid fuel source into the furnace system.

[0007] In some instances, the hatch lid is provided in the form of at least one of aluminum, steel, stainless steel, or combinations thereof.

[0008] In additional instances, the upper portion is provided in the form of an approximately circular shape, and further wherein the upper portion has a first diameter, and the lower portion has a second diameter that is less than the first diameter.

[0009] In further instances, the body includes one or more indentations designed to reduce a volume of the lower

portion. The body includes one or more support structures separating the one or more indentations to provide structural support for the body.

[0010] In some instances, the baffle area includes at least one curved surface.

[0011] In yet another instance, at least a portion of the upper portion extends over the baffle area.

[0012] In one instance, a cover plate assembly for use with a furnace system is provided. The cover plate assembly includes a plate, a central opening formed within the plate, a hatch lid positioned at least partially within the central opening, including a body with a baffle area, and an inlet structure designed to direct a fluid fuel source towards the central opening. The baffle area is positioned towards the inlet structure forming a fluid pathway between the inlet structure and the baffle area.

[0013] In some instances, the plate has an approximately circular shape and the central opening is formed in approximately a center of the plate. The central opening has an approximately circular shape.

[0014] In further instances, the inlet structure includes an inlet opening having an approximately rectangular shape or an approximately circular shape, and the inlet structure has an approximately rectangular shape.

[0015] In another instance, the body of the hatch lid includes an upper portion including a plurality of connection points designed to connect the upper portion to the plate.

[0016] In one instance, a furnace system for generating heat is provided. The furnace system includes a housing including a combustion chamber positioned within an internal chamber designed to combust a fuel source, and a cover plate assembly coupled to the housing. The cover plate assembly includes a central opening positioned in approximately a center of the cover plate assembly, a hatch lid positioned within the central opening, including a body with a baffle area, and an inlet structure designed to direct a fluid fuel source towards the central opening and into the combustion chamber.

[0017] In some instances, at least a portion of the hatch lid is designed to extend into the internal chamber and wherein the hatch lid is designed to reduce an air volume between the hatch lid and the combustion chamber.

[0018] In a further instance, the hatch lid is removable.

[0019] In another instance, the hatch lid includes a lower portion including a plurality of connection points designed to connect the hatch lid to the combustion chamber.

[0020] In yet another instance, the fuel source is a mixture of gas and air.

[0021] In another instance, the heat exchanger is designed to utilize heat generated from the fuel source.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Examples are described with reference to the following drawing figures. The same numbers are used throughout the figures to reference features and components.

[0023] FIG. 1 is a top isometric view of a cover plate assembly without a hatch lid illustrating a fluid flow pattern of a fuel source through a fuel source inlet;

[0024] FIG. 2A is a side isometric view of a furnace system illustrating a fluid flow pattern of a fuel source through the furnace system including a cover plate assembly with a hatch lid;

[0025] FIG. 2B is a front elevational view of a schematic of an internal chamber of a furnace system illustrating various flow regions within the internal chamber; and

[0026] FIG. 2C is a back elevational view of a schematic of an internal chamber of a furnace system illustrating various flow regions within the internal chamber; and

[0027] FIG. 3 is a partial exploded top isometric view of the top portion of the furnace system of FIG. 2A;

[0028] FIG. 4 is an exploded top isometric view of FIG. 3;

[0029] FIG. 5 is a partial top isometric view of the furnace system of FIG. 2A with a hatch lid removed;

[0030] FIG. 6 is a top isometric view of a burner access hatch plate assembly of the furnace system of FIG. 2A;

[0031] FIG. 7 is a top isometric view of the burner access hatch plate assembly of FIG. 6 with some portions rendered transparent (e.g., in broken lines) for clarity;

[0032] FIG. 8 is a top isometric view of a cover plate assembly for use with the furnace system, such as the furnace system of FIG. 2A;

[0033] FIG. 9 is a top isometric view of the hatch lid of FIGS. 2A and 3-7;

[0034] FIG. 10 is a front isometric view of the hatch lid of FIG. 9;

[0035] FIG. 11 is a top elevational view of the hatch lid of FIG. 9;

[0036] FIG. 12 is a side elevational view of the hatch lid of FIG. 9;

[0037] FIG. 13 is a bottom isometric view of the hatch lid of FIG. 9;

[0038] FIG. 14 is a bottom elevational view of a hatch lid according to another embodiment;

[0039] FIG. 15 is a partial cross-sectional side view of a top portion of the furnace system of FIG. 2A;

[0040] FIG. 16 is a partial cross-sectional side view of FIG. 15 with some portions rendered transparent for clarity;

[0041] FIG. 17 is a top isometric view of a plate having a rounded fluid entryway for use with the furnace system disclosed herein; and

[0042] FIG. 18 is a top isometric view of a cover plate assembly with a hatch lid illustrating a fluid flow pattern of a fuel source through a fuel source inlet.

DETAILED DESCRIPTION

[0043] Before any 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 arrangement of components set forth in the following description or illustrated in the following drawings. The system is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including,” “comprising,” or “having” and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof, as well as additional items. Unless specified or limited otherwise, the terms “mounted,” “connected,” “supported,” “controlled,” “coupled,” and “communicated” and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, controls, and couplings. Further, “connected” and “coupled” are not restricted to physical or mechanical connections or cou-

plings and can also include electrically and communicatively coupled configurations in addition to other forms of connections or couplings.

[0044] The following discussion is presented to enable a person skilled in the art to make and use embodiments of the system. Various modifications to the illustrated embodiments will be readily apparent to those skilled in the art, and the generic principles herein can be applied to other embodiments and applications without departing from embodiments of the system. Thus, embodiments of the invention are not intended to be limited to embodiments shown but are to be accorded the widest scope consistent with the principles and features disclosed herein. The following detailed description is to be read with reference to the figures, in which like elements in different figures have like reference numerals. The figures, which are not necessarily to scale, depict selected embodiments and are not intended to limit the scope of embodiments of the system. Skilled artisans will recognize the examples provided herein have many useful alternatives and fall within the scope of embodiments of the invention.

[0045] Additionally, while the following discussion may describe features associated with specific devices, it is understood that additional devices and/or features can be used with the described systems and methods and that the discussed devices and features are used to provide examples of possible embodiments without being limited.

[0046] Referring first to FIG. 1, a fuel gas flow pattern through a cover plate assembly 100 is shown. The cover plate assembly 100 includes a plate 110, a central opening 120, and an inlet structure 130. As can be seen, the cover plate assembly 100 does not include a cover plate hatch (or hatch lid), including an air baffle. The cover plate assembly 100 can be used with a conventional furnace system, as described herein.

[0047] The cover plate assembly 100 can include a plurality of notches 115 designed to help fasten the cover plate assembly 100 to a furnace assembly. For instance, the plurality of notches 115 can be designed to be used with a clamping system included with the furnace system. The plurality of notches 115 can be positioned around the circumference of the plate 110. As shown, in one instance, the plate 110 includes seven notches 115a-115g. It is to be understood that the plate 110 can include more or fewer notches 115. Further, each of the plurality of notches 115 is shown as having an approximately triangular shape. However, it is to be further understood that the plurality of notches 115 can be provided in any shape.

[0048] The central opening 120 can be designed to permit a fuel source to flow into a combustion chamber of a furnace system. The central opening 120 can be positioned in the center of the cover plate assembly 100. The inlet structure 130 can be designed to direct the fuel source into the central opening 120. As shown in FIG. 1, a flow pattern 140 of the fuel source is not uniform through the inlet structure 130 and into and/or through the central opening 120. The uneven flow pattern 140 of the fuel source can be caused by the shape of the inlet structure 130 and/or other components that direct the flow of the fuel source. As illustrated, the inlet structure 130 can include an approximately semi-circular pathway 150 (e.g., a flat wall and a curved wall) and an elbow 160. As the fuel source flows from the pathway 150 into the elbow 160, the fuel source flow pattern 140 can become uneven. The shape of the inlet structure 130 can

make it difficult to control a pressure drop of the fuel source when the fuel source enters the furnace system (e.g., flows into and/or through the central opening 120). In turn, the distribution of the fuel source into a combustion chamber can also be uneven.

[0049] An uneven distribution of the fuel source can reduce a furnace system's reliability, safety, and efficiency and produce noise due to the harmonic effects of the uneven flow. Accordingly, the following systems disclosed below illustrate various cover plate assemblies designed to distribute a fuel source evenly into a combustion chamber and reduce noise-producing harmonic effects in the furnace system.

[0050] It can be beneficial to have a controlled pressure drop as the fuel source enters the combustion chamber of a furnace system because it can improve the mixing of the fuel source, help stabilize the burner flame, increase temperature control, reduce flashback, and improve efficiency.

[0051] Turning to FIG. 2A, a furnace system 200, including a cover plate assembly 220 designed to distribute a fuel source evenly and reduce harmonic effects, is shown. The furnace system 200 can include a housing 210, the cover plate assembly 220, and an outlet assembly 230. As discussed in more detail below, the cover plate assembly 220 can be designed to direct a fuel source into the housing 210. The housing 210 can include a combustion chamber 240, positioned within an internal chamber 245, designed to ignite the fuel source, and a heat exchanger 250, designed to utilize the heat generated by the combusted fuel source.

[0052] FIGS. 2B and 2C illustrate a schematic of the internal chamber 245 of the furnace system 200. The internal chamber 245 can be sectioned into four quadrants for reference when analyzing a flow of a fuel source (e.g., a combination of air and gas) through the internal chamber 245. Further, each of those quadrants can be sectioned into a front and a back quadrant. FIG. 2B illustrates a front view (e.g., an "a-side") of the internal chamber 245, showing four front quadrants 1a, 2a, 3a, and 4a, and FIG. 2C illustrates a back view (e.g., a "b-side") of the internal chamber 245, showing four back quadrants 1b, 2b, 3b, and 4b that correspond to 1a, 2a, 3a, and 4a, respectively. The front quadrants 1a-4a and the back quadrants 1b-4b can collectively be referred to as the quadrants 1-4. As discussed in more detail below, the quadrants 1-4 can be used to determine an approximate fuel flow pattern through the internal chamber 245.

[0053] Turning to FIGS. 3-7, various views of an upper portion of the furnace system 200 of FIG. 2A is shown. Specifically, FIGS. 3-7 illustrate detailed views of the cover plate assembly 220 and its associated components. The cover plate assembly 220 can include a plate 310, a central opening 320, a removable hatch lid 330 designed to fit within the central opening 320, an inlet structure 340, and an inlet opening 350 designed to direct a fuel source into the combustion chamber 240. The inlet opening 350, the inlet structure 340, and the central opening 320 can form a fluid pathway.

[0054] The plate 310 can include a plurality of notches 610 (e.g., evenly spaced and positioned circumferentially around an outer edge of the plate 310 and best shown in FIG. 6) designed to help secure the cover plate assembly 220 to the housing 210 of the furnace system 200.

[0055] As shown in FIGS. 3-7, the inlet structure 340 can be provided in an approximately rectangular shape. In other

instances, the inlet structure 340 can be provided in the form of any shape. For instance, the inlet structure 340 can have an approximately semi-circular shape, as depicted by the inlet structure 130 of FIG. 1. In some instances, the inlet opening 350 can be shaped similarly to the inlet structure 340. For example, in instances where the inlet structure 340 is approximately rectangular, the inlet opening 350 can also be approximately rectangular.

[0056] As shown in FIGS. 3-7, the central opening 320 can be centered within the plate 310 and may have any suitable shape (e.g., round) or size. In one instance, the central opening 320 has a size that is substantially the same as the hatch lid 330, so that the central opening 320 is designed to receive at least a portion of the hatch lid 330 therein. In other instances, the central opening 320 may be a size that is different than that of the hatch lid 330. For example, the central opening 320 may include a flange designed to engage at least a portion of the hatch lid 330.

[0057] In some instances, and as shown in FIGS. 3-7, the hatch lid 330 is removable with respect to the plate 310. Thus, the internal components of the furnace system 200, like the combustion chamber 240, can be accessed through the central opening 320 when the hatch lid 330 is removed. A benefit of having a removable hatch lid 330 is that the internal components of the furnace system 200 can be accessed without having to remove the entire cover plate assembly 220. For instance, maintenance can be performed on the furnace system 200 without disconnecting gas and/or water lines. The removable hatch lid 330 can reduce time and effort when inspecting, repairing, or cleaning some of the internal components of the furnace system 200. In other instances, the hatch lid 330 is not removable from the plate 310.

[0058] Further, as best shown in FIGS. 4 and 5, the combustion chamber 240 can be connected to the hatch lid 330 and extend into the internal chamber 245. Thus, in some instances, the combustion chamber 240 and/or a fuel source distributor (not shown) can be removable so that when the hatch lid 330 is removed, the internal components of the furnace system 200 can be accessed via the central opening 320.

[0059] Turning to FIG. 8, a cover plate assembly 800 is shown. The cover plate assembly 800 is similar to the cover plate assembly 220 of FIGS. 2-7. However, instead of a plurality of notches 610, as shown in FIG. 6, the cover plate assembly 800 can include a plurality of tabs 810 designed to help secure the cover plate assembly 800 to a furnace housing, such as the housing 210. As shown, the cover plate assembly 800 can include seven tabs 810a-810g. However, it is to be understood that the cover plate assembly 800 can include more or fewer tabs 810. In one instance, the plurality of tabs 810 can be evenly spaced and positioned circumferentially around an outer edge of the plate 310.

[0060] Referring now to FIGS. 9-13, various views of the hatch lid 330 are shown. The hatch lid 330 can include a body 910 having a center, and the hatch lid 330 can include a lower hatch lid portion 915 and an upper hatch lid portion 920. In one instance, the lower hatch lid portion 915 extends outwardly from the upper hatch lid portion 920. In some instances, the body 910 can be made of cast aluminum, steel, stainless steel, a combination thereof, or other suitable materials designed to withstand the heat of the furnace system 200. In some instances, the body 910 is a unitary structure (e.g., formed as a single structure). For example,

the body 910 can be formed from an injection mold or cast. In other instances, the lower hatch lid portion 915 can be coupled to the upper hatch lid portion 920 to form the body 910. Additionally, in one instance, the upper hatch lid portion 920 can have a first thickness, measured along a y-axis (as best shown in FIG. 12), and the lower hatch lid portion 915 can have a second thickness, also measured along the y-axis. In one instance, the second thickness is greater than the first thickness. In other instances, the upper hatch lid portion 920 and the lower hatch lid portion 915 may have substantially the same thickness.

[0061] In one instance, a diameter of the upper hatch lid portion 920 can be greater than a diameter of the lower hatch lid portion 915 so that the upper hatch lid portion 920 can engage at least a portion of a plate (e.g., the plate 310 of FIGS. 3-8), and the lower hatch lid portion 915 can engage at least a portion of the opening 320 and/or the combustion chamber 240.

[0062] The upper hatch lid portion 920 can include a plurality of connection points 930. The plurality of connection points 930 can be designed to serve as connection points for coupling the hatch lid 330 to the cover plate assembly 220 of FIGS. 2-7 and/or the cover plate assembly 800 of FIG. 8. As shown, the hatch lid 330 can include five connection points 930a-930d. In one instance, the connection points 930 of the hatch lid 330 are substantially evenly spaced and positioned circumferentially around an outer edge of the hatch lid 330. However, it is to be understood that the hatch lid 330 can include more or fewer connection points 930. Further, in some instances, the connection points 930 can be placed at varying distances from each other (e.g., the connection points 930 are not substantially evenly spaced). Each connection point can be designed to receive at least one coupling mechanism therein to couple the hatch lid 330 to at least a portion of the plate 310 and/or the furnace system 200. For example, a coupling mechanism is a screw designed to withstand the extreme temperatures of the furnace system 200.

[0063] As shown best in FIGS. 9, 10, 12, and 13, similar to the upper hatch lid portion 920, the lower hatch lid portion 915 can include a plurality of connection points 955. The plurality of connection points 955 can be designed to serve as connection points for coupling the hatch lid 330 to one or more internal components of the furnace system 200. For instance, referring back to FIG. 4, it can be seen that the plurality of connection points 955 can be designed to connect the hatch lid 330 to the combustion chamber 240.

[0064] As shown best in FIGS. 11-13, the hatch lid 330 can include four connection points 955a-955d. In one instance, the connection points 955 of the hatch lid 330 are substantially evenly spaced and positioned circumferentially around an outer edge of the lower hatch lid portion 915. However, it is to be understood that the hatch lid 330 can include more or fewer connection points 955 and the connection points 955 may not be substantially evenly spaced. Each connection point is designed to receive at least one coupling mechanism therein to couple the hatch lid 330 to at least a portion of an internal component of the furnace system 200. For example, a coupling mechanism is a screw designed to withstand the extreme temperatures of the furnace system 200.

[0065] In some instances, the body 910 (e.g., the lower hatch lid portion 915) can include indentations 925. The indentations 925 can reduce the amount of material needed

to construct the hatch lid 330. Thus, the indentations 925 can reduce the cost to produce the hatch lid 330. Further, the indentations 925 can help increase the heat transfer capacity of the hatch lid 330 because it can be easier for heat to dissipate from the hatch lid 330 when the material is thinner. Additionally, in some instances, the body 910 can include support structures 935 (e.g., that can extend outwardly from the center of the body 910) within or between the indentations 925. The support structures 935 can be designed to reinforce the structural integrity of the hatch lid 330. Moreover, the support structures 935 can also provide additional surfaces to aid in heat transfer.

[0066] As illustrated in FIGS. 10, 12, and 13, the lower hatch lid portion 915 can include an inner surface 1010 and an opposing outer surface 1020. The lower hatch lid portion 915 can have a cavity (e.g., formed at least in part by the inner surface 1010) designed to act as a baffle. Accordingly, the cavity can be referred to as a baffle area 940. The baffle area 940 can act as a fluid baffle or an air baffle designed to direct the flow of the fuel source into the combustion chamber 240 in a uniform flow pattern, and, in turn, the baffle area 940 can reduce hotspots in the furnace system. Additionally, the baffle area 940 can reduce harmonic effects (i.e., noise) by promoting an even distribution of the fuel source.

[0067] In some instances, at least a portion of the inner surface 1010 of the lower hatch lid portion 915 that at least partially defines the baffle area 940 can be curved or have an approximately "U" shape. The curved shape of the baffle area 940 can help create an even flow pattern when directing the fuel source into the furnace system 200. In other instances, the baffle area 940 can have any suitable shape.

[0068] In one instance, at least a portion of the upper hatch lid portion 920 can extend over the baffle area 940 such that when the hatch lid 330 is installed in a cover plate assembly (e.g., the cover plate assembly 220 of FIGS. 2-7 and/or the cover plate assembly 800 of FIG. 8), there is no gap at the top of the cover plate assembly that would permit the fuel source to flow out of the cover plate assembly.

[0069] Further, in some instances, the baffle area 940 can reduce the volume of the body 910 by about 10% to about 60%. In other instances, the baffle area 940 can reduce the volume of the body 910 by about 20% to about 50%. In another instance, the baffle area 940 can reduce the volume of the body 910 by about 30% to about 40%. Thus, the shape and size of the baffle area 940 can be customized to the furnace system 200.

[0070] Turning to FIG. 14, a hatch lid 1400 is illustrated. The hatch lid 1400 can be similar to the hatch lid 330 of FIGS. 3-13. Here, the hatch lid 1400 can include four connection points 1410a-1410d and a recessed portion 1420. The recessed portion 1420 can be shaped differently than the baffle area 940. For example, the recessed portion 1420 can have a triangular shape or have an approximately "V" shape. However, the recessed portion 1420 can perform similar functions to the baffle area 940 of FIGS. 9-13 (e.g., reduce harmonic effects and promote an even distribution of a fuel source).

[0071] Therefore, the hatch lid 330 and/or the hatch lid 1400 can improve the life of a furnace system by reducing failures and improving efficiency and safety. Accordingly, FIGS. 15 and 16 illustrate how a recessed portion, such as the baffle area 940 of FIGS. 9-13, can direct the flow of the fuel source through the furnace system 200.

[0072] Referring to FIGS. 15 and 16, cut-away (e.g., partial cross-sectional) views of an upper portion of the furnace system 200 are illustrated. As shown, when installed, the baffle area 940 can be oriented to face an inlet flow path (e.g., the inlet opening 350 and the inlet structure 340) of the fuel source. In one instance, the baffle area 940 can be aligned with and in fluid communication with at least one of the inlet structure 340 and/or the inlet opening 350. Thus, the baffle area 940 can direct the flow of the fuel source down into the combustion chamber 240 or the furnace system 200 to improve burner ignition, reduce hotspots, and reduce flashbacks during the operation of the furnace system 200. As such, the furnace system 200 can have improved transient responses and be more robust in various environmental conditions compared to conventional burner assemblies.

[0073] Further, the lower hatch lid portion 915 of the hatch lid 330 can reduce the headspace within the internal chamber 245 (e.g., because the lower hatch lid portion 915 can act as a recess within the internal chamber 245). By decreasing the headspace or (e.g., air) volume above the burner or the combustion chamber 240, the fluid and/or air volume in the furnace system 200 can be reduced, thereby reducing harmonic effects (e.g., combustion effects).

[0074] Moreover, the cover plate assembly 220 and the hatch lid 330 can be designed to reduce or streamline a top profile of the furnace system 200. As shown best in FIG. 16, a top or upper plane (not shown) that aligns horizontally with the hatch lid 330 can be approximately even with or below a top or upper plane (not shown) of the inlet opening 350 and/or the inlet structure 340. Streamlining the top profile of the furnace system 200 decreases the height of the furnace system 200 and can improve efficiency. Thus, it can be easier for a user to access the furnace system 200 when the furnace system 200 is installed in a small or confined area. Alternatively, a larger furnace system 200 can be designed to fit in the same footprint as a traditional furnace system, not including the cover plate assemblies and/or hatch lids disclosed herein. Accordingly, a method of assembling the furnace system 200 can include connecting the hatch lid 330 and the cover plate assembly 220. As discussed hereinabove, the hatch lid 330 can be connected to the cover plate assembly 220 via the plurality of connection points 930 (see FIGS. 9-13). When installing the hatch lid 330, a user can orient the baffle area 940 such that the baffle area 940 faces or is directed towards (e.g., aligns with) the inlet opening 350 and/or the inlet structure 340 so that a continuous fluid pathway is formed between the inlet opening 350, the inlet structure 340, and/or the baffle area 940.

[0075] The method of assembly can further include connecting the combustion chamber 240 to the hatch lid 330 via the plurality of connectors 950 (see FIGS. 9 and 11-13), such that at least a portion of the lower hatch lid portion 915 may be inserted into and is in fluid communication with the combustion chamber 240.

[0076] The method can also include connecting the cover plate assembly 220 to the housing 210 of the furnace system 200. As discussed above, the cover plate assembly 220 can include a plurality of notches 610 (see FIG. 6) and/or a plurality of tabs 810 (see FIG. 8) designed to help facilitate connecting the cover plate assembly 220 to the housing 210 of the furnace system. In one instance, at least one of the hatch lid 330, the combustion chamber 240, or the plate 310 can be axially (e.g., vertically (along the y-axis shown in

FIG. 12) or horizontally (along the x-axis shown in FIG. 12)) aligned with respect to one another.

[0077] It is to be understood that the order of assembling the components of the furnace system 200 can be performed in any order. For instance, the hatch lid 330 can be connected to the combustion chamber 240 before or after the cover plate assembly 220 has been connected to the housing 210 of the furnace system 200.

[0078] Further, the hatch lid 330 and/or the hatch lid 1400 can be included in other cover plate assembly designs while still improving the efficiency, safety, and reliability of a furnace system. For instance, as shown in FIG. 17, a cover plate assembly 1700 can be used with the hatch lid designs disclosed herein.

[0079] Referring to FIG. 17, the cover plate assembly 1700 is shown. The cover plate assembly 1700 can be similar to the cover plate assembly 220 of FIGS. 2-7 and 15 and 16. For instance, the cover plate assembly 1700 can include a plate 1705, a plurality of notches 1710 (e.g., evenly spaced and positioned circumferentially around an outer edge of the plate 1705), a central opening 1720, an inlet structure 1740, and an inlet opening 1750.

[0080] As shown, the cover plate assembly 1700 can include seven notches 1710a-1710g. However, it is to be understood that the cover plate assembly 1700 can include more or fewer notches 1710. Further, the plurality of notches 1710 are shown as having an approximately triangular shape. However, it is to be further understood that the plurality of notches 1710 can be provided in any shape.

[0081] Moreover, the hatch lid designs disclosed herein can be used with additional cover plate assemblies, such as the cover plate assembly 220 of FIG. 2A. The cover plate assembly 1800 can include a plate 1805, a plurality of notches 1810 designed to help secure the cover plate assembly 220 to a furnace housing, a central opening 1820, and an inlet opening 1850.

[0082] The cover plate assembly 1800 can be similar to the cover plate assembly 220 of FIGS. 2-7, the cover plate assembly 800 of FIG. 8, and/or the cover plate assembly 1700 of FIG. 17. In contrast to the instances described hereinabove, the inlet structure 1840 of the cover plate assembly 1800 can have two fluid pathways. As shown, the inlet structure 1840 can include a first fluid pathway 1841 and a second fluid pathway 1842. The first fluid pathway 1841 and the second fluid pathway 1842 can branch off of the inlet opening 1850, follow the approximate shape of the plate 1805, and converge at an outlet 1844 positioned on a side of the plate 1805 approximately opposite the inlet opening 1850.

[0083] Similar to the other cover plate assemblies disclosed herein, the central opening 1820 can be designed to house or contain a hatch lid (e.g., the hatch lid 330 of FIGS. 3-7 and 9-16 and/or the hatch lid 1400 of FIG. 14). In some instances, a recessed portion of the hatch lid (e.g., the baffle area 940 of the hatch lid 330) can be positioned so that the recessed portion faces the outlet 1844. Accordingly, as the fuel source flows through the outlet 1844 and into the central opening 1820, the recessed portion of the hatch lid can direct the fuel source down into a combustion chamber of a furnace system (e.g., the combustion chamber 240 of FIG. 2A).

[0084] Accordingly, a method of operating a furnace system, including the cover plate assemblies and/or hatch lids disclosed herein, can include determining one or more operating conditions and/or needs of the system and feeding

a fuel source into the furnace system to generate heat. For instance, the method can include determining a heating need for a system to be heated. The system to be heated can include an air volume, such as a volume of air in a room. The operating conditions can include a feed rate of the fuel source, a firing rate of the burner (e.g., a low-fire and a high-fire mode), a time period for operating the furnace system, a setpoint temperature, and/or any other known furnace operating condition.

[0085] Referring back to FIGS. 2B and 2C, a benefit of the furnace systems, such as the furnace system 200, disclosed herein is that a fuel source (e.g., an air and gas mixture) can be evenly distributed through the furnace system during operation. For instance, in a model simulation, a fuel source distribution pattern through the internal chamber 245, as illustrated in FIGS. 2B and 2C, was measured. It was determined that the fuel source was distributed approximately evenly through each of the quadrants 1-4.

[0086] Table 1 below illustrates the fuel source distribution pattern through each of the quadrants 1-4.

TABLE 1

	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4
Front Quadrants (e.g., FIG. 2B showing the a-side including 1a, 2a, 3a, and 4a)	13%	13%	13%	13%
Back Quadrants (e.g., FIG. 2C showing the b-side, including 1b, 2b, 3b, and 4b)	12%	13%	12%	11%

[0087] As shown in Table 1, the fuel source distribution pattern through each of the (e.g., eight, such as 1a, 2a, 3a, 4a, 1b, 2b, 3b, 4b) quadrants (e.g., of the combustion chamber 240) is between about 8% of the total flow to about 15% of the total flow of the fuel source or between about 10% and about 13%. In some instances, a target fuel source distribution pattern can be about 12.5% in each of the front quadrants 1a-4a and each of the back quadrants 1b-4b. Therefore, the furnace systems disclosed herein having substantially even fuel source distribution into the burner can improve safety, efficiency, and reliability compared to conventional furnace systems, improving burner ignition, reducing hotspots, and/or reducing flashbacks during the operation of the furnace system.

[0088] Thus, the systems described herein illustrate the benefits of using a cover plate assembly with a hatch lid (or access hatch) designed to promote even flow distribution of a fuel source into a combustion chamber of a furnace system, including the hatch lid.

[0089] It will be appreciated by those skilled in the art that while the above disclosure has been described above in connection with particular embodiments and examples, the above disclosure is not necessarily so limited and that numerous other embodiments, examples, uses, modifications, and departures from the embodiments, examples, and uses are intended to be encompassed by the claims attached hereto. The entire disclosure of each patent and publication cited herein is incorporated by reference as if each such patent or publication were individually incorporated by reference herein. Various features and advantages of the above disclosure are set forth in the following claims.

1. A hatch lid for use with a furnace system, the hatch lid comprising:

- a body including:
 - an upper portion; and
 - a lower portion extending outwardly from the upper portion, wherein the body forms a baffle area designed to direct a fluid fuel source into the furnace system.

2. The hatch lid of claim 1, wherein the hatch lid is provided in the form of at least one of aluminum, steel, stainless steel, or combinations thereof.

3. The hatch lid of claim 1, wherein the upper portion is provided in the form of an approximately circular shape, and further wherein the upper portion has a first diameter, and the lower portion has a second diameter that is less than the first diameter.

4. The hatch lid of claim 1, wherein the body includes one or more indentations designed to reduce a volume of the lower portion.

5. The hatch lid of claim 4, wherein the body includes one or more support structures separating the one or more indentations to provide structural support for the body.

6. The hatch lid of claim 1, wherein the baffle area includes at least one curved surface.

7. The hatch lid of claim 1, wherein at least a portion of the upper portion extends over the baffle area.

8. A cover plate assembly for use with a furnace system, comprising:

- a plate;
- a central opening formed within the plate;
- a hatch lid positioned at least partially within the central opening, including a body with a baffle area; and
- an inlet structure designed to direct a fluid fuel source towards the central opening,

wherein the baffle area is positioned towards the inlet structure forming a fluid pathway between the inlet structure and the baffle area.

9. The cover plate assembly of claim 8, wherein the plate has an approximately circular shape and the central opening is formed in approximately a center of the plate.

10. The cover plate assembly of claim 8, wherein the central opening has an approximately circular shape.

11. The cover plate assembly of claim 8, wherein the inlet structure includes an inlet opening having an approximately rectangular shape.

12. The cover plate assembly of claim 8, wherein the inlet structure includes an inlet opening having an approximately circular shape.

13. The cover plate assembly of claim 8, wherein the inlet structure has an approximately rectangular shape.

14. The cover plate assembly of claim 8, wherein the body of the hatch lid includes an upper portion including a plurality of connection points designed to connect the upper portion to the plate.

15. A furnace system for generating heat, the furnace system comprising:

- a housing including a combustion chamber positioned within an internal chamber designed to combust a fuel source; and
- a cover plate assembly coupled to the housing, the cover plate assembly including:
 - a central opening positioned in approximately a center of the cover plate assembly;

a hatch lid positioned within the central opening, including a body with a baffle area; and
an inlet structure designed to direct a fluid fuel source towards the central opening and into the combustion chamber.

16. The furnace system of claim **15**, wherein at least a portion of the hatch lid is designed to extend into the internal chamber and wherein the hatch lid is designed to reduce an air volume between the hatch lid and the combustion chamber.

17. The furnace system of claim **15**, wherein the hatch lid is removable.

18. The furnace system of claim **15**, wherein the hatch lid includes a lower portion including a plurality of connection points designed to connect the hatch lid to the combustion chamber.

19. The furnace system of claim **15**, wherein the fuel source is a mixture of gas and air.

20. The furnace system of claim **19**, further including a heat exchanger designed to utilize heat generated from the fuel source.

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