



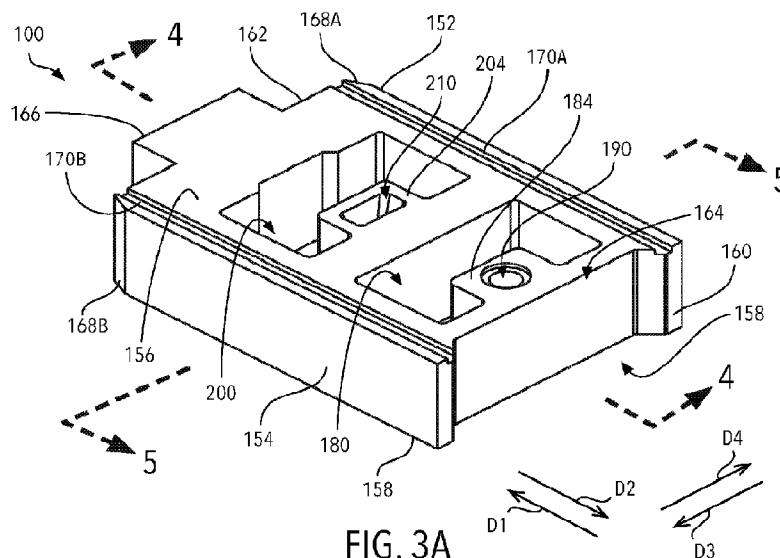
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(54) **Titre : BOISSEAU A COLONNES MONTANTES INTEGREES POUR PAROI CHAUFFANTE D'UNE BATTERIE DE FOUR A COKE**
(54) **Title: FLUE BLOCK WITH INTEGRATED RISERS FOR A HEATING WALL OF A COKE OVEN BATTERY**



(57) **Abrégé/Abstract:**

A flue block for a heating wall of a coke oven battery, the flue block having a proximal end and a distal end, the flue block comprising a first aperture disposed within the flue block, and a riser arranged in said first aperture. The flue block may also comprise a second aperture disposed therein, the second aperture spaced apart from the first aperture, and a second riser arranged in the second aperture. The flue block may be configured such that the riser is arranged to extend past the proximal end of the flue block. The flue block may be also configured such that the first riser extends past the proximal end. The flue block may be further configured such that the second riser extends past the proximal end.



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Abstract:

A flue block for a heating wall of a coke oven battery, the flue block having a proximal end and a distal end, the flue block comprising a first aperture disposed within the flue block, and a riser arranged in said first aperture. The flue block may also comprise a second aperture disposed therein, the second aperture spaced apart from the first aperture, and a second riser arranged in the second aperture. The flue block may be configured such that the riser is arranged to extend past the proximal end of the flue block. The flue block may be also configured such that the first riser extends past the proximal end. The flue block may be further configured such that the second riser extends past the proximal end.

FLUE BLOCK WITH INTEGRATED RISERS
FOR A HEATING WALL OF A COKE OVEN BATTERY

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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under Articles 4 and 8 of the Stockholm Act of the Paris Convention for the Protection of Industrial Property of U.S. Provisional Patent Application No. 63/2162,571, filed on October 15, 2021, which application is hereby incorporated
10 by reference herein in its entirety.

FIELD

[0002] The present invention relates to coke ovens, and more particularly, to a flue block including integrated risers to facilitate proper dispersion of fluids, gases, and/or heat, in a flue.

BACKGROUND

15 [0003] Coke is typically produced by heating coal in a coke oven battery. This battery may have anywhere from 40 to over 100 side-by-side coking chambers or ovens separated from each other by heating walls. Gas is burned within the walls to heat the coal arranged in the ovens. The floor bricks of each oven rest upon corbels. Below the corbels is an area called the regenerator. The regenerator is filled with bricks that have a relatively large amount of surface area per volume,
20 generally due to slots formed in the bricks. In the regenerator, exhaust waste heat is used to pre-heat incoming air as well as cool the exhaust waste heat prior to discharge. The slotted bricks are called checker bricks, and they facilitate the heat transfer from the exhaust waste heat to the combustion materials. The regenerator supports the corbels. In turn, the corbels support the coke oven floor bricks and the heating walls. The heating walls, floor bricks, and corbels have
25 traditionally been made of silica brick.

[0004] Coal is crushed and blended prior to being charged in a coke oven. A larry car charges the individual oven with the blended coal. In the coke oven, the coal is heated to 1,800°F for up to 18 hours—thus the importance of the regenerator to conserve heat. During that time, the volatiles of the coal are driven into the offgas (removed), and a pure carbon form called “coke”
30 remains.

[0005] However, current coke oven battery designs do not allow for optimal air and gas flow within the heating wall, specifically the flue, and lead to undesirable heating characteristics

(i.e., loss of heat, increased fluid pressure within the flue, etc.) For example, current coke oven battery designs do not mix gas and air at various elevational levels throughout the oven wall. Furthermore, current coke oven battery designs do not ensure proper fluid flow rates in the flue.

[0006] Thus, there is a long felt need for a flue block that includes integrated risers therein to mix air and gas at various elevational levels within a flue and improves air and gas flow therein.

[0007] There is another long felt need for a flue block that includes integrated risers therein, where the flue block may have two risers having different heights.

SUMMARY

[0008] The present invention generally comprises a flue block for a heating wall of a coke oven battery, the flue block having a proximal end and a distal end, the flue block comprising a first aperture disposed within the flue block, and a riser arranged in said first aperture. The flue block may also comprise a second aperture disposed therein, the second aperture spaced apart from the first aperture, and a second riser arranged in the second aperture. The flue block may be configured such that the riser is arranged to extend past the proximal end of the flue block. The flue block may be also configured such that the first riser extends past the proximal end. The flue block may be further configured such that the second riser extends past the proximal end.

[0009] In other embodiments the first side surface comprises a recess. In some embodiments, the second side surface comprises a protrusion. In some embodiments, the top surface comprises at least one groove. In some embodiments, the first hole is bounded by at least one wall, and the first riser extends from the at least one wall. In some embodiments, the first riser comprises a recess extending from the top surface. In some embodiments, the first riser comprises a countersink extending from the bottom surface. In some embodiments, the flue block further comprises a second hole extending from the top surface to the bottom surface, the second hole being spaced apart from the first hole, and a second riser arranged in the second hole. In some embodiments, the second hole is defined by at least one wall, and the second riser extends from the at least one wall. In some embodiments, the second riser comprises a recess extending from the top surface. In some embodiments, the recess is constant in width in a first direction, and variable in width in a second direction, perpendicular to the first direction. In some embodiments, the second riser comprises a countersink extending from the bottom surface.

[0010] The present invention also generally comprises a coke oven battery. The coke oven battery comprises a heating wall, including a first flue, and a second flue spaced apart from the

first flue, and a flue block for a heating wall of a coke oven battery, comprising a top surface, a bottom surface, a front surface, a rear surface, a first side surface, a second side surface, a first hole extending from the top surface to the bottom surface, the first hole in fluid communication with the first flue, and a first riser arranged in the first hole.

5 **[0011]** The coke oven battery may further comprise a second hole (or aperture) extending from the top surface to the bottom surface, the second hole in fluid communication with the second flue, and a second riser arranged in the second hole. In some embodiments, the first hole is defined by at least one wall, and the first riser extends from the at least one wall. In some embodiments, at least one of the first riser and the second riser comprises a countersink extending from the bottom
10 surface. In some embodiments, the first riser comprises a counterbore recess extending from the top surface. In some embodiments, the second riser comprises a recess extending from the top surface. In some embodiments, the recess comprises a variable width. In some embodiments, the second hole (or aperture) is defined by at least one wall, and the second riser extends from the at least one wall.

15 **[0012]** The present invention may further comprise a coke oven battery, the battery comprising a heating wall, the first heating wall includes a first flue, and a second flue spaced apart from the first flue, and a flue block for a heating wall of a coke oven battery, the flue block includes a top surface, a bottom surface, a front surface, a rear surface, a first side surface, a second side
20 surface, a first aperture extending from the top surface to the bottom surface, the first aperture in fluid communication with the first flue, and a first riser arranged in the first aperture. The coke oven battery may further comprise a second aperture extending from the top surface to the bottom surface, the second aperture in fluid communication with the second flue, and a second riser arranged in said second aperture. The coke oven battery may also be configured such that the first aperture is defined by at least one wall, the first riser extends from the at least one wall, the second
25 aperture is defined by at least one wall, the second riser extends from the at least one wall, wherein at least one of the first riser and the second riser comprises a countersink extending from the bottom surface, wherein the first riser comprises a counterbore recess extending from the top surface, wherein the second riser comprises a recess extending from the top surface.

30 **[0013]** Generally, the primary object of the present invention, in its various embodiments, is to provide for mixing of air and gas within a flue of a heating wall of a coke oven battery, specifically, in some embodiments of the present invention, the flue block is configured such that

the mixing of air and gas may occur at different elevations within the flue block, thereby providing for better combustion characteristics and potentially decreasing inefficiencies in existing coke oven batteries, where the flue block of the present invention may be used during repair of the existing coke oven batteries.

5 **[0014]** In some embodiments, the present invention may generally comprise a heating wall of a coke oven battery, the heating wall comprising a plurality of flue blocks, each of the flue blocks including a flue, at least two risers, where each riser is located within one of the plurality of flues, wherein the at least two risers are of different heights.

10 **[0015]** In other configurations, the present invention may generally comprise a heating wall of a coke oven battery, comprising a plurality of flue blocks, each of the flue blocks including a flue and at least one riser positioned within one of the flues.

[0016] These and other objects, features, and advantages of the present invention will become readily apparent upon a review of the following detailed description, in view of the drawings and appended claims.

15 **BRIEF DESCRIPTION OF THE DRAWINGS**

[0017] Various embodiments are disclosed, by way of example only, with reference to the accompanying schematic drawings, in which corresponding reference symbols indicate corresponding parts, in which:

20 Figure 1 is a partial perspective view of a coke oven battery, in accordance with some embodiments of the present invention;

 Figure 2 is a partial cross-sectional view of the coke oven battery taken generally along line 2-2 in Figure 1;

 Figure 3A is a top front perspective view of a flue block, as shown in Figure 1;

 Figure 3B is a bottom rear perspective view of the flue block shown in Figure 3A;

25 Figure 3C is a top elevational view of the flue block shown in Figure 3A;

 Figure 4 is a cross-sectional view of the flue block taken generally along line 4-4 in Figure 3A;

 Figure 5 is a cross-sectional view of the flue block taken generally along line 5-5 in Figure 3A;

30 Figure 6A is a perspective view of an alternative configuration of the flue block shown in Figure 3A;

Figure **6B** is a cross-sectional view taken generally along line **6B-6B** in Figure **6A**;

Figure **7A** is a perspective view of a second alternative configuration of the flue block shown in Figure **3A**; and,

Figure **7B** is a cross-sectional view taken generally along line **7B-7B** in Figure **7A**.

DETAILED DESCRIPTION

[0018] At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical, or functionally similar, structural elements. It is to be understood that the claims are not limited to the disclosed aspects.

[0019] Furthermore, it is understood that this disclosure is not limited to the particular methodology, materials and modifications described and as such may, of course, vary. It is also understood that the terminology used herein is for the purpose of describing particular aspects only, and is not intended to limit the scope of the claims.

[0020] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which this disclosure pertains. It should be understood that any methods, devices or materials similar or equivalent to those described herein can be used in the practice or testing of the example embodiments. The assembly of the present disclosure could be driven by hydraulics, electronics, pneumatics, and/or springs.

[0021] It should be appreciated that the term “substantially” is synonymous with terms such as “nearly,” “very nearly,” “about,” “approximately,” “around,” “bordering on,” “close to,” “essentially,” “in the neighborhood of,” “in the vicinity of,” etc., and such terms may be used interchangeably as appearing in the specification and claims. It should be appreciated that the term “proximate” is synonymous with terms such as “nearby,” “close,” “adjacent,” “neighboring,” “immediate,” “adjoining,” etc., and such terms may be used interchangeably as appearing in the specification and claims. The term “approximately” is intended to mean values within ten percent of the specified value.

[0022] It should be understood that use of “or” in the present application is with respect to a “non-exclusive” arrangement, unless stated otherwise. For example, when saying that “item x is A or B,” it is understood that this can mean one of the following: (1) item x is only one or the other of A and B; (2) item x is both A and B. Alternately stated, the word “or” is not used to define an “exclusive or” arrangement. For example, an “exclusive or” arrangement for the statement “item

x is A or B” would require that x can be only one of A and B. Furthermore, as used herein, “and/or” is intended to mean a grammatical conjunction used to indicate that one or more of the elements or conditions recited may be included or occur. For example, a device comprising a first element, a second element and/or a third element, is intended to be construed as any one of the following structural arrangements: a device comprising a first element; a device comprising a second element; a device comprising a third element; a device comprising a first element and a second element; a device comprising a first element and a third element; a device comprising a first element, a second element and a third element; or, a device comprising a second element and a third element.

[0023] Moreover, as used herein, the phrases “comprises at least one of” and “comprising at least one of” in combination with a system or element is intended to mean that the system or element includes one or more of the elements listed after the phrase. For example, a device comprising at least one of: a first element; a second element; and, a third element, is intended to be construed as any one of the following structural arrangements: a device comprising a first element; a device comprising a second element; a device comprising a third element; a device comprising a first element and a second element; a device comprising a first element and a third element; a device comprising a first element, a second element and a third element; or, a device comprising a second element and a third element. A similar interpretation is intended when the phrase “used in at least one of:” is used herein.

[0024] As also used herein, the terms “fluid communication”, “communication”, and/or substantial equivalents thereof, are meant to mean two or more components are connected such that a substance, e.g., gases, fluid, etc., can flow between and/or within the two components. “Fluid communication”, “communication”, and/or equivalents thereof, are also intended to include heat transfer between two or more components.

[0025] It should be appreciated that the terms “surface” and “end”, used herein, are substantially interchangeable.

COKE OVEN BATTERY

[0026] Referring now to the figures, Figure 1 is a partial perspective view of coke oven battery 10, in accordance with some embodiments of the present disclosure. Figure 2 is a partial cross-sectional view of coke oven battery 10 taken generally along line 2-2 in Figure 1. Coke oven battery 10 generally comprises regenerator 20 and one or more ovens 34.

[0027] Regenerator **20** comprises a plurality of piers or pillars **22**, which are spaced apart to form regenerator regions **24**. In some embodiments, each of pillars **22** comprises a plurality of bricks or blocks. Pillars **20** support corbels **40**. Each of corbels **40** comprises a plurality of blocks. In some configurations, corbels **40** comprise a plurality of blocks arranged in a plurality of tiers.

5 [0028] Corbels **40** are arranged on top of pillars **20** and support the oven section of coke oven battery **10**. Specifically, corbels **40** support floor **28**, heating walls **30**, and coal **300** placed in ovens **34**, allow air to flow between flues **32** and regenerator **20**, and/or allow gas to be injected into flues **32**. For example, gas or fuel is injected into corbels **40** horizontally via hole or through-bore **42** and flows vertically through through-bores **46** and into flues **32**. Air flows up through
10 through-bores **48** and into flues **32** where it mixes with the fuel and combusts to heat heating walls **30**, thus cooking the coal arranged in ovens **34**, transforming it into coke. (Coal **300** shown in the drawing is merely representative. In practice, the coal is crushed and blended prior to being charged in the coke oven.). Exhaust gases are created from such combustion, these hot exhaust gases may flow down through through-bores **48** and into regenerator regions **24**, thereby
15 preheating the incoming gas and/or air. Preheating gas and/or air as it flows into flues **32** prior to combustion is desirable because it produces more efficient vaporization and higher combustion efficiency than cold fuel. Coke oven battery **10** may further comprises shut-off means (not illustrated) operatively arranged to selectively shut off the gas flow through one or more through-bores **42**. The shut-off means (e.g., valves) allow the operator to control the temperature in each
20 flue **32** and thus ovens **34**. As shown in Figures **1** and **2**, coke oven battery **10** further comprises one or more flue blocks or modules **100** operatively arranged to facilitate the optimal transfer of fluids between corbels **40** and regenerator **20**, and flues **32**, as will be described in greater detail below.

[0029] Floor **28** is arranged on and/or engaged with corbels **40**. Floor **28** is operatively
25 arranged to support the coal in ovens **34**. Floor **28** may comprise a plurality of blocks, where the plurality of blocks may be arranged in a plurality of tiers. Heating walls **30** are arranged on corbels **40** and/or floor **28** and comprise flues **32** arranged therein (**32A – 32H** in Figure **2**), respectively. Flues **32** (flues **32A – 32H** in Figure **2**) are in fluid communication with through-bores **46** and through-bores **48**. An oven ceiling can be arranged proximate the, or on, top of heating walls **30**.
30 Thus, coking ovens **34** are formed by floor **28**, heating walls **30**, and the oven ceiling. A battery top (represented in broken lines and “**12**” in Figure **2**) can be arranged on top of heating walls **30**

and may enclose flues **32**. In some configurations of coke oven **10**, each flue **32** is in fluid communication with at least one through-bore **46** and at least one through-bore **48**, which thereby provides gas (via through-bore **46**) and air (via through-bore **48**) to that flue. The arrangement of having at least one gas injection through-bore **46** and an air injection through-bore **48** in a single
5 flue provides a desirable combustion mixture of air and fuel. Further, flue block **100** comprises risers, or vertical pipes, fluidly connected to through-bores **46** and through-bores **48** such that air and gas is mixed at different elevational levels within flues **32**, as will be described in greater detail below.

FLUE BLOCK

10 **[0030]** Figure 3A is a top front perspective view of flue block **100**. Figure 3B is a bottom rear perspective view of flue block **100**. Figure 3C is a top elevational view of flue block **100**. Figure 4 is a cross-sectional view of flue block **100** taken generally along line **4-4** in Figure 3A. Figure 5 is a cross-sectional view of flue block **100** taken generally along line **5-5** in Figure 3A.

[0031] Flue block **100** comprises front surface **152**, rear surface **154**, top surface **156** (or proximal surface), bottom surface **158** (or distal surface), side surface **160**, and side surface **162**. In some embodiments, front surface **152** is arranged parallel to rear surface **154**. In other embodiments, top surface **156** is arranged parallel to bottom surface **158**. Side surface **160** may be arranged parallel to side surface **162**. In a preferred embodiment flue block **100** is a single integrally formed element, as flue block **100** must also be composed of a material composition that
15 can withstand at least 1,800°F without deformation or deterioration—although flue block **100** may be configured with separate components that are fixedly secured thereto. It should be further appreciated that flue block **100** is composed of a material composition that can withstand the aforementioned temperature minimum during daily operation of the coke oven battery for a minimum of 20 years. The aforementioned material composition of flue block **100** preferably is
20 approximately 90%, or greater, of SiO₂ (Silicon Dioxide) and has modulus of rupture is approximately 6.9 MPa (MegaPascal) at 1090° C and 3.5 MPa at 1480 °C.

[0032] Side surface **160** preferably comprises recess **164**. Recess **164** extends into side surface **160** in direction **D1** and comprises a bottom surface and two side surfaces. The bottom surface is arranged parallel to side surface **160**. The two side surfaces are arranged at angle **A** with
30 respect to side surface **160**. In some embodiments, angle **A** is an acute angle. In some configurations of flue block **100**, recess **164** extends from top surface **156** to bottom surface **158**.

Recess **166** is substantially a “recessed section” or “recessed portion” and may be configured with different lengths, widths, shapes to accommodate different coke oven configurations—during repair and/or construction.

[0033] Side surface **162** comprises protrusion **166**. Protrusion **166** extends from side surface **162** in direction **D1**. Protrusion **166** comprises a top surface and two side surfaces. As illustrated, the top surface, or proximal surface, is arranged parallel to side surface **162** and the two side surfaces are arranged perpendicular to side surface **162**. In some embodiments, protrusion **166** extends from top surface **156** to bottom surface **158**. Protrusion **166** is substantially a “protruding section” or “protruding portion” and may be configured with different lengths, widths, shapes to accommodate different coke oven configurations—during repair and/or construction.

[0034] It should be noted that recess **164** of flue block **100** is arranged to at least partially accept protrusion **166** of an adjacently arranged flue block **100** therein—eliminating and/or limiting movement in directions **D3** and **D4** (as referenced in Figure **3A**) between the two adjacently arranged flue blocks.

[0035] Flue block **100** may further comprise at least one tapered surface, such as tapered surfaces **168A-B**. Tapered surface **168A** extends from front surface **152** to side surface **162** and tapered surface **168B** extends from rear surface **154** to side surface **162**. Tapered surfaces **168A-B** effectively reduce a width of flue block **100**. Tapered surfaces **168A-B** are arranged at angle **B** with respect to front surface **152** and rear surface **154**, respectively. In some embodiments, angle **B** is an acute angle. In a preferred embodiment, top surface **156** comprises at least one groove, for example grooves **170A-B**. Groove **170A** is arranged proximate to front surface **152** and extends from side surface **160** to side surface **162**. In alternative configurations, groove **170A** does not extend from side surface **160** to side surface **162**. Groove **170B** is arranged proximate to rear surface **154** and extends from side surface **160** to side surface **162**. In other embodiments, groove **170B** does not extend from side surface **160** to side surface **162**. Although not illustrated, flue block **100** may also include at least one protruding member, extending from bottom surface **158**, substantially collinearly arranged with a respective groove, **170A** and/or **170B**, and extending from side surface **160** to side surface **162**. This protruding member is arranged to be seated in one of the grooves, **170A** and/or **170B** when the respective flue block is arranged on top of another flue block, thereby limiting movement in directions **D3** and **D4**.

[0036] Flue block **100** further comprises aperture or flue **180** extending from top surface **156** to bottom surface **158**. Aperture **180** forms at least a portion of the flue with which it is aligned. Aperture **180** may be defined by walls **182A-D**. Alternatively, aperture **180** may be defined by a singular wall, i.e., circular, or rounded. Wall **182A** is parallel to wall **182C**, and wall **182B** is parallel to wall **182D**. Riser **184** is arranged in aperture **180**. Specifically, riser **184** extends from wall **182D** in direction **D1**. As shown and in a preferred embodiment, riser **184** is arranged between and spaced apart from walls **182A** and **182C**—although it should be appreciated that riser **184** may be positioned alternatively within aperture **180**. Riser **184** comprises through-bore **190** which extends completely therethrough. Hole **190** is operatively arranged to be in fluid communication with through-bore **46**. Specifically, gas flows through through-bore **42**, up through through-bore **46**, and then up through through-bore **190**. Riser **184**, and thus through-bore **190**, is considered a “pass through” riser in that gas does not release into flue **32** therefrom. Rather, after flowing through through-bore **190**, gas enters an additional conduit **36**, as best shown in Figure 2, such that it can be released into flue **32** at a higher elevational level. In some embodiments, gas is released into flue **32** from through-bore **190**. In some embodiments, through-bore **190** comprises counterbore or recess **192** extending from top surface **156** (*See* Figure 4). Recess **192** may interact with a nipple or protrusion on conduit **36** such that a better seal is formed therebetween—a fluid connection is formed. In some embodiments, through-bore **190** comprises countersink or recess **194** extending from bottom surface **158**. Countersink **194** forms a nozzle of decreasing diameter that increases the velocity of the gas flowing from corbel **40** to flues **32**.

[0037] The portion of aperture **180** formed around riser **184** is in fluid communication with or fluidly connected to through-bore **48**. Thus, the flow of air and exhaust gases between flues **32** and regenerator **20** occurs through aperture **180**. Air, exiting through-bore **46**, is mixed with gas in flue **32B** elevationally above top surface **156**, after such air flows through aperture **180** around riser **184**, and up past conduit **36** (*See*, Figure 2).

[0038] Flue block **100** further comprises aperture or flue **200** extending from top surface **156** to bottom surface **158**. Aperture **200** forms at least a portion of the flue with which it is aligned. Aperture **200** is defined by walls **202A-D**. Alternatively, aperture **200** may be defined by a single wall, i.e., circular or rounded. Wall **202A** may be arranged parallel to wall **202C**, and wall **202B** may be arranged parallel to wall **202D**. Riser **204** is arranged in aperture **200**. Specifically, riser **204** extends from wall **202D** in direction **D1**. In some embodiments, riser **204** is arranged between

and spaced apart from walls **202A** and **202C**. Riser **204** comprises through-bore **210** which extends completely therethrough. Through-bore **210** is operatively arranged to be in fluid communication with through-bore **46**. Specifically, gas flows through through-bore **42**, up through through-bore **46**, and then up through through-bore **210**. Riser **204**, and thus through-bore **210**, is considered a “distribution” riser in that gas is released into flue **32** directly therefrom. For example, as best shown in Figure 2, gas is released into flue **32A** directly from riser **204**. In some embodiments, through-bore **210** is connected to a conduit such that gas is released at a higher elevational level within the flue. Through-bore **210** may also comprise recess **212**, disposed within top surface **156**. Recess **212** preferably has a constant width, or a width equal to that of through-bore **210**, in direction **D1** and direction **D2** (See Figure 4). Recess **212** comprises a variable width in direction **D3** and direction **D4**, specifically, increasing in width from through-bore **210** to top surface **156** (See Figure 5). The increase in the width of through-bore **210** approaching the output of riser **204** acts as an eductor, or divergent nozzle, which increases the volume of the gas being released into the flue. This configuration provides for a better mixing of gas and air and thus better combustion within the flue. In some embodiments, through-bore **210** comprises countersink or recess **204** extending from bottom surface **158**. Countersink **204** forms a nozzle of decreasing diameter that increases the velocity of the gas flowing from corbel **40** to flues **32**.

[0039] Wall **202B** may further comprises recess **206**. Recess **206** extends from top surface **156** to bottom surface **158**. As shown, recess **206** is arranged between and spaced apart from wall **202A** and wall **202C**. Recess **206** comprises a bottom surface and two side surfaces. In some configurations, the bottom surface is arranged parallel to wall **202B** and the two side surfaces are tapered in direction **D1**.

[0040] The portion of aperture **200** formed around riser **204** is in fluid communication with or fluidly connected to through-bore **48**. Thus, the flow of air and exhaust gases between flues **32** and regenerator **20** occurs through aperture **200**. In some embodiments, and as shown, air from through-bore **46** is mixed with gas in flue **32A** at top surface **156**, after such air flows through aperture **200** around riser **204** (See Figure 2).

[0041] In an example embodiment, and as best shown in Figure 2, flue block **100** is arranged on corbel **40** such that bottom surface **158** is engaged therewith. Aperture **180** and riser **184** is arranged in/fluidly connected to flue **32B**. Specifically, air from regenerator **20** flows into flue **32B** via aperture **180** and through-bore **48**. Through-bore **190** is fluidly connected to through-

bore **46** such that gas flows into flue **32B** through through-bore **190**. In some embodiments, through-bore **190** is further connected to conduit **36** such that gas is released into flue **32B** at an elevationally higher level than top surface **156**. Aperture **200** and riser **204** is arranged in/fluidly connected to flue **32A**. Specifically, air from regenerator **20** flows into flue **32A** via aperture **200** and through-bore **48**. Through-bore **210** is fluidly connected to through-bore **46** such that gas flows into flue **32A** through through-bore **210** at top surface **156**.

FLUE BLOCK: ALTERNATIVE CONFIGURATIONS

[0042] The following description should be taken in consideration of the aforementioned figures and Figures **6A** through **7B**. Figures **6A** through **7B** generally illustrate alternative configurations of flue block **100**, specifically Figure **6A** illustrates a perspective view of flue block **100A**, Figure **6B** illustrates a cross-sectional view taken generally along lines **6B-6B** in Figure **6A**, Figure **7A** illustrates a perspective view of flue block **100B**, and Figure **7B** illustrates a cross-sectional view taken generally along lines **7B-7B** in Figure **7A**. Broadly, flue blocks **100A** and **100B** are representative embodiments of alternative configurations of flue block **100**, and comprise substantially the same components, as described *supra*.

[0043] Flue block **100A** includes extension **184A**. Extension **184A** is arranged to extend from riser **184** and in a direction away from top surface **156**. Extension **184A** is substantially equivalent to conduit **36**, shown in Figure **2**. Extension **184A** (or conduit) allows gas traveling through through-bore **190** to be released into a flue at an elevationally higher level than top surface **156**. This distance between apex **184B** of extension **184A** and top surface **156** is length **L1**.

[0044] Flue block **110B** includes extensions **184A** and **204A**, extending from risers **184** and **204**, respectively. Extensions **184A** and **204A** are arranged to extend from their respective risers in a direction away from top surface **156**. Extension **184A** (or conduit) allows gas traveling through through-bore **190** to be released into a flue at an elevationally higher level than top surface **156**. This distance between apex **184B** of extension **184A** and top surface **156** is length **L2**. Extension **204A** (or conduit) allows gas traveling through through-bore **210** to be released into a flue at an elevationally higher level than top surface **156**, and at an elevationally higher level than extension **184A**—allowing greater variation in the elevational levels of mixing between gas and air. The distance between apex **184B** of extension **184A** and top surface **156** is length **L2**. The distance between apex **204B** of extension **204A** and top surface **156** is length **L3**—greater than **L2**.

[0045] It should be noted that various components of the flue block of the present invention may have variations. For example, the through-bores described *supra*, are not limited to a cylindrical shape, and may take alternative forms, e.g., rectangular, triangular, etc. As such, the risers, apertures, countersinks, recesses, and the like, may also take alternative forms.

5 **[0046]** It will be appreciated that various aspects of the disclosure above and other features and functions, or alternatives thereof, may be desirably combined into many other different systems or applications. Various presently unforeseen or unanticipated alternatives, modifications, variations, or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

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LIST OF REFERENCE NUMERALS

	10	Coke oven battery
	12	Battery top
5	20	Regenerator
	22	Pier or pillar
	24	Regenerator region
	28	Floor
	30	Heating wall(s)
10	32	Flue(s)
	32A	Flue
	32B	Flue
	32C	Flue
	32D	Flue
15	32E	Flue
	32F	Flue
	32G	Flue
	32H	Flue
	34	Oven
20	36	Conduit
	40	Corbel
	42	Through-bore
	46	Through-bore
	48	Through-bore
25	100	Flue block or module
	100A	Flue block or module
	100B	Flue block or module
	152	Front surface
	154	Rear surface
30	156	Top surface
	158	Bottom surface

	160	Side surface
	162	Side surface
	164	Recess
	166	Protrusion
5	168A	Taper
	168B	Taper
	170A	Groove
	170B	Groove
	180	Aperture or flue
10	182A	Wall
	182B	Wall
	182C	Wall
	182D	Wall
	184	Riser
15	184A	Extension of riser 184
	184B	Apex of extension 184A
	190	Through-bore
	192	Counterbore or recess
	194	Countersink or recess
20	200	Aperture or flue
	202A	Wall
	202B	Wall
	202C	Wall
	202D	Wall
25	204	Riser
	204A	Extension of riser 204
	204B	Apex of extension 204A
	206	Recess
	210	Through-bore
30	212	Recess
	214	Countersink or recess

	300	Coal
	A	Angle
	B	Angle
	D1	Direction
5	D2	Direction
	D3	Direction
	D4	Direction
	L1	Length
	L2	Length
10	L3	Length

CLAIMS

What Is Claimed Is:

1. A flue block for a heating wall of a coke oven battery, said flue block having a proximal end and a distal end, said flue block comprising:
 - a first aperture disposed within said flue block; and,
 - a riser arranged in said first aperture.
2. The flue block recited in Claim 1, further comprising:
 - a second aperture disposed therein, said second aperture spaced apart from said first aperture; and,
 - a second riser arranged in said second aperture.
3. The flue block recited in Claim 1, wherein said riser is arranged to extend past said proximal end of said flue block.
4. The flue block recited in Claim 2 wherein said first riser extends past said proximal end.
5. The flue block recited in Claim 2 wherein said second riser extends past said proximal end.
6. The flue block recited in Claim 5, further comprising:
 - a first end, said first end having a protruding section extending therefrom; and,
 - a second end, said second end having a recessed section therein.
7. The flue block recited in Claim 6, wherein said protruding section is arranged to be at least partially seated within a recessed section of an adjacently arranged flue block.

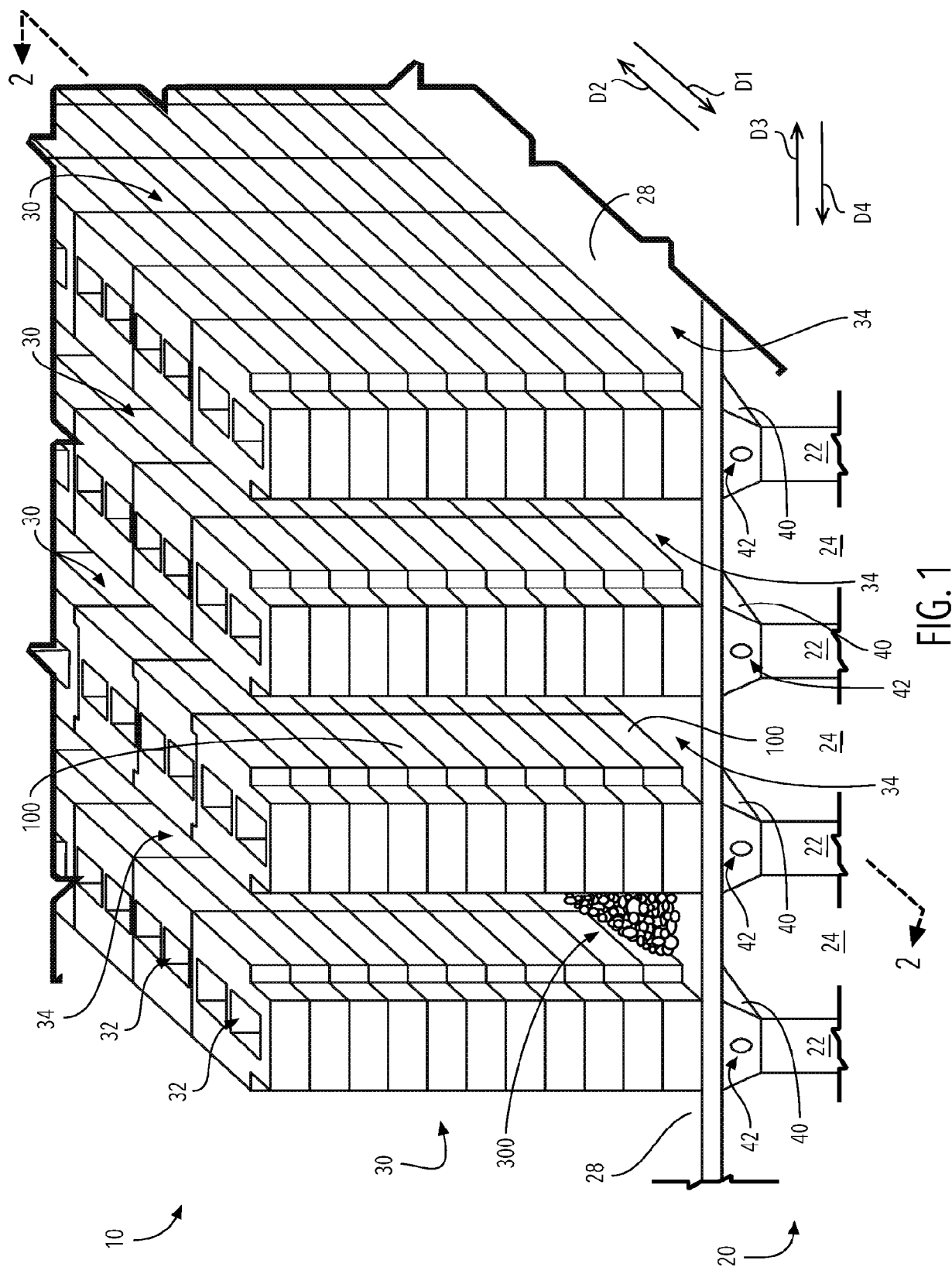
8. A flue block for a heating wall of a coke oven battery, comprising:
 - a top end;
 - a bottom end;
 - a front end;
 - a rear end;
 - a first side end;
 - a second side end;
 - a first aperture extending from said top end to said bottom end; and,
 - a first riser arranged in said first aperture.
9. The flue block as recited in Claim 8, wherein said first side end comprises a recessed section therein and said second side end comprises a protruding extending therefrom.
10. The flue block as recited in Claim 8, wherein said top end comprises at least one groove.
11. The flue block as recited in Claim 8, wherein said first aperture is defined by at least one wall, and, said first riser extends from said at least one wall.
12. The flue block as recited in Claim 8, wherein said first riser comprises a recess extending from said top end and said first riser comprises a countersink within said bottom end.
13. The flue block as recited in Claim 8, further comprising:
 - a second aperture extending from said top end to said bottom end, said second aperture being spaced apart from said first aperture; and,
 - a second riser arranged in said second aperture.
14. The flue block as recited in Claim 13, wherein:
 - said second aperture is defined by at least one wall; and,
 - said second riser extends from said at least one wall.

15. The flue block as recited in Claim 13, wherein said second riser comprises a recess within said top surface and said second riser comprises a countersink within said bottom surface.
16. The flue block as recited in Claim 15, wherein said recess is:
constant in width in a first direction; and,
variable in width in a second direction, perpendicular to said first direction.
17. A coke oven battery, comprising:
a heating wall, including:
a first flue; and,
a second flue spaced apart from said first flue; and,
a flue block for a heating wall of a coke oven battery, comprising:
a top end;
a bottom end;
a front end;
a rear end;
a first side end;
a second side end;
a first aperture extending from said top end to said bottom end, said first aperture in fluid communication with said first flue; and,
a first riser arranged in said first aperture.
18. The coke oven battery as recited in Claim 13, further comprising:
a second aperture extending from said top end to said bottom end, said second aperture in fluid communication with said second flue; and,
a second riser arranged in said second aperture.

19. The coke oven battery as recited in Claim 18, wherein said first aperture is defined by at least one wall, said first riser extends from said at least one wall, said second aperture is defined by at least one wall, said second riser extends from the at least one wall, wherein at least one of said first riser and said second riser comprises a countersink within said bottom surface, wherein said first riser comprises a counterbore recess within said top surface, wherein said second riser comprises a recess within said top surface.

20. A heating wall of a coke oven battery, comprising:
a plurality of flue blocks, each said flue block including a flue;
at least two risers, where each riser is located within one of said plurality of flues,
wherein said at least two risers are of different heights.

21. A heating wall of a coke over battery, comprising a plurality of flue blocks, each said flue block including a flue and at least one riser positioned within one of said flues.



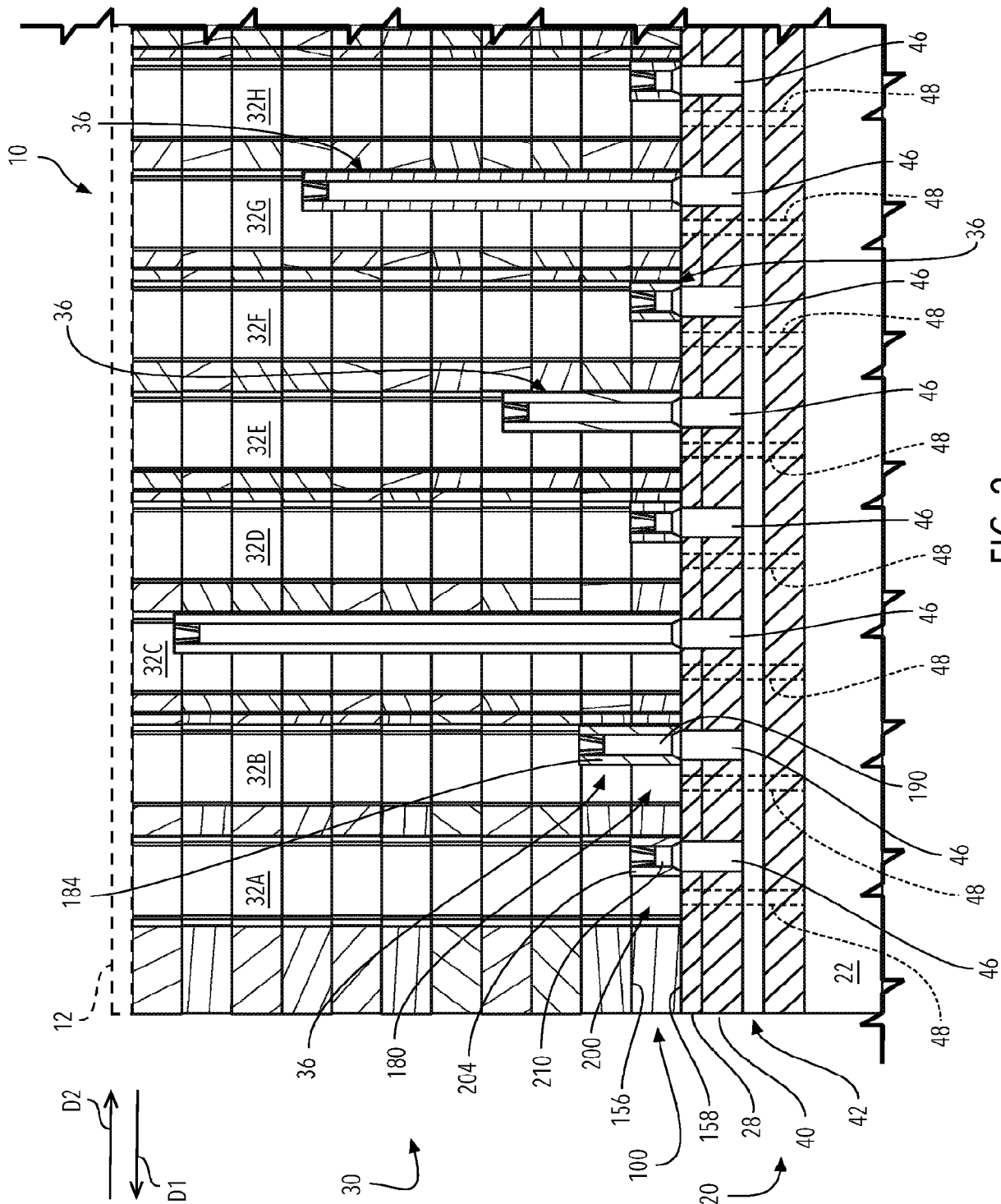


FIG. 2

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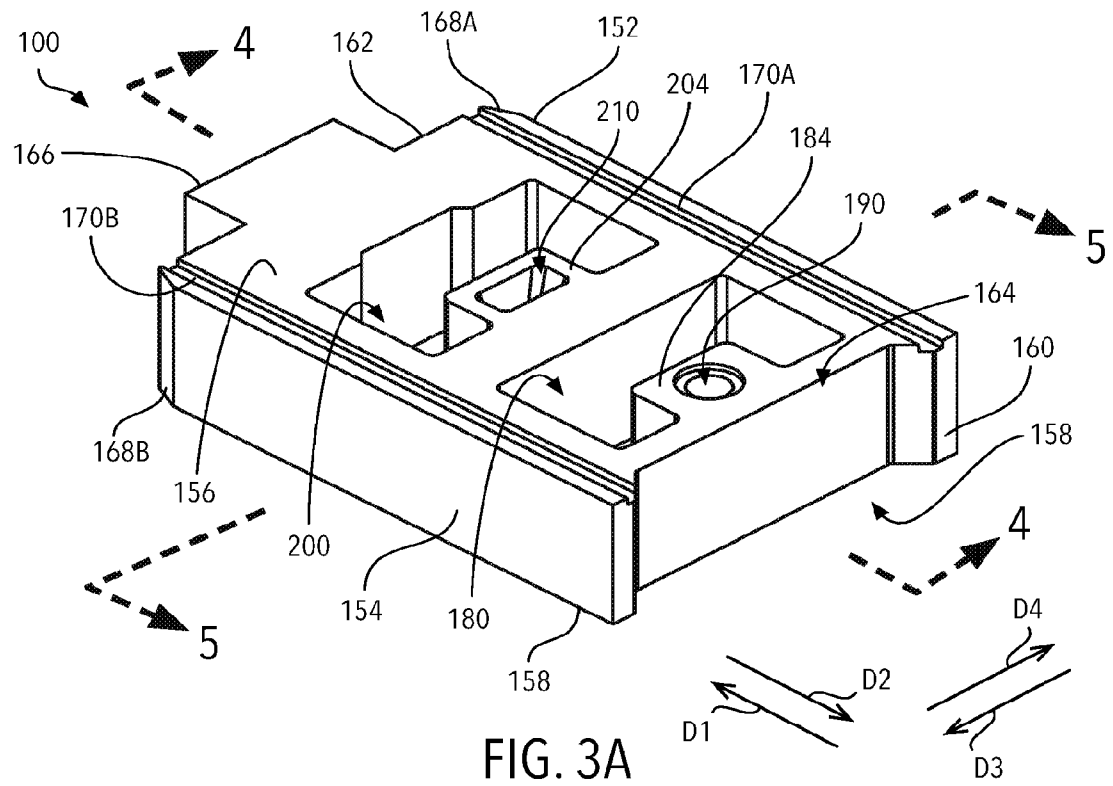


FIG. 3A

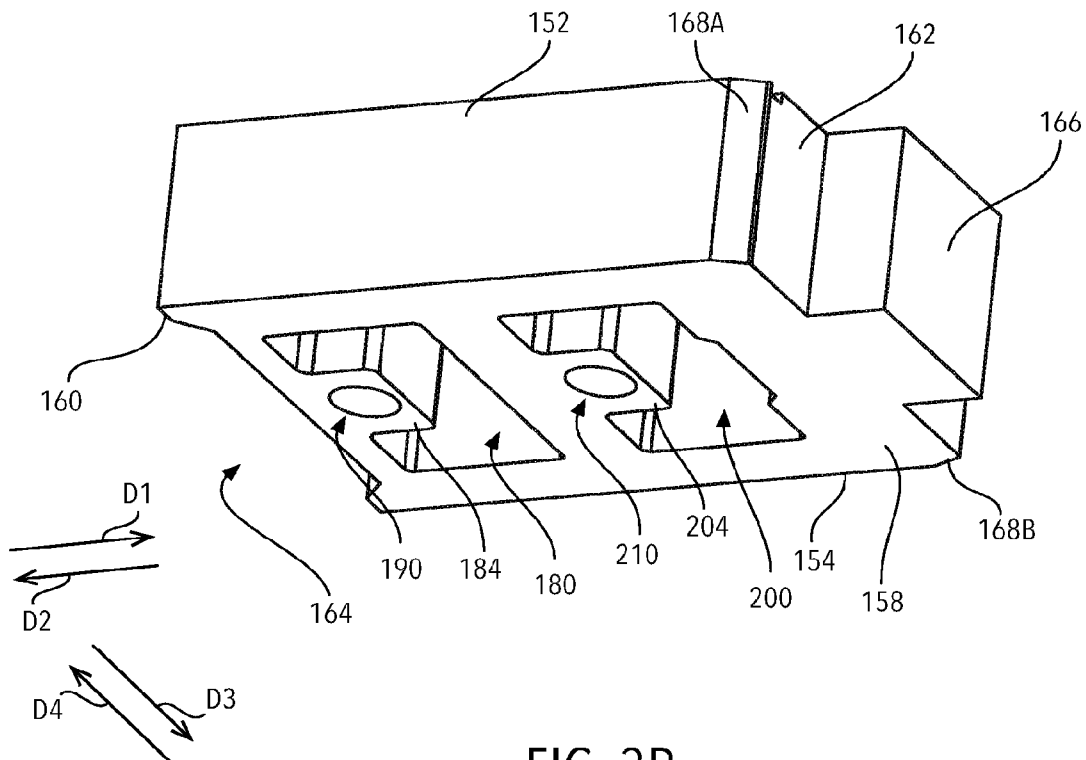


FIG. 3B

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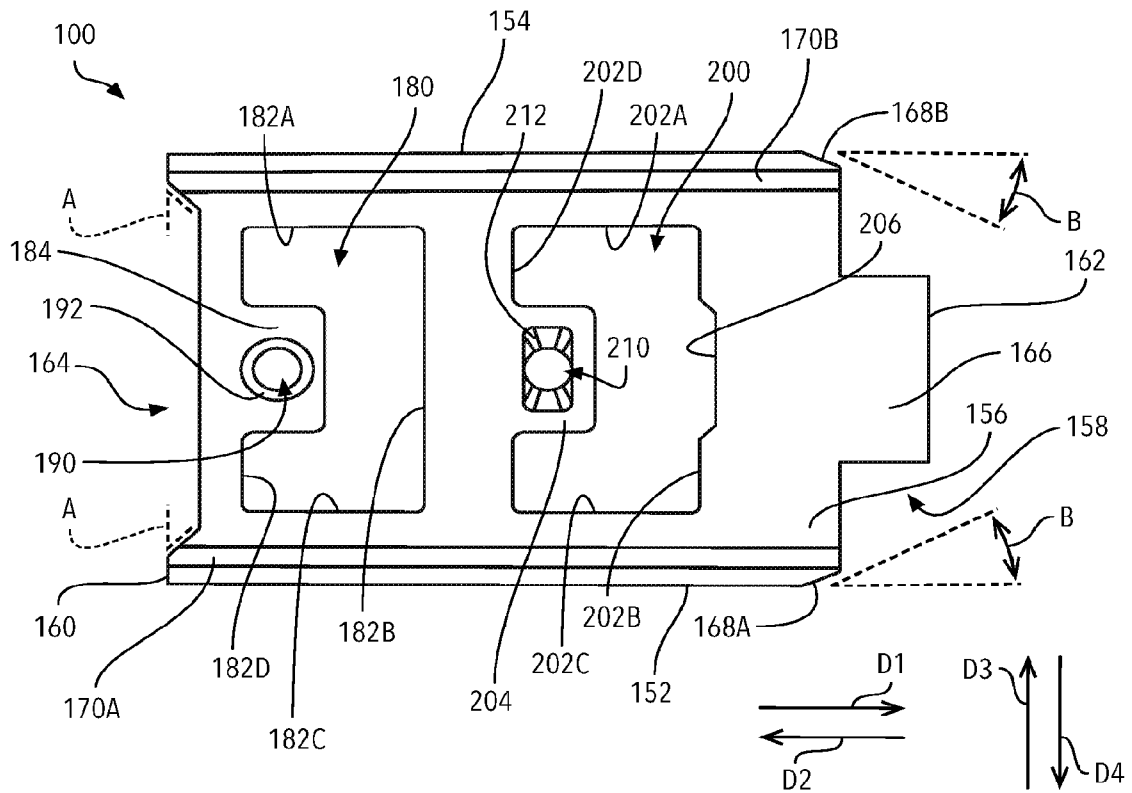


FIG. 3C

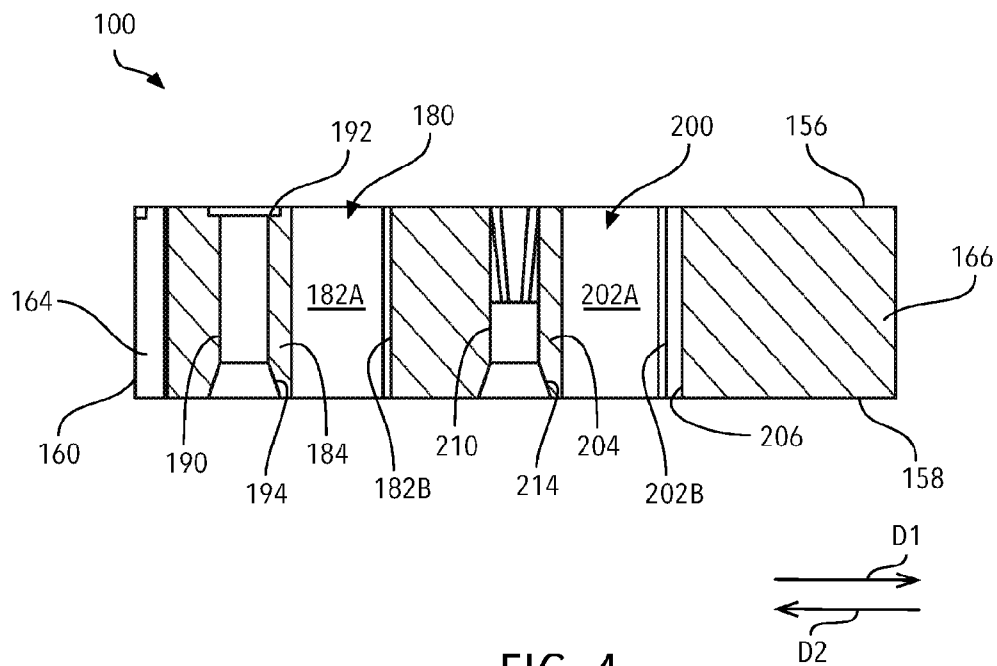


FIG. 4

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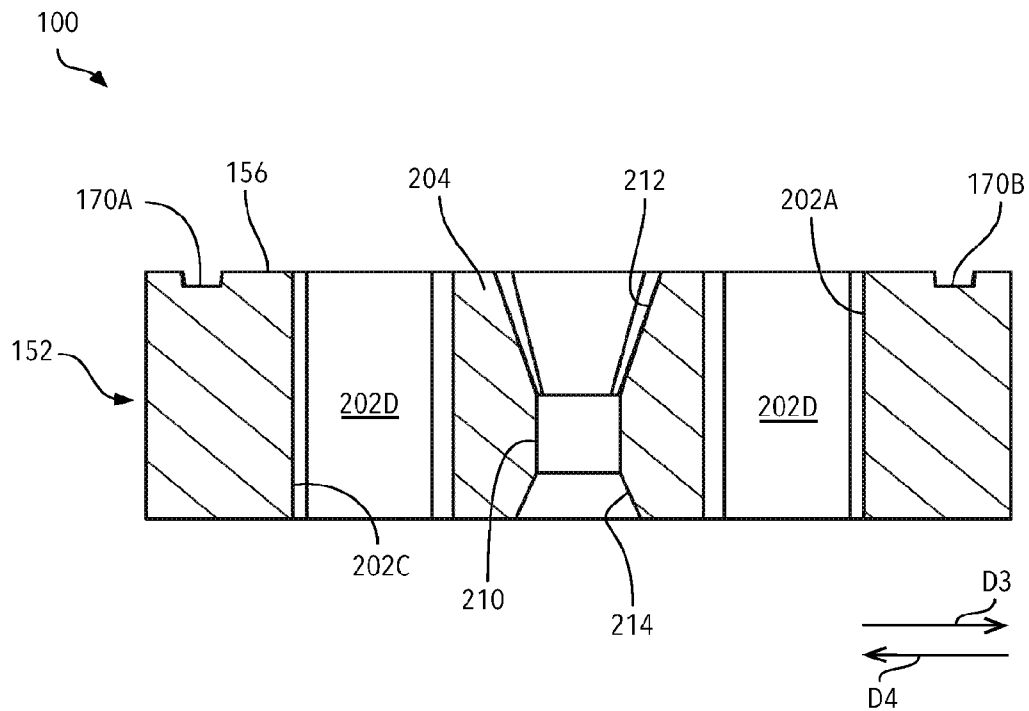


FIG. 5

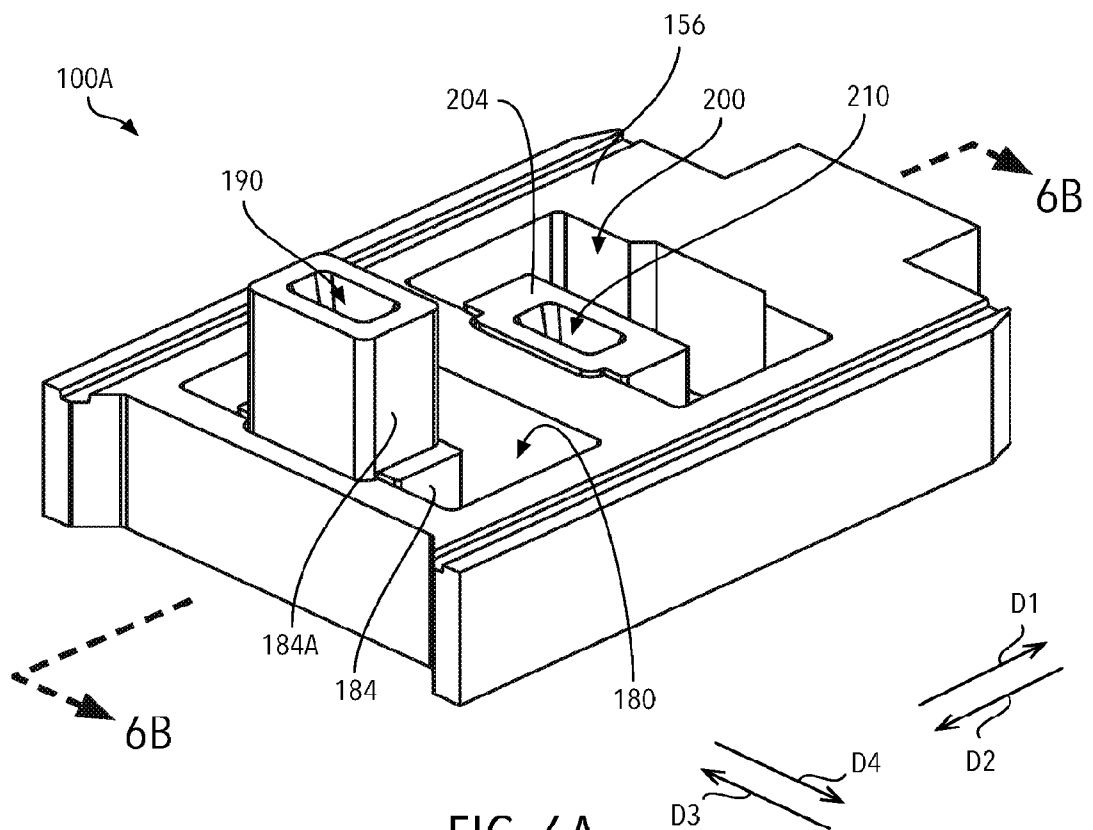


FIG. 6A

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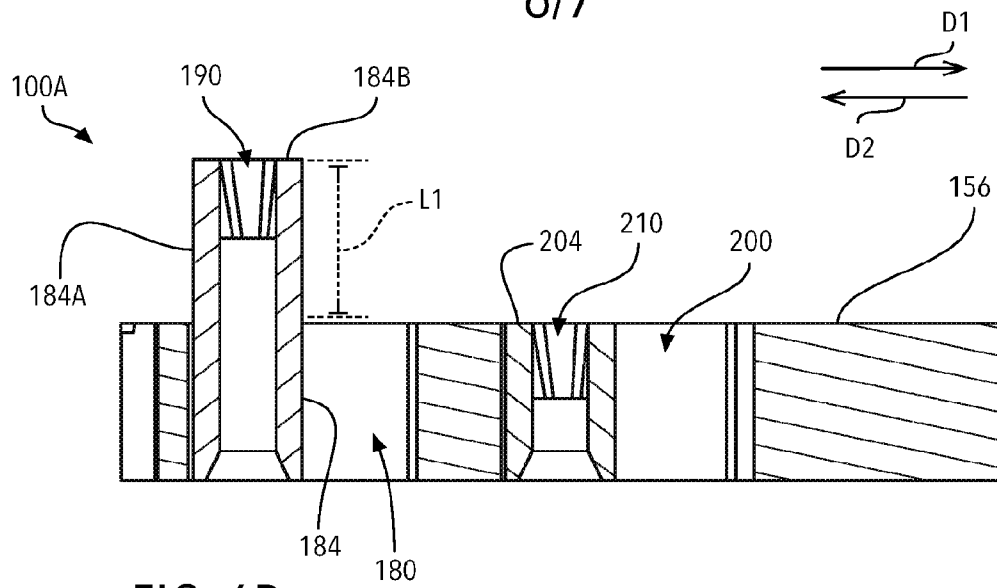


FIG. 6B

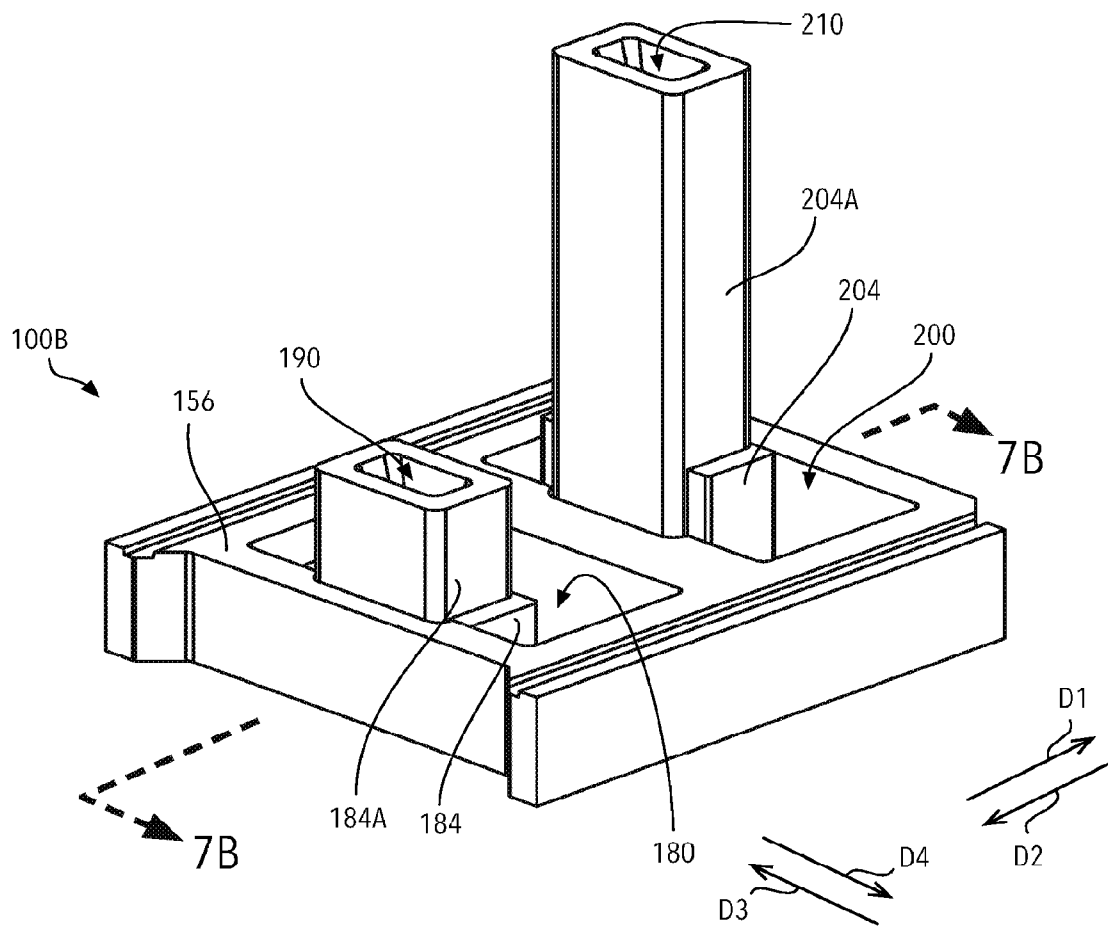


FIG. 7A

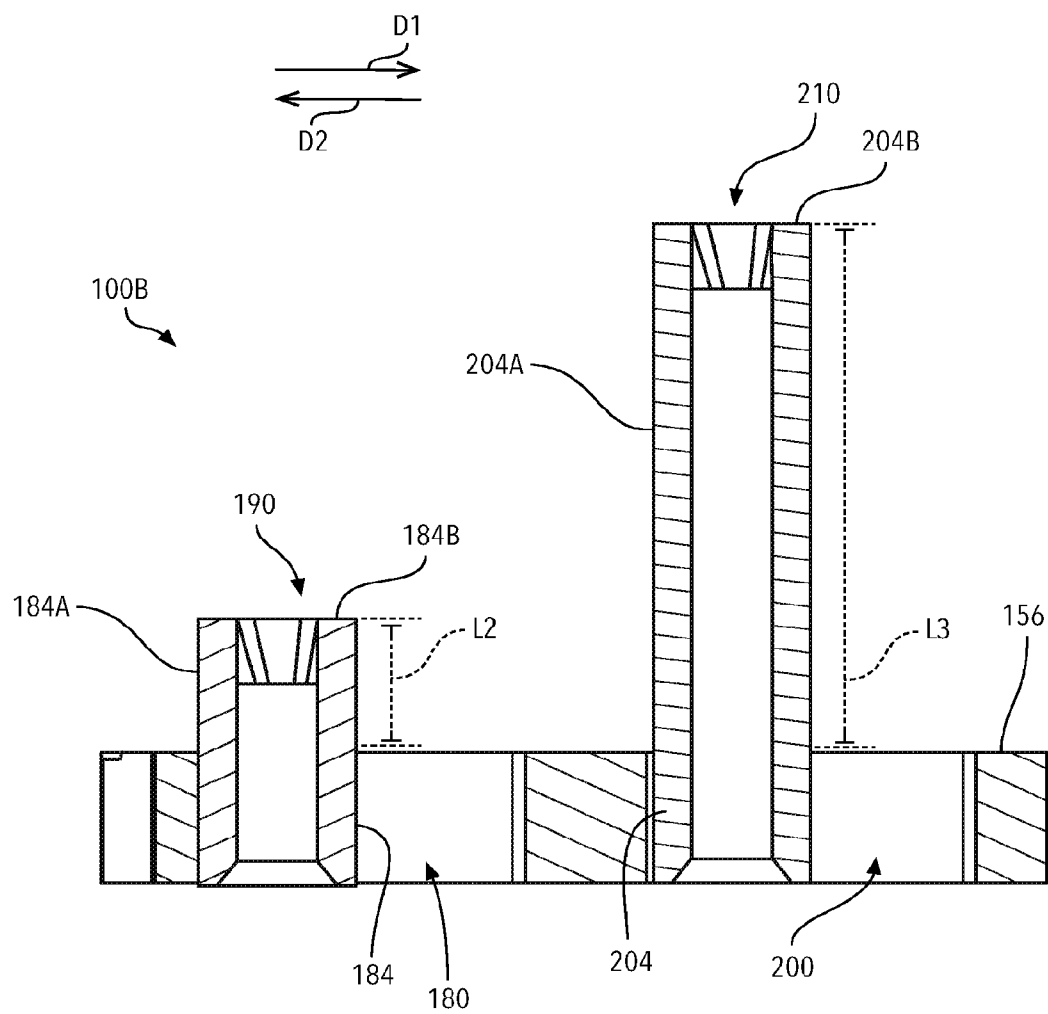


FIG. 7B

