



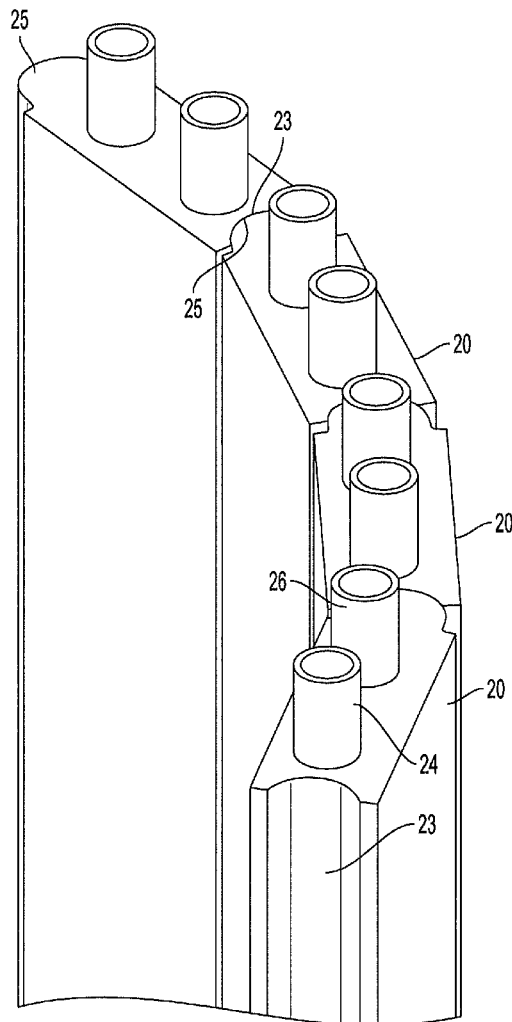
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(19) **United States**(12) **Patent Application Publication**
Kovacic(10) **Pub. No.: US 2018/0128545 A1**(43) **Pub. Date: May 10, 2018**(54) **MODULAR FURNACE COOLING WALL**(52) **U.S. Cl.**(71) Applicant: **Berry Metal Company**, Harmony, PA
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(2013.01); **F27D 11/08** (2013.01); **F27B 3/24**
(2013.01)(72) Inventor: **Thomas Kovacic**, Harmony, PA (US)(21) Appl. No.: **15/803,089**

(57)

ABSTRACT(22) Filed: **Nov. 3, 2017****Related U.S. Application Data**(60) Provisional application No. 62/418,800, filed on Nov.
8, 2016.**Publication Classification**(51) **Int. Cl.****F27D 1/12** (2006.01)
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F27D 11/08 (2006.01)

A modular furnace cooling wall, comprising: a plurality of segments wherein each interior segment houses or defines a cooling fluid conduit having an inlet and an outlet; wherein a first side of each segment defines a concave groove or channel; wherein a second side of each segment defines a convex edge; and wherein the plurality of segments are assembled so that the convex edge of one or more of the segments is received within the concave groove of an adjacent segment.



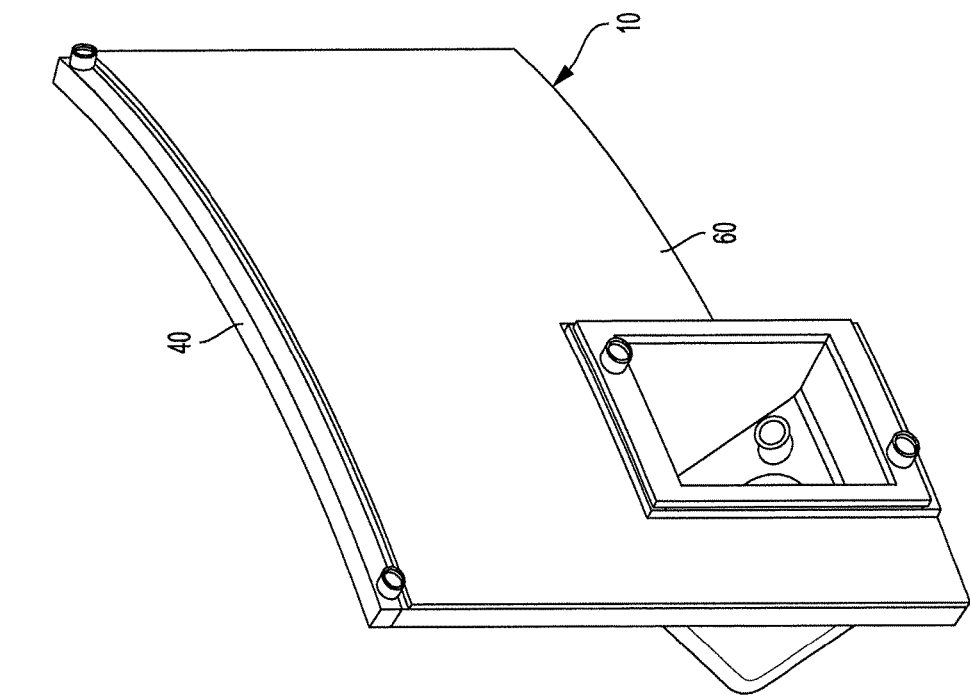


FIG. 1A

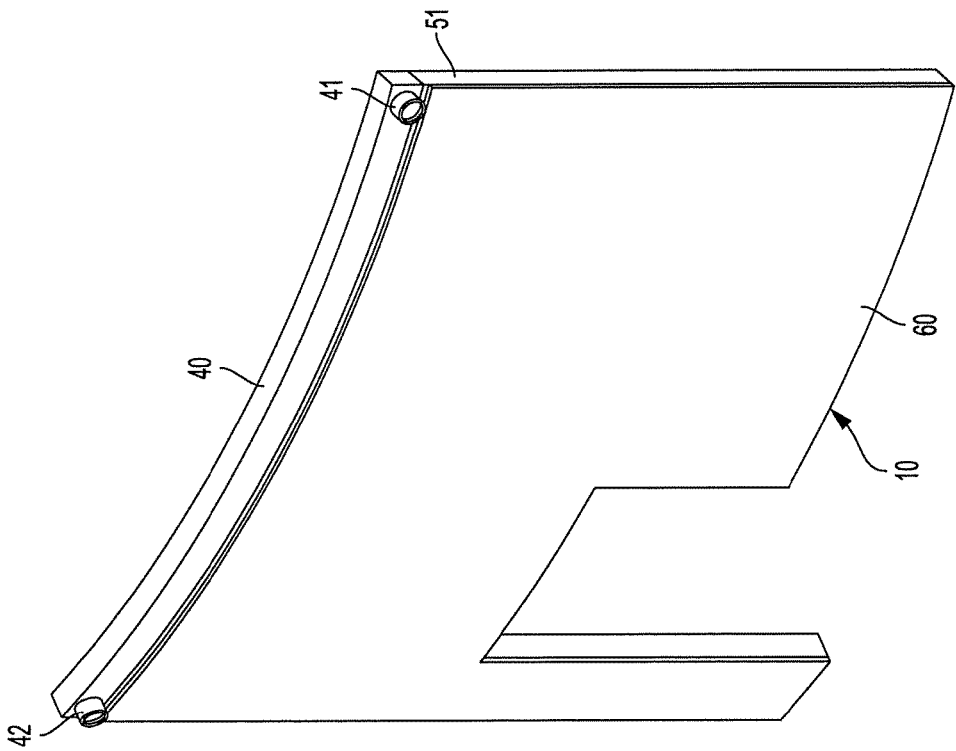
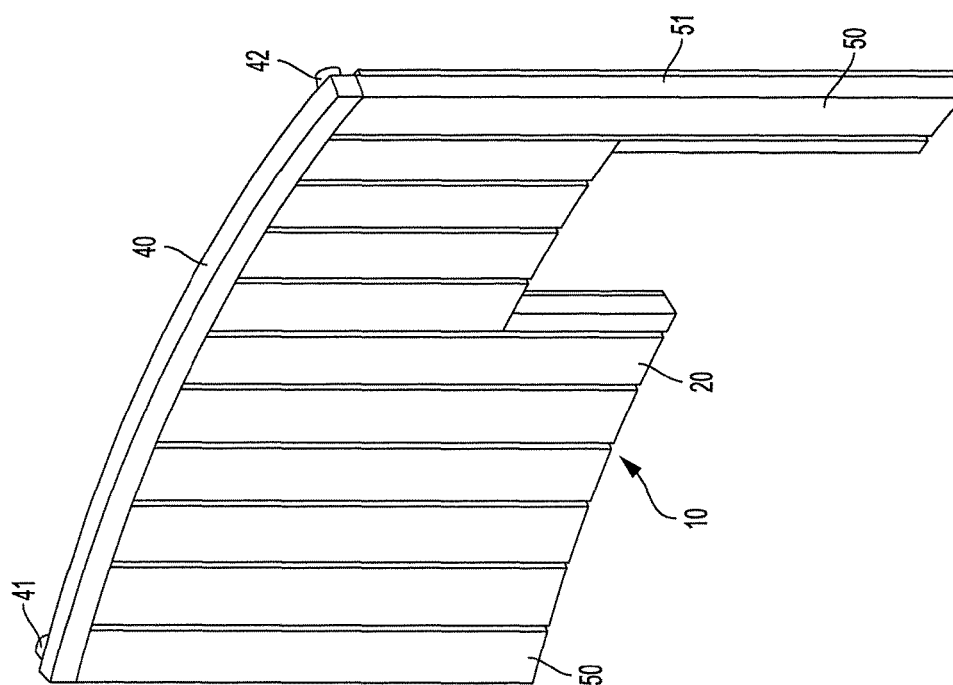
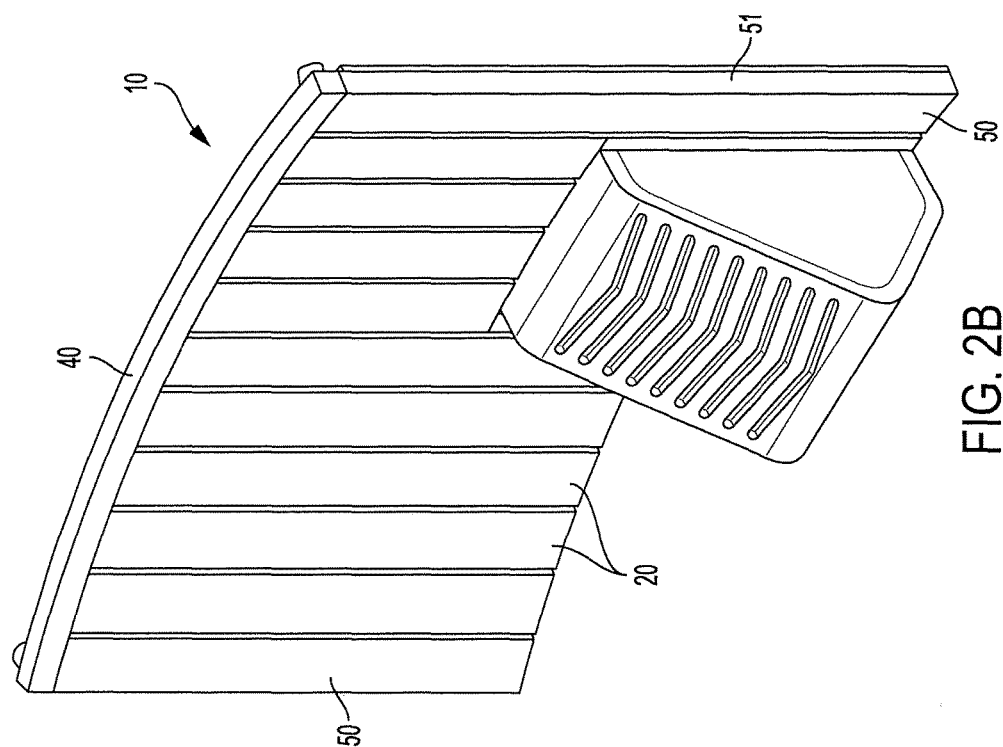


FIG. 1B



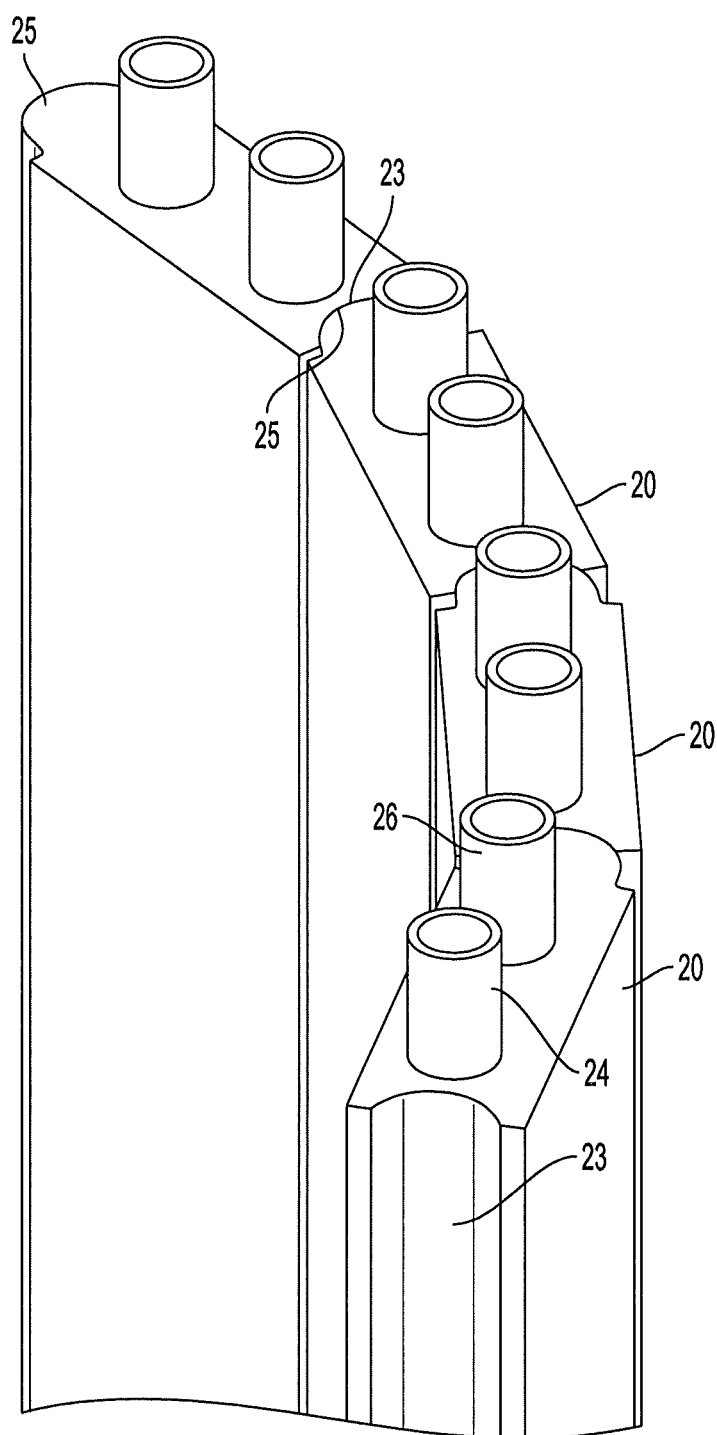


FIG. 3

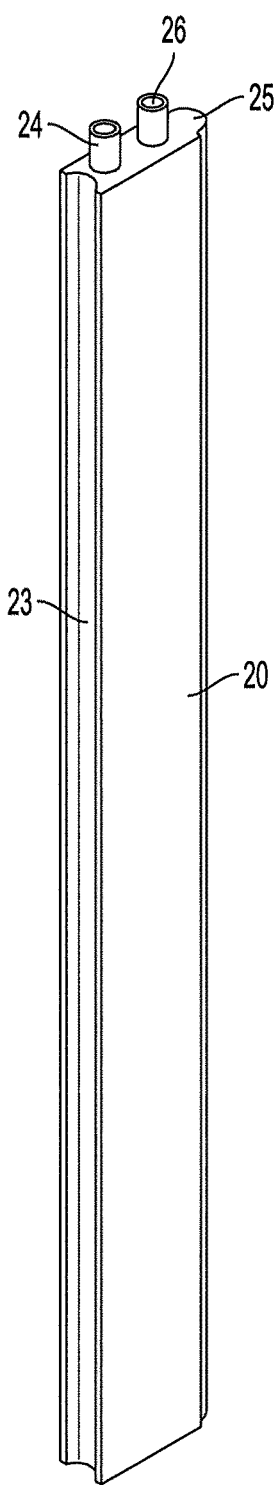


FIG. 4

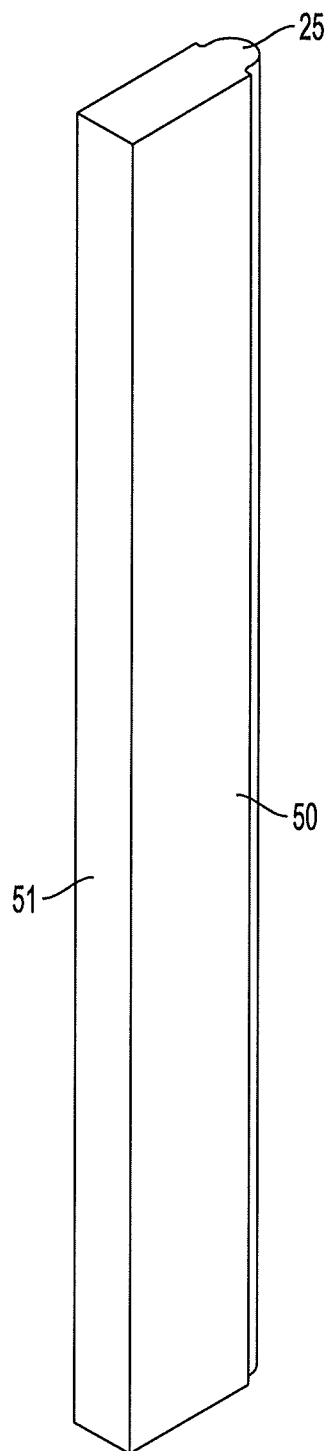


FIG. 5

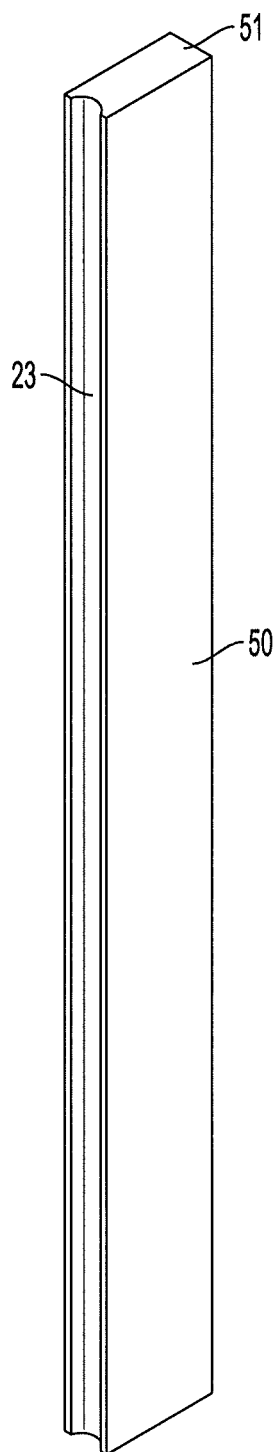


FIG. 6

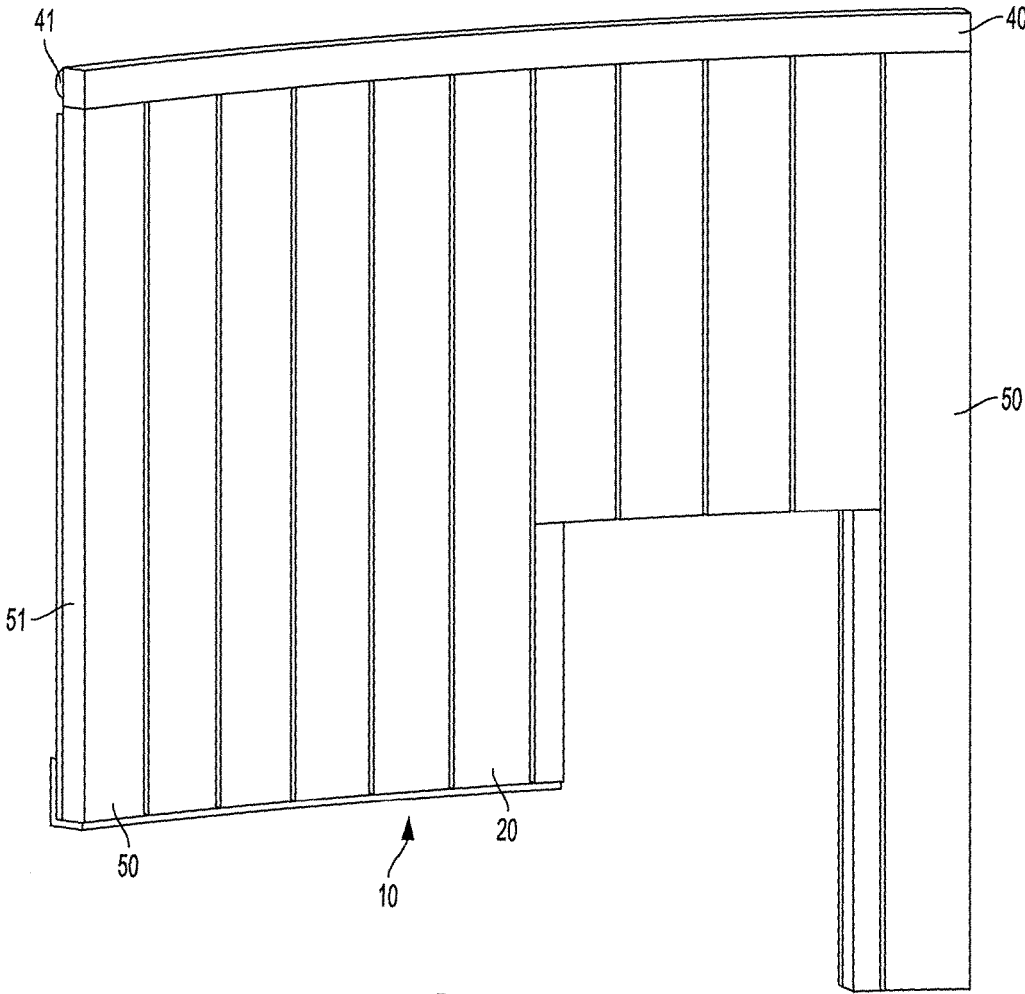


FIG. 7

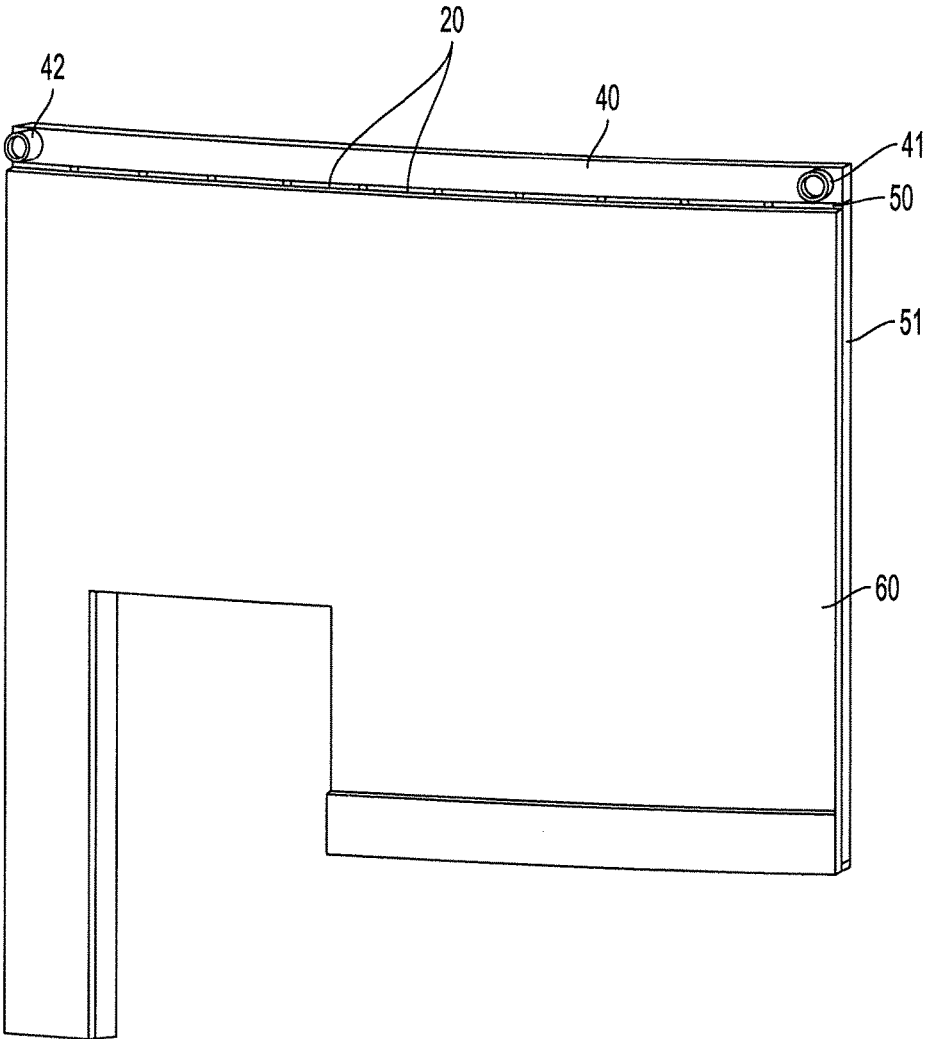


FIG. 8

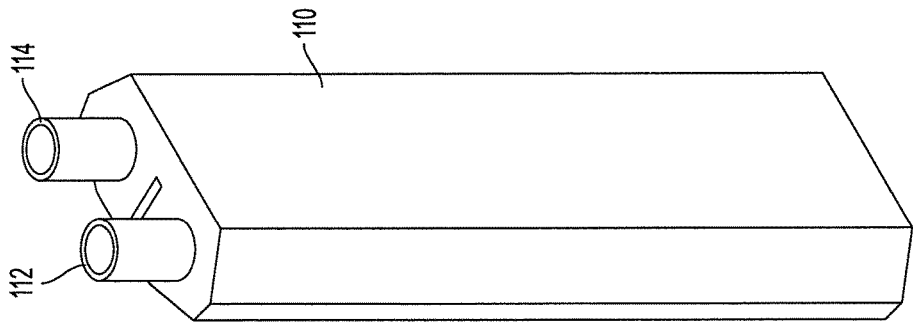


FIG. 10

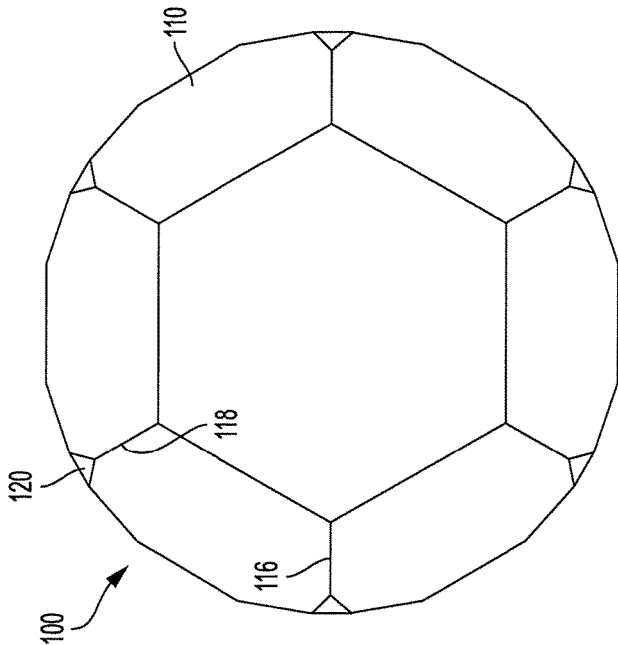


FIG. 9

MODULAR FURNACE COOLING WALL

[0001] This application claims the benefit of provisional patent application U.S. Ser. No. 62/416,800 filed Nov. 3, 2016, which is incorporated by reference herein for all purposes.

FIELD OF THE DISCLOSURE

[0002] The present disclosure is related to apparatus and methods for cooling the furnace shell of blast furnaces and other metallurgical furnaces. Related fields include cooling staves.

BACKGROUND OF THE DISCLOSURE

[0003] Generally there exist two principal types of cooling systems for blast furnaces or electric arc furnaces. These two cooling systems have been cooling plates and cooling staves, each with their own advantages and disadvantages.

[0004] Conventional cooling plates are tongue shaped coolers which protrude through a single hole in the steel furnace shell and stick into the vessel on average approximately 24 inches and are approximately 24 inches wide. Such plates are securely fastened to the steel shell and the plates are connected to an external cooling source.

[0005] Staves are elements placed between the inner side of the steel shell of a furnace and the refractory lining. The staves are typically formed with a series of tubes to carry a heat transfer fluid, such as water. The staves can cool a furnace uniformly as they may be installed to have almost complete steel shell coverage. Typical stove coolers are approximately 30" to 50" wide by 48" to 144" tall. These staves are typically bolted to the furnace wall and may have small gaps between them to allow for installation.

[0006] In order to overcome the disadvantages associated with typical furnace cooling plates and cooling staves, it would be desirable to provide a modular furnace cooling wall comprising a plurality of generally rectilinear or any shaped interior segments wherein each interior segment houses or defines its own cooling fluid conduit or circuit having a cooling fluid inlet and a cooling fluid outlet.

[0007] It would also be desirable to provide a modular furnace cooling wall that provides simplified assembly, reduced copper wall thickness, less overall weight due to reduced casting sizes but with all the benefits of large cast furnace panels.

BRIEF SUMMARY OF THE DISCLOSURE

[0008] Many other variations are possible with the present disclosure, and those and other teachings, variations, and advantages of the present disclosure will become apparent from the description and figures of the disclosure.

[0009] One aspect of a preferred embodiment of the present disclosure comprises a modular furnace cooling wall, comprising: a plurality of segments wherein each interior segment houses or defines a cooling fluid conduit having an inlet and an outlet; wherein a first side of each segment defines a concave groove or channel; wherein a second side of each segment defines a convex edge; and wherein the plurality of segments are assembled so that the convex edge of one or more of the segments is received within the concave groove of an adjacent segment.

[0010] In another aspect, the modular furnace cooling wall further comprises one or more end segments having a first

side defining either a concave groove or channel or a convex edge and a second side defining a generally flat surface.

[0011] In another aspect of a preferred modular furnace cooling wall of the present disclosure, at least one of the one or more end segments is assembled to an outer side of an assembled segment, wherein the generally flat surface of the end segment is disposed as an outer narrow sidewall of the modular furnace cooling wall.

[0012] In another aspect of a preferred modular furnace cooling wall of the present disclosure, the first side of each of the one or more end segments defining either a concave groove or channel or a convex edge is assembled to a mating side of one of the plurality of segments.

[0013] In another aspect, the modular furnace cooling wall further comprises a mounting plate or bracket to which each of the segments is removably pinned or otherwise removably attached.

[0014] In another aspect, the modular furnace cooling wall further comprises one or more support braces or brackets removably attached to one or more of the segments or end segments.

[0015] In another aspect of a preferred modular furnace cooling wall of the present disclosure, the modular furnace cooling wall defines a curved wall, a semi-circular wall, a circular wall or an enclosed wall the perimeter of which defines a geometric or non-geometric shape.

[0016] In another aspect, the modular furnace cooling wall further comprises a cooling fluid manifold in fluid communication with the inlet and outlet of each segment.

[0017] In another aspect, the modular furnace cooling wall further comprises a cooling fluid manifold in fluid communication with the inlet and outlet of each segment and end segment.

[0018] Another aspect of a preferred embodiment of the present disclosure comprises an interior segment of a modular furnace cooling wall, the interior segment comprising: a housing which defines and houses a cooling fluid conduit having an inlet and an outlet; a first side of the housing defining a concave groove or channel; and a second side of the housing defining a convex edge.

[0019] Yet another aspect of a preferred embodiment of the present disclosure comprises an end segment for a modular furnace cooling wall, the end segment comprising: a generally rectilinear housing which defines and houses a cooling fluid conduit having an inlet and an outlet; a first side of the housing defining either a concave groove or channel or a convex edge; and a second side defining a generally flat surface.

[0020] Another aspect of a preferred embodiment of the present disclosure comprises a modular furnace cooling wall, comprising: a plurality of generally rectilinear wall segments wherein each wall segment houses or defines a cooling fluid conduit having an inlet and an outlet; wherein each wall segment has planar first and second sides that are each beveled; and wherein the plurality of wall segments are assembled and secured together to form a straight, curved, angled or enclosed wall.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0021] For the present disclosure to be easily understood and readily practiced, the present disclosure will now be described for purposes of illustration and not limitation in connection with the following figures, wherein:

[0022] FIG. 1A shows an exterior top, perspective view of a preferred modular furnace cooling wall having a cut-out section for a burner housing according to the present disclosure;

[0023] FIG. 1B shows an exterior top, perspective view of a modular furnace cooling wall having a burner housing installed in a cut-out section according to the present disclosure;

[0024] FIG. 2A shows an interior top, perspective view of a modular furnace cooling wall having a cut-out section for a burner housing according to the present disclosure;

[0025] FIG. 2B shows an interior top, perspective view of a modular furnace cooling wall having a burner housing installed in a cut-out section according to the present disclosure;

[0026] FIG. 3 shows a top, perspective view of individual cooling segments making up a modular furnace cooling wall according to the present disclosure;

[0027] FIG. 4 shows a top, perspective view of an individual cooling segment for use in making up a modular furnace cooling wall according to the present disclosure;

[0028] FIG. 5 shows a top, perspective view of an individual end cooling segment (cooling fluid inlet and cooling fluid outlet not shown) for use in making up a modular furnace cooling wall according to the present disclosure;

[0029] FIG. 6 shows a top, perspective view of an individual interior cooling segment (cooling fluid inlet and cooling fluid outlet not shown) for use in making up a modular furnace cooling wall according to the present disclosure;

[0030] FIG. 7 shows an interior perspective view of a modular furnace cooling wall according to the present disclosure;

[0031] FIG. 8 shows an exterior perspective view of a modular furnace cooling wall according to the present disclosure;

[0032] FIG. 9 shows a modular furnace cooling wall forming an enclosed perimeter of a generally hexagonal shape according to the present disclosure comprising a plurality of wall segments wherein each wall segment has planar first and second sides that are each preferably beveled; and

[0033] FIG. 10 shows an individual cooling segment used in making up the modular furnace cooling wall forming an enclosed perimeter of FIG. 9.

DETAILED DESCRIPTION

[0034] In the following detailed description, reference is made to the accompanying examples and figures that form a part hereof, and in which is shown by way of illustration specific embodiments in which the inventive subject matter may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice them, and it is to be understood that other embodiments may be utilized and that structural, logical, and electrical changes may be made without departing from the scope of the inventive subject matter. Such embodiments of the inventive subject matter may be referred to, individually and/or collectively, herein by the term “disclosure” merely for convenience and without intending to voluntarily limit the scope of this application to any single disclosure or inventive concept if more than one is in fact disclosed.

[0035] The following description is, therefore, not to be taken in a limited sense, and the scope of this disclosure is defined by the appended claims.

[0036] A preferred modular furnace cooling wall 10, such as for an EAF (Electric Arc Furnace), blast furnace or other type of metallurgical furnace, of the present disclosure, comprises: a plurality of generally rectilinear or any shaped interior segments 20 wherein each interior segment houses or defines a cooling fluid conduit or circuit (such as piping or drilled and plugged design) having an inlet 24 and an outlet 26; wherein a first side of each interior segment defines a concave groove or channel 23; wherein a second side of each interior segment defines a convex “ball” or radiused edge 25; wherein the plurality of interior segments are assembled so that the convex ball or radiused edge 25 of one or more of the interior segments is received within the concave groove 23 of an adjacent interior segment; and a cooling fluid manifold 40 in fluid communication with the inlet 24 and outlet 26 of each interior segment with the cooling fluid manifold 40 having cooling fluid inlet 41 and outlet 42.

[0037] In another aspect, a preferred modular furnace cooling wall 100 of the present disclosure further comprises one or more end segments 50 having a first side defining either a concave groove or channel 23 or a convex ball or radiused edge 25 and a second side defining a generally flat surface 51.

[0038] In another aspect of a preferred modular furnace cooling wall 10 of the present disclosure, the one or more end segments 50 is/are assembled to the side or sides of the assembled interior segments 20 wherein the generally flat surface 51 of the end segment 50 is disposed as an outer narrow sidewall of the modular furnace cooling wall 10.

[0039] In another aspect of a preferred modular furnace cooling wall 10 of the present disclosure, the first side of each of the one or more end segments 50 defining either a concave groove or channel 23 or a convex ball or radiused edge 25 is disposed with a mating side of one of the interior segments 20.

[0040] In yet another aspect, a preferred modular furnace cooling wall 10 of the present disclosure further comprises mounting plate or bracket 60 to which each of the interior segments 20 is removably pinned or otherwise removably attached.

[0041] In another aspect, a preferred modular furnace cooling wall of the present disclosure further comprises one or more support braces or brackets 60 removably attached to one or more of the interior segments 20 and/or end segments 50.

[0042] In another aspect of a preferred modular furnace cooling wall of the present disclosure, the modular furnace cooling wall 10 defines a curved wall, a semi-circular wall, a circular wall or an enclosed wall the perimeter of which defines a geometric or non-geometric shape.

[0043] A preferred interior segment 20 of a modular furnace cooling wall 10 of the present disclosure, comprises: a generally rectilinear or any shaped housing which defines and houses a cooling fluid conduit having an inlet 24 and an outlet 26; wherein a first side of each interior segment defines a concave groove or channel 23; wherein a second side of each interior segment defines a convex “ball” or radiused edge 25; wherein the plurality of the interior segments may be assembled so that the convex ball or

radiused edge **25** of one or more of the interior segments is received within the concave groove **23** of an adjacent segment **20**.

[0044] A preferred end segment **50** of a modular furnace cooling wall **10** of the present disclosure, comprises: a generally rectilinear or any shaped housing which defines and houses a cooling fluid conduit having an inlet and an outlet; a first side defining either a concave groove or channel **23** or a convex ball or radiused edge **25** and a second side defining a generally flat surface **51**.

[0045] In another aspect of a preferred end segment of a modular furnace cooling wall **10** of the present disclosure, the one or more end segments **50** is/are assembled to the side or sides of assembled any interior segments **20**, wherein the generally flat surface **51** of the end segment **50** is disposed as an outer narrow sidewall of the modular furnace cooling wall **10**.

[0046] In yet another aspect of a preferred end segment **50** of a modular furnace cooling wall **10** of the present disclosure, the first side of the end segment **50** defining either a concave groove or channel **23** or a convex ball or radiused edge **25** is disposed with a mating side of one of an interior segment **20**.

[0047] In yet another aspect of a preferred end segment **50** of a modular furnace cooling wall **10** of the present disclosure, the inlets **24** and outlets **26** of each segment **20**, **50** are removably installed in fluid communication with a cooling fluid manifold **40** of the modular furnace cooling wall **10**.

[0048] In another aspect of a preferred end segment **50** of a modular furnace cooling wall **10** of the present disclosure, each segment **20**, **50** is removably pinned or otherwise removably attached to mounting plate or bracket **60**.

[0049] In another aspect of preferred end and/or interior segments **20**, **50** of a modular furnace cooling wall **10** of the present disclosure, each segment **20**, **50** is removably attached to one or more support braces or support brackets **60**.

[0050] In another aspect of preferred end and/or interior segments **20**, **50** of a modular furnace cooling wall **10** of the present disclosure, each segment **20**, **50** forms a part of the modular furnace cooling wall **10** that defines a curved wall (of any radius), a semi-circular wall (of any radius), a circular wall (of any radius) or an enclosed wall the perimeter of which defines a geometric or non-geometric shape.

[0051] Additional aspects of a preferred modular furnace cooling wall **10** of the present disclosure include simplified assembly, reduced copper thickness, less overall weight due to reduced casting sizes but with all the benefits of large cast furnace panels.

[0052] Further aspects of a preferred modular furnace cooling wall **10** of the present disclosure include that the segments **20**, **50** may be made from any suitable material including, copper, steel or other metal; the ball and socket system components for connecting the furnace cooling wall segments maybe machined from any material, at any length and width; drilled, cross drilled and plugged to form a circuit; cooling fluid circuits may be connected by pipe, pipe fittings and/or hoses for the purpose of “jumping” or “bypassing” a damaged furnace cooling wall segment a damaged circuit.

[0053] Yet additional aspects of a preferred modular furnace cooling wall **10** of the present disclosure include: (1) single and/or multiple cast in cooling fluid pipe circuits in each segment of any pipe diameter or pipe material; (2)

specially designed ball and socket connection between segments to allow a curved or enclosed wall of virtually any radius or shape to be formed; (3) segments and panels to any length, width or thickness; (4) faces of the segments may be with or without slag retainers or shelves; (5) the segments may be cast from any suitable material such as copper or steel or other metal; (6) the preferred ball and socket joint between segments creates a weld seam and allows for thermal expansion; (7) Steel back plate and connections for rigidity, mounting and weldability; (8) cooling fluid circuits connected by baffled header of any material and (9) for use in all ferrous and non-ferrous metal making facilities.

[0054] Further aspects of a preferred modular furnace cooling wall of the present disclosure include faces of the modular wall **10** that may be a smooth face, slag pockets, refractory shelf and/or frame and brick constructions as shown in U.S. Pat. No. 9,102,990 (incorporated by reference herein); the ability to incorporate features of larger castings i.e., thermocouples, etc., decreased production/delivery time; repairable wall segments; the ability to sell spares and/or “repair kits”; simple installation similar to pipe panels.

[0055] It will be appreciated that this background description has been created by the inventors to aid the reader, and is not to be taken as an indication that any of the indicated problems were themselves appreciated in the art. While the described principles can, in some respects and embodiments, alleviate the problems inherent in other systems, it will be appreciated that the scope of the protected innovation is defined by the attached claims, and not by the ability of any disclosed feature to solve any specific problem noted herein.

What is claimed is:

1. A modular furnace cooling wall, comprising:

a plurality of segments wherein each interior segment houses or defines a cooling fluid conduit having an inlet and an outlet;

wherein a first side of each segment defines a concave groove or channel;

wherein a second side of each segment defines a convex edge; and

wherein the plurality of segments are assembled so that the convex edge of one or more of the segments is received within the concave groove of an adjacent segment.

2. The modular furnace cooling wall of claim 1 further comprising one or more end segments having a first side defining either a concave groove or channel or a convex edge and a second side defining a generally flat surface.

3. The modular furnace cooling wall of claim 2 wherein at least one of the one or more end segments is assembled to an outer side of an assembled segment, wherein the generally flat surface of the end segment is disposed as an outer narrow sidewall of the modular furnace cooling wall.

4. The modular furnace cooling wall of claim 2 wherein the first side of each of the one or more end segments defining either a concave groove or channel or a convex edge is assembled to a mating side of one of the plurality of segments.

5. The modular furnace cooling wall of claim 1 further comprising a mounting plate or bracket to which each of the segments is removably pinned or otherwise removably attached.

6. The modular furnace cooling wall of claim 2 further comprising one or more support braces or brackets removably attached to one or more of the segments or end segments.

7. The modular furnace cooling wall of claim 1 wherein the modular furnace cooling wall defines a curved wall, a semi-circular wall, a circular wall or an enclosed wall the perimeter of which defines a geometric or non-geometric shape.

8. The modular furnace cooling wall of claim 1 further comprising a cooling fluid manifold in fluid communication with the inlet and outlet of each segment.

9. The modular furnace cooling wall of claim 2 further comprising a cooling fluid manifold in fluid communication with the inlet and outlet of each segment and end segment.

10. An interior segment of a modular furnace cooling wall, the interior segment comprising:

a housing which defines and houses a cooling fluid conduit having an inlet and an outlet;

a first side of the housing defining a concave groove or channel; and

a second side of the housing defining a convex edge.

11. An end segment for a modular furnace cooling wall, the end segment comprising:

a generally rectilinear housing which defines and houses a cooling fluid conduit having an inlet and an outlet;

a first side of the housing defining either a concave groove or channel or a convex edge; and

a second side defining a generally flat surface.

12. A modular furnace cooling wall, comprising:

a plurality of generally rectilinear wall segments wherein each wall segment houses or defines a cooling fluid conduit having an inlet and an outlet;

wherein each wall segment has planar first and second sides that are each beveled; and

wherein the plurality of wall segments are assembled and secured together to form a straight, curved, angled or enclosed wall.

* * * * *