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LINER FOR HOT GAS CHAMBERS

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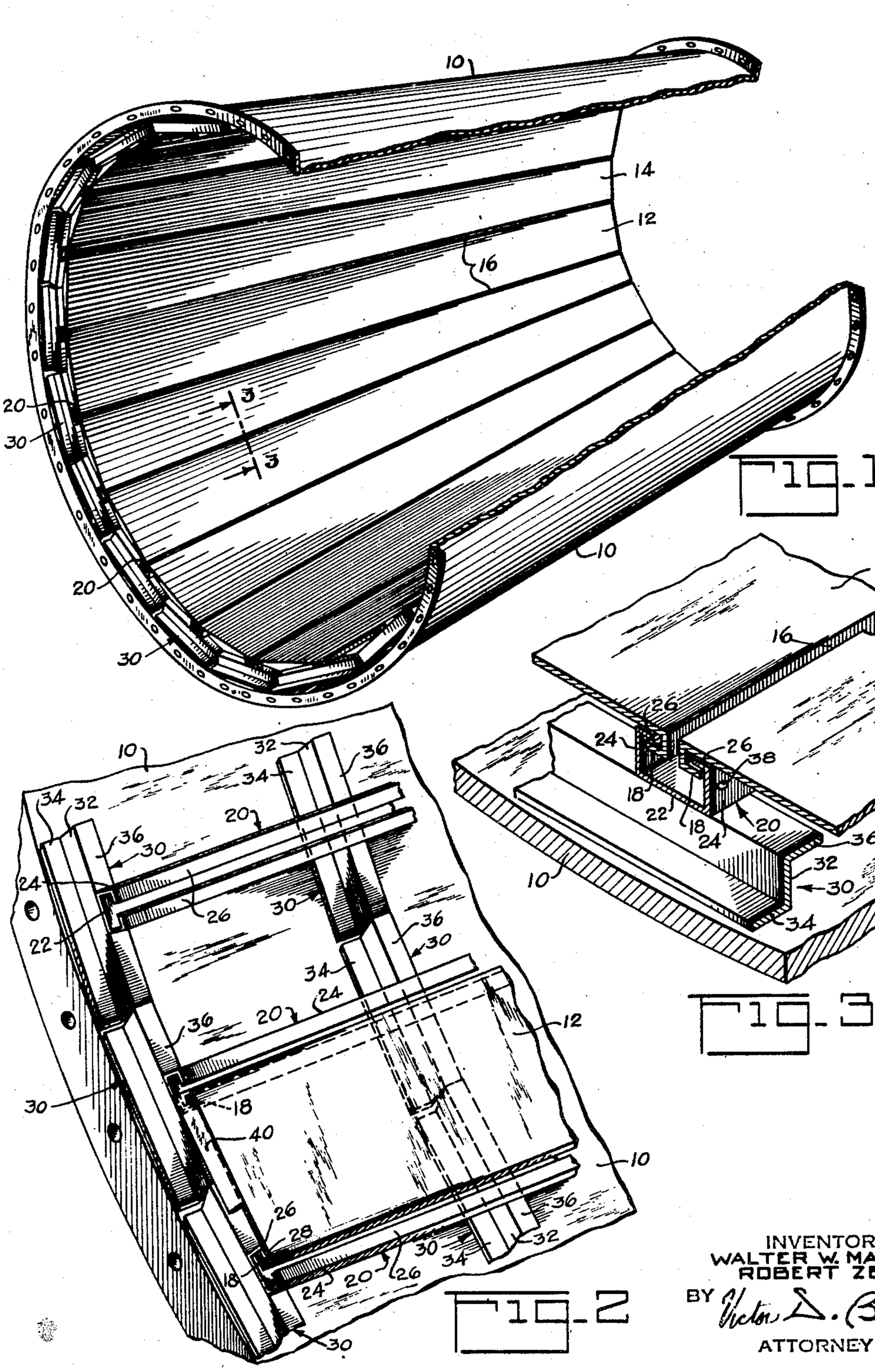

FIG. 1

FIG. 3

FIG. 2

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LINER FOR HOT GAS CHAMBERS

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This invention relates to combustion or other hot gas chambers and/or ducts and is particularly directed to an internal liner construction for such chambers or ducts. As herein used the term "chamber" is intended to include ducts and portions thereof.

A combustion or other hot gas chamber commonly comprises a structurally rigid metallic wall whose internal surface is protected from the heat and corrosive action of the combustion gases by a suitable liner construction. In the case of aircraft installations, stainless sheet steel has been used for such liners in order to provide a lightweight construction. Within any given combustion chamber, the temperature of the combustion gases will vary considerably along the chamber. Therefore not only should the chamber liner construction be such so as not to buckle or warp upon a uniform increase in temperature within said chamber but said liner construction should not buckle or warp even though the increase in temperature is non-uniform. Accordingly an object of this invention comprises the provision of a novel and simple liner construction for a hot gas chamber which does not buckle or warp with changes in temperature in said chamber regardless of whether said changes are uniform or non-uniform throughout said chamber.

Other objects of the invention will become apparent upon reading the annexed detailed description in connection with the drawing in which:

Figure 1 is a perspective view partly in section illustrating a combustion or other hot gas chamber having a liner construction embodying the invention;

Figure 2 is an enlarged view of a portion of Figure 1 with some of the liners removed; and

Figure 3 is an enlarged sectional view taken along line 3—3 of Figure 1.

Referring to the drawing, reference numeral 10 designates the structurally rigid tube-like outer wall 10 of a combustion or other hot gas chamber through which said gases flow. The wall 10 is internally lined with a plurality of side-by-side elongate sheet metal strips 12 and 14 preferably of heat and corrosion resistant stainless steel, each of said strips being substantially parallel to the adjacent portion of the chamber wall 10 and extending in the general direction of gas flow through said chamber. In a chamber having an outer wall 10 with a diameter of approximately fifty inches, the strips 12 and 14 have a width which is preferably no greater than three inches. The longitudinal edges of the

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metal strips 12 are parallel so that said strips have a constant width while the strips 14 taper in width, said strips 12 and 14 being otherwise similar. The reason for this difference in the shape of the sheet metal strips 12 and 14 is hereinafter explained.

The sheet metal liner strips 12 and 14 are disposed so as to leave a gap 16 between the longitudinal edge of one strip and the adjacent longitudinal edge of the adjacent strip. Each strip 12 and 14 has a flange 18 extending outwardly toward the adjacent portion of the chamber wall 10 with the end of said flange being turned toward a corresponding flange 18 formed along the other longitudinal edge of its strip.

The sheet metal strips 12 and 14 are supported in spaced side-by-side relation by a plurality of longitudinally extending channel members 20 secured to the wall 10 by means hereinafter described. The bottom wall 22 of each channel member 20 faces the adjacent portion of the wall 10. The open end of each channel member 20 is disposed parallel to, faces and bridges the gap 16 formed between the adjacent longitudinal edges of a pair of sheet metal liner strips. The longitudinal edge of each side wall 24 of a channel member 20 is provided with a flange 26 coextensive with said edge and extending toward a corresponding flange 26 formed along the other side wall of said channel member. Each flange 26 of the channel members 20 is slidingly received between a sheet metal strip flange 18 and the adjacent portion of the associated sheet metal strip overlying the channel side wall 24 of said flange 26. Thus each flange 18 forms a groove with its associated sheet metal strip within which the flange or tongue 26 of a channel member 20 is received.

Each channel member 20 is supported on the interior surface of the wall 10 by a plurality of brackets 30. Each bracket 30 comprises a blade portion 32 with a flange 34 at its radially outer end and a flange 36 at its radially inner end. The flanges 34 and 36 are respectively secured to the chamber wall 10 and to the bottom wall 22 of its associated channel member 20, for example by welding. Each blade 32 is flat and is disposed in a plane at right angles to the longitudinal dimension of its associated channel member whereby said blade can bend or deflect in a direction parallel to said longitudinal dimension. This arrangement permits longitudinal expansion and contraction of the channel members 20 relative to the chamber wall 10.

As illustrated, the chamber wall 10 is conical,

that is said wall has a circular cross-section which tapers or gradually decreases in area from one end to the other. Therefore the internal liner of said chamber preferably has a similar taper. For this purpose the strips 14 are of tapering width and are alternately disposed between the strips 12 of constant width. With this construction, after the channel members 20 are secured to the wall 10, the tapered strips 14 are assembled on the channel members 20 before the rectangular or constant width strips 12 are assembled thereon. Thus a tapered strip 14 is first disposed slightly to the right (Figure 1) of its ultimate position on the channel members 20 so that each of its flanges 18 can be inserted laterally outwardly between the side flanges of a channel member 20. Said tapered strip 14 is then slid longitudinally to the left (Figure 1) to its ultimate position so that its flanges 18 engage under the channel flanges 26. After all the tapered strips 14 have been so disposed in position on the channel members 20, the rectangular strips 12 can be disposed in position on said channel members by simply longitudinally sliding said strips 12 into position between said tapered strips 14. The invention obviously is not limited to a construction where alternate strips are tapered and the remaining strips are rectangular. If a pair of adjacent strips are both tapered the one strip should be longitudinally shifted to the left from its position of Figure 1 so as to permit each of the flanges 18 of the adjacent strip to be inserted laterally between the side walls 24 of a channel member 20. Obviously, if instead of being tapered the chamber formed by the wall 10 had a constant cross-sectional area then all the liner strips could be rectangular like the strips 12.

It is not necessary to first secure the brackets 30 and the channel members 20 to the chamber wall 10 before disposing the sheet metal liner strips 12 and 14 in position of said channel members. For example, the channel members 20 may be laid out on a flat surface with the liner strips 12 and 14 engaging the channel member flanges 26. This liner construction comprising the liner strips 12 and 14 and the channel members 20 is then handled as a unit and disposed in position within the chamber wall 10 on the brackets 30. The liners 12 and 14 are then temporarily slid longitudinally out of the way in order to permit welding of the channel members 20 to their supporting brackets 30.

As already mentioned, the chamber wall 10 is conical and each liner strip 12 and 14 is flat. Obviously, however, as far as this invention is concerned said chamber need not be conical and each liner strip may have a transverse curvature corresponding to the circular transverse curvature of the chamber wall 10. Furthermore, each liner strip may have a curvature in a plane parallel to its long dimension, as may be desired if the chamber wall 10 were provided with a similar longitudinal curvature. If each liner strip is provided with such a longitudinal curvature, then the channel supporting members 20 should be similarly curved.

The fit or junction between the flanges 26 and 18 is only frictional, therefore fluid can flow or leak through said junction. Accordingly the fluid pressure within the chamber and the fluid pressure within the annular space between the liner strips 12 and 14 and the wall 10 can equalize by fluid flow through the junction between the flanges 26 and 18. This is important because if

a large fluid pressure difference should occur between the pressure within said annular space and that within the chamber the liner strips 12 and 14 might buckle under said pressure difference. Some combustion or hot gas chambers—as for example the combustion chambers of gas turbine engines—are subject to sudden large changes in pressure so that the leakage flow path between said annular space and the interior of the chamber should be sufficiently large to prevent the creation of large pressure differences across the liner strips 12 and 14 as the result of said sudden pressure changes. Accordingly, it may be desirable to provide one or more holes 38 in at least some of the side walls 24 of the channel members 20, as illustrated in Figure 3, in order to decrease the resistance of said leakage flow path.

In order to prevent the sheet metal strips 12 and 14 from sliding longitudinally out of position, each strip may be made slightly longer than its associated channel member 20 and then after said strips are assembled in position their projecting ends can be bent outwardly over the adjacent ends of the channel members 20, as indicated at 40 in Figure 2.

The strips 12 and 14 form an internal liner construction or wall spaced from the outer chamber wall 10. Accordingly, cooling air or other fluid may be caused to flow through the annular space between said liner construction and the outer wall 10. The quantity of cooling air flowing between said liner construction and the outer chamber wall 10 can be limited by the extent to which the tabs 40 close off the ends of the space between each liner strip 12 or 14 and the adjacent portion of the wall 10. For example, if a large flow of cooling fluid is desired, each tab 40 may have large cut out openings or may be limited to two portions each disposed at a longitudinal edge of its liner strip and bent over the end of the adjacent channel member 20. In lieu of said cooling fluid flow, the annular space between the liner strips 12 and 14 and the chamber wall 10 could be filled with suitable heat insulating material.

With the aforedescribed construction, the flanges 18 of the sheet metal strips 12 and 14 frictionally clamp the longitudinal edges of the respective strips to the flanges 26 of the channel members 20 so as to leave each sheet metal strip free to expand and contract in all directions along its surface relative to its supporting channel member 20. In addition, because of the gap 16 between said sheet metal strips, expansion and contraction of one sheet metal strip has no effect on its adjacent strip. Also because the strips 12 and 14 are narrow in transverse width a local hot zone in any one of said strips will extend entirely across said strip and therefore will only cause longitudinal expansion of said strip. Accordingly, the sheet metal liner construction for the wall 10 provided by the strips 12 and 14 will not buckle or warp because of high temperatures within the chamber formed by the wall 10 regardless of whether said temperature is uniform or non-uniform throughout said chamber. Another advantage of the present construction is that each liner strip 12 or 14 can readily be replaced without removing any of the other strips—for example in case certain liners should become burned, mutilated, or otherwise damaged.

While we have described our invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after un-

derstanding our invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. We aim in the appended claims to cover all such modifications.

We claim as our invention:

1. A liner construction for a wall of a chamber the interior of which is to be subjected to hot gases; said construction comprising a plurality of elongate strips of sheet metal forming an internal liner for said wall, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips; and means for supporting said strips from said wall so as to permit expansion and contraction of each strip in all directions along its surface relative to the adjacent strips.

2. A liner construction as recited in claim 1 in which said wall and strips have overlapping flanges for supporting said strips.

3. A liner construction for a wall of a chamber the interior of which is to be subjected to hot gases; said construction comprising a plurality of elongate strips of sheet metal forming an internal liner for said wall, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips, each of said elongate strips having a flange along its one longitudinal edge turned toward a corresponding flange along its other longitudinal edge; and means secured to said wall and only frictionally engaged by said flanges for supporting said elongate strips.

4. A liner construction for a wall of a chamber the interior of which is to be subjected to hot gases; said construction comprising a plurality of elongate strips of sheet metal forming an internal liner for said wall, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips; and a plurality of elongate members secured to said wall for supporting said strips, each of said support members being disposed parallel to a longitudinal edge of one of said strips and having a longitudinal flange overlying a surface of said longitudinal edge facing the interior of said chamber.

5. A liner construction for at least a portion of a tube-like wall of a chamber the interior of which is to be subjected to hot gases flowing therethrough; said construction comprising a plurality of elongate strips of sheet metal extending in the general direction of flow through said chamber and forming an internal liner for said wall portion, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips; and means secured to said wall portion and having a tongue and groove connection with the longitudinal edges of said strips to support said strips so as to permit expansion and contraction of each strip in all directions along its surface relative to adjacent strips.

6. A liner construction for at least a portion of a tube-like wall of a chamber the interior of which is to be subjected to hot gases flowing therethrough; said construction comprising a plurality of elongate strips of sheet metal extending in the general directioin of flow through said chamber and forming an internal liner for said chamber wall portion, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips; and a plurality of elongate members disposed parallel to the longitudinal edges of said strips and secured to said chamber wall portion, each longitudinal edge of said sheet metal strips having a tongue and groove connection with one of said elongate members for support thereby.

7. A liner construction for at least a portion of a tube-like wall of a chamber the interior of which is to be subjected to hot gases flowing therethrough; said construction comprising a plurality of elongate strips of sheet metal extending in the general direction of flow through said chamber and forming an internal liner for said chamber wall portion, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips; a plurality of elongate members disposed parallel to the longitudinal edges of said strips, means securing said elongate members to said chamber wall portion so as to permit their longitudinal expansion and contraction relative to said wall portion, each longitudinal edge of said sheet metal strips having a tongue and groove connection with one of said elongate members for support thereby.

8. A liner construction for a wall of a chamber the interior of which is to be subjected to hot gases; said construction comprising a plurality of elongate strips of sheet-metal forming an internal liner for said wall, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips, each of said elongate strips having a flange along one longitudinal edge turned toward a corresponding flange along its other longitudinal edge, each of said flanges being on the side of its strip facing said wall; and means frictionally engaged between each said flange and its associated elongate strip for supporting said strips from said wall.

9. A liner construction for a wall of a chamber of tapering cross-sectional area the interior of which is to be subjected to hot gases flowing therethrough; said construction comprising a plurality of elongate strips of sheet metal extending in the general direction of flow through said chamber and forming an internal liner for said chamber wall portion, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips, some of said strips having a constant width and other of said strips, disposed between said constant width strips, having a tapering width so that said strips provide a liner construction which has a taper conforming approximately to the taper of said wall, and means secured to said wall and having a tongue and groove connection with the longitudinal edges of said strips to support said strips from said wall so as to permit expansion and contraction of each strip in all directions along its surface, relative to adjacent strips.

10. A liner construction for at least a portion of a tube-like wall of a chamber the interior of which is to be subjected to hot gases flowing therethrough; said construction comprising a plurality of elongate strips of sheet metal extending in the general direction of flow through said chamber and forming an internal liner for said wall portion, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips, each of said elongate strips having a flange along one longitudinal edge turned toward a corresponding flange along its other longitudi-

nal edge and each of said flanges being on the side of its strip facing said wall portion, and a plurality of channel members carried by said wall portion for supporting said elongate strips, each of said channel members having its bottom side facing said wall portion with its open side disposed parallel to, facing and bridging the gap between an adjacent pair of said elongate strips, each of said channel members also having a flange along one of its longitudinal edges extending toward a corresponding flange along its other longitudinal edge with each of said flanges being received under the oppositely directed flange of the adjacent elongate strip.

11. A liner construction for at least a portion of a tube-like wall of a chamber the interior of which is to be subjected to hot gases flowing therethrough; said construction comprising a plurality of elongate strips of sheet metal extending in the general direction of flow through said chamber and forming an internal liner for said wall portion, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips, each of said elongate strips having a flange along one longitudinal edge turned toward a corresponding flange along its other longitudinal edge and each of said flanges being on the side of its strip facing said wall portion, a plurality of channel members having its bottom side facing said wall portion with its open side disposed parallel to, facing and bridging the gap between an adjacent pair of said elongate strips, each of said channel members also having a flange along one of its longitudinal edges extending toward a corresponding flange along its other longitudinal edge with each of said flanges being received under the oppositely directed flange of the adjacent elongate strip; and means supporting said channel members from said wall portion so as to permit longitudinal expansion and contraction of said channel members.

12. A liner construction as recited in claim 11 in which said means comprises a plurality of spaced bracket members for supporting each channel member, each bracket member being secured at one end to said wall and at its other end to one of said channel members and being capable of deflecting in a direction parallel to the longitudinal dimension of its channel member to permit said longitudinal expansion and contraction of said channel members.

13. A liner construction for a wall of a chamber of tapering cross-sectional area the interior of which is to be subjected to hot gases flowing therethrough; said construction comprising a plurality of elongate strips of sheet metal extending in the general direction of gas flow through said chamber and forming an internal liner for said wall, said strips being disposed in side-by-side relation with a gap between the adjacent longitudinal edges of each pair of adjacent strips, some of said strips having a constant width between their longitudinal edges and other of said strips having a tapering width and being disposed between said constant width strips; each of said elongate strips having a flange along its other longitudinal edge and each of said flanges being on the side of its strip facing said wall, a plurality of channel members for supporting said elongate strips, each of said channel members having its bottom portion facing said wall with its open side disposed parallel to, facing and bridging the gap between an adjacent pair of said elongate strips, each of said channel members also having a flange along one of its longitudinal edges extending toward a corresponding flange along its other longitudinal edge with each of said flanges being received under the oppositely directed flange of the adjacent elongate strip; a plurality of spaced bracket members for supporting each channel member from said wall, each bracket member being secured ot one end to said wall and its other end to one of said channel members and being capable of deflecting in a direction parallel to the longitudinal dimension of its channel member to permit longitudinal expansion and contraction of said channel member.

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