May 16, 1961 K. S. JOHNSON ET AL 2,984,235

COMBUSTION CHAMBERS

Filed Aug. 6, 1958

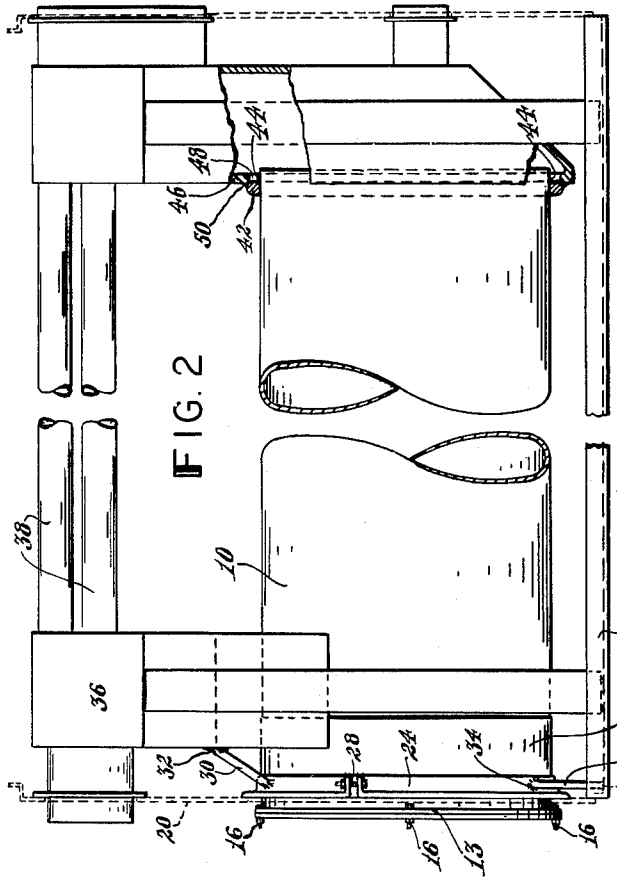


FIG. 2

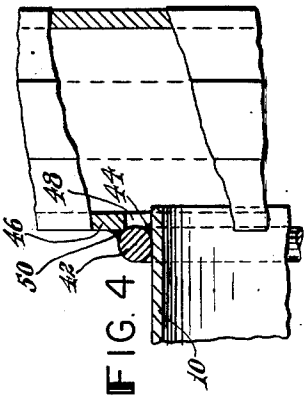


FIG. 4

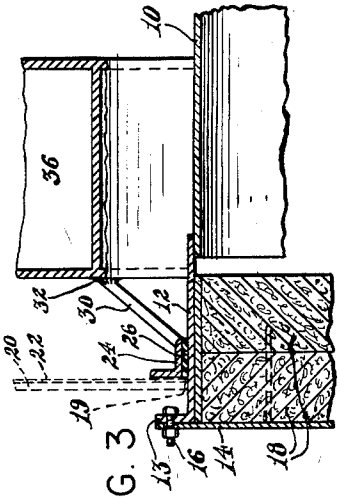


FIG. 3

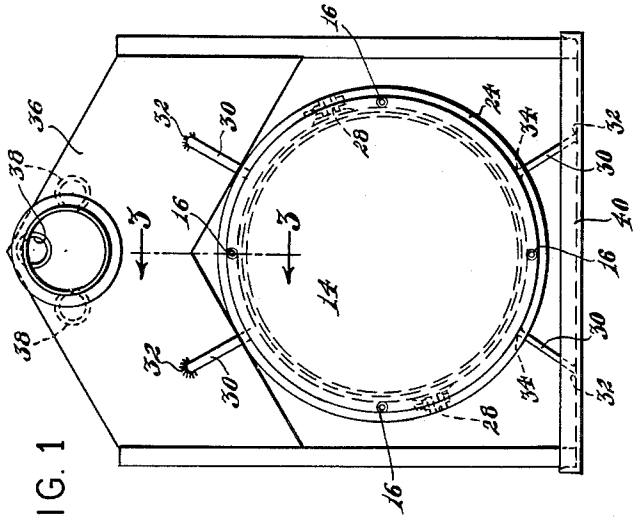


FIG. 1

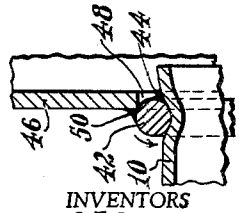


FIG. 5

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COMBUSTION CHAMBERS

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This invention relates to improvements in combustion chambers and provides, more particularly, an improved supporting structure for combustion chambers of the tubular shell variety which expand and contract in both longitudinal and radial directions in response to temperature changes.

The invention is herein disclosed in its application for supporting a combustion chamber in the form of a cylindrical shell suitable for use in a heater or furnace for warm air heating of building interiors. However, the disclosed features of novelty may be utilized advantageously in connection with combustion chambers which may be other than round in cross-section.

It is among the objects of the invention to provide a supported combustion chamber of the tubular shell variety wherein a supporting means at one end portion of the combustion chamber is in sealing engagement with and around said one end portion but permits longitudinal sliding movement of the combustion chamber relative to the said supporting means, and wherein a supporting means at the opposite end portion of the combustion chamber is mechanically connected to and around said opposite end portion maintaining the latter said end portion against any appreciable longitudinal movement but being yieldable in radial directions for accommodating radial expansion and contraction of the said opposite end portion of the combustion chamber.

Another object of the invention is to provide a supported combustion chamber of the tubular shell variety wherein one end portion of the combustion chamber has a connecting member whose cross-section is in substantial part arcuate, said member extending exteriorly all around the combustion chamber and being secured to said combustion chamber and to a relatively fixed support at radially spaced locations which are substantially in a common plane, whereby adjacent portions of the combustion chamber in response to substantial temperature rise, expand in radial direction with a rolling action about the said arcuate cross-sectional portions of the connecting member, the said securements of the member permitting relatively small yield at the connections during the said radial rolling expansion of the chamber walls.

It is, moreover, our purpose and object generally to improve the structure and effectiveness of combustion chamber supports and especially such supports which have a sealing mechanical connection at one end of the chamber which must accommodate radial expansion and contraction of the adjacent wall portions of the combustion chamber.

In the accompanying drawing:

Fig. 1 is a front-end elevation of an interior portion of a warm air heater equipped with a supported combustion chamber embodying features of the present invention, the outer casing of the heater being omitted;

Fig. 2 is a side elevation of the structure of Fig. 1 but showing, by dotted lines, portions of outer casing end walls, and showing the welded jointing member in cross-section;

Fig. 3 is a detail cross-sectional view approximately on line 3—3 of Fig. 1, on a larger scale;

Fig. 4 is a detail cross-sectional view through the combustion chamber at the location of the welded jointing member, on a still larger scale, showing the welded sealing joint at room temperature; and

Fig. 5 is a view generally similar to Fig. 4 but diagrammatically representing the sealing joint under elevated operating temperature, the expansion and relative movement of parts being somewhat exaggerated.

Referring to the drawing, a cylindrical-shell combustion chamber is represented at **10**, disposed with its axis horizontal, and supported only at its opposite end portions. Its forward end has force fit within, or may be otherwise secured to, a sleeve element **12** whose forward end is flanged at **13** for receiving the end-closure member **14**, which may be removably secured in closing relation to the forward end of the thus extended combustion chamber **10, 12** by the bolts **16**, or comparable securing means, extending through the margin of the member **14** and the flange **13**. Preferably a sheet of insulating material **18** will be suitably associated with the interior face of member **14**, within the sleeve element **12**.

The flanged sleeve element **12** extends loosely through an opening at **19** in the front wall **20** of the outer casing of the illustrated warm air heater, this outer wall **20** preferably being interiorly insulated by an suitable insulating material **22**.

A flanged annular claming ring **24** extends around the sleeve element **12** with an annular gasket **26**, or the like, intervening between the ring and the sleeve element **12**, and adapted to be relatively tightly engaged around sleeve element **12**, by suitably tightening the ring clamp by means of the clamping bolts **28**, or the like. The clamping ring **24** may be secured in a relatively stable position by the inclined bars or rods **30** which may have their similar radially outer ends welded or otherwise secured, at **32**, to relatively fixed portions of the supporting structure, with their radially inner ends welded, or otherwise secured, at **34**, to the clamping ring **24**. As herein represented, the raidally outer ends of the upper pair of rods **30** are welded to the forward wall of the front header **36** into which the front ends of air tubes **38** are open, and the radially outer ends of the lower pair of rods **30** are welded to a base member **40**.

The ring clamp **24**, when suitably tightened, supports the forward end of the extended combustion chamber **10, 12** but permits the combustion chamber to expand and contract in longitudinal directions relatively to the clamping ring **24**.

The opposite end of the combustion chamber **10**, which is the hotter end in service, has a cross-sectionally round ring **42** secured to the chamber wall exteriorly thereof and relatively close to said opposite end. Ring **42** preferably is welded at **44** to the chamber wall and, during assembly, constitutes an annular stop for engaging a wall **46** when the adjacent end of the chamber is inserted through an opening at **48**, in said wall **46**. The ring **42** then may be secured at **50**, preferably by welding, to the said wall **46** all around the opening **48**.

It is important that a permanent seal be effected between the combustion chamber **10** and wall **46** to prevent escape of combustion products into air which is being heated exteriorly of the combustion chamber and within the outer casing of the warm air heater. Hence, the welds at **44, 50** must be continuous all around the annulus of ring **42** and must withstand stresses resulting from temperature induced expansion and contraction of parts. The herein disclosed annular joint between the combustion chamber **10** and the rear header wall **46** effectively accomplishes a permanent seal due to the annular weld at **44** of the ring **42** to the combustion

chamber and the annular weld at **50** of the ring to the vertical wall **46**. The welds are at substantially spaced locations around the circular cross-section of the ring leaving intervening portions of the cross-section which are not directly attached to either the combustion chamber or wall **46**. Ring **42** expands somewhat in diameter in response to high operating temperatures but its radial expansion is appreciably less than the radial expansion of the combustion chamber **10**. Hence, the ring **42** acts as a restraining collar around the inner end portion of the combustion chamber **10** during radial expansion of the latter and causes the adjacent wall portions of the combustion chamber to expand a little around the ring and generally in horizontal direction, as diagrammatically represented in Fig. 5. The cross-section of ring **42** is caused to rotate a little, in the direction of the arrow in Fig. 5, which relieves the welds at **44, 50** of stresses which otherwise might rupture or crack the welds. Actually, the relative movement of parts is small and is considerably exaggerated in Fig. 5 to illustrate the yielding action at the joint. Experiments and tests have demonstrated that when a ring **42** is rigidly welded to the combustion chamber and wall **46** with no permissible expansive rotation of the ring cross-section, the weld becomes ruptured when the parts expand in response to operating temperatures, especially when different materials having differing coefficients of expansion are employed. The present welded ring joint effectively resists rupture even though the combustion chamber **10** is of stainless steel and wall **46** is of hot rolled steel plate. Ring **42** may be of hot rolled steel, and it is exteriorly of the combustion chamber and subject to the cooling effects of the air being propelled within the outer casing by a blower or blowers.

When the combustion chamber **10** is of stainless steel and ring **42** of hot rolled steel, the weld at **44** preferably will be a stainless steel weld, and the weld at **50** preferably will be a mild steel weld when wall **46** is of hot rolled steel plate.

It will be apparent from the foregoing that the combustion chamber **10** is relatively free to expand longitudinally due to its forward support which permits relative sliding movement of the chamber and its supporting means. Also, the fore portions of the combustion chamber can expand radially without imposing rupturing stresses on the said supporting means which are located where the temperatures are not so extreme as at the welded ring rear-end joint.

Various changes may be made in details of the structure as herein disclosed within the scope of the appended claims, and it is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty exist in the invention disclosed.

We claim as our invention:

1. In a heater, a tubular combustion chamber, means at one end portion of said chamber slidably supporting said one end portion for axial movements in response to temperature induced expansion and contraction thereof, a relatively rigid ring having a circular radial cross-section and arranged over and around the opposite end portion of said chamber, an annular continuous weld securing said ring to said combustion chamber at that side of the ring which is toward said opposite end portion of said chamber, a wall substantially perpendicular to said chamber and having an opening therein smaller in diameter than the outside diameter of said ring, said opposite end portion of said chamber being inserted in said opening to bring said ring into engagement with said wall annularly around said opening, and an annular continuous weld securing said ring to said wall at that side of the wall which is toward said one end portion of said chamber, whereby the two said welds are spaced substantially apart around the cross-section of said ring, and said opposite end of said chamber can expand and with incidental rotation of the said cross-section of said ring generally about the circular axis of the ring in response to the differential expansion between said ring and said wall.

2. In a heater having a tubular combustion chamber supported at one end portion by a wall of material having a materially different coefficient of expansion from that of the material of which said chamber is made, said wall being substantially perpendicular to the axis of said chamber and having an opening therein through which said one end portion of the chamber extends, a substantially rigid ring having an ovate radial cross-section and extending exteriorly around said one end portion of said chamber and secured to said chamber by a weld extending continuously all around said ring and chamber at that side of the ring which is toward said wall opening, said welded ring being in engagement with said wall all around the said opening, and a weld continuous all around said ring securing said ring to said wall radially outward from the first mentioned weld, whereby differential expansion of said chamber, ring and wall is accompanied by rotation of the cross-section of said ring generally about the circular axis of the ring to relieve said welds of rupturing stresses.

3. In a heater having a mounted combustion chamber as defined in claim 2, wherein the said combustion chamber comprises a substantially straight cylinder of stainless steel, said ring is of hot rolled steel, and said weld securing the ring to the combustion chamber is a stainless steel weld.

4. In a heater having a mounted combustion chamber as defined in claim 2, wherein the said wall is of hot rolled steel plate, said ring is of hot rolled steel, and said weld securing the ring to said wall is a mild steel weld.

5. A heater comprising a tubular combustion chamber, a wall generally perpendicular to the axis of said chamber, a relatively rigid metallic ring having an ovate radial cross-section and arranged with close fit around an end portion of said chamber, exteriorly thereof, a weld securing said ring to said chamber annularly and continuously all around the circumference of said chamber at that side of the ring which is toward the extreme end of said end portion of the chamber, there being a circular opening in said wall having diameter larger than the outside diameter of said chamber and smaller than the outside diameter of said ring, said end portion of the chamber being inserted in said wall opening to bring said ring into engagement with said wall all around the said opening, and a weld securing said ring to said wall annularly and continuously all around the said wall opening and spaced substantially from the first mentioned weld in direction around the cross-section of said ring.

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