

Oct. 18, 1966

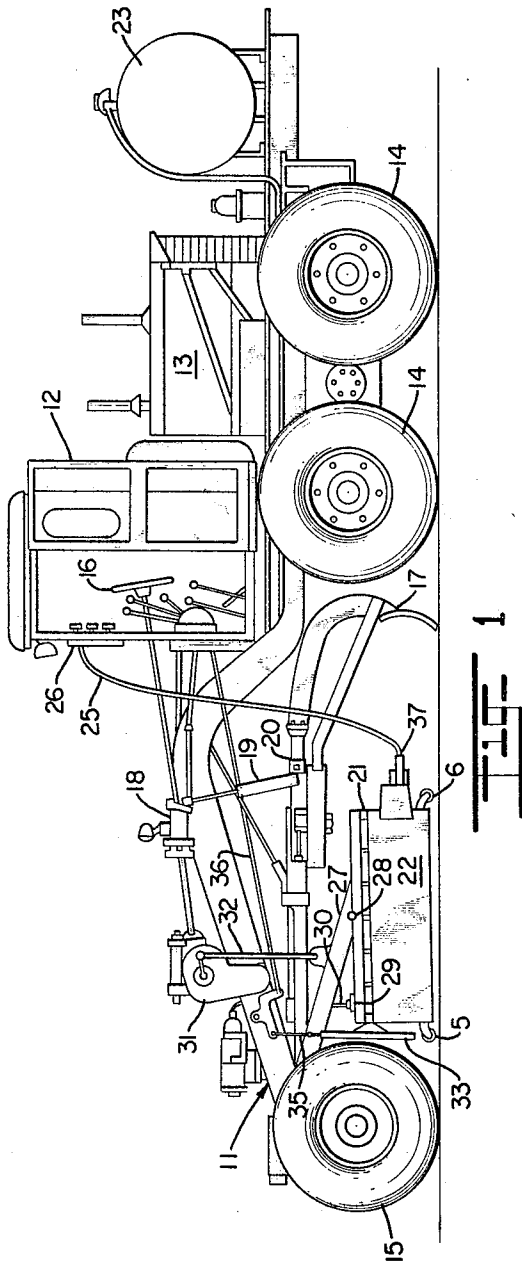
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3,279,458

LINED COMBUSTION DEVICES

Filed Dec. 14, 1965

3 Sheets-Sheet 1



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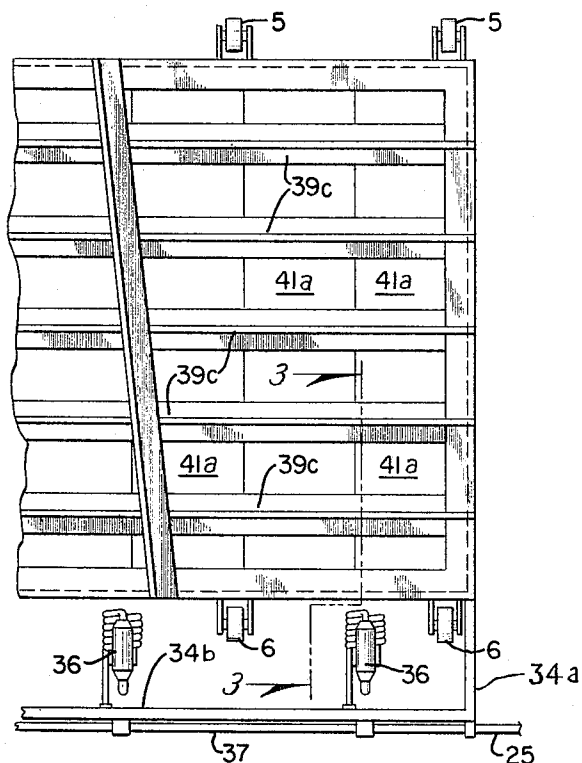


Fig. 2

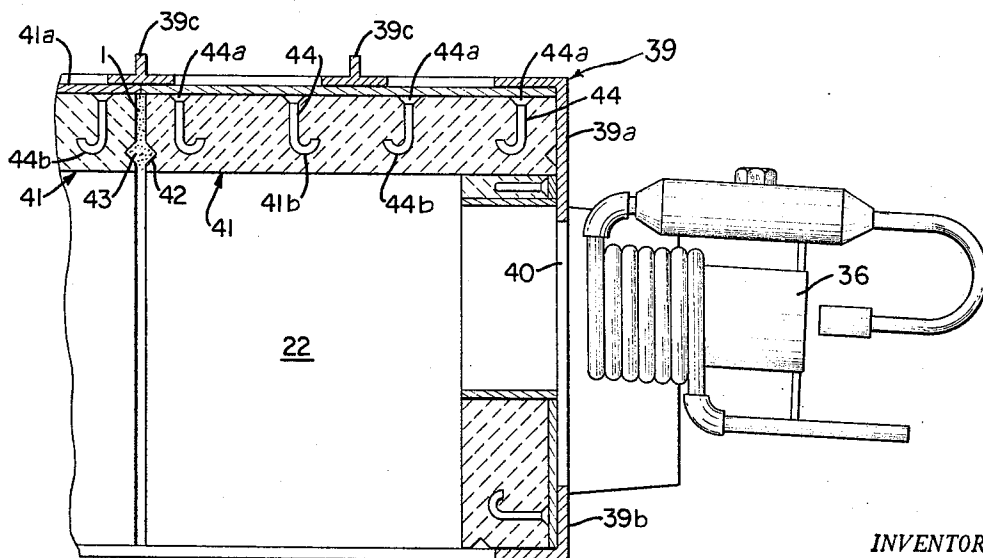


Fig. 3

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3 Sheets-Sheet 3

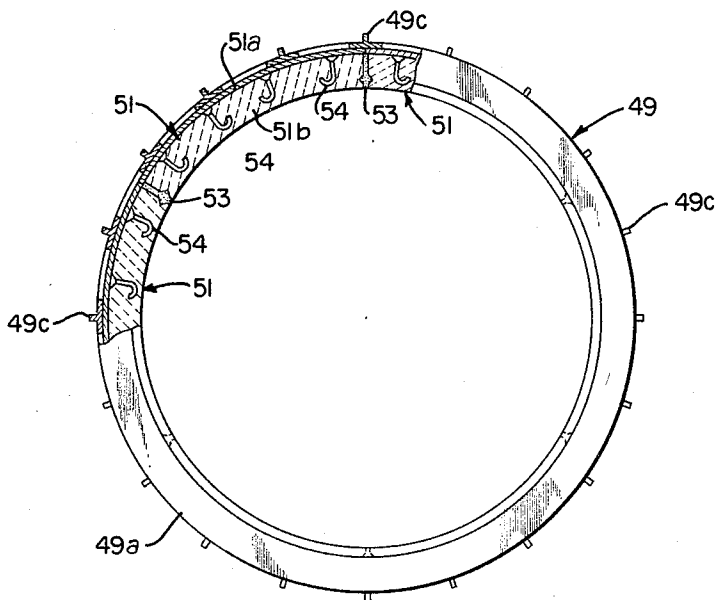


FIG. 4

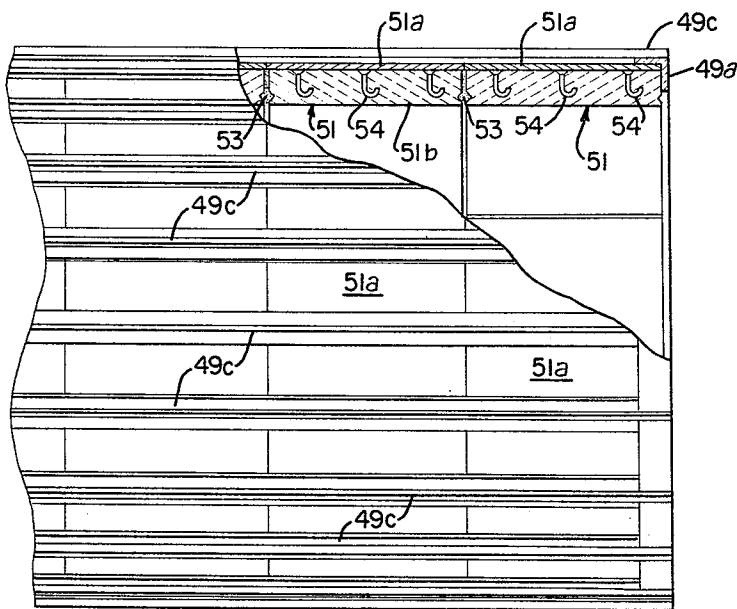


FIG. 5

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LINED COMBUSTION DEVICES

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Filed Dec. 14, 1965, Ser. No. 513,780

8 Claims. (Cl. 126—271.2)

This is a continuation-in-part of application Serial No. 301,508, filed August 12, 1963, now Patent No. 3,233,605.

This invention relates to combustion devices and methods of making same and more particularly relates to portable combustion devices or chambers which are frequently subjected to substantial impact or vibratory forces resulting from bumping during movement over rough roads.

Various types of combustion devices or chambers having interior linings are moved over rough roads during operation or when moved from one location to another and are thereby subjected to severe shaking conditions which may result in damage to the lining. The likelihood of workers stepping on or otherwise coming in physical contact with the exterior surface of such combustion devices also requires that the lining be of a high insulating quality.

Asphaltic heaters frequently used in combination with smoothing blades is one example of such combustion devices. Asphalt or "blacktop" surfaces are widely used as highway surfaces and in parking areas, etc., where large areas have to be covered with an all-weather, hardtop surface over which automobiles and other heavy vehicles and loads are moved and which is resistant to prevailing temperature and atmospheric effects. In the course of such usage, irregularities develop, particularly corrugated or undulating surfaces, which become a hazard to the normal uses of such areas and are developed or increased by continuing usage.

Such pavement is formed in the first instance by hot application and, while hot, is shaped to form a relatively flat surface. After forming, it is allowed to cool and harden so that it provides a relatively permanent, hard surface over which vehicles travel. Unfortunately, soft spots and moisture collection in the base structure supporting the pavement develop, and repeated bumping of heavy vehicles over such soft spots increases the undulating or corrugated effect to such an extent that such surfaces become a traffic hazard by inducing erratic vehicular movement over same with resulting increase in the intensity of the undulating or "washboard" effect.

The present invention recognizes the need to recondition such undulating or corrugated surfaces without rebuilding the entire top surface, and provides a simple, economical and efficient procedure by which such irregular surfaces may be flattened and smoothed through a combination of heating and softening actions followed by smoothing such as by scraping.

Such treatments may be produced by one treatment unit which provides the heating and softening and a second unit which provides the necessary scraping or smoothing. An operation of this type requires plural operator control, plural vehicular movement, and the possibility of erratic timing causing an unwanted interval of inactivity between heating and smoothing. As a consequence, such operations may be expensive and frequently are inefficient.

Another example of a combustion device which may utilize this invention is a portable rotary kiln-type dryer which is frequently moved from one location to another and receives considerable bumping during such movement.

Accordingly, it is an object of my invention to provide simple, durable and efficient apparatus adapted to be mounted on existing road-working equipment which provides a combined heating or softening action and a smoothing or scraping action for improving defective surfaces.

Another object of my invention is to provide a novel

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combustion chamber and method of making same in which any one of a plurality of individual liner members may be easily replaced when damaged.

It is a further object of my invention to provide a novel method of making a combustion chamber which will withstand severe bumping when moved over rough roads.

A still further object of my invention is to provide a novel combustion chamber in which the exterior surface is effectively heat-insulated from heat generated therein.

Other objects reside in novel details of construction and novel combinations and arrangements of parts, all of which will be described in the course of the following description.

Briefly stated, in a combustion device and method of making embodying my invention there is provided individual liner members of substantially uniform shape, each including an outer backing plate with a plurality of fasteners welded to the inner surface of the backing plate. A refractory material is molded on the inner surface of the backing plate covering the fasteners. Grooves are provided in each side of the refractory portion of the liner member.

A plurality of the liner members are attached to a housing of selected shape, such as box-like or a cylinder by welding each backing member in abutting relationship individually thereto to provide a substantially continuous lining within the housing. An insert material, preferably a glazing composition of the aluminum silicate type, fills the grooves and spaces between the adjoining liner members.

My invention will be described with reference to the accompanying drawings, in the several views of which like parts bear similar reference numerals. In the drawings:

FIG. 1 is a side elevation of a road grader on which the apparatus of my invention has been mounted;

FIG. 2 is a partial top plan view of the combustion chamber and burner assembly of the apparatus shown in FIG. 1;

FIG. 3 is a fragmentary section taken along the lines 3—3, FIG. 2, and drawn to an enlarged scale;

FIG. 4 is an end view of a rotary kiln-type dryer partly broken away to show the liner structure; and

FIG. 5 is a partial side elevation view of the dryer shown in FIG. 4 partly broken away to show the liner structure.

FIG. 1 represents a typical arrangement in which the novel apparatus is mounted on road-working equipment of any standard type having a scraper blade adjustable to different contact positions. As shown, the road grader 11 has an elongated frame, supporting an operator's cab 12 and power unit 13 mounted at its rear over the drive wheel assembly 14. The forward end of the frame is supported by wheels 15 controlled from cab 12 by a steering wheel 16 for steering and maneuvering the grader vehicle. The grader blade or moldboard 17 is disposed under an elevated portion of the vehicle frame between the front and rear wheels, usually in a position to be observed by the vehicle operator while operating.

The vehicle 11 has a hydraulic power system and a hydraulic drive unit 18 is connected at 19 with a hinged beam 20 on which the moldboard 17 is carried, permitting it to be tilted laterally and raised or lowered so that the blade can be disposed in selective cutting positions by control of the operator in cab 12. The apparatus of my invention includes a novel combustion chamber and burner assembly 21 which is mounted in a suspended position under the forward end of the frame in advance of moldboard 17 for selectively heating and softening portions of the pavement in the line of advance of the moldboard. The features of the mounting and controls of the combustion chamber assembly will be set forth in detail in the following description.

The aforesaid arrangement permits the operator of the

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vehicle 11 to selectively heat and soften roughened areas of the pavement preparatory to cutting and removing elevated surfaces by the following movement of the mold-board. In ordinary operation, there is no direct flame on the asphalt, and burner temperatures on the order of 2400° F. are developed with the heat energy radiated by the liners to penetrate the pavement with a major portion of the heat input in the infrared region of the spectrum.

A low-pressure gas is utilized as the fuel supply to the combustion chamber 22, and a supply tank 23 is mounted at the rear of vehicle for delivery through a conduit system including control members 26 located in the cab 12, and a header or manifold in the burner assembly 24 supplied by a line 25 extending from the control station 26 in cab 12. A pair of beams 27 fixed on the vehicle frame has a hinged connection 28 with the top of combustion chamber 22 at opposite sides of its center line and extensible rods or hangers 30 have hinged connections 29 with the forward end of the combustion chamber assembly and such connections preferably include a coil spring as shown.

Another hydraulic power unit 31 is connected with beams 27 for raising or lowering same under operator control as shown at 32 and additional adjustment is provided by manually extending or retracting connections 29 to predetermine positions of inclination whereby the forward end of the combustion chamber is maintained in closely spaced but proximate relation to the pavement surface, while its rear end is disposed at a slightly higher elevation to provide the desired exhaust of the products of combustion. Forward rollers 5 and rear rollers 6 are secured at the forward end and rear end, respectively, of the combustion chamber and will be described more fully with respect to FIG. 2. Combustion chamber 22 is supported so that rollers 5 and 6 are not normally in contact with the ground surface but will touch when irregularities in the ground surface are encountered to maintain the bottom portion of the combustion chamber in spaced relation with the ground surface. A heat shield 33 is supported forwardly of the combustion chamber by a pair of spaced channel members, one on each end, attached to a forward portion of the combustion chamber. Suitable linkage 35 couples between shield 33 and an operator control rod 36 for sliding the shield up and down in the channel members.

As shown in FIG. 2, the manifold 37 supplied by line 25 is carried on a framework of channel members, including side members 34a which are attached to the combustion chamber 22 at its rear and an integral end or bridging member 34b along which manifold 37 extends. A plurality of burner units 36 are carried on bridging member 34b in spaced relation and adjoining the rear end of combustion chamber.

A shell or housing 39 including upper and lower right angle end members 39a and 39b and T-shaped cross section members 39c provide a cage-like support for the individual liner members. One of the features of the combustion chamber assembly is that the liner members are mounted as an integral cover for the entire inside of the combustion chamber shell or housing and the joints are sealed to eliminate gaps which would function as heat paths and damage the housing by excessive temperatures. The shell or housing 39 when lined is a box-like member open at its bottom and provided at its rear with a plurality of side openings 40 which comprise the ports through which the fuel discharge from the burners is directed.

The liner members 41 as shown in FIG. 3 are formed in individual oblong blocks. Each liner member includes a backing plate 41a with a plurality of fasteners 44 attached to the inner surface and molded portion 41b of refractory material onto one side of the plate, covering the fasteners in the refractory material. The fasteners 44 have flat end portions 44a secured to the plate, preferably by welding and hook portions 44b embedded in the refractory material.

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The refractory portion 41b of the liner members includes aligned grooves 42 on the four sides of right angle shape. When positioned in the housing as shown in FIG. 2, the recesses of adjoining liner members align to form cup-like portions or air gaps which are filled with a glazing composition of the aluminum silicate type as shown at 43. The glazing composition may be the product of Carborundum Corporation sold under the trademark "Fibrefrax." The molded portion 41b of the liner members may be of any suitable composition capable of easy molding and withstanding high temperatures produced in the combustion chamber without warping and shrinking, such as a ceramic material. A material of the type used in the lining of smelting furnaces is well suited for this purpose. However, under some conditions it may be preferable to utilize metallic alloys capable of withstanding the high temperatures produced. This filler material has been found to remain in generally plastic condition after extended periods of continued usage.

The backing plate portion 41a and housing 39 are preferably of steel material. The liner members are rigidly attached to the inner surfaces of the housing portions 39a, 39b and 39c preferably by welding to backing plate portion 41a to provide a durable integral assembly capable of withstanding transport over bumpy roads.

As shown in FIG. 3, the lower portion of the side liner member held by housing portion 39b is of sufficient thickness to extend a substantial distance inwardly of portion 39b to effectively heat insulate this lower open portion of the housing from the heat generated in the chamber. Burner 36 is illustrated as sloping upwardly so as to direct the flame against the refractory liners and not to fire the pavement when the combustion chamber is used for pavement heating. The details of the burner unit 36 forms no part of this invention and is fully described in the copending application Serial No. 452,307 of which I am a coinventor. Air for combustion in the chamber is supplied through the burner 36 and opening 40.

The control of the fuel to burner 36 is varied for starting and moving from location to location and is described fully in the parent application. The heating is fast enough so that the combustion chamber is ready for regular operation within about 10-15 minutes, bringing the temperature on the inner face of the liner members to approximately 2100° F. When the heat has reached the operating requirements, the vehicle is moved at a slow speed, usually about 0.40 m.p.h. or less and the heating of the pavement in such action softens the roughened surfaces sufficiently so that they are readily removed by the scraping or cutting contact of the blades 17.

As the apparatus of the present invention is designed for installation on existing road working equipment, I have found it convenient to utilize the power system of such equipment for the various mechanical movements required in the operation and positioning of the apparatus. In the preceding description, reference has been made to the hydraulic system of the vehicle and the hydraulic power sources utilized in adjusting the combustion chamber position, etc. It will be understood that some road working equipment utilizes mechanical drives or power sources rather than hydraulic and mechanical drives will be quite satisfactory in the positioning of the combustion chamber and the like.

Although the novel liner assembly of the combustion chamber requires infrequent replacement during the life of the apparatus, the arrangement of the header and nozzle mounting, together with the fastening of the liner members, permits a relatively simple and easy relining procedure. The fuel supply and burner assembly are easily demounted by a few simple operations and the entire combustion chamber can be moved to a position in which its interior is exposed for removal of worn

liner sections and installation of a new liner assembly.

As shown in FIGS. 1 and 2, fuel delivered through manifold 37 discharges into a branch line supplying each of the burners 36. Burner unit 36 is positioned at a slight angle with the horizontal so that the flame is directed upwardly to heat the liner members. The liner members absorb this heat and reflect in the infrared spectrum. No flame or fire is directed onto the pavement. While any suitable fuel may be used, I prefer propane, although under some circumstances butane may be used.

The embodiment shown in FIGS. 4 and 5 comprises a cylindrical skeletal housing 49 including a circular end member 49a of right angle section at each end and intermediate cross members 49c of T-shaped section which extend axially in spaced relation between the end members. A plurality of liner members 51 are fitted in abutting relationship circumferentially and lengthwise of inside the housing to line the interior of the housing 49. Each liner member includes a backing plate portion 51a with hook-shaped fasteners 54 having a flat head attached in spaced relation to the backing plate. A molded portion 51b of refractory material extends inwardly of the backing plate portion and is of sufficient thickness to heat-insulate the interior walls of the housing. The inner refractory portion has alined grooves in each of its four sides forming cup-like portions between facing grooves. A glazing composition of the aluminum silicate type similar to that described with reference to FIGS. 2 and 3 fills the grooves and space between the adjoining liner members as shown at 53.

The backing plate portion 51a of each liner member is individually attached to the housing 51 by welding so that each liner member is individually removable, facilitating easy repair in case of breakage or deterioration of one member.

A novel method of making or assembling the above-described combustion chambers is used. The hook-shaped fasteners are attached to one side in spaced relationship on each plate by welding. A suitable mold is placed over the plate and the refractory mold material is poured into the mold covering the fasteners. The mold forms grooves in each of the four sides of the refractory material. After the refractory portion has hardened, the mold is removed and the liner member is completed. Each liner member is individually secured to the housing by welding with the refractory portion extending inwardly. Then the grooves and space between adjoining liner members are filled with the glazing composition previously described, thereby providing a substantially continuous lining within the housing.

From the foregoing, it is apparent that each liner member is securely attached to the outer skeletal housing and may be individually removed. The insert material between each individual member maintains enough fluidity throughout long periods of use so that it seldom cracks or breaks when subjected to severe bumping and effectively blocks any heat paths therethrough. The liner material is of sufficient thickness so there is low heat transfer to the outer surface. The welded attachment of the hooks is not heated excessively.

While it is understood that a combustion device and method of making same embodying this invention will provide a useful assembly for a permanent location, it is pointed out that the greatest utility is in portable apparatus which is subjected to periods of severe shaking.

Changes and modifications may be availed of within the spirit and scope of the invention as set forth in the hereunto appended claims.

I claim:

1. A combustion chamber comprising a housing, a plu-

rality of four-sided heat-radiating liner members, each having an inner portion of refractory material in abutting relationship lining the interior of said housing and being of sufficient thickness to heat-insulate the housing and an outer backing plate portion separately attached and rigidly secured to the housing, the inner refractory portion having an alined groove portion in each of its four sides forming cup-like portions between facing grooves, a glazing composition of the aluminum silicate type filling said cup-like portions and the space between said adjoining liner members to close the air space and to prevent heat transmission therebetween, thereby providing a substantially continuous lining within the housing, said composition retaining its generally plastic condition after continued periods of usage, and said lining receiving a heat supply and radiating the heat in the infrared region of the spectrum.

2. A combustion chamber as set forth in claim 1 wherein said housing is skeletal and box-like.

3. A combustion chamber as set forth in claim 1 wherein said housing is skeletal and cylindrical.

4. A combustion chamber as set forth in claim 1 wherein said housing includes upper and lower end members and cross members with a bottom opening, and the refractory portion extends beyond the lower end members to insulate the housing adjoining the bottom opening.

5. A combustion chamber as set forth in claim 1 wherein said lining receives a heat supply from at least one burner unit attached to a side of the housing which directs heat to the refractory portion of the liner members.

6. A combustion chamber as set forth in claim 1 wherein roller means are disposed forwardly and rearwardly of the housing in a normal position above a ground surface over which the housing is moved and contacts the ground surface when irregularities in the ground surface are encountered.

7. A combustion chamber as set forth in claim 1 wherein said housing is skeletal with end openings and includes a pair of spaced end members connected by axially extending cross members.

8. The method of assembling a combustion chamber which comprises the steps of forming a plurality of four-sided heat-radiating liner members having a plurality of fasteners secured on backing plates in spaced relation and with a refractory material molded onto one side of the plate covering the fasteners in a layer of sufficient thickness to heat-insulate the exterior of the chamber, forming alined grooves in each of the sides of the liner members, lining the interior walls of a housing with the lining members by securing each backing plate to an outer surface of the chamber with the refractory portion of the liner member extending inwardly, and filling the alined grooves and the space between adjoining liner members with a glazing composition which retains a generally plastic condition after continued periods of usage at high temperatures to close the air space and prevent heat transmission therebetween, thereby providing a substantially continuous lining for the interior walls of the housing.

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70 CHARLES J. MYHRE, *Primary Examiner*.