June 23, 1942. F. O. HESS 2,287,245

FURNACE WALL BURNER

Filed May 3, 1938 2 Sheets-Sheet 1

Fig. 1.

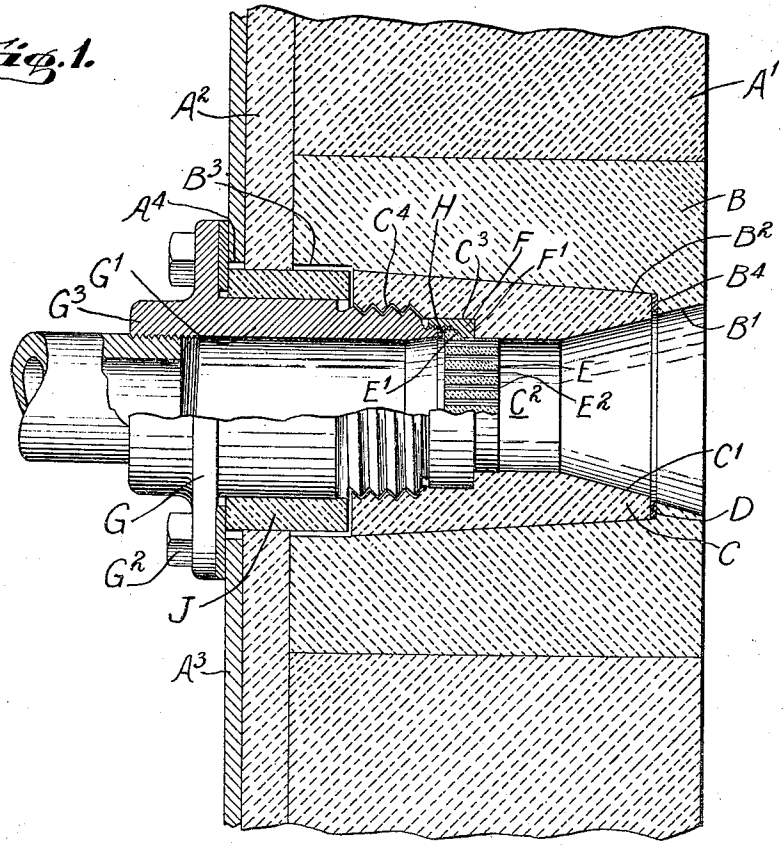


Fig. 2.

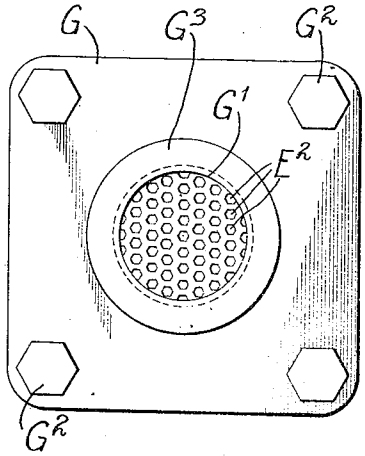
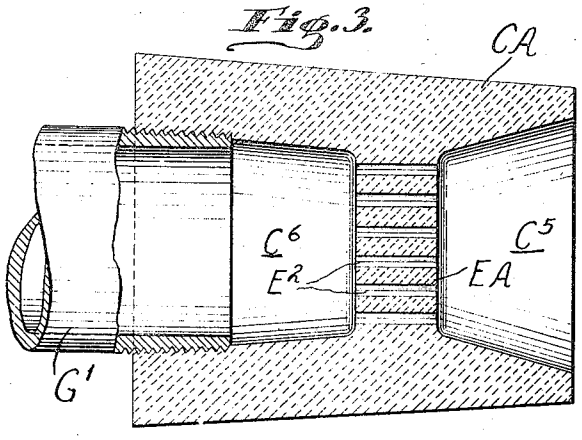


Fig. 3.



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Fig. 4.

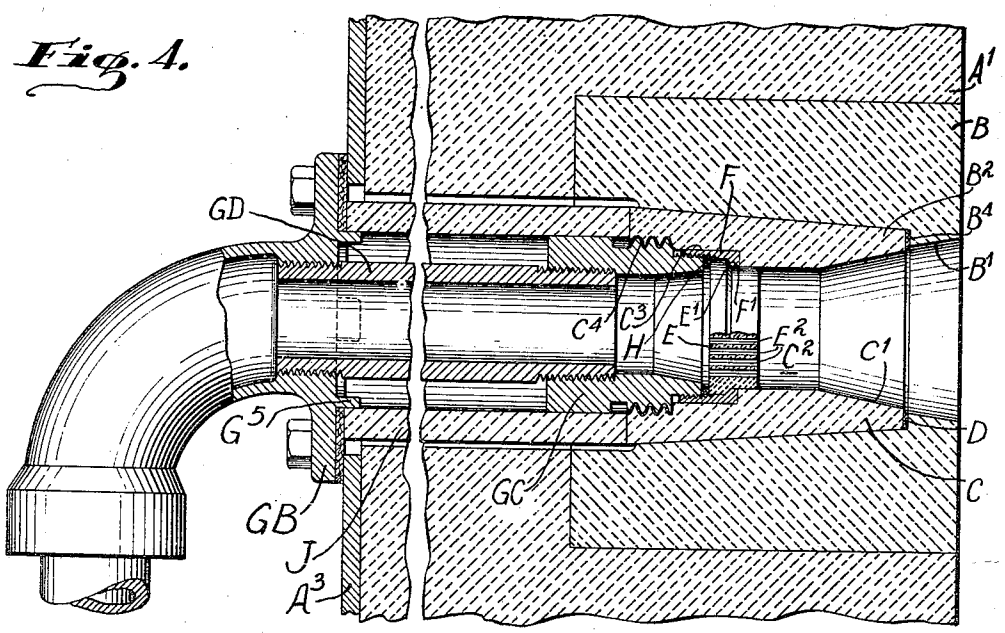
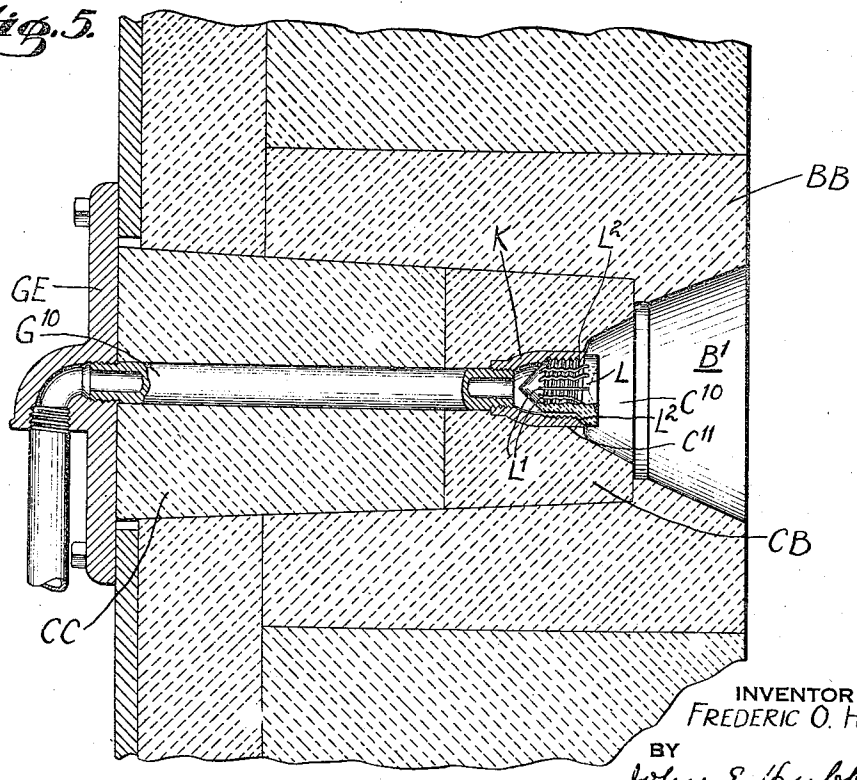


Fig. 5.



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FURNACE WALL BURNER

Frederic O. Hess, Philadelphia, Pa., assignor to The Selas Company, Philadelphia, Pa., a corporation of Pennsylvania

Application May 3, 1938, Serial No. 205,681

15 Claims. (Cl. 158—7)

The general object of the present invention is to provide improvements in a furnace of the type comprising a furnace chamber heated by one or more gas burners mounted in the wall of the chamber.

A specific object of the present invention is to provide for the removable mounting in the furnace wall of burner parts which may be put in place, and removed for replacement and repairs, from the outer side of the wall.

Another specific object of the invention is to provide a self-contained burner unit adapted for removable mounting in an opening formed for the purpose in and extending through the wall of the furnace chamber, so that the burner unit can be withdrawn and replaced, while the furnace is hot, and without significant disturbance in furnace operating conditions, if, as is usual, the furnace has a plurality of burners in its wall, so that the temporary removal of a single burner need reduce the rate of heat supply to the furnace but little, if any.

In preferred forms of the present invention, I permanently incorporate in the furnace wall a special perforated refractory burner block for each burner, each such block being formed with a suitably shaped passage to receive a burner assembly having its inner portion formed of refractory material fitting snugly in said passage.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however; its advantages, and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

Of the drawings:

Fig. 1 is a section through a portion of a furnace wall and through a burner mounted in said wall;

Fig. 2 is an end elevation, of the burner shown in Fig. 1;

Fig. 3 is an axial section of a portion of a modified burner assembly; and

Figs. 4 and 5 are views, each taken similarly to Fig. 1, and each illustrating a different burner assembly modification.

In the arrangement shown in Fig. 1, A′ represents the firebrick or other refractory inner body portion of a wall of a furnace adapted for operation with relatively high furnace chamber temperatures. An outer portion A^2 of said wall, is formed of so-called heat insulating refractory material, and A^3 represents the outer metallic shell or casing customarily employed in such furnaces. Permanently incorporated in the inner wall body A′, to receive each burner removably mounted in the furnace wall in accordance with the present invention, is a corresponding special refractory block B.

Each block B is formed with a through passage open at its inner end to, and extending away from the furnace chamber. As shown in Fig. 1, said passage comprises coaxial inner, intermediate and outer portions B′, B^2 and B^3, respectively. The inner portion B′ is conical, or tapering in cross section with its smaller end outermost. The section B^2 is also conical, or tapering in cross section with its smaller end innermost and larger in cross section than the adjacent end of the portion B′, the block B having an annular shoulder B^4 extending radially outward from the inner end of the portion B′ to the peripheral wall of the portion B^2. The passage portion B^3 is cylindrical.

In the construction shown in Fig. 1, an externally tapered tubular burner body part C of refractory material is inserted into, and fills, the tapered passage portion B^2, and has its inner end attached by cement D to the shoulder B^3 of the block B. The passage through the tubular body C is coaxial with the passage through the block B, and comprises sections C′, C^2, C^3 and C^4 at successively greater distances from the inner face of the furnace wall A. The passage portion C′ is tapered in the same direction as the block passage portion B′, and unites with the latter to form an expanding nozzle portion of the burner tunnel or combustion space. The passage portion C^2, C^3 and C^4 are shown as cylindrical and of progressively increasing diameters, and the wall surrounding the passage portion C^4 is formed with a coarse internal screw thread.

A burner orifice wall member E, in the form of a disc of ceramic material, has an inner end portion received in and filling the outer end of the passage portion C^2, and has a larger diameter outer end portion within the passage portion C^3. In the construction shown in Fig. 1, the enlarged outer end portion of the member E does not fill the passage portion C^3, but is surrounded by a ring shaped member F made of refractory metallic alloy material, and having an internally threaded outer end portion and formed at its inner end with an internally extending flange portion F′, which abuts against the tapered shoulder E′ of the member E connecting the

peripheral surfaces of the smaller and larger diameter portions of the member. The burner wall member E is shown as formed with a multiplicity of relatively fine burner orifices E^2 of polygonal cross section, and separated from one another by relatively thin walls, as specified and claimed in my prior Patent 2,103,365, granted Dec. 28, 1937.

As shown in Fig. 1 the burner parts C, E and F are secured together, by a metallic burner member G, which, as shown, is a one-piece casting comprising a plate-like outer portion and a tubular inner portion G'. The latter has its inner end threaded into the member F, and in clamping engagement with the outer side of the member E directly, or, as shown, through a gasket ring H. The portion G' is provided with a coarse external thread at the outer end of the member F, for threaded engagement with the threaded wall of the passage portion C^4. The outer portion of the member G is in the form of a plate of rectangular outline extending transversely to the burner axis, outwardly from the periphery of the tubular portion G', to overlap the portion of the metallic furnace wall shell A^3 at the margin of the burner opening A^4 therein. The member G is secured to the furnace wall as by means of bolts G^2 connecting it to the shell A^3, a gasket I being interposed between the part G and shell A^3. As shown, the member G, is formed with an externally extending, internally threaded boss G^3, for the attachment of a pipe supplying gas, or, more usually, a combustible mixture of air and gas to the burner. In the particular construction shown, a ring J of insulating refractory material surrounds the tubular portion G' at the outer end of the ceramic burner body part C.

The construction shown in Figs. 1 and 2 has important practical advantages. Since all of the non-metallic refractory burner parts including the blocks B are molded and fired and none needs to have its shape altered in the field, erection costs are reduced, and closer tolerances, and the use of higher grade materials, in the manufacture of said parts, are permitted than would be possible if the parts were to be manufactured, or modified in shape, by a field operation in the process of erecting the furnace and installing burners therein.

As the burner blocks B are relatively massive and are built into the main firebrick portion of the furnace wall, it is comparatively easy to accurately position those blocks in the wall, in the construction of the latter, and there is practically no risk of the subsequent displacement of the blocks, so long as the furnace wall remains in operative condition.

The accurate shaping of all of the refractory burner parts insures that when a burner assembly is put in place in a burner block, the relatively movable parts will all be accurately positioned, and, in particular, that the burner block tunnel portion B' and the passage portion C' in the burner body part C will be properly positioned relatively to one another, as is necessary for full burner efficiency. The accurate shaping and fitting together of the parts facilitates the removal of the burner assembly parts for inspection, repairs, or for replacements. The easy replacement of burner assembly parts is particularly important, because of the fact that the best combustion results requires the use of an orifice member E, having differently proportioned orifices for fuel mixtures of different compositions. Moreover, the burner refractory forms which will give the most satisfactory results in the operation of a particular furnace, cannot always be determined until the furnace has been built and subjected to test operations.

The fact that the burner assembly is assembled and may be inspected externally of the furnace, and that the passageway through each burner block may be inspected when the assembly is not in place, contributes to the proper juxtaposition of the parts of the burner assembly, and the proper mounting of the latter in the corresponding burner block passage. The cement joint D between the burner assembly and the block surface B^4 is easily broken when necessary for the removal of the burner assembly, and the surface B^4 and the end of the burner part C may be readily cleaned preparatory to the re-establishment of the cement joint, when the burner assembly is again put in place in the furnace wall, after first putting cement in place on the small end of the part C.

The use of the metallic clamping ring F practically insures against leakage through the joint between the parts G and E, and provides protection for the latter against accidental injury. The use of a coarse threaded connection between the parts G' and C and the relatively large diameter of that connection makes its connection a strong one and makes it possible to apply considerable force to the refractory part C through the metallic part G when necessary in unseating and removing the burner assembly.

As previously indicated, the fact that the burner assembly may be inserted and removed by an attendant at the outer side of the furnace, not only contributes to the ease of the insertion and removal operation, but permits those operations to be effected with little or no disturbance in furnace operating conditions. The fact that the entire burner structure includes no metal exposed to the high temperatures which may exist in the furnace chamber and burner tunnel, contributes to burner longevity, reduces the burner construction and maintenance cost, and adapts the burner to use with high furnace chamber temperatures. As has been practically demonstrated, such a furnace wall construction as is shown in Figs. 1 and 2, is adapted for use with a furnace chamber temperature as high as 3400° F.

While the burner assembly illustrated was primarily devised for, and it is expected that its use will be confined mainly to furnace wall use, the burner assembly itself is an operative structure, and is capable of use when it is not mounted in a furnace wall, and when not inserted in the block B in which it is normally incorporated.

The division of the burner assembly into parts shaped, relatively positioned, and connected as it is in the construction shown in Fig. 1, and in the other constructions, hereinafter described, practically eliminates risk of burner assembly failure as a result of relative thermal expansion and contraction of the burner assembly parts.

In Fig. 3, I have illustrated a modified burner construction comprising a refractory burner body part CA differing essentially from the part C of Fig. 1, in that it comprises an integral burner-wall or orifice portion EA. The latter corresponds functionally, and in its general location, to the separate orifice member E of the construction first described. As shown, the wall EA extends between a tapered tunnel or combustion

space C^5 and an inlet chamber C^6 into which the tubular portion G' of the outer metallic burner member is threaded. The part CA is readily molded, and is relatively simple in construction and inexpensive to manufacture, and is inherently capable of a long operative life, if made of refractory material which will not crack or distort in the course of its manufacture and normal use.

To permit burner units for use in furnace walls of various thicknesses, to be assembled for the most part from standard stock parts, I may employ the construction shown in Fig. 4, which differs from the construction shown in Figs. 1 and 2, essentially only in that the one-piece outer metallic member G of Figs. 1 and 2, is replaced in Fig. 4, by a metallic burner member comprising separate sections or parts GB, GC and GD. The parts GB and GC are shown as similar, respectively, to the integrally connected plate and tubular portions of the member G. The part GD is a nipple, or pipe section, extending between and in threaded engagement with each of the parts GB and GC. The length of the pipe section GD and the length of the surrounding insulation ring J, are each determined by the thickness of the particular wall in which the burner is incorporated. As shown, the part GB is formed at its inner side with lugs G^5 extending into, and centering the outer end of the member J.

While all the burner forms described above include an orifice wall of the type of my above mentioned prior Patent No. 2,103,365, the practice of the present invention does not require the use of the special orifice wall of that patent. On the contrary, a burner constructed in accordance with the present invention may be of the simple, single, orifice and tunnel type, or of other and quite different types.

In particular, it is advantageous in some cases, to employ a burner of the type shown in Fig. 5, wherein the combustible fuel mixture is discharged into a refractory walled combustion space C^{10}, in jets diverging away from the burner axis, alongside corresponding portions of the wall of said space. The burner unit assembly shown in Fig. 5 comprises a conical refractory insert consisting of inner and outer refractory bodies CB and CC. The body CB is formed with the hereinbefore mentioned combustion space C^{10}, which opens to the inner end of the burner block passage portion B'. The refractory bodies CB and CC are connected to an outer plate-like metallic part GE, generally like the part GB of Fig. 4, by a pipe section G^{10} threaded at its outer end to the part GE, and threaded at its inner end into a tubular part K. The latter is seated in a socket C^{11} formed for the purpose in the refractory body CB, and opening centrally into the combustion space C^{10}. The part K, which is of smaller diameter at its inner end than at its outer end, and the pipe G^{10}, thus form means for clamping the other burner assembly parts together. The member K is internally theraded and has its inner end surface outwardly flared or bevelled.

A burner tip or orifice member L, preferably formed of ceramic material, comprises an externally threaded body portion which is screwed into the member K, and an outer head portion of larger diameter connected to the body portion by a bevelled surface which is parallel to and bears against the bevelled end surface of the member K. The tip member L is formed with grooves L' each comprising an axially extending body portion in the body portion of the member, and an outer end portion L^2, inclined away from the axis of the burner at approximately the same angle as are the surface elements of the bevelled end surface of the member K. Said bevelled end surface closes the otherwise open surface outer edge of each inclined groove portion L^2, and the body of the member L similarly closes the otherwise open outer side of the body portion of each groove L.

The previously mentioned combustion space C^{10} may be described as cup-shaped, with the portions of the surface elements of its wall adjacent the member L, diverging from the burner axis as do the inclined burner tip grooves L^2. The angle of divergence from the burner axis of the burning jets discharged into the space C^{10}, diminishes as the distance from the outer end of the combustion space increases, and the wall of the space C^{10} is so shaped that the angle of divergence to the burner axis of each surface element of said wall similarly diminishes, so that the burning jets may be close to the wall of the space C^{10} at all points along the lengths of the jets, without impingement of the inner flame cones of the burning jets against said wall.

The burner construction shown in Fig. 5 is the best form of burner known to me for use where it is desirable to effect complete combustion within the combustion space collectively formed by the space C^{10} and the passage portion B' of Fig. 5, and where it is desirable that a relatively large portion of the heat liberated should be radiated into the furnace chamber. A burner including provisions for discharging burning jets into a cup-shaped combustion space in the manner just described, while novel with me, is not claimed herein, but is claimed in Patent No. 2,215,079, granted September 17, 1940, on my prior application, Ser. No. 88,744, filed July 3, 1936. The construction shown in Fig. 5 is shown and described but not claimed per set, in Patent No. 2,215,081, granted September 17, 1940, on my prior application, Ser. No. 162,263, filed Sept. 30, 1937, of which the present application is to be regarded as a continuation in part.

As will be apparent, in addition to their special advantages, the constructions shown in Figs. 3, 4, and 5, have the above mentioned general advantages of the construction shown in Figs. 1 and 2, and while in accordance with the provisions of the statutes, I have illustrated and described herein the best forms of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed herein, without departing from the spirit of my invention as set forth in the appended claims, and that, in some cases, certain features of my invention may be used with advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The combination with a masonry furnace wall, including a molded prefired block of refractory material permanently mounted in said wall and having one side facing the furnace chamber and having a passage which extends through said wall and block and comprises a burner seat portion formed in said block, and a tubular molded refractory burner body seated in said seat and insertable in and removable from said seat

through the outer end of said passage and comprising an orifice wall portion which forms the outer end wall of a combustion space including the inner end portion of said passage and which is formed with a plurality of orifices adapted to discharge distributed jets of a combustible mixture of air and gas into said combustion space.

2. The combination with a masonry furnace wall, including a molded prefired block of refactory material permanently mounted in said wall, and having one side facing the furnace chamber and having a passage which extends through said wall and block and comprises a conical burner seat portion formed in said block and having its larger end outermost, and a hollow conical molded refractory burner body seated in said seat portion and movable into and removable through the outer end of said seat and comprising an orifice wall portion which forms the outer end wall of a combustion space including the inner end portion of said passage and which is formed with a plurality of orifices adapted to discharge distributed jets of a combustible mixture of air and gas into said combustion space.

3. The combination with a masonry furnace wall, including a molded prefired block of refractory material permanently mounted in said wall and having one side facing the furnace chamber and having a passage which extends through said wall and block and comprises a burner seat portion formed in said block, a tubular molded refractory burner body seated in said seat portion and insertable in and removable from said seat through the outer end of said passage and comprising an orfice wall portion which forms the outer end wall of a combustion space including the inner end portion of said passage and which is formed with a plurality of orifices adapted to discharge distributed jets of a combustible mixture of air and gas into said combustion space, and a tubular metallic burner part attached to and extending away from said tubular body to the outer side of said wall and adapted to hold said refractory body in said seat portion and to serve as a conduit supplying said mixture to said orifices.

4. The combination with a masonry furnace wall, including a molded prefired block of refractory material permanently mounted in said wall and having one side facing the furnace chamber and having a passage which extends through said wall and block and comprises a burner tunnel portion adjacent said side and an adjacent burner seat portion, both of said portions being formed in said block, said burner seat portion having its end adjacent said tunnel portion larger in cross section than said tunnel and smaller in cross section than the end of the seat portion remote from the tunnel, a tubular molded refractory burner body fitting, and seated in said seat portion, and movable into and out of the latter through the outer end of said passage and comprising an orifice wall portion which forms the outer end wall of a combustion space including the inner end portion of said passage and which is formed with a plurality of orifices adapted to discharge distributed jets of a combustible mixture of air and gas into said combustion space and a tubular metallic burner part attached to and extending away from said tubular body and adapted to hold said burner body in place and as a conduit supplying said mixture to said orifices.

5. The combination with a furnace wall, comprising an outer metallic casing and a masonry body portion, the latter including a molded prefired block of refractory material permanently mounted in said wall and having one side facing the furnace chamber, and having a passage which extends through said wall and block, said passage comprising a burner seat portion formed in said block, a tubular molded refractory burner body shaped to fit in said seat portion and movable into and out of the latter through the outer end of said passage and comprising an orifice wall portion which forms the outer end wall of a combustion space including the inner end portion of said passage and which is formed with a plurality of orifices adapted to discharge distributed jets of a combustible mixture of air and gas into said combustion space, and a metallic burner part comprising a tubular portion attached to and extending outwardly away from said tubular body and an outer portion detachably secured to said metallic casing.

6. A burner assembly adapted for insertion in the outer portion of a burner passage extending through the refractory wall of a furnace chamber, comprising a tubular non-metallic refractory body larger in cross section at one end than at the other and having a portion displaced from its smaller end internally threaded and formed with a plurality of spaced apart burner orifices and a metallic member comprising a tubular portion extending into said tubular refractory body at the larger end of the latter and in threaded engagement with its threaded portion and adapted to supply a combustible fluid mixture to said orifices.

7. A burner assembly adapted for insertion in the refractory wall of a furnace chamber, comprising a tubular non-metallic refractory body formed with a seat intermediate its ends and with an internally threaded end portion, an orifice member of ceramic material and formed with spaced apart orifices and insertable in said seat through said threaded end portion and fitting against said seat and making a gas tight joint therewith, and a metallic member comprising a tubular portion extending into said tubular refractory body and in threaded engagement with its threaded portion and clamping said orifice member against its seat.

8. A burner assembly adapted for insertion in the refractory wall of a furnace chamber, comprising a tubular non-metallic refractory body larger in cross sectional outline at one end than at the other and having a portion adjacent its larger end internally threaded, orifice means extending across the passage through said body and providing a plurality of small orifices leading from said internally threaded portion to the portion of said passage adjacent the smaller end of the body, and a metallic member comprising a tubular portion extending into said tubular refractory body at the larger end of the latter and in threaded engagement with its threaded portion.

9. A burner assembly adapted for insertion in the refractory wall of a furnace chamber, comprising a tubular non-metallic refractory body formed with a seat intermediate its ends and with an internally threaded end portion, a metallic ring insertable into said seat through said end portion and having a threaded end portion and having an annular seat formed in its other end portion, an orifice member of ceramic material insertable into the last mentioned seat through the threaded end portion of said ring,

and a metallic member comprising a tubular portion extending into said tubular refractory body and in threaded engagement with the threaded portions of said refractory body and ring.

10. A furnace wall burner construction comprising a molded block of refractory material adapted to be built into a refractory furnace chamber wall with one side facing the furnace chamber and having a passage which extends from said side to the opposite side of the block and comprises a burner tunnel portion adjacent said side and a burner seat portion having one end adjacent to and larger in cross section than said tunnel portion and smaller in cross section than the other end of said seat portion, a tubular non-metallic refractory burner body shaped to fit in and movable into and out of said seat portion through the end of said passage adjacent said other side of the block.

11. The combination with a masonry furnace wall, including a molded prefired block of refractory material permanently mounted in said wall and having one side facing the furnace chamber and having a passage which extends through said wall and block and comprises a burner seat portion formed in said block, a tubular non-metallic refractory burner body seated in said seat and insertable in and removable from said seat through the outer end of said passage and comprising an orifice wall portion which forms the outer end wall of a combustion space including the inner end portion of said passage and which is formed with a plurality of orifices adapted to discharge distributed jets of a combustible mixture of air and gas into said combustion space and cement providing a frangible seal for the joint between said seat and body.

12. The combination with a masonry furnace wall, including a molded prefired block of refractory material permanently mounted in said wall and having one side facing the furnace chamber and having a passage which extends through said wall and block and comprises a burner tunnel portion adjacent said side, and an adjacent burner seat portion formed in said block said burner seat portion having its end adjacent said tunnel portion larger in cross section than the adjaent end of said tunnel portion, a tubular non-metallic refractory burner body fitting and seated in said seat portion and movable into and out of said seat through the outer end of said passage and comprising an orifice wall portion which forms the outer end wall of a combustion space including the inner end portion of said passage and which is formed with a plurality of orifices adapted to discharge distributed jets of a combustible mixture of air and gas into said combustion space.

13. The combination with a masonry furnace wall, including a molded prefired block of refractory material permanently mounted in said wall and having one side facing the furnace chamber and having a passage which extends through said wall and block and comprises a burner tunnel portion adjacent said side, and an adjacent burner seat portion formed in said block said burner seat portion having its end adjacent said tunnel portion larger in cross sectional outline than the adjacent end of said tunnel portion, a tubular refractory burner body fitting and seated in said seat portion and movable into and out of said seat through the outer end of said passage and comprising an orifice wall portion which forms the outer end wall of a combustion space including the inner end portion of said passage and which is formed with a plurality of orifices adapted to discharge distributed jets of a combustible mixture of air and gas into said combustion space, and cement in the joint between the inner end of body and the adjacent portion of said block.

14. A burner assembly, comprising an elongated one-piece non-metallic refractory body adapted to extend into and plug a passage in the refractory wall of a furnace chamber and formed with a combustion space in its furnace end chamber portion and with an inlet chamber in its other end portion and with an integral orifice wall between said space and chamber and a metallic member mechanically connected to said body and comprising a tubular conduit portion opening into said inlet chamber.

15. A burner assembly comprising a tubular non-metallic refractory burner body adapted for insertion in a passage in the refractory wall of a furnace chamber and comprising an orifice wall portion which forms the outer end wall of a combustion space including the inner end portion of said passage and which is formed with a plurality of orifices adapted to discharge distributed jets of a combustible mixture of air and gas into said combustion space and having an internally threaded portion adjacent its outer end, a tubular metallic part in threaded engagement with said internally threaded portion, an outer metallic part adapted to engage the outer side of the furnace wall at the margin of said passage, and a pipe section having its ends threaded one into said tubular part and the other into said outer metallic part.

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