

June 28, 1949.

F. O. HESS

2,474,313

INCANDESCENT GAS BURNER FOR FURNACE WALLS

Filed Oct. 25, 1943

4 Sheets-Sheet 1

Fig. 1.

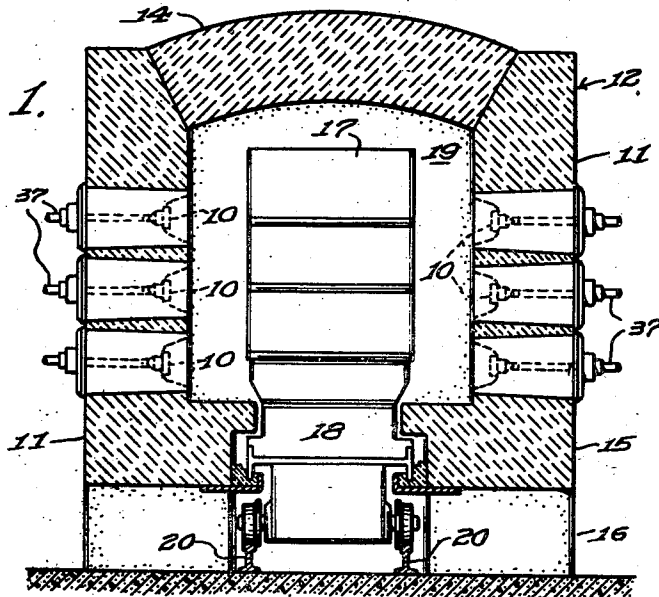
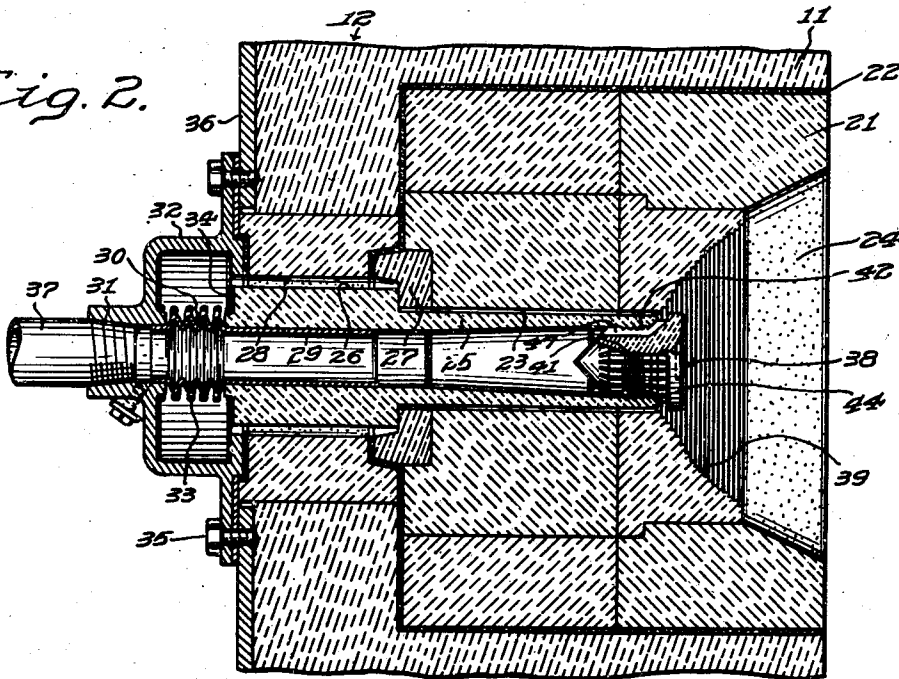


Fig. 2.



WITNESS

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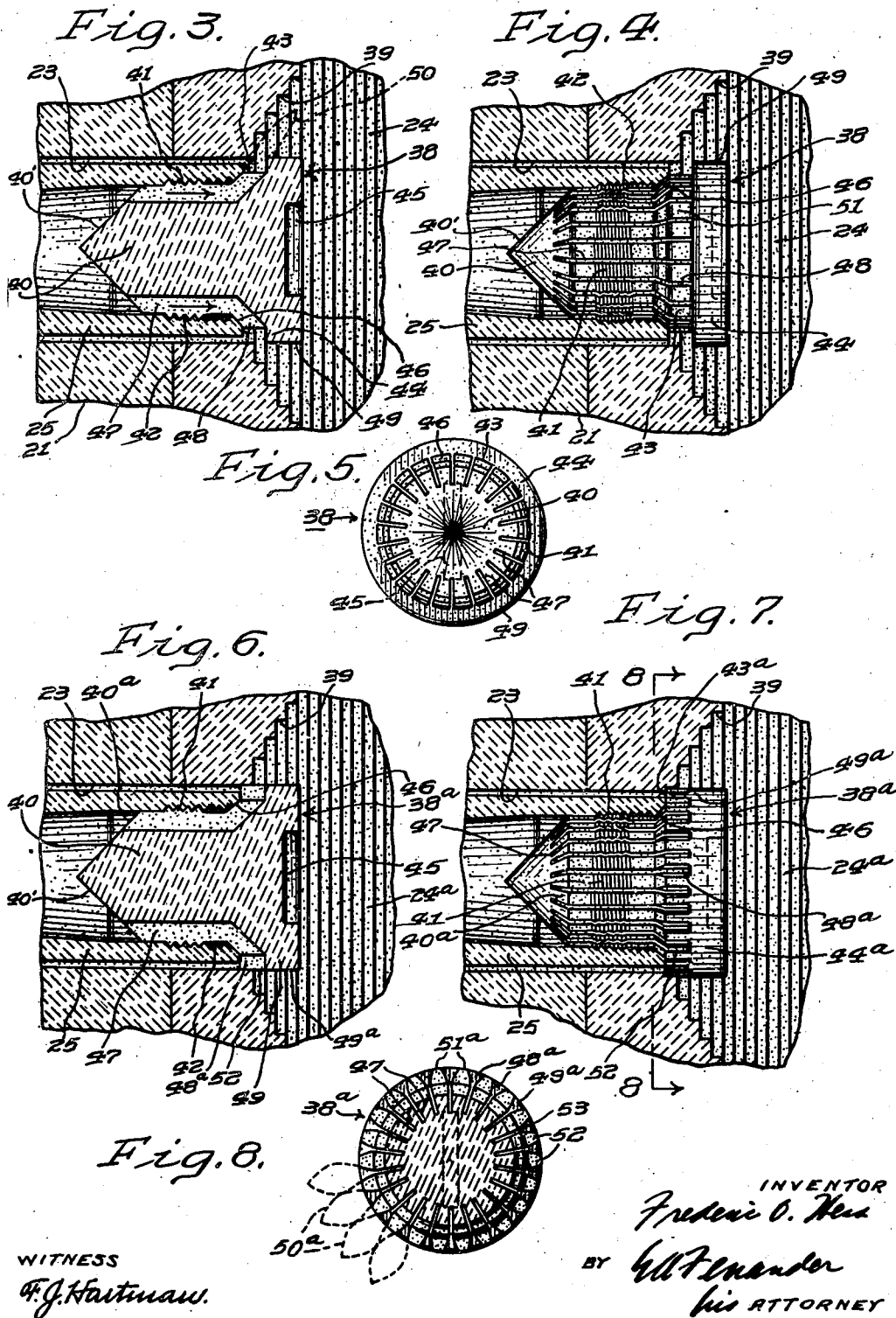
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4 Sheets-Sheet 2



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INCANDESCENT GAS BURNER FOR FURNACE WALLS

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4 Sheets-Sheet 4

Fig. 11.

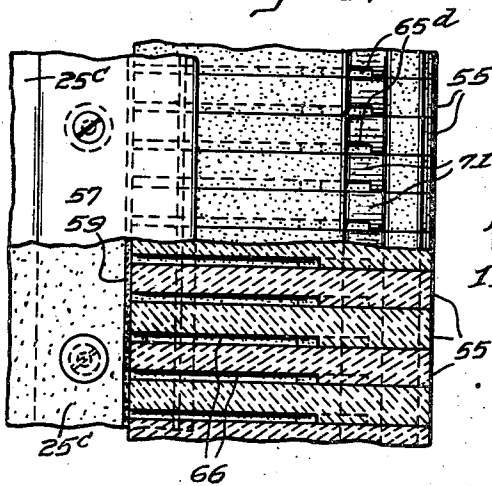


Fig. 12.

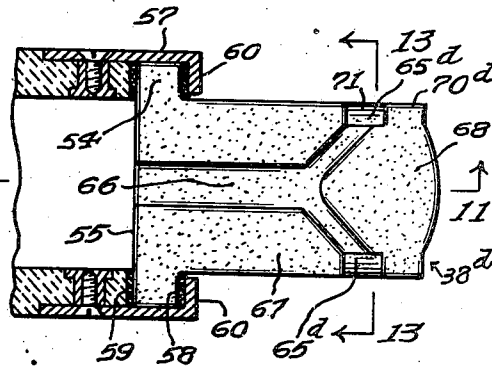


Fig. 13.

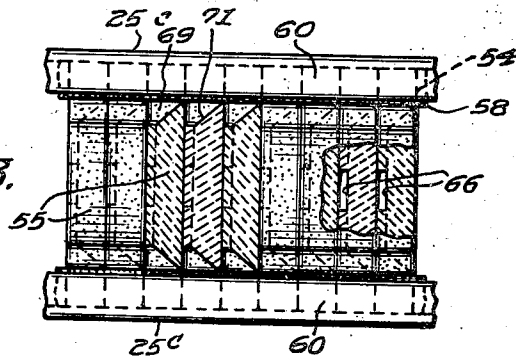


Fig. 14.

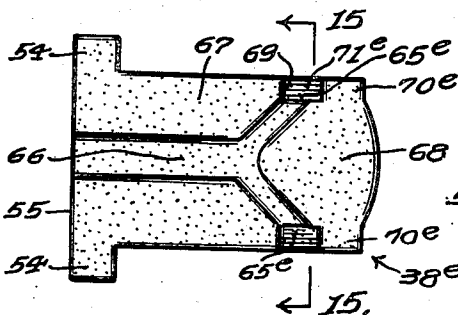
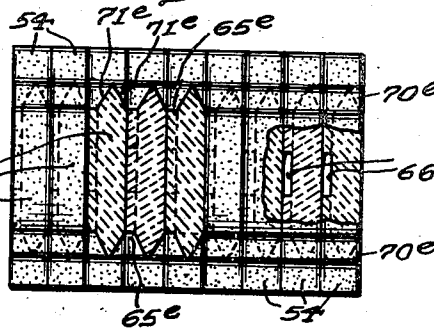


Fig. 15.



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2,474,313

INCANDESCENT GAS BURNER FOR
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Application October 25, 1943, Serial No. 507,492

11 Claims. (Cl. 158—7)

1

My invention relates to gas burners, and more particularly to burners having a distributor for sub-dividing a combustible gas mixture into a plurality of streams and at a surface of which a plurality of flames are produced and maintained. This application is a continuation-in-part of application Serial No. 365,440, filed November 13, 1940 and now abandoned.

Although not to be limited thereto, my improved distributor for gas burners is especially useful in a burner of the kind described and illustrated in Hess Patent No. 2,215,079 granted on September 17, 1940, and assigned to the same assignee as this application. While the above-mentioned patent discloses a distributor for a burner which is satisfactory for most uses, there are a few special instances in which the burner distributor is sometimes troublesome in operation. This is especially true when slow burning natural gases are used, for example, in which case there is an occasional ignition failure when the burners are being operated at relatively low capacity and at reduced temperature. When distributors of the character heretofore provided are used in burners for heating furnaces, such distributors are satisfactory in most cases. However, when materials are being heated from which vapors are expelled and such vapors condense on the distributors and form a deposit, such as glaze, for example, objectionable clogging of the gas passages may result.

It is, therefore, an object of my invention to provide an improved burner provided with a distributor capable of maintaining ignition even when the latter is being operated at reduced capacity, and particularly when using slow burning natural gases or other gases of a similar nature.

Another object of my invention is to provide an improved distributor of such shape that the outlets of the slots or passages formed therein, and from which the gas streams are discharged, are protected from any matter tending to deposit thereon at the regions between the slot outlets.

A further object of my invention is to provide an improved distributor having slots or passages formed therein of such shape that the velocity of the gas mixture flowing through the passages is reduced before issuing from the discharge ports, thereby insuring a velocity of the gas mixture in the greatest part of the passages which is beyond the range of flame propagation while the velocity of at least a part of the gas mixture at the outlet ends of the passages and just be-

2

fore issuing from the discharge ports is within the range of flame propagation.

A still further object of my invention is to provide a distributor having the slots or passages formed so that streamline flow of the individual gas streams is effected as the streams issue from the distributor slots, whereby the regions at the vicinity of the slot outlets are always in an environment filled by the issuing gas streams and re-circulated gases containing objectionable deposit forming vapors cannot be drawn toward and come in contact with the surfaces of the distributor and form a deposit at the immediate vicinity of the slot outlets or discharge ports.

A still further object of my invention is to provide a distributor for a burner having a refractory wall associated therewith, in which improved heating of the refractory wall to incandescence is effected by a plurality of flames maintained at the surface of the distributor, thereby increasing the temperature of the refractory wall which serves as a source of radiant heat.

The invention, together with the above and other objects and advantages thereof, will be more fully understood upon reference to the following description and the accompanying drawings forming a part of this specification, and of which:

Fig. 1 is a sectional view of a furnace provided with burners embodying the invention;

Fig. 2 is an enlarged sectional view of one of the burners shown in Fig. 1 to illustrate the burner structure more clearly;

Fig. 3 is an enlarged sectional view of the burner distributor shown in Fig. 2 to illustrate the shape of the distributor and also several of the slotted passages therein;

Fig. 4 is a view similar to Fig. 3 illustrating the distributor in elevation;

Fig. 5 is an end view of the burner distributor shown in Fig. 4, looking at the distributor from the tapered or pointed end toward the opposite enlarged end;

Figs. 6 and 7 are views similar to Figs. 3 and 4 illustrating another embodiment of the invention;

Fig. 8 is a view generally similar to Fig. 5 and taken at line 8--8 of Fig. 7;

Fig. 9 is a horizontal plan view of a furnace provided with elongated burners illustrating a further embodiment of the invention;

Fig. 10 is a sectional view of one of the burners diagrammatically illustrated in Fig. 9;

Fig. 11 is an enlarged sectional view of a burner distributor, taken at line 11--11 of Fig. 12, illus-

trating a still further embodiment of the invention;

Fig. 12 is a vertical sectional view of the burner distributor shown in Fig. 11;

Fig. 13 is an end view of the burner distributor of Fig. 12 looking toward the enlarged end thereof, and partly broken away and in several fragmentary sections including that taken at line 13—13 of Fig. 12;

Fig. 14 is a sectional view similar to Fig. 12, illustrating a still further embodiment of the invention; and

Fig. 15 is an end view of the burner distributor of Fig. 14 looking toward the enlarged end thereof, and partly broken away and in several fragmentary sections including that taken at line 15—15 of Fig. 14.

Referring to Fig. 1, burners 10 provided with distributors embodying the invention are mounted and incorporated in the side walls 11 of a furnace 12. The furnace 12 is formed with a roof 14 and a floor 15 which is supported by a foundation 16 on a supporting surface. The material 17 to be heated within the furnace 12 may be mounted on a car 18 which is moved slowly through the furnace chamber 19 on a track 20.

The burners 10 are arranged at different elevations and distributed lengthwise of the side walls 11, the number of burners and distribution being such that desired heating is effected of the material 17 passing through furnace chamber 19.

The burners 10 are mounted in and form a part of the side walls 11. As shown most clearly in Fig. 2, each burner 10 comprises a molded block 21 of ceramic material which is secured in position in one of the side walls 11 by a suitable high temperature fire-brick cement 22. The blocks 21 may have different portions thereof formed of refractory materials possessing different heat resisting and thermal conducting properties, so that each portion will possess the most desirable heat resisting and thermal properties for its particular position in the block. The different portions of each block are compacted into a single unitary structure by a suitable molding operation to provide the blocks 21 which are rectangular in cross-section.

The blocks 21 are formed with central passages 23 which extend therethrough and terminate at cup-shaped spaces 24 formed at the inner faces of the side walls 11. Within the passage 23 is disposed a burner tube or sleeve 25 having the inner end thereof terminating at a region closely adjacent to the inner end of the passage 23. The outer portion of tube 25 is formed with an outwardly extending shoulder 26 which fits snugly against a collar 27. The collar 27 may be a pre-formed and pre-fired body of porcelain which is thereafter united to the block 21 at the same time that the different portions of a block are united together by a firing operation. In order to position the tubes 25 accurately in the passages 23, the surfaces of the collars 27 engaged by the shoulders 26 may be ground after the blocks 21 are formed. The shoulder 26 of each tube 25 is positioned in an enlarged opening or well 28 extending from the outer end of passage 23 to the outer face of the side wall 11. Within the outer end of burner tube 25 is secured the inner end of a metal tube 29, as by cement, for example.

The outer end of each metal tube 29 is secured to the inner end of a short length of flexible

tubing 30 which is fastened at its opposite end to the inner end of an internally threaded opening 31 formed in a hollow cover plate 32. Within the hollow cover plate 32 is provided a helical coil spring 33 which is arranged to exert force against the outer end 34 of shoulder 26. In this way the shoulder 26 will always snugly press against the collar 27 irrespective of the relative expansion of the different burner parts over the wide temperature range encountered during operation of the furnace 12. The cover plate 32 is sufficiently large to close the enlarged opening or well 28 and is secured at 35 to the outer metallic shell 36 of the furnace 12.

A suitable combustible mixture is delivered from a source of supply through conduits 37 connected to the internally threaded openings 31 of the burners 10. The conduits 37 for supplying combustible gas mixture to the burners 10 may be arranged in any desirable manner, and suitable controls may be provided to adjust the pressure and the rate at which the combustible gas mixture is supplied to each burner 10. In each burner 10 the combustible gas mixture passes through the short length of flexible tubing 30 and metal tube 29 into the burner tube 25.

At the inner end of each tube 25 is secured a distributor 38 for sub-dividing the combustible gas mixture into a plurality of gas streams which are discharged from a surface of the distributor and at which region a plurality of burner flames are produced and maintained. The burner flames project outwardly from the distributor 38 about the entire peripheral surface thereof. The combustion space 24 is of such shape and the flames project outwardly at such an angle from the axis of the burner that the flames are closely adjacent to and follow the cup-shaped refractory wall to heat the latter to incandescence.

The distributors 38, which are preferably formed of high temperature refractory material, are so positioned at the inner ends of the tubes 25 that the inner cones of the individual flames will always be out of contact with the wall surface irrespective of the lengths of the flames. The relationship of the angle of divergence of the individual flames and the shape of the wall of the combustion space 24 is fully disclosed in the aforementioned Hess patent which may be considered as being incorporated in this application, and, if desired reference may be had thereto for a more detailed description of the burner structure. In order to increase the combustion space wall area and the amount of radiant heat emitted therefrom, especially when the burners are being operated at reduced capacity, the walls of the combustion chamber spaces 24 are formed with ribs 39. This is clearly described and illustrated in Hess and Ehlinger application Serial No. 373,728, filed January 9, 1941, now Patent No. 2,339,477 granted January 18, 1944.

In accordance with my invention, the distributors 38 are of such shape that the likelihood of flame extinction is minimized when the burners 10 are being operated at relatively low capacity, and at the same time the shape of the distributor is such that the distributor passages are protected from matter which tends to deposit thereon in certain uses of the burners. As shown most clearly in Figs. 3 and 4, each distributor 38 includes a cylindrical body portion 40 which is tapered at one end at 40' to facilitate the sub-dividing of the combustible gas mixture into a plurality of gas streams.

The periphery of the body portion 40 is threaded

5

6

at 41 so that the distributor may be accurately secured in position at the internally threaded inner end 42 of the burner tube 25. Immediately adjacent to and joining the body portion 40 is a first enlarged head portion 43 having a straight-sided wall part substantially parallel to the axis of the distributor, and an inclined or beveled wall part extending inwardly from the straight-sided wall part to the body portion 40. Immediately adjacent to the first enlarged head portion 43 is a second enlarged head portion 44 more remote from the body portion 40 than the first enlarged head portion 43. The second and innermost enlarged head portion 44 may be slotted at 45 to facilitate the insertion and removal of the distributor 38 into and from the threaded inner end of the burner tube 25.

The extreme inner end of the burner tube 25 is beveled at 46, and, when the distributor 38 is threadedly secured in position, the inclined or beveled part of the first enlarged head portion 43 bears and fits snugly against the beveled surface 46, so that the distributor 38 will be accurately positioned in the cup-shaped combustion chamber space 24.

The main body portion 40 and first enlarged head portion 43 are formed with a plurality of slots 47 extending lengthwise of the distributor 38 from the tapered end 40' to the underside of the second enlarged head portion 44, as shown most clearly in Figs. 3 and 4. The slots 47 are distributed about the periphery of the body portion 40 and first enlarged head portion 43, and are of uniform depth from the tapered end 40' to the first enlarged head portion 43, as shown most clearly in Fig. 3. The bottom walls of the slots 47 are inclined outwardly at the first enlarged head portion 43 and are substantially parallel to the beveled or inclined end 46 of the burner tube 25.

It will now be understood that the three-sided slots or grooves formed in the distributor 38 and the inner wall surface of the burner tube 25 together form the passages 47 into which the combustible gas mixture flows to sub-divide the gas mixture into a plurality of gas streams. The only portions of the slots, which are not covered and are exposed, are the portions 48 at the straight-sided outer part of the first enlarged head portion 43. The portions 48 just referred to constitute the ports or discharge orifices from which the individual gas streams are discharged, and it is at these regions that the burner flames are produced and maintained.

The second and innermost enlarged head portion 44 extends laterally or radially beyond the discharge orifices or ports 48, as indicated at 49 in Fig. 4. In some cases the burner tube 25 and passage 23 formed in the burner block 21 may be of such size that the entire burner unit including the distributor 38 may be inserted into and withdrawn from a furnace wall as a complete assembly. However, it may be desirable in many cases to employ distributors 38 in which the innermost enlarged head portion 44 extends radially outward to such an extent that it cannot be inserted into position or withdrawn therefrom through the passage 23, and in such cases the distributor 38 may be secured into and removed from the inner end of the tube 25 from within the furnace chamber.

During operation of the burner 10, the gas flames project outwardly from the discharge orifices 48 at an inclined angle from the burner axis, as pointed out above and diagrammatically indi-

cated at 50 in Fig. 3. By providing the second and innermost enlarged head portion 44 on the distributor 38, the individual gas flames brush against and come in contact with the underside and outer peripheral surface portions of the lateral projection 49, thereby heating these regions to incandescence. The incandescent regions produced at the lateral projections 49 are highly beneficial in maintaining ignition of the combustible gas mixture issuing from the ports 48, and this is especially true when the burners are being operated at relatively low capacity and at reduced temperature. It has been found that when burners provided with distributors 38 like those described and illustrated are being operated with a slow burning gas, such as natural gas high in methane, for example, reliable ignition is obtained under all operating conditions. In addition, the lateral projections 49 improve ignition of slow burning gases by effecting a change in the velocity curve of the combustible gas mixture issuing from the ports or discharge orifices 48. This is clearly shown in Fig. 3 by the fact that the flame 50 is deflected by brushing against the underside of the enlarged head portion 44. Further, the underside of the enlarged head portion 44 offers frictional resistance to the combustible gas mixture brushing and coming in contact therewith, thereby having a tendency also to reduce the velocity of the gas mixture.

The second and innermost enlarged head portion 44 also provides a protective skirt about the ports 48. The vapors produced when certain materials are being heated in a furnace have a tendency to condense and form a deposit at regions between the ports 48 in distributors of the kind heretofore provided. This is due to the fact that these regions, indicated at 51 in Fig. 4, are zones which are at a reduced pressure and low temperature, so that objectionable condensing of vapors tends to occur at these places and form a deposit which may eventually accumulate to such an extent that the ports 48 becomes clogged. It is to be noted that this only occurs when objectionable vapors are present tending to form such deposits. However, the protective skirt formed by the lateral projection 49 prevents the free and unobstructed flow of objectionable vapors to the regions 51, which reduces to a marked degree the depositing of matter in the vicinity of the ports, and any deposits will then tend to take place on the top surface of the innermost enlarged head portion 44 which is not harmful nor detrimental for continuous and successful burner operation.

In Figs. 6 to 8 inclusive I have shown another form of distributor 38a which differs from the distributor 38 previously described in that teeth 52 are added about the periphery of the straight-sided wall part of the first enlarged head portion 43a. The teeth 52 are tapered and extend radially outward the same distance as the projection 49a of the innermost enlarged head portion 44a, as shown most clearly in Fig. 8.

By providing tapered teeth 52 at the regions between the passages 47, the portions of the passages at the vicinity of the first enlarged head portion 43a are extended radially outward the depth of the teeth. Further, the tapered teeth 52 provide discharge orifices or ports 48a having outwardly curved diverging side walls which are extensions of and in communication with the inclined portions of the passages 47 at the vicinity of the beveled end 46 of the burner tube 25. By providing discharge orifices or ports 48a having curved diverging side walls, a more or less stream-

line flow of the combustible gas mixture is effected as it is discharged from the passages 47 about the periphery of the distributor 38a.

The ports 48a permit the combustible gas mixture issuing from the passages 47 to expand and completely fill up the ports and also the regions in the immediate vicinity of the tips of the teeth 52, the nature of the gas flow being such that flow of gases in the vicinity of the teeth is always radially outward with no objectionable eddy currents being produced between adjacent ports 48a. By causing stream-line flow of the gas mixture passing from the ports 48a and eliminating eddy currents at the tips of the teeth 52, no regions of reduced pressure and low temperature are produced between adjacent ports 48a at the outer edges of the teeth 52, whereby gases re-circulating in the combustion chamber space, and which may contain deposit forming vapors when such vapors are present, cannot come in contact with the distributor surfaces adjacent to the ports 48a and the forming and building up of a deposit is practically eliminated.

When burners provided with distributors 38a are operated with the gas mixture being supplied thereto at a sufficient pressure and at a sufficient rate, flames are produced at the ports 48a which have a tendency to spread out and push against each other at the regions beyond the extremities of the teeth 52 and substantially midway between adjacent ports 48a, as diagrammatically indicated at 50a in Fig. 8. This spreading action of the flames is highly beneficial and tends to effect extremely uniform heating of the walls of the combustion chamber spaces 24 as the flames project outwardly and follow paths of flow closely adjacent to the cup-shaped refractory walls. This substantially uniform heating of the walls of the combustion chamber spaces is effected even though there is some slight variation in flame intensity between the center parts of the flame directly opposite the passages 47, and the parts at which adjacent flames push against each other.

The highest flame intensity is produced at the regions where adjacent flames push against each other, and this can be readily observed by the fact that when operation of a burner is first started, the surface regions of the refractory wall directly opposite the teeth 52 are first heated to incandescence. After a short interval of time of burner operation, however, the entire cup-shaped refractory wall rapidly reaches an incandescent temperature, thereby effecting substantially uniform heating of the cup-shaped wall in a relatively short interval of time.

Due to the stream-line flow of the combustible gas mixture issuing from the ports 48a and the frictional resistance offered to the gas mixture coming in contact with and brushing against the diverging side-walls of the ports, the velocity of the issuing gas mixture is reduced considerably. As a result of this reduction in velocity of the issuing combustible gas mixture, it is possible to supply the gas mixture at such a pressure and rate to a burner that the velocity of the gas mixture through the passages 47, from the tapered inlet ends 40' to the regions indicated at 53 in Fig. 8, is beyond the range of flame propagation; while the velocity of at least a part of the gas mixture in the ports 48a and before the gas mixture issues from the distributor is within the range of flame propagation. This is especially beneficial in that the likelihood of backfire is substantially avoided, and at the same time the

flames can be produced and maintained closely adjacent to the ports 48a and in the immediate vicinity of the teeth 52 not only with city gas but also with slow burning natural gases. It has been found that in using distributors generally like the distributor 38a just described, the refractory walls of the combustion chamber spaces 24a are uniformly heated to incandescence with no dark spots at regions about and closely adjacent to the outer periphery of the distributor. Not only is improved heating of the walls of the combustion chambers 24a effected, but it has also been observed that the refractory walls are heated to higher temperatures than heretofore possible. This increase in temperature of the refractory walls of the combustion chambers 24a is as much as 200° F. and higher, thereby providing higher temperature sources of radiant heat.

It has already been pointed out that the ports 48a are always filled with the issuing gas streams due to the stream-line flow of the gas mixture being discharged from the ports, and this is the condition that usually obtains when the burners are operated under normal operating conditions. The particular region at which combustion of the gas mixture starts to take place in the ports 48a depends upon the pressure and the rate at which the gas mixture is supplied to the burners. When the pressure and rate at which the gas mixture is supplied to the burners is reduced sufficiently, tiny flames are produced within the ports 48a, and in such cases the flames heat the teeth 52 to incandescence. This promotes and facilitates ignition of the gas mixture when the burners are being operated at a relatively low capacity.

Therefore, when the burners are being used in a furnace and certain materials are being heated that produce deposit forming vapors, the distributors 38a can be operated continuously without any objectionable matter depositing thereon, so that the ports 48a and surfaces adjacent thereto will always remain clean and free from any deposits which tend to form when certain deposit forming vapors are present. As in the embodiment previously described, the innermost enlarged head portion 44a serves as a protective skirt for the discharge orifices or ports 48a, thereby providing a burner distributor of desirable shape for all uses and particularly useful when it is necessary to employ a distributor that must be protected from objectionable deposit-forming vapors.

In Figs. 9 and 10 I have illustrated a further embodiment which differs from the previously described embodiments in that burners 10c of an elongated type are employed to effect heating in a furnace 12c. In Fig. 9, the burners 10c are mounted and incorporated in the side walls 11c of the furnace 12c. The furnace 12c is formed with the usual roof, floor 9c, and end walls 8c having doors 7c. A track 20c extending through the furnace may be provided for a car similar to that shown in Fig. 1, and upon which is mounted the material to be heated. The burners 10c may be positioned and distributed at the opposing vertical walls 11c in any suitable manner to effect desired heating of materials in the furnace chamber 19c. Although the elongated burners 10c are shown in a horizontal position in Fig. 9, it should be understood that the burners may be positioned vertically at the walls 11c when desired.

As shown in Fig. 10, each burner 10c includes a molded block section 53 which may be formed of one or more blocks depending upon the length

of the burner. When the block section 53 is formed from a number of blocks, these blocks are united together and the entire block section then united at 22c to the side wall 11c by a suitable high temperature fire-brick cement.

The block sections 53 are formed with elongated passages 23c extending lengthwise of the side walls 11c and terminating at the inner face of the side walls at combustion spaces 24c. Each combustion space 24c is cup-shaped in section and includes top and bottom refractory surface portions extending radially outward from the burner axis and toward the inner face of the side wall 11c. The walls of the combustion spaces 24c may be provided with ribs 39c, similar to the ribs 39 in Fig. 2, which extend lengthwise of the furnace side walls.

Within each passage 23c of the block section 21c is positioned a hollow rectangular-shaped burner sleeve 25c which extends between the opposite vertical side walls of the passage 23c. A plurality of relatively thin plates 55, which are stacked together to form a distributor unit 38c which will be described hereinafter, are securely held in any suitable manner to the inner end of burner sleeve 25c. As shown, the plates 55 are formed with lugs 54 which are held against the extreme inner end of sleeve 25c by angle members 57 fixed to the sleeve. The inner end of the sleeve 25c and angle members 57 form recesses to receive the lugs 54 of the plates 55. In order to provide a tight gas seal, asbestos packing or the like may be employed at 58 between the lugs 54 and vertical arms of the angle members 57, and fire brick cement may be employed at 59 between the lugs 54 and extreme inner end of the sleeve 25c.

The angle members 57 fit snugly against a shoulder 60 formed intermediate the ends of passage 23c. Each passage 23c extends from the outer portion of a block section 53 through the furnace wall 11c to the outer face thereof.

The outer portion of each burner sleeve 25c passes through an opening formed in a cover plate 32c which is secured at 35c to the outer metallic shell 36c of the furnace 12c. When the cover plate 32c is secured in position, the outer wall 61 of such plate snugly fits against the outer end of the burner sleeve 25c, thereby maintaining the angles 57 at the inner end thereof snugly fitting against the shoulder 60. A manifold 62, to which a suitable combustible gas mixture is supplied through a conduit 37c, is secured at 63 to the cover plate 32c. A suitable fire brick cement may be employed at 64 between the outer end of sleeve 25c and the outer wall 61 of the cover plate 32c to provide a gas tight seal between these parts.

The combustible gas mixture supplied to each manifold 62 passes therefrom into the burner sleeve 25c. As in the embodiment illustrated in Figs. 1 and 2, the conduits for supplying the gas mixture to the burners 10c may be arranged in any desirable manner, and suitable controls may be provided to adjust the pressure and the rate at which the combustible gas mixture is supplied to each burner.

The distributor unit 38c positioned at the inner end of the burner sleeve 25c effects distribution of the gas mixture, whereby the gas mixture is discharged from a plurality of ports 65 disposed at opposite side edges of the plates 55. The flames produced at the ports 65 project upwardly and downwardly at such an angle that the flames are closely adjacent to and follow the top and

bottom portions of the refractory wall to heat the latter to incandescence. The distributor 38c is so positioned in the burner that the inner cones of the individual flames always will be out of contact with the wall surface irrespective of the lengths of the burner flames.

One face of each plate 55 is formed with a Y-shaped slot 66 of relatively narrow depth, and a plurality of such plates are stacked together with a slotted face of each plate contiguous to and contacting a smooth face of an adjacent plate. In this way a plurality of Y-shaped passages 66 are formed in the distributor unit 38c for sub-dividing the gas mixture entering the burner sleeve 25c into a plurality of gas streams issuing from the ports 65.

The plates 55 include a main body portion 67 at the outermost end of which are formed the lugs 54. From the main body portion 67 projects a head portion 68 of reduced width. The ports 65 are located at a region of the head portion 68 closely adjacent to the shoulder 69 formed in the plates 55 at the juncture of the body portion 67 and head portion 68.

In accordance with my invention, the plates 55 are provided with tabs 70 at the extreme end of the head portion 68 to form a protective skirt for the distributor unit 38c. The tabs 70 also form a head portion of such shape that the likelihood of flame extinction is minimized when the burners 10c are being operated at reduced capacity.

The distributor unit 38c is similar to the distributor 38 illustrated in Figs. 3 and 4 in that the individual gas flames brush against and come in contact with the underside and outer surface portions of the tabs 70, thereby heating these regions to incandescence. By providing the tabs 70 to form a protective skirt, deposit forming vapors cannot readily come in contact with the plates 55 at the regions of the ports 65 when such vapors are present in the furnace chamber 19c, thereby reducing to a marked degree the depositing of matter in the vicinity of the ports 65.

Figs. 11, 12 and 13 illustrate a still further embodiment which is generally similar to the distributor unit 38c just described and differs therefrom in that, in addition to the tabs 70d similar to the tabs 70 in Fig. 10, beveled projections 71 are added to the top and bottom edges of the plates 55d at the head portion 68d and between the shoulder 69 and the underside of the tabs 70d. The beveled projections 71 are directly opposite the innermost ends of the Y-shaped passage 66, as shown in Fig. 12, and extend or project outwardly the same distance as the tabs 70d.

Figs. 14 and 15 illustrate a still further embodiment which is generally like that illustrated in Figs. 11 to 13 inclusive and differs therefrom in that the projections 71e are tapered and pointed instead of being beveled in the manner shown in Fig. 13.

By adding the beveled projections 71 and 71e in the embodiments in Figs. 11 to 15 inclusive, the branch passages of the Y-shaped slots 66, which terminate at the opposite side edges of the plates 55, are extended or projected outwardly a distance equal to the depth of the beveled and tapered projections. The beveled projections 71 and tapered projections 71e permit expansion of the gas as it is being discharged from the Y-shaped slots 66, whereby a more or less streamline flow of the gas streams is effected at the discharge orifices or ports 65d and 65e formed between adjacent projections 71 and 71e. This

permits the gases passing from the slots 66 to expand and completely fill up the ports 65d and 65e and also the immediate regions in the vicinity of the beveled and tapered projections. The nature and character of the gas flow at and in the immediate vicinity of the ports is similar to that previously described in connection with the embodiment in Figs. 6 to 8 inclusive, and such that the flow of gas in the vicinity of the projections 71 and 71e is always from the ports 65d and 65e with no objectionable eddy currents being produced between adjacent ports. In this way re-circulated gases in the combustion chamber spaces cannot pass and come in contact with the distributor surfaces immediately adjacent to the ports 65d and 65e, so that the forming of a deposit on such surfaces is substantially avoided. As in the embodiment shown in Figs. 6 to 8 inclusive and described above, a spreading action of the individual burner flames is also obtained by providing the beveled and tapered projections 71 and 71e, respectively, thereby facilitating and promoting rapid uniform heating of the walls of the combustion chamber spaces.

When distributor units 38d and 38e like those just described are operated at a relatively low capacity and tiny flames are produced within the ports 65d and 65e, respectively, such flames rapidly heat the projections to incandescence, thereby promoting and facilitating ignition of the burners under such operation conditions. In addition, the heating of the projections 71 and 71e to incandescence under the operating conditions just mentioned insures that these regions will always be maintained at a sufficiently high temperature, so that deposits cannot form and accumulate thereon when deposit forming vapors are present. The tabs 70d and 70e at the extremity of the head portion 68 also provide a protective skirt about the ports 65d and 65e, as in the previously described embodiments, thereby providing several forms of distributors for burners of the elongated type which may be used for all heating purposes and especially when it is desired to minimize the risk of flame extinction and the formation of a deposit when deposit forming vapors are present.

While several embodiments of the invention have been shown and described, it will be apparent to those skilled in the art that various modifications and changes may be made without departing from the spirit and scope of the invention, as pointed out in the following claims.

What is claimed is:

1. The combination with a burner of an elongated type having a refractory wall surface arranged to be heated to incandescence by a plurality of flames and from which radiant heat is emitted, such wall surface having an opening leading thereto for the supply of a combustible gaseous mixture, of a distributor unit positioned in the opening, such distributor unit being formed of a plurality of relatively thin plates in stacked relation and including a body portion and a head portion, said plates having slots or grooves therein forming, when said plates are in stacked relation, a plurality of passages extending therethrough for sub-dividing into a plurality of gas streams the combustible gaseous mixture introduced into the opening, said passages having inlets at the body portion and outlets or discharge ports at the peripheral surface of said head portion at which region the flames are produced and maintained, the outlets or discharge ports being enlarged with respect to the

cross-sectional areas of the passages, at the regions thereof extending backward from the outlets to the inlets, and formed to provide spaces of such shape that the gaseous mixture passing therein may expand and the velocity of at least a portion of each gas stream is reduced before the gas streams issue from the head portion.

2. The combination set forth in claim 1, in which said discharge ports are formed by a plurality of spaced teeth at the peripheral edges of said head portion, said discharge ports being in communication with said passages and adjacent teeth having side walls diverging from each other toward the extreme peripheral edges of said plates.

3. The combination set forth in claim 1, in which said discharge ports are formed by beveled edges at the parts of said plates constituting said head portion.

4. The combination set forth in claim 1, in which said discharge ports are formed by teeth at regions of said plates forming said head portion.

5. The combination with a burner of an elongated type having a refractory wall surface arranged to be heated to incandescence by a plurality of flames and from which radiant heat is emitted, such wall surface having an opening leading thereto for the supply of a combustible gas mixture, of a distributor positioned in the opening, such distributor being formed of a plurality of relatively thin plates in stacked relation and including a body portion and a head portion, such plates having slots therein forming, when said plates are in stacked relation, a plurality of passages for sub-dividing into a plurality of streams the combustible fuel mixture introduced into the opening, said passages having outlets or discharge ports at the peripheral surface of the head portion at which region the flames are produced and maintained, said head portion including a part contiguous to and extending laterally beyond said discharge ports and cooperating with the latter so that the surfaces of each part adjacent to the discharge ports will overhang and be heated to incandescence when the burner is being operated under such fuel mixture delivery pressure that the flames contact said part, thereby facilitating and improving ignition of the combustible gas mixture issuing from said ports.

6. A distributor for an elongated type gas burner formed of refractory material, such distributor being formed of a plurality of relatively thin plates in stacked relation and including a body portion and a head portion, said plates having slots formed therein to provide a plurality of passages extending therethrough when said plates are in stacked relation, said plates having teeth at the sides of said head portion, adjacent teeth having side walls diverging outwardly toward the surface of the sides of said plates and forming discharge ports communicating with the portions of said passages at said head portion.

7. A gas burner distributor member of refractory material for use in a burner of the type described and comprising a cylindrical body portion and two enlarged abutting head portions of which the first is adjacent and the second more remote from said body portion, respectively, said first adjacent portion of said head being smaller in diameter than said second more remote portion and larger in diameter than said body portion, said member being formed with gas supply grooves each comprising a portion at the periphery of, and extending longitudinally of said body

13

portion, each supply groove having an end portion at the side of said first adjacent head portion and extending outwardly to the periphery of said first adjacent head portion.

8. A gas burner distributor member of refractory material for use in a burner of the type described and comprising a cylindrical body portion, an enlarged head portion at one end of said member and an intermediate head portion located between said body portion and enlarged head portion and smaller in diameter than the latter and larger in diameter than said body portion, said member being formed with gas supply grooves each comprising a portion at the periphery of and extending longitudinally of said body portion, each supply groove having a portion at the side of said intermediate head portion adjacent said body portion and extending to the periphery of said intermediate portion.

9. A gas burner comprising refractory material shaped to form the wall of a cup-shaped combustion chamber; a gas supply passage having an end thereof communicating with said chamber at the bottom thereof; a distributor of refractory material comprising a cylindrical body portion, an enlarged head portion, and a cylindrical intermediate portion between said body and head portions smaller than said head portion and larger than said body portion; said distributor being formed with grooves, each groove being open at its outer surface and comprising a portion at the periphery of said body portion and extending longitudinally thereof, and an end portion formed at the periphery of said cylindrical intermediate portion; said passage being formed to receive said cylindrical body portion, so that said head and cylindrical intermediate portions are disposed within and adjacent to the bottom of said cup-shaped combustion chamber and said grooved end portion opens into said combustion chamber between the bottom of said chamber and said head portion.

10. For use in a wall of a heating chamber, a gas burner unit comprising a body of refractory material having a combustion space cavity facing the interior of the chamber, an opening through the wall communicating with the cavity for supplying a combustible gas mixture thereto under pressure, a distributor formed of refractory material having a body portion disposed in the opening and a head portion disposed in the cavity, said distributor having a plurality of grooves on its surface and cooperating with the wall of the opening in which it is received to form passages which subdivide into a plurality of gas streams the gas mixture supplied to the opening, said passages having inlets at the body portion and outlets or discharge ports at said head portion and within the cavity, the axis of said discharge ports or outlets being transversely disposed with respect to the longitudinal axis of the distributor in said

14

head portion adjacent said body portion so that the gas streams will issue from the head portion closely adjacent to and alongside of the wall of the combustion space cavity to heat such wall to incandescence, the outlets or discharge ports being enlarged with respect to the cross-sectional areas of the passages, at the regions thereof extending backward from the outlets toward the inlets, the gas mixture passing through the enlarged discharge ports expanding before the gas streams issue from the head portion, such expansion of the gas mixture at the discharge ports acting to cause the gas streams to substantially sweep over the wall surfaces of the discharge ports and the peripheral surface of the head portion at the regions of the discharge ports to prevent matter from depositing on the head portion which would tend to clog the discharge ports.

11. A burner including a refractory block having a cavity formed in one face thereof, said cavity having converging sides that terminate in an opening that extends through said block, a distributor comprising a body portion received in said opening and a head portion projecting into said cavity, said body being formed with passages of uniform size extending from the end thereof in said opening toward said head, said head being formed with transversely extending passages forming continuations of said first mentioned passages, the passages in said head increasing in size from said first mentioned passages to the periphery of said head and said head having a smooth portion beyond the passages formed therein extending into said cavity.

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