Sept. 4, 1962 H. J. PUGSLEY ETAL 3,052,456

BURNER SYSTEM FOR A FURNACE OR THE LIKE USING PREHEATED AIR FOR COMBUSTION

Filed Oct. 10, 1957 3 Sheets-Sheet 1

FIG. 1.

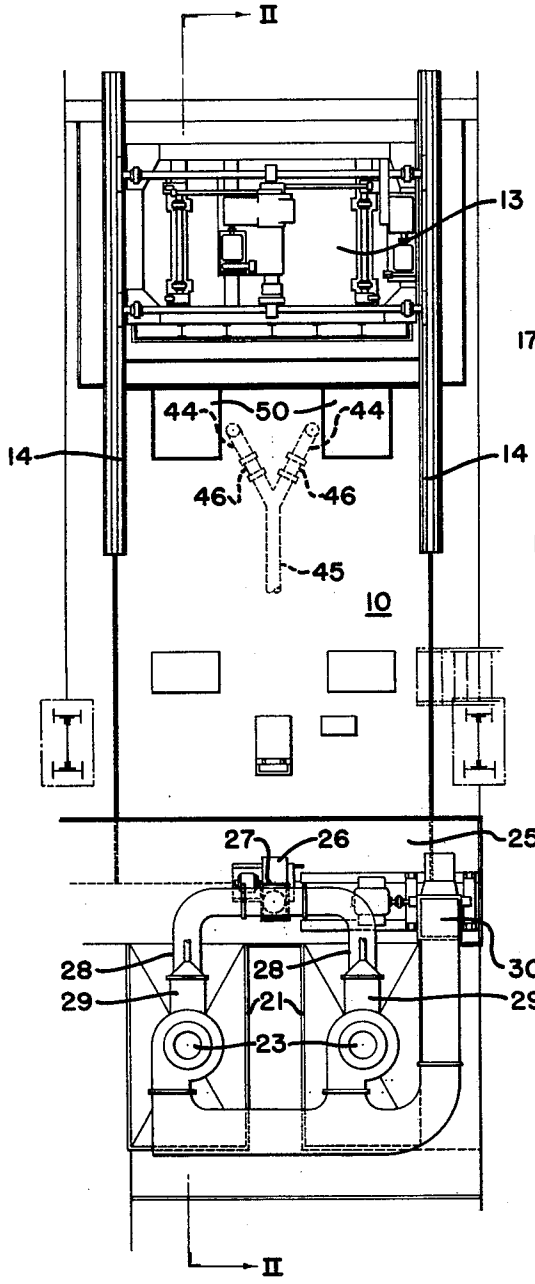
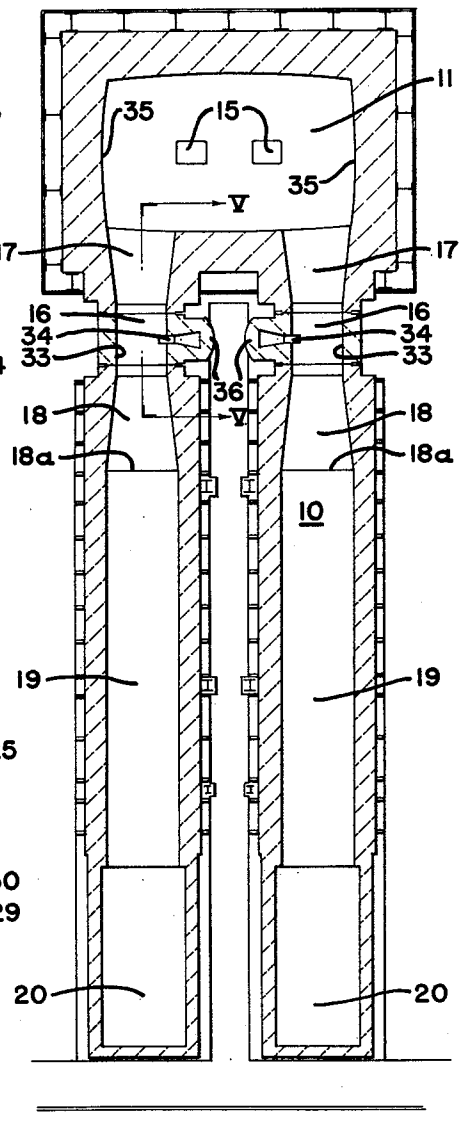


FIG. 3.



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FIG. 4.

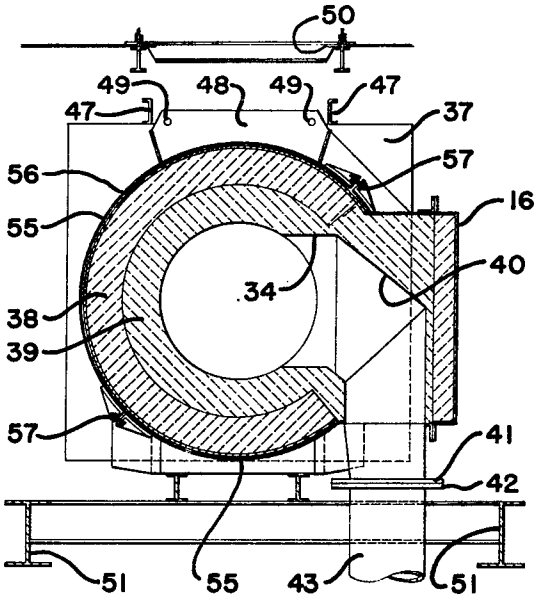
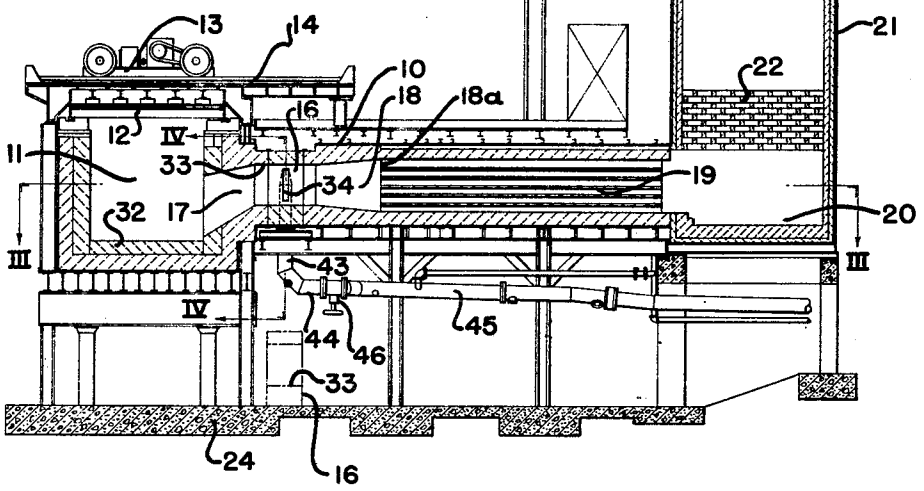


FIG. 2.



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FIG. 6.

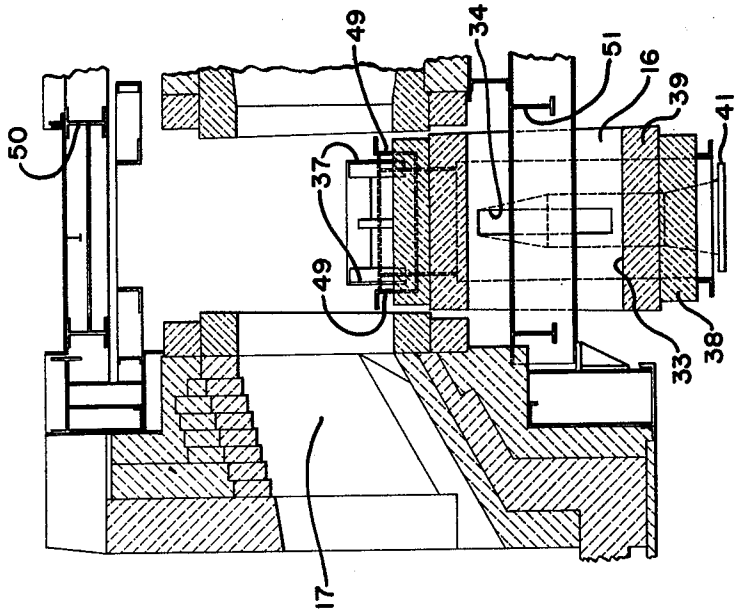
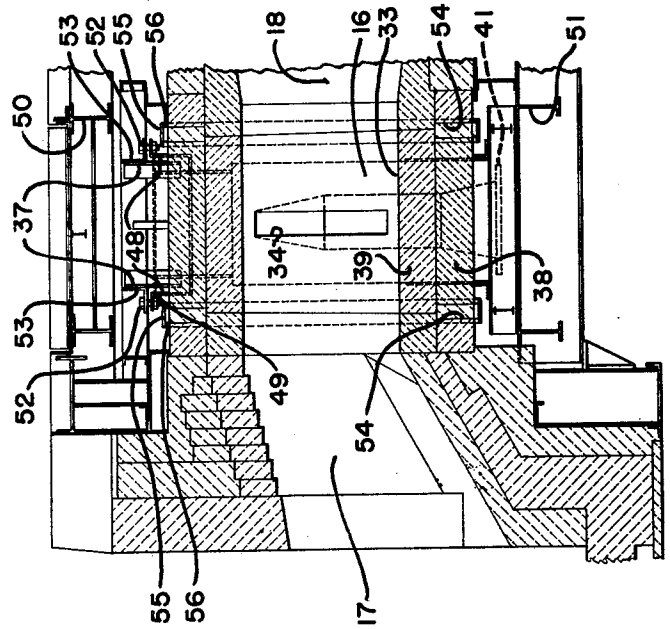


FIG. 5.



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BURNER SYSTEM FOR A FURNACE OR THE LIKE USING PREHEATED AIR FOR COMBUSTION

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5 Claims. (Cl. 263—15)

This invention relates to a novel burner system for a furnace or the like of a kind generally adapted to use preheated air for combustion. More particularly, it pertains to a new relatively low headroom, replaceable burner construction for such furnaces and a new method for uniformly heating metal ingots or the like in such a furnace while inhibiting detrimental flame impingement upon them.

In illustrative prior constructions of, for example, soaking pit furnaces, such as those of the regenerative type for the heating or reheating of metal work like ingots, the problem of headroom exists in view of the size of such furnaces and the crane and other handling and mill equipment required. Moreover, when burning a relatively low calorie or low pressure fuel gas, the size of the burners required augments the headroom and construction difficulties. In addition, particularly where the burners are located directly in the heating chamber, such chamber as a general rule must be made oversized in order to provide a combustion space in addition to a heating space, or the risk of harmful flame impingement upon the work may be encountered in the case of a smaller heating chamber with burners therein. When efforts are made to provide a bottom-fired furnace with firing either directly into the heating chamber or with the burner located outside the heating chamber, slag accumulations and deposits tend to interfere either with the burner or the operation thereof. On the other hand, efforts to build burners into the top of a furnace have encountered practical height limitations, particularly when endeavoring to burn relatively low pressure fuel gas.

The new burner system of our invention is applicable to new soaking pit and other types of furnaces, or it may be used in the modification of existing furnaces. Further, devices constructed in accordance with this invention provide a removable burner section which neither is subject to slag deposit difficulty nor is it one which increases the headroom required. At the same time, our new burners preferably have a removable section for adjustment ease and for any maintenance or replacement that may be required and such may also be used to provide access to the air checkers. Moreover, the fuel outlet is preferably located in such section which may be made in the shape of a venturi throat so that relatively low pressure fuel gases, such as blast furnace gas, may be utilized readily and mixed to better advantage with preheated combustion air. And, provision is made for the meeting of the preheated air and fuel streams at an angle to provide effective mixing and relatively prompt combustion to aid in the uniform heating of metal work in the heating chamber substantially by combustion gases.

Other objects, features and advantages of our invention will be apparent from the following description and the accompanying drawings, which are illustrative of one embodiment only, in which

FIGURE 1 is a plan view of one type of regenerative soaking pit furnace utilizing one embodiment of our new burner system;

FIGURE 2 is a view in elevation of the construction shown in FIGURE 1 taken along line II—II of FIGURE 1;

FIGURE 3 is a view in plan taken along the line III—III of FIGURE 2;

FIGURE 4 is a detail view taken along line IV—IV of FIGURE 2;

FIGURE 5 is a detail view taken generally along line V—V of FIGURE 3; and

FIGURE 6 is a detail view of the portion shown in FIGURE 5 with a removable section of one embodiment of our new burner in separated relation to the balance of the structure.

Referring to the drawings, a regenerative soaking pit **10** is provided with a refractory lined heating chamber **11**. The top of chamber **11** is covered with a removable cover **12** supported by a carriage **13** which is provided with controls adapted to lift cover **12** and move it along the rails **14** whenever the heating chamber pit **11** is to be opened for the insertion or removal of metal work like ingots **15** therein, which in number may substantially fill heating chamber **11**. Each new burner construction **16** of our invention is provided with a burner section or port **17** in which combustion occurs and an air port **18** furnishing a connection between heating chamber **11** and horizontal air checkerwork **19**. Each of the horizontal air ducts in the form of checkers **19** respectively communicates with a slag pocket **20** at the base of a stack flue **21** having stack checkers **22** therein. As shown, the flues **21** are a part of Isley-type stacks **23**. Furnace **10** is supported on a foundation **24** normally below mill floor level by structural steel work which is also tied into the structural steel binding for the furnace as will be understood by those having skill in such matters. The rails **14** for pit cover **12** are also rigidly connected to the structural steel framework of furnace **10**.

A fan platform **25** is provided to support a motor-blower set **26** which operates through a reversing air damper **27** to alternately blow "cold" air at ambient temperature downwardly through a pipe **28** into the top of the respective stack flue **21** whenever the stack valve **29** in that respective stack is closed. Conversely, when valve **27** closes off a particular stack flue **21** and the checkers **22** therein, the stack valve **29** for that particular stack is open so that air from an induction air fan **30** will rise in an annular chamber **31** to increase the draft operative upon the waste gases exiting through the respective horizontal checkers **19**, the vertical checkerwork **22** and the stack **23** in which such valve **29** is then open. In the course of such discharge of waste gases on each side, the refractory in the respective checkers **19** and **22** on that side is heated so that upon a reversal of flow therethrough, the air from blower **26** will be preheated by the time it reaches entry port **18** of the respective burner **16** on that firing side at the time being. As shown, when one side of the furnace is a firing side, the other side is a waste gas discharge side, and conversely, in furnace **10**.

Preferably, the burner passageway or port **17** on each side is directed downwardly toward the bottom of heating chamber **11** having a hearth **32** therein on which the work **15** rests so that hot gases passing into chamber **11** during a firing cycle from a respective side will fill the chamber with heating gases without leaving relatively cool spots or uneven temperature zones between the bottom and the top of the work. Moreover, it will be noted that the axis of each burner **16** including its burner combustion section **17** is situated so that all the work in heating chamber **11** will be heated by combustion gases and products being discharged from the respective burners **16** on the respective sides. Further, such hot gases discharged into heating chamber **11** will be well mixed and distributed for the maintenance of optimum conditions for the heating of such work **15**.

The smaller stack end of the burner ports **17** as compared to their heating chamber ends and the narrower area of the air passageways or ports **18** toward the heating chamber **11** as compared with the area of the ends **18***a*

toward the stacks 23 provide, in the embodiment shown, the approximate limits of a reduced or throat section 33 in each burner 16 having a venturi quality. Thereby, even a fuel gas of relatively low pressure, such as blast furnace gas is likely to be, exiting from a gas outlet 34 in section 33 may be used readily and at the same time better mixing with the combustion air will be obtained. In addition, each fuel gas outlet 34 in the illustrated embodiment is normal to the axis of its respective burner 16. Thereby, such fuel gas upon discharge from outlet 34 will contact axially moving preheated air and produce a tendency for the line of force or direction of the heating gases to veer toward the adjacent lateral wall 35 on the respective side of heating chamber 11, thereby promoting effectiveness of heating, avoidance of harmful flame impingement upon work 15 and uniformity of temperature obtainable in a heating chamber 11.

The central section 33 of each burner 16, and each burner 16, require relatively low head room and are relatively trouble-free because the gas outlet 34 is on the side with the larger burner bend and cover plate portion 36 accommodated inboard of and between the respective sides of furnace 10 as shown in FIGURE 3.

The removable quality of burner section 33 not only accommodates a change in case a different fuel gas is to be used or a different flame adjustment is desired, but it also facilitates any maintenance or replacement activity and, further, enables the respective side of the furnace to be entered for work upon that side such as work on the respective horizontal checkers 19. As shown, each section 33 comprises a structural frame 37 within which is supportably mounted an outer refractory layer 38 and an inner refractory layer 39 and provided with an opening therethrough which constitutes gas outlet 34. Outlet 34 may be made of cast refractory with a fuel gas passage having an approximate right-angled bend portion 40. The lower end of passage 40 is continued by a flanged pipe section 41 connected in turn to a flange 42 at the end of a fuel gas branch supply pipe 43. Each branch supply pipe 43 makes a further bend and becomes a horizontal portion 44 of a Y piping arrangement supplied from a common fuel gas supply pipe 45. Respective valves 46 are included in the respective branches 44 of the Y for suitable control by supplying of fuel gas to the firing side only during a firing cycle, whether that firing cycle be alternated immediately with a firing cycle on the other side, or whether the furnace 10 is operated under firing and dampering conditions.

The structural support 37 of each removable section 33 is also provided with longitudinally extending binding members 47 and cross support members 48 having sling holes 49 for the raising and lowering of section 33 as illustrated respectively in FIGURES 5 and 6, the structural overgirding of furnace 10 having a hatch way 50 for such purpose on each side above each section 33. Likewise, the structural undergirding of furnace 10 is provided with a lower hatchway 51 so that when section 33 is to be lowered, as shown in FIGURE 6, the piping can be disconnected and section 33 can pass through the lower hatchway 51 when suspended, for example, from slings connected to the hook of a crane and extending through upper hatchway 50. When a section 33 is fully lowered as shown in FIGURE 2, it may rest on foundation 24 or it may be lowered onto a dolly and moved out from beneath furnace 10 whereupon it can be lifted again by a crane or other device and taken to another location for storage or other purpose. Such steps, when taken in reverse, will enable a section 33 to be moved beneath the respective side of furnace 10 below vertically aligned hatchways 50 and 51 on that side so that such section 33 can be put into place in a burner 16 needing it.

When each section 33 is in aligned position relative to the rest of its burner 16, bolts 52 are connected between the members 48 and angles 53 to secure such section 33 in place. Preferably, as shown in FIGURES 5 and 6, each section 33 is made so as to taper, as viewed from the side, from the bottom to the top to effect appropriate seating and registry of inner refractory section 39 with corresponding refractory at the respectively adjoining ends of the ports 17 and 18 associated therewith. In addition, an outer refractory ring 38 is cut back from the seating face of the inner refractory ring to provide peripheral recesses 54 which preferably can be filled with a refractory cement when section 33 is in place. A split hoop 55 providing inwardly extending asbestos tape ring seals 56 adjacent each edge thereof are placed around each joint and the halves of each hoop on each side of section 33 are drawn together by the bolts 57 completing the gas-tight positioning assembly of each section 33 in its respective burner 16. After such mounting of section 33, branch pipe portions 43 and 44 are reconnected by means of their respective flanges to the pipe members 41 and 45.

Although the fuel gas outlet 34 in the illustrated embodiment of a burner 16 has its major axis vertical and its plane of discharge at right angles to the axis of section 33, the angle of intersection between such plane and axis may be changed by substituting such a section in which the fuel gas outlet has a different such angle. In that way, an adjustment may be provided with facility to correspond to a desired change in the service to be performed or to a desired change in the flame character.

For example, it would appear, without this invention being limited thereto, that if such plane of discharge of the fuel gas outlet is swung about a vertical axis so that fuel gas issues across the combustion air stream from port 18 with a minor direction component counter to the flow of that air, the resulting mixing time would appear to be somewhat reduced and the flame length somewhat shortened. On the other hand, when such plane is angled across the combustion air with the issuing fuel gas having a forward direction component relative, a lengthening effect upon the flame character would appear to be producible. And the angling of such plane may also be made in a skew manner, about an axis other than a vertical axis, if desired.

Further, although the illustrated embodiment has the burners 16 inboard of the inner sides of the respective sides of furnace 10, the bend and cover plate portions of the removable section in the burner may be placed outboard for particular kinds of operation or rearrangements of the spatial relation between the work to be heated and the heating chamber. In addition, each section of a new burner corresponding to section 33 may be provided with opposed fuel outlets therethrough. In such last-mentioned situation, each branch of the fuel gas supply pipe would be divided again to furnish such fuel gas to each one of the opposed outlets. With two fuel gas outlets in each such burner section, control of the direction of the heating gases may also be obtained, if desired, by proportioning the respective sizes or angles of discharge of such outlets in one section.

Although the illustrated embodiment has been described in combination with a soaking pit furnace utilizing preheated air, it will be recognized by those to whom our invention is disclosed that our new burner system is applicable to various types of furnaces or the like including those utilizing combustion air at ambient temperature without preheating. Further, various modifications may be made in details of the embodiment illustrated, and other embodiments including those described above may be provided, without departing from the spirit of our invention or the scope of the appended claims.

We claim:

1. A soaking pit furnace or the like with a built-in burner system for metal ingots or the like, comprising, in combination, a heating chamber, a hearth, refractory lined side and end walls and a cover for said chamber, a pair of laterally spaced generally downwardly directed burner passageways in one of said side walls, said burner

passageways extending generally from said hearth to the upper portion of said side wall, said burner passageways further having an expanding cross section in the direction of said heating chamber, a removable venturi throat section for each of said burner passageways having a side wall and its interior in registry with the respective outer ends thereof, an air passageway for each of said sections connected to the outer ends thereof and flaring in a direction away from said heating chamber, said burner and air passageways being built into said furnace as an integral part thereof, a combustion air duct in registry with the outer end of each of said air passageways, each said section having a vertical fuel gas outlet slot extend- through the side wall of said section to discharge fuel gas generally at right angles to the axis of said section and in intersecting reation thereto, means for holding each said section in upwardly wedged and sealed alignment between the respectively adjoining ends of its respective burner and air passageways, a conduit removably connected to each of said outlet slots, means to supply fuel gas alternatively to said sections, and means for preheating and supplying combustion air alternatively to the outer ends of each of said air passageways in timed relation to said supply of fuel gas.

2. In a built-in burner system for a soaking pit furnace or the like having a walled heating chamber, apparatus comprising, in combination, a burner passageway adapted to open through a wall of said heating chamber and cooperate with said furnace, said burner passageway adapted to expand in cross section in the direction of said heating chamber, a full opening air passageway having an expanding cross section adapted to flare in the direction away from said heating chamber, said passageways adapted to be an integral part of said furnace, a removable passage section of reduced area relative to said passageways positioned between said passageways in graduated registry with said passageways, said removable passage section having a side and a fuel gas outlet slot through said side at an oblique angle to the axis of said removable passage section, said slot extending above said axis, means to seal said section in said registry, and means for holding said removable passage section from above in alignment with said passageways.

3. In a furnace or the like for heating metal work, apparatus comprising, in combination, a heating chamber, a firing passageway opening into said heating chamber to discharge burning heating gases thereinto, a burner forming an integral part of said passageway, said burner having a removable central portion in full registry with said passageway, a structural framework for said central portion of said burner having at least one hatchway below said central portion, means for supplying combustion air to the outer end of said passageway, means for supplying fuel gas to said passageway through said central portion in a stream the plane of which intersects the axis and a major portion of the interior of said central portion at an abrupt angle to the axis of said central portion, peripheral means for sealing said central portion in place,

and means for removing said central portion by lowering it beneath said passageway.

4. A burner for a combustion air passage of a furnace or the like for heating metal work and having a heating chamber, said burner having a wall and providing a firing passageway adapted to open into a heating chamber to discharge burning heating gases thereinto, said burner having a removable central venturi portion, said burner further having an elongated outlet extending through the wall thereof into the interior of said venturi portion, a combustion air passageway in registry with said venturi portion, means for supplying combustion air through said burner and fuel gas to the interior of said burner through said venturi portion substantially at an oblique angle to the axis of said venturi portion, overhead framework means for suspending said venturi portion to position it, and means for removing said venturi portion of said burner from below to open said combustion air passageway for replacement of a venturi portion of selected character preparatory to further operation thereof in cooperation with said furnace.

5. In a burner system for a soaking pit furnace or the like, apparatus comprising, in combination, a burner having a central portion of venturi shape in longitudinal section, said burner having its central portion removable, said central portion having a side wall and further having its edges at the forward and rearward ends thereof lying in upwardly converging planes, mating edges in the remaining portions of said burner for seating said edges of said central portion, means for mounting said central portion between the mating edges of said burner to align said central portion when said respective mating edges are engaging the edges of said central portion, and peripherally extending band means for sealing the respective joints between said central portion and the remaining portions of said burner, said central portion having a fuel outlet extending through the side wall thereof into the interior of said central portion, said fuel outlet having its major dimension vertical and its plane of discharge substantially at right angles to the axis of said central portion in intersecting relation thereto, whereby said remaining portions of said burner may be built into a burner system adapted to cooperate with a furnace and said central portion may be removed by lowering the same below the rest of said burner as needed or desired.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,052,456 September 4, 1962

Hugh J. Pugsley et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, line 13, for "extend-" read -- extending --; line 16, for "reation" read -- relation --.

Signed and sealed this 8th day of January 1963.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents