

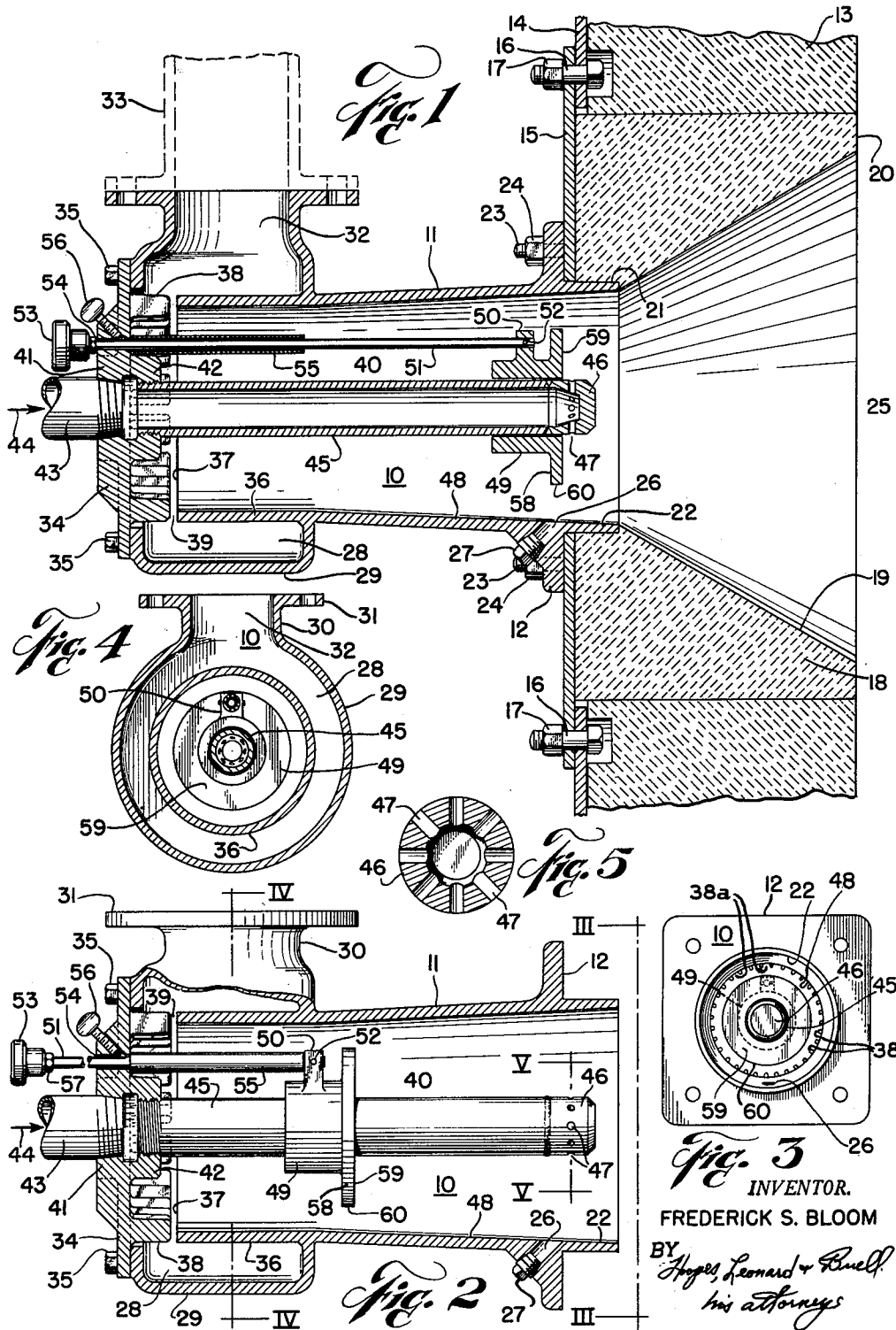
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VARIABLE FLAME TYPE GAS BURNER

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VARIABLE FLAME TYPE GAS BURNER

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This invention relates to a novel adjustable burner construction whereby the characteristics of flame produced thereby may be varied. More particularly, this invention pertains to new industrial burners particularly useful, for example, in the heating of slabs and billets in the steel industry, in which burners and adjustment may be made for varying flame character between flame which is relatively long and luminous, and, flame which is relatively short and clear for given conditions of fuel and combustion air supply.

In the design and construction of furnaces in the steel industry, as an example, for heating slabs or billets, particular burners have heretofore been extensively provided which yield the so-called luminous or long flame of relatively high radiating character. While such burners are highly satisfactory in many applications, particularly in those cases where the burner has been constructed on a custom-made basis for the particular installation, the fact remains that such burners are relatively inflexible. Hence, if need should arise at a given fuel capacity for a relatively shorter flame or a relatively clearer flame, it has been necessary to modify or replace the burners in that particular furnace. Further, any such modification itself constituted a relatively inflexible alteration, a significant difficulty especially in view of the relative unpredictability of furnace action in many cases until actually tried out. Heretofore, also, industrial burners having a luminosity of flame character built into them have tended to be slower burning than desired for a given luminosity and, moreover, there has also tended to be a carbon or smoke problem present with the flame in many such installations. Still further, at relatively low turndown of fuel, generally with fuel gas like coke oven gas or natural gas in such prior luminous flame burners, and combustion air, there has been a tendency in numerous installations for the flame to lick the furnace wall as it exited from the port block and sometimes, to move too slowly.

The foregoing and other difficulties are overcome by the present invention. By means of my invention, new burner equipment is provided and is adjustable so that in each such new burner the flame character may be varied between a flame which is relatively long and luminous, and, a flame which is relatively short and clear. Further, that novel variation is obtainable without significant alteration in a given burner of either the pressure of the fuel, such as a fuel gas, or of the combustion air. Moreover, the fuel gas is never starved for combustion air in my new construction and those flames which are luminous are more brightly luminous and in all cases burn completely without carbon or smoke residue. The lack of any necessity to vary the respective fuel and air pressures also means that a particular furnace using my invention may have some of the burners on luminous operation with others of the burners on semi-luminous or on clear flame operation as occasion demands to control in the furnace the place of occurrence of flame temperature peak, the flame and heat pattern itself, the spread of temperature between the inside furnace wall and the work being heated, and other elements of possible controlling significance in obtaining a furnace and burner operation of highest efficiency. It may also be remarked that at low turndown with my new burner construction, even on an operation of maximum luminosity, the flame produced does not "lick up" the adjacent furnace wall but proceeds

relatively directly and quickly into the furnace interior for maximum effectiveness.

Other and further objects and advantages of my invention will be apparent from the following description and from the accompanying drawings, which are illustrative only, in which

FIGURE 1 is a view in cross section of an embodiment of my invention showing one adjustment position and a possible mounting arrangement;

FIGURE 2 is a view of the embodiment of FIGURE 1 in less complete cross section in another adjustment position;

FIGURE 3 is a front view of my new burner, on a more reduced scale, taken along line III—III of FIGURE 2;

FIGURE 4 is a view in section of my new burner taken along line IV—IV of FIGURE 2; and

FIGURE 5 is a view in section of the nozzle element in the illustrated embodiment, taken along line V—V of FIGURE 2.

Referring to the drawings, my new burner 10 may comprise an air body or housing 11 having a mounting flange 12 to enable burner 10 to be readily mounted in a wall 13 of a furnace. Such furnace may include such a vertical wall 13 of refractory within a metal shell 14 to which a port block plate 15 is readily attachable by the employment of studs 16 and nuts 17. A refractory port block 18 may be provided so as to fit in an opening in wall 13, the aforesaid port block having a flaring port 19 extending from the face 20 of port block 18 to a counterrecess 21. A cylindrical projection 22 on body 11 may be provided to fit recess 21 when new burner 10 is in mounting position. Burner 10 may be affixed to studs 23 secured by welding or otherwise to port block plate 15, mounting flange 12 being held on such studs, for example, by nuts 24. So mounted, new burner 10 discharges fuel, such as natural or manufactured or process reaction gas, with combustion air toward port 19 in the course of a combustion operation in the direction of the flare of the port 19 so that flame of a desired characteristic passes into the furnace interior 25 for the heating service to be performed by my new burner 10.

Air body or housing 11 is tubular, and cylindrical in the illustrated embodiment, with a slight divergence in a forward direction toward furnace interior 25, although such divergence is not necessary and housing 11 in many cases will be made as a straight tubular combustion air body. A light-off hole 26 may also be provided adjacent the forward end of body 11 through which ignition of the combustible mixture may be effected upon initiation of a burner operation utilizing burner 10. Normally a plug 27 closes the outer end of hole 26. As shown further, air body 11 is cast with an annular combustion air chamber 28 adjacent the back thereof, that chamber 28 having outer wall 29 terminating in a conduit 30 with a fastening flange 31 to define a combustion air entry 32. A combustion air header 33 is fastened to conduit 30 and supplies combustion air therethrough to conduit 30 and new burner 10 in the desired volume and at the desired pressure and temperature. The temperature of such combustion air may be ambient or room temperature, or in some cases, the combustion air may be preheated as will be well understood by those skilled in the art to whom this invention is disclosed.

A back plate 34 may be provided and fastened by bolts 35 to the rear of wall 29 to close annular chamber 28. Inner wall 36 of chamber 28 may be an integral part of body 11 and extend rearwardly to a rear edge 37. Back plate 34 may be provided with forwardly extending radial ribs 38 in a cylindrical arrangement which, when back plate 34 is in mounted position, is positioned close to rear edge 37 generally leaving a short space 39. Thereby, combustion air from header 33 may readily flow

through the radial interstices 38a between the ribs 38 and through any space 39 into the interior 40 of air body 11 from around the entire periphery of inner wall 36, giving relatively uniform distribution of air going through the burner parallel to the longitudinal axis of new burner 10.

Back plate 34 may be provided with spaced annular bosses 41 and 42, the outer boss 41 being tapped, for example, for connection to a pipe 43 through which a gas, which is suitable for use as a fuel, may flow in the direction shown by the arrow 44. The inner or forward boss 42 may be tapped to enable a tubular nozzle 45 to be screwed into boss 42. Thereby, hollow nozzle 45 in effect affords a continuation to pipe 43 to conduct the fluid fuel toward a nozzle tip 46 at the forward or inner end of nozzle 45. Nozzle tip 46 may be provided with radially extending outlet passages 47 whereby the fuel is discharged at an angle to the axis of new burner 10 into combustion air flowing toward interior 25 through air body 11 between the inside 48 thereof and the outside of nozzle 45, effecting a combustible mixture for a burning operation and yielding a flame to heat work in the furnace interior 25. Suitable controls, not illustrated, will usually be provided so that as the volume of fuel is varied, the volume of combustion air fed to new burner 10 will correspondingly be varied to maintain whatever fuel-combustion air ratio is selected in advance for the particular operation utilizing my new burner.

A collar 49 is provided in new burner 10 to fit around the outside of nozzle 45, in slidable relation thereto. A lug 50 on collar 49 enables it to be moved back and forth to any adjustment position within burner 10 between, in the illustrated embodiment, extreme positions respectively shown in FIGURES 1 and 2. A rod 51 may be secured to lug 50 by a pin 52, an adjustment knob 53 being secured to the other end of rod 51. Rod 51 may pass through an opening 54 in back plate 34 which opening is of lesser diameter than the diameter of a spacing sleeve 55 through which rod 51 may also extend. A set screw 56 may be provided to lock rod 51 in either extreme position or in any intermediate position between extreme adjustment positions of collar 49. The forward or inner extreme adjustment position of collar 49 may be fixed by the employment of an abutment nut 57 to stop against the back of back plate 34 as shown in FIGURE 1. Conversely, the outer or rearward extreme adjustment position of collar 49 may be fixed by providing sleeve 55 with a suitable predetermined length which is operative as is shown in FIGURE 2 when the rear extreme adjustment position is selected.

A transversely extending plate 58 constitutes, in the illustrated embodiment, an imperforate discoidal flange forming a part of collar 49. Plate 58 has an inner or forward face 59 and a peripheral edge 60 spaced from the inside 48 of air body 11. In general, the annular area between peripheral edge 60 and inside 48 of air body 11 is at least as great as the area that is bounded by the peripheral edge 60 of flange 58.

I have found that a new burner construction, such as is illustrated and described herein for use with a combustible gas, enables the characteristic of the flame produced by that burner to be varied at will. Thus, in the extreme rear or outward adjustment position shown in FIGURE 2, for the illustrated embodiment, the flame produced by that burner 10 in operation will be relatively long and luminous. Even at low turndown when the capacity of the burner is reduced by a reduction of the quantity of fuel and combustion air fed thereto, the flame will not "lick up" the face 20 of port block 18 and of wall 13, but will move on into the furnace in the same direction that it does when the fuel and air are turned up. Still further, I have found that carbon particles and smoke are significantly absent from flame produced by the new burner even when the burner is adjusted so that the flame is luminous, a circumstance which may permit of shorter

and therefore less expensive furnace construction, and, the yielding of greater heat to the work. When in a luminous flame position, my new burner still burns relatively fast rather than acting as a so-called "lazy" flame.

On the other hand, with the transversely extending plate in the extreme forward or inward adjustment position shown in FIGURE 1, the flame produced by new burner 10 in operation will be relatively clear and a relatively shorter flame. In other words, in more forward positions of plate 58, my new burner produces a relatively bluer, faster burning and shorter flame than it does with flange 58 in adjustment positions farther away from nozzle tip 46. A significant consequence of my new construction is that a furnace provided with my new burners can be furnished with length and kind of flame desired and, in addition, a heat pattern that is most desirable for the particular service in which that furnace is engaged at the time then being. Since furnace construction involves certain imponderables, the flexibility and flame adjustment character of my new burners permits ready correction of any combustion defects which might otherwise have shown up in such a furnace were it to have been operated with conventional burners.

Thus, in using a plurality of my new burners in the wall or walls, including ceilings and floors, of a furnace, some of those burners may be provided with the plate corresponding to flange 58 in an adjustment position such that the flame issuing therefrom is longer and more luminous whereas in others of my new burners in that furnace, a different adjustment will be used to provide clearer and shorter flames for a joint cooperative flame character and heating effect suited to the particular requirement at the time being. If and when a furnace utilizing my new burners is scheduled for a somewhat different kind of service in heating work passed therethrough, my burners may be readjusted as and to the extent required to readily and conveniently suit the new flame and heating pattern that is optimum for the changed furnace requirement. Between the extreme adjustment positions of the transversely extending plate in one of my new burners, a flame character in between the extreme "clear flame" and the extreme "luminous flame" conditions is obtainable. Hence, by means of my new construction and the adjustability thereof, a new burner may have whatever variation between clear and luminous flame and length of flame are desired in the range of the capacity of the new burner. Further and quite importantly, adjustments of my new burner to vary, at will, the flame condition and length as recited herein, afford such flexibility without requiring modification of the temperature or static pressure at which the combustion air and fuel are respectively supplied.

In addition to gas fuels, other fluid fuels capable of acting with a gaseous-like aspect may also be supplied through a pipe like pipe 43 to a nozzle like nozzle 45 in a burner constructed in accordance with this invention.

Thus, atomized oil in a so-called emulsion with a pressure atomizing fluid such as air or steam may be used in a new burner of this invention. Further, nozzle 45 may be replaced in a fluid pressure atomizer discharging a mixture of atomized oil and atomizing air, for example, at an angle to the longitudinal axis of the new burner in co-operation with the other elements of my new construction for the achievement of advantages thereof. Indeed, various modifications in assembly and construction of structural elements may be made without departing from the spirit of my invention or the scope of the appended claims. In making my new burners, the portions exposed to sufficient heat will preferably be made of a suitable heat-resisting ferrous alloy while the remaining portions of my new structure may be made of less thermally resistant materials.

I claim:

1. In combination, in an adjustable burner, a tubular air body of generally uniform cross section free from transverse constriction adjacent its inward part, a cham-

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ber adjacent the outer end of said air body to receive and distribute substantially all of the combustion air uniformly to the inside of said body, a fuel nozzle extending axially within said air body toward the inner end of said body, said nozzle having means to discharge at least a portion of the fuel transversely adjacent said inner end, a transversely extending flange plate fitting around said nozzle for sliding movement thereon between a position adjacent the back of said discharge means and a position toward the outer end of said body, said flange plate having a peripheral edge substantially uniformly spaced from the inside of said body in any operative position of said flange plate such that in the plane of said flange plate the annular area between said edge and said inside of said body is generally at least as great as the area within said periphery of said flange plate, and means extending to the outside of said burner for moving said flange plate to a selected adjustment position within its range of movement, whereby said burner may be adjusted to vary a flame produced therefrom from a relatively more luminous and longer flame when the inward face of said flange plate is away from said discharge means, to a relatively clearer and shorter flame when said face of said flange plate is nearer to said discharge means.

2. In combination, in a fuel gas burner adapted to have its inner end extending toward a furnace interior, a fixed axially extending nozzle to conduct substantially all of said fuel, said nozzle having outlet means adjacent said inner end adapted to discharge at least a portion of the fuel gas substantially transversely around the axis of said nozzle, a transversely extending annular plate surrounding said nozzle in relatively close fitting relation thereto and movable therealong through a substantial distance range, means extending to the outside of said burner to move said plate to a selected adjustment position outwardly of said outlet means and relative to said inner end of said burner for any operative position of said plate, tubular body means of substantially uniform internal cross section inclusive of the inner discharge end thereof for conducting substantially all of the combustion air for said fuel substantially axially inwardly past the periphery of said plate, said inner discharge end being adjacent said outlet means, said tubular body means surrounding said plate and being transversely spaced from said periphery thereof in any operative position of said plate, and limit means to prevent said plate being positioned inwardly of said tubular body means, whereby the character of a flame provided by said burner may be varied by axial movement of said plate relative to said outlet means.

3. In combination, in a burner for a gaseous fuel, an axially extending tubular body, a hollow nozzle extending axially and generally centrally of said body, a lateral plate surrounding said nozzle and mounted thereon for movement generally axially within said body, said nozzle having an outlet member generally adjacent the inner end of said nozzle and said body to discharge fuel inwardly of said plate in any operative position thereof, said plate having a planar face transverse to the axis of said nozzle, the operative peripheral edge of said plate being spaced a substantially uniform distance from the inside of said body in any operative position of said plate, said body having an inlet for combustion air positioned axially outwardly of said member and said plate, said body also having a portion of substantially constant cross section axially coincident with every operative position of said plate, said body further being adapted to have substantially all of the combustion air forced into said body outwardly of said plate, said plate further being movable through a substantial distance range within said body between extreme operative positions, and limit means operable from the outside of said burner for adjustably moving said plate to hold it between said out-

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let member and said combustion air inlet and within said portion of substantially constant cross section in every operative position of said plate, whereby the farther that said plate is positioned away from said member the more luminous and longer a flame produced by said burner will be, and vice versa.

4. In combination, in a burner for fuel gas adapted to close a burner opening through a furnace enclosure, a tubular air body having a generally straight portion extending to and defining the inner discharge end of said burner, means for directing substantially all combustion air for said burner into said body for axial inward flow therethrough, a substantially annular transverse plate within said body having an operative periphery in substantially uniform spaced relation to and within said portion in each relative operative position of said plate, a fuel nozzle extending into said body along the axis thereof and through said plate in adjoining relation thereto, said plate being shiftable through a substantial distance range along said nozzle and within said body, said nozzle having an inner end adjacent the inner end of said body for the discharge of fuel gas generally inwardly of each operative position of said plate, said inner end of said nozzle being axially outwardly of the inner end of said body, and limit means to hold said plate within said portion in a selected operative position relative to said inner end of said nozzle.

5. In combination, in a gaseous fuel burner adapted to close a burner opening through a furnace enclosure, a generally cylindrical air body, means for directing substantially all combustion air for said burner to the outer end of said body for uniformly distributed entry thereto, an annular plate within said body having a generally circular peripheral edge in substantially equidistant spaced relation to and within said body in each relative operative position of said plate, said body having a substantially constant operative cross section portion inwardly of each relative operative position of said plate, a fuel nozzle extending into said body along the axis thereof and through the center of said plate in shiftable fitted relation thereto, said plate being shiftable through a substantial distance range along said nozzle and within said portion, limit means to prevent said plate being positioned inwardly of said portion, said nozzle having an inner end adjacent the inner end of said body with a plurality of outlet openings therein in spaced relation around the axis of said nozzle for transverse discharge of at least a portion of the fuel therethrough generally inwardly of each operative position of said plate, and means operable from the outside of said burner to selectively move said plate axially relative to the position of said outlet openings and thereby vary the spacing thereof in said body outwardly from said inner end of said nozzle.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,154,134

October 27, 1964

Frederick S. Bloom

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 1, line 14, for "and" read -- an --; column 4, line 59, for "in" read -- by --.

Signed and sealed this 6th day of April 1965.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents