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METHOD AND MEANS RELATING TO HIGH CAPACITY FORCED DRAFT GAS BURNER ART

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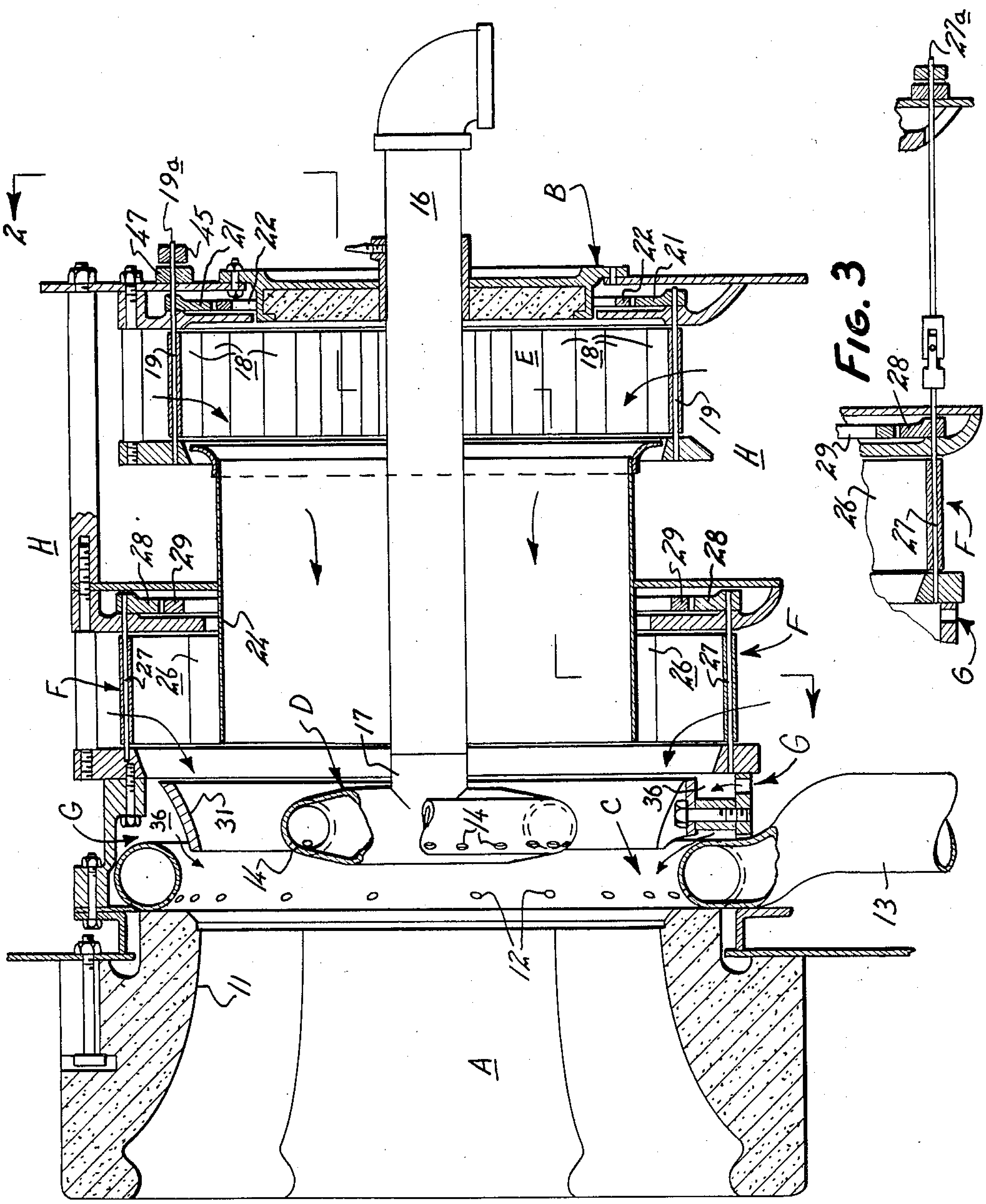

FIG. 3

FIG. 1

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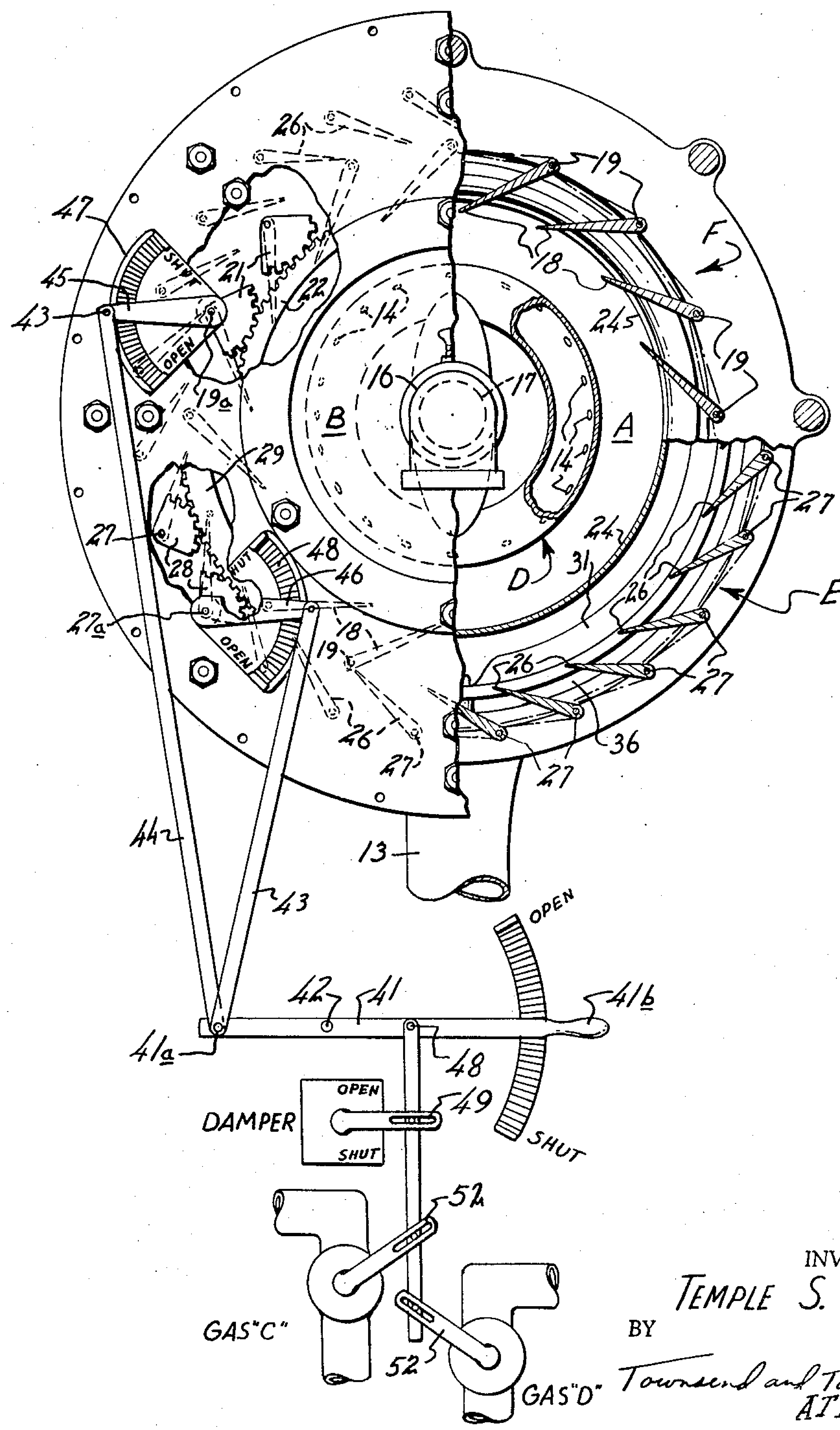
FIG. 2



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METHOD AND MEANS RELATING TO HIGH CAPACITY FORCED DRAFT GAS BURNER ART

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6 Claims. (Cl. 158—109)

This invention relates generally to the art of forced draft air gas burners.

A principal object of the present invention is to provide a high heat release forced draft burner utilizing low pressure gas as fuel. In order to provide a high capacity or high heat release burner, it is necessary to introduce relatively large quantities of air into the combustion chamber throat admixed with proportionately large volumes of the gas fuel. In such a construction certain inherent problems result in the use of a low pressure gas supply as follows:

To secure safe and efficient conditions of combustion within the chamber throat, it is essential that the gas and air be introduced into the chamber not only in proper volume ratio but in such manner that a thorough admixture between the gas and air is made to occur rapidly and relatively high up in the combustion chamber throat. By maintaining the base of flame propagation high up in the refractory tile surfaces of the throat, a much hotter fire can be maintained and the safety conditions are also enhanced in that no substantial amount of raw gas is permitted to be swept up out of the combustion chamber into the furnace.

An inherent difficulty in providing a high capacity burner utilizing a low pressure gas source is that in order to establish a combustible mixture of gas and air in the chamber throat using a large volume of air and gas required for high capacity, means must be provided to impart sufficient relative movement between the air and gas molecules to secure thorough penetration and admixing of the gas within the relatively larger moving air stream. However, the amount of jet force or thrust of low pressure gas streams impinging against the moving air body constitutes in itself an insufficient means for causing the gas to thoroughly penetrate and admix with the air at least within the relatively short time and distance that the air and gas travel before reaching the point in the combustion chamber throat whereat combustion should occur.

A more specific difficulty encountered in providing a high capacity burner utilizing a low pressure gas source is that unless precautions are taken, the large body of swirling air entering the combustion chamber from the air register has a tendency to centrifugally force outwardly toward the chamber walls gas introduced from the usual gas ring positioned coaxial with and adjacent the inlet opening of the combustion chamber. This results in the virtual sweeping of unignited gas down the walls of the burner throat and into the furnace proper leading to both inefficient and unsafe operation.

An object of the present invention is to provide in a high capacity burner of the type mentioned a novel method of and means for directing and controlling forced draft air and low pressure gas into a combustion chamber throat in such manner that rapid and thorough intermixing of gas and air is made to occur so that the base of flame propagation is anchored relatively high up in the chamber throat. In the specific embodiment of the invention illustrated in the drawings and to be hereinafter

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described in more detail, two concentrically mounted gas rings are provided for introducing low pressure gas. These rings operate in conjunction with three forced draft air inlet and control means for introducing three separate streams of air having different rotational or swirl characteristics and arranged so as to insure optimum admixing between gas and air. As will be more fully explained, the three streams of air introduced into the chamber include two inner concentric counterrotating streams and an outer concentric non-rotating or non-swirling stream, the latter functioning as an air flow buffer between the gas emitted from the larger of the two gas rings and the relatively rapidly swirling middle air stream. In this regard, the outer non-swirling air stream allows gas from the larger of the two gas rings to penetrate radially inwardly into the moving air body and intermix therewith without being centrifugally swept outwardly along the walls of the throat before proper and thorough intermixture with the air body.

As will also appear, the air mixture of the two inner concentric counterrotating streams create a scrubbing action at the approximate point where gas from the smaller of the two rings radially is injected outwardly into the moving air mass. This relative scrubbing action between the two air streams causes the discrete streams of gas to rapidly break up and diffuse within the larger moving mass of air to establish a combustible mixture.

Other numerous objects and advantages of the invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

Fig. 1 is a vertical sectional view of burner construction embodying the invention showing certain portions broken away.

Fig. 2 is a sectional view taken substantially on line 2—2 of Fig. 1 showing certain parts broken away, and showing substantially schematically a centralized or unitary fuel and air supply control mechanism.

Referring now more specifically to the drawings, the reference character A indicates generally a combustion chamber throat defined by refractory material indicated at 11 and which may be considered conventional in design and construction.

Reference character B indicates generally a housing or frame support in which is mounted first and second gas rings indicated generally at C and D. Gas ring C has an inner diameter or circumference approximately equal to the diameter or circumference of the inlet opening to combustion chamber A, and said ring C is mounted coaxial to and adjacent said throat inlet opening. Ring C is further formed with a plurality of gas inlet ports 12 from which gas supplied from conduit source 13 is injected in a direction generally inwardly radially toward the central axis of the chamber throat.

The gas ring D is mounted rearwardly of and concentrically with reference to ring C. The outer diameter of ring D is substantially greater than the inner diameter of ring C whereby an annular air passage between rings D and C is established. Ring D is provided with a plurality of gas ports 14 which operate to inject discrete streams of gas in a direction generally radially outwardly and toward the combustion chamber inlet opening. Low pressure gas to ring D is supplied via a conduit 16 entering the rear of housing B and extending centrally axially thereof and connected to ring D by means of a conventional T connection 17. By fuel control means to be hereinafter described, approximately two-thirds of the total gas supply can be introduced via gas ring C and approximately one-third of the total supply introduced through gas ring D when the burner is operating.

The housing B also supports or establishes three separate air inlet control means which are designated generally at E, F and G, respectively. Forced draft air introduced and controlled through the said means E, F and G is all supplied from a common windbox or plenum surrounding the housing B and designated generally at H.

The air inlet and adjustable control means E comprises, more specifically a circular adjustable louver or vane type air register in air flow communication with the windbox H. The air register may be of substantially conventional design and comprises a plurality of vanes 18 each pivotally mounted on an axle 19 supported by the frame components of housing B. Each axle 19 is provided with a gear segment 21 in mesh engagement with a ring gear 22. A control shaft 19*a* (comprising an integral extension of one of the axles 19) and projecting exteriorly of the housing B may be operated to cause the ring gear 22 to rotate in a predetermined direction of rotation which, for purposes of simplicity and explanation, may be assumed to be in a clockwise direction. Rotation of the ring gear through mesh engagement with the axle gear segments 21 will cause corresponding simultaneously opening and closing of all of the air vanes 18.

It is appreciated that the further the vanes 18 are closed, the greater the swirling action will be imparted to air flowing through the register and through connecting air tube 24 mounted at the discharge side of register E to direct swirling air axially of the housing and toward the combustion chamber A. It is noted that the diameter of air tube 24 is substantially larger than the outside diameter of gas ring D but is of lesser diameter than the inside diameter of the larger gas ring C.

The second air inlet and adjustable control means heretofore designated generally at F comprises an annular adjustable air vane type air register comprising a plurality of air vanes 26 each pivotally mounted on an axle 27, and with each axle provided with a gear segment 28 in mesh engagement with a ring gear 29. A control shaft 27*a* comprising an extension of one of the axles 27 and projecting exteriorly of housing B may be similarly operated to cause ring gear 29 to move in a counter-rotational movement (e.g., counter-clockwise) relative to the rotational movement of previously described ring gear 22. Consequently, rotation of ring gear 29 will cause simultaneous opening and closing of air vanes 26 and in such manner that the air directed through register F will have imparted to it a counter rotational swirl relative to the swirling air discharged from register E into air tube 24.

Air discharged from register F is directed into an annular air conduit 31 of larger diameter than air tube 24, and located forwardly thereof and concentrically thereto. At this point it may be observed that clockwise swirling air from tube 24 will pass over gas ring D and through annular air conduit 31 and into chamber A simultaneously with the counter-rotating air stream discharged from annular air register F. As a result, a scrubbing action will occur between contiguous air molecules of the two air streams. This relative scrubbing action between the two air streams functions to efficiently and rapidly break up and diffuse the discrete streams of gas injected from ports 14 of gas ring D. As above noted, this results in a rapid and thorough admixture of air and gas for combustion relatively high up in the chamber throat where the base of flame propagation should be anchored.

The third mentioned air inlet and fixed control means G comprises an annular air passage 36 also having its inlet side connected with windbox H. The discharge side of passage 36 is defined between the annular space between air conduit 31 and the inner circumference of the gas ring C. Air introduced through passage 36 flows through gas ring C into the chamber in a substantially straight line or non-swirling path of movement. As a consequence, this annular stream of relatively non-swirling air establishes an air buffer between the low pressure gas being injected from gas ports 12 and the outer perimeter of the air stream discharged from the register F into which a relatively high degree of swirl has been imparted. The non-swirling air stream from passage 36 permits gas from ports 12 to penetrate a substantial distance into the moving air mass with minimum danger of the swirling air mass centrifugally forcing the gas outwardly toward the combustion chamber throat walls and/or from sweeping unignited gas along the tiled wall throat surfaces into the furnace. On the other hand, non-swirling air from passage 36 into which gas from ports 12 has been allowed to penetrate is then caused to thoroughly and rapidly intermix with the swirling air mass from air conduit 31 due to the relative scrubbing action that results from the different swirl characteristics between the said air streams entering from passage 36 and 31, respectively. Hence, during a very short time cycle and before the entire air and gas mixture has had occasion to move relatively far down the chamber throat, a thorough and complete inter-mixing between all of the air and gas will have been made to occur whereby combustion is established relatively high up in the chamber throat.

Referring more specifically to Fig. 2 of the drawings, there is indicated schematically a system for simultaneously regulating the air supply in proper relation to the gas supply.

More specifically, the master unitary control may comprise a lever 41 pivotally supported as at 42. One end 41*a* of the master control lever 41 is connected by links 43 and 44 to air register control arms 45 and 46, respectively. Arm 45 is adapted to rotate control axle 19*a* which, as previously noted, is meshed with ring gear 22 for simultaneously opening and closing air vanes 18 of circular register E. Arm 46 is similarly mounted to control axle 27*a* meshed with ring gear 29 for simultaneously opening and closing air vanes 26 of annular register F. Each of the arms 45 and 46 is adapted to swing relative to an associated quadrant, such as are indicated at 47 and 48.

The opposite end 41*b* of master control lever 41 is provided with a linkage 48 interconnecting the damper control with the gas supply to rings C and D. In this connection, it is contemplated that the burner construction embodying the present invention will be utilized with an adjustable louver air damper (not shown) which may be of conventional design, and which may be regulated in usual fashion to control the amount of air admitted to windbox H. As indicated in Fig. 2, the damper control arm 49, as well as gas valve arms 51 and 52 for respectively controlling gas supply to rings C and D are all interconnected with link arm 48 in order to secure the desired mode of operation and control as follows:

When the burner is started during the ignition cycle handle end 41*b* of lever 41 is moved relatively downwardly toward its closed position. This movement in turn will cause end 41*a* of the lever to swing upwardly, and, through link connections 43 and 44 likewise cause control arms 45 and 46 to move upwardly toward their relatively shut positions. The effect of this is to substantially nearly close all of the vanes in both of the registers E and F whereby a minimum volume of air will flow through such registers but at a maximum degree of swirl. Non-swirling air entering from passage 36 of air inlet and control means G will, on the other hand, be unaffected by movement of lever arm 41 except insofar as the volume of air is controlled because of movement of the damper toward closed position by virtue of linkages 48—49. Likewise, movement of the lever arm 41*b* toward its closed position will cause both the gas control valve arms 51 and 52 to assume their nearly closed positions. As the demand for heat increases it is obvious that the master lever may be moved further toward open position and this in turn will cause the damper to admit a correspondingly greater volume of air into the windbox H, while at the same time the flow of gas is correspondingly increased as is also the flow of air through the air vanes of registers E and F.

As earlier noted it is practical to admit about ⅔ of the total gas supply through ring C and the remaining ⅓ through ring D. This ratio may be established and maintained by providing ring C with about twice as many outlet parts as ring D, while supplying gas to both rings from the same or equal gas pressure source.

Although the present invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be made within the spirit of the invention as limited only by the scope of the claims appended hereto.

What is claimed is:

1. In the forced draft air gas burning art the method which includes the steps of: introducing into the inlet opening of a combustion chamber throat from a first location adjacent the perimeter of said opening discrete streams of gas having a directional component directed generally radially inwardly toward the central axis of said throat; simultaneously introducing from a second location adjacent the projected axis of said throat opening discrete streams of gas with a component directed generally radially outwardly toward the perimeter of said throat opening; simultaneously introducing through said throat opening counter-rotating concentric streams of forced drafted air in a path of travel directed to impinge against and intermix with said radially outwardly directed gas streams from said second location; and simultaneously introducing into said chamber throat an annular non-swirling forced draft air stream concentrically sheathing said counter-rotating streams and directed to impinge against and intermix with said radially inwardly directed gas streams and to establish a non-swirling air buffer of air between said first location and said counter-rotating streams of air.

2. In a high capacity gas burner the combination comprising: an air register housing having a discharge opening adapted for positioning adjacent the inlet opening of a combustion chamber; first gas supply means mounted adjacent the perimeter of said housing opening for introducing discrete streams of gas in a direction having a component directed generally radially inwardly toward the axis of said housing discharge opening; second gas means mounted interiorly of said housing for introducing discrete streams of gas in a direction having a component directed generally radially outwardly toward the perimeter of said housing discharge opening; first and second air register means for discharging through said housing opening first and second counter-rotating swirling air streams in path of flow to impinge against and intermix with said gas streams from said second gas means; and air inlet means interposed between said registers and said first gas supply means for introducing through said housing discharge opening an annular non-swirling buffer stream of air concentrically sheathing said first and second air streams and directed in a path of flow to impinge against and intermix with gas streams from said first gas supply means.

3. The combination of claim 2 and wherein said first gas supply means comprises a gas ring having an inside circumference approximately equal to the circumference of and mounted adjacent and coaxial with said housing discharge opening.

4. The combination of claim 3 and wherein said second gas supply means comprises a second gas ring mounted interiorly of said housing coaxial with said first gas ring and having an outside diameter substantially less than the inside diameter of said first gas ring.

5. In a high capacity gas burner the combination comprising: an air register housing having a discharge opening adapted for positioning adjacent the throat opening of a combustion chamber; first, second and third forced draft air inlet and control means in said housing all communicating and supplying forced draft air through the discharge opening of said housing; first and second gas supply rings in said housing; said first ring disposed coaxial with and adjacent said discharge opening of said housing; said second ring having an outside diameter substantially less than the inside diameter of said first ring and mounted in said housing coaxial with said first ring; said first air inlet and control means including a circular adjustable air vane register having a discharge passage disposed coaxial with said first and second rings and having a diameter smaller than said first ring but larger than said second ring; the vanes in said circular register adjustable to impart a swirl in a first direction of rotation to air directed therethrough; said second air inlet and control means comprising an annular adjustable air vane register having a discharge conduit of larger diameter than, and disposed concentric with, the discharge passage of said circular register; the vanes of said annular register positionable to impart a counter-rotational swirl to air directed therethrough whereby swirling air from said circular register is discharged through said housing discharge opening concentrically sheathed within and counter-rotating relative to air discharged from said annular register; said third air inlet and control means comprising an annular discharge air passage located between said first gas ring and the discharge passage of said annular air register and having a diameter larger than the outlet end of said discharge passage of said annular register; means for emitting non-swirling air through the discharge passage of said third means whereby swirling air from said annular register is discharged through said housing opening concentrically sheathed within non-swirling air discharged from said annular air passage, and whereby said non-swirling air stream establishes an air buffer between said swirling air streams and the gas introduced from said first gas supply ring.

6. The combination of claim 5 and including gas valve means for controlling gas to said first and second gas rings; an adjustable damper for controlling the volume of air to said first, second, and third air inlet and control means; and a central control means inter-connected to said damper, to said annular and circular fuel registers, and to said gas valve means operable to simultaneously open and close the vanes of said circular and annular air registers and to simultaneously regulate the flow of gas from said first and second gas rings proportionate to the volume of air introduced to said first, second and third air inlet and control means from said damper.

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