Feb. 3, 1953 C. J. WESTLING 2,627,307

CONCENTRIC GAS AND AIR BURNER

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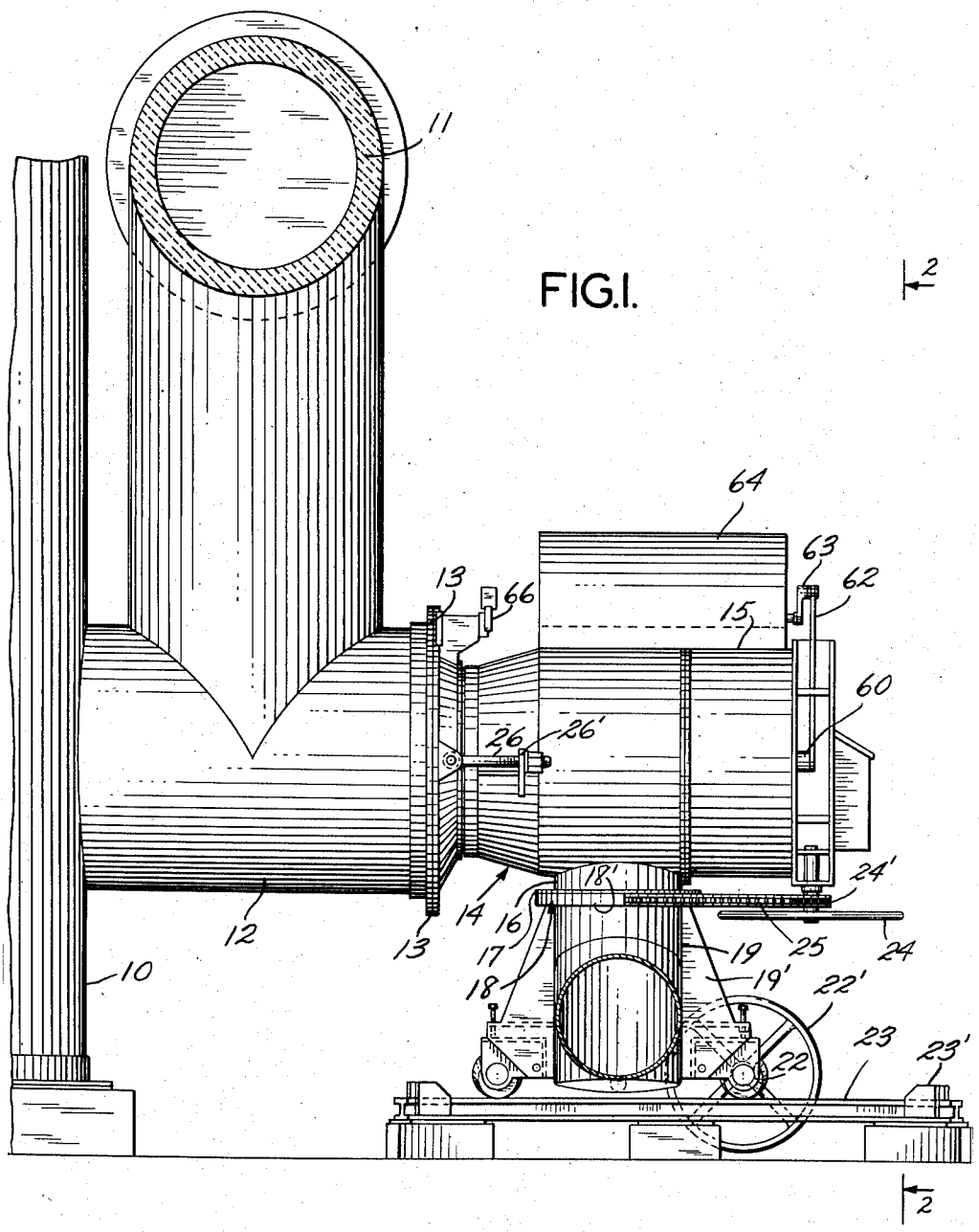


FIG.I.

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CONCENTRIC GAS AND AIR BURNER

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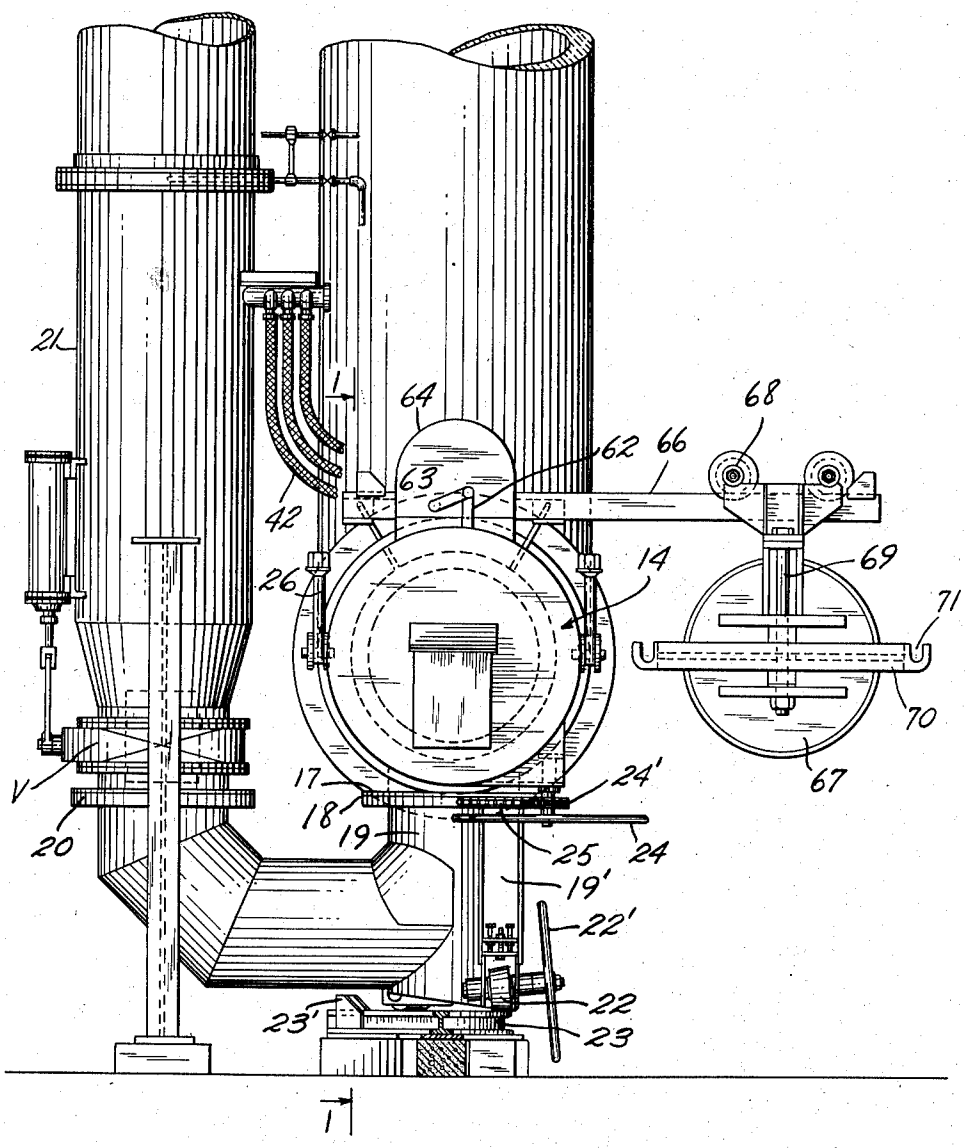


FIG. 2.

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CONCENTRIC GAS AND AIR BURNER

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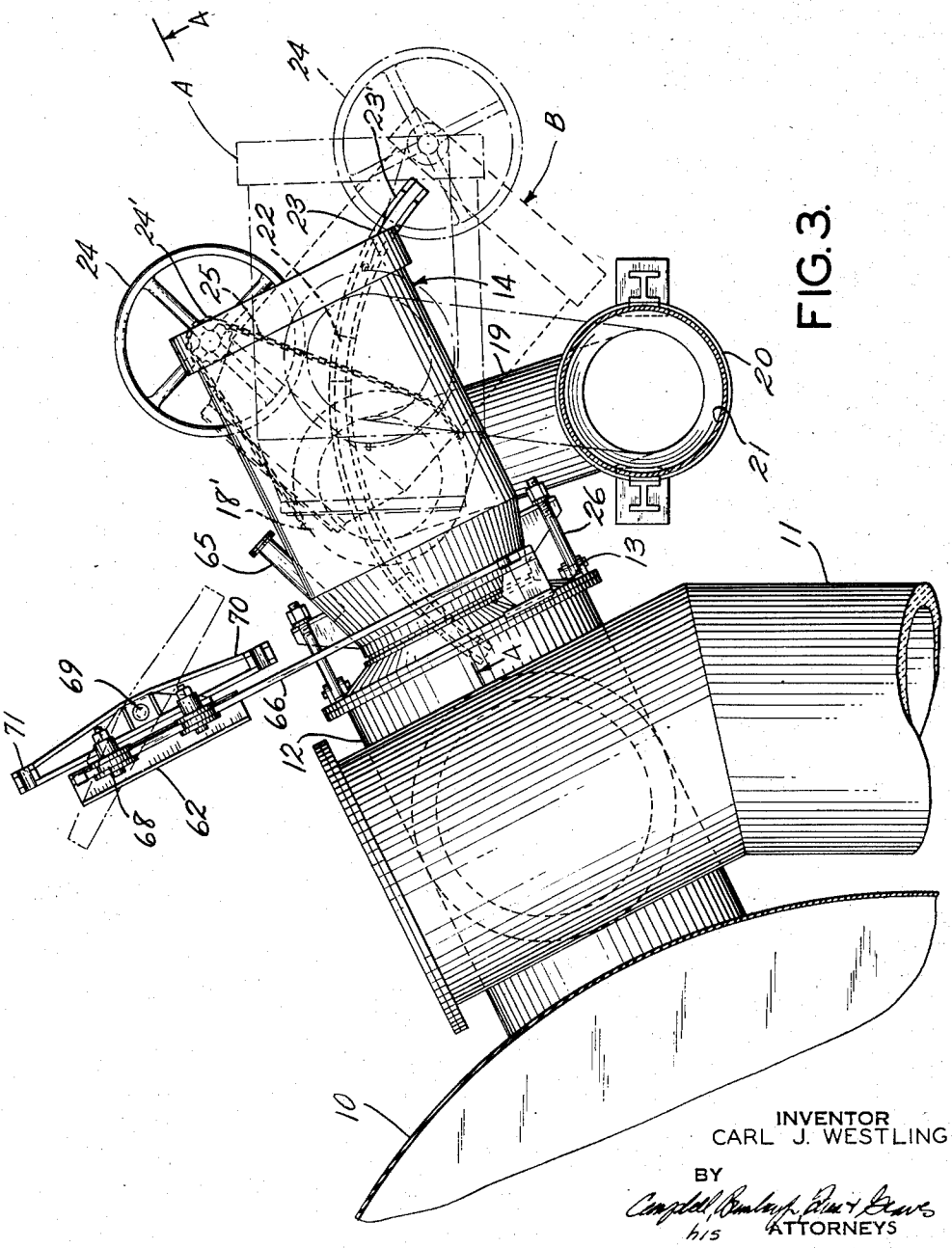


FIG. 3.

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CONCENTRIC GAS AND AIR BURNER

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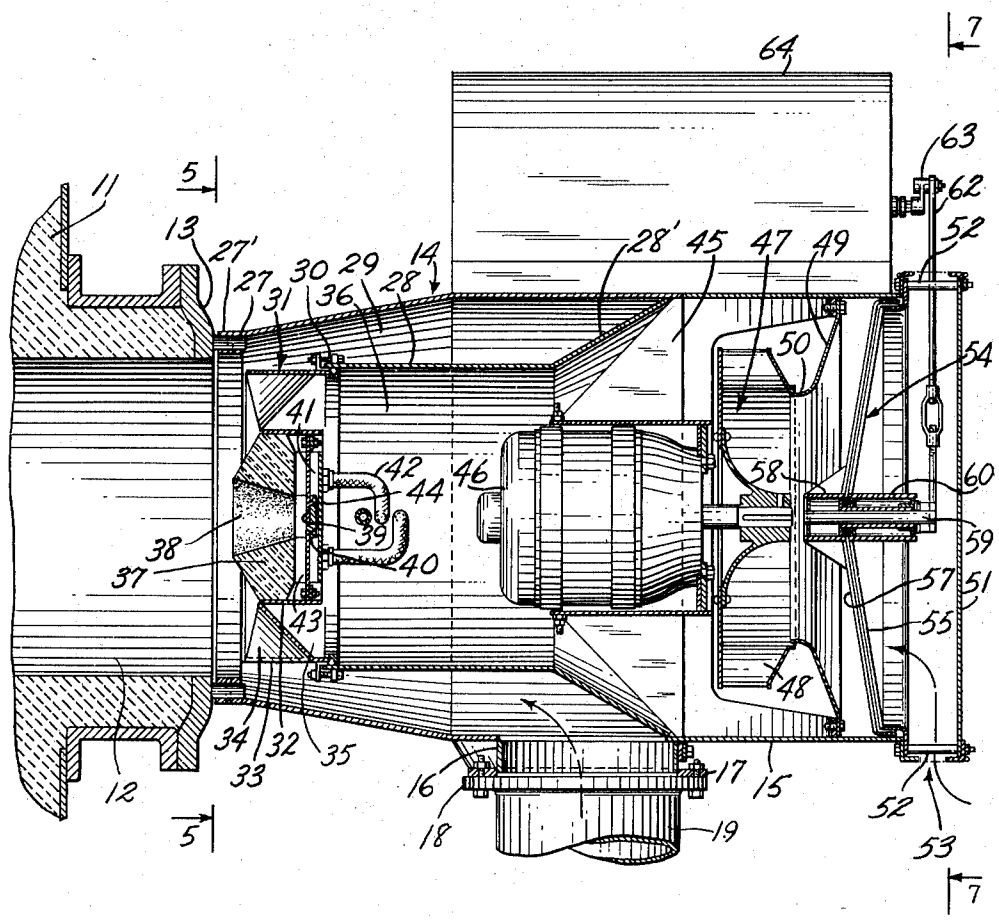


FIG. 4.

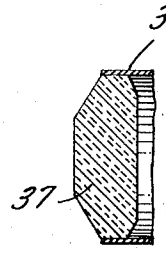


FIG. 4a.

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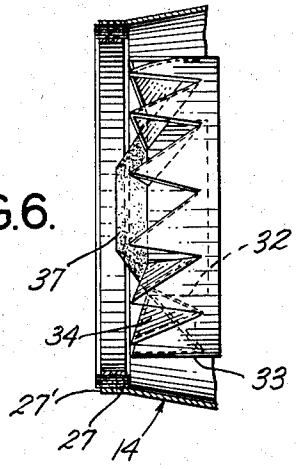
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CONCENTRIC GAS AND AIR BURNER

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FIG.6.



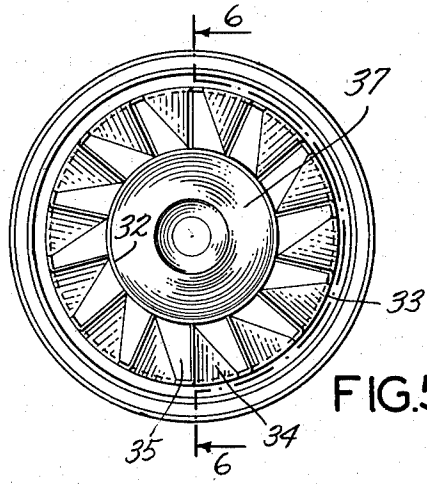


FIG.5.

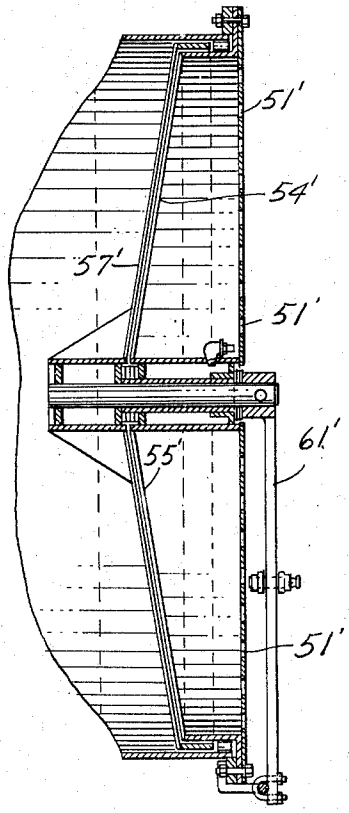


FIG.8.

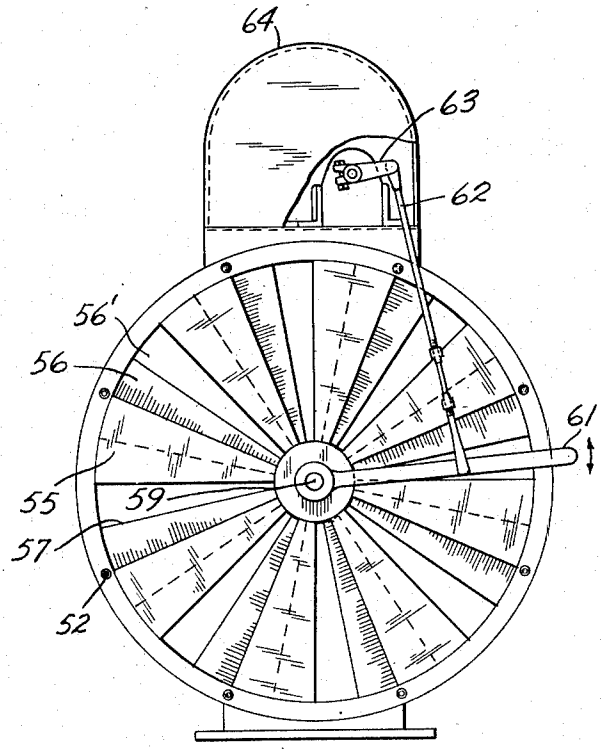


FIG.7.

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Patented Feb. 3, 1953 2,627,307

UNITED STATES PATENT OFFICE

2,627,307

CONCENTRIC GAS AND AIR BURNER

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Application July 24, 1950, Serial No. 175,579

11 Claims. (Cl. 158—109)

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This invention relates to gas burners, and has particular reference to burners for burning gas under pressure for the purpose of heating regenerators, stoves, checkerwork, and heat exchangers and preheaters generally, although the invention is not limited to that use.

Gas burners of the aforementioned general type usually are arranged horizontally, and their nozzles must be disengagedly connected with a corresponding opening in the stove in order that the burners may be relatively easily disconnected and replaced for repair and maintenance purposes. Such burners operate by aspirating a proportional amount of air for intermixture with the gas stream to form the combustible mixture as in the older type of burner. In the case of more modern burners, an air blast is controlled by metering type regulators to maintain a correct ratio of air to gas flow from which the primary impulse is obtained. The gas-air mixture generally has been ignited by the incandescent combustion chamber walls at the start of the burner operation. In order to secure efficiency, modern pressure burners are used with which pressure is created just beyond the nozzle of the burner and, unless the joint between the nozzle and the stove is tight, gas and flame leaks or "stings" out through the disconnectable joint so that a dangerous carbon monoxide gas or flame hazard for the operators is created. Arrangements to make the joint tight generally impair the facility of disconnection required when changing the regenerator stove from the firing to the blast portion of the cycle or vice versa.

In accordance with the present invention, a pressure gas burner for heating blast furnace stoves, regenerators and the like is provided, in which the area at the nozzle outlet is under positive pressure substantially at all times instead of suction, thereby precluding entry of atmospheric air, and in which the burner is sealed to the stove in such a way that outward leakage of gas or flame is precluded and coupling and uncoupling of the burner to and from the stove are facilitated, thus enabling ready and rapid inspection, repair and replacement.

In a preferred embodiment of the invention, the tubular burner is horizontally mounted on a radial track rail on which the burner is advanced and retracted by a simple arrangement, including a swivel gas supply connection for coupling and uncoupling the burner to and from the stove, and the burner nozzle is provided with a gasket which engages and seals the joint between the nozzle and the stove under sufficient pressure to maintain a tight joint to prevent outward leakage,

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notwithstanding the differential pressure at the burner nozzle and the atmosphere. Mounted within the tubular housing of the burner is a burner casing having a pilot burner or refractory cone positioned in the axial center of the nozzle and encircled by an annular ring of vanes inclined from the periphery at an angle so that the vanes impart a generally spiral flow to the gas, which is supplied under pressure to the annular space between the burner casing and the tubular housing.

The annular gas space between the burner casing and the tubular housing is separated from the outer end of the housing by a diagonal partition and a centrifugal fan driven by an electric motor is mounted axially within the housing for drawing atmospheric air through a damper and forcing it axially through the burner casing between the annularly arranged inclined vanes to impart a spiral flow and to mix with the gas stream beyond the burner nozzle for combustion within the stove.

The annulus type of orifice provides a means to accurately measure the volume of air flow through the burner without the necessity of having a long straight length of pipe as is required for a conventional orifice plate and is characterized by a very stable impulse and the magnitude of the difference in pressure for any given flow rate may be varied by adjusting the width of the annular opening.

The arrangement of the centrifugal fan is such as to produce the effect of an axial flow blower, but with less critical clearance requirements between impeller and casing than is required in axial blowers to maintain efficiency. The damper comprises a slotted cone-shaped disc rotated axially of the burner relatively to a complementary slotted conical plate, the rotation being effected by an automatic control regulated by use of metering orifices on gas and air so as to provide the proper fuel-air mixture for efficient combustion.

The pilot burner may be separately supplied with fuel and maintains constant and immediate ignition of the gas and air mixture at the nozzle of the burner and within the stove. Gas to the pilot burner may be supplied from the annular gas passage of the burner when the gas is sufficiently clean to prevent fouling of the relatively small pilot burner gas ports. The burner is a refractory case or ring having a center burner tunnel in which the gas-air mixture burns to provide an incandescent surface at the end of the burner block, thereby insuring the constant and immediate ignition of the combustible mixture.

It will be seen that the pressure gas burner

of this invention provides a highly efficient means for effecting complete combustion within the stove and at the same time, is compact and self-contained by reason of its construction and may be readily disconnected from and connected to the stove by the novel mounting and coupling mechanism described.

For a more complete understanding of the invention, reference may be had to the accompanying drawings, in which:

Figure 1 is a side elevation of the gas burner of this invention, shown coupled to a stove, as seen along the line 1—1 of Fig. 2;

Fig. 2 is a rear elevation, as seen along the line 2—2 of Fig. 1;

Fig. 3 is a plan view of the stove, showing it in various uncoupled positions as seen along the line 3—3 of Fig. 1;

Fig. 4 is an axial section through the burner as seen along the line 4—4 of Fig. 3;

Fig. 4–A is an axial section of a solid burner nose block;

Fig. 5 is an axial view of the nozzle of the burner as seen along the line 5—5 of Fig. 4;

Fig. 6 illustrates the construction and arrangement of the vanes of the mixing nozzle as seen along the line 6—6 of Fig. 5;

Fig. 7 is a transverse section through the outer end of the air intake of the burner as seen along the line 7—7 of Fig. 4; and

Fig. 8 is a fragmentary section through the outer end of the burner showing a modification of the air metering damper.

Referring to the drawings, numeral 10 designates the casing of a conventional stove having the hot blast main 11, both connected to the horizontal burner duct 12 with whose flange 13 the nozzle of the burner 14 of this invention is adapted to be connected.

The burner 14 includes a cylindrical housing 15 having the gas pipe extension 16 on its lower side provided with a flange 17 which forms part of a swivel 18 by which the burner is rotatably but gas-tightly connected to the elbow duct 19 in turn connected by second swivel 20 to the gas main 21.

The lower flange 18′ of swivel 18 and elbow duct 19 are supported on a frame 19′ having rollers 22 resting on a curved rail 23 whose center of curvature is the center of the swivel 20, i. e., the center of gas main 21. One of the rollers 22 is provided with a handwheel 22′ whereby the entire burner 14 may be bodily swung toward and away from abutting connection with the stove duct 12, to the limit of rail stop 23′. Further turning of the burner proper for more ready access for clean-out purposes may be effected about swivel 18 by rotating handwheel 24 and connected sprocket 24′ meshing with a chain 25 whose opposite ends are fixed to the opposite sides of the lower flange 18′ of the swivel 18, as shown in Figs. 1 and 3.

The burner 14 is removably connected to the stove duct 12 by bolts 26, pivoted on stove duct flange 13 and removably connectable to slotted brackets 26′ on the burner casing. When the bolts 26 are coupled with burner brackets 26′ and the corresponding nuts tightened, the burner 14 is securely connected to the stove duct flange 13. The joint between the burner 14 and the stove duct flange 13 is sealed by a non-metallic gasket 27 such as asbestos, or the like, clamped between the inner end of the burner housing 15 and a clamping ring 27′ so as to project slightly beyond the inner or nozzle end of the stove housing 11, as is shown in Fig. 4. Accordingly, by rotating handwheel 22′ until the gasket 27 abuts the stove duct flange 13 and then drawing bolts 26 tightly, the joint between the burner 14 and the stove 10 is sealed. Conversely, when bolts 26 are disengaged from the burner 14 and the handwheel 22′ is rotated in the opposite direction, the burner 14 rolls back over rails 23 to the rail stop 23′ and the burner 14 is readily disconnected from the stove 10. Further rotation of the burner may be obtained by rotating handwheel 24, its various positions being shown in phantom in Fig. 3.

Referring now to Fig. 4, the housing 15 contains the tubular casing 28 forming with the interior of the housing 11 an annular gas passage 29, communicating with gas pipe 16 but disconnected from the interior of the housing 15 by a diagonal partition 28′ welded at its opposite ends to the casing 28 and housing 15.

Bolted to the inner end of the casing 28 by bolts 30 is the burner nozzle 31, which comprises two eccentric short tubes 32 and 33 of sheet steel. As shown particularly in Figs. 4, 5 and 6, the outer tube 33 is slotted substantially axially at spaced points and the ears thus formed are bent backwardly against the upper edge of the inner tube 32 and welded thereto to form the diagonal vanes 34. The adjacent vanes 34 accordingly form between them the inwardly and tangentially inclined passages or slots 35 which communicate with the plenum chamber 36 within the casing 28.

Mounted within the inner nozzle tube 32 is the ceramic pilot burner 37 which is provided with a diverging or tapering central passage 38 terminating in a conical tip which becomes incandescent when the combustible mixture of fuel gas and air is supplied thereto through nozzle plate 39 having jet passages 40 communicating with a space 41 supplied with gas by pipes 42 from gas main 21 at a point ahead of the main gate valve V. The lower end of the pilot tube 32 is closed by the partition 43 carrying the nozzle plate 39 and forming with partition 44 the pilot gas chamber 41 to which gas pipes 42 are connected. The pilot burner block 37 may be made solid as shown in Fig. 4–A, so as to maintain ignition by its incandescence. Block 37 also acts as a heat insulating barrier protecting the blower.

Mounted coaxially with the burner housing 15 and the casing 28, and suitably supported on brackets 45 is an electric motor 46 whose shaft carries and drives the bladed wheel 47, which is of a conventional design of centrifugal blower wheel including the peripheral, substantially radial but curved blades 48. A transverse partition 49 extends across the housing 15 outwardly from the centrifugal blower 47 and has a central opening formed by inwardly turned flange 50 and communicating with the eye of the centrifugal blower 47.

The outer end of the housing 15 is closed by the imperforate plate 51 connected thereto by bolts and spacers 52 so as to provide the lateral air intake opening 53 through which atmospheric air is drawn by blower 47 into casing 28 as indicated by the arrows in Fig. 4.

Interposed between the intake opening 53 and the partition 49 is a damper 54 composed of a fixed plate 55 of generally conical cross-section, as shown in Fig. 4, and having the radial slots 56 shown in Fig. 7. A disc 57 overlies the inner surface of the stationary plate 55 and is provided with corresponding slots 56′ which are adapted to cooperate with slots 56 as the disc 57 is rotated about its axis relatively to the

stationary disc 55. Movable disc 57 is provided with a hub 58 secured to a shaft 59 journalled in a tubular extension 60 on the stationary damper plate 55. The projecting outer end of shaft 59 is secured to a radial lever 61 which in turn is connected near its outer end by a link 62 to a crank 63 of a conventional form of control mechanism housed within hood 64 and operated by thermocouples within the stove to control the temperature by regulating the damper 54 through the crank 63, link 62, lever 61 and relatively movable slotted disc 57.

In Fig. 8 a modified form of damper is shown in which the atmospheric air is admitted through the perforated bottom plate 51' to the relatively movable slotted damper plates 55' and 57' constituting the damper 54' which is actuated in the manner described from the automatic control mechanism in hood 64 through the lever 61'.

Observation of the burner flame may be seen by looking through inspection port 65 sighted between the vanes 34 at the proper angle, as is indicated in Fig. 3.

The burner coupling flange plate 13 mounted on the burner duct 12 preferably is of special construction and is fitted with the horizontal rail 66 on which the circular door 67 is carried on rollers 68 about a vertical pivot 69. The door 67 carries the cross bar 70 having end notches 71 in which the bolts 26 are adapted to lodge to lock the door 67 in place when the door 67 is centered on rails 66 in registry with the burner duct 12 to close the same after uncoupling the burner.

In operation of the apparatus of this invention, the pilot flame at orifice 38 is lit and the burner 14 coupled to the stove after the door 67 is unlatched and moved along its rail 66 to the position shown in Fig. 2 opening duct 12. The burner coupling operation involves first assuring that the burner 14 is swung by handwheel 24 to the limit of its counterclockwise position about swivel 18, which aligns the burner axis tangent to an arc having its center of curvature at the axis of gas main 21 and swivel 20. Then the burner 14 is rolled on its carriage 19' along track 23 by pushing the same or by rotating handwheel 22' whereby the burner 14, elbow 19 and carriage 19' move about swivel 20 until the gasket 27 in the nose of the burner 14 abuts the flange 13, as shown in Fig. 4. The bolts 26 are engaged with brackets 26' on the burner and drawn up to airtightly seal the joint between the burner 14 and the stove duct flange 13 as indicated in Figs. 1 and 4.

The air damper orifices 56' are initially adjusted manually by means of handle 61, shown in Fig. 7, the switch of motor 46 closed to start the motor 46 driving centrifugal blower 47, which forces pressure air through the casing 28 in the manner of an axial flow blower but with the greater volume of a centrifugal blower, because of the arrangement of the partition 49, 50 and casing 28.

When main gas valve V is opened, gas under pressure enters annular space 29 from gas pipe 16 to flow between the diagonal vanes 34 to mix with the air also flowing between the vanes 34 from plenum chamber 36 within the casing 28. The inclination of the vanes 34 is such that a converging spiral flow is imparted to the air-gas mixture, which converges just beyond the pilot orifice 38 to be ignited thereby and burn within the insulated burner duct 12. Proper gas-air mixture is maintained automatically by the mechanism housed within hood 64, which adjusts the rotating slotted damper disc 57 relatively to stationary damper plate 55 by means of crank 63, link 62 and lever 61 to regulate the air entering the burner through slot 53 for best efficiency.

The orifice 38 through pilot burner block 37 is made diverging and the tip of the block conical, so that the burner tip becomes incandescent to maintain pilot burner ignition for a time in case of short duration failure of pilot gas supply or the like. Inspection of the pilot flame and burner flame may be made through port 65.

In order to uncouple the burner 14 from the stove, the gas valve V is closed, the blower 47 is shut off after combustion ceases, and bolts 26 released. The entire burner 14 is rolled back on its tracks 23 to the limit of stop 23', which places it in the normal out position shown in phantom position and designated A in Fig. 3. The door 67 is then rolled along its rails 66 and locked closed over duct 12 by bolts 26.

In the event that the burner 14 is to be inspected or parts are to be replaced or repaired, the burner 14 may be swung at a wider angle, from position A to position B in Fig. 3, by rotating handwheel 24, which pivots the burner 14 on its carriage 19' about swivel 18. It will be observed from Fig. 3 that when the burner 14 stands in position B, it is freely accessible from both ends, and inspection and repair are facilitated.

Although a preferred embodiment of the invention has been illustrated and described herein, it is to be understood that the invention is not limited thereby, but is susceptible of changes in form and detail within the scope of the appended claims.

I claim:

1. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a nozzle at one end, a support mounting said housing in substantially horizontal position, a power driven fan within said housing for forcing air through said nozzle, a main supplying gas under pressure connected to said nozzle for admixture with the air forced therethrough, a vertical axis swivel in said main, a rail concentric with the axis of said swivel, and rollers on said support and engaging said rail about which said burner may be moved to couple the same to and from said stove.

2. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a nozzle at one end, a support mounting said housing in substantially horizontal position, a power driven fan within said housing for forcing air through said nozzle, a main supplying gas under pressure connected to said nozzle for admixture with the air forced therethrough, a vertical axis swivel in said main, a pipe connecting said swivel to said housing, a rail concentric with the vertical axis of said swivel, rollers on said support and engaging said rail about which said burner may be moved to couple the same to and from said stove.

3. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a nozzle at one end, a support mounting said housing in substantially horizontal position and for rotation in a substantially horizontal plane, a power driven fan

within said housing for forcing air through said nozzle, a main supplying gas under pressure connected to said nozzle for admixture with the air forced therethrough, a vertical axis swivel in said main, a pipe connecting said swivel to said housing, a second swivel interposed between said pipe and said housing about which said burner housing may be rotated relative to said support and independently of said first swivel, a rail concentric with the axis of said first swivel, rollers on said support and engaging said rail about which said burner may be moved to couple the same to and from said stove.

4. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a nozzle at one end, a support mounting said housing in substantially horizontal position and for rotation in a substantially horizontal plane, a power driven fan within said housing for forcing air through said nozzle, a main supplying gas under pressure connected to said housing for admixture with the air forced therethrough, a vertical axis swivel in said main, a pipe connecting said swivel to said housing, a second swivel interposed between said pipe and said housing about which said housing may be rotated independently of said first swivel and said support, a rail concentric with the axis of said first swivel, rollers on said support and engaging said rail about which said burner may be moved to couple the same to and from said stove, and driving connections between said burner housing and said second swivel for rotating said burner relatively to said first swivel.

5. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a nozzle at one end, a support mounting said housing in substantially horizontal position, a power driven fan within said housing for forcing air through said nozzle, a main supplying gas under pressure connected to said housing for admixture with the air forced therethrough, a vertical axis swivel in said main, a U-shaped pipe connecting said swivel to said housing and carried at its free end on said housing support, a second vertical axis swivel interposed between the free end of said pipe and said housing about which said housing may be rotated relative to said pipe and said support, a rail concentric with the axis of said first swivel, rollers on said support and engaging said rail about which said burner may be moved to couple the same to and from said stove, and means for rotating said burner housing about the axis of said second swivel independently of said first swivel and said support.

6. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having an opening at one end, a support mounting said housing in substantially horizontal position, a tubular casing within said housing and forming an annular space therewith, said casing having a nozzle at one end adjacent to said opening, a fan within said housing for forcing air through said casing toward said opening, motive means for driving said fan, a tube concentrically mounted within said nozzle and forming an annular passage therewith, vanes inclined with respect to the axis of said casing and extending substantially radially between said nozzle and said tube for imparting a spiral motion to the air, and a source of gas under pressure connected to said annular space to supply gas for admixture with the air forced through said nozzle.

7. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a substantially circular opening at one end, a support mounting said housing in substantially horizontal position, a tubular casing within said housing and forming an annular space therebetween, said casing having a nozzle at one end adjacent to said opening, a fan within said housing for forcing air through said casing toward said opening, motive means for driving said fan, a tube concentrically mounted within said nozzle in spaced relation thereto, vanes inclined with respect to the axis of said casing extending substantially radially between said tube and said nozzle and forming apertures between them communicating with said annular space and said casing for imparting a spiral motion to the air, and a source of gas under pressure connected to said annular space to supply gas for admixture with the air forced through said nozzle.

8. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a substantially circular opening at one end, a support mounting said housing in substantially horizontal position, a tubular casing within said housing and forming an annular space therebetween, said casing having a nozzle at one end within said extension, a fan within said housing for forcing air through said casing for discharge through said opening, motive means for driving said fan adjacent to said casing, a tubular nozzle on said casing adjacent to said opening, a tube concentrically mounted within said nozzle, said nozzle being slit at peripherally spaced points and having ears bent inwardly toward said tube to form vanes inclined relative to the axis of said tube and extending substantially radially between said nozzle and said tube for imparting a spiral motion to the air, and a source of gas under pressure connected to said annular space to supply gas for admixture with the air forced through said nozzle.

9. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a substantially circular opening at one end, a support mounting said housing in substantially horizontal position, a tubular casing within said housing and forming an annular space therewith, said casing having an inner end spaced inwardly of said opening, a nozzle on said inner end of said casing, a fan within said housing for forcing air through said casing for discharge through said opening, a motive means for driving said fan, a tube concentrically mounted within said nozzle, fixed vanes extending substantially radially between said nozzle and said concentric tube, said vanes being substantially inclined with respect to a plane perpendicular to the axis of said casing to impart a spiral motion to the air, a pilot burner within said tube adjacent to said opening and a source of gas under pressure connected to said pilot burner and to said annular space to supply gas for admixture at the opening with the air forced through the nozzle.

10. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a discharge opening at one end, a support mounting said housing in substantially horizontal position, a damper comprising relatively rotatable slotted discs mounted in the opposite end of said housing from said discharge opening, a partition mounted across said

housing adjacent to said damper and having an axial air inlet opening, a centrifugal fan mounted within said housing adjacent to said partition and coaxially with the inlet opening, a tubular casing within said housing extending from said fan substantially to said discharge opening, to convey air from said fan to said discharge opening, said casing having a nozzle thereon adjacent to said discharge opening, motive means for driving said fan, axially diagonal vanes extending substantially radially of and within said nozzle for imparting a spiral motion to the air, and a source of gas under pressure connected to said housing for admixture at said discharge opening with the air forced through said casing.

11. In a gas burner for heating a hot blast stove and the like, the combination of a substantially tubular housing having a discharge opening at one end, a support mounting said housing in substantially horizontal position, a damper comprising relatively rotatable slotted discs mounted in the opposite end of said housing from said nozzle, a partition mounted across said housing adjacent to said damper and having an axial air inlet opening, a centrifugal fan mounted within said housing coaxial with the partition opening and adjacent to said partition, a tubular casing extending from adjacent to said fan substantially to said discharge opening to convey air from said fan to said discharge opening, a nozzle on the end of said casing adjacent to said discharge opening, motive means for driving said fan, substantially parallel vanes inclined with respect to a plane perpendicular to the axis of said casing and extending substantially radially of and within said nozzle for imparting a spiral motion to the air, a tube concentrically mounted within said nozzle to which said vanes extend, a pilot burner mounted within said concentric tube, and a source of gas under pressure connected to said pilot burner and to said housing for admixture at said discharge opening with the air forced through said casing and nozzle.

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