April 5, 1960 D. M. MARSHALL 2,931,430

COMBUSTION OIL AND GAS BURNER

Filed Feb. 21, 1957

FIG. 1

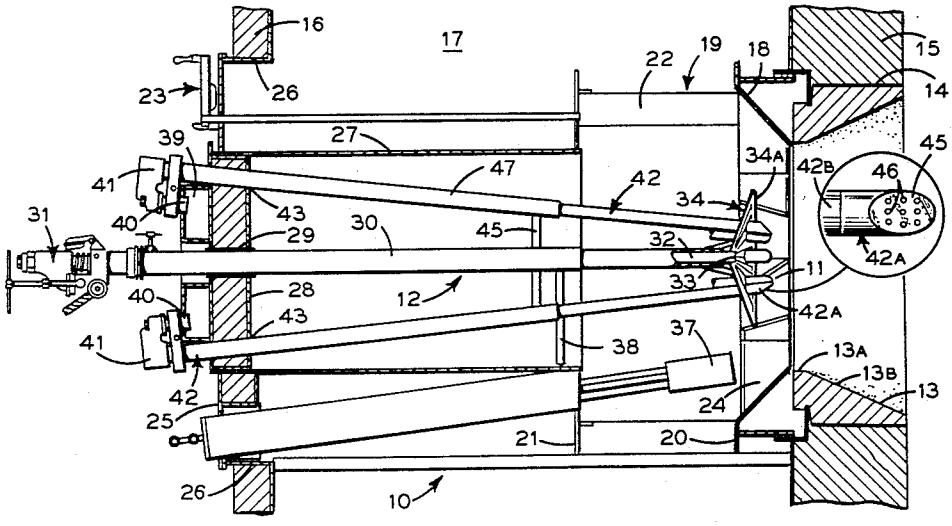
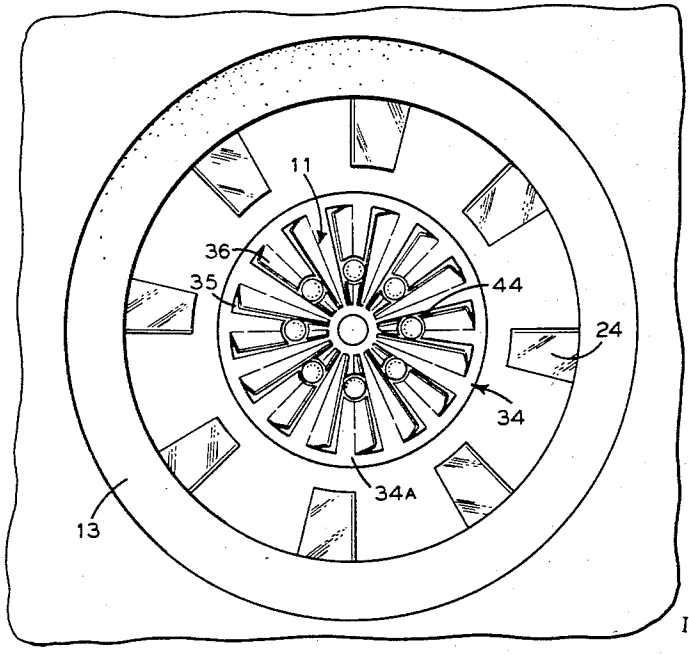


FIG. 2



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United States Patent Office

2,931,430

Patented Apr. 5, 1960

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COMBINATION OIL AND GAS BURNER

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Application February 21, 1957, Serial No. 641,654

10 Claims. (Cl. 158—11)

This invention relates to a fuel burner and more particularly to an improved center-fired gas burner having a novel multiple nozzle or spud arrangement, the instant invention constituting an improvement of a burner arrangement described in a copending application Ser. No. 309,255, filed September 12, 1952, now Patent 2,826,249.

In order to provide for overall fuel economy in firing a furnace or combustion chamber of a steam boiler or the like, the combustion chamber or furnace is generally provided with a compact firing arrangement comprising a fuel burner capable of burning alternate fuels such as gas, oil or pulverized coal which may be fired separately and/or in combination depending upon the amount and availability of the particular kind of fuel.

Heretofore, in a high pressure center-fired gas burner an annular gas header or ring formed with a plurality of gas ports was utilized in conjunction with an oil burner or pulverized coal burner, the gas ring or header circumferentially embracing or otherwise being integrally formed or connected to the burner tube or nozzle of an oil and/or coal burner. However, experience has shown that several distinct disadvantages have been encountered in the use of a gas burner so arranged. Due to the high temperatures involved, high temperature stresses are set up in the heretofore known center-fired gas burner fuel ring which eventually provide the cause for failure of the gas burner and/or its connection to the gas supply which extends into the vicinity of the high temperature zones. To overcome this troublesome effect, it has been necessary to utilize an expensive expansion joint to prevent cracking of the gas burner and/or its supply connections due to the differential expansion.

Another disadvantage in a gas burner of this type was that the embracing or integrally formed gas ring burner and associated alternate fuel burner parts constituted a relatively bulky, heavy and unwieldy piece of equipment, thereby rendering it difficult to permit immediate repair or replacement of the same for cleaning or the like, the weight and bulk thereof becoming particularly aggravated as the size of the burner is increased.

An object of the instant invention is to provide an improved, center-fired, gas burner which is free from the expansion difficulties heretofore inherent in center-fired gas burners and which is compact and light in weight and the parts of which are readily rendered replaceable or removable with a minimum of effort whereby the entire burner need not be completely withdrawn from the furnace port.

Another object of this invention is to provide an improved gas burner capable of achieving greater flame stability over an increased load range.

More specifically the instant invention burner arrangement comprises an endless or annular gas manifold removed from the heat of the furnace and arranged to be disposed in a spaced parallel plane of a burner throat extending into a burner port of a furnace wall, the manifold being connected to a source of gas supply under

pressure. Spaced about the gas manifold and connected thereto by readily releasable coupling means are a plurality of individually removable elongated gas spuds which are substantially equal in length and which are extended toward the burner throat, the gas spuds being arranged so as to have their free discharge ends converging toward the central axis of the burner and terminate in a plane substantially parallel to the entrance opening of the burner throat.

According to this invention, there is supported adjacent the entrance opening of the burner throat in a plane substantially parallel thereto an impeller means provided with a plurality of apertures for receiving the discharge ends of the gas spuds, the converging discharge ends of the respective spuds extending therethrough in the direction of the burner throat and terminate in a plane surface having a diameter smaller than that of the impeller.

The discharge end or nozzle tip of each conduit is provided according to this invention with a face portion having a plurality of gas ports or gas orifices, the face being obliquely disposed relative to an axial plane of the conduit. Accordingly, each conduit is positioned relative to one another so that the face portion thereof discharges gas outwardly therefrom in a stream which diverges outwardly toward the peripheral marginal portion of the burner throat to form a conical spread for admixture with the air and for combustion of the discharged gaseous fuel in the presence of combustion air delivered to the burner port by the usual air register means.

A feature of the instant invention resides in the provision whereby instant burners may be utilized solely as a gas burner and/or may be utilized in a multiple fuel burner arrangement whereby a fuel other than gas may be fired as an alternate in combination therewith.

Another feature of this invention resides in the provision of a center-fired gas burner that is compact, light in weight, having a plurality of gas spuds which are individually and readily removable without necessitating complete removal of its associated or alternate fuel burning means when utilized in combination therewith.

Still another feature of this invention resides in the provision that the improved gas burner is relatively simple in construction, economical, easily maintained, and positive in operation.

Other features and advantages will be readily apparent when considered in view of the drawings and specification in which:

Fig. 1 is a sectiional side view of the improved burner of the instant invention, with the detail of the gas burner nozzle shown enlarged; and

Fig. 2 is a furnace end view of the burner.

While the burner of the instant invention may be utilized as a gas burner only, it will be noted that the novel gas burner arrangement herein described is readily adapted for use in a multiple fuel burner arrangement whereby either a liquid fuel atomizing means and/or a pulverized coal burning means may be utilized in conjunction therewith for burning an alternate fuel, either separately or in combination therewith. However, for the purpose of description, the improved gas burner of the instant invention is herein illustrated in an arrangement in combination with a fluid fuel burning means.

Referring to the drawings, the burner combination **10** is illustrated with the instant gas burning means **11** novelly arranged in combination with a liquid fuel atomizing means **12** which may be, for example, of the type shown in U.S. Patent 2,260,062. Accordingly, the liquid fuel atomizing means **12** is mounted centrally of a circular type burner **10** having a burner throat **13** adapted to extend into a port **14** formed in a wall portion **15** of a furnace of a steam generating unit or the like. The burner throat **13** is formed of a suitable re-

fractory material and includes a cylindrical relatively short entrance section 13*a* which is continuous with a diverging conduit section 13*b* leading into the interior of the furnace. Spaced from the furnace wall 15 and extending substantially parallel thereto is an outer casing 16 in which the space formed therebetween constitutes an air plenum 17 for the flow of combustion air from a forced draft fan (not shown) to the burner port.

An air entrance means in the form of a truncated cone 18 is supported immediately adjacent to the exterior side of the port 14 to direct air into the port. In the illustrated arrangement, the directing cone 18 converges toward the entrance of the port, the cone being supported to a structural frame work extending between the furnace wall 15 and the casing 16. The combustion air is directed to the cone 18 from an air register 19 having an inner wall 20 and an outer wall 21, inner wall 20 being connected to the entrance cone 18. It will be noted that between the walls 20 and 21, the air register is provided with adjustable air doors 22 suitably controlled by operating means 23. In order to impart a whirling or swirling movement to the air, the cone 18 is provided with a plurality of vanes 24.

An annular cover plate 25 closes an access opening 26 in the casing 16 and a cylindrical housing or casing 27 extends inwardly from the inner periphery of the access cover plate 25 through the air plenum 17 to the outer wall 21 of the air register 19, the casing or housing 27 embracing the burner means 11 and 12 which extend therethrough. The outer ends of the two fuel dispersing means 11 and 12 extend through the small circular cover 28 closing the central opening in the annular cover plate 25, the circular cover 28 forming an outer closure for the casing or housing 27.

The circular cover 28 supports a central sleeve member 29 through which there extends a distance piece 30 forming part of the fuel oil atomizer 12. If desired, the distance piece 30 may be rendered axially adjustable along the central axial of the burner 10. At the outer end of the distance piece there is connected thereto a liquid fuel supply assembly 31 which connects the fuel pipe or oil burner barrel 32 disposed centrally of the distance piece 30 with a source of fuel and oil (not shown). On the inner end of the barrel 32, there is provided a fuel atomizing head 33 which is spaced a short distance from the burner port, the atomizing head 33 being preferably of the type producing a conical spray of atomized oil having the axis of the conical spray co-axial with the entrance cone 18 and burner port 14.

Attached to the inner end of the distance piece 30 and externally surrounding the atomizer head 33 is an air deflector or impeller means in the shape of a truncated cone 34 having the base 34*a* thereof extending outwardly toward the furnace chamber, the impeller cone being concentrically disposed about the longitudinal axis of the burner means 10. The conical surface of the impeller means is provided with a series of equally spaced air openings 35 and corresponding air deflector plates or vanes 36 associated therewith for imparting a whirling motion to the air directed through the impeller to the central portion of the burner port. If desired, an observation port (not shown) may be provided in the circular cover 28. Also an igniting means 37 is provided. Intermediate the ends of the distance piece 30 and more closely adjacent the forward end of the oil burner 12, there is provided a support member or spider 38 for supporting the distance piece in position within the casing 27.

The improved gas burner arrangement 11 of the instant invention includes an endless or annular gas manifold 39 disposed in a plane substantially parallel to the burner port 14 and spaced therefrom, the manifold 39 being disposed immediately adjacent the cover plate 28 on the outer side thereof. Means (not shown) are suitably arranged to connect the manifold to a suitable source of gas supply under pressure. Spatially disposed and substantially equidistantly spaced about a peripheral portion of the gas manifold, there are provided a plurality of nipples 40 in communication with the interior of the manifold 39. Connected to the other end of each nipple 40 there is a bend 41 to which an elongated gas conduit or spud 42 is releasably connected. As shown the plurality of elongated gas spuds 42 are equi-distantly spaced about the manifold 39 and concentrically disposed about the longitudinal axis of the burner, the spuds 42 extending through spaced openings 43 in the circular cover 28 and inwardly through the casing 27 toward the burner port 14. To achieve the center-fire gas burner effect, the forward or discharge end 42*a* of the elongated gas spuds 42 in the illustrated embodiment are coverged toward the central axis of the burner combination 10, the discharge ends 42*a* terminating in a plane parallel to and spaced from the plane of the burner port.

According to this invention, the impeller cone 34 is provided with a plurality of equi-distantly spaced apertures 44 spaced inwardly of the base marginal portion for receiving the discharge ends 42*a* of the gas spuds. It will be noted that the apertures 44 have a diameter slightly larger than that of the gas spuds for loosely receiving the discharge ends which are projected beyond the base portions of the impeller and terminate in a spud circle having a smaller diameter than that of the base portion 34*a* of the impeller cone. With this arrangement, it has been discovered that the eddy currents produced by the air flowing through and around the impeller cone 34 produce a condition which tends to stabilize a gas flame when gas is fired. If desired, suitable brackets 45 may be provided to support the gas spuds 42 intermediate the ends thereof to the distance piece 30.

With this arrangement, it will be noted that the gas supply manifold 39 supplying the gas spuds 42 with gas is disposed so as to be removed from the radiant heat of the gas flame and furnace proper and therefore free of any troublesome effects resulting therefrom. Further, due to the freely supported discharge ends 42–*a* of the gas conduits 42 which extend through the enlarged apertures 44 of the impeller 34 adjacent the burner port where the highest temperature occurs, the individual gas spuds 42 are free separately to expand without imposing excessive strains on the remainder of the assembly. Since the spuds 42 and their discharge tip portions 42*a* are the only portions of the gas burner arrangement subjected to conditions producing strains and/or corrosive deterioration, they can be readily and simply removed independently of each other by simply breaking the readily releaseable connection provided for that purpose, in the event that inspection, replacement or repair of the spud element is required.

According to this invention, discharge end 42*a* of the elongated gas spuds 42 is provided with a face portion 45 disposed in a plane oblique relative to that of an axial plane of the spud. The face portion 45 of each conduit is further provided with a plurality of apertures or orifice openings 46 through which gas is discharged. As shown in Figs. 1 and 2, it will be noted that the face portions 45 of each gas spud are positioned relative to each other so that the gas discharged therefrom is directed outwardly therefrom in a conical diverging stream flowing toward the marginal portion of the burner throat.

While the gas spuds 42 may be provided with an integrally formed discharge tip or nozzle, in the illustrated embodiment the gas spud includes a separable tip or discharge nozzle 42*a* which may be suitably connected to the barrel portion 42*b* of the gas spud 42 by any suitable means such as threaded members. However, it will be noted that in either case, the elongated gas spuds 42 are formed without interruptions along the length thereof so as to be free of any interfering projections which would tend to obstruct or hinder the removability of the spud

from the burner arrangement. If desired a supporting sleeve 47 may be provided for receiving the gas spuds 42.

It has been discovered that with the gas burner arrangement herein described, the instant gas burner can be successfully operated separately or in combination with an alternate fuel burner over a range of gas pressures ranging from .1 inch of mercury to 25 p.s.i., whereby the geometrical arrangement of the burner is such that effective flame stabilization is achieved throughout the entire pressure range. As a result of the effective flame stabilization produced by the instant gas burner arrangement throughout the wide gas pressure range, the operating range or capacity between minimum and maximum peak loads of a steam generator, boiler or the like adapted to be fired by the instant burner can be greatly increased over that which was heretofore possible.

From the foregoing, it will be noted that the instant burner is relatively simple in construction, light in weight, easily maintained, economical and operatable throughout a relatively wide gas pressure range. Furthermore, the gas burner arrangement is such that effective mixing of the gas and air is achieved so that sufficient flame stabilization is had throughout the entire operative gas pressure range of the burner, whereby the effective flame stabilizing conditions established throughout the gas pressure range enable the range between minimum and maximum boiler capacities fired by the instant burner to be greatly increased. It is to be further noted that the arrangement of the spuds going through the impeller provides not only a shield from the air flow which helps to get the lower load conditions, but also permits a small amount of air to mix around the spuds to permit early ignition which makes for a more stable burner over its entire range.

While the instant invention has been disclosed with reference to a particular embodiment thereof, it is to be appreciated that the invention is not to be taken as limited to all of the details thereof as modifications and variations thereof may be made without departing from the spirit or scope of the invention.

What is claimed is:

1. An improved gas burner comprising an air register means through which combustion air flows, said register means having an inlet and an outlet end, a vaned air deflector supported therein adjacent said outlet end, and a plurality of gas conduits for conducting fuel gas under pressure, extending through said register and terminating adjacent said outlet end, said conduits having their discharge ends extended through said vaned air deflector whereby the discharge ends thereof are arranged within the periphery of said deflector so as to be shielded from the direct blast of air flowing through said register means, said conduit discharge ends having a plurality of orifices, the orifices of said conduits being disposed to direct streams of gas in a diverging outwardly directed path with respect to the longitudinal axis of the burner.

2. An improved gas burner comprising an air register means through which combustion air flows, said register means having an inlet and an outlet end, a vaned air deflector concentrically disposed therein adjacent said outlet end, and a plurality of gas conduits for conducting fuel gas under pressure, extending through said register and terminating adjacent said outlet end, said conduits having their discharge ends extending longitudinally about the central axis of said burner, the discharge ends of said conduits being extended through said air deflector whereby the discharge ends thereof are concentrically arranged about said axis within the periphery of said deflector so that said discharge ends of said conduits are shielded from the direct blast of air flowing through said register means and orifices in said discharge ends for ejecting streams of gas in a radially outward direction therefrom relative to the longitudinal axis of said burner.

3. An improved gas burner comprising an air register means through which combustion air flows, said register means having an inlet and an outlet end, a vaned air deflector concentrically disposed therein adjacent said outlet end, a manifold means adapted to be connected to a source of fuel gas supply, and a plurality of individually readily removable gas conduits detachably connected to said manifold for conducting fuel gas under pressure, extending through said register and terminating adjacent said outlet end, said conduits having their discharge end extending toward the central axis of said burner, the discharge ends of said conduits being projected through said air deflector whereby said discharge ends are concentrically arranged about said axis within the periphery of said deflector so that said discharge ends of said conduits are shielded from the direct blast of air flowing through said register means, said conduit discharge ends having a plurality of orifices, the orifices of said conduits being disposed to direct streams of gas in a diverging outwardly directed path with respect to the longitudinal axis of the burner.

4. An improved gas burner comprising an air register means through which combustion air flows, said register means having an inlet and an outlet end, a vaned air deflector concentrically disposed therein adjacent said outlet end, and a plurality of gas conduits for conducting fuel gas under pressure, extending through said register and terminating adjacent said outlet end, each conduit including a gas discharge tip portion comprising a face provided with a plurality of orifice openings disposed in a plane oblique to the axial plane of said conduits, said conduits being arranged to extend longitudinally of said burner, the discharge tip portion of said conduits being extended through said air deflector whereby said discharge tip portions are concentrically arranged about said axis within the periphery of said deflector so that said gas discharge tip portions are shielded from the direct blast of air flowing through said register means, the face of each conduit being disposed so that the streams of gas passing through the orifice openings therein flow in a radially outward direction toward the periphery of said outlet end of the register means.

5. An improved gas burner having greater flame stability over a greater load range comprising a burner throat adapted to extend through a burner port in a furnace wall, a gas manifold spaced from said burner throat and adapted to receive fuel from a source of gas supply, an air register means having an inlet and outlet end disposed between said manifold and burner throat for admitting combustion air into said burner throat, means for imparting a swirling movement to said air whereby the major portion of said air tends to form a swirling band of air hugging the peripheral portion of said burner throat, a vaned air deflector spatially disposed within said register adjacent the outlet end thereof, and a plurality of elongated gas nozzles spatially connected about said manifold, said gas nozzles being extended through said register and arranged to extend toward the burner throat so that said nozzles extend through said air deflector so as to be shielded from said combustion air and said nozzles having a plurality of orifices discharging gas streams at the center portion of the burner throat in a radially outward direction toward said band of swirling combustion air.

6. An improved gas burner having greater flame stability over a greater load range comprising a burner throat adapted to extend into a burner port in a furnace wall, an endless gas manifold spaced from said burner throat adapted to receive fuel from a suitable source of gas supply, an air register means disposed between said manifold and burner throat, said register means being axially aligned with said throat for admitting combustion air thereto, means for imparting a swirling movement to said air whereby the major portion of said air tends to form a swirling band of air hugging the peripheral portion of said burner throat, a vaned air deflector spatially disposed adjacent the outlet end of said register and a plurality of

elongated gas conduits spatially connected about said manifold, said gas conduits extending longitudinally of said burner toward said burner throat, a nozzle means connected to the extended end of each conduit, each of said nozzle means having a face provided with a plurality of orifice openings projected through said air deflector to shield the same from the combustion air, said face being disposed in a plane oblique to an axial plane of its respective conduit whereby gas streams discharged therefrom adjacent the center portion of the burner throat are positively directed radially outward into the major flow of combustion air hugging the peripheral portion of said burner throat to promote thorough mixing of the gas and air.

7. An improved multi-fuel burner comprising an air register through which combustion air flows, said register having an air inlet opening and an axial outlet end means, means for burning an alternate fuel extending through said air register along the central longitudinal axis of said register, a vaned impeller supported by said alternate fuel burning means adjacent said outlet opening, said impeller being concentrically disposed within said register, and a plurality of elongated gas conduits for conducting fuel gas under pressure, extending through said air register, said gas conduits having their discharge end extending toward the central axis of said burner, the extended ends of said conduits being projected through said impeller so that the discharge ends thereof project therebeyond and concentrically arranged about said axis within the periphery of said impeller whereby said discharge ends of said gas conduits are shielded from said blast of air flowing through said register, said discharge ends each having a plurality of orifices arranged to eject streams of gas in a radially outward direction toward the periphery of the axial outlet of said air register.

8. An improved combination oil and/or gas burner comprising an air register through which combustion air flows, said register having an air inlet opening and an axial outlet end, an oil atomizing means extending through said air register along the central longitudinal axis of said register, a vaned impeller supported by said atomizing means adjacent said outlet end, said impeller being concentrically disposed within said register, and a plurality of elongated gas conduits for conducting fuel gas under pressure, extending through said air register, said gas conduits having their discharge end extending through said register, the extending ends of said conduits being projected through said impeller so that the discharge ends thereof extend therebeyond and are concentrically arranged about said axis within the periphery of said impeller whereby said discharge ends of said gas conduits are shielded from the direct blast of air flowing through said register, each of said discharge ends having a plurality of orifices discharging streams of gas in a radially outward direction to form a diverging conical spray.

9. An improved gas burner comprising an air register means through which combustion air flows, said register means having an inlet and an outlet end, a vaned air deflector supported therein adjacent said outlet end, and

a plurality of gas conduits extending through said register means and terminating adjacent said outlet end, said conduits having their gas discharge ends extended through said air deflector whereby the discharge ends thereof are arranged within the periphery of said deflector so as to be shielded from the direct blast of air flowing through said register means, and said discharge end of each conduit having orifice means disposed to eject streams of gas radially outward with respect to the longitudinal axis of said burner toward the periphery of said axial outlet end of said register means and into the air stream flowing around said air deflector.

10. An improved combination oil and/or gas burner comprising a circular burner throat adapted to extend into a burner port of a furnace, an air register means having an air inlet opening and an outlet for admitting combustion air to said burner throat, means for imparting a swirling movement to said air whereby the major portion of said air forms a swirling band of air hugging the peripheral portions of said burner throat, an oil atomizing means extending through said air register along the central longitudinal axis of said register, an impeller supported by said atomizing means adjacent said outlet opening, said impeller being concentrically disposed within said register, an endless gas manifold adapted to connect to a source of gas supply, and a plurality of elongated readily removable gas conduits spatially connected about said manifold and extending through said air register, said gas conduits converging toward the central axis of said burner, a nozzle means connected to the converging end of each conduit, said nozzle means including a face portion disposed in a plane oblique to the axis of the conduit, said face portion having a plurality of discharge orifice openings, the converging end of said conduits being extended through said impeller so that the nozzle means extend therebeyond and concentricaly arranged about said axis within the periphery of said impeller, said nozzle face portions being disposed to discharge streams of gas outwardly toward the periphery of said circular burner throat and into said swirling band of air.

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