This invention relates generally to a multiple spud or nozzle type gas burner, and more particularly to an improvement over the burner arrangement disclosed in U.S. Patent No. 2,825,249.

To provide for overall fuel economy, a combustion chamber or a furnace of a steam boiler is generally fired by one or more compact fuel burners capable of firing either gas or oil, separately or in combination depending on the amount and availability of each kind of fuel. Of late the gas burning portion of such burners comprises a multiple nozzle and spud type burner in which the tip ends of the respective spuds are disposed in a spud circle which has a diameter that is smaller than that of the burner throat opening to the combustion chamber. Herefore, difficulty has been encountered with the multiple spud gas burner portion of such burners due to unstable ignition, which is particularly pronounced when the amount of excess air is normally high as at light off, at low load firing rates, and at rapid load changes. The instability of ignition of the known multiple spud type gas burners during the above mentioned conditions is believed to be due to the relative position of the spuds within the burner, i.e., in the known constructions the spuds are positioned so that their tip ends terminate in an air flow zone which is radially influenced by minor burner adjustments or changes in firing rate, and more especially by those adjustments which effect changes in total air flow. As a result, initial ignition was required to be stabilized in the air flow eddies in front of the impeller. These eddies have been discovered constitute those which are most subjected to extreme changes with only minor adjustments in total air flow.

Therefore an object of this invention is to improve the ignition stability of multiple spud type gas burners during light off, during low load operations, and during other operating conditions when excess air is normally high.

Another object is to position the multiple spuds of the gas burner with respect to the air flow through the burner throat in such a manner that the air eddies which have an effect on ignition and which are produced adjacent the point of gas ignition are not adversely affected by changes in air flow.

Still another object is to provide in a combustion oil and gas burner assembly an improved multiple spud gas burner arrangement in which the gas spuds and burner throat are specially arranged and constructed so as to greatly enhance ignition stability when gas is fired, and which is not adversely affected when oil is fired.

Another object is to provide a novelly constructed burner tip or nozzle for a multiple spud type gas burner.

The foregoing objects, and other features and advantages are attained by a burner arrangement which includes an air register for supplying combustion air through a burner throat, and a multiple spud type gas burner in which the tip ends of the spuds are disposed in a spud circle having a diameter greater than that of the throat. According to this invention the throat extending through a wall of a combustion chamber is provided with a plurality of angularly disposed slots, circumferentially spaced about the inner periphery thereof and extending in a direction substantially parallel to the longitudinal axis of the burner. In this arrangement the spuds of the gas burner are positioned in alignment with each of the slots so that the gas issuing from each of the spuds flows into the slots of the throat in which initial ignition is permitted to occur. In this manner, ignition is stabilized since the air flow in the slot is not readily influenced by changes in total burner air flow, and further a fuel-rich, easily ignitable mixture can be continually contained and maintained in the slots.

A feature of this arrangement resides in providing the burner throat with a plurality of circumferentially disposed slots about the inner periphery thereof and positioning the gas spuds in alignment with the slots so that the gas discharged therefrom is injected into the slots in which ignition occurs.

Another feature resides in a particular construction of the spud tip or nozzle, per se, which is arranged and constructed for injecting streams of gaseous fuel axially into the slots of the burner throat, and also radially inward toward the center of the burner.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a sectional side view of the combined gas and oil burner in accordance with this invention.

FIG. 2 is a front end view of FIG. 1.

FIG. 3 is a detail side view of the spud clip, per se.

FIG. 4 is an end view of FIG. 3.

FIG. 5 is an enlarged fragmentary detail view of FIG. 2.

While the multiple spud burner arrangement of the present invention may be utilized as a gas burner only, the novel gas burner and spud element, to be herein described, is readily adapted for use in a burner assembly having in combination therewith either a liquid fuel atomizing means and/or even a pulverized coal burning means, so that various kinds of fuel can be fired either separately and/or in combination. Furthermore, the novel multiple gas burner arrangement and spud element of this invention is illustrated in combination with a liquid fuel burning means.

Referring to FIG. 1, reference numeral 10 is directed to a wall of a combustion chamber, as for example a water cooled furnace wall of a vapor generating unit or the like, having a circular burner opening or port 11 extending therethrough. Generally the port 11 is lined with a suitable heat resistant refractory material 12 to define a burner throat having a relatively short cylindrical section 13 which connects to a conical section 14 diverging toward the heated side of wall 10. A plurality of fluid cooled tubes, not shown, may be disposed adjacent the burner port 11 to provide effective cooling of the throat refractory 12.

In accordance with this invention the burner throat refractory 12 is provided with a plurality of angularly disposed slots 15, circumferentially spaced about the inner periphery, and they extend in a direction substantially parallel to the longitudinal axis of the throat. As shown, the slots 15 extend the length of the cylindrical portion 12 of the throat, and terminate in the conical portion 14 thereof. As will be hereinafter described, the slots 15 in the burner throat refractory described enhance ignition stability when gas is being fired under circumstances in which excess air is normally high, as at light off, at low loads, and during rapid load changes.

Spaced from the furnace wall 10 is an outer wall cas-
ing 16 that defines therebetween a windbox or passage-
way 17 through which combustion air is directed from a
suitable air blower, not shown, to the burner assembly
18.

The burner assembly 18, which includes an air register
means 19, is supported on and between the furnace wall
10 and 12, and thereby provides the air register front and rear
end walls, respectively. A cylindrical duct or burner casing 22, connected to
and extending forwardly of the front end wall 20 spaces the
air register 19 from the furnace wall 10.

The rear end of the burner assembly 18 is supported
in the outer casing wall 16 by means of a circular burner
housing or casing 23 which connects the rear end wall
21 of the air register 19 to the outer casing wall 16. The
outer end of the casing 23A is supported in an annular
closure member 24 which forms the fitting or closure for
the burner assembly access opening 25 in outer wall 16.

Closing the outer end 23A of the burner casing 23 in
the plane of the outer casing wall 16 is an access door
26, which, if desired, may be pivotally connected to the
outer casing wall 16 for swinging between open and
closed position.

Circumferentially spaced and mounted between the end
walls 20, 21 of the air register 19 and adjacent the outer
periphery thereof are a plurality of air register doors or
vanes 27 which are adapted to pivot between open and
closed position and thereby provide the air register with
an air inlet. With the air register doors 27 in open posi-
tion, the air register 19 is rendered in communication
with the windbox 17. If desired, the air doors 27 may
be suitably geared, linked or otherwise connected so
as to be responsive to an operating means (not shown)
which may be either manually or automatically controlled
to simultaneously operate the doors in response to the
actuation thereof. Thus it will be noted that in the event
it is necessary to shut down the burner, all the air
register doors 27 may be simultaneously moved to closed
position, thereby cutting off the air supply.

The air doors 27 are suitably arranged to impart to
the air entering into the air register 19 from the wind-
box 17 a whirling, spinning or angular velocity. While
combustion air is admitted substantially tangentially into
the air register 19 through the openings defined by ad-
jacent pivoted doors 27, it is discharged therfrom axially
through the outlet 28 which is disposed in substantially
axial alignment with the burner throat 12.

As shown, the axial outlet 28 is defined by a frusto-
conical shaped entrance piece 30A which converges to-
ward the burner throat 12, with the small end of the
entrance piece 30A having a diameter substantially equal
to the internal diameter "D" of the cylindrical burner
throat portion 12, in co-axial alignment therewith.

The liquid fuel or oil burner portion 40 of the burner
assembly 18 comprises a fuel oil conduit 41 which ex-
tends along the central axis of the burner assembly 18.
As shown, the access door 26 of the rear burner casing
23A supports a central sleeve 42 wherein the fuel con-
duit 41 extends in a direction toward the burner port 14.
If desired, the conduit 41 is rendered axially adjustable
along the central axis of the burner assembly. At the outer
end of the conduit there is connected a liquid fuel
supply connection 43. Connected to the conduit 41 at
its exit is a fuel atomizing head 44, preferably
of a known construction for producing a conical spray
coaXially with the burner port, and an impeller means
45 is attached to the oil conduit 41 adjacent the atomiz-
ing head 44. Included also is an observation means 46
and igniter means (not shown).

The improved multiple spud gas burner portion in-
cludes an endless or annular gas manifold 50 disposed
in a plane substantially parallel to the furnace wall 10
and spaced from the outer side of cover 24. Means
(not shown) are suitably arranged to connect the manifold
to a source of gas supply. A plurality of nipples 51,
connected to the manifold are circumferentially spaced
about the inner periphery thereof. On the other end of
each nipple there is attached a union 52 to which an
elongated gas conduit or spud 53 is connected. Prefer-
ably the union 52 is constructed so as to render the in-
dividual spuds 53 readily detachable to facilitate their
removal or replacement during cleaning and/or repair-
ing. The spuds 53 are preferably equi-distantly spaced
about the periphery of the manifold with each spud ex-
tending from a manifold opening 54 in cover 24 and in-
wardly through casing 23 toward the burner throat 12.

Each spud 53 comprises an elongated barrel 53A portion
and tip end or nozzle 53B connected thereto, prefer-
ably by a suitably threaded connection. In accord-
ance with this invention the gas spuds 53 are arranged
so that their tip ends 53B or nozzles terminate in a spud
circle disposed in a plane parallel to and adjacent the
furnace wall 10. As shown, the diameter of the spud
circle is equal to the distance between center lines of
diametrically opposed spud tips and the arrangement is
such that the diameter of the spud circle is slightly
larger than the inside diameter of the cylindrical throat
portion 12 or diameter "D." For this reason it will be observed
that the entrance cone 30A defining the axial outlet 28
of the air register 19 is provided with circumferentially
spaced matches 30B for receiving the tip end 53B of
the spuds 53.

In accordance with this invention the spuds 53 are po-
sitioned so that their tip ends 53B are placed in respective
alignment with the slots 15 in the burner throat 12.
Thus the gas issuing from each of the spud tips 53B flows
into their respective slots 15. The relative posi-
tion of the spud tips 53B with respect to the slots 15 is
such that initial ignition is self occurring within the
slots 15. It has been discovered that this arrange-
ment results in very stable ignition since the air in the
slots 15 is not readily influenced by changes in burner
air flow. Consequently, a fuel-rich, easily ignitable mix-
ture can be continually maintained within the slots 15.
Ignition is further stabilized by the eddies created by
squirting a part of the gas issuing from spuds 53 against
the side of the slots, and by eddies created by air flow
which sweeps at an angle across the top of the slots;
and the ignition of this squirted gas is supported by the
gas burned in the slots.

FIGS. 3 and 4 illustrate the spud tip or nozzle 53B which
is particularly suitable for use in the multiple gas
burner described.

As shown, the burner tip 53B includes a tubular mem-
ber adapted to be connected to the end of the spud bar-
rel, and has a pair of side faces 60 and 61 disposed in
planes extending at substantially equal and opposite
oblique angles to an axial plane of the spud. The planes
of the oblique faces 60, 61 intersect in the axial plane,
but the faces 69, 61 terminate short of their planar inter-
section, and are joined by a comparatively narrow, short,
flat central face 62 disposed perpendicular to the axial
plane of the spud. The central face 62 terminates end
faces 63, 64 which extend in equal and opposite oblique
planes disposed normal to the axial plane of the tip.
As shown, a plurality of discharge orifices 65 are drilled
in only one of the oblique side faces, viz. face 60. The
other side face 61 has no holes or orifices drilled therein.
Also the central face 62 and each of the end faces 63 and
64 have gas discharge orifices 66 and 66A, re-
respectively. Also the barrel portion 53A of the spud
53 is provided with several rows of orifices 67 extending
longitudinally thereof and disposed adjacent to the tip end
thereof. It is to be observed that the orifices 66 in the
side face 60 and those orifices 67 in the barrel portion
53A of the spud 53 are disposed on the same side of the
axial planes thereof. It is to be noted that the
barrel portion 53A does not contain any other orifices on the back side or sides not illustrated. As seen in FIG. 2, the tip 53B of each spud is connected to its respective barrel portion 53A with the discharge orifices in their respective faces 60 oriented so as to direct the streams of gases discharging therefrom radially inward. The orifices disposed along the forward edge in each of the barrel portions 53A are likewise oriented to discharge radially inward.

Referencing FIG. 2, it will be seen that the bottom 15A of each notch 15 falls slightly below the axial plane of the tip end 53B of the spud. Thus the orifices in faces 60, 62, 64 and 63 of the tip end 53B direct the streams of gas into their respective notches 15, while orifices 67 extending longitudinally of the barrel 53A direct streams of gas inwardly toward the center of the burner. With spud tips 53B so constructed and arranged, it has been discovered that ignition is stabilized by initially igniting the gas within notches 15 and in part is due to the eddies created in squirting part of the gas against the sides of the slots and by the eddies created by air flow sweeping at an angle across the top of the slots 15.

While in accordance with the provisions of the statutes there is illustrated and described herein the best form and mode of operation of the invention now known to the inventor, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by the claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. In combination, a furnace wall having a burner throat therein forming a circular burner port, a fuel burner assembly comprising an air register having a discharge end opening to said burner port, means supplying combustion air to said register for flow through the register to and through said burner port, a plurality of circumferentially spaced slots formed in the inner periphery of and extending longitudinally of said burner throat, a gas manifold, means supplying a combustible gas to said manifold, and a plurality of gas spuds connected to said manifold, each of said spuds having its free end formed with a burner tip spaced from one of said slots and having its longitudinal axis extending parallel to and substantially aligned with the longitudinal axis of the corresponding slot, the burner tip of each spud being formed with a multiplicity of orifices, some of said orifices opening to the corresponding slot and arranged to direct streams of gases generally parallel to the axis of said port and into and longitudinally of the corresponding slot for ignition therein and with others of said orifices arranged to direct streams of gas transversely of and toward the axis of said port.

2. In combination, a furnace wall having a burner throat therein forming a circular burner port, a fuel burner assembly comprising an air register having a discharge end opening to said burner port, means supplying combustion air to said register and effecting a whirling path of travel through said register and port and along said throat, a plurality of circumferentially spaced slots formed in the inner periphery of and extending longitudinally of said burner throat, a gas manifold, means supplying a combustible gas to said manifold, and a plurality of gas spuds connected to said manifold, each of said spuds having its free end formed with a burner tip spaced from one of said slots and having its longitudinal axis extending parallel to and substantially aligned with the longitudinal axis of the corresponding slot, the burner tip of each spud being formed with a multiplicity of orifices opening to the corresponding slot and arranged to direct streams of gas generally parallel to the axis of said port and into and longitudinally of the corresponding slot for ignition therein and with others of said orifices arranged to direct streams of gas transversely of and toward the axis of said port.

References Cited in the file of this patent

UNITED STATES PATENTS

1,912,730 Schrader ___________________ June 6, 1933
2,040,011 Meacham __________________ May 5, 1936
2,439,609 Middendorf ________________ Apr. 13, 1948
2,751,973 Messey ________________ June 22, 1956
2,826,249 Poole ___________________ Mar. 11, 1958
2,851,093 Zink et al. ________________ Sept. 9, 1958
2,931,430 Marshall ________________ Apr. 5, 1960
2,982,347 Kidwell et al. ___________ May 2, 1961
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,076,496

February 5, 1963

John M. Rackley et al.

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

Column 1, line 25, for "gear" read -- gas --; column 2, line 33, for "clip" read -- tip --; column 3, line 27, for "thet" read -- the --; column 6, line 49, for "interest" read -- intersect --.

Signed and sealed this 18th day of May 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents