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2,284,708

FUEL BURNER

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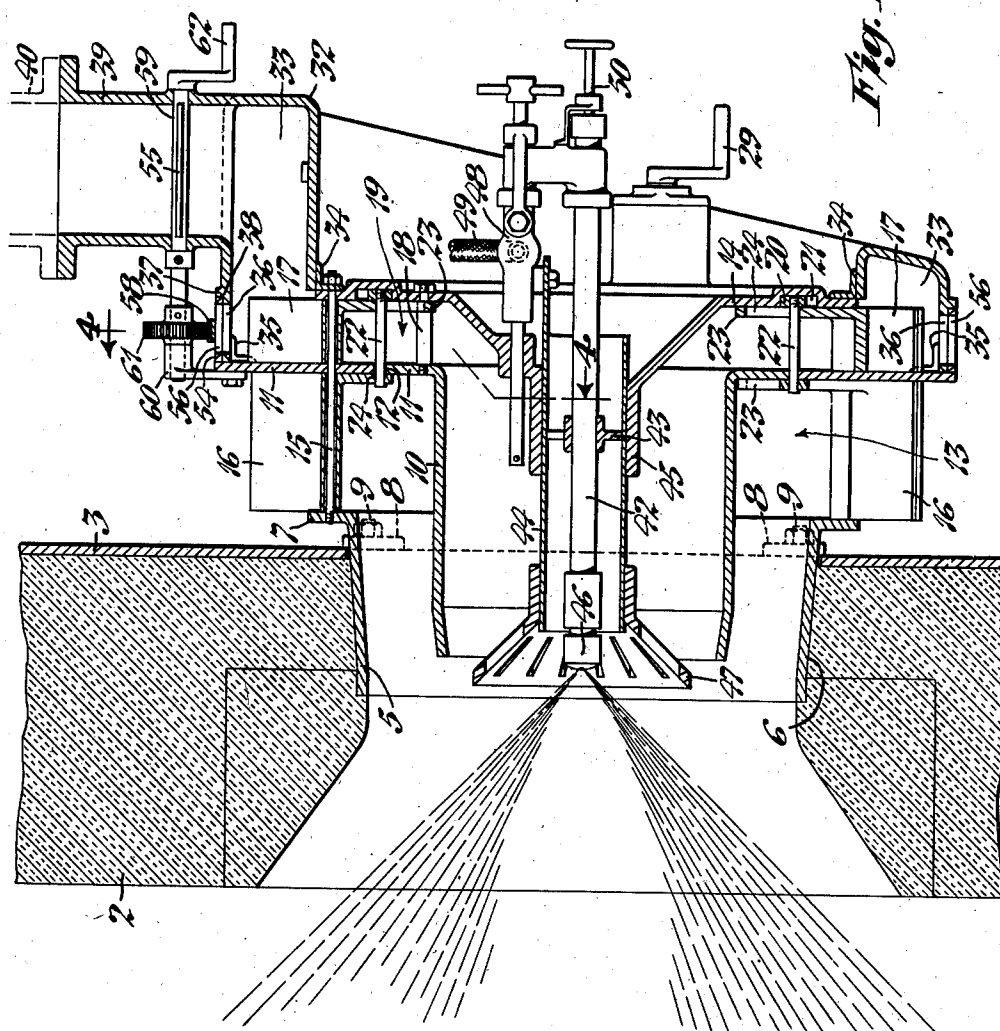


Fig. 1.

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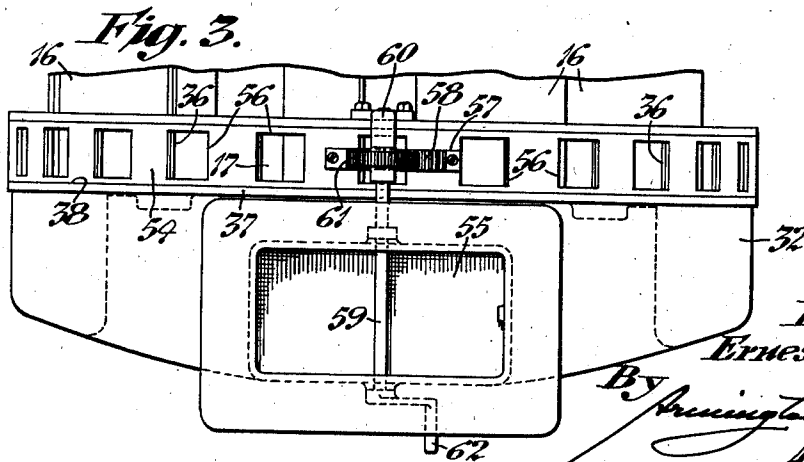
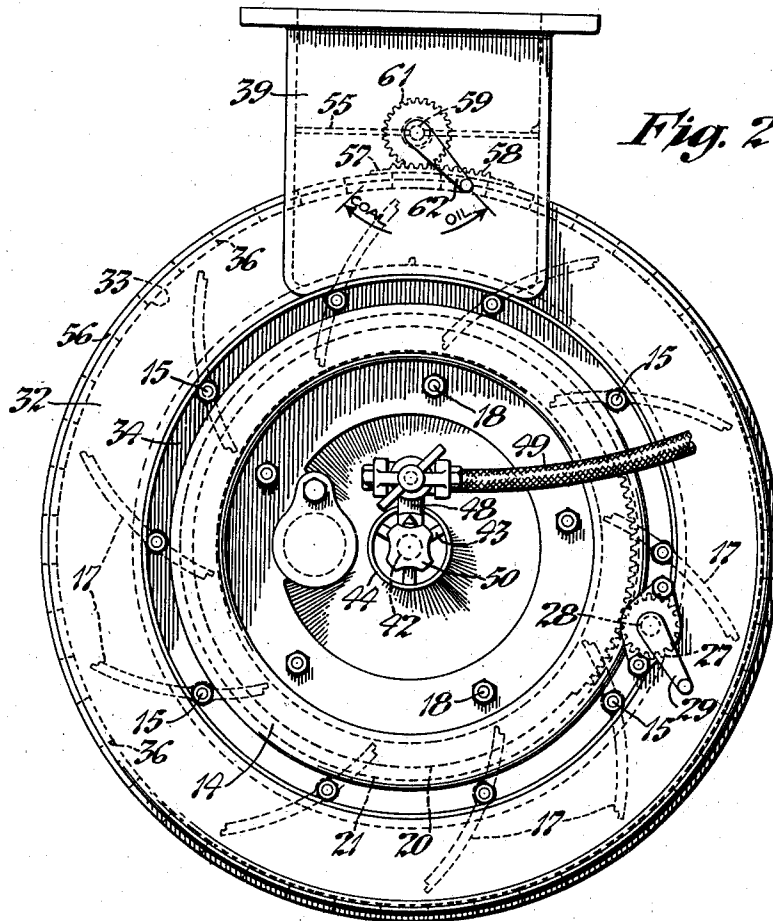
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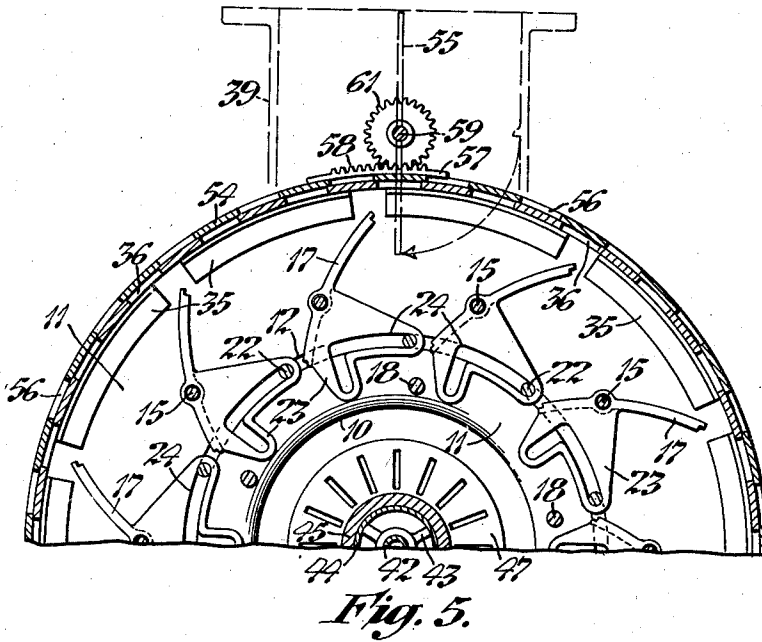
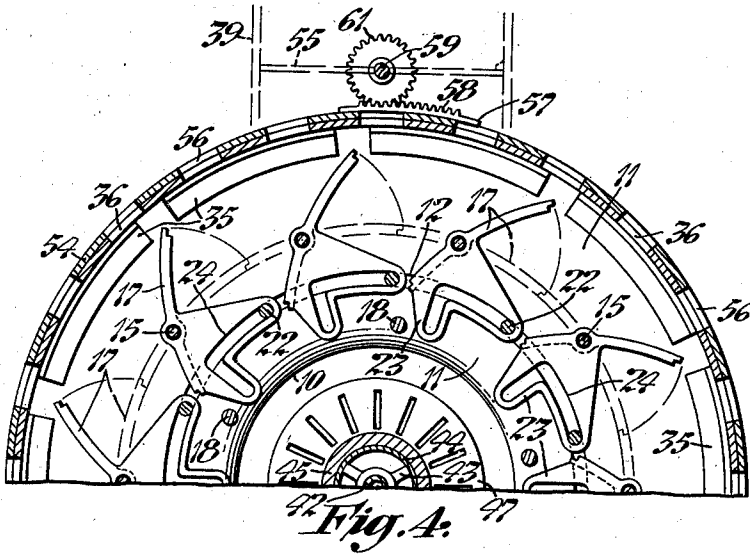
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UNITED STATES PATENT OFFICE

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FUEL BURNER

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10 Claims. (Cl. 110—22)

This invention relates to improvements in fuel burners of the type illustrated and described in my prior United States Letters Patent for Liquid fuel burner No. 2,126,853, issued August 16, 1938, and particularly adapted for use with steam boilers or other furnaces.

One of the objects of the present invention is to provide an apparatus of the type indicated adapted to burn liquid and powdered fuels either separately or in conjunction.

Another object of the invention is to provide an apparatus of the type indicated adapted to supply adequate primary and secondary air to the burner for insuring complete combustion of the liquid fuel and/or a mixed charge of powdered fuel and air.

Another object of the invention is to provide an apparatus of the type indicated in which the primary air for the liquid fuel may be shut off simultaneously with the admission of the mixed charge of powdered fuel and air to the burner.

Another object of the invention is to provide an apparatus of the type indicated having means for controlling the supply of primary and secondary air independently of the means for shutting off the supply of primary air.

Still another object of the invention is to provide an apparatus of the type indicated which is efficient in operation and of simple, compact and rugged construction to adapt it for use over long periods of time without repair or replacement of parts.

Further objects of the invention are set forth in the following specification which describes a preferred form of construction of the apparatus, by way of example, as illustrated by the accompanying drawings. In the drawings:

Fig. 1 is a vertical sectional view through a conventional type of boiler front wall showing the present improved burner applied to the opening therein;

Fig. 2 is an end view of the burner illustrated in Fig. 1 showing the liquid fuel supply pipe at the axis of the burner and a conduit at the periphery of the burner-casing for supplying powdered fuel;

Fig. 3 is a partial plan view of the apparatus showing the valve-means for controlling the admission of powdered fuel and primary air;

Fig. 4 is a part-sectional view taken on line 4—4 of Fig. 1 showing the conduit for supplying powdered fuel closed and the intake for primary air open; and

Fig. 5 is a view similar to Fig. 4 showing the

conduit for supplying powdered fuel open and the intake for the primary air closed.

The present apparatus comprises generally a casing constituting an air register and having two or more concentric annular throats for supplying primary and secondary air to promote combustion of the fuel with dampers in each throat for controlling the amount of air supplied therethrough. A supply pipe for liquid fuel extends longitudinally of the casing in the inner throat and has a burner-tip at its end. The casing has separate apertures at its periphery for supplying primary air for the liquid fuel and a mixed charge of powdered fuel and air. Valve-means are also provided for simultaneously closing the apertures for supplying primary air and opening the aperture for supplying a mixed charge of powdered fuel and air, or vice versa.

Referring to Fig. 1 of the drawings, 2 designates the masonry forward wall of a boiler furnace which is covered by an outer shell or front plate 3. The present improved burner is preferably embodied in a unitary casing adapted to be attached to the front of the boiler furnace and serving as the means for supporting fuel supply means and also the controls thereof. As herein shown the burner-casing comprises an annular sleeve 5 of slightly tapered form adapted to fit closely within the opening 6 in the front of the furnace and formed with a radial flange 7 at its outer end. The annular sleeve or member 5 is provided with perforated ears or lugs 8 on its periphery which receive studs 9 projecting from the furnace front plate 3 with nuts 35 screwed onto their ends to secure the sleeve fixedly in position. The sleeve 5 forms the outer boundary wall of the larger throat of the air register and cooperating therewith is an inner concentric annulus 10 which forms a second internal throat. The inner annulus 10 is provided with a radial flange 11 at its outer end which projects radially beyond the flange 7. The flange 11 may be continuous and integral with the annulus 10, but as herein illustrated it is made in two parts spaced from each other to provide an annular slot 12 therebetween, see Fig. 4. The space between the flange 7 on the annulus 5 and the flange 11 of the annulus 10 serves as the inlet opening or intake 13 for the secondary air which is admitted through the outer throat.

The inner annulus 10 is supported from a radial flange or end closure-plate 14 which is suspended on bolts 15 screwed into the flange 7 of the sleeve 5. Stud 13 extend between the

closure-plate 14 and the flange 11 of the annulus 10 to support the latter and hold it in its proper relation to the sleeve 5. Thus, the space between the flange 11 on the annulus 10 and the closure-plate 14 serves as the inlet opening or intake 19 for the primary air admitted through the inner throat.

A series of arcuate vanes 16 are pivoted on the bolts 15 between the flange 7 on the sleeve 5 and the flange 11 of the annulus 10 to adapt them to be rocked or swung to vary the area of the intake 13 to control the volume of the secondary air current introduced through the outer throat or to entirely close the intake. A series of similar vanes 17 are pivoted on the bolts 15 between the flange 11 on the annulus 10 and the closure-plate 14 to adapt them to be rocked for varying the area of the intake 19 to control the volume of primary air introduced through the inner throat.

The construction and arrangement of the vanes 16 and 17 are illustrated and described in detail in my prior patent referred to above. Suffice it to state herein that the series of vanes 16 and 17 are operated in sequence by means of a ring 20 rotatable in an annular recess 21 in the closure-plate 14 and having a series of pins 22 extending longitudinally of the casing through the arcuate slot 12 in the radial flange 11 of the annulus 10. Each of the vanes 16 and 17 has a depending flange 23 with a slot 24 through which the pins 22 extend, see Figs. 4 and 5. Although the slots 24 may have other forms, as herein illustrated they comprise an arcuate portion with a right-angular continuation at one end with the right-angular portions reversed in position on the respective vanes 16 and 17 as shown in detail in my prior patent referred to above. Thus, upon rotation of the ring 20 the series of pins 22 first act in the radial slots 24 in the vanes 17 to rock them to the open position illustrated in Figs. 4 and 5 to open the primary air intake 19 to the inner throat. Continued rotation of ring 20 causes the second set of vanes 16 to be rocked to open position while the pins 22 slide in the arcuate portion of the slots 24 to hold the vanes 17 open. The ring 20 has a series of gear-teeth on its periphery in mesh with the teeth of a gear 27 shown in Fig. 2. The gear 27 is keyed to one end of a shaft 28 having a crank-handle 29 at its opposite end for rotating the gear in either direction to turn the ring 20 to operate the vanes 16 and 17.

In accordance with the present invention a casing section 32 of generally circular contour and U-shaped in cross-section cooperates with the flange 11 of the annulus 10 and closure-plate 14 adjacent their outer peripheries to provide an annular chamber 33 surrounding the intake 19 for the inner throat. As illustrated in Fig. 1, the casing section 32 is connected to the end closure-plate 14 by means of a ring 34 welded or otherwise fastened to its inner annular wall and having an angular flange bolted to the plate 14 by the studs 15. The casing section 32 is further connected to the flange 11 of the annulus 10 by means of a series of arcuately-shaped angle-brackets 35, see Fig. 4, welded or otherwise suitably fastened thereto. Preferably, the casing section 32 is of gradually tapering width from top to bottom for a purpose as will appear later. The casing section 32 has a series of spaced apertures or openings 36 in its periphery, see Figs. 1 and 3, and an annular rim or bead 37 at one side of the openings which cooperates with the

outer rim of the flange 11 of the annulus 10 to provide an annular guideway 38 encircling the openings. The casing section 32 is provided at the top with a conduit 39 flanged for bolting a fuel feed pipe or chute 40 thereto as indicated in Fig. 1.

The supply pipe 42 for liquid fuel is mounted on the end closure-plate 14 and extends axially of the annulus 10. As herein illustrated the supply pipe 42 is supported in a tube 44 by means of a spider 43 having a hub which closely fits the pipe and arms which engage the interior of the tube. The tube 44, in turn, is slidably mounted in a sleeve 45 on the closure-plate 14 to adapt it for adjustment longitudinally of the annulus 10. The tube 44 also serves as an additional air-pipe surrounding the fuel-pipe 42 for supplying a small amount of air to the burner. A burner-tip 46 for the liquid fuel is carried at the inner end of the supply pipe 42 and a diffusion plate 47 is supported at the end of the tube 44 surrounding the burner-tip. The outer end of the supply pipe 42 is clamped to a fitting 48 connected by a pipe 49 to a source of liquid fuel supply in the usual manner and the fuel supplied to the burner is controlled by a manually-operable valve 50.

In addition to the liquid fuel, solid fuel may be supplied to the burner through the conduit 39 and intake opening 19 by way of the inner throat. The solid fuel is introduced as a mixed charge comprising powdered coal suspended in an air blast from a blower, not herein shown. Thus, the primary air for the combustion of the solid fuel is supplied therewith so that when powdered coal is used the openings 36 in the casing section 32 for supplying primary air to the inner throat are closed.

Valve-mechanism is provided for simultaneously closing the air intake openings 36 and opening the conduit 39 in the casing 32, and vice versa. As illustrated herein the valve-mechanism comprises a ring-closure 54 surrounding the primary air intake openings 36 and a butterfly-valve 55 in the conduit 39. The ring-closure 54 fits closely in the annular guideway 38 on the casing-section 32 and has a series of openings 56 of the same shape and spaced from each other the same distance as the openings 36 in the casing-section. Thus, when the ring-closure 54 is moved to the position illustrated in Fig. 4 the openings 56 therein align with the openings 36 in the casing section 32 to admit air to the intake 19. When the ring-closure 54 is moved to the position illustrated in Fig. 5 the openings 56 and 36 are offset to close the intake 19.

The butterfly-valve 55 in the conduit 39 is of rectangular shape to conform to the interior contour of the conduit, being carried by a stem 59 extending through bearing apertures in the sides of the conduit, see Figs. 1 and 3. As illustrated most clearly in Fig. 1, the stem 59 for the valve 55 extends rearwardly from the conduit 39 above the ring-closure 54 with its end journaled in a bearing 60 supported on the flange 11 of the inner annulus 10. A gear 61 fixed to the rearward extension of the stem 59 meshes with the teeth 58 of a rack 57 fastened to the ring-closure 54 to operate the latter and the stem may be turned by a crank-handle 62 mounted on its outer end. The ring-closure 54 and butterfly-valve 55 are so arranged with respect to each other that when one is in open position the other is in closed position and the gear 61 and rack 57 on the ring-closure are so proportioned that a quarter turn

of the crank-handle 62 will move the ring-closure from the position shown in Fig. 4 to that shown in Fig. 5, or vice versa. One embodiment of the invention having now been described in detail, the mode of operation of the burner is explained as follows:

The present improved burner is adapted to burn liquid fuels such as oil, or comminuted fuels such as powdered coal, either separately or in conjunction. When a cold boiler is to be started the ring 20 is rotated by means of the crank-handle 29 to cause the pins 22 extending from the ring to engage the right-angular portions of the slots 24 in the depending flanges 23 of the vanes 17 and rock the latter on the bolts 15 to open the intake throat 19. The ring-closure 54 is also operated by means of the crank-handle 62 to the position shown in Fig. 4 to uncover the openings 36 in the casing section 32 to admit primary air through the intake 19 to the inner throat.

The control-valve 50 for the liquid fuel supply pipe 42 is then cracked to permit a relatively small charge of oil to be ejected from the burner-tip 46 which is ignited by a torch or the like. The vanes 16 and 17 are then adjusted by manipulating the crank-handle 29 to control the admission of primary and secondary air to the flame to insure complete combustion of the liquid fuel without diluting the products of combustion. A small amount of air is admitted at the front of the casing to be drawn through the tube 44 to feed directly to the flame adjacent its axis, this being of advantage to avoid overheating the burner-tip. Thus, the flame and products of combustion produce a relatively low heat in the furnace to slowly warm up the boiler and the amount of fuel and primary and secondary air are gradually increased from time to time until the boiler is thoroughly heated.

The fuel supply may then be changed to powdered fuel. To this end the crank-handle 62 is operated to rotate the stem 59 through a quarter turn which operates to simultaneously rock the butterfly-valve 55 to open the conduit 39 and turn the ring-closure 54 to close the openings 36 in the casing section 32 as illustrated in Fig. 5. As stated above, rotation of the crank-handle 62 rocks the butterfly-valve 55 and rotates the gear 61 on the rearward extension of the stem 59 which meshes with the teeth 58 on the rack 57 to operate the ring-closure 54. Thus, the supply of primary air to the throat 19 is shut off and a mixed charge of powdered fuel and air is introduced into the casing section 32. The mixed charge of fuel and air passes through the intake 19 and inner throat and discharges into the furnace through the opening between the end of the inner annulus 10 and outer periphery of the diffusion plate 47. As the mixed fuel charge strikes the flame it is ignited, sufficient primary air being supplied with the powdered fuel to insure combustion. Due to the tortuous path of the mixed charge of powdered fuel and air through the pivoted vanes 17 a high degree of turbulence is produced therein which insures practically complete combustion. Furthermore, the tapered form or funnel-shape of the involute casing-section 32 insures the admission of the mixed fuel charge uniformly around the periphery of the intake 19.

The liquid and powdered fuels may be burned simultaneously with the primary air for both being supplied through the conduit 39 and the secondary air supplied through the intake 13 and

controlled by the vanes 16. In the preferred method of operation, however, after the mixed charge of powdered fuel has been ignited the supply of liquid fuel is shut off by manipulating the valve 50. The apparatus thereafter operates as a powdered fuel burner.

By sliding the tube 44 in its supporting sleeve 45 on the end-closure 14 the area of the annular opening between the diffusion plate 47 and the end of the inner annulus 10 may be varied to control the pattern of the flame. Likewise, the supply of secondary air may be controlled by manipulating the crank-handle 29 to rock the vanes 16 and thereby vary the area of the air-intake 13. It will be understood that for overload conditions the oil-burner may be brought in to complement the burning of the powdered fuel.

It will be observed from the foregoing specification that the present invention provides a burner of novel construction adapted to burn both liquid and powdered fuels either separately or in conjunction. It will also be observed that the improved apparatus provides means for controlling the amount of primary and secondary air supplied when liquid fuel is used and independent means for simultaneously shutting off the primary air supply and admitting a mixed charge of powdered fuel and air to convert the device to a powdered fuel burner.

While a preferred embodiment of the invention is herein described and illustrated, it will be understood that modifications may be made in the structure and arrangement of the parts of the device without departing from the spirit or scope of the invention. Therefore, without limiting myself in this respect, I claim:

1. In an apparatus of the type indicated, a casing, a burner for liquid fuel in the casing, means for supplying air to the casing, a conduit for supplying a mixed charge of powdered fuel and air to the casing, and means for simultaneously cutting off the first mentioned air supply and opening the conduit for supplying a mixed charge of powdered fuel and air, or vice versa.

2. In an apparatus of the type indicated, an annular casing, a burner for liquid fuel at the axis of the casing, means at the periphery of the casing for supplying air to support combustion of the liquid fuel, a conduit at the periphery of the casing for supplying a mixed charge of powdered fuel and air, and valve-means for simultaneously cutting off the air supply and opening the conduit for supplying a mixed charge of powdered fuel and air.

3. In an apparatus of the type indicated, a casing having two separate inlets, one of said inlets being adapted to supply air to the interior of the casing, a liquid fuel burner in the casing, a conduit for supplying a mixed charge of powdered fuel and air through the other inlet, and valve-means for simultaneously closing one of the inlets and opening the other inlet.

4. In a device of the type indicated an annular casing having a series of openings at its periphery for supplying air to the interior thereof, a ring-closure rotatable on the casing for closing the series of openings, a conduit at the periphery of the casing for supplying a mixed charge of powdered fuel and air, a valve for opening and closing the conduit, and manually-operable means for simultaneously rotating the ring-closure to closing position on the casing and opening the valve in the conduit.

5. In an apparatus of the type indicated, an annular casing having a series of openings at

its periphery for supplying air to the interior thereof, a ring closure rotatable on the casing to open or close the series of openings in the latter and having gear-teeth thereon, a conduit at the periphery of the casing for supplying a mixed charge of fuel and air to the casing, a valve in said conduit, and a gear meshing with the teeth on the ring and connected to the valve in the conduit, said gear being operable to open the valve in the conduit and turn the ring-closure to close the series of openings in the casing, or vice versa.

6. A burner for liquid and powdered fuels comprising a casing having separate throats with intake openings for supplying primary and secondary air to support combustion, means for supplying liquid fuel to one of the throats, a conduit for supplying a mixed charge of powdered fuel and air to said throat, and means for simultaneously closing the intake opening in said casing for supplying primary air and opening the conduit for supplying a mixed fuel charge to said throat, and vice versa.

7. A burner for liquid and powdered fuels comprising a casing having its interior divided into a plurality of concentric annular throats with separate intake openings at its periphery for each throat, dampers in each throat for controlling the intake openings, means for supplying liquid fuel to the inner throat, a chamber surrounding the intake opening to said inner throat and having openings for supplying air, a conduit for supplying a mixed charge of powdered fuel and air to said inner throat, and means for controlling the air and mixed fuel charge supplied to said inner throat.

8. A burner for liquid and powdered fuels comprising a casing having separate throats for supplying primary and secondary air to the casing, dampers in each throat for controlling the amount of air supplied to the casing, means for

supplying liquid fuel to one of the throats, an annular chamber surrounding said last-named throat and having cooperating inlets for admitting air and supplying a mixed charge of powdered fuel and air, and valve-means for simultaneously closing one of the cooperating inlets and opening the other inlet.

9. A burner for liquid and powdered fuels comprising a casing having its interior divided into a plurality of concentric annular throats with separate intake openings for each throat, a series of vanes in each throat for controlling the intake openings, a chamber surrounding the intake openings for the inner throat and having a series of openings for supplying air, a feed pipe for liquid fuel in the inner throat, a burner-tip at the end of said pipe, a conduit for supplying a mixed charge of powdered fuel and air to the chamber, and valve-means for simultaneously closing the air openings in the chamber and opening the conduit for the mixed fuel charge, and vice versa.

10. A burner for liquid and powdered fuels comprising a casing having separate throats for supplying primary and secondary air to the casing, dampers in each throat for controlling the amount of air supplied to the casing, means for supplying liquid fuel to one of the throats, an annular casing section surrounding said last-named throat and having separate inlets for admitting air and supplying a mixed charge of powdered fuel and air to the throat, a damper for closing the inlet in the casing section for supplying air, a conduit for supplying the mixed charge of powdered fuel and air to the other inlet in the casing section, a valve in said conduit, and means for simultaneously operating the damper for the inlet supplying air and the valve in the conduit whereby to open one and close the other.

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