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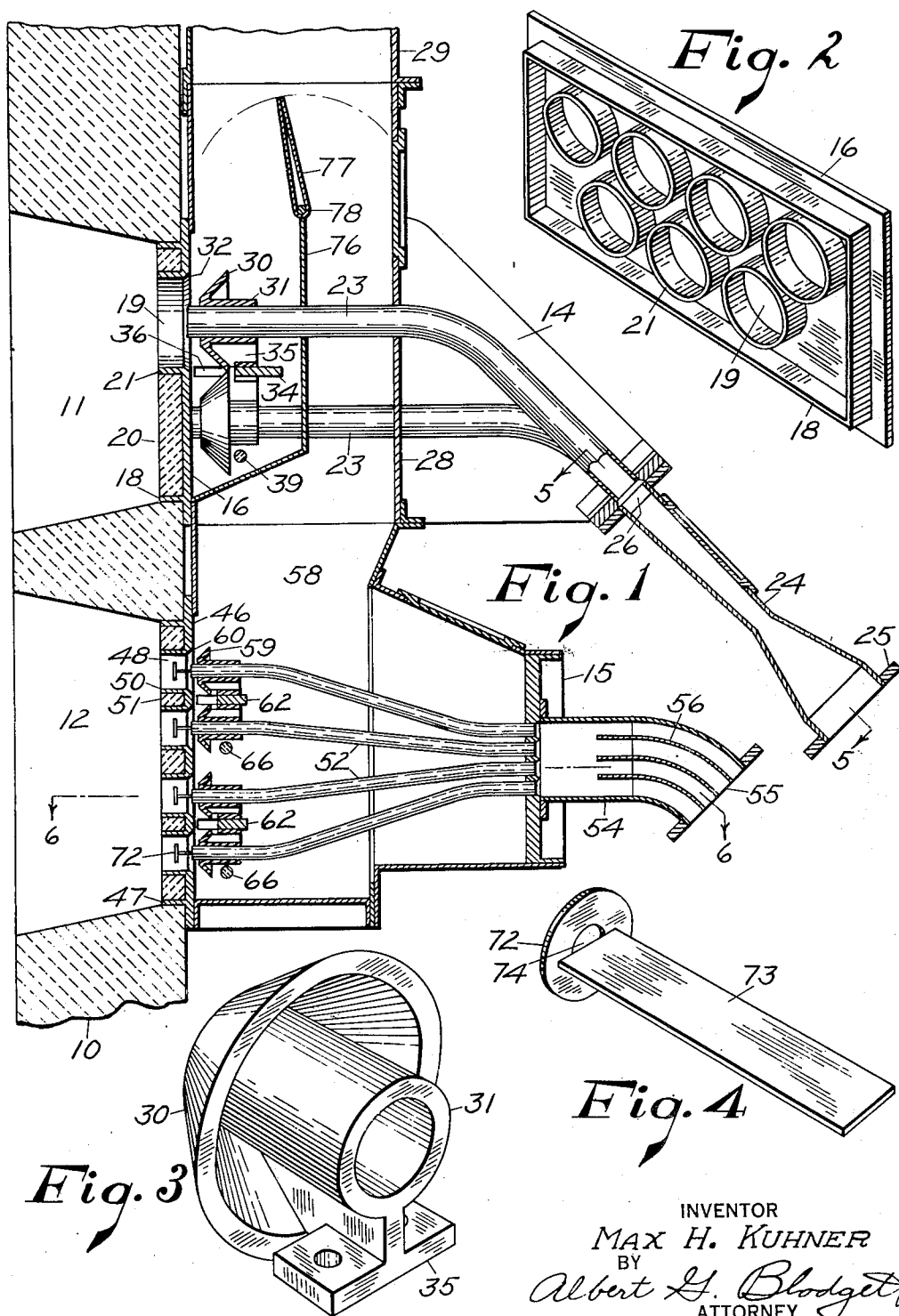
M. H. KUHNER

2,018,179

FUEL BURNER

Filed Feb. 29, 1932

2 Sheets-Sheet 1



INVENTOR

MAX H. KUHNER

BY

Albert L. Blodgett

ATTORNEY

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M. H. KUHNER

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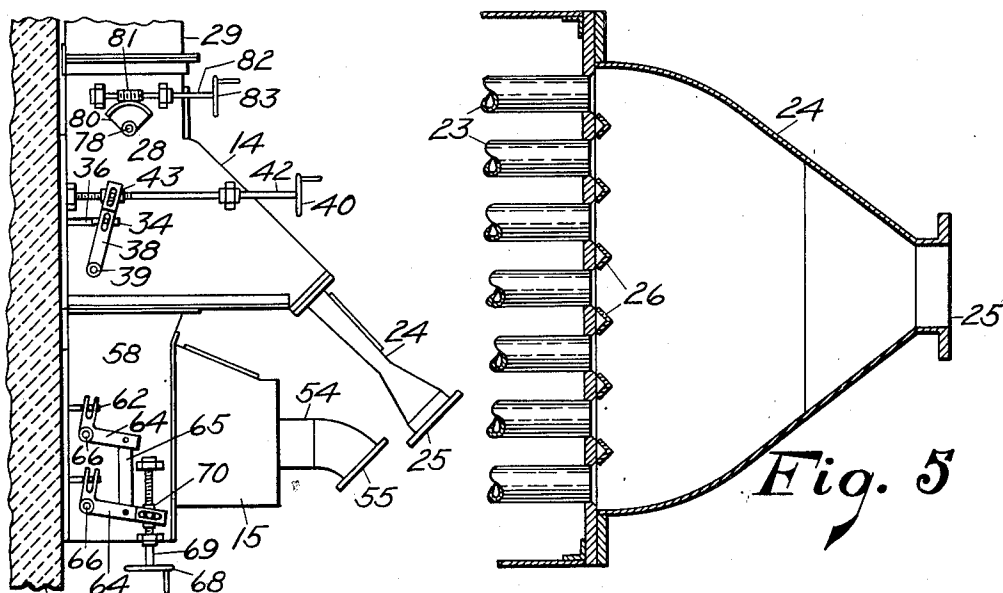


*Fig. 5*

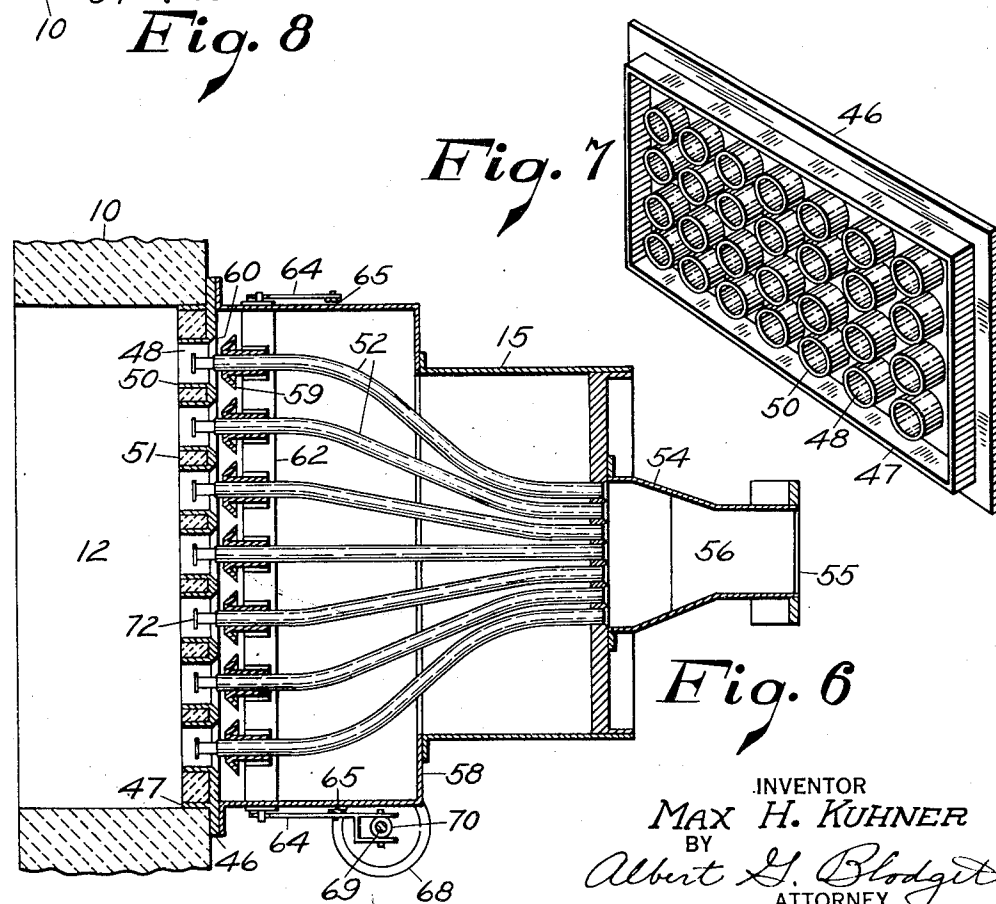


*Fig. 7*

*Fig. 6*

**.INVENTOR**

MAX H. KUHNER

BY

BY  
Albert G. Blodgett  
ATTORNEY

ATTORNEY

## UNITED STATES PATENT OFFICE

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## FUEL BURNER

Max H. Kuhner, Worcester, Mass., assignor to  
Riley Stoker Corporation, Worcester, Mass., a  
corporation of Massachusetts

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## 1 Claim. (Cl. 110—104)

This invention relates to fuel burners, and more particularly to burners for fuels such as gas, pulverized coal, or saw dust, which are suitable for burning in suspension in the combustion chamber of a furnace.

In burning fuels of this type, it is desirable to produce a rapid and thorough mixture of the fuel and air within the furnace, so that combustion will be rapid and the flame will occupy as small a space as possible. Attempts have been made to obtain this result by introducing the fuel stream into the furnace within a surrounding annular stream of air, and whirling both the air and the fuel about the axis of the fuel stream. This has resulted in an outwardly flaring flame which cannot be used satisfactorily in a narrow furnace, since it impinges on the furnace side walls and causes slagging troubles, incomplete combustion, and rapid destruction of the walls. Moreover, a burner of the whirling type tends to throw the coarser particles of fuel out of the flame under the influence of centrifugal force, and these particles drop to the furnace floor and remain unconsumed. This separation of coarse particles is more pronounced in the case of saw dust and wood shavings, because of the comparatively large size of the individual pieces, and great difficulty has been experienced in burning wood refuse of this character in suspension, even though no whirling motion is imparted to the fuel.

It is accordingly one object of the invention to provide a burner for fuel which will cause the fuel and air to mix rapidly and thoroughly within the furnace chamber and produce immediate and efficient combustion in a comparatively small space.

It is a further object of the invention to provide a burner which will produce a short flame without appreciable flaring, so that it may be used satisfactorily in connection with a narrow furnace chamber.

It is a further object of the invention to provide a burner which will produce rapid ignition of the fuel, and which is so constructed that it will be capable of withstanding the heat of the flame without injury.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claim appended hereto.

Referring to the drawings illustrating one embodiment of the invention, and in which like reference numerals indicate like parts,

Fig. 1 is a vertical section through a furnace

wall having a wood refuse burner and a pulverized coal burner associated therewith;

Fig. 2 is a perspective view of the burner plate for the wood refuse burner, showing the plate prior to the application of the refractory material;

Fig. 3 is an enlarged perspective view of one of the frusto-conical air valves for the wood refuse burner;

Fig. 4 is an enlarged perspective view of one of the fuel stream deflectors used on the pulverized coal burner;

Fig. 5 is a section on the line 5—5 of Fig. 1;

Fig. 6 is a section on the line 6—6 of Fig. 1;

Fig. 7 is a perspective view of the burner plate for the pulverized coal burner, showing the plate prior to the application of the refractory material; and

Fig. 8 is a small scale side elevation of the two burners, showing the operating mechanism for the damper and valves.

The embodiment illustrated comprises a comparatively thick furnace wall 10 constructed of non-metallic refractory material and provided with a rectangular opening 11 and a second rectangular opening 12 located beneath the first opening. A burner 14 for wood refuse is arranged to discharge through the upper opening 11, and a burner 15 for pulverized coal is arranged to discharge through the lower opening 12.

The wood refuse burner 14 comprises a flat rectangular burner plate 16 having a rib 18 projecting from the rear face thereof toward the furnace. This rib is spaced inwardly from the outer edge of the plate and fits within the opening 11 in the furnace wall, the plate contacting with the wall around the opening. The plate 16 is provided with a number of openings 19, preferably circular in shape, through which fuel and air may be discharged into the furnace. As shown in Fig. 2, 40 these openings 19 are located in two horizontal rows with the openings in the lower row staggered with respect to the openings in the upper row. In order to protect the burner plate from the radiant heat of the furnace and to provide an increased incandescent surface which will facilitate ignition and combustion of the fuel, I form a comparatively thin lining 20 of non-metallic refractory material over the rear face of the plate. I have found that chrome ore, applied in plastic form, is a suitable material for this lining, but it will be apparent that other refractories may be employed within the scope of my invention. By using a plastic material I provide a monolithic lining. The application and supporting of the refractory lining is 55

facilitated by surrounding each opening 19 with a rearwardly projecting annular rib 21.

A jet of fuel is projected through each opening 19 by means of a horizontal tube 23. These tubes 5 are mounted coaxial with the openings, and their rear or discharge ends are preferably in substantially the same vertical plane as the front surface of the burner plate 16. The front or inlet ends of the tubes are bent downwardly at an angle into 10 a common plane and connected to a flat laterally flaring "fish-tail" distributing conduit 24 having a flanged inlet connection 25 at its lower end. The conduit 24 serves to spread out the stream of wood refuse and primary or carrying air, and distribute 15 it among the tubes 23. Small angle irons 26 are provided between the inlet ends of adjacent tubes to aid in splitting the fuel stream. While I do not wish to be limited to any specific size of fuel tubes, I have found that tubes having an internal diameter of approximately three inches are satisfactory for burning wood refuse consisting of saw 20 dust and shavings. Such refuse contains some rather large particles, and it is not desirable to use tubes much smaller than this, since they would become plugged too easily.

Each jet of fuel is surrounded by an annular stream of air to support the combustion thereof. This secondary air is preferably supplied under pressure, and for this purpose I provide walls 30 forming an air chamber 28, and deliver air to this chamber by means of a duct 29 from a suitable fan or other apparatus (not shown). The burner plate 16 forms the rear wall of the air chamber and the openings 19 in the burner plate are therefore supplied with air directly. These openings 19 are 35 considerably larger in diameter than the fuel tubes, so that ample area is available for the air to flow into the furnace with the fuel.

The rate of air flow into the furnace must be 40 varied to correspond with the rate at which fuel is being supplied. For this purpose I preferably utilize a separate damper or valve 30 at each opening 19, and provide a suitable mechanism for adjusting all the valves simultaneously. Each valve 45 30 as illustrated is frusto-conical in shape, with its smaller end at the rear, and provided with a forwardly projecting hollow cylindrical portion 31 which is slidable on the outer surface of the corresponding fuel tube 23. The frusto-conical 50 shape has an important advantage in that it directs the air stream inwardly at an angle toward the central fuel stream and thus promotes rapid and thorough mixing of the fuel and air. The front edge of each opening 19 may be beveled as 55 shown at 32 (Fig. 1), to provide a seat for the valve.

The air control valves are preferably arranged for simultaneous adjustment, and for this purpose I have shown a transverse horizontal bar 34 located between the upper and lower rows of fuel 60 tubes 23. Each valve 30 is provided with a T-shaped bracket 35 which is secured to this bar. The ends of the bar 34 project through horizontal slots 36 in the side walls of the air chamber 28 and are connected to arms 38, the lower ends of the arms being connected by a transversely extending rotatable shaft 39. The arm 38 at one 65 side of the burner may be manually actuated by means of a hand wheel 40 (Fig. 8) mounted on a horizontal rotatable shaft 42. The shaft 42 is screw threaded for a portion of its length and carries a nut 43 which engages the upper end of the arm 38. By turning the hand wheel 40, the shaft 42 will be rotated, causing the nut 43 to travel 70 along the shaft and thereby swinging the arms 38.

This serves to slide the bar 34 along the slots 36 and to adjust the air valves 30 to or from the burner plate 16. Various other mechanisms may be employed for adjusting these valves.

The pulverized fuel burner 15 is in many respects similar to the wood refuse burner, and comprises a flat rectangular burner plate 46 having a rib 47 projecting from its rear face. This rib fits within the furnace wall opening 12. The plate 46 has a number of circular openings 48 therein, 5 these being located in four horizontal rows with the openings in the different rows aligned vertically. The openings 48 are surrounded by rearwardly projecting annular ribs 50, and the rear face of the plate is protected by a comparatively 15 thin lining 51 of chrome ore or other refractory material.

A jet of pulverized fuel is projected through each opening 48 by means of a horizontal tube 52. The tubes 52 are coaxial with the openings, and 20 their forward portions are brought together both horizontally and vertically and connected to a distributing chamber 54 having a rectangular cross-section. The forward part of the chamber 54 is curved downwardly and provided with a 25 flanged inlet opening 55. Curved vanes 56 may be mounted in the curved portion of the chamber 54 to prevent excessive segregation of the fuel due to centrifugal force. Since pulverized coal is usually ground exceedingly fine, the tubes 52 can 30 be and preferably are considerably smaller than the tubes 23. I have found that tubes having an internal diameter of approximately one and one-quarter inches are satisfactory for fuels such as 35 pulverized coal or gas.

Air is supplied to the fuel jets from an air chamber 58 which communicates with the air chamber 28 thereabove. Frusto-conical air valves 59 are slidably mounted on the rear portions 40 of the tubes 52, and cooperate with beveled seats 60 on the burner plate 46 to control the air flow through the openings 48. These air valves 59 are fastened to transverse bars 62, one located between the two upper rows of fuel tubes and one located between the two lower rows of 45 fuel tubes. The bars are horizontally slidable in slots in the side walls of the air chamber 58, and their ends are connected to bell crank levers 64 which are joined by vertical links 65. The corresponding levers at opposite sides of the 50 burner are connected by transverse rotatable shafts 66. The damper mechanism may be operated by means of a hand wheel 68 mounted on a vertical screw threaded shaft 69 which carries a nut 70 connected to one of the bell crank levers. 55

In some cases it is found desirable to interpose deflecting surfaces in the path of the fuel jets issuing from the tubes 52, thereby causing a more rapid mixture of the fuel and air. I have shown 60 a deflector in the form of a flat annular plate 72 slightly larger in outside diameter than the fuel tube and mounted coaxial with and slightly in the rear of each tube. This plate 72 may be welded or otherwise secured to a thin rectangular strip 73 65 which fits tightly within the tube 52. A part of the fuel stream will pass through the central opening 74 in the deflector, while the remainder will be deflected laterally into the surrounding air stream. 70

It may at times be desirable to operate one of the burners alone, the air and fuel supplies to the other burner being shut off. While the valves 30 and 59 may be used for this purpose, I have illustrated an auxiliary damper mechanism which 75

can be adjusted to direct the entire air stream to either burner desired. This comprises a wall or plate 76 extending vertically through the central part of the air chamber 28 and rearwardly 5 beneath the air control valves 30. At the upper edge of the wall 76 I provide a damper 77. This damper is mounted on a horizontal rotatable shaft 78, so that it can be swung to either side desired and thus shut off the air flow to either one 10 of the burners. With the damper in the position shown, both burners will be supplied with air. The shaft 78 may be adjusted by means of the mechanism illustrated in Fig. 8, which comprises a worm gear segment 80 mounted on the 15 shaft and a worm 81 in mesh therewith. A shaft 82, provided with a handwheel 83, is connected to the worm 81.

The operation of the invention will now be apparent from the above disclosure. A stream of 20 pulverized coal and primary air is supplied to the inlet connection 55 of the burner 15, and a stream of saw dust and primary air is supplied to the inlet connection 25 of the burner 14. Secondary air is delivered by a suitable fan to the duct 29. 25 The fuel issues from the rear ends of the tubes 23 and 52, and each fuel jet is surrounded by an annular stream of secondary air. The frusto-conical valves 30 and 59 direct the air inwardly toward the fuel stream, thus promoting rapid mixing and thorough combustion. By adjusting 30 these valves, the air flow can be varied to correspond with the rate of fuel supply. Since the air

control valves are located at the point of air discharge, the air velocity can be maintained high even at low combustion rates. This makes it possible to ensure satisfactory mixing of fuel and air though the demand for heat be low. 5

The fuel as it enters the openings 11 and 12 is surrounded by the refractory surfaces of the wall 10 and is directly exposed to radiation from these surfaces as well as from the refractory linings 20 and 51. This is of great value in obtaining 10 immediate ignition and a comparatively short flame. The linings 20 and 51 furthermore protect their respective burner plates 16 and 46 from warping and burning. Since no whirl is imparted to the fuel, there is no tendency for the coarser 15 particles of fuel to be thrown out of the flame by centrifugal force. Moreover, because of this lack of whirl, the flame does not flare laterally to any great extent, and hence will not impinge upon the side walls of a narrow furnace. 20

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

A burner for fuel comprising a flat burner plate having a plurality of openings therethrough 25 tubes mounted in front of the openings to discharge jets of fuel therethrough, an air valve slidably mounted on each tube to control the air flow through the adjacent opening, and means to operate the air valves simultaneously. 30

MAX H. KUHNER.