Aug. 28, 1923.

1,466,186

C. H. PIDGEON

HYDROCARBON BURNER

Filed Aug. 3, 1920

3 Sheets-Sheet 1

Fig. 1

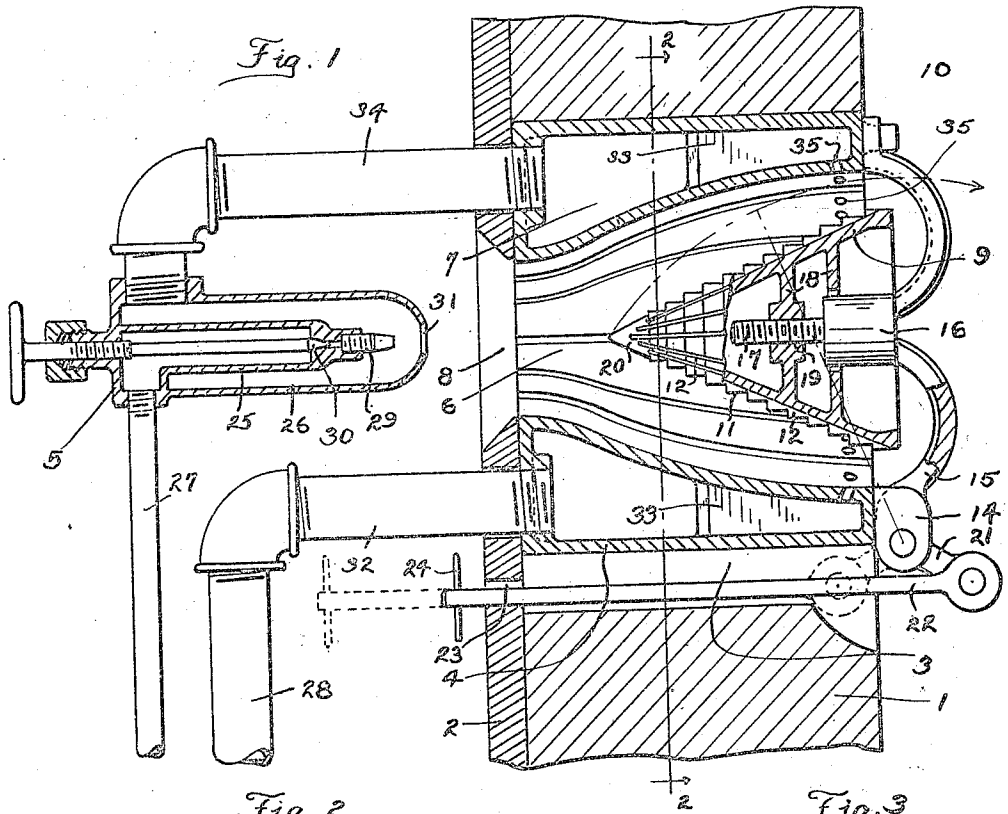


Fig. 2

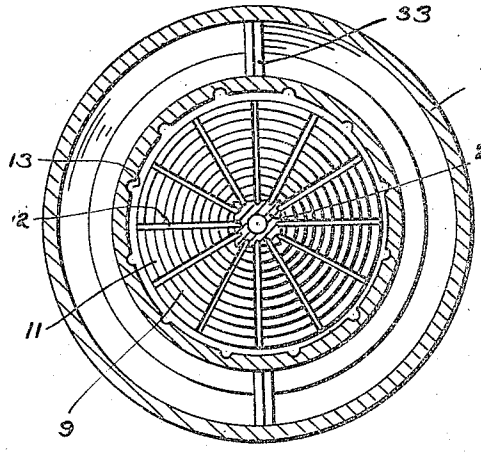
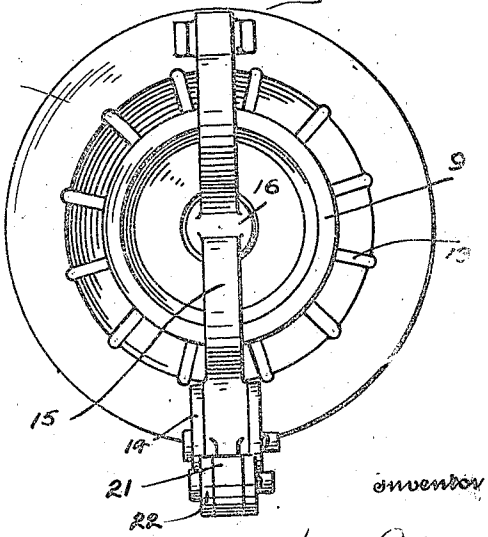


Fig. 3



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3 Sheets-Sheet 2

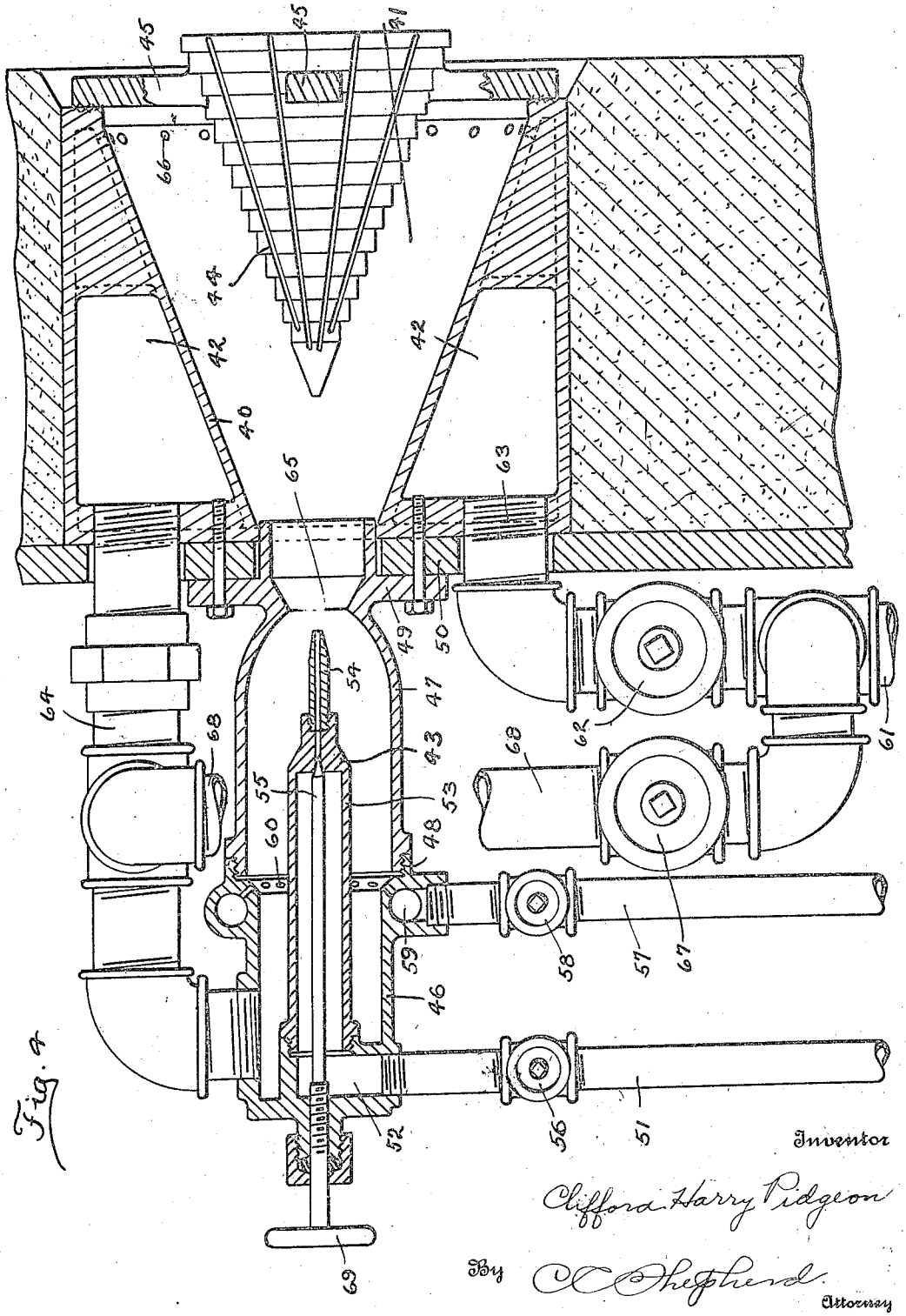

Fig. 4

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Fig. 5

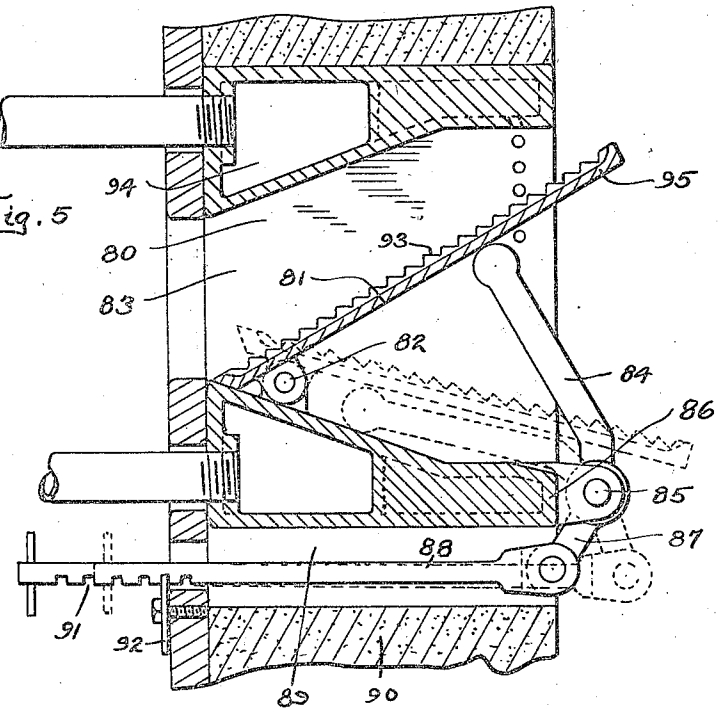
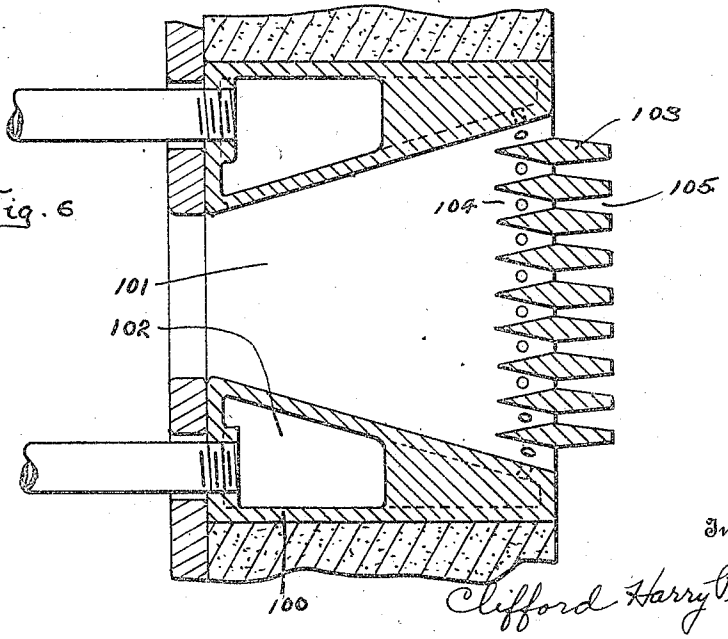


Fig. 6



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Patented Aug. 28, 1923. 1,466,186

UNITED STATES PATENT OFFICE.

CLIFFORD HARRY PIDGEON, OF COLUMBUS, OHIO.

HYDROCARBON BURNER.

Application filed August 3, 1920. Serial No. 400,920.

To all whom it may concern:

Be it known that CLIFFORD HARRY PIDGEON, a citizen of the United States, residing at Columbus, in the county of Franklin and State of Ohio, has invented certain new and useful Improvements in Hydrocarbon Burners, of which the following is a specification.

This invention relates to improvements in drocarbon burners, and has for its object provide in combination with such burners, an improved apparatus having features of construction embodied therein for effecting the preheating of the air and fuel prior to the intermingling and combustion of the latter, to secure complete combustion of such fuel by effectively gasifying or atomizing the fuel stream, and to construct the apparatus so that any suitable fuel such as fuel oil, distillates, tar, gas, powdered coal and other liquid, powdered and gaseous fuels may be efficiently utilized.

With these and other objects in view, as will appear as the description proceeds, the invention accordingly consists in the novel features of construction, combinations of elements and arrangements of parts, hereinafter to be fully described and pointed out in the appended claims.

In the accompanying drawings, forming a part of this specification, and in which similar characters of reference denote like and corresponding parts:

Figure 1 is a vertical sectional view taken through the burner apparatus comprising one of the preferred forms of the invention.

Figure 2 is a vertical transverse sectional view taken through the apparatus on the plane disclosed by the line 2—2 of Figure 1.

Figure 3 is a rear elevation of the apparatus.

Figure 4 is a vertical sectional view taken through a slightly modified form of the apparatus and disclosing more particularly a burner structure capable of utilizing gaseous, powdered or liquid fuels.

Figure 5 is a similar view disclosing a further modification, and,

Figure 6 is a similar view disclosing a still further modified form of the apparatus.

In the form of the invention disclosed in Figures 1 to 3, the numeral 1 designates the side wall of a furnace setting which, as usual, is formed from a refractory material and is provided with an outer metallic plate 2. Formed in the wall 1 is a burner opening 3 in which is adapted to be situated the improved burner apparatus 4, comprising the present invention.

As shown, the apparatus 4 is designed to be employed in connection with a fuel injector 5, which is situated exteriorly of the setting 1 so that an air inlet space will be provided between the inner end of the structure 5 and the apparatus 4, a feature which permits the air to be entrained in the moving fuel stream ejected from the structure 5 and to permit of the intermingling thereof while passing through the apparatus 4. This apparatus may be formed from any suitable metal such for example as nichrome cast metal or other high heat resisting material and is preferably of the circular construction shown in Figures 2 and 3. This apparatus or casing is of hollow formation and embodies an inner vaporizing, atomizing and combustion chamber 6 and an annular air preheating chamber 7. The wall of the chamber 6 is of substantially hollow funnel shaped configuration and has its smaller end situated so as to converge into the entrance opening 8 provided in the plate 2. Therefore, by the provision of the opening 8, fuel delivered from the fuel injector 5 will be received within the chamber 6 for purposes of thoroughly mixing the fuel with suitable quantities of air so as to insure efficient and effective combustion with but a minimum of fuel loss due to uncarbureted fuel.

To this end, there is mounted within the chamber 6 a vaporizing element 9, which element in this instance is of hollow, conical form and is formed from any suitable heat conducting metal, the apex of the element 9 being situated toward the front or outer portion of the chamber 6 so as to be in a position to intercept and spread the fuel stream delivered from the injector 5. The larger or base end of the element 9 is situated so as to project into the interior 10 of the furnace in order that when in operation, the base end of the vaporizing element may receive the benefit of the heat within the furnace, and to enable the heat received therefrom to be therefore rapidly transmitted to the forward portion of the vaporizing element and to thereby effect the heating of the entire element, the coolest portion thereof being disposed toward the forward end of the chamber 6 and the hottest portion thereof toward the interior of the furnace. Preferably, the

outer surface of the element 9 is provided with a series of annular steps 11 which present uneven surfaces to the passage of the stream, and in fact serve to arrest the flow of the fuel stream, in order that the fuel particles may be subjected to the heat of the vaporizing element, and to thereby vaporize or render more volatile the fuel particles, and to thereby enable such particles to be readily commingled with the air or oxygen associated therewith and passing through the chamber 6. It will be seen that the vaporizing element offers a series of steps or projections in the path of the fuel stream toward the furnace, which steps effectively arrest the uninterrupted travel or passage of the fuel stream and serve to break down the heavy composition of the latter and to vaporize or gasify the fuel stream. Therefore, by the inclusion of the element 9, it is possible to employ cheap or low grade fuel in connection with the burner and yet to secure efficient results and high temperatures. Also, the element 9 is provided with a series of longitudinally extending radial grooves 12, in which the fuel may be collected and forced rearwardly by the incoming fuel pressure toward the furnace. Grooves of this nature are also provided in the wall of the chamber 6 and are indicated by the numeral 13. By their inclusion the fuel is permitted to collect therein and to travel longitudinally of the atomizing chamber. When under actual conditions of operation, the rear end of the vaporizing element 9 becomes highly heated by reason of the fact that the same extends within the furnace. Heat from this end of the element is permitted to travel forwardly or longitudinally thereof, heating portions of the element adjacent to the base end of the latter. When the vaporized fuel comes into contact with these highly heated portions of the vaporizing element, a kindling temperature is reached which causes the combustion of the vaporized gases.

To effect the mounting of the element 9, the rear wall of the apparatus 4 is provided with a pair of spaced integral lugs 14, in which is pivoted a curved arm member 15, said arm member being formed to include a centrally disposed boss 16, from which extends a threaded shank 17, the latter being formed so as to lie within the hollow interior of the element 9. In the present instance, the interior of the element 9 is formed to include spaced vertical walls 18, one of which is provided with an opening for the reception of the boss 16, while the other wall is provided with a threaded opening 19 for the reception of the shank 17. By this construction it will be manifest that a secure mounting is to be had for the element 9 and one which will serve to maintain the element in its operative position within the chamber 6. By the provision of the threaded shank 17, it is possible to adjust the element 9 longitudinally, bringing its apex toward or away from the discharge end of the injector 5, a feature which enables the vaporized element to be so situated as to engage the center of the fuel stream and to thereby insure a complete spreading of the fuel over the full area of the vaporized element. The forward end of the vaporizing element is provided with a pyramidal portion 20, which is adapted to receive an adjusting wrench, which may be readily positioned within the opening 8 to facilitate the adjustment of the element 9. One end of the arm member 15 is provided with a crank portion 21, which is adapted to receive the inner end of the longitudinally extending rod 22, the latter being so mounted as to project through an opening 23 formed in the wall 1, and has its outer end equipped with a cross pin 24. By grasping the outer end 24 of the rod, the latter may be longitudinally reciprocated, thereby causing the actuation of the crank portion 21 of the arm member, a feature which enables the vaporized element 9 to be swung into or out of active positions. While the rod 22 is pulled outwardly, the vaporizing element 9 will be swung about its pivot so as to lie within the interior 10 of the furnace, whereby said element may be subjected to the heat of the furnace and to have its temperature rapidly increased until a working temperature is reached, whereupon the rod 22 is pushed inwardly, forcing the vaporizing element into its working position within the chamber 6, and to permit the same to be actively used in its capacity for breaking up and vaporizing the fuel stream passing from the injector 5. When the vaporizing element is positioned inwardly of the furnace, the chamber 6 will be uninterrupted, permitting a clear flow of the fuel through the apparatus 4, a feature which enables the furnace to be readily started.

In order to enable thick heavy fuel to be utilized, the injector 5 is of special design, and the same consists, in the simple form shown in Figure 1, of a pair of inner and outer casings 25 and 26 respectively, the inner casing communicating with a source of fuel supply 27, while the casing 26 communicates with a source of compressed air supply 28. One end of the casing 25 terminates in a nozzle 29, through which fuel passage is controlled by means of a needle valve 30, the latter passing longitudinally through the burner. It will be manifest that upon actuating the valve 30, fuel will be permitted to pass through the nozzle structure 29 and will be entrained within the moving body of air passing through the casing 26 and out of the discharge orifice 31. In order to preheat the air before the latter is commingled with the oil supply, the pipe 28,

constituting the source of air supply, terminates in a lateral branch 32 which enters the annular air chamber 7 provided in the casing 4, thus bringing the air into direct contact with the heated wall of the chamber 6, a feature in construction which materially raises the temperature of the compressed air before the latter is commingled with the oil ejected from the nozzle 29. Dividing plates 33 are situated within the chamber 7 so that the air entering the chamber will be spread in two directions and hence passed around the wall of the chamber 6 in opposed streams, so that the greater body of the air will be subjected to the temperature and heat of the casing 4. Leading from the chamber 7 is an outlet pipe 34, which leads over to the interior of the casing 26, thus permitting the preheated air to surround and come into contact with the inner casing 25. Inasmuch as the latter is of extended length, it follows that the temperature of the oil contained therein will be materially elevated, thereby causing the oil to flow more freely, to prevent stoppage of the same within the nozzle 29, and to enable low grade fuels to be utilized. Also, it has been found that by preheating the fuel, the action of the vaporizing element 9 is rendered more positive and efficient.

To further aid in the combustion of the fuel within the chamber 6, the wall of the latter contiguous to the furnace 10, is provided with a circular array of ports 35, which bear a certain restricted ratio to the area of the lateral inlet pipe 32. By the provision of these small ports 35, a restricted quantity of the preheated air is permitted to pass directly into the chamber 6, without being continued through the burner structure, in order that the air may readily combine with the vaporized fuel, to secure perfect combustion, and to eliminate or minimize greatly the presence of smoke or unburned fuel.

From the foregoing description, it will be manifest that an oil burning apparatus of a simple and efficient nature is provided by the present invention. The apparatus is substantially automatic in operation and necessitates but a minimum of manual control and adjustment. By the construction described, low grade fuel may be freely utilized, in order that by the provision of the apparatus, economical fuels may be consumed. It is therefore, by the combined efforts of the vaporizing element 9, the air preheating mechanism and the peculiar type of burner or mixer structure that an apparatus is provided capable of burning fuels of the character related. In the modification disclosed in Figure 4, the burner apparatus consists of a casing 40, which is formed to include the funnel shaped vaporizing compartment 41, the air preheating compartment 42 and the fuel injector 43. In common with the preferred form, the smaller end of the vaporizing compartment 41 is situated in communication with the discharge end of the injector 43, and the vaporizing element 44 is arranged to be mounted, as above related, longitudinally within the vaporizing compartment. This vaporizing element is substantially the same in construction as the element 9 but differs from the latter in that the longitudinal adjustment is omitted. To support the element 44, the same is provided with radial arms 45, which may be secured at their outer ends in any suitable manner to the inner end of the casing 40. It will be observed that the base end of the element 44 is situated so as to project into the interior of the furnace, for the purpose of facilitating the heating of the element and to thereby render its operation more positive and efficient. It will be appreciated that fuel is discharged, as before mentioned, from the injector 43, and is deposited upon the stepped or uneven surfaces of the element 44, in order that the fuel will be subjected to the heat of said element and thereby broken up into lighter, more volatile or vaporized particles. So vaporized, the fuel will more readily commingle with the incoming air to produce a mixture of high combustibility.

The injector 43 is capable of using both liquids, powdered and gaseous fuels, and to this end said injector is formed to comprise a two-part casing, one part being designated by the numeral 46 and the other by the numeral 47, both parts however being united by means of threads or their equivalents 48. Also, the inner part 47 is provided at one end with a flange 49, by means of which the same may be bolted or otherwise suitably secured to the wall 50 of the furnace setting, and to be positioned in alignment with the entrance to the vaporizing compartment 41. A liquid or pulverized fuel pipe 51 is arranged to enter the outer part 46 through an opening or pocket 52 provided therein, said pocket communicating with an elongated tube 53 extending longitudinally through the mixer. The end of this tube 53 is provided with a nozzle 54, and the flow of fuel from the tube 53, into the nozzle 54 is controlled by means of a needle valve or its equivalent 55. The pipe 51 is provided with a hand controlled valve 56 by means of which the supply of fuel to the mixer may be readily controlled. When it is desired to employ a gaseous fuel, a pipe 57 is utilized through which gas is permitted to travel, said pipe 57 being provided with a valve 58 for the purpose of governing the flow of the gaseous fuel into the mixer. The pipe 57 terminates in an annular chamber 59 formed in the part 46 of the injector casing, said chamber being, in turn, provided with

a plurality of circularly arranged ports or jets 60, through which the gas stream is permitted to pass into the casing part 47 and hence into the vaporizing compartment 41.

To supply this fuel with suitable quantities of compressed air, an air supply pipe 61 is utilized. This pipe is provided with a manually controlled valve 62 and terminates in the extension 63 which leads into the air preheating compartment 42 provided in the casing 40. By the opening of the valve 62 air will be permitted to flow under pressure through and around the compartment 42 so as to be subjected to the heat of the annular wall of the compartment 41. When heated, the air is permitted to pass from the compartment 42 by way of the pipe 64, which terminates within the mixer casing 46 so as to pass longitudinally through the mixer, thereby coming into contact with the tube 53 in order to heat the fuel passing through said tube. The compressed air then passes through the nozzle 65 formed by restricting the end of the casing part 47, causing fuel from the nozzle 54 to be entrained therein and conducted forwardly into the vaporizing compartment 41. The combined air and fuel is then subjected to the mixing action of the casing 40, and to the vaporizing action of the element 44, in order that efficient combustion may be procured. Also, the air compartment has its inner end provided with small ports 66, which serve to allow a secondary quantity of air to pass directly into the vaporizing compartment from the source of air supply, a feature which greatly facilitates and promotes efficient combustion, and the absence of smoke.

In the event of the tube 53 becoming overheated, the temperature thereof may be lowered by closing the valve 62, and by opening a valve 67 provided in a shunt pipe 68 which leads from the air pipe 61 to the pipe 64, or the valves 62 and 67 may be partially opened, permitting the temperature of the air within the mixer to be regulated at will. By the provision of the shunt pipe 68, premature combustion of the fuel within the mixer is prevented. It will be understood that the needle valve may be operated by means of the exteriorly located hand wheel 67. The form of the invention just described is advantageous in many respects over the preferred form, in that the casing 40 may be more economically constructed, the same consisting essentially of but two cast parts. Also, the more or less fragile parts provided for effecting the adjustment of the vaporizing element are omitted. Again, the mixer 43 is so constructed as to permit both gaseous and liquid fuels to be utilized, and to heat such fuels before the same are admitted to the vaporizing compartment 41, and to provide means, in the nature of a shunt pipe 68, whereby the temperature of the mixer may be maintained within desirable bounds.

In Figure 5, the modification shown centers chiefly about the construction of the vaporizing element, as it is only in this respect that the form disclosed differs from the preceding forms previously described. In Figure 5, it will be noted that the vaporizing element, designated generally by the numeral 80, consists of a plate 81, which is hinged at its forward end as at 82 within the vaporizing compartment 83, the plate being of such construction as to enable the same to be swung so that the same will be out of the path of the fuel stream passing through the compartments, or may be raised to various angular positions so that the same will obstruct or partially obstruct the flow of the fuel stream through the compartment. This adjustment of the plate 81 is effected by the provision of a lever 84, which is pivoted as at 85 upon the inner wall of the apparatus casing 86. The lever is provided at one end with the crank extremity 87 to which is pivotally connected an actuating rod 88. This rod extends through an opening 89 provided in the furnace setting 90, and the forward end of the rod is provided with notches 91, which are adapted to be selectively positioned upon the upper edge of a fixed plate 92, by means of which notches and plate, the adjustment of the vaporized element may be regulated. It will be noted that the plate 81 is provided with a serrated or stepped face 93 for the purpose of arresting the fuel stream and to effect its more complete vaporization. The casing 86 is provided with an air preheating chamber 94 and the apparatus as a whole may be utilized in connection with any suitable type of mixer or burner structure. By actuating the rod 88, it will be manifest that the crank 87 may be raised or lowered to permit of corresponding movement on the part of the plate 81 in order that desired positions of actuation of the plate may be secured. The inner end of the plate 95 projects into the furnace a suitable distance, in common with the forms previously described, in order that this inner end 95 may be subjected to the heat within the furnace and thereby be capable of having a higher operating temperature than devices which lie wholly within the vaporizing chamber.

The modification disclosed in Figure 6 illustrates a very simple form of the combustion apparatus (which is made in one casting and) wherein the apparatus is formed to include the usual casing 100, which is provided with a vaporizing chamber 101 and an air preheating chamber 102. The casing as a whole is adapted to be mounted within the setting of a furnace

wall in the manner described and shown for the previously mentioned forms of the invention, and with which air and fuel pipes are associated in the manner described. As in the modification disclosed in Figure 5, the present modification differs only from the preferred form of the invention in the form of the vaporizing element. In Figure 6 the vaporizing element consists of a plurality of vertically arranged parallel bars 103, which are substantially diamond shaped in cross section and are formed to include forward nozzle openings 104 and flaring discharge openings 105. It will be manifest that the fuel stream forced into the chamber 101 will be directed into the nozzles 104, coming into contact with the sloping surfaces of the bars 103. Since these bars are positioned contiguous to the furnace end of the casing, it follows that the same will attain relatively high temperatures, a feature which causes the fuel stream to be readily vaporized and to more readily combine with the oxygen associated therewith. It will be noted that the bars 103, in common with the other vaporizing elements, project into the furnace, in order that the same may receive the benefit of the furnace heat and to possess a relatively high operating temperature.

From the forms of the invention described, it will be observed that by the construction thereof, the preheated air is permitted to heat and thin the oil entering the burner or mixer structures, causing oil to flow more freely through the valves of such structures, and to permit low grade fuel to be utilized. The air also cools the vaporizing chambers which are likely to become overheated and saves heat energy which, due to the high temperatures, would be lost ordinarily through the sides and top of the furnace. It will be observed that when the fuel enters the vaporizing compartments, the same impinges upon the vaporizing cone by engaging with the steps, flows around the steps and enters the grooves in the latter. The fuel is then carried out of these longitudinal grooves by the force of the air into the gradually hotter zone, where it is permitted first to gasify and to then reach a kindling temperature or combustion zone, at which point combustion begins. It will be noted in all the forms of the invention that the vaporizing element protrudes out into the heated chamber of the furnace, and there becomes heated by the internal temperature of the furnace. This heat is then conducted through the metal back toward the outer end of the vaporizing element, in order to cause the vaporizing chamber and element to heat much more quickly to the kindling temperature. By this construction the furnace will start to burn without smoke, and will heat up to a working temperature much more quickly than by ordinary construction. Preferably, the end of the vaporizing element protruding into the furnace chamber is cast heavier than the remaining portions of the vaporizer in order to withstand the relatively high temperatures to which it is subjected.

Preferably, the vaporizing cone is adjustable in and out by means of a small socket wrench, which fits over the square end of the cone, or in the screw driver slot. By the adjustment of the cone, it is possible to locate the same to suit various conditions and pressures of the oil and air. In the preferred form of the invention, this cone can also be hinged, as shown, so that it can be swung out in the furnace, in order to thereby permit of a clear view in the furnace, and, also, to facilitate starting a cold furnace, as the entire cone will become heated when swung into the furnace, then when it is moved back, after being heated, the same will be ready for immediate chamber combustion. The adjustable or fixed vaporizing cone produces an uneven surface upon which the incoming fuel impinges and which causes the fuel and air to be churned about, gasified and completely mixed with the incoming air and burned in this high temperature combustion chamber, due primarily to being retained between the vaporizing cone and the outer wall of the vaporizing chamber. By reason of combustion therein, the chamber obtains a very high temperature, sufficient to gasify and burn very thick low grade, cheap, heavy and viscous fuels. The apparatus is preferably constructed from nichrome cast metal, and can be used in either a horizontal, vertical or angular position. It will be observed that combustion takes place within the apparatus instead of against the back walls of the furnace. This greatly prolongs the life of the brick work in the furnace as well as the furnace itself.

While the foregoing description specifically sets forth what are now believed to be the best modes of applying the principles of the invention, yet it should be understood that said description does not necessarily measure the invention, except as the latter is defined by the following claims.

What is claimed is:

1. In mechanism of the class described, the combination with a fuel and air injector, of a combustion supporting apparatus comprising a casing arranged to be positioned within an opening provided in the wall of a furnace setting, said casing being provided with a vaporizing chamber situated to receive the fuel stream discharged from said mixer, a vaporizing element positioned within said chamber and subject to the internal heat of the furnace, said element being positioned so as to intercept the fuel stream passing into the chamber from said mixer, and a handle located outside the furnace and

connected to the vaporizing element for moving it.

2. In mechanism of the class described, a fuel and air injector, a combustion supporting apparatus arranged to be positioned within a wall of a furnace setting, said apparatus being provided with an inwardly flaring vaporizing and combustion chamber, a substantially conical vaporizing element arranged to be situated within said chamber so as to intercept said fuel stream, the outer surface of said element being roughened to present surfaces occupying varying planes.

3. In mechanism of the class described, the combination with a fuel and air injector, a combustion supporting apparatus arranged to be seated within a wall of a furnace, said apparatus being formed to include a longitudinally disposed chamber capable of establishing communication between said injector and the interior of said furnace, a vaporizing element of substantially conical form positioned within said chamber so as to intercept the fuel stream discharged from said mixer, and said element being formed to include a stepped uneven surface and a plurality of longitudinally extending grooves.

4. In mechanism of the class described, a fuel injector, a casing arranged to be positioned within a wall of a furnace setting, said casing being provided with a longitudinally extending chamber capable of establishing communication between said mixer and the interior of said furnace, the inner walls of said chamber being formed to present a plurality of longitudinally extending grooves, a substantially conical vaporizing element situated longitudinally within said chamber, the apex end of said element being disposed toward said mixer, the base end of said element being situated so as to extend within said furnace, and a plurality of uneven surfaces provided upon the outer part of said element, said surfaces being intercepted by a plurality of longitudinally extending grooves.

5. In apparatus of the class described, a casing arranged to be positioned within an opening formed in the wall of a furnace setting, said casing being of hollow construction and provided with an inner wall, said wall serving to define a vaporizing and combustion chamber and an air preheating chamber, intermediate walls connecting the inner and outer walls of said pre-heating chamber, a fuel injector, an air pipe leading into said air preheating chamber, and a second pipe leading from said chamber and extending to said fuel mixer.

6. In mechanism of the class described, in combination, a fuel injector, said injector including an internally located fuel chamber and a surrounding air chamber, a casing arranged to be positioned within the wall of a furnace setting, said casing being of hollow construction and including an inner wall which serves to define a combustion chamber and an air preheating chamber, said combustion chamber being subjected to the internal heat of the furnace, a source of air leading into the lower part of said air preheating chamber, and a conduit leading from the top of said air preheating chamber to the air chamber of said injector.

7. In mechanism of the class described, in combination, a fuel injector, a casing arranged to be positioned within the wall of a furnace setting and located substantially in alignment with said fuel injector, said casing being formed to include a centrally disposed wall, the latter serving to define the centrally disposed longitudinally extending combustion chamber and a surrounding air preheating chamber, a source of air supply entering said air preheating chamber, a conduit leading from said air chamber and extending to said fuel injector to effect the preheating of the fuel of the latter prior to its expulsion, and said inner wall being provided with openings permitting of restricted air flow from said air chamber into the inner end of said combustion chamber.

8. In apparatus of the class described, a casing arranged to be seated within the wall of a furnace setting, said casing being formed to include a longitudinally extending chamber, the latter acting to establish communication between a fuel injector situated exteriorly of the furnace and the interior of said furnace, a vaporizing element situated within said compartment, the wall of said chamber being roughened to provide uneven surfaces capable of receiving a portion of the fuel ejected from said mixer.

9. In mechanism of the class described, a fuel and air mixer, a combustion supporting apparatus arranged to be positioned in a wall of the furnace setting, said apparatus being provided with a longitudinally extending combustion chamber, a substantially conical vaporizing element arranged to be situated within said chamber so as to intercept the fuel stream of said mixer, and a plurality of curved arms extending from said vaporizer to the wall of said chamber, said arms being situated within the interior of said furnace and arranged to deflect a portion of the burning fuel discharged from said apparatus toward and in engagement with said vaporizer.

In testimony whereof I affix my signature.

CLIFFORD HARRY PIDGEON.