May 3, 1938. M. A. POWERS 2,115,873

IGNITING DEVICE FOR LIQUID FUEL BURNERS

Filed June 20, 1934 2 Sheets-Sheet 1

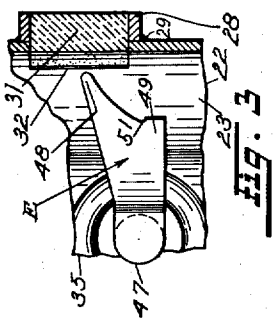

FIG. 3

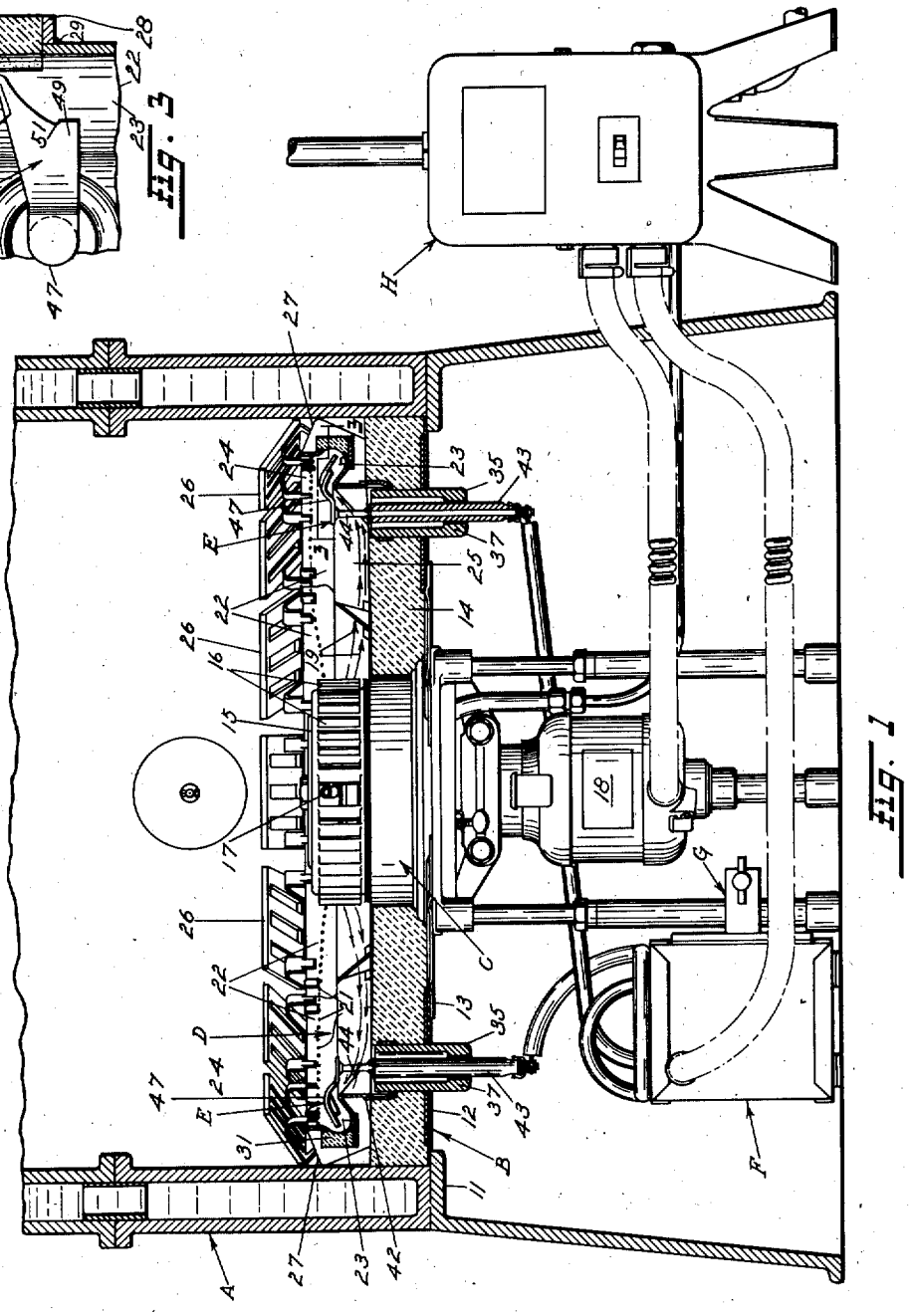

FIG. 1

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Fig. 4

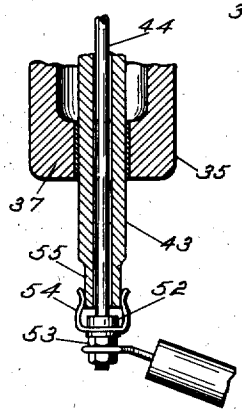

Fig. 5

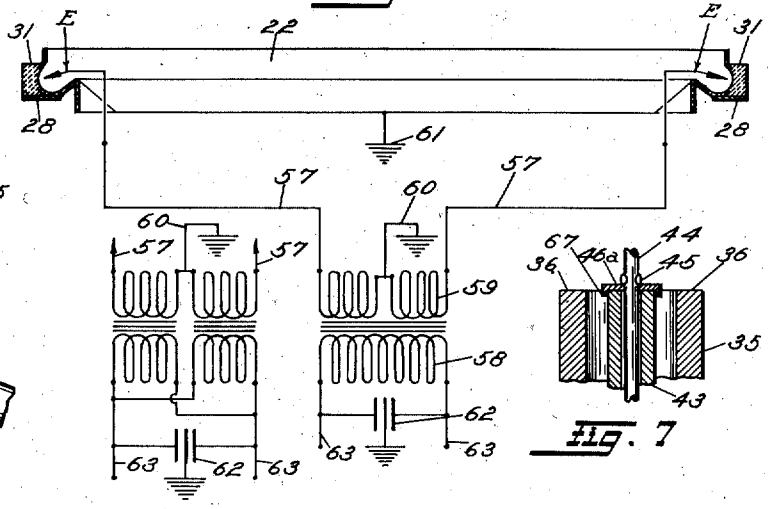

Fig. 7

Fig. 2

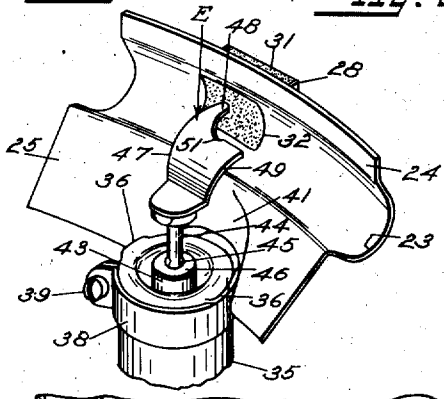

Fig. 6

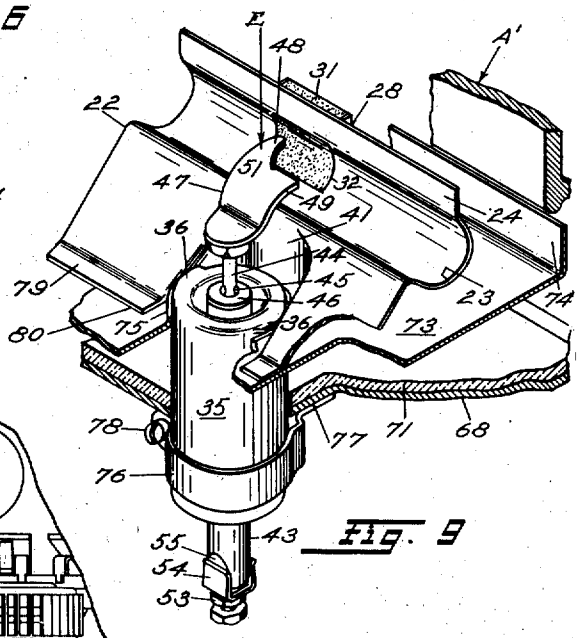

Fig. 9

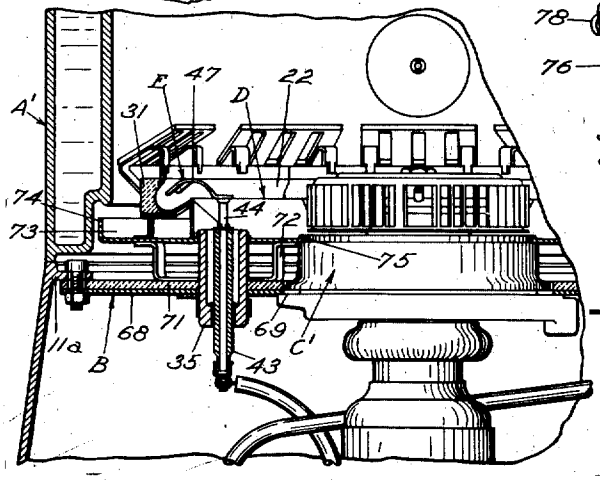

Fig. 8

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2,115,873

UNITED STATES PATENT OFFICE

2,115,873

IGNITING DEVICE FOR LIQUID FUEL BURNERS

Milton A. Powers, Detroit, Mich., assignor, by mesne assignments, to The Timken-Detroit Axle Company, a corporation of Ohio

Application June 20, 1934, Serial No. 731,562

14 Claims. (Cl. 175—115)

The present invention relates to devices for igniting liquid fuel burners, and it is more particularly concerned with igniting devices for oil burners of the general character employed for heating residences, although it is not limited to use with this type of burner.

In some types of oil burners, ignition is easily possible, as there is some point in the combustion zone where a readily ignitable mixture may always be found and in which an electric spark gap may be located. However, in a liquid fuel burner of the wall flame type, for instance, a vertical rotary burner, where combustion takes place at a distance from the source of air and fuel supply, this condition does not exist. In such oil burners the oil is ordinarily thrown in a substantially solid or un-atomized state toward a refractory combustion surface, where it is broken up and volatilized, mixed with air and combusted. In burners of this type, the conventional electric spark will frequently ignite the air fuel mixture in the region of the combustion surface, when the latter is hot, but this is almost impossible of achievement when the combustion chamber has been completely cooled. Moreover, in such devices, the spark between the electrodes is extended or drawn out by reason of the high velocity air striking it, and even though a very hot spark may be used, the heat thereof is not conserved, but is dissipated into the rapidly moving air stream surrounding it. Accordingly, in such devices, the oil spray passes between or near the electrode, and while at times it may be momentarily ignited, the high velocity of the surrounding air prevents the flame from propagating and ignition failure results.

In my prior patent, No. 1,888,695, granted November 22, 1933, I have disclosed an igniting device for an oil burner of the general character just discussed, and it has proven satisfactory for such burners, for the reason that electrical energy, with a secondary current of twenty-five milleamperes, is supplied the electrodes through a transformer having an input of at least seventy-five watts, with the result that a flaming arc, as distinguished from a jump spark or intermittent spark is produced. Moreover, in my prior construction the flaming arc is sheltered from the high velocity air stream, or is located in a semi-quiescent zone, whereby the air and volatilized oil in the region of the arc moves comparatively slowly into the combustion zone, with the result that the hydro-carbon and air ionize to a great extent and accordingly greatly reduces the gap resistance effecting a substantial lowering of the voltage and minimizing radio interference. Locating the arc in a zone that is protected from the high velocity air currents also permits the arc to heat the surrounding air and volatilized oil to a high temperature, resulting in rapid vaporization and ignition of the combustible mixture.

The present invention possesses all of the highly important features of the construction disclosed in my prior patent just discussed, and also possesses several further highly desirable characteristics that will hereinafter appear.

Certain features of my invention are disclosed in my copending application, Serial Number 675,341, filed June 12, 1933, and the present application is accordingly a continuation in part of said co-pending application.

It is a primary object of the present invention to devise a novel liquid fuel burner of the wall flame type having an igniting device which is positive in performance, and yet which is simple in design.

It is a further major object of my invention to devise an improved burner organization having a carbureting wall of low heat content and an igniting device located adjacent thereto, so that when combustion is initiated the carbureting wall will heat up quickly and rapidly volatilize fuel impinging thereagainst and propagation of combustion will be rapid.

It is another important object of my invention to provide an improved burner organization having a carbureting wall disposed substantially normal to the direction of fuel directed thereagainst, with a member inclined to the carbureting wall for deflecting air upwardly over its surface, and with means, located between the deflecting member and the carbureting wall, for igniting fuel impinging against the latter.

It is a further object of my invention to devise an improved burner having a metallic carbureting wall and several electrodes located adjacent thereto, the carbureting wall forming a part of the circuit between the electrodes.

A further object of my invention is to devise an improved metallic carbureting element having a non-metallic electrode associated therewith for arcing cooperation with a second electrode which is insulated from the carbureting element.

My invention further aims to provide a metallic liquid fuel carbureting element with a "built in" or embedded electrode, which is so designed that it does not change the configuration of the surface of the carbureting element.

It is another object of my invention to devise novel means for mounting an ignition elec-

trode in the hearth of a liquid fuel burner assembly.

A further object of my invention resides in the provision of a liquid fuel burner of the character having a hearth and means for burning fuel above the hearth, with an improved electrode having nested members that are joined together below the hearth, whereby the joint is protected from the direct heat of the burning fuel.

It is another object to devise an electrode for use in a liquid fuel burner, which is so constructed that the parts thereof may freely undergo expansion and contraction in response to thermal changes, whereby distortion or fracture thereof is avoided.

It is another object to devise an electrode for use in a liquid fuel burner having parts that may freely move relatively in response to temperature changes, and yet which are positively restrained against improper movement in response to vibrations.

Further objects of my invention will become apparent as the specification proceeds in connection with the accompanying drawings, and from the appended claims.

In the drawings:

Figure 1 is a vertical sectional view of a coal-burning furnace, having my liquid fuel burner and igniting devices applied thereto.

Figure 2 is a perspective view of one of the igniter assemblies employed in the device shown in Figure 1, as it appears when removed from the furnace.

Figure 3 is a sectional view taken on the line 3—3 of Figure 1, looking in the direction of the arrows.

Figure 4 is an enlarged vertical sectional view of the lower part of one of the electrodes employed in the device shown in Figure 1.

Figure 5 is a diagrammatic view of the transformer and the circuit employed for connecting it to the carbureting ring of the construction illustrated in Figure 1.

Figure 6 is a diagrammatic view showing a modified form of transformer for use with my burner and igniter construction.

Figure 7 is a fragmental sectional view of a modified form of electrode, also forming part of my invention.

Figure 8 is a vertical sectional view of liquid fuel igniter and burner embodying my invention, but illustrating it mounted in a hearth construction of modified form, and

Figure 9 is a fragmental sectional view of one of the electrodes employed in the construction shown in Figure 8 and the associated structure.

With continued reference to the drawings, wherein like reference characters have been employed to designate like parts throughout the several figures thereof, my liquid fuel igniter and burner is shown in the present instance as being mounted in a furnace A, and it consists of a hearth assembly B, supported in the furnace, a burner head C, which throws oil and air outwardly toward a fuel volatilizing and combusting assembly, consisting of cooperating segments D which form a carbureting ring. A plurality of igniting devices E cooperate with the carbureting ring to ignite the fuel-air mixture and electric energy is supplied thereto from a transformer F, which is preferably grounded to the burner head assembly, as at G. Control of the device is effected by mechanism located in a control stand H, and as the latter forms no part of the present invention, it will not be further described.

The furnace or boiler base is provided with an inwardly extending flange 11 upon which the outer edge of a hearth supporting plate 12 rests, and the inner periphery of the latter is supported on the outer portions of split rings 13, which are supported in a groove provided in the burner head. The hearth proper consists of a refractory material, indicated at 14, which is molded upon the hearth supporting plates. The various elements that are molded therein will be described hereinafter.

A burner head 15 is rotatably supported and carries a plurality of fan blades 16, and a plurality of upwardly and outwardly inclined oil nozzles 17 thereupon. Head 15 is driven by a motor 18 which is supported by a stand in any suitable manner. The air issuing from head 15 takes the general path indicated by the arrows 19 in Figure 1, and the oil droplets take the path indicated at 21. The burner-head construction just described, and the means utilized for controlling oil and air flow forms no part of the present invention as it is claimed elsewhere and is fully considered, for example, in my Patent No. 2,051,130, of August 18, 1936, which may be referred to for a more detailed disclosure of these parts.

Immediately above and resting upon the hearth is a series of metallic segments 22, which are firmly clamped together in any suitable manner, so as to form a continuous ring, that is spaced inwardly from the boiler wall. Each segment is provided with a groove gutter portion 23, a vertical flange 24 or impact wall and an upwardly sloping, air-deflecting portion 25. All of the segments except the igniter segments are identical in construction and hence they are interchangeable. The detailed construction of the igniter segments will be described hereinafter.

A plurality of grills, designated generally as 26, are supported at their inner ends on portions 24 of members 22, and at their rear ends upon members 27, which in the present instance are also utilized to secure the various segments in assembled relationship. Segments 22 and grills 26 and connectors 27 are all preferably constructed of a special heat-resistant steel in order to withstand the high temperatures to which these parts are subjected when the burner is in use. Grills 26 function to hold the flame down where it may be more advantageously utilized, and as they are fully disclosed and claimed in the application of John A. Wilson, Serial No. 682,374, filed July 27, 1933, which may be referred to for a more complete disclosure, they will not be further described in the present application.

With respect to Figures 1 and 2, two diametrically opposite segments 22 are each provided with an igniter assembly, and the electrode thereof that is built in or embedded in the carbureting ring, will now be described. Each ring electrode consists of a preferably metallic container 28, whose side walls are shaped to conform to the shape of gutter portion 23 of segment 22, and are welded to segment 22 as at 29. Each container or box 28, is filled with a carborundum mass 31, which is preferably formed by mixing granular carborundum and an insulating refractory binder and water, to form a plastic mass, which hardens to a solid mass presenting a face which is curved to conform substantially exactly with the curved surface of gutter portion 23. As seen in Figure 3, an aperture 32 is formed in segment 22 through which mass 31 extends, so as

to render a portion of the interior of the ring a curved electrode surface. The insulating material is incorporated with the carborundum in order to increase the resistance thereof and thereby cause it to heat up when a current is passed through it.

Although I prefer to equip the carbureting ring segment with separate or independent electrodes, it is to be understood that in some cases, particularly if high quality fuel is used, it may be desirable to eliminate pocket 28 and its carborundum insert, thus allowing the inner electrodes to fire across the gap directly against the metal surface of the ring, and it is to be understood that the appended claims are intended to cover my device when it is used in this manner.

Cooperating with each ring electrode is an inner electrode that will now be described. An outer insulating member 35 having a pair of nibs 36 formed at its upper end, and having an apertured bottom 37, extends through an aperture in plate 12 and is embedded in hearth 14. Member 35 is frictionally held in a clamping member 38 by means of a screw 39, and the clamp is provided with an upwardly extending portion that is secured to a pressed vertical cylindrical portion 41 of member 22 by a welding operation, indicated at 42, or the like. As previously indicated, members 35 are embedded in hearth 14, along with clamp member 38, when the hearth is molded in place upon the hearth plates.

Extending through the apertured bottom of each member 35 is an inner sleeve-like insulating member 43, which is rigidly secured thereto by cement or any other suitable means. "Sillimanite" is the preferred material from which insulator elements 35 and 43 are made, for it has been found that its insulating abilities remain intact at higher temperatures than other known insulating materials that are practical for use. A conductor 44 extends rather loosely through inner insulator 43 and is formed with a pair of nibs or ears 45 at the upper end thereof which rest upon a washer 46. Ears 45 cooperate with washer 46 and accordingly restrain conductor 44 against downward movement under the influence of gravity. Secured to the top of each conductor 44, as by a welding or riveting operation, is an electrode 47 which is preferably made of a heat resisting metal, as is also conductor 44, and has a lug at its inner end into which conductor 44 extends. As seen in Figures 1 and 2, electrode 47 is of ribbonlike construction and has an upwardly curving portion that extends from the lug to its main body portion and then slopes slightly downwardly toward its outer end where it terminates in a somewhat blunt tip 48.

As seen in Figure 1, each tip 48 terminates a short distance away from the carborundum ring electrode thus forming a spark or arc gap. The tip portion 48 of each member 47 is shaped so that the arc will pass suddenly between two points if there is no outside influence. However, upon movement of the surrounding atmosphere, there will be a tendency for the arc to move along the top of the metal electrode and wander over the surface of the carborundum electrode, and the somewhat blunt tip serves to accentuate this characteristic. The upwardly curving portion of each electrode 47 is provided with a lateral downwardly deflected extension 49 and it is disposed on the side toward the air spray. A notch 51 is formed at the junction of the outer edge of the downwardly deflected extension and the main body of the electrode.

As previously stated, conductors 44 are only loosely disposed within inner insulating members 43, and this is done in order to allow these members to freely expand and contract both longitudinally and radially under the influence of temperature changes without causing fracture of the insulator. In the electrodes heretofore proposed, wherein the conductor was closely disposed within inner insulator, it was found that upon gradual heating of the parts the metal would expand faster than the insulator in view of its greater coefficient of thermal expansion, with the result that the latter would often be fractured. On the other hand, conditions are sometimes encountered wherein the porcelain expands more rapidly than the metal. For example, upon rapid heating in a cold boiler, that portion of the insulator surrounding the electrode may be subjected momentarily to a much greater temperature rise than the conductor, with the result that despite the lower coefficient of expansion of the insulator, the parts of such prior electrodes become loose under such conditions and allow the electrode tip to rock out of proper gap-forming relationship. I have overcome all of these difficulties by loosely mounting the conductors within the inner insulators, and by providing means for positively holding the conductors in fixed relationship to the carbureting ring, so as to maintain the electrodes in proper angular position at all times. The structure I preferably employ for producing these results will now be described.

With particular reference to Figure 4, the lower end of each conductor 44 is provided with a flange or boss 52, which is preferably spaced from the bottom of insulator 43, so that there will be no danger of binding of the parts as they undergo longitudinal expansion and contraction. Clamped between boss 52, and a nut and washer assembly 53, threaded on conductor 44, is a U-shaped spring-steel clip member 54. The fingers of each clip member 54 frictionally engage a pair of flat faces 55 provided on insulator 43 and thereby prevent conductor 44 from rocking within insulator 43, and as the latter is rigidly secured to insulator 35, it is obvious that each electrode 47 is positively maintained in proper gap-forming relation with electrode 31 at all times. It should be particularly observed that the points of connection between the insulators 43 and clips 54, and the joint between insulators 55 and 43 are located in a region that is below the hearth and they are therefore not exposed to the direct action of the flame.

It is observed that the upper end of each conductor 44 extends above the plane of insulators 35 and 43. This is done for two reasons: first, there is less area disposed for deflecting the air issuing from burner head C, and second, the expansion and contraction of conductor 44 is a maximum in this region as it is exposed to the radiant heat developed above the grills.

Electrical energy may be supplied to the electrodes in any suitable manner, but I preferably employ a transformer having an input of approximately 75 watts and a secondary current of 25 milliamperes. Referring now to Figure 5, wherein the ignition wiring system is schematically shown, the transformer is diagrammatically shown as having a single primary winding 58 and a double secondary winding 59, which is balanced and grounded at its electrical midpoint 60. Secondary winding 59 is connected in series, by wires 57, with the igniters which in these figures are indicated by arrows E. The secondary

circuit is through one insulated electrode, across the spark gap into the carborundum electrode carried by the metal carbureting ring, thence along the carbureting ring, thence across the second spark gap into the other insulated electrode and back into the secondary winding. The metal ring may also be grounded as diagrammatically shown at 61, and the appended claims are intended to embrace my device when it is connected up in this manner. My ignition system will work equally satisfactorily, from the fuel-igniting point of view, without grounding the midpoint of the secondary circuit, or the carbureting ring, but it is preferably grounded in order to minimize radio interference. It is accordingly desirable to effect a good electrical connection between the various carbureting ring segments, and also between the latter and the boiler in order to prevent any sporadic sparking which might otherwise occur and manifest itself as radio interference.

It is becoming common practice for the manufacturer of rotary wall flame burners to use a motor equipped with a condenser as a substitute for the usual starting winding and switch mechanism of the conventional split phase motor, and I have indicated such condenser at 62 in Figure 5, as being connected across the power wires 63. The condenser remains in the circuit during the entire period of operation of the burner, and in addition to functioning as a starting device for the motor, it serves to greatly reduce the oscillating currents, set up in the secondary winding when the ignition system is operating, from feeding back into the power wires and thence into radios where they would manifest themselves as audible disturbances. The condenser has the capacitance of 3 m. f. d., and has been found to greatly reduce radio interference in many cases where trouble has been experienced.

When ignition of the fuel has been successfully inaugurated, the current for the primary circuit of the transformer is automatically broken by means of a device indicated at 64, which is disposed adjacent the combustion zone and is responsive to temperature changes. In view of the fact that this mechanism forms no part of the present invention it will not be further discussed.

The operation of my device will now be described and it will be assumed first that the carbureting ring is substantially cold.

When the motor circuit is closed under such conditions, the transformer sets up an initial potential difference across each electrode of approximately 7500 volts. That is, a total voltage drop of 15,000 volts across both gaps. However, arcs are immediately established between the points 48 of electrodes 47 and the curved surfaces of electrodes 31, which is of a flaming character, that is, it is not an intermittent or puncturing type of discharge. The flaming arcs produced by the electrodes rapidly ionize the air and hydrocarbon vapors in the regions of them, and the resultant decrease in the resistance of the spark gaps materially reduces the voltage drop, and this accordingly results in a tremendous reduction of the strain in the high voltage circuit and minimizes radio interference.

With the arcs going in the manner just described, and with reference to Figure 1, it is observed that they are sheltered from the direct action of the outwardly and upwardly moving air currents emanating from the burner head, with the result that they are not drawn out, and the air and hydrocarbon vapors in the region of the hearth are not displaced, with the result that the heat of the arcs is conserved, and the temperature of the hydrocarbon vapors raised greatly. Under these conditions the arcs maintain a bushy white appearance, as distinguished from the reddish appearance they exhibit when operated in the open air.

In view of the fact that gutter 23 is substantially protected against air movements, the main flow of air moves upwardly past the carbureting ring without entering the gutter, where it is mixed with the oil vapors arising from the gutter. Accordingly, the mixture in the gutter, except in the region of the ignitors, is too rich for combustion. However, downwardly curving portions 49 formed on electrodes 47 cause a portion of the upwardly moving main body of air to be directed downwardly into the gutter and adjacent the arcs. The air supplied the arcs in this manner not only exerts a scouring action and hence keeps the electrodes clean, but it also supplies sufficient oxygen for the inauguration of combustion of the hydrocarbon-air mixture adjacent the arc, and from these two points flame propagation extends circularly in both directions around the carbureting ring, and upwardly thereof, in view of the lack of a combustible mixture in the portions of the gutter that are remote from the igniters.

It is not only important to properly inaugurate combustion, but it is absolutely essential to efficiently propagate combustion after ignition of the hydrocarbon mixture in the region of the electrodes has been effected, and it is to be particularly observed that even though the carbureting ring is constructed of metal, which has a comparatively high specific heat, it is thin and accordingly has a low heat content and heats up rapidly, with the result that it rapidly volatilizes the substantially liquid fuel impinging thereon from head 15, and fuel volatilization is accordingly very efficient.

An added advantage resulting from the introduction of air to the vicinity of the arcs exists when the burner is called upon to start with the hearth ring in a highly heated condition. Under these circumstances substantially all of the oil discharged from the burner head is immediately vaporized upon impingement against the carbureting ring. The large volume of vapors immediately fills the gutter in which the arcs are located, and as the vapor in the tube is too rich for combustion, ignition would lag unless air was introduced to the arcs, as provided by my device.

Soon after ignition has been effected, any excess oil that may be present in gutter 23 is vaporized and when the vapor release becomes sufficiently high, either from oil accumulated in gutter 23, or from oil striking impact surface, the flame entirely leaves the gutter and burns above grills 26.

The amount of air introduced into the region of the arcs may be variably adjusted by properly twisting downwardly extending portions 49 of electrodes 47 to interpose a more or less extended surface in the air path immediately adjacent the arcing gaps. The air directed to the vicinity of the arcs also serves to burn away any carbon which might tend to collect between the electrodes from any cause, among which most important are the incomplete combustion of poor grades of oil, cracking of oil under the intense heat of the arc, or the action of stringy carbon structures which have been found to bridge the electrodes in prior constructions when starting cold.

The substantially flat nature of each electrode 31, when taken in connection with the blunt

nature of tip 48 of electrode 47, and the air currents directed thereto by portions 49 of electrodes 47, causes the arc to "wander" over a portion of electrode 31. Such wandering of the point of arc impingement eliminates any bad effects that have been manifested in prior constructions, due to a slow building up of a pile of carbon between the electrodes. As the carbureting ring is made of metal and is comparatively thin, it heats up more rapidly and attains a higher temperature than the old ceramic tile, with the result that no trouble is experienced with carbon deposits in gutter 23.

In Figure 6 I have shown a modified form of transformer for use with the ignition device just described and the major difference resides in the fact that the primary winding is double, and each winding is connected across line 63 in parallel.

In Figure 7 I have shown a slightly modified form of electrode, and with continued reference to this figure, washer 46a fits tightly around conductor 44 in fluid tight relation therewith. Washer 46a is provided with a downwardly extending flange or lip 67, which is spaced from the cylindrical wall of insulator 43 so that the two parts may readily independently expand and contract radially in response to temperature changes. Washers 46a are designed in this manner so as to prevent oil from finding its way between conductors 44 and insulators 43, as it might leak downwardly and gum up the terminals. Accordingly oil trickling down the conductor 44 is deflected into the annular cup between insulators 35 and 43, where it is volatilized and burnt when the burner attains a sufficient temperature.

With reference to Figures 8 and 9, I have illustrated my invention as applied to a burner having a metallic hearth construction. In this form of the invention an annular plate 68 is secured to flange 11a of boiler A' by means of nuts and bolts and it rests at its inner edge upon a flange 69 formed on burner C'. A layer of heat insulating material 71 is disposed immediately on top of plate 68 and serves to shield the latter and motor 18 from the high temperatures developed in the furnace. Resting on top of insulator 71, and removably secured to plate 68 in any suitable manner are a series of U-shaped hearth supporting members 72, which are disposed at intervals radially around the burner head and the upper portion of whose legs are bent to support a metal hearth 73. Hearth 73 is apertured and lipped at its inner diameter to fit snugly on a shoulder provided on burner C', and has a deep lip 74 at its outer periphery so as to define a fuel catching pan. The construction just described is also shown in my application Serial No. 729,928 filed on June 9, 1934 now Patent No. 2,065,393.

The igniter assemblies extend through apertures in members 68 and 71 and through upwardly flanged apertures 75 in hearth plate 73. Insulators 35 are held in proper assembled relation with the hearth assembly by means of clamps 76 which are preferably welded to the bottom face of plate 68 as at 77. Clamp 76 is held in position by means of a screw 78, which extends through the meeting ends thereof. In this form of the invention, carbureting ring segments 22 are provided with flanges 79, which are preferably welded to hearth plate 73 at spaced points, as at 80, which results in an extremely rigid construction.

As this construction functions in a manner similar to those previously described, it will not be again set forth.

With further reference to the transformers employed with my burner igniting devices, they may be of any suitable form, but I preferably use a transformer designed to deliver a secondary circuit-power of relatively low power factor, and whose wave form is flattened and has a step wave front so that the wave passes through zero rapidly. This minimizes the length of the intervals of time between each cycle when no current is flowing with the result that the arc produced is of a "flaming" character, and is not extinguished each cycle. This type of secondary-circuit power wave may be produced in any suitable manner but I preferably bring it about by incorporating magnetic shunts in the magnetic circuit of the transformer, and as transformers of this general character are well known in the electrical art, and as I make no claim to it aside from in combination with the igniter of a liquid fuel burner, it is believed unnecessary to specifically illustrate the transformer. The power factor of the transformer varies from 10.9 percent with the secondary short-circuited, up to as high as 17.9 percent with the secondary open-circuited.

Although I have illustrated the electrode tips as having integrally formed air deflectors, it is to be understood that they may be omitted and air deflecting means be associated with the hearth or carbureting ring for directing air to the arcs, or, if the carbureting ring is designed to produce proper air-vapor condition at the arcs, the air deflecting means may be omitted altogether without departing from the spirit of my invention.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:—

1. In a liquid fuel igniting and burning apparatus, a metallic carbureting element; means for projecting fuel toward said carbureting element; means for igniting said fuel, comprising at least two electrodes spaced stationarily disposed in proximity to definite spaced portions of each other and from said carbureting element; and means for establishing electric arcs between said electrodes and said definite spaced portions of said carbureting element, said carbureting element forming between said definite spaced portions a part of the circuit for said last-named means.

2. The construction described in claim 1, wherein said spaced portions of said carbureting element includes at least two electrodes in direct electrical contact with said element and which cooperate with said first-named electrodes.

3. In a liquid fuel burning apparatus in subcombination, a metallic element against which fuel is adapted to be sprayed; said element having an aperture therein; and an electrode of higher resistance than said element mounted on said element in electrical contact therewith and in registry with said aperture.

4. The apparatus described in claim 3, wherein said element has integral metallic supporting means and said electrode comprises a carborun-

dum body having refractory insulating material disseminated therethrough and carried by said supporting means.

5. In a liquid fuel apparatus in subcombination, an apertured hearth having an upper surface which is subjected to the heat of the burning fuel; an electrode for igniting said fuel extending through said electrode comprising inner and outer concentric insulating members and means, located below the upper surface of said hearth, for holding said outer member in position in and against vertical displacement with respect to said hearth.

6. The apparatus described in claim 5, wherein said means comprises a strap disposed below the lower surface of said hearth and secured to the latter.

7. In a liquid fuel burning apparatus, a hearth having an aperture therein; a sleeve-like insulator substantially vertically mounted in said aperture; a conductor relatively loosely disposed within said insulator; and means engaging the lower end of said insulator and secured to said conductor to maintain the latter in concentricity and out of contact with said insulator.

8. The apparatus described in claim 7, wherein said means is operable to allow said conductor and insulator to automatically undergo relative longitudinal movement in response to temperature variations.

9. The combination with a combustion chamber having a metal combustion ring, of an electrical ignition system having two pairs of electrodes, one electrode of each pair being electrically insulated from said ring and the other being electrically connected therewith and the insulated electrodes being connected to opposite sides of a common source of electricity, whereby said ring serves as a part of the electric circuit for the two pairs of electrodes.

10. An ignition system for oil burners having a hearth and metallic flame ring consisting of a source of electrical energy, electrodes supported by the hearth and projecting therethrough, second electrodes attached to and embedded in the metal flame ring adjacent the first mentioned electrodes thereby forming a spark gap therebetween, said electrodes being connected in series with said metal flame ring.

11. An oil burner equipped with a metal flame ring, a hearth, and electrical ignition means wherein at least a portion of said metal flame ring forms a part of the electrical circuit, said electrical ignition means comprising electrodes projecting through said hearth and complementary electrodes therebetween embedded in said metal flame ring adjacent said projecting electrodes to form spark gaps with respect thereto.

12. In a liquid fuel burning apparatus, an ignition system including a wall of thin metal of high heat resistance and of good electrical conductivity, an electrode comprising a block of material of higher electrical resistance than said wall, thin metal supporting means integral with said wall to position said block of material, and a second electrode disposed adjacent said block to form therewith a spark gap.

13. In the apparatus defined in claim 12, said wall having a portion curved to form a concave fuel impingement face, said curved portion having an aperture, said block fitting said aperture and extending therebeyond in a direction to the rear of said face, and said metal supporting means likewise projecting rearwardly from the edge of said aperture.

14. In a liquid fuel burning apparatus, an elongated fuel impingement metal ring carrying a pair of spaced electrodes and itself establishing a connection of electrical conductivity between them, a pair of cooperating electrodes one adjacent each of said spaced electrodes, a transformer having a secondary winding connected at its ends to the second mentioned electrodes and connected substantially at its midpoint to said ring at a point approximately midway of the space between the first mentioned electrodes.

MILTON A. POWERS.

CERTIFICATE OF CORRECTION.

Patent No. 2,115,873. May 3, 1938.

MILTON A. POWERS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, first column, line 8, claim 5, after "through" insert the words and semi-colon said aperture;; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of June, A. D. 1938.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)

dum body having refractory insulating material disseminated therethrough and carried by said supporting means.

5. In a liquid fuel apparatus in subcombination, an apertured hearth having an upper surface which is subjected to the heat of the burning fuel; an electrode for igniting said fuel extending through said electrode comprising inner and outer concentric insulating members and means, located below the upper surface of said hearth, for holding said outer member in position in and against vertical displacement with respect to said hearth.

6. The apparatus described in claim 5, wherein said means comprises a strap disposed below the lower surface of said hearth and secured to the latter.

7. In a liquid fuel burning apparatus, a hearth having an aperture therein; a sleeve-like insulator substantially vertically mounted in said aperture; a conductor relatively loosely disposed within said insulator; and means engaging the lower end of said insulator and secured to said conductor to maintain the latter in concentricity and out of contact with said insulator.

8. The apparatus described in claim 7, wherein said means is operable to allow said conductor and insulator to automatically undergo relative longitudinal movement in response to temperature variations.

9. The combination with a combustion chamber having a metal combustion ring, of an electrical ignition system having two pairs of electrodes, one electrode of each pair being electrically insulated from said ring and the other being electrically connected therewith and the insulated electrodes being connected to opposite sides of a common source of electricity, whereby said ring serves as a part of the electric circuit for the two pairs of electrodes.

10. An ignition system for oil burners having a hearth and metallic flame ring consisting of a source of electrical energy, electrodes supported by the hearth and projecting therethrough, second electrodes attached to and embedded in the metal flame ring adjacent the first mentioned electrodes thereby forming a spark gap therebetween, said electrodes being connected in series with said metal flame ring.

11. An oil burner equipped with a metal flame ring, a hearth, and electrical ignition means wherein at least a portion of said metal flame ring forms a part of the electrical circuit, said electrical ignition means comprising electrodes projecting through said hearth and complementary electrodes therebetween embedded in said metal flame ring adjacent said projecting electrodes to form spark gaps with respect thereto.

12. In a liquid fuel burning apparatus, an ignition system including a wall of thin metal of high heat resistance and of good electrical conductivity, an electrode comprising a block of material of higher electrical resistance than said wall, thin metal supporting means integral with said wall to position said block of material, and a second electrode disposed adjacent said block to form therewith a spark gap.

13. In the apparatus defined in claim 12, said wall having a portion curved to form a concave fuel impingement face, said curved portion having an aperture, said block fitting said aperture and extending therebeyond in a direction to the rear of said face, and said metal supporting means likewise projecting rearwardly from the edge of said aperture.

14. In a liquid fuel burning apparatus, an elongated fuel impingement metal ring carrying a pair of spaced electrodes and itself establishing a connection of electrical conductivity between them, a pair of cooperating electrodes one adjacent each of said spaced electrodes, a transformer having a secondary winding connected at its ends to the second mentioned electrodes and connected substantially at its midpoint to said ring at a point approximately midway of the space between the first mentioned electrodes.

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