Sept. 17, 1968 L. M. KEY, JR 3,401,673

DIRECT FIRED FLUID HEATER

Filed Aug. 30, 1966 4 Sheets-Sheet 1

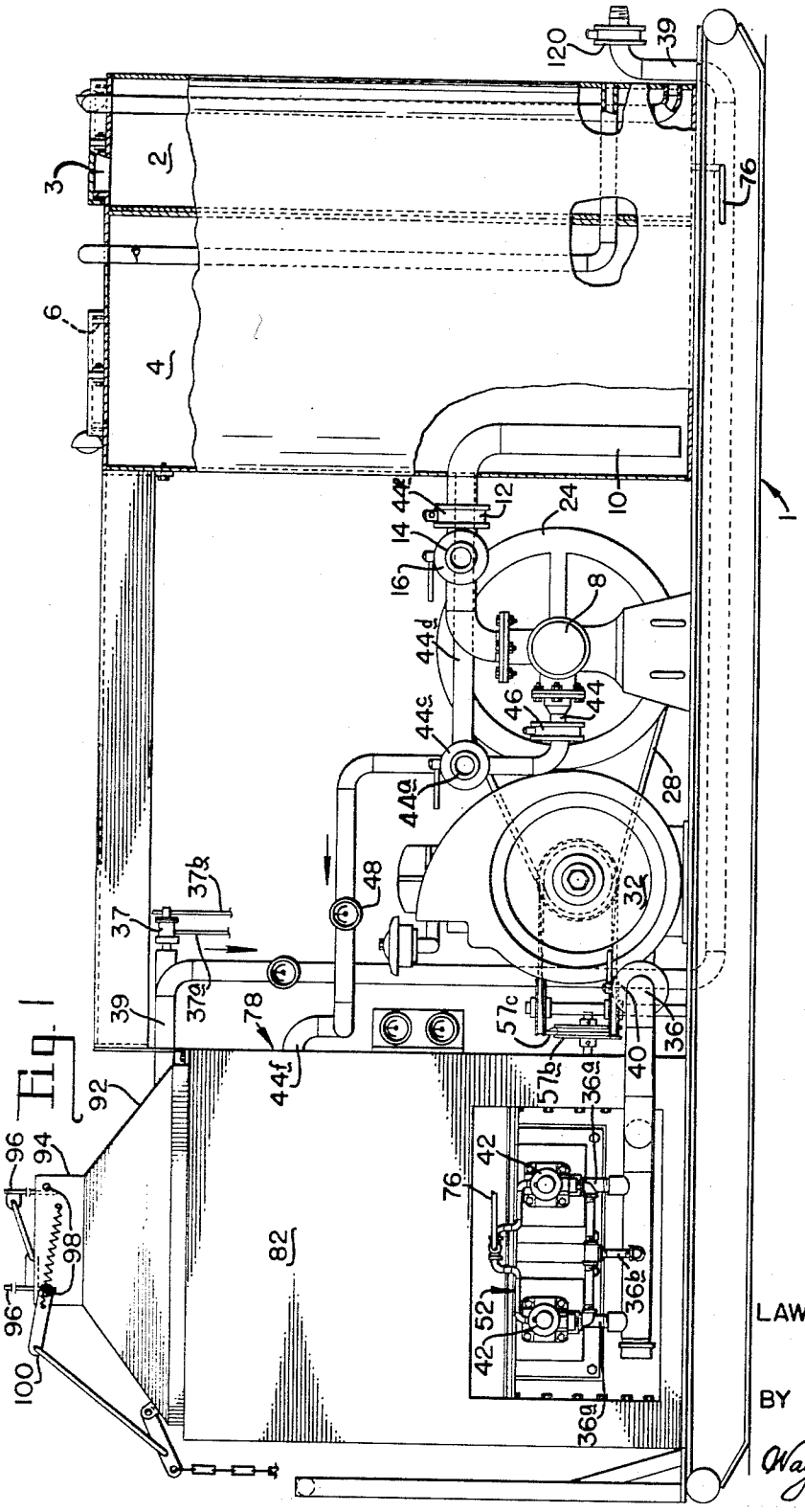


Fig. 1

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DIRECT FIRED FLUID HEATER

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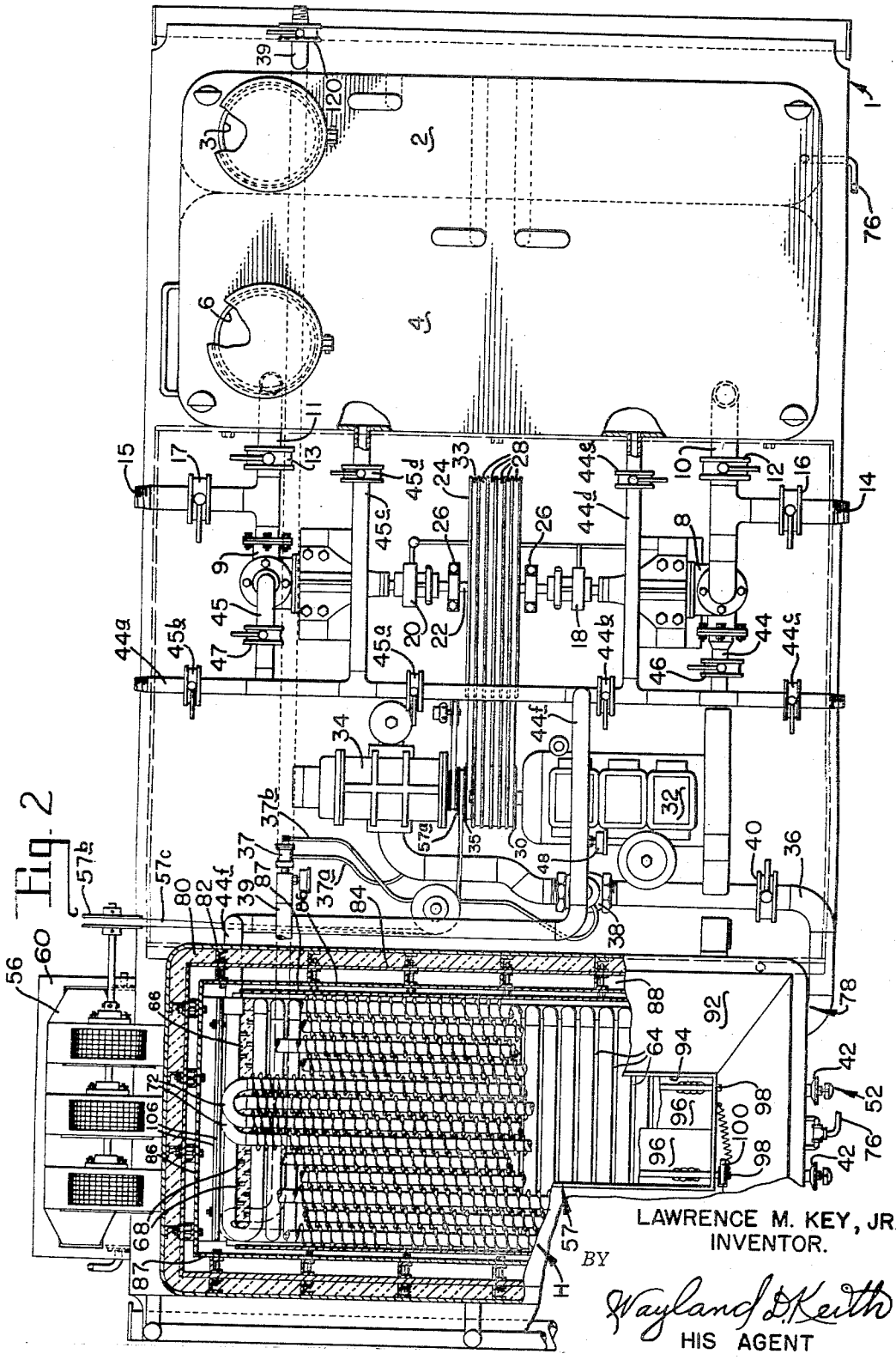


Fig. 2

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DIRECT FIRED FLUID HEATER

Filed Aug. 30, 1966 4 Sheets-Sheet 3

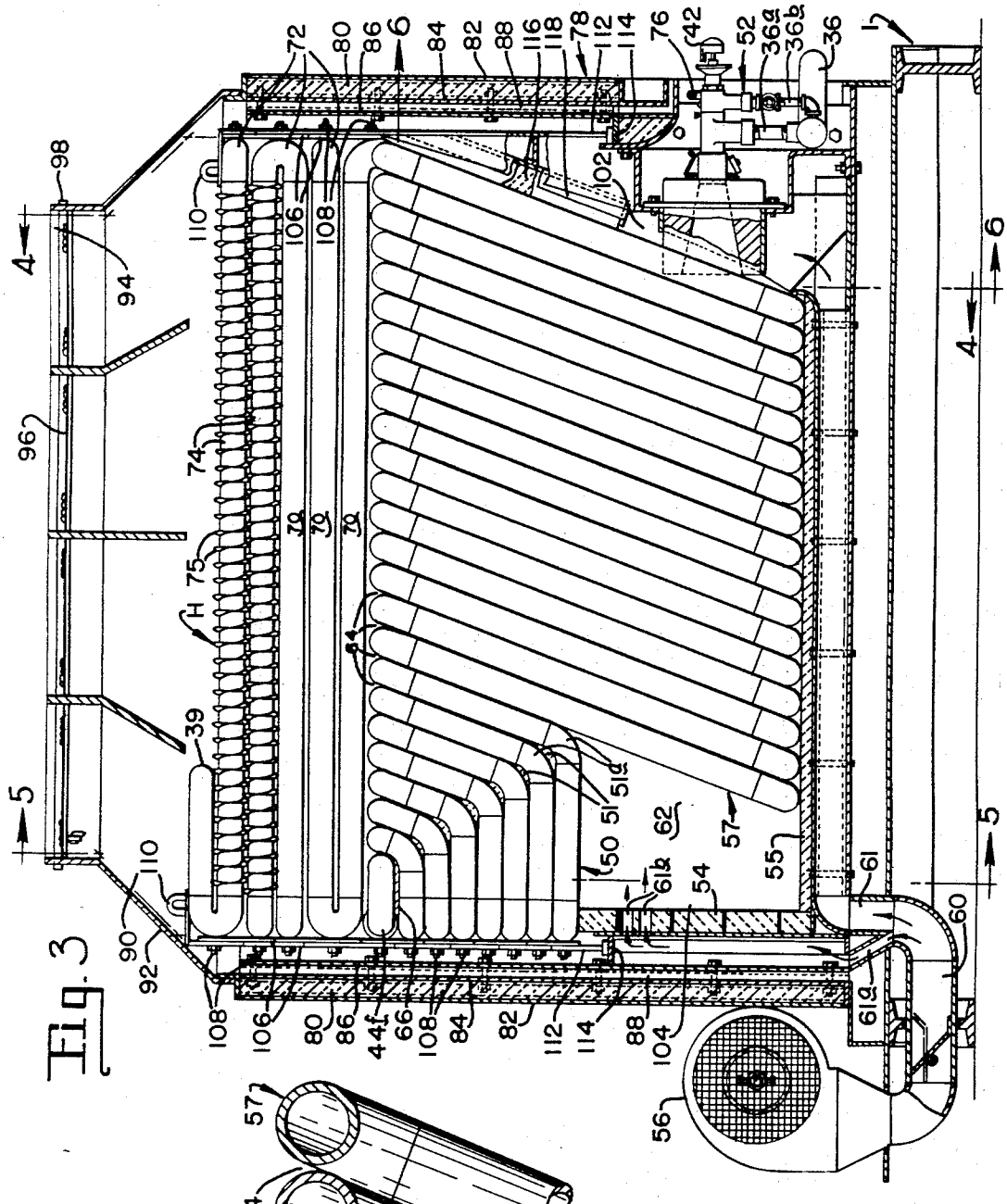


Fig. 3

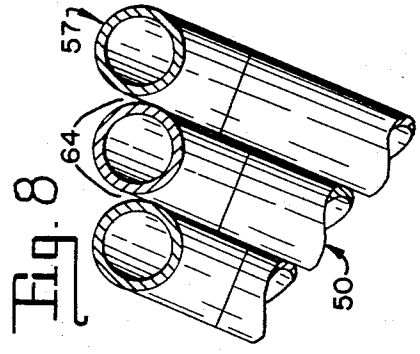


Fig. 8

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DIRECT FIRED FLUID HEATER

Filed Aug. 30, 1966 4 Sheets-Sheet 4

Fig. 4

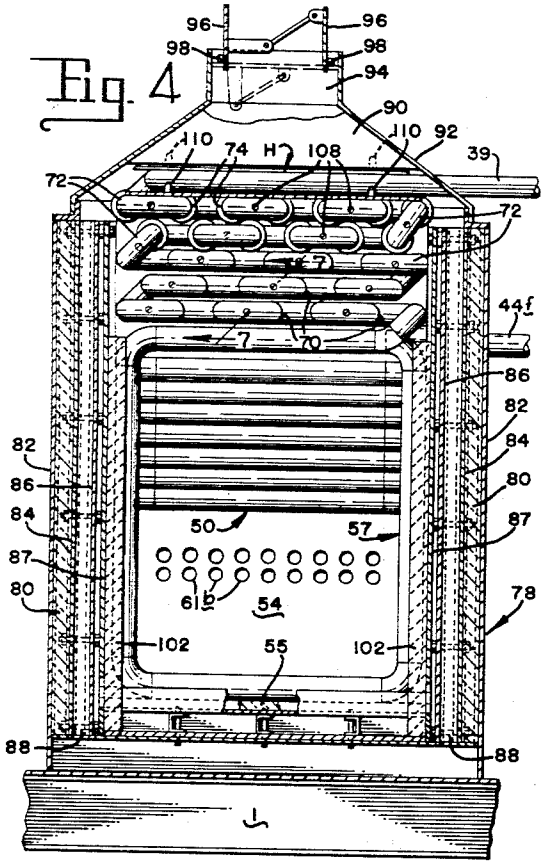


Fig. 5

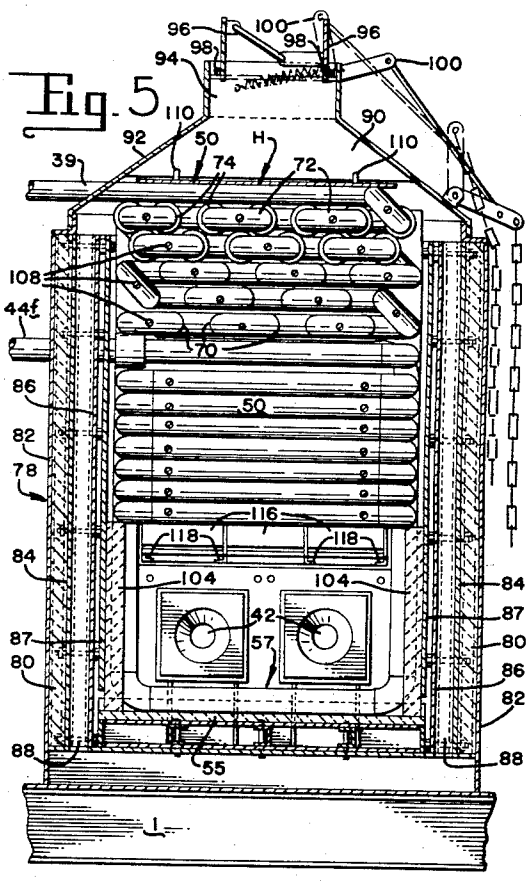


Fig. 6

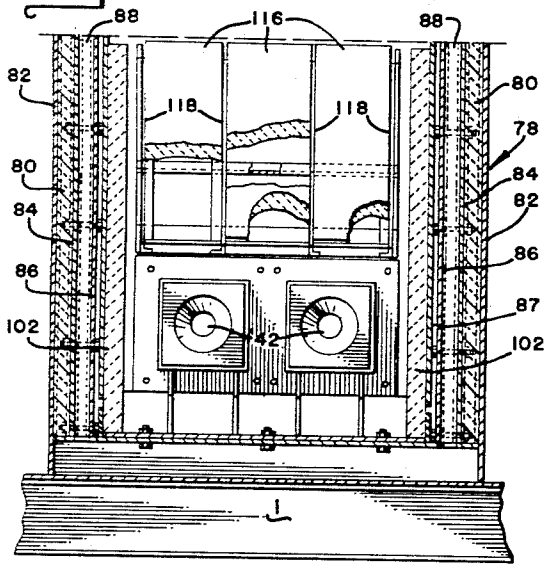
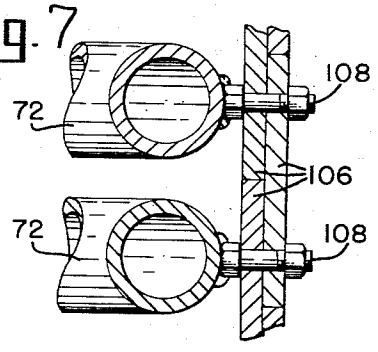


Fig. 7



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Patented Sept. 17, 1968

3,401,673

DIRECT FIRED FLUID HEATER

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Filed Aug. 30, 1966, Ser. No. 576,040
6 Claims. (Cl. 122—250)

ABSTRACT OF THE DISCLOSURE

A portable, self-contained, heat exchange system for heating oil or other fluids, wherein a sectionalized coil system is utilized in such manner as to enable a section of coil to be removed, repaired and replaced with a minimum of coil sections having to be removed and replaced. The heater is so constructed as to effect the maximum heat exchange between the heat produced by the burner and the coil system, which coils are removably fitted within an insulated housing, so as to retain a maximum of heat therein, but prevent the heat radiating through the housing to such extent as to be dangerous and without being wasteful of the radiated heat. A burner system is provided which utilizes primary and secondary air to obtain maximum combustion. Provision is made to circulate the oil or fluid continuously through the heating coil and either into a storage tank or into an oil well or the like which is being treated to remove paraffin and to treat the producing formation.

This invention relates to improvements in heaters, and more particularly to a heater for continuously heating a fluid, especially such fluid as oil or water, as it is passed through a conduit in a continuous flow.

Various heaters have been proposed heretofore for continuously heating fluid within a conduit, as it flows therethrough; however, most of these, due to their construction, were inefficient and required large units by which to heat the fluid in the volume required. This manner of heating often prevented these heaters from being portable, to enable the ready transportation thereof from one place to another for heating fluids, such as oil, for treating oil wells which reqire a relatively high heat for large quantities of oil.

The present device is so constructed that it will furnish hot oil or other fluid in large quantities and may be so arranged that the oil may be furnished, under high pressure, by a pump.

The device is so constructed as to enable a supply of oil to be carried therewith, which oil may be heated and directed into a well under pressure. Furthermore, additional storage is provided, which enables fuel oil to be carried, if the fluid being heated is not of suitable fuel quality.

While the device is designed to use either oil or gas as fuel, it is often not possible to obtain gas at the locations where the heating operations take place. However, with the present device, an oil burner may be utilized which will direct the flame of the oil burner into the combustion chamber, where it is admixed with primary and secondary air in such a manner that intense heat is created therein.

The combustion chamber is surrounded, for the most part, by a continuous conduit in the form of coils and a return conduit, some of which have heat absorption fins thereon to enable a greater amount of heat to be absorbed by the fluid conduit in heat exchange relation to enable the greatest efficiency with the least amount of fuel.

Furthermore, the primary and secondary air is introduced into the combustion chamber, under pressure, by a

blower, so as to furnish sufficient oxygen for complete combustion of the fuel used.

The present invention is an improvement on my Patent No. 3,106,915, issued Oct. 15, 1963, for Portable Oil Heating Unit.

The heat exchange unit comprises coils and return heat exchange tubes which are so assembled into one continuous conduit that the heat exchange unit may be lowered into the combustion chamber, as an assembled unit, and removed therefrom, as an assembled unit, for replacement or repair. The coils and conduits of the heat exchange unit are arranged into a continuous conduit within the combustion chamber, so that the area of intense heat in the combustion chamber is so arranged as to deflect and direct the heat as evenly as possible onto and around the entire coil and conduit arrangement, thereby to lessen the danger of burning out the heat exchange coils and conduits from the direct blast of the burner fire.

The heat exchange coils and conduits are arranged in sections, so a particular section may be removed with a cutting torch and repaired and reinstalled, or replaced with a new section without disturbing other heat exchange coils or conduits. The present coil sections and conduits are installed on sectional plates so that the bolts thereof may be readily removed, when the coil section has been lifted from the combustion chamber, that particular section may be repaired or otherwise serviced in a minimum of time, with a minimum of expense and trouble.

The present combustion chamber, which encloses the coil, is so designed that secondary air is introduced into the combustion chamber at two points so as to create an intense heat which is evenly distributed throughout the combustion chamber.

An object of this invention is to provide a heater for heating fluids to a relatively high temperature, particularly oil and water in large quantities, with a relatively small heating unit.

Another object of the invention is to provide a portable heating unit which may be mounted on skids for transportation by truck, trailer, or the like.

Still another object of the invention is to provide a portable unit for heating fluids, which unit is self-contained, and which includes fuel supply tanks, fuel circulating tanks, pumps, blowers, and burners to enable fluids in remote areas, to be expeditiously heated by the use of the portable unit.

A still further object of the invention is to provide a heater for heating large quantities of fluid, such as water or oil, which unit is safe and economical in use.

Still another object of the invention is to provide a conduit heat exchange system for a combustion chamber, which may be readily installed, as a unit, into the combustion chamber and removed therefrom as a unit.

Yet another object of the invention is to provide a coil and heat exchange unit for use in a combustion chamber, which unit is sectionalized to enable removal, repair, or installation of a section of the unit without the entire heat exchange unit having to be removed and replaced.

Still another object of the invention is to provide a conduit heat exchange unit for fluids, which has a continuous conduit completely surrounding the combustion chamber, and which is so arranged as to be out of the direct intense heat in the chamber, but so the heat will be evenly dispersed throughout the combustion chamber.

Still a further object of the invention is to provide a blower system for supplying air to a plurality of points within the combustion chamber to enable maximum combustion of the fuel within the combustion chamber.

Still another object of the invention is to provide a combustion chamber housing that is so insulated that a

minimum of heat is transferred directly therethrough into the outer wall.

Another object of the invention is to provide a coil design and heat exchange unit for heating with a direct fired fluid heater wherein the conduit surrounds the greater portion of the combustion chamber without being in direct line of the blast of the flame, with the heat produced by the fuel passing upward through openings between other portions of the conduit in such manner as to get a maximum heat exchange of heat produced by the fuel on the conduit with a minimum of refractory material required to contain the heat generated by the combustion of fuel within an area in heat exchange relation with conduit.

Another object of the invention is to provide a conduit system within a combustion chamber that requires a minimum amount of insulation and refractory material to contain the heat therein as compared to conventional type combustion chambers.

Still another object of the invention is to provide a conduit arrangement to form a combustion chamber whereby the combustion chamber will use a minimum of weight or refractory material which enables a direct fired fluid heater unit to be made portable.

A further object of the invention is to eliminate the greater part of refractory material from a combustion heater of a direct fired fluid heater thereby eliminating breakage of the refractory material while being transported over rough terrain when used with a portable direct fired fluid heater.

Still a further object of the invention is to provide a burner of high heat intensity within a combustion chamber which is surrounded by heat exchange coils which are arranged in side by side relation on the sides thereof, and with abridging top portions of the coils at the top of the combustion chamber being spaced apart to provide passages therebetween and between the runs of elongated heat exchange conduit, some of which runs are finned to provide sufficient combustion space to enable substantially the entire heat generated by the fuel to be absorbed by the conduit with the minimum of direct flame impingement on the coils.

Still a further object of the invention is to provide a burner and combustion chamber whereby the fuel of the burner is thoroughly atomized by the introduction of primary air thereinto, and the combustible mixture is thoroughly mixed with secondary air at a multiplicity of points, to provide excess air under pressure, to furnish sufficient oxygen for the fuel to burn with intense heat, a soot-free flame and with a flame of minimum size for the fuel consumed.

A penultimate object of the invention is to provide an oil heater unit for combustible fluids that are passed through a conduit in a heated combustion chamber in heat exchange relation with a regulated degree of flow therethrough to maintain, for the unit, safe working conditions at all times.

A final object of the invention is to provide a heating unit for fluids that is relatively low in cost of construction, easy to maintain and operate, easy to repair at a minimum of cost, and efficient in operation.

With these objects in mind and others which will become manifest as the description proceeds, reference is to be had to the accompanying drawings in which like reference characters designate like parts in the several views thereof, in which:

FIG. 1 is a side elevational view of the oil heating system, including oil and fuel supply reservoirs, showing a power unit, an air compressor for supplying air to the fuel burner, a pressure pump for pumping fluids at normal temperature through the heat exchange coils and conduits, within the combustion chamber, to heat the fluid being pumped therethrough to a predetermined temperature, before discharge into a place of use, and further, showing a power driven blower to supply air under pressure into the combustion chamber, with portions broken away and with portions being shown in section, to bring out the details of construction;

FIG. 2 is a top plan view of the oil heating system, as shown in FIG. 1, with portions broken away and with portions being shown in section to bring out the details of construction;

FIG. 3 is an enlarged, side elevational view of the heater unit, with a portion of the housing broken away and shown in section, to bring out the details of construction, of the heat exchange coils and the linear tubes of the heat exchange conduit system;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3 looking in the direction indicated by the arrows;

FIG. 5 is a view taken on the section line 5—5 of FIG. 3 looking in the direction indicated by the arrows;

FIG. 6 is a sectional view taken on line 6—6 of FIG. 3 looking in the direction indicated by the arrows;

FIG. 7 is an enlarged, fragmentary, detailed, sectional view taken on line 7—7 of FIG. 4 looking in the direction indicated by the arrows; and

FIG. 8 is an enlarged, fragmentary elevational view of a portion of the upper coils which surround the combustion chamber, with parts broken away and with parts shown in section to show the spacing of the upper horizontal lengths of conduit due to the angularity of the upright lengths of conduit positioned on each side of the combustion chamber.

With more detailed reference to the drawings, the numeral **1** designates generally a base which may be made either stationary or portable; or the base may be a truck or trailer frame. However, for representation of a base, structural members in the form of skids are shown.

A fuel supply reservoir **2** is mounted on the base **1**, preferably near one end thereof and has an access and fill opening **3** in the top thereof. A fluid supply reservoir **4** is provided so, in the event that the fluid being circulated through the system is not of combustible quality or is non-volatile, the fuel supply reservoir **2** can be used, which reservoir is usually of sufficient capacity to keep the unit operating for a period of time. Additional circulating fluid may be introduced through an access opening **6** into the fluid supply reservoir **4**. Pumps **8** and **9** are mounted on base **1** and have the respective suction conduits **10** and **11** extending into the fluid supply reservoir **4** to a point near the bottom thereof. Valves **12** and **13** respectively are provided in the respective conduits **10** and **11**, intermediate the fluid supply reservoir **4** and the respective pumps **8** and **9** to control the flow of fluid from the fluid supply reservoir **4** to the respective pumps. This is particularly desirable when a second source of fluid, which fluid is to be heated, is drawn in through one of the auxiliary conduits **14** or **15** from an auxiliary source of supply. The respective conduits **14** and **15** are controlled by the respective valves **16** and **17** to enable the switching of suction of the pumps from conduit **10** to conduit **14**, without interrupting the heating operations of the fluid passing therethrough, or fluid may be introduced through conduit **15** by opening a valve **17** therein and closing valve **13** in conduit **11**, to enable pump **9** to be operated without altering the continuous fluid heating operation in the event the other pump should become incapacitated.

Clutches **18** and **20** are provided on jack shaft **22**, which is journaled in bearings **26**, which bearings are mounted on base **1**, so that the pumps **8** and **9** may be selectively driven by a prime mover **32**, such as an engine or an electric motor, by selectively operating the clutches **18** or **20**. A pulley **24** is shown mounted on shaft **22**, so that the multiple belts **28** which surround pulleys **24** and **30** will enable the pulley **24**, on jack shaft **22**, to be driven by drive pulley **30** mounted in operative relation on prime mover **32**, which is usually an internal combustion engine. However, an electrical motor or the like may be used to supply power.

A high pressure blower or air compressor **34** is oper-

atively connected to pulley **24** by a belt **33** which also passes around pulley **35** on the shaft of air compressor **34**, to direct air from air compressor **34** through conduit **36**, through air actuated control valve **38** therein, to regulate the flow of air through valve **40** in conduit **36**, to burners **42**, as will best be seen in FIG. 1.

The air control valve **38** is actuated by a thermo-control element **37** which has a heat sensing element in the heated fluid discharge conduit **39**. The thermo-control element **37** has an air supply line **37***a* leading from air supply conduit **36** to the thermo-actuated element **37** and a second air supply line **37***b* leads from the thermo-control element **37** to an air actuated control valve **38**, which is preferably of the diaphragm type and is actuated by the air, under pressure, passing from air supply conduit **36** through air supply line **37***a*, through a valving element (not shown) in thermo-actuated element **37** and through air supply line **37***b* to direct air to air control valve **38**, which controls the flow of primary air to burners **42**.

The pumps **8** and **9** have the respective discharge conduits **44** and **45** leading therefrom, which conduits have valves **46** and **47**, respectively, therein. The pumps **8** and **9** direct fluid, such as oil, water or other fluid to be heated, from the fluid supply reservoir **4** into a common header conduit **44***a*. The header conduit has valves **44***b* and **44***c* therein, on each side of discharge conduit **44**, and valves **45***a* and **45***b* therein on each side of discharge conduit **45**. A by-pass conduit **44***d* leads from header **44***a* intermediate valves **44***b* and **44***c* to enable fluid to be directed from header conduit **44***a* back into fluid supply reservoir **4** by pump **8** when the valves **44***b*, **44***c* and **44***e* are in selected positions. The by-pass conduit **44***d* has a valve **44***e* therein intermediate the fluid supply reservoir **4** and header conduit **44***a*. A by-pass conduit **45***c* leads from header conduit **44***a*, intermediate valves **45***a* and **45***b* to enable fluid to be directed from header conduit **44***a* back into storage reservoir **4**, which fluid is being pumped by pump **9**, when valves **45***a*, **45***b* and **45***d* are in selected positions. With various combinations of open and/or closed valves, all, or a portion of, the fluid being pumped may be directed into an inlet conduit **44***f*, as will best be seen in FIG. 2, and into a coil arrangement, as indicated at **50**, as will best be seen in FIGS. 2, 3 and 5.

The heat exchange coil system designated generally at H is unique in arrangement, in that it is preferably formed of a single continuous conduit, which is formed, in this present instance, by welding a multiplicity of lengths of pipe, L's, and 180 degree return bends, so as to form the conduits and bends into the heat exchange unit, which is fitted within the combustion chamber or furnace box of the housing, so a large part of the conduit system will form the bottom, side walls, the top and at least a portion of the end wall of the combustion chamber. The portions of the conduit of the heat exchange system H forming the combustion chamber being spaced apart to form elongated openings **64** between the respective adjacent, horizontal transverse runs or lengths of conduit formed by the upright lengths of conduit being so angulated as to form these openings, as will best be seen in FIG. 8, which openings **64** permit hot gases to pass therebetween to heat the fluid which is being passed through the conduit system. Furthermore, the hot gases will pass upward to heat lengths of pipe which go to make up the portion **70** of the conduit system, and furthermore, the hot gases pass upward in contact relation with conduit **74**, which has fins **75** thereon, which fins are so arranged as to give approximately four times the heat absorption capacity as plain conduit, therefore, a hundred feet of finned conduit will be as effective in heat transfer, as four hundred feet of unfinned conduit.

The peculiar manner the fluid in inlet conduit **44***f* enters the combustion chamber, allows for absorbtion of the greatest amount of heat, with the incoming fluid first passing through a portion of the conduit system which is designated generally at **50**, which is so arranged as to form a portion of an end of the combustion chamber, which has the greatest concentration of heat, with the coil portion **50** covering a portion of the sides and a portion of the top, with the upper horizontal conduits being spaced apart to form the openings **64**, as will best be seen in FIG. 8. The angularity of the upright, side lengths of conduit **50** being the same as the angularity of the lengths of conduit **57**, as will best be seen in FIG. 8. This arrangement enables the side portions of the conduit to be in substantially side by side, contact relation to form a wall, with only a small portion of refractory material **51** being necessary to fill between the L's **51***a* which join the horizontal lengths of conduit to the upright lengths of conduit **50**.

While the heat exchange unit H is supported on support members **112**, it is preferable to have the lower side of the coils rest on an insulation mat **55**, such as a "Locon" blanket or a pad of asbestos material to prevent the channeling of hot gases therebelow. This allows hot gases to be directed upward and through the aforementioned conduit system, to obtain a high degree of efficiency in heating fluid, as it is passed through the system, or, if desired, to vaporize oil or oil products into gases, or to vaporize water into super-heated steam.

While mention has been made of a substantial portion of the coil **57** being upright and horizontal, the principal intent of the present arrangement is to provide a conduit system, the greater portion of which forms the walls and top of a combustion chamber, with the side portion of the conduit system being so angulated as to form openings between adjacent lengths of conduit on the upper side of the combustion chamber so as to pass hot gases therethrough into further heat exchange relation with the conduits arranged thereabove. It is preferable to have the combustion chamber of uniform shape, such as rectagular or circular in cross-section, however, for greater efficiency, it is preferable to have the coil system form the walls of a combustion chamber, when fitted within a furnace box.

The present direct fired fluid heater may be used for various purposes, such as heating fluid, such as oil, in large quantities to be directed out of a discharge conduit **39** into an oil well to liquify the paraffin therein with the heated fluid, thereby to enable the oil being introduced and the liquified paraffin to be forced from the well by pump pressure, thereby leaving the pipe within the well clean and free of paraffin and also removing the paraffin from the face of the producing formation.

When used as a steam generator, the unit will convert water into steam, to supply steam at a desired controlled pressure, to be discharged through valve **120** to the place of use. The temperature of the steam is maintained constant, even at super-heated temperatures, by the thermo-control element **37** and the control valve **38**.

The space between the horizontal lengths of coil **50**, resulting from a 180 degree return bend, for the first space only, is filled with a refractory material **66**, so as to cause the heat to be directed upward through openings **64** between the horizontal lengths of the coils **50** and **57**, at the upper side of the combustion chamber **62**. A pressure gauge **48** is provided within inlet conduit **44***f* to register the fluid pressure passing through the conduit **44***f*, into the conduit which makes up the heat exchange coil system **50** and **57**, which coil system is positioned within combustion chamber **62**.

The arrangement of coils **50** and **57** is such that they cover and form the major portion of the combustion chamber **62**, except directly forward of the burner system **52**, which, in the present instance, comprises two burners **42**. The portion of the wall surface opposite the burners **42** has a refractory material **54** thereon, which material provides a target area for the flame. This will cause a dispersal of the flame and of the heat created thereby to prevent direct impingement of the flame issuing from the burners **42** on the coils **50** and **57**. However, the opening between the inlet conduit **44***f* and the first

length of horizontal conduit connected thereto by a 180 degree return bend is filled with the refractory material **66**, which material is supported by outwardly extending pins **68**, as will best be seen in FIG. 3.

With this opening between these conduits closed, the heat generated by the flame from the burners **42** will flow upward through openings **64** to heat longitudinal lengths of conduit **70** which longitudinal lengths of conduit are connected together by return bends **72**, and is a part of the heat exchange coil system directly above the coils **50** and **57**. The longitudinal lengths of conduit **70** are connected with further longitudinal lengths of conduits **74**, which have spiral heat exchange fins thereon, with the conduits being arranged in staggered relation, so as the heated gases from the flame pass upwardly therearound, the heat will be absorbed by the lengths of conduit. However, as the flow of hot gases from the combustion chamber will lose some of the heat, a greater percentage of the heat from the heated gases issuing from the combustion chamber **62** will be absorbed by providing the upper horizontal rows of conduits **74**, with spiral, heat exchange fins. The fluid, such as oil, water or the like, will be heated to the desired temperature; and the burners will be regulated by the thermo-actuated element **37**, which actuates the thermo-control valve **38** to control the admission of air through primary, high pressure air pipes **36***a* and **36***b*, which are connected to air supply conduit **36**, as will best be seen in FIG. 3.

A fuel inlet pipe **76** leads from reservoir **2** to the burners **42** and has automatic controls thereon to control the supply of fluid to the burners in the correct proportion to the air supplied by the primary air supply pipes **36***a* and **36***b*, as is well known in the art of combustion.

A housing **78** is mounted on the base **1** and is insulated, as indicated at **80**, on the sides and ends between plates **82** and **84**. A further plate **86** is spaced inward from plate **84** to provide an open air duct **88** between the combustion chamber **62** and plate **84**. The duct **88** directs air upward from the lower side of housing **78** to a point above the coils **50** and **57**, and conduits **70** and **74**, into a chamber **90** which is formed by hood **92**. The hood **92** has a vent flue **94** on the upper side thereof for the discharge of the products of combustion from the combustion chamber. The plates **86** on the sides of the combustion chamber **62** have stainless steel plates **87** secured thereto, a spaced distance inward therefrom to protect plates **86** against excessive heat. Dampers **96** are pivotally mounted in flue **94** on the respective shafts **98**, which dampers are operated by a lever **100**.

A blower **56** is connected in driven relation, by a belt **57***c* and pulleys **57***a* and **57***b*, with the prime mover **32** which provides the power through pulley **57***a*. The blower **56** directs a large volume of secondary air, under low pressure, through air conduit **60** into branch conduits **61** and **61***a*, with the greater portion of the air being discharged through branch conduit **61** directly below the burner system **52** within the confines of slabs of refractory material **102**, as will best be seen in FIGS. 3 and 6, which fill the space between the upright portions of the coils **57** at the burner end of the combustion chamber and the wall in which the burner is mounted. The branch air conduit **61***a* connects with a plurality of discharge openings **61***b* in refractory material **54** into the combustion chamber **62** to provide an excess of air to insure complete, soot-free combustion of the fuel within the combustion chamber **62**, with the hot gases of combustion passing upward through openings **64** between horizontal lengths of coils **50** and **57**.

A wall **104** of refractory material is positioned at each side of the combustion chamber **62** to close the space between the lower side of coils **50** and the sides of the combustion chamber **62** intermediate the refractory material **54** and the adjacent upright portions of coil **57**.

By having portions of the coils **50** and **57** extending angularly upward, as will best be seen in FIG. 3, the upright portions of the conduit may be made to lie in substantially side-by-side relation. However, the greater the divergence of the upright lengths of the coil **57**, the greater the width of openings **64** between adjacent lengths of conduit. It is preferable that the upper horizontal lengths of the coils **50** and **57** be of approximately ⅜ inch spacing to enable heated gases to pass upward therethrough to further heat the longitudinal lengths of conduit **70** and **74**, before the products of combustion pass into the chamber **90** and out through flue **94**, which is regulated by dampers **96**.

Sectional plates **106** are secured in overlapping relation to coils **50**, and conduits **70** and **74**, as will best be seen in FIGS. 3 and 7, by bolts **108**, which will enable specific sectional plates to be removed to permit repair or replacement of a section of coils or conduits when the heat exchange unit, comprising coils **50** and **57** and conduits **70** and **74**, is lifted from the housing **78** by a hoist mechanism which engages eyes **110** which are secured to the uppermost of the sectional plates **106**, after the hood **92** has been removed. A support **112** is secured to the lowermost sectional plate, at each end of the coils, and extends downward to rest on an outwardly extending support **114** within each end of the housing **78**.

It will be seen that, with the present arrangement, heat exchange coils within combustion chamber **62**, the combustion chamber is a substantially closed system of conduits in heat exchange relation, except in the direct line of discharge of the flame and a small portion of the wall on each side thereof, which is covered with refractory material, and a portion of the rear wall which is covered with refractory material **116** which is supported on angle members **118**, which are secured to the coil support **112** above the burners **42**.

With this arrangement of the heat exchange conduits within the combustion chamber, a maximum efficiency of the heat exchange relation between the heat produced in the combustion chamber and the coils and conduits which make up the system may be had with the minimum use of refractory materials both in volume and weight, which enables a directly fired, fluid heater to be used with great fluid heating capacity with a minimum of refractory material, which enables the unit to be made portable. Furthermore, the minimum use of refractory material is desirable in portable, fluid heaters as this minimizes breakage of the refractory material when moving the heater over rough terrain.

Having thus clearly shown and described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A direct fired fluid heater, including a combustion chamber having at least one conduit extending therethrough, which heater comprises,

(a) a housing comprising sides, bottom and top,

(1) said top of said housing having a vent formed therein,

(b) a combustion chamber within said housing,

(c) a heat exchange system comprising at least one continuous conduit, which conduit passes into said combustion chamber, with lengths thereof being arranged to cover at least a portion of the interior sides, bottom and top of the combustion chamber,

(1) the portions of the conduit which make up the sides, bottom and top of the combustion chamber forming substantially rectangular convolutions and having the lengths of conduit which form the sides being in close, side by side relation and angulated with respect to the vertical to produce elongated passages between said top conduits,

(2) said combustion chamber formed by said rectangular convolutions of said conduit, being a hollow, rectangular, combustion chamber,

(3) said heat exchange conduit system having an

inlet opening and an outlet opening formed therein,

(4) said conduits covering the bottom of the combustion chamber rest on a covering which fills the spaces therebetween,

(d) a burner associated with said combustion chamber for producing heated gases therein to be directed upwardly through the passages between the top conduits, and

(e) means creating fluid pressure for directing fluid under pressure through said conduit system.

2. A direct fluid heater, as defined in claim 1; wherein

(a) said housing has air ducts extending upward therein from the lower side thereof to above said conduits which form the combustion chamber,

(b) the walls of said housing forming an air inlet passage which connects to the lower side of said upright ducts for passage of air therethrough, and

(c) said air ducts being in communication with said vent leading from said combustion chamber.

3. A direct fired fluid heater, which heater comprises;

(a) a base,

(b) a fluid storage reservoir mounted on said base,

(c) a pump mounted on said base,

(d) a prime mover mounted on said base and being connected in driving relation with said pump,

(e) a housing mounted on said base,

(1) said housing having a combustion chamber formed therein,

(2) a vent leading from said combustion chamber,

(f) a continuous length of conduit, lying in vertical and horizontal planes, and forming a heat exchange system forming said combustion chamber, which is rectangular in cross-section,

(1) said heat exchange conduit system comprising upright and horizontal lengths of conduit,

(2) said upright lengths of conduit being angulated with respect to the vertical and being in side by side, contact relation,

(3) the upper horizontal lengths of said conduit having elongated spaces formed therebetween due to the angulation of the lengths of said upright conduit,

(g) further lengths of spaced apart conduit mounted at a right angle above the lengths of conduit which define the top of the combustion chamber,

(h) said heat exchange conduit system having an inlet and a discharge therein,

(i) a burner system associated with said combustion chamber, for directing flame onto the area surrounded by said lengths of conduit on the interior of the combustion chamber,

(j) a suction conduit leading from said pump to said fluid storage reservoir and being in fluid communication therebetween,

(k) a discharge conduit leading from said pump and connecting with said inlet of said heat exchange conduit system in fluid communication, and

(l) control valve means controlling the flow of fluid through said discharge conduit leading from said heat exchange conduit system, in accordance with the temperature thereof.

4. A direct fired fluid heater, which heater comprises;

(a) a base,

(b) a fluid storage reservoir mounted on said base,

(c) a pump mounted on said base,

(d) a prime mover mounted on said base and being connected in driving relation with said pump,

(e) a housing mounted on said base,

(1) said housing having a combustion chamber formed therein,

(f) a continuous length of conduit forming a heat exchange system mounted within said combustion chamber,

(1) said heat exchange conduit system comprising upright and horizontal lengths of conduit which surround the interior of said combustion chamber,

(2) said upright lengths of conduit being angulated with respect to the vertical and being in side by side relation,

(3) the upper horizontal lengths of said conduit having spaces formed therebetween due to the angulation of the lengths of said upright conduit,

(g) further lengths of conduit mounted above the top lengths of conduit which define the top of the combustion chamber,

(h) said heat exchange conduit system having an inlet and a discharge therein,

(i) a burner system associated with said combustion chamber, for directing flame onto the area surrounded by said lengths of conduit on the interior of the combustion chamber,

(j) a suction conduit leading from said pump to said fluid storage reservoir and being in fluid communication therebetween,

(k) a discharge conduit leading from said pump and connecting with said inlet of said heat exchange conduit system in fluid communication therebetween,

(l) control valve means controlling the flow of fluid through said discharge conduit leading from said heat exchange conduit system,

(m) a thermo-control valve is associated with said discharge conduit leading from said heat exchange conduit system,

(n) a high pressure air compressor,

(1) a discharge conduit leading from said high pressure air compressor to said burner system,

(2) an air actuated control valve within said conduit leading from said burner system,

(3) an air conduit connected with said first mentioned air conduit and to said thermo-control valve, and

(4) a still further air conduit leading from said thermo-control valve to said control valve in said first mentioned air conduit to control the volume of primary air from said compressor to said burner system to regulate the out-put of heat to said burner system in accordance with the fluid discharge from said exchange conduit system.

5. A heat exchange continuous conduit system for use in a combustion chamber, which system comprises;

(a) a first coil unit of said conduit system,

(1) said first coil unit having an inlet pipe,

(2) a first group of transverse, horizontal lengths of pipe arranged to form an approximately vertical wall,

(3) a second group of transverse, horizontal length of pipe arranged in spaced apart, side by side relation to form a top portion of the combustion chamber,

(4) a third group of horizontal and angulated pipes connecting said first group of transverse, horizontal lengths of pipe with said second group of transverse, horizontal lengths of pipe in fluid communication,

(b) a second coil unit of said conduit system having an inlet pipe thereof connected in fluid communication with the discharge pipe of said first unit of said conduit system,

(1) said second coil unit having spaced apart lengths of pipe extending transversely across the top and bottom respectively of the combustion chamber,

(2) upright, angulated pipes arranged in side by side relation and being connected in fluid communication with said respective lengths of pipe extending across the top and bottom of the

combustion chamber so as to form a portion of the walls thereof,

(c) a third coil unit of said conduit system having an inlet pipe which is connected in fluid communication with the discharge pipe of said second coil unit,

(1) the pipes of said third coil unit being spaced apart and positioned above the pipes of said first coil unit and forming the top portion of the combustion chamber,

(2) said third coil unit also being positioned above the top pipes of said second coil unit, which pipes extend transversely of said pipes in a series of layers thereabove,

(3) a discharge pipe leading from said third coil unit.

6. A heat exchange conduit system as defined in claim 5; wherein

(a) at least some of the lengths of pipe of said third coil unit having radiation fins thereon.

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