United States Patent

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[54] **FLUID HEATER**

21 Claims, 9 Drawing Figs.

[52] U.S. Cl. .... 122/250 R, 122/367 C, 122/406 R

[51] Int. Cl. F22b 27/08

[50] Field of Search .... 122/248, 250, 367, 367 C, 406

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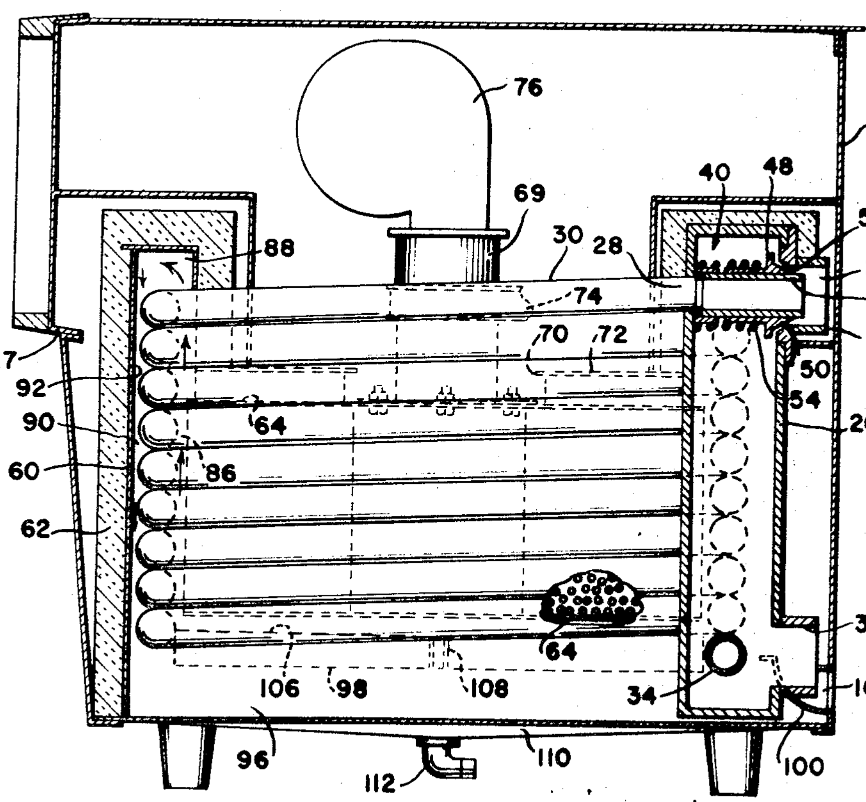
ABSTRACT: A swimming pool heater having an infrared gas burner therein for supplying radiant heat to pool water flowing in a tubular heat exchanger adjacent the burner plate. The heat exchanger is arranged in a heater housing to define therewith a flow path adjacent the tubes for the products of combustion from the burner whereby additional heat by convection is supplied to the tubes from the exhaust gases. The input end of the heat exchanger includes a valve member adapted to maintain a predetermined rate of flow of water through the tubes and to bypass excess water back to the pool.



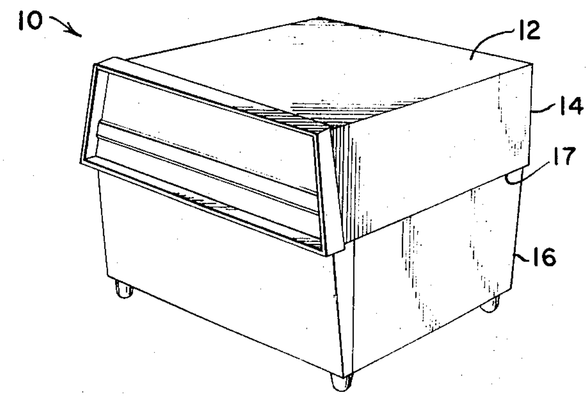


Fig. I

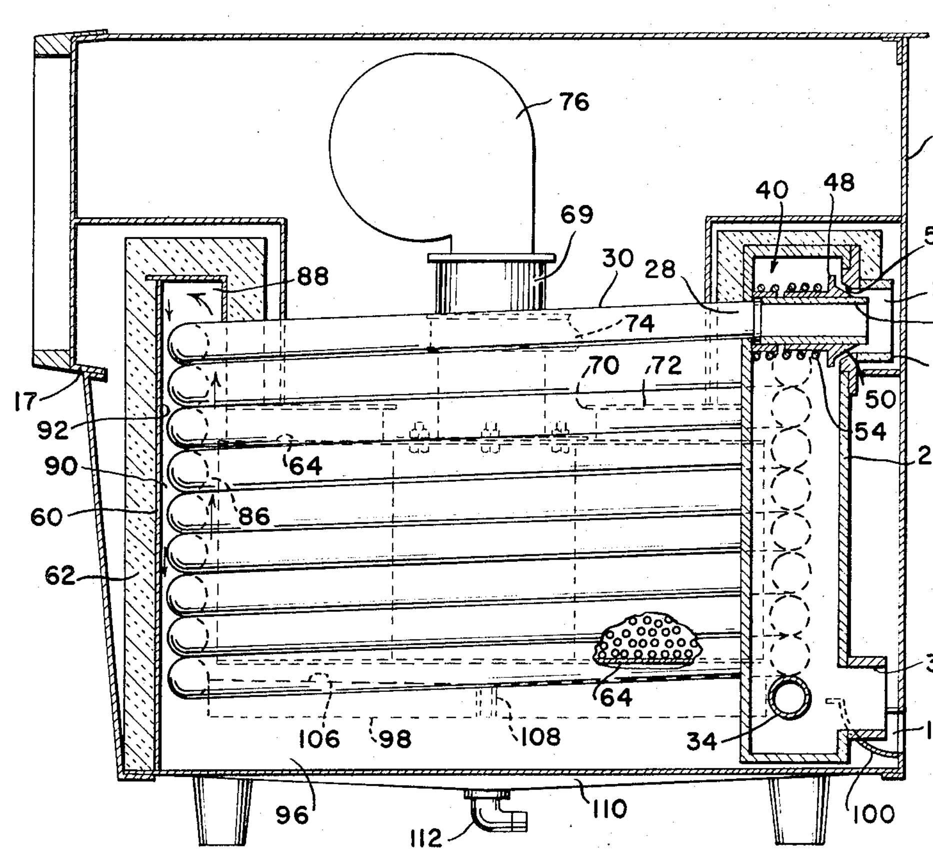


Fig. 3

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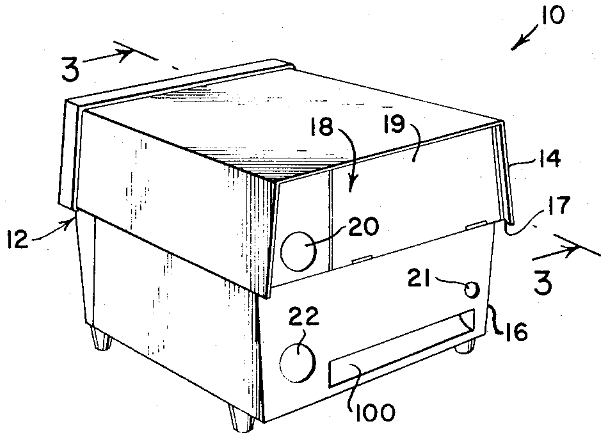

Fig. 2

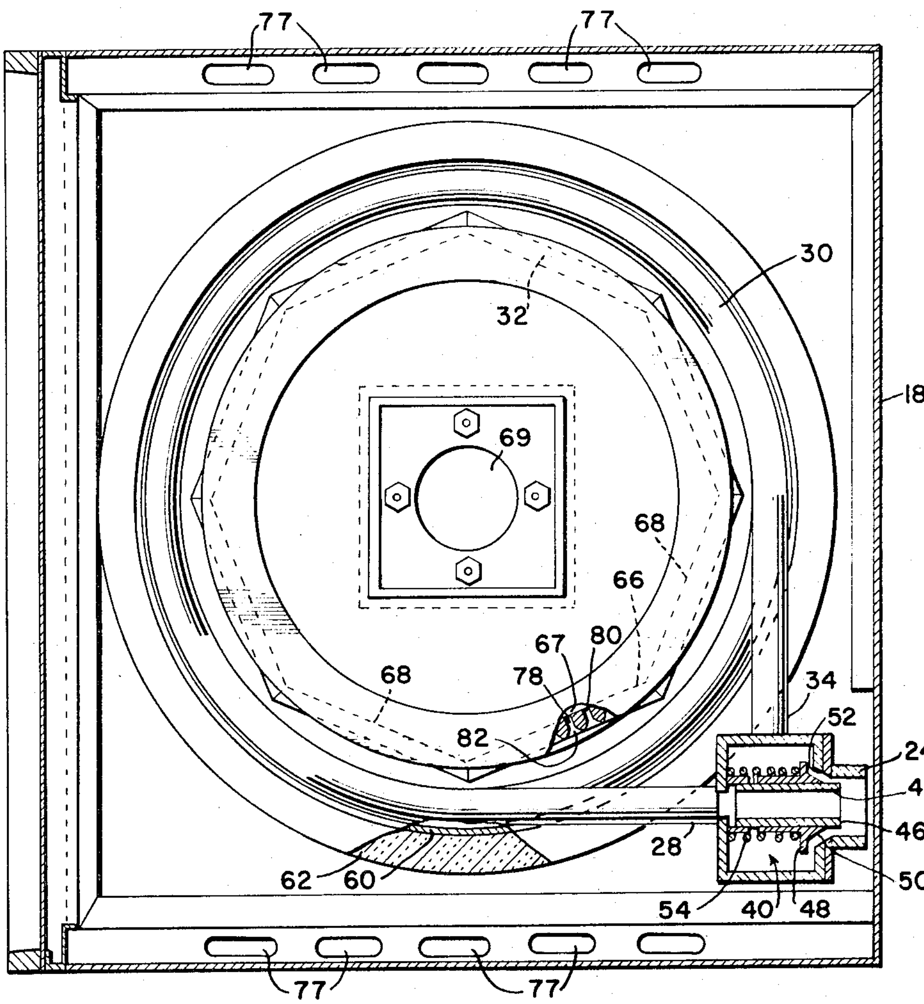

Fig. 4

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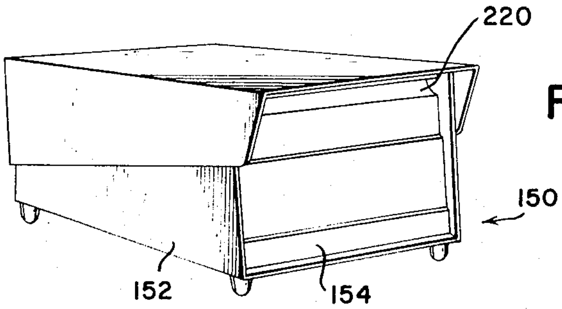

Fig. 5

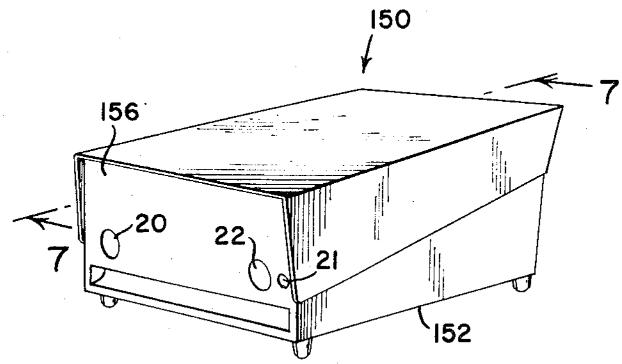

Fig. 6

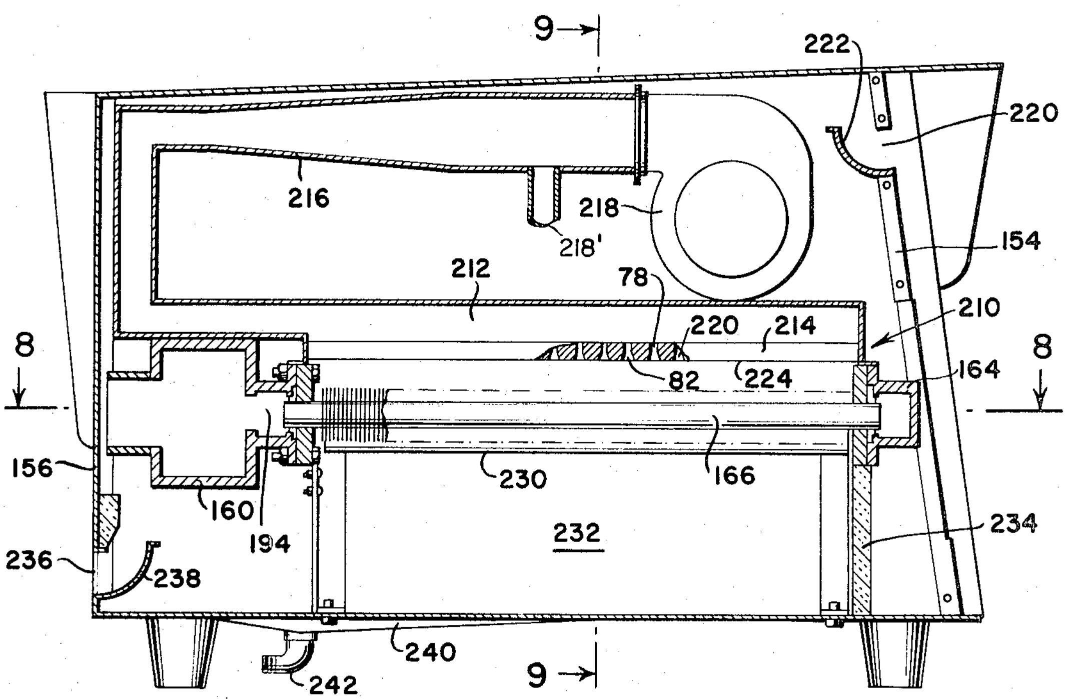

Fig. 7

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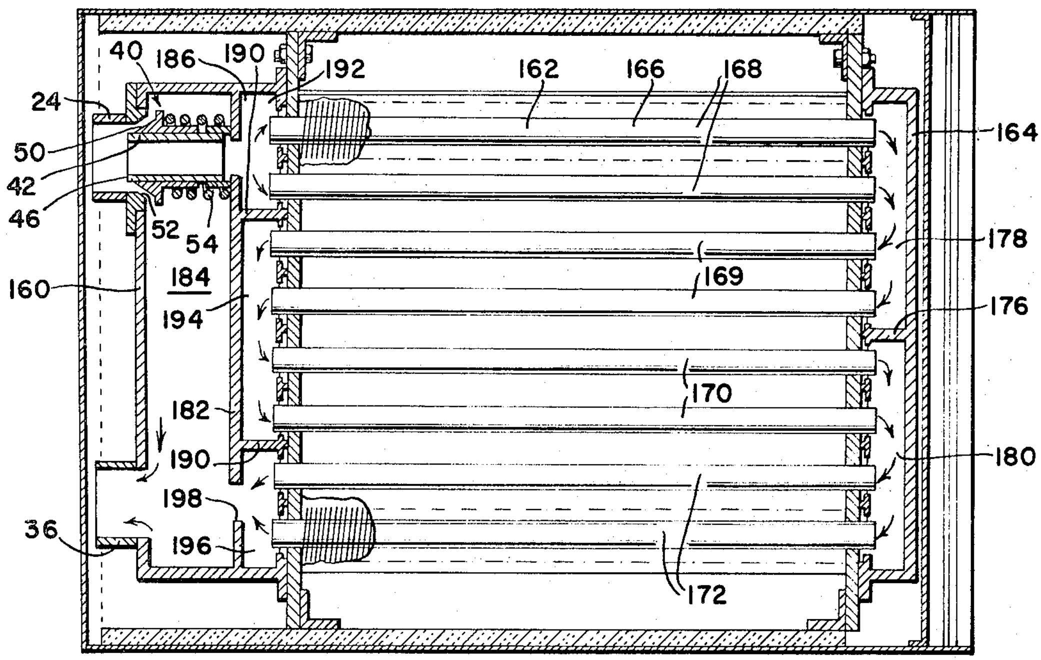

Fig. 8

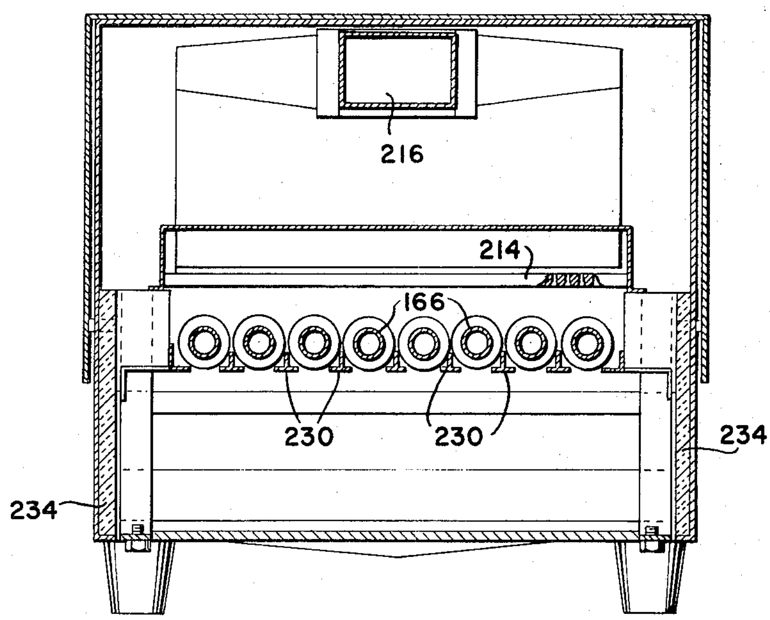

Fig. 9

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FLUID HEATER

This invention relates to swimming pool heaters and more in particular to swimming pool heaters having infrared gas burners for supplying radiant heat to pool water.

In swimming pool water treatment systems presently available, water is conducted from the pool through a filtering and circulation system and flow path for the water. Typically, these units utilize either direct blue flame gas burners, or an electrical heating element and they are relatively inefficient in the production of necessary heat. As a result, the cost of operation of conventional swimming pool heaters in order to maintain desirable water temperatures, particularly in large pools, is inordinately high.

It is an object of this invention to provide a heater unit for efficiently maintaining desired water temperatures in swimming pools. It is another object of this invention to supply increased amounts of heat to water in a swimming pool circulation system. It is a further object of the invention to provide a swimming pool heater wherein the volume of water flowing through the heater is controlled for maximum heat transfer efficiency. It is a still further object of this invention to provide compact, efficient and inexpensive swimming pool water heaters.

In accordance with an aspect of this invention a generally gastight housing is provided which contains a coiled heat exchange tube forming a part of the flow path in the swimming pool water pump and filtration system. A gas burner unit is mounted in the housing within the cylindrical chamber formed by the coiled heat exchange tube and the burner unit has an apertured peripheral sidewall forming a peripheral burner plate. A combustible gas mixture flows from the interior of the burner through these apertures for combustion therein, whereby the burner plate is heated to incandescence to produce radiant heat. This radiant heat is transmitted to the inside surface of the coiled heat exchange tube to heat water flowing therein, and, as will be more fully explained hereinafter, additional heat is transferred from the products of combustion to the coiled heat exchange tube by convection and conduction prior to discharge from the housing.

In another embodiment of the invention the gas burner is provided with an apertured base member or burner plate, similarly adapted to produce radiant heat. The heat exchanger in this embodiment includes a plurality of finned tubes interconnected to permit liquid flow therebetween and is positioned below the burner plate to receive infrared radiation from the burner plate. The heater is sealed so that all of the products of combustion flow between and around the tubes and provide additional heat by convection and conduction to the tubes and provide additional heat by convection and conduction to the tubes prior to discharge from the heater. Deflector baffles are provided below the heat exchange tubes and beneath the spaces between conduits to force the products of combustion passing through the heat exchanger to contact the entire surface area of the tubes to provide substantially uniform convective heat thereto. In addition, these deflector baffles reflect radiation which passes between the tubes back to the heat exchanger.

The burner plates of each embodiment are formed of a ceramic material having venturilike apertures or orifices as disclosed in commonly assigned copending Pat. Application Ser. No. 775,978, filed Oct. 2, 1968, the disclosure of which application is incorporated herein by reference. Flashback of flame through the orifices is prevented by the venturilike configurations which afford a throat portion of small cross section leading to an expanding or diverging outlet portion so that at least the requisite flow velocity is maintained within the throat portion for avoiding flashback over a relatively wide range of gas flow rates. Combustion of gases within the expanding portion of the orifices heats portions of the ceramic plate to incandescence to form radiant heat. By supplying the combustible gas to burners of this type at increased mass flow rates, as disclosed in commonly assigned copending U.S. Pat. application Ser. No. 3,943 filed Jan. 19, 1970 (identified by Curtis, Morris & Safford's File No. 17-1514), the disclosure of which application is also incorporated herein by reference, substantially the entire surface of the diverging outlet portion of each orifice is heated to incandescence and resulting in substantially great increases in the infrared output. In this manner a greater total heat output is achieved from the combustible gases supplied and a more efficient and compact water-heating unit results therefrom.

Pool water is supplied to the heaters of this invention through a control bypass valve which maintains the desired flow of water through the heat exchanger and bypasses any surplus water from the pool filtration system back to the pool.

The construction of such preferred embodiments as well as the advantages thereof will become further apparent from the following specification when considered in conjunction with the accompanying drawing wherein:

FIG. 1 is a perspective view of one embodiment of the swimming pool heater of the present invention showing the front and one side thereof;

FIG. 2 is a perspective view similar to FIG. 1 showing the rear and the other side of the heater;

FIG. 3 is a sectional view of the heater of FIG. 1, with parts broken away, taken on line 3—3 of FIG. 2;

FIG. 4 is a top plan view, with parts broken away of the device of FIG. 1;

FIG. 5 is a perspective view similar to FIG. 1 of another embodiment of the invention;

FIG. 6 is a perspective view similar to FIG. 2 of the embodiment shown in FIG. 5;

FIG. 7 is a sectional view of the heater of FIG. 5; with parts broken away, taken on line 7—7 of FIG. 6;

FIG. 8 is a sectional view taken on line 8—8 of FIG. 7; and

FIG. 9 is a sectional view taken on line 9—9 of FIG. 7.

Referring now to the drawings and in particular to FIGS. 1 and 2, there is illustrated a swimming pool heater **10** constructed in accordance with the present invention. Heater **10** includes an outer decorative housing **12** having an upper portion **14** which is somewhat wider than its lower portion **16** and thus forms an overhang **17** for purposes which will be more fully explained hereinafter. A rear wall **18** of housing **12** includes a hinged door **19** which provides access to the interior of the housing and a pair of openings **20** and **22** through which water lines are connected to heater components within the housing. Water from the pool's filter system is supplied by conduits (not shown) through opening **20** to the inlet **24** of manifold or header **26** and flows therefrom through one end **28** of a tubular heat exchanger **30** which is connected to the manifold.

Heat exchanger **30** is a generally tubular member formed of a close-packed cylindrical coil which surrounds an infrared heater or burner unit **32** which, as will be more fully described hereinafter, heats pool water flowing through the coil. The opposite end **34** of heat exchanger **30** is connected to manifold **26** adjacent its base, as seen in FIG. 3. The heater water flowing out of coil **30** into manifold **26** is discharged from manifold exhaust port **36** to a conduit (not shown), which extends through opening **22** in housing wall **18**.

As seen in FIGS. 3 and 4, a valve **40** is positioned between manifold inlet **24** and end **28** of heat exchanger **30**. Valve **40** controls the volume of water flowing into heat exchanger **30** and bypasses excess waterflow from the heater. The center portion of valve **40** includes conduit member **42** which is connected to manifold **26** at one end adjacent the heat exchanger inlet **28**, and has its free end **46** extending into inlet **24**. An annular valve member **48** is slidably mounted on conduit **42** and includes an annular sealing surface **50** adapted to engage a mating valve seat **52** on manifold **26** at inlet **24**. Valve member **48** is biased against seat **52** by a spring **54** in order to close the annular opening between conduit **42** and inlet **24**.

In pool water heaters it is desirable to maintain a constant flow of water through the heater coil to prevent excessive lime buildups within the coil, and valve **40** is provided to maintain this desired rate. Thus, the diameter of conduit **42** and the compression characteristics of spring **54** are chosen to permit only the maximum desired flow rate into the heat exchanger so that when the total water flow from the filtration system is equal to or below the desired flow rate through the heater coil all water flows through conduit **42**, and through coil **30**.

When the total waterflow rate from the filtration system increases above the desired flow rate through the heater, the additional force exerted by the increased flow of water against the tapered face **50** of valve member **48** moves it against the action of spring **54** away from its seat **52**. Thus, the additional water flowing into the unit bypasses valve **40** and heater coil **30** and flows directly through header **26** to outlet **36** where it is mixed with heated water from coil **30** and returned to the swimming pool. Spring **54** is designed to maintain valve member **48** on its seat if the total waterflow rate from the filtration system is equal to or less than the desired flow rate through the heater coil.

Heat transfer coil **30** is positioned within a generally cylindrical housing **60** which is substantially gastight and enclosed by housing **12**. Housing **60** is surrounded by thermal insulating material **62**, as seen in FIG. **3**, which prevents loss of heat from within the housing, as will be more fully explained hereinafter.

Heater unit **32** is positioned in housing **60** within the interior of the cylindrical space defined by coil **30** and includes upper and lower plate members **64** and a peripheral sidewall **66**. Sidewall **66** is formed by eight apertured ceramic burner plates **68** to form an octagonally shaped burner, as seen in FIG. **4**. Top plate **64** is connected to a supply duct **69** which extends through an opening **70** in top plate **72** of housing **60**. A combustible mixture of gas and air is supplied to plenum chamber **67**, in the interior of burner **32**, defined by the ceramic plates **68**, through duct **69** from gas supply line **74** and air blower **76**. Gas supply line **74** may be provided with a conventional pressure regulator and electric gas valve (not shown) to volume accurately control the column of gas supplied to plenum **67**. It is noted that rear wall **18** of housing **12** includes an opening **21** through which the gas supply line extends for connection to line **74**. Air for blower **76** is drawn into housing **72** through a plurality of apertures **77** formed in the overhang portion **17** of the housing. By this construction unsightly flues and ducts are avoided and a compact structure is provided.

As shown in FIGS. **3** and **4**, each of the apertures in burner plates **68** has a venturilike configuration which includes a throat portion **78** extending from an inlet **80** opening to plenum chamber **67** to an expanding or diverging outlet portion **82** at the outer face of the burner plate opposed to the interior surface of heat transfer coil **30**. As disclosed in the above mentioned U.S. Pat. application Ser. No. 3,943 (C M & S File No. 17–1514) in burner plates of this type, with relatively high mass flow rates of supplied combustible fuel, a laminar flow is established in throat portion **78** which is projected into diverging outlet portion **82** as a central jet which separates from the surface of outlet portion **82** so as to create a zone of turbulent flow between the central jet and the surface of outlet portion **32**. The lower velocity gases in this zone are ignited and these gases very efficiently transfer heat to the ceramic walls of the burner plates **68** at a temperature at which the ceramic material incandesces. In this manner the heat produced by a given area of burner plate is greatly increased and, as a result, the heater unit of the present invention may be made substantially smaller than other known swimming pool heater units. It is noted that in order to initially ignite the flowing gases, a spark or glow coil ignition system (not shown) is provided in the preferred embodiments in lieu of conventional pilot lights since the latter may readily be blown out under high winds when the heater is used for outdoor pools.

The incandescing burner plates **68** direct radiant heat toward coil **30** to heat the coil and thereby heat the water flowing therethrough. Additional heat is transferred to coil **30** from the products of combustion which are formed as a result of the combustion of gases in burner plates **68**. This additional heat is supplied by convection and is facilitated by the tight or close-packed coil construction of heat exchanger **30**, since the

products of combustion are prevented from passing between individual helices of the coil and are thus forced upwardly in annular zone **86** between burner plates **68** and coil **30** and transfer a portion of their heat by convection thereto.

At the top **88** of housing **60** of the products of combustion flow, as indicated by the arrows in FIG. **3**, over the top helical portion of coil **30** into the annular zone **90** between the sidewall **92** of housing **60**, where the gases flow downwardly in a manner, whereby additional heat is transferred from the products of combustion to coil **30**. As noted above, the exterior portion of housing **60** is supplied with a covering **62** of thermally insulating material which minimizes loss of heat through housing **60** to the atmosphere and thus makes more heat available for transfer to the water flowing in coil **30**.

The relatively cool products of combustion flow from zone **90** along the base portion **96** of housing **60** through an opening in the housing (not shown) adjacent rear wall **18** of exterior housing **12**. The gases flowing in base portion **96** are separated from the burner **32** by a plate **98** which isolates the hot combustion gases therein from the relatively cool gases being discharged. Rear wall **18** of housing **12** includes a flue deflector **100** adjacent an opening **102** and the exhaust gases from housing **60** flow around deflector **100** for final discharge through opening **102** to the atmosphere.

While coil **30** of the present embodiment has been illustrated without fins it is foreseen that the exterior surface thereof may be provided with fins to increase the heat transfer area available to receive heat by convection from the gases. In either case, moisture will tend to form on the coil from the condensation of the products passing along the cooler coil walls. The condensation forming on the interior surface of coil **30** enhances the overall heat transfer to the coils since the liquid is a good absorber of the infrared radiation and is quickly heated; this heat is then transferred by conduction through the tube walls to the water flowing therein. The moisture forming on the inside surfaces of coil **30** runs down this surface and is deposited on the upper face **106** of plate **98** which is sloped as seen in FIG. **3** to direct the liquid to an opening **108** therein, whereby the liquid is deposited in base **110** of housing **12**. Similarly moisture forming on the exterior surfaces of coil **30** runs down these surfaces to base **110**, which is also sloped, and which directs the liquid to drain **112** whereby it is discharged from the housing.

In operation the heater is adapted to function automatically when the pool pump is in operation and is provided with a conventional thermostat or aquastat (not shown) which senses inlet water temperature. If the water temperature is below the desired minimum temperature the fan or blower **76** is turned on by conventional control means and when it is up to speed, the electric gas valve and ignition system are actuated to start the burner and heat pool water flowing through valve **40** and coil **30**. A flame proving system (not shown) is provided to detect ignition and shut down the burner on failure of the burner to ignite. In addition, a high-limit temperature switch in the outlet **34** of coil **28** may be provided to prevent overheating of the unit in the event of insufficient waterflow and a timer can be incroporated with blower **76** to cool the unit after the burner shuts off and thereby reduce lime buildup in the heat exchanger.

Another embodiment of the swimming pool heater of the present invention is illustrated in FIGS. **5–9**, and more specifically, in FIGS. **5** and **6** there is shown a generally rectangular swimming pool heater **150** having an outer decorative housing **152** including front and rear wall panels **154** and **156** respectively. The function and operation of the heater of this embodiment is somewhat similar to the previously described heater and, accordingly, numerals applied to the elements of the prior embodiment are utilized below to indicate like parts.

As in the prior embodiment rear wall **156** of housing **150** includes three openings **20, 21** and **22** through which the various water and gas lines extend for connection with the heater components therein. Water from the pool's filter system is supplied through opening **20** to inlet **24** of a manifold **160** and flows therefrom through the multiple tube heat exchanger **162** which extends between manifold **160** and manifold **164**. The heat exchanger illustrated in FIG. **7** is a four pass type which utilizes two tubes **166** in each pass of the water flow from one manifold to the other; however, it is noted that one, or more than two tubes, may be used in each pass as desired. As illustrated, however, tubes **166** are arranged in pairs and there are four pairs **168**, **169**, **170** and **172** extending from rear manifold **160** to front manifold **164**.

The ends of each of the tubes **166** are mounted in and suitably sealed to, their associated manifold. Manifold **164** includes a central wall member **176** which divides the manifold into two separate chambers **178** and **180**, whereby chamber **178** connects the downstream end of the first pair of tubes **168** to the upstream end of the second pair **169**, and chamber **180** connects the downstream end of pair **170** with the upstream end of pair **172**.

Referring now to manifold **160**, it is seen that this manifold includes an interior wall **182** which separates the manifold into two sections **184** and **186**. Manifold section **184** provides a bypass passage for excess water bypassed from heat exchanger **162** by valve **40**, in the manner discussed above with respect to heater **10**, so that it is returned directly to the pool through outlet passage **36**. Manifold section **186** provides intercommunication between the various tubes **166** and is provided with a pair of integral partition walls **190** which divides the section into chambers **192**, **194** and **196**. Water entering inlet opening **24** of manifold **160** communicates with chamber **192** through valve **40** and at most only the maximum desired flow rate enters chamber **192** through conduit **42**. The water in chamber **192** is in direct communication with the inlet ends of the pair of heat exchange tubes **168** and flows through these tubes in the first pass across the heater to chamber **178** in manifold **164**. The water is returned from chamber **178** on the second pass through conduit **169** to chamber **194** where it is in communication with the inlet ends of the third pair of tubes **170**. At the end of the third pass, the water flows from chamber **180** through tubes **172** to chamber **196** where it is discharged through opening **198** into manifold section **184** and returned through outlet **36** to the pool.

Heat exchanger **162** is mounted in an intermediate portion of housing **150** directly below planar heating unit **210**. Heater unit **210** includes a generally rectangular plenum chamber **212** which corresponds substantially in size to the heat exchanger **162**. An apertured ceramic burner plate **214** is provided as the base of plenum **212** which corresponds substantially to the plates **68** previously described. As before, a combustible mixture of gas and air is supplied to plenum chamber **212** through duct **216** from blower **218** and a gas supply line **218**. The air required for combustion is drawn by fan **218** through an opening **220** which is formed in front panel **154** and is provided with a deflector plate **222**, thereby eliminating unsightly flues and ducts.

Burner plate **214** is provided with a plurality of venturilike apertures **220** having a generally cylindrical inlet throat port **78** and an expanding outlet portion **82** on its outer face **224** opposite the upper surfaces of tubes **166**. As with burner plate **68**, the combustion of gases in apertures **82** heats the outer surfaces of ceramic plate **214** to incandescence to produce substantial amounts of infrared radiation. Under certain conditions, it has been found that sixty (**60**) percent of the available energy supplied to the burner by the combustible flue mixture is converted into radiant energy. This energy is directed downwardly toward tubes **166** to heat the tubes and the water flowing therein. These tubes, as seen in FIGS. **8** and **9**, are spaced from each other and are provided with radiating fins which are adapted to absorb additional heat by convection from the products of combustion formed as a result of the combustion in burner **214**, which products are discharged downwardly upon and through the spacing between the tubes. It is noted that tubes **166** may be provided with other known types of surface extensions in lieu of fins in order to enhance heat transfer.

A plurality of generally inverted T-shaped deflectors **230** are mounted below tubes **166** downstream of the flow of products of combustion which deflects the hot gases around the bottom portion of the tubes to increase distribution of the gases and effect an increased and more uniform transfer of convective heat therefrom. In addition, these deflectors **230** will reflect radiation which passes between the tubes **166** back toward the tubes to insure substantially full utilization of the radiation produced by burner **214**. While deflectors **230** have been illustrated as T-shaped members, it is noted that other deflector shapes may also be utilized, and in particular it is foreseen that flat or curved plate members will provide satisfactory deflection of gases and reflection of radiation.

After the products of combustion pass between deflectors **230** they flow downwardly into discharge chamber **232** immediately below heat exchanger **162**. Chamber **232** is thermally insulated at its sides and front by plates **234** to conserve heat and effect maximum heat transfer by convection to tubes **162**. However, the rear portion of chamber **232** is open to permit the escape of the relatively cooled exhaust gases through an opening **236** having a deflector **238** in rear wall **156**.

As in the prior embodiment, condensate will tend to form on the relatively cool tubes **166** as the hot gases pass through; this condensate falls from the tubes to the base **240** of housing **150** which is sloped to direct the moisture to a drain **242** for discharge.

The operation of heater unit **150** is substantially the same as heater **10** previously discussed.

Although the illustrative embodiments of the invention have been described herein with reference to the accompanying drawings and for heating water for swimming pools, it is to be understood that the invention is not limited to that field of use or to the precise embodiment described herein, and that other fluids may be heated and that various changes and modifications may be effected therein by one skilled in the art without departing from the true scope or spirit of this invention.

We claim:

1. A fluid-heating device in the fluid flow path of a water circulation system comprising, a heat transfer conduit forming a portion of said fluid flow path, a gas burner associated with said conduit and adapted to supply heat to said conduit to heat the water flowing therein upon combustion of fuel in said burner, said burner being positioned centrally of said housing and said conduit providing a close packed heat transfer coil surrounding said burner, a generally airtight housing adapted to contain said conduit and said burner, said housing including an exhaust opening adapted to discharge products of combustion formed by said gas burner, wherein said coil and said housing cooperate to define a flow path in the housing for said products of combustion whereby said products of combustion first flow generally upwardly between said peripheral sidewalls and said coils and then downwardly between said coils and the walls of said housing prior to discharge through said exhaust opening whereby additional heat is provided to said coil by convection from said products of combustion.

2. A device as defined in claim **1** wherein said burner includes peripheral sidewalls adapted to produce radiant heat upon combustion of gases within the burner whereby said close packed heat transfer coil surrounding said burner receives radiant heat from said peripheral sidewalls.

3. A device as defined in claim **2** wherein said peripheral sidewall comprises, a plurality of burner plates having a plurality of orifices extending therethrough, each of said orifices including a throat portion of relatively small cross section extending from an inlet at one surface of said plate and an expanding outlet portion extending from said throat portion to an opening at an opposite surface of the plate opposite said coil and having cross sections increasing from said throat portion to said opening.

4. A device as defined in claim **3** including, means for supplying a combustible air-gas mixture to said one surface of said plates for passage through said orifices at a mass flow rate such that the velocity of flow of the mixture through said throat portion of each orifice is greater than the velocity of flame propagation in the mixture and establishes a substantially laminar flow in said throat portion which projects a jet of said mixture centrally into said outlet portion with separation of said jet from the surface of said outlet portion, whereby to create a zone of turbulent low velocity recirculating flow between said jet and said surface of the outlet portion.

5. A device as defined in claim **1** wherein said housing is thermally insulated along the exterior thereof whereby a substantial portion of the heat from said products of combustion is transferred to said coils by convection and heat loss through said housing is avoided.

6. A device as defined in claim **1** wherein said housing includes a second opening through which condensate forming on said coils is discharged.

7. A fluid-heating device in the fluid flow path of a water circulation system comprising, a heat transfer conduit forming a portion of said fluid flow path, a gas burner associated with said conduit and adapted to supply heat to said conduit to heat the water flowing therein upon combustion of fuel in said burner, a generally airtight housing adapted to contain said conduit and said burner, said housing including an exhaust opening adapted to discharge products of combustion formed by said gas burner, said housing and said conduit cooperating to define a flow path in said housing for said products of combustion whereby additional heat is provided to said conduit by convection from said products of combustion, said burner being positioned adjacent the upper portion of said housing and including, a base member adapted to produce radiant heat upon combustion of gases within the burner, and said conduit including a plurality of heat transfer ducts operably interconnected for fluid communication therebetween, said ducts being located below said base member to receive radiant heat therefrom.

8. A device as defined in claim **7** wherein said heat transfer ducts comprise spaced finned members whereby the products of combustion from said burner flow between and around said ducts prior to discharge through said exhaust opening.

9. A device as defined in claim **8** including, a plurality of deflection plates mounted in said housing below said heat transfer ducts to deflect combustion products flowing between said ducts to effect substantially uniform convective heating of said ducts by said products of combustion.

10. A device as defined in claim **8** wherein said base member comprises, a burner plate having a plurality of orifices extending therethrough, each of said orifices including a throat portion of relatively small cross section extending from an inlet at one surface of said plate and an expanding outlet portion extending from said throat portion to an opening at an opposite surface of the plate opposite said coil and having cross sections increasing from said throat portion to said opening.

11. A device as defined in claim **10** including, means for supplying a combustible air-gas mixture to said one surface of said plates for passage through said orifices at a mass flow rate such that the velocity of flow of the mixture through said throat portion of each orifice is greater than the velocity of flame propagation in the mixture and establishes a substantially laminar flow in said throat portion which projects a jet of said mixture centrally into said outlet portion with separation of said jet from the surface of said outlet portion, whereby to create a zone of turbulent low velocity recirculating flow between said jet and said surface of the outlet portion.

12. A fluid-heating device comprising, a substantially airtight housing, gas burner means in said housing for producing radiant heat therein positioned adjacent the upper portion of said housing, said gas burner means including a base member adapted to produce radiant heat upon combustion of gases within the burner, means defining a flow path for said fluid through said device adjacent said burner means whereby fluid is heated by said radiant heat, said means defining a fluid flow path including a plurality of heat transfer ducts operably interconnected for fluid communication therebetween, said ducts being located below said base member to receive radiant heat therefrom, said housing having an exhaust opening therein for the products of combustion formed in said burner and confining said product of combustion prior to discharge through said opening adjacent said flow path defining means to supply additional heat to said fluid by convection.

13. A radiant fluid-heating device comprising, an annular insulated housing defining a generally cylindrical heating chamber, burner means mounted within the central portion of said chamber having an apertured peripheral sidewall adapted to produce radiant heat in said chamber upon combustion of gases adjacent said apertures, an annular close- packed coil within said housing surrounding said burner and receiving radiant heat therefrom said coil defining a first annular exhaust passage between said peripheral sidewall and said coil and a second annular exhaust passage between said coil and the walls of said housing, said exhaust passages being in airflow communication adjacent the top of said housing said heating chamber having an exhaust opening therein, whereby products of combustion from said burner flow upwardly in said first passage to said second passage wherein said gases flow downwardly adjacent said coils to said exhaust opening and supply additional heat by convection to said coils and the water flowing therein.

14. A device as defined in claim **13** for heating water for a swimming pool including, valve means operatively connected to said coils for supplying a predetermined volume flow of water to said coil and bypassing excess water back to the pool.

15 A radiant fluid-heating device comprising, an insulated housing defining a heating chamber therein, burner means mounted within said chamber adjacent the top of said housing and having an apertured substantially planar base portion adapted to produce radiant heat in said chamber upon combustion of gases adjacent said apertures, a plurality of generally elongated tubular heat transfer ducts mounted within said housing below said burner and receiving radiant heat therefrom, said heat transfer ducts being connected in liquid communication with each other to provide a flow path for said water and defining an exhaust chamber in the base of said housing, said exhaust chamber having an exhaust opening therein adapted to provide communication between said exhaust chamber and the atmosphere, whereby products of combustion from said burner flow downwardly through and around said heat transfer ducts to said exhaust chamber and said exhaust opening to supply additional heat by convection to said coils and the water flowing therein.

16. A device as defined in claim **15** for heating water for a swimming pool including, valve means operatively connected to said coil for supplying a predetermined volume flow of water to said coil and bypassing excess water back to the pool.

17. A device as defined in claim **15** including, a plurality of deflection plates mounted in said housing below said heat transfer ducts to deflect said products of combustion about said heat transfer ducts prior to discharge from said housing to effect substantially uniform convection heating of said ducts by said products of combustion and to reflect radiation passing between said ducts upwardly towards said ducts.

18. A system for heating swimming pool water wherein the water is circulated from and to the pool which includes a radiant heating device for the water which comprises, a substantially airtight housing, gas burner means in said housing for producing radiant heat therein, means defining a flow path for said fluid through said device adjacent said burner means whereby said fluid is heated by said radiant heat, said housing having an exhaust opening therein for products of combustion formed in said burner and confining said products of combustion prior to discharge through said opening adjacent said flow path defining means to supply additional heat to said fluid by convection, and means forming a bypass to divert water from flowing along said flow path which includes a slide valve member having a closed position in which all of the water flows along said flow path and which is movable from said closed position to permit a controlled portion of the water to flow through said bypass, said valve element being annular and concentrically positioned with respect to the stream of water entering said system and being slidable axially from said closed position thereby to open annular passageway to said bypass, and a coil spring surrounding said valve element and urging said valve element to said closed position, said spring having the characteristic that it holds said valve element in said closed position when the rate of waterflow along said heating path is below a predetermined level and it permits the water pressure to move said valve element from said closed position upon an elevation in the said flow.

19. Apparatus as described in claim **18** wherein said valve element has a waterflow passageway thereto of lesser diameter than the diameter of the stream of water flowing into said device.

20. A system as defined in claim **1** for heating water for a swimming pool including, valve means operatively connected to said coil for supplying a predetermined volume flow of water to said coil and bypassing excess water back to the pool.

21. A system as described in claim **20** including a bypass to divert water from flowing along said flow path and wherein said valve means comprises a slide valve member having a closed position in which all of the water flows along said flow path and which is movable from said closed position to permit a controlled portion of the water to flow through said bypass, said valve element being annular and concentrically positioned with respect to the stream of water entering said system and being slidable axially from said closed position thereby to open an annular passageway to said bypass, and a coil spring surrounding said valve element and urging said valve element to said closed position, said spring having the characteristic that it holds said valve element in said closed position when the rate of water flow along said heating path is below a predetermined level and it permits the water pressure to move said valve element from said closed position upon an elevation in the said flow rate.

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