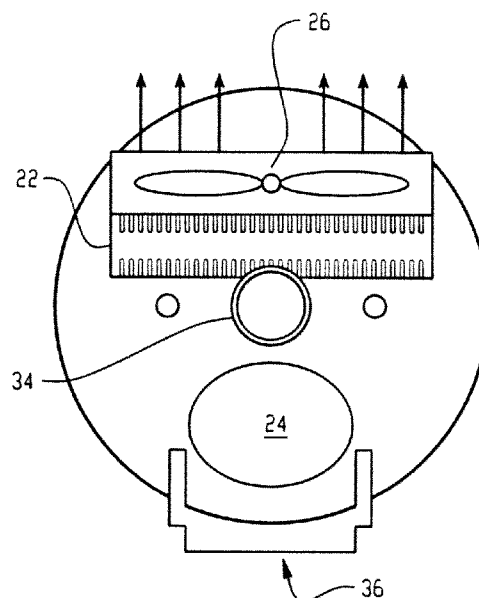
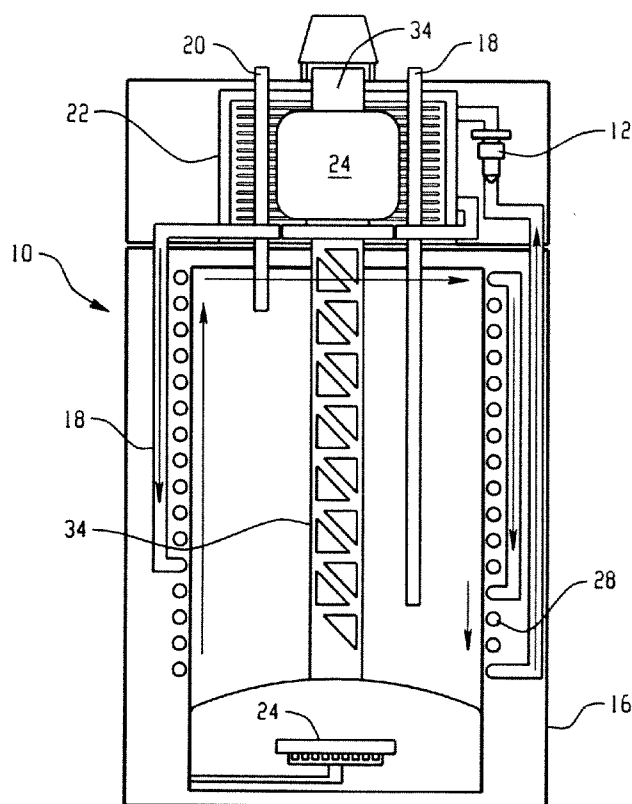




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(19) **United States**(12) **Patent Application Publication**
Nelson et al.(10) **Pub. No.: US 2013/0042635 A1**(43) **Pub. Date: Feb. 21, 2013**(54) **HEAT PUMP WATER HEATER IN
CONJUNCTION WITH GAS WATER HEATER**(52) **U.S. CL.** 62/79; 62/238.7(75) Inventors: **Jonathan D. Nelson**, Louisville, KY
(US); **Michael Thomas Beyerle**, Peewee
Valley, KY (US); **Susan Elizabeth
Gregory**, Louisville, KY (US); **Michelle
Gross**, Louisville, KY (US)(57) **ABSTRACT**

A method for heating water delivered and stored in a water heater storage tank includes activating at least one of dual fuel heater types in response to various modes of operation. The water heater is preferably a dual fuel or hybrid heat pump gas water heater that includes a heat pump as the first type of heater for heating the water, and a gas burner as the second type of heater that transfer heat to the water. One or more sensors monitor water temperature and communicate with a controller to activate one of, or both of, the first and second types of heaters. If there is an electrical power outage, the hybrid heat pump gas water heater is still able to heat the water.

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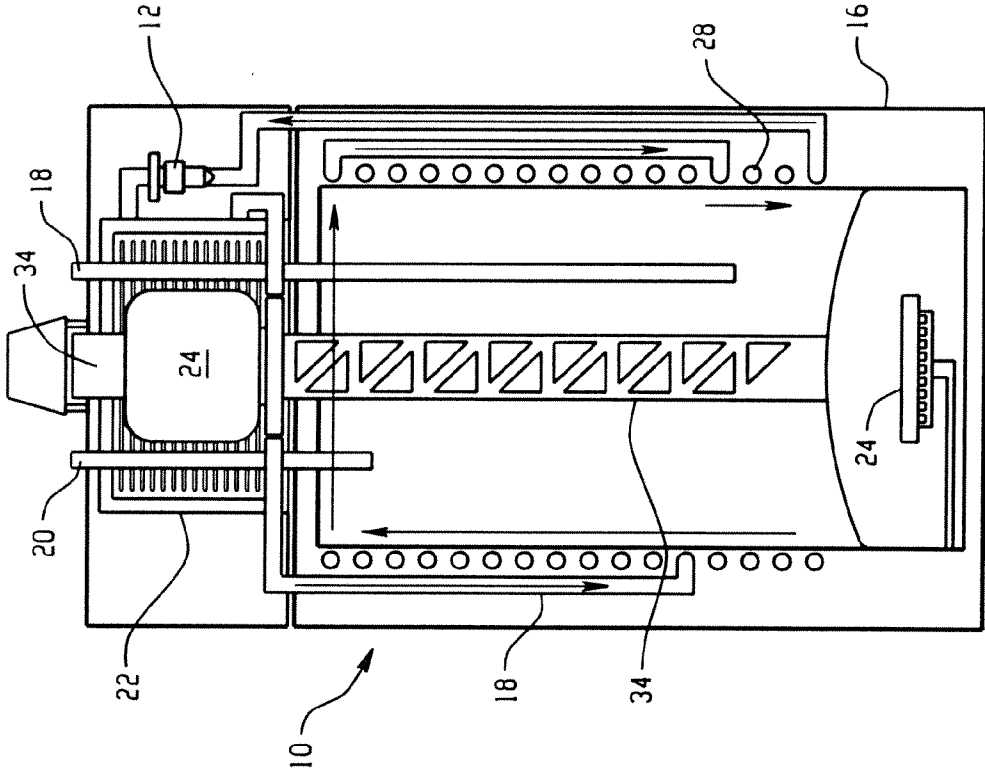


Fig. 1A

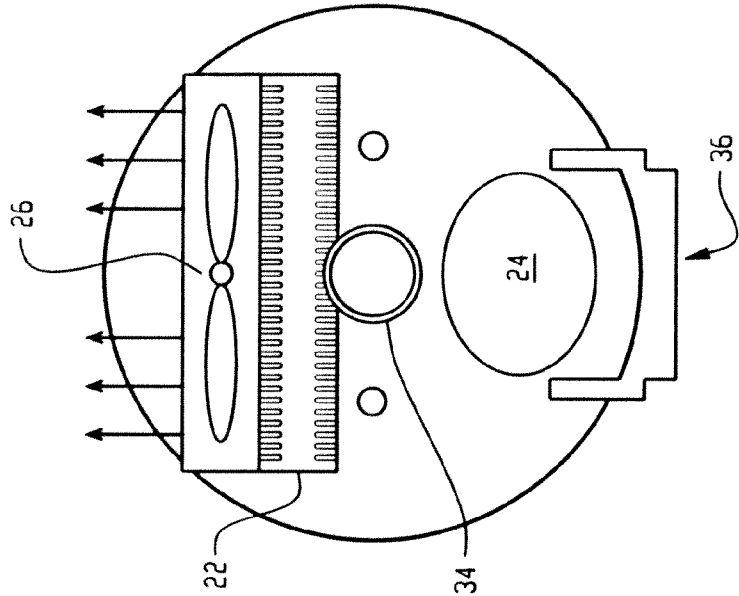


Fig. 1B

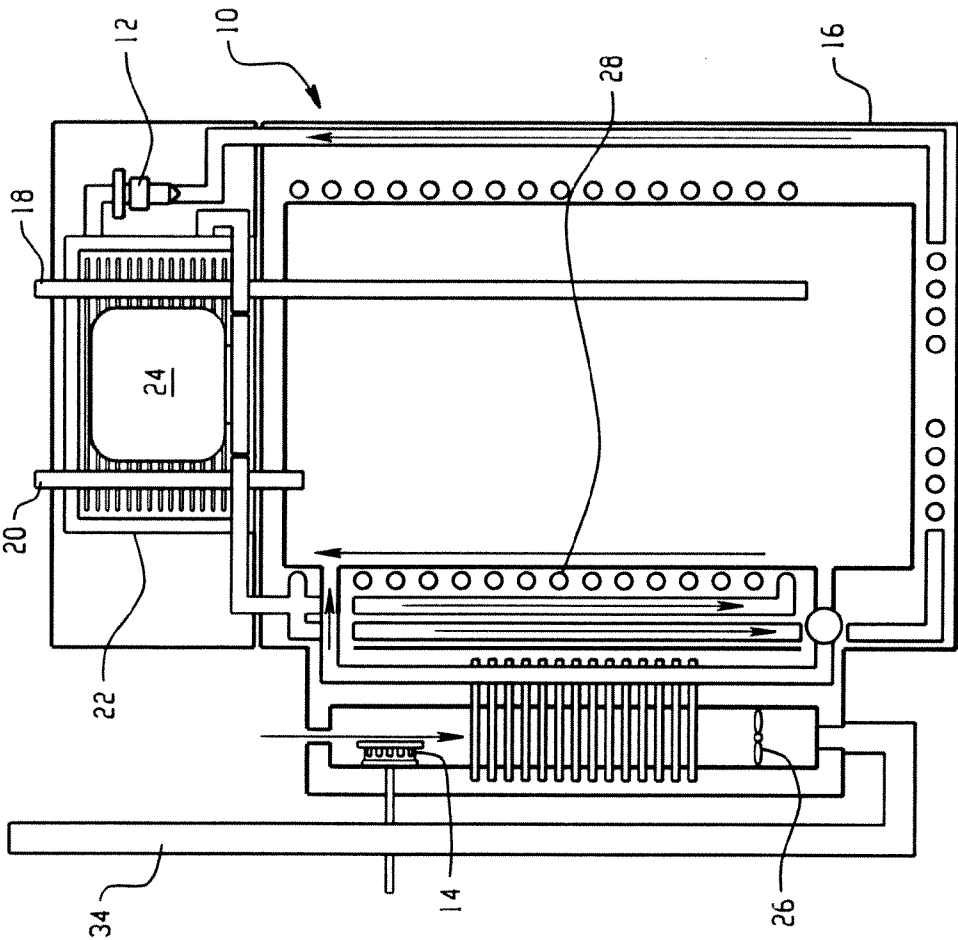


Fig. 2A

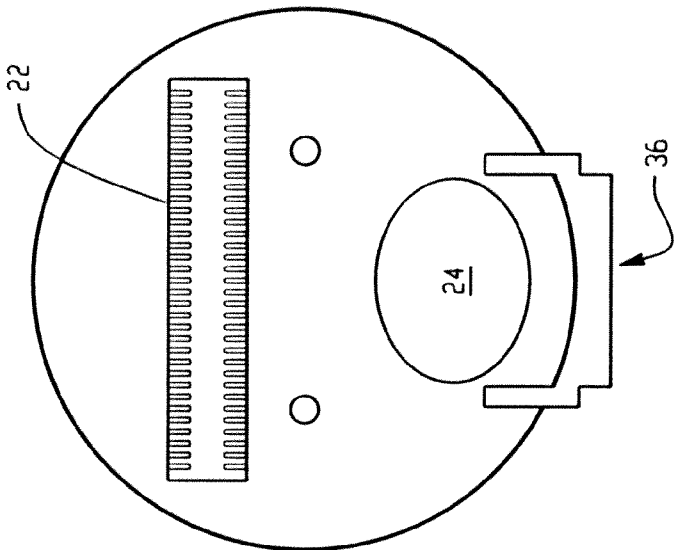


Fig. 2B

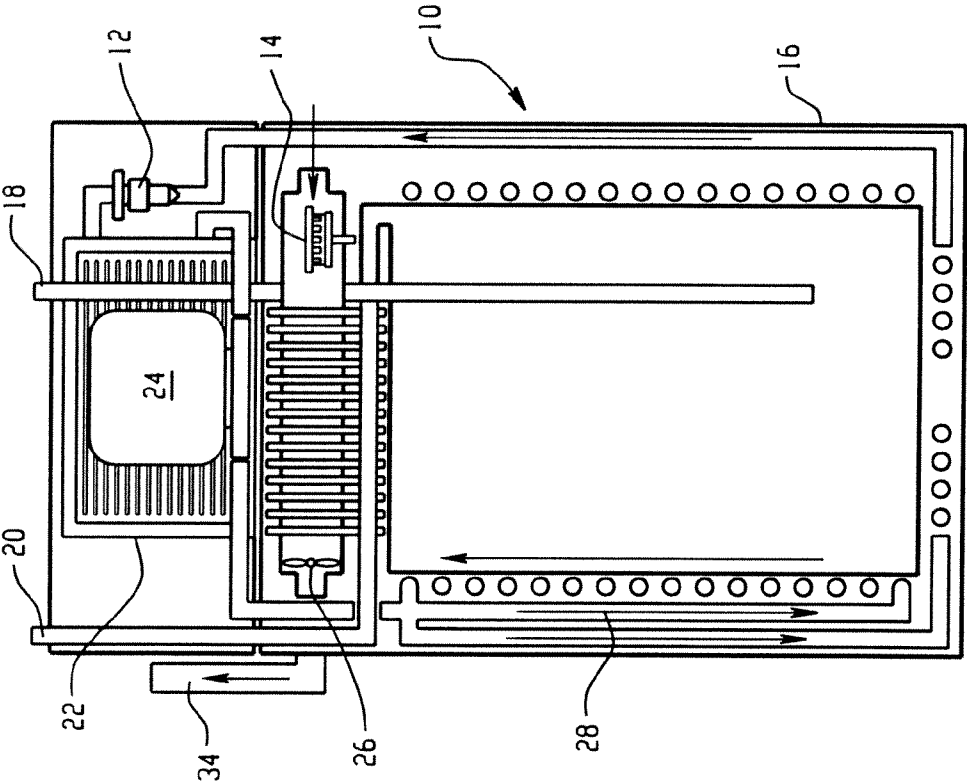


Fig. 3A

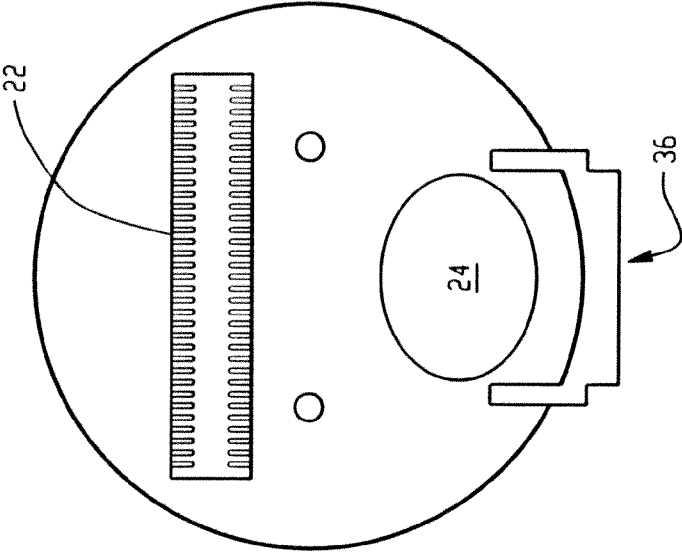


Fig. 3B

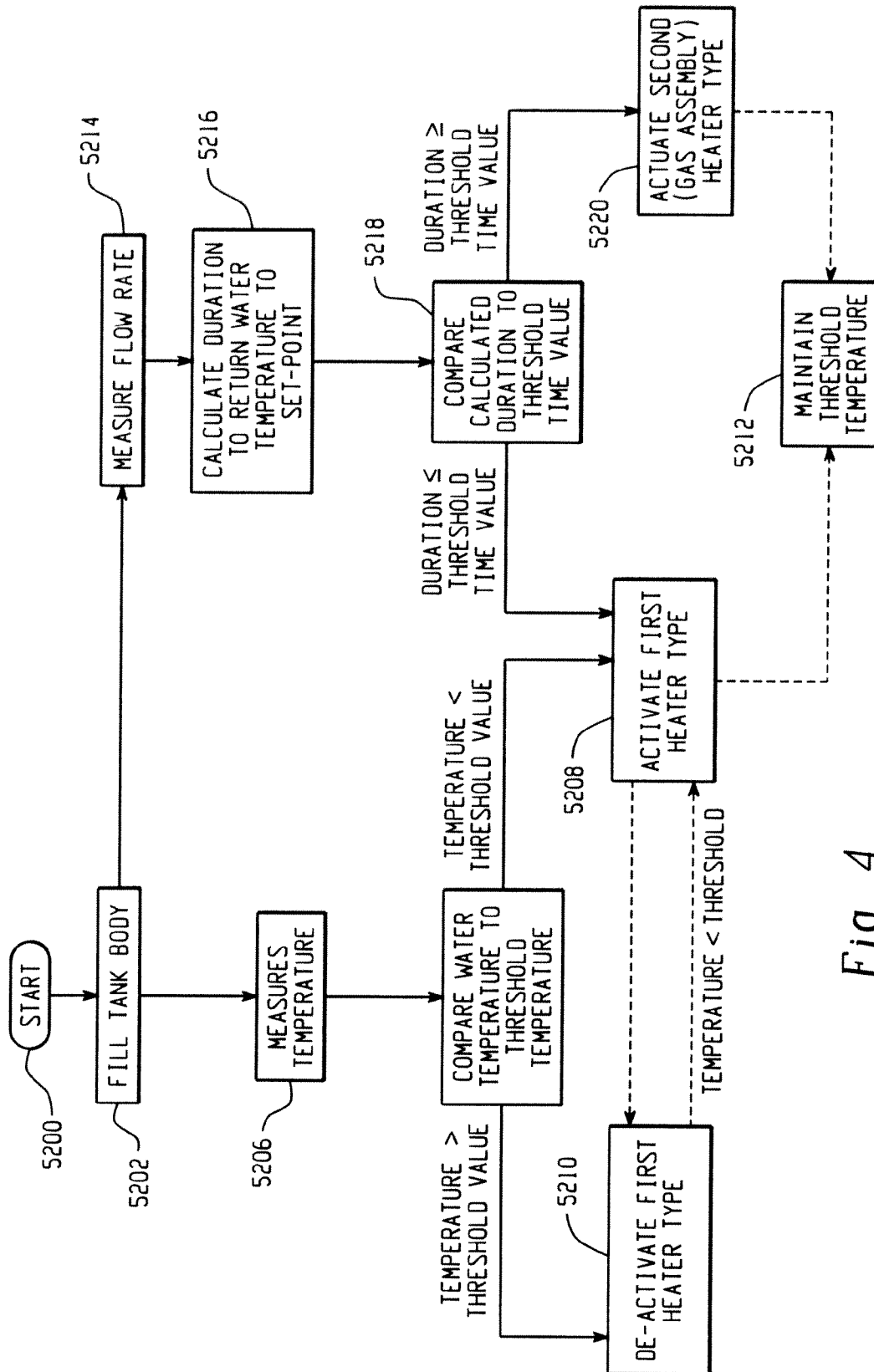


Fig. 4

HEAT PUMP WATER HEATER IN CONJUNCTION WITH GAS WATER HEATER

BACKGROUND OF THE DISCLOSURE

[0001] This disclosure is directed to water heaters, and is more particularly directed to a hybrid water heater that is also referred to as a dual fuel water heater or hybrid heat pump gas water heater.

[0002] One skilled in the art understands that different heat sources offer different advantages, and likewise have different disadvantages. For example, full-sized tank water heaters usually require either an electrical connection in which the circuit is a 220/240 V and 30 amp circuit or a gas connection capable of supplying 40 to 100 K BTUs per hour. Typically, the tank water heater relies upon a single energy source—either electric or gas. Thus, installations in the home are made based upon the energy requirements of the water heater. That is, either a 30 amp connection or a gas connection is provided in order to connect with an electric or gas water heater, respectively, in the home.

[0003] As will be appreciated, replacement water heater units for the home are usually based upon the previous type of installation. For example, if the homeowner wants to replace a gas water heater, then a similar sized gas water heater is purchased to “drop-in” as a replacement. Preferably, the gas and flue connections are substantially identical, the electrical connection for the gas water heater is similar, and the inlet and outlet water connections are likewise similar to facilitate ease of replacement.

[0004] On the other hand, rather than merely replacing an electric water heater with a new electric water heater, some consumers have opted to switch to a hybrid water heater that uses a highly efficient heat pump water heater available as a “drop-in” replacement for the electric water heater market. Typically, the heat pump water heater is operated at 240 V and 30 amps so that the replacement hybrid heat pump water heater is direct wired in the same fashion as a standard electric water heater. Likewise, the same water inlet and outlet configurations are used in the new heat pump water heater to facilitate replacement. One commercially available hybrid-type water heater includes multiple resistor type heaters and a heat pump type heat source used to heat the water in the tank. A controller energizes one or more of these heat sources in response to various temperature data inputs. The water temperature and the rate of temperature change are monitored, and the data input to a controller which then determines which heat source to use, i.e., the compressor of the heat pump, the upper electric resistance heater, and/or the lower resistance heater.

[0005] Heat pumps are highly efficient but take a longer period of time to raise the temperature of the water in the tank. Gas burners, on the other hand, can quickly raise the temperature of the water in the tank. Nevertheless, no hybrid, heat pump water heater offering is available as a replacement in the gas water heater market. Gas fuel costs versus electrical costs in some areas make the electrical heat pump water heaters less attractive in terms of payback. Further, higher installation costs are required if a heat pump water heater is installed as a replacement and particularly if the replacement water heater requires a 240 volt, 30 amp dedicated circuit. That is, tank gas water heaters do not require the elevated voltage or amperage in a dedicated circuit and therefore a homeowner would have to update the electrical service if a hybrid heat pump electrical water heater were used to replace

the gas water heater. Likewise, utilities may resist fuel switching from gas to electric. Hence, a 240 V heat pump water heater may not be as attractive to a consumer/homeowner or may encounter other resistance as a replacement to a gas water heater.

[0006] Another obstacle to replacing a gas water heater, and particularly one that is at least partially electric such as a gas heat pump water heater, is that installation costs are a big factor. Electrical connections, gas line connections, and the associated flue all contribute to the potential cost to the homeowner who is considering a change to a gas heat pump water heater as a substitute for the gas water heater.

[0007] Utilities also become a factor. There are times when a utility wants to encourage electrical use, and still other times such as peak demand when the utility would prefer that the consumer not use electricity for the water heater. Therefore, if a homeowner is considering moving away from a gas water heater to electric water heater, for example one that uses 240 V, a utility may offer some resistance to such change.

[0008] Thus, a need exists for a high-efficiency, hybrid heat pump water heater, and more specifically a gas heat pump water heater or dual fuel water heater, replacement to a gas water heater where the heat pump portion of the hybrid water heater can maintain the hot water temperature at a lower cost than using a high-powered gas burner when water is not being used or when the draw is low. Further, the high-efficiency hybrid heat pump water heater is capable of using the voltage and current level that is readily available in a convenient outlet located near a gas water heater installation that is being replaced. Likewise, the replacement must be as compatible with existing connections as possible to minimize any cost to the homeowner related to the changeover, i.e., gas connections, electrical connections, flue connections, footprint, etc.

SUMMARY OF THE DISCLOSURE

[0009] A first exemplary embodiment of the disclosure is directed toward a water heater including a tank body for storing a volume of water. A cold water supply line delivers water to the tank body. A water discharge line provides for egress of heated water from the tank body. The water heater further includes a first type of heater and a second type of heater using a different energy/fuel source than the first heater type for heating the water in the tank body.

[0010] The disclosure is directed toward a water heater including a tank body for storing a volume of water. The water heater includes a cold water supply line for delivering water to the tank body and a water discharge line for egress of heated water from the tank body. The water heater further includes a heat pump for heating the water in the tank body. The gas burner is mounted within or adjacent but external to the tank body to transfer heat to the water stored in the tank body, or the gas burner may be an instantaneous type water heater that raises the temperature of the outlet water.

[0011] An exemplary water heating method of the present disclosure includes delivering water to a tank body through a water supply line and storing a volume of the water in the tank body. The method further includes heating the water in the tank body with a first type of heater, and selectively using a second type of heater using a different energy/fuel source than the first heater type to heat the water in the tank body when a threshold is met.

[0012] One advantage of the present disclosure is to provide a hybrid water heater that operates with high energy efficiency.

[0013] Another advantage of the present disclosure is to provide a water heater that reduces costs of operating and installation.

[0014] Still another advantage of the present disclosure relates to providing a high efficiency electric heat pump to maintain hot water temperature at a lower cost than using a high-powered gas burner when water is not being used or when hot water consumption is low or moderate.

[0015] Yet another advantage is that with a hybrid gas heat pump water heater if electrical power is lost, hot water can still be provided to the homeowner.

[0016] The present disclosure provides the consumer a choice of a gas or electric water heater for new construction, as well as replacing a gas water heater with a hybrid gas heat pump water heater.

[0017] A dual fuel heat pump water heater/gas water heater that can easily drop-in and replace a standard gas water heater that preferably has the same inlet and outlet water connections, the same gas vent pipe connection, same relative footprint, and that will operate in the event of loss of electrical power.

[0018] Still other benefits and advantages of the present disclosure will become apparent upon reading and understanding the following detailed description

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 (FIGS. 1A and 1b) shows a hybrid heat pump gas water heater assembly.

[0020] FIG. 2 (FIGS. 2A and 2B) is another embodiment of the dual fuel, hybrid heat pump gas water heater assembly.

[0021] FIG. 3 (FIGS. 3A and 3B) is still another embodiment of the dual fuel, hybrid heat pump gas water heater assembly.

[0022] FIG. 4 is a flow-chart for an exemplary mode of operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] FIG. 1 illustrates a multiple heater type water heater (hereinafter “hybrid water heater 10”) according to an exemplary embodiment of the disclosure. The hybrid water heater 10 includes a first heater type 12 and a second heater type 14, which is a different fuel or energy source from the first heater type. More specifically, the first heater type 12 is a heat pump system and the second heater type 14 is a gas burner assembly. It is contemplated that the presently disclosed hybrid water heater 10 can be installed as an alternative water heater in regions of the country that traditionally use a gas water heater, or can be used as a replacement for a gas water heater. When used as a replacement, consideration is also given to ease of replacement and includes drop-in features such as aligning and sizing with an exhaust gas flue, gas supply, water connections, and size. For example, the exhaust duct size may be 3 inches for 40,000 BTU burners or less, and typically 4 inch diameter doctors use for burners greater than 40,000 BTUs. Existing gas lines are typically ½ inch and ¾ inch, and the electrical connection is preferably a 120 V corded plug that can reach a 120V, 15 amp outlet.

[0024] The present disclosure is directed toward a stand-alone storage water heater 10 including a housing 15 that encloses a tank body 16 for storing a volume of water therein. Cold water is delivered to the tank body 16 from a water supply line 18 (i.e., a “dip tube”) connected to a cold water

supply (not shown). This water supply line 18 delivers the cold water toward a bottom portion of the tank body 16, and the delivery of the cold water displaces a volume of water already contained therein the lower region toward a top portion of the tank body. Because warm water is less dense than cold water, the warmer water rises to the top portion of the tank body 16. Therefore, a water outlet or egress line 20 is situated at the top portion of the tank body 16 for delivery of heated water to various faucets and appliances in the home.

[0025] The heat pump 12 is mounted to the tank body 16. One exemplary heat pump is described in application Ser. No. _____ (Attorney Docket No. 60280.0012US01; GE Docket No. 225439) to Nelson, et. al.; however, operation and features of the heat pump are not limited to any one disclosure. Any known heat pump system may be incorporated into the present water heater 10 to achieve a function of the disclosure including activation of the heat pump heater type corresponding to at least one mode of operation. In the illustrated embodiment, the heat pump 12 includes a compressor 24, condenser 28, a restriction, an evaporator 22, and a fan 26. A working fluid circulates through the heat pump to heat the water in the tank body 16. More specifically, the fan 26 directs the warm ambient air over the evaporator 22 for transferring heat into the working fluid. The working fluid (e.g., a refrigerant) exits the evaporator 22 in vapor gas form, i.e., in a near gas state. The working fluid is received in the compressor 24, where it increases in pressure and temperature to an associated superheated gas vapor as it enters the condenser. The vapor enters the condenser 28 and transfers energy to the water stored in the tank body 16. The working fluid vapor changes phase to liquid state as the energy is transferred to the water. A throttling device (not shown) receives the working fluid before it returns to the evaporator.

[0026] In the illustrated embodiment, the evaporator 22, the compressor 24, and the fan 26 are mounted to a top, horizontally extending and planar surface of the housing 15, however, there is no limitation made herein to a surface of the housing body of which the various components of the heat pump 12 are supported. In one embodiment, the condenser 28 is in contact with a (e.g., continuous) sidewall surface 30 of the tank body 16 for transferring heat to the water contained therein. In the preferred embodiment, the condenser 28 is in contact with the sidewall 30 of greatest surface area, e.g., the elongated sidewall of the tank body. In the illustrated embodiment, the condenser 28 is preferably wrapped around an exterior sidewall surface of the tank body 16 in a helical or serpentine fashion, or in any other manner that provides for effective heat transfer with the tank body. In this embodiment, an insulator or similar functioning insulating material 29 may surround the outer sidewall surface of the tank body 30 within the housing 15, thus limiting heat loss to the ambient air. In this manner, the condenser 28 is situated between the outer sidewall surface 30 of the tank body 16 and the insulator 29. In another contemplated embodiment, the condenser 28 can be situated in the interior 32 of the tank body 16 where it is in direct contact with the water. Embodiments are further contemplated in which a heat exchanger (not shown) is situated external to the housing 15, wherein water is pumped from the tank body at a first temperature, through the heat exchanger where energy is transferred thereto, and returned to the tank body at a higher temperature.

[0027] The second heater type 14 is a gas burner assembly that includes a standing or an intermittent pilot, which ignites a gas flame in a main burner of the assembly. In the illustrated

embodiment of FIG. 1, the gas burner assembly 14 is shown situated at and heating a base portion of the tank body 16. The gas burner assembly heats the colder water contained at the bottom of the tank body 16 due to its greater density.

[0028] A majority of the gas water heaters have a 3 inch vent pipe that comes out the top of the appliance, although some have a 4 inch vent pipe. Preferably the drop-in heat pump water heater/gas water heater will replace a 3 inch vent pipe, although some models could also be available for replacing the 4 inch vent pipe. The replacement model for the 3 inch vent pipe will only have a 40,000 BTU maximum burner, whereas a 4 inch vent pipe can accommodate a larger BTU burner. It will also be appreciated that a dual fuel water heater with a 3 inch flue/vent pipe can be installed in a 4 inch vent pipe application. Typically, a 1/2 inch gas supply line is provided for existing gas water heaters, and thus the dual fuel heat pump water heater of the present disclosure is intended to serve as a drop-in unit without having to change any of the existing infrastructure.

[0029] In the first configuration of FIGS. 1A and 1B, there is shown a 120 V heat pump water heater with storage tank and a standard burner. The dual fuel heat pump water heater has the ability to operate with the loss of electrical power, it has the ability to drop in and hook up to a 3 inch vent pipe, and uses the same gas supply, that is a 1/2 inch or 3/4 inch gas supply line, as the standard gas water heater that it replaces. This dual fuel hybrid heat pump gas water heater does require external power whereas an existing gas water heater does not, but the dual fuel hybrid heat pump water heater of the present application is designed to connect with the 120 V circuit (e.g. a cord connection able to plug-in to a nearby, convenient electrical outlet versus installation of a dedicated 240V, 30 A circuit).

[0030] The illustrated embodiment of FIG. 1 shows a flue 34 extending vertically upwardly coincident or in proximity to a central axis of the housing 15 or tank body 16. This flue 34 vents byproducts of combustion. The flue gases naturally rise through the flue 34, which extends toward or connects with further ductwork (not shown) terminating at an exterior of the home. Of course one skilled in the art will appreciate that the present disclosure is not limited to a natural draft ventilation system and that a direct-vent, a horizontally extending vent, or a fan-assisted or power-vented ventilation system can be used without departing from the scope and intent of the present disclosure.

[0031] Other embodiments are contemplated in which the gas burner assembly is situated proximate to an outer surface of the tank body 16 and spaced from a base portion of the tank body 16. One example shown in FIG. 2 (FIGS. 2A and 2B) includes a removed gas burner assembly 14 situated adjacent and exterior to the sidewall 30 of the housing 15. In this embodiment, it is envisioned that the water can be introduced from the tank body 16 through a conduit 17 that passes in proximity to the ignited gas burner assembly 14 in order to heat the water. The water returns to the tank body at a temperature higher than the temperature it was before the gas heater cycle. Since the gas burner assembly 14 is situated at a location removed from directly beneath the bottom surface of the tank body 16, a flue extends upwardly from the gas burner assembly 14 to carry away combustion gases produced therefrom. There are several advantages associated with this arrangement: (1) the flue 34 does not consume space inside the tank body 16, and hence the tank is capable of containing a greater volume of water; (2) the flue does not extend out-

wardly and upwardly from a top surface of the tank body, and therefore does not obstruct various arrangements for the heat pump components mounted on the top surface of the water heater; and, (3) the flue does not remove energy from the standing water stored in the tank body, and therefore does not contribute to lowering the temperature of the water surrounding the flue. It does have the disadvantage of an increased footprint for the water heater (which may not be an issue for new construction), and possibly impacting ease of replacement of a smaller standard gas water heater.

[0032] The heat pump water heater with a gas burner on the side and not on the bottom as shown in FIG. 2 is provided with a 120 V heat pump water heater, and a storage tank with a side arm style burner that still uses the same return flow style condenser. The burner heats water in the tank through a side arm heat exchanger (i.e. it is not intended as an outlet flow instantaneous type water heater design) and thus is intended to raise the tank temperature to a desired temperature level. Generally the burner is much higher capacity than a standard natural draft style burner (e.g. 40,000 BTU burner) and therefore the same venting cannot be used, and may have to use an increased gas supply (e.g. changing from a 1/2 inch gas supply to a 3/4 gas supply line), although it is preferred that the gas supply line need not be changed and instead the largest burner available without increasing the gas supply line would be desired.

[0033] For example, gas line and vent pipe size limitations may govern the "drop-in" envelope requirements of the dual fuel heat pump water heater. It is generally known that a standard gas water heater that is drop-in ready has a naturally vented installation, a 1/2 inch gas line, and a 3 or 4 inch vent or vent connector. By definition, a vent exits vertically through the roof of a home or similar structure, and exhausts combustion products of the naturally-drafted water heater and any other naturally-drafted appliances. A vent connector attaches from the draft hood of an appliance to the main vent that exits the home. Likewise, appliances may also be attached directly to the vent without a vent connector. Vent materials may include single or double wall metal pipe, a lined masonry chimney, or other code or agency-approved vent material. For a 3 inch existing vent or vent connector, a drop-in gas water heater must have a burner rated at 40,000 BTU per hour or below. For a 4 inch existing vent or vent connector, the burner rating is limited to 134,000 BTU per hour (for a 50 foot vent height). Two or more naturally vented appliances with a 4 inch vent and connectors are limited to 89,000 BTUs per hour for a 100 foot vent height, 86,000 BTUs per hour for a 50 foot vent height as provided by the NFPA National Fuel Gas Code vent sizing regulation. The capability of a 1/2 inch gas line is dependent on the number of other gas appliances in the home, the length of the gas line between the home meter and the appliance, and the pressure in the gas line. Each consumer or homeowner has a potentially different installation. The maximum 1/2 inch pipe capacity with a straight length of 10 feet will allow for an appliance rated up to 175,000 BTUs per hour (NFPA National Fuel Gas Code vent sizing for pressure less than 2 psi in W.C. Drop). Tankless-style and power-vented gas water heaters can also be included, with metal or PVC vents, 2-4 inches in diameter, up to a maximum capacity of a 1/2 inch gas line as defined above. The drop-in dual fuel heat pump water heater must be able, therefore, to attach to a 3-4 inch vent with a maximum burner rating for the 3 inch vent of 40,000 BTUs, a 4 inch vent has a maximum 134,000 BTUs, a 1/2 inch gas line, and preferably the dual fuel heat pump water

heater is able to plug into a standard 120 V outlet so that no dedicated circuit for the water heater is required.

[0034] It would also be desirable to not have to change the vent pipe, however, this will be required in some arrangements because code will require a forced draft associated with a tankless burner that requires a fan and cannot be ducted into the same chimney associated with a natural venting style burner. Therefore, some configurations will require venting to an independent chimney or a wall vent per code requirements.

[0035] In still another embodiment of FIG. 3 (FIGS. 3A and 3B), the water can be routed from the gas burner assembly 14 situated at the outlet (i.e., outside of the tank body 16 and may be within the housing) and directly to an appliance or delivery faucet. In the configuration of FIG. 3, the burner 14 is provided on the outlet and is not intended to heat the water in the entire tank. The heat pump is used to heat the water in the tank, and the burner raises the temperature of the water passing through the outlet to the final desired temperature if the tank temperature is not sufficient to meet the temperature demand. A 120 V heat pump water heater with the storage tank is provided that uses a high efficiency burner. The burner of FIG. 3 heats the outlet water, and raises the outlet temperature to a desired level whenever the heat pump is unable to deliver water at the desired temperature level. The burner capacity of this configuration is limited by the existing gas supply, and in this arrangement, there is requirement to vent to the independent chimney or the wall vent per code requirements. Therefore, this configuration of FIG. 3 (like the embodiment of FIG. 2) has some advantages in replacing a conventional gas water heater, but may not be as desirable as the embodiment of FIG. 1 which more completely matches all of the associated infrastructure.

[0036] A controller 36 is operatively associated with both the first and the second heater types 12 (heat pump), 14 (gas burner). The controller 36 selectively energizes the heater types based on data representative of water temperature within the interior tank body and/or the occurrence of a flow event transmitted to the controller 36 for processing. The controller 36 is operatively connected to the first and second heater types 12, 14 and includes a module that facilitates the automatic selection and energizing of at least one of the heat pump 12 and the gas assembly 14 in response to the data received that is representative of the water temperature and/or flow event.

[0037] At least one sensor 38 measures the temperature of the water stored in the tank body. The controller 36 receives a signal from the sensor(s) 38 indicative of the water temperature. The controller 36 can use inputs from other sensors to base calculations and to make similar determinations. The sensor 38, for example, may be situated in or on the tank body 16 to measure water temperature. A first sensor may be placed on or in a lower portion of the tank body 16 to monitor water temperature in that region. Alternatively, the sensor may be placed in an upper portion of the tank body 16 depending on the particular embodiment of dual fuel, hybrid gas water heater that is used. In still another arrangement, at least first and second sensors may be placed on or in at least two regions of the tank body 16.

[0038] In other arrangements, additional data or sensor information may be provided to the controller. For example, a sensor such as a thermistor may be added to monitor one or more of the compressor outlet, the evaporator inlet, evaporator outlet, or sense ambient temperature. However, one skilled in the art will appreciate that these additional sensors are

optional only and may provide greater accuracy or control, although the additional sensors are not required for effective operation of the dual fuel/hybrid heat pump gas water heater.

[0039] For example, with respect to the embodiment of FIG. 1, the controller receives sensor inputs T1 and T2, i.e. representative of two sensors on the tank, although it may be possible to use a single sensor to monitor the tank temperature. If two sensors are used, one of the sensors may be used for the redundant gas control (if power is lost) and the water heater would be capable of operating without power using the single sensor. However, if external power is provided, the main control monitors the first or upper sensor and operates the water heater based on this data. In yet another embodiment, two sensors can be used by the same controller, with the output from the first sensor being used to operate the first heater type, and the output from the second sensor being used to operate the second heater type.

[0040] The controller may receive data regarding the evaporator inlet (T3A) and the evaporator outlet (T3B), the compressor discharge temperature (T4), and ambient temperature (T5). The main control can turn the heat pump on and off as an output, and likewise turn the gas burner on and off as an output. In addition, the controller may provide an output signal to an external boost fan for ducted kits.

[0041] Still further, the main controller may provide for mode selection and the controller preprogrammed for various modes. For example, in an "economic mode", heat may only be provided by the heat pump which in the long run is the most energy efficient. Another choice may be to use a "hybrid" mode in which control could be alternated between the heat pump and the gas. Still another choice is to use a "standard gas" mode, that is, to operate the dual fuel heater in a gas only mode. Still another choice may be a "high demand" mode which uses the heat pump and gas as a mix, but more readily uses gas. By way of example only, in the "hybrid" mode noted above, gas is used as a backup when the tank is substantially emptied but in the "high demand" mode, gas is used readily when the tank is only partially emptied. Still another mode could be "external demand response module" in which operation of the dual fuel water heater depends on a utility provided real-time signal or data that would operate the water heater as the utility would prefer. In still another mode, referred to here as a "low dollar cost mode", the user inputs the gas and electricity rates and the controller then operates the dual fuel water heater in the lowest cost or expense to the homeowner. Yet another option may be a "peak load control" mode that serves as a balance between the homeowners desired use of the dual fuel water heater based on cost or expense relative to the real-time electric and gas rate data received from the utility. Accordingly, the user interface of the controller would allow a homeowner to select one of these options or modes, although one skilled in the art will understand that these modes are representative only and other modes could be used or provided as options without departing from the scope and intent of the present disclosure.

[0042] One feature associated with the present disclosure is an ability to utilize the least expensive utility in regions of the country that generally heat water by only a gas water heater source. It is anticipated that the heat pump 12 portion of the presently disclosed water heater 10 can operate on a maximum of six amps and one-hundred-twenty volts power, which is a voltage and a current level readily available at most convenience outlets located in proximity of the water tank installation. Electric utility can be used for the main heater

type source to generally heat the water for slower recovery periods, but the gas utility can be used for instances requiring faster recovery periods. The threshold value can be programmed into the controller 36 to be such that the controller deactivates the first heater type 12 and actuates the second heater type 14 at values that are the most economical and cost efficient. The controller may selectively set, reset and/or change predetermined temperature thresholds based on input received from an energy billing device, which indicates periods of high and low energy demand. Alternatively, the temperature thresholds can be input by a homeowner at a user interface, or the user inputs current average gas rates and electrical rates, and the controller uses the lowest total cost source of the mix/ratio/combination to heat water at the lowest cost. Other embodiments are contemplated which utilize a twenty Amp, two-hundred-forty volt circuit. Still, there is no limitation made herein to a capacity or a power range in which the heat pump heater type requires or utilizes.

[0043] FIG. 4 illustrates a method of heating water in a water tank utilizing the two heater types disclosed herein and, more specifically, a method of heating the water stored in the tank utilizing at least two modes of operation. The controller receives inputs at any given time and operatively manages various modes of operation to achieve set temperatures as shown in FIG. 4. The method starts at step 200. The tank body is filled with water from an external water supply source through the water supply line at step 202. This water is generally cold and/or cooler in temperature than the water stored in the tank depending on the season and the source of supply. The controller receives a signal 204 from a water tank sensor indicative of the temperature of the water. The temperature is compared against a threshold temperature value 206. The controller actuates the first heater type 208 if the water temperature is below the temperature threshold value. The controller more specifically actuates the first heater type 208 by controlling the power supply to the heat pump fan(s) and power to the compressor.

[0044] Another instance when water may fall below the temperature threshold value is when the water volume is left in the tank for long durations. For example, if there is no water displacement occurring as a result of water removed from the tank for delivery to faucets and appliances, then the tank water may fall below the desired temperature threshold value. In both instances, the controller can actuate the first heater type 208 to heat the water to the desired temperature. For example, the controller actuates the first heater type 208 to heat the water to a temperature having a preselected threshold value. In another embodiment, the controller 36 may also set and adjust threshold temperature values based on predicted demands, which the controller estimates using previous water usage patterns that it tracks. The user interface (not shown) may also be included on an exterior of the water tank 10 for user-input, wherein user-selected temperature threshold settings may be programmed into the controller for the predetermined values used in the controller calculations.

[0045] The first heater type preferably maintains the value above the set-point 210. In one embodiment, the controller de-energizes 212 the first heater type once the temperature of the water reaches above the set-point temperature. The first heater type then re-energizes 212 when the temperature falls below the set point.

[0046] Dual fuel water heaters are also dependent on the relative costs of the different fuels. At times, electricity may be a more stable cost and thereby a utility may encourage the

homeowner to use the heat pump and only occasionally use the backup or gas burner during those periods of peak need. Thus, interaction or communication with utility is often required so that the homeowner is encouraged to flexibly use the dual fuel water heater and take advantage of benefits offered by the utility, for example in terms of cost. If the homeowner has only a single fuel water heater, the choice in response to communication from the utility would be a simple on/off condition, i.e., either use the water heater or don't use the water heater dependent on the communication received from the utility. However, with the dual fuel water heater, the choices for the homeowner are much wider ranging. Therefore, the homeowner may select one fuel or another based simply on cost, while the utility may encourage one fuel or another based on what is best for the overall grid or utility system. It will be appreciated that the homeowner choice, and that being encouraged by the utility company, may not always be the same. However, if the water heater is capable of catering to either the selection of the homeowner or the suggestion proffered by the utility, then the options or solutions can likely be satisfied with a dual fuel water heater. Generally, however, the homeowner will be encouraged to use the heat pump to slowly and more efficiently heat the water stored in the tank. Further, and as noted above, the dual fuel water heater offers the advantage of providing heated water even when electrical power is lost. Likewise, providing a drop-in replacement that is highly efficient is also achieved.

[0047] The disclosure has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the disclosure be construed as including all such modifications and alterations.

What is claimed is:

1. A water heater, comprising:
 - a tank body for storing a volume of associated water, including:
 - a cold water supply line for delivering associated water to the tank body, and,
 - a water discharge line for egress of heated associated water from the tank body;
 - a first type of heater for heating the associated water in the tank body; and,
 - a second type of heater having a different energy/fuel source than the first heater type for heating the associated water.
2. The water heater of claim 1, wherein the first heater type includes a heat pump.
3. The water heater of claim 2, wherein the heat pump includes:
 - an evaporator;
 - a compressor operatively associated with the evaporator;
 - a condenser for transferring heat thereto;
 - a restriction, and
 - a fan operatively associated with the evaporator for directing ambient air over the evaporator and transferring heat thereto.
4. The water heater of claim 3, wherein the condenser is wrapped around an outer surface of the tank body.
5. The water heater of claim 1, wherein the second heater type is a gas burner.
6. The water heater of claim 5, wherein the gas burner assembly is situated at and heats a base portion of the tank body.

7. The water heater of claim 5, wherein the gas burner assembly is situated proximate to the tank body.

8. The water heater of claim 1, further including:
at least one sensor for measuring a temperature of the associated water stored in the tank body; and,
a controller receiving a signal from the at least one sensor indicative of associated water temperature; and,
the controller actuates at least one of the first and second heaters in response to the sensed temperature.

9. The water heater of claim 1 wherein one of the first and second heater types is operational in the event of an electrical power outage.

10. A method of heating water, comprising:
delivering water to a tank body through a water supply line;
storing a volume of the water in the tank body;
heating the water in the tank body with a first type of heater;
and,
selectively using a second type of heater having a different energy/fuel source than the first heater type to heat the water when a threshold is met.

11. The method of claim 10, further including using a heat pump assembly for the first heater type.

12. The method of claim 11, further including using a gas burner assembly for the second heater type.

13. The method of claim 10, wherein a first heater type heats the water to a preselect temperature, and a second heater type supplements heating of the water.

14. The method of claim 10, wherein the first heater type is a heat pump and the second heater type is a gas burner assembly.

15. A water heater, comprising:
a tank body for storing a volume of associated water, including:
a cold water supply line for delivering associated water to the tank body, and,
a water discharge line for egress of heated associated water from the tank body;

a heat pump for heating the associated water in the tank body with an associated working fluid that circulates through the heat pump, including:
an evaporator,
a compressor,
a condenser for transferring heat to the associated water stored in the tank body,
a throttling device, and,
a fan for directing air over the evaporator and transferring heat from the air to the associated working fluid in the evaporator; and,
a gas burner assembly for heating the associated water;
at least one sensor for measuring a temperature of associated water stored in the tank body; and,
a controller receiving a signal indicative of the temperature of the associated water and selectively using the heat pump and/or gas burner.

16. The water heater of claim 15, wherein the controller actuates the gas burner assembly if a relative temperature change over a preselect time period exceeds a threshold value.

17. The water heater of claim 15, wherein the condenser is received around an outer surface of the tank body.

18. The water heater of claim 15, wherein the gas burner assembly is situated at and heats a base portion of the tank body.

19. The water heater of claim 15, wherein the gas burner assembly is situated proximate to a surface of the tank body.

20. The water heater of claim 15 further comprising a demand response module for communicating with an associated utility, and a controller that receives data input from the water heater and the utility to determine a desired operation of the water heater.

21. The water heater of claim 15 wherein the condenser is either located remotely and water from the tank body is recirculated via a pump or via natural convection to the condenser and back to the tank body, or the condenser is in direct contact with water in the tank body.

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