



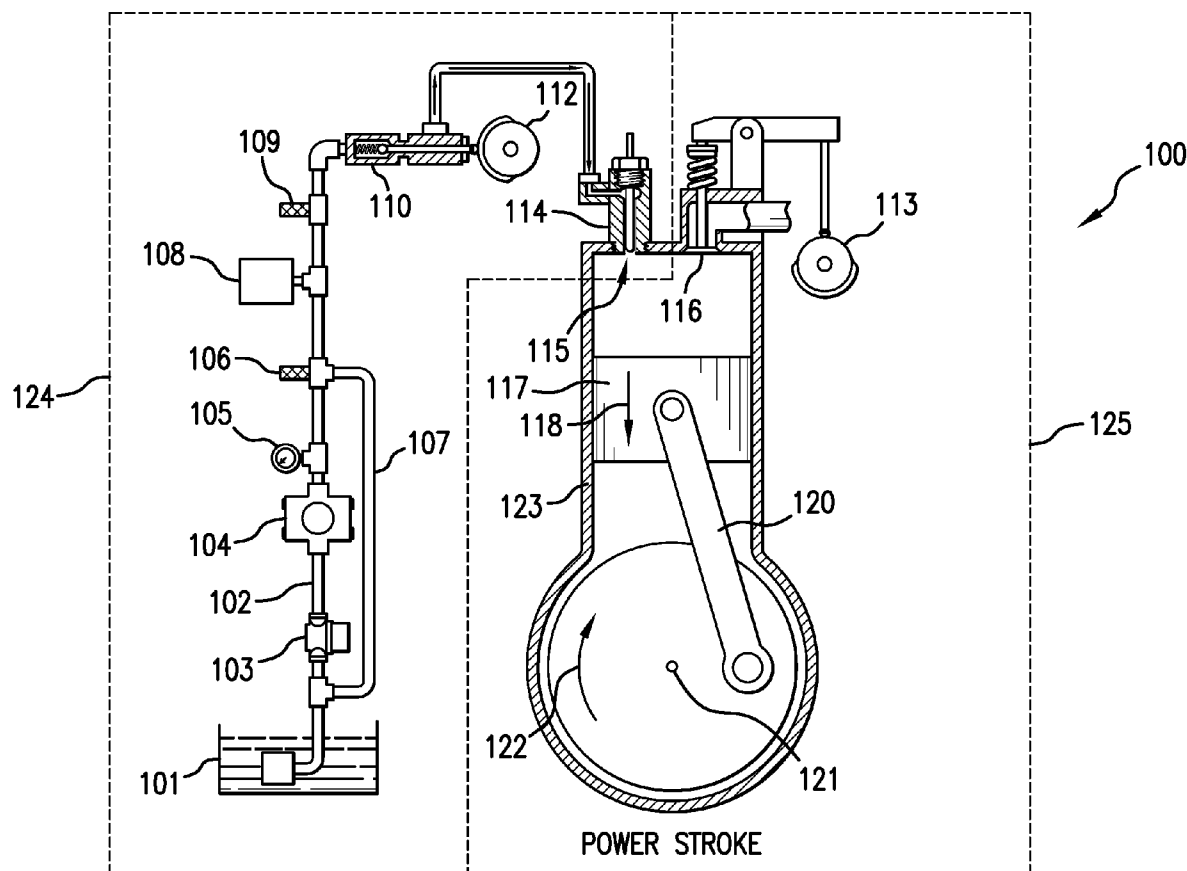
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(19) **United States**(12) **Patent Application Publication**
Jordan(10) **Pub. No.: US 2007/0251238 A1**(43) **Pub. Date: Nov. 1, 2007**(54) **STEAM ENGINE DEVICE AND METHODS
OF USE**(52) **U.S. Cl. 60/645**(76) **Inventor: Kenneth Jordan, Daniels, WV (US)**(57) **ABSTRACT**

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(21) **Appl. No.: 11/737,516**(22) **Filed: Apr. 19, 2007****Related U.S. Application Data**(60) **Provisional application No. 60/793,274, filed on Apr. 19, 2006.****Publication Classification**(51) **Int. Cl.**
F01K 13/00 (2006.01)

Steam engine products and related methods are disclosed. In one embodiment of the present invention, a steam engine includes a water pump, a steam generation system having a water inlet configured to receive water from the water pump, an electric heating element configured to convert the water into pressurized steam, and a steam outlet configured to expel the pressurized steam from the steam generation system. The steam generation system is configured to receive water through the water inlet, channel the water to the electric heating element, and expel pressurized steam through the steam outlet. The steam engine also has a power generation system having a steam inlet configured to receive pressurized steam from the steam generation system and generate mechanical energy, wherein the electric heating element is configured to convert water into pressurized steam as the water is pumped into the steam generation system.



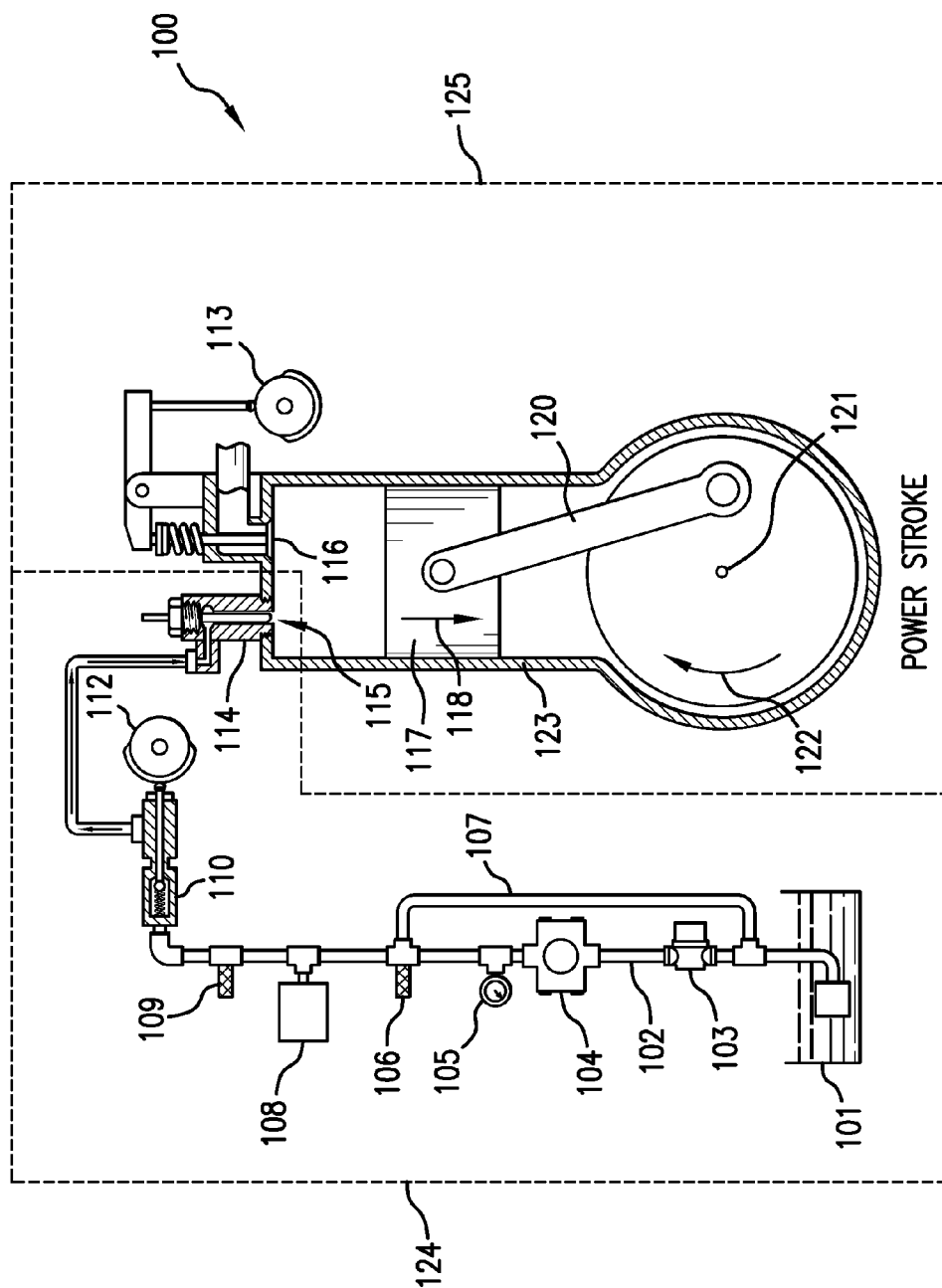


FIG. 1

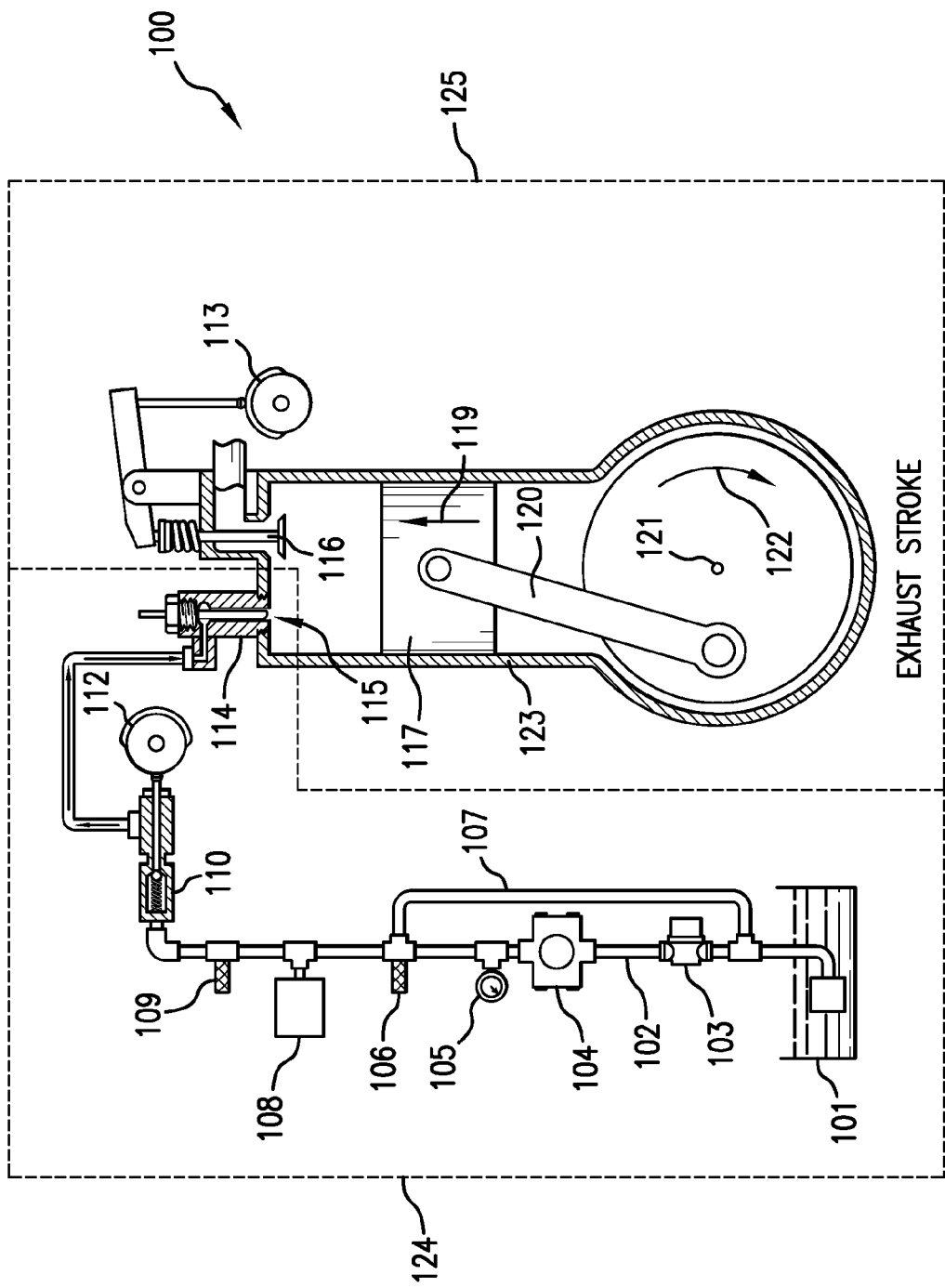


FIG.2

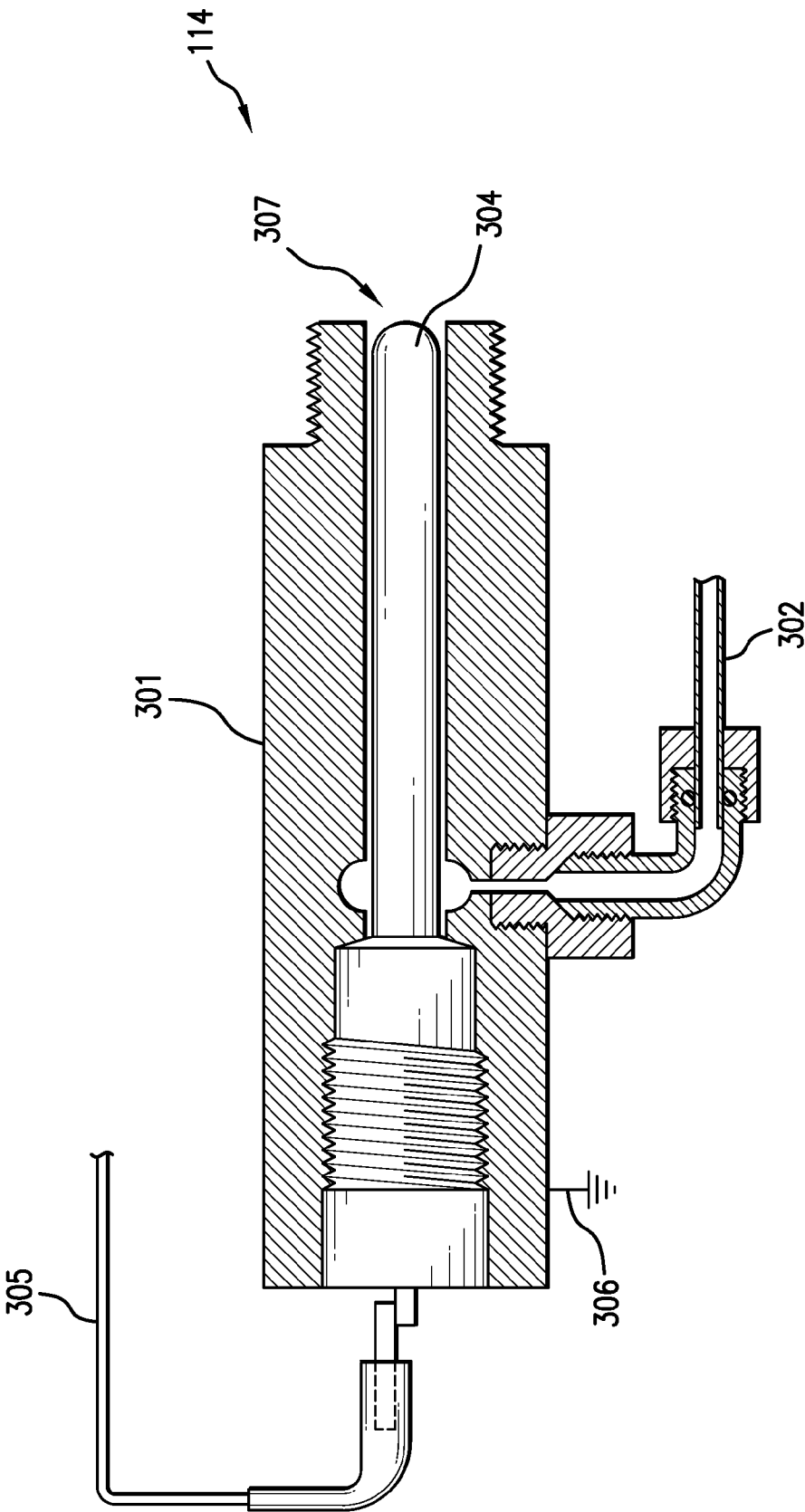


FIG.3

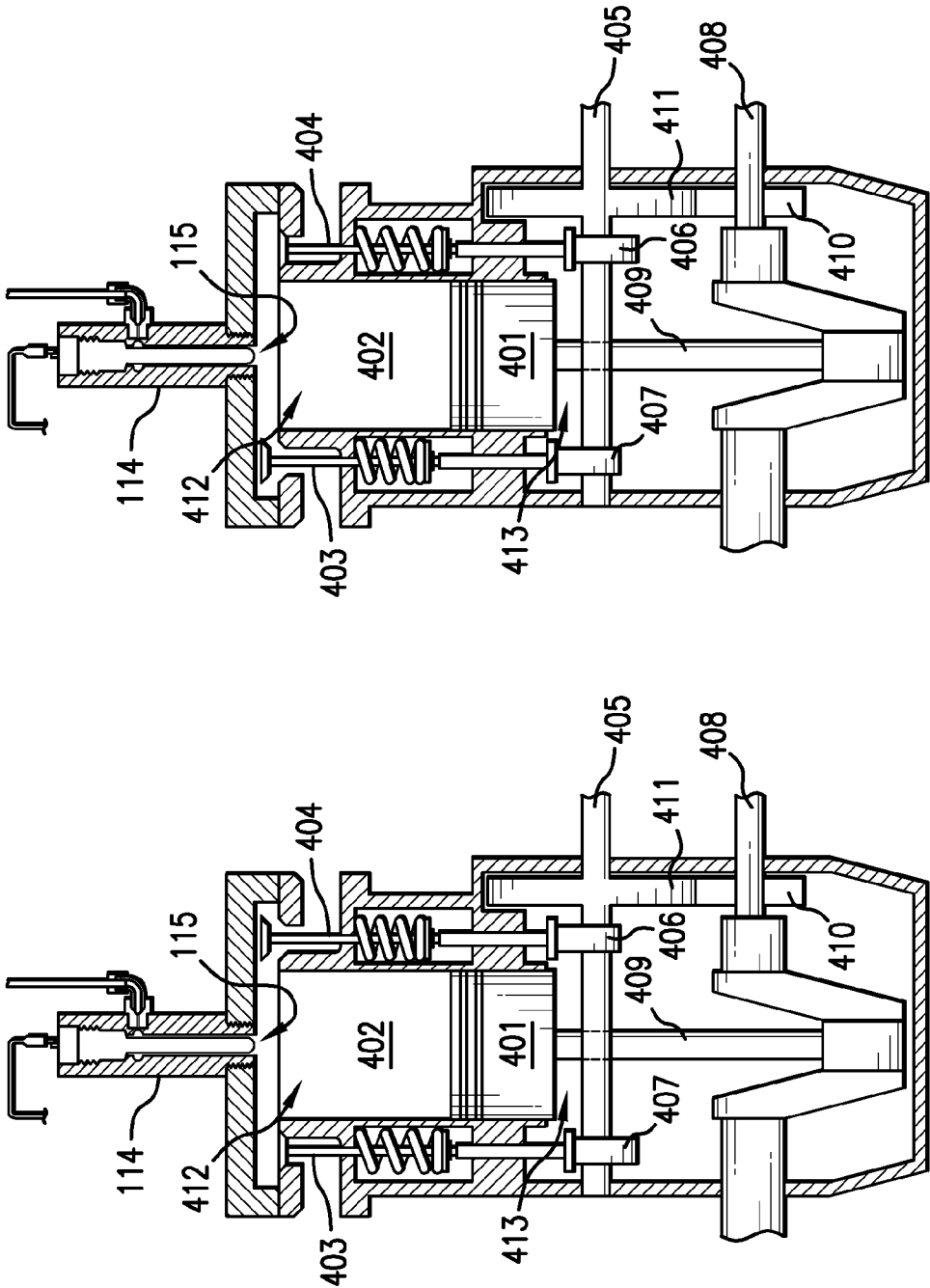


FIG. 5

FIG. 4

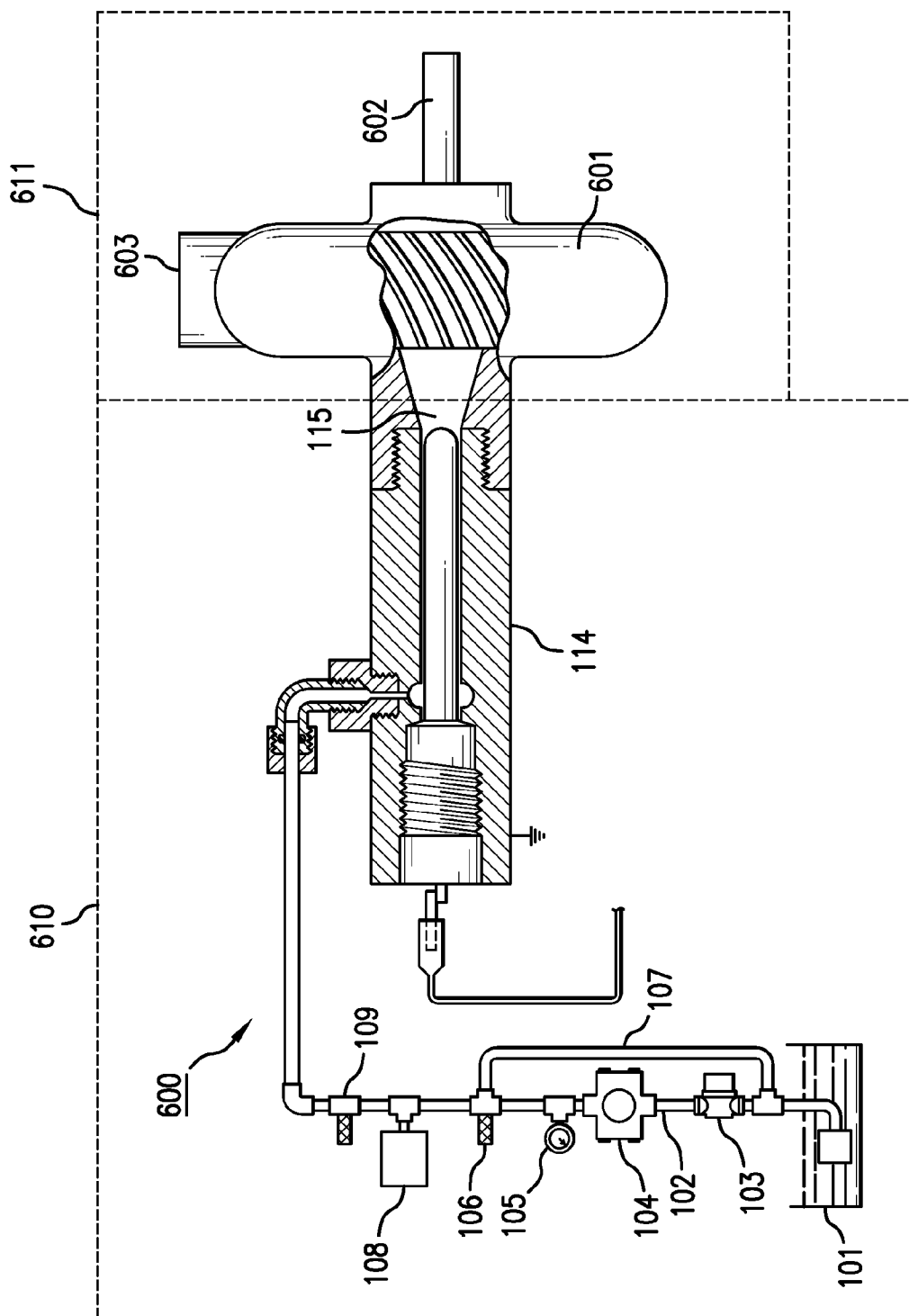


FIG. 6

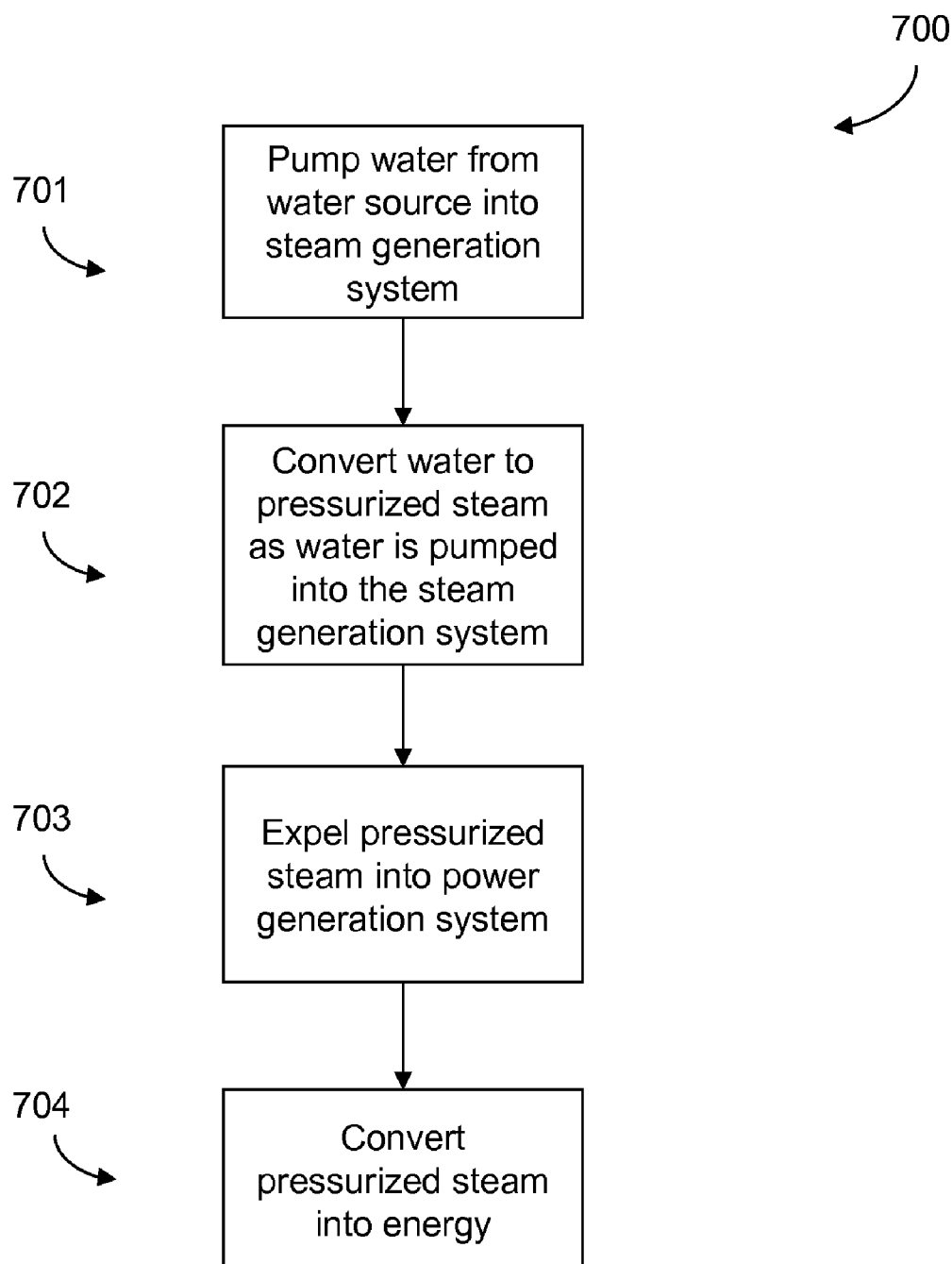


Figure 7

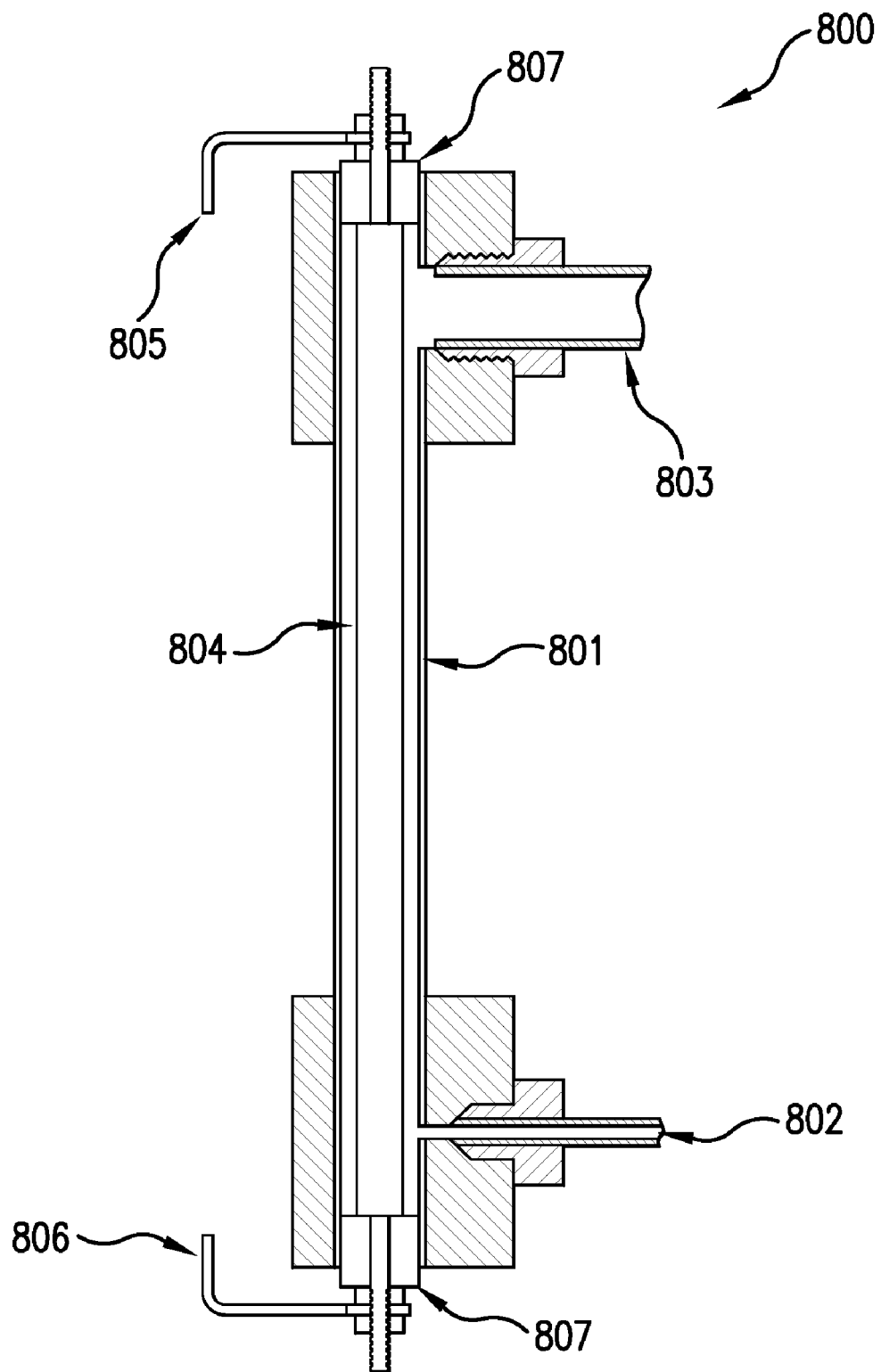


FIG. 8

STEAM ENGINE DEVICE AND METHODS OF USE**CROSS-REFERENCES TO RELATED APPLICATION**

[0001] This application claims priority to U.S. Provisional Patent Application No. 60/793,274, filed Apr. 19, 2006, entitled "Steam Engine Products and Related Methods," the entirety of which is hereby incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to engines and more particularly to steam engines.

BACKGROUND

[0003] The use of pressurized steam may be an effective means of generating motive energy in an engine. A conventional steam engine may include, for example, a boiler, partially filled with water, which is heated by a fire such that the water is converted to steam. The steam may be pressurized and routed through pipes into, for example, a cylinder where it may force a piston to move.

[0004] Such a steam engine may be used to provide power, for example, for locomotives and ships. On a locomotive, the piston may be attached to one or more wheels by a drive rod and a coupling rod. A boiler may generate steam that is pressurized and routed to move a piston. As the piston moves, it forces the drive rod and the coupling rod to move back and forth, providing force to turn the wheels of the locomotive. On a ship, the piston may be connected to a crankshaft that causes a propeller to turn.

[0005] Conventional steam engines may have disadvantages in their structure and operation. The boiler of a conventional steam engine may contain high pressure steam during operation. If the boiler ruptures, it may cause a catastrophic explosion. Boilers and the water within may require a substantial amount of time to heat and to generate enough steam to begin generating power. Additionally, when a conventional steam engine is turned off, a substantial amount of energy may be wasted as the unused steam condenses and the water in the boiler cools.

SUMMARY

[0006] Embodiments of the present invention may provide steam engine devices and methods of use. One embodiment of the present invention provides a steam engine comprising a water pump system, and a steam generation system comprising an electric heating element configured to convert water received from the water pump system into pressurized steam as the water is pumped into the steam generation system. The steam engine may further comprise a power generation system configured to receive the pressurized steam from the steam generation system and generate energy.

[0007] This illustrative embodiment is provided as an example to aid in understanding of the present invention. As will be apparent to those of skill in the art, many different embodiments of steam engines and methods of use according to the present invention are possible. Additional uses, advantages, and features of the invention are set forth in the illustrative embodiments discussed in the detailed descrip-

tion herein and will become more apparent to those skilled in the art upon examination of the following.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] These and other features, aspects and advantages of the present invention may be better understood when the following Detailed Description is read with reference to the accompanying drawings.

[0009] FIG. 1 is a diagrammatic view of components of a steam engine showing a power stroke in one embodiment of the present invention.

[0010] FIG. 2 is a diagrammatic view of components of the steam engine of FIG. 1 showing an exhaust stroke.

[0011] FIG. 3 is a diagrammatic view of a steam generation system in one embodiment of the present invention.

[0012] FIG. 4 is a diagrammatic view of components of the steam engine of FIG. 1 showing an exhaust stroke.

[0013] FIG. 5 is a diagrammatic view of components of the steam engine of FIG. 1 showing an exhaust stroke.

[0014] FIG. 6 is a diagrammatic view of components of a steam turbine engine in one embodiment of the present invention.

[0015] FIG. 7 is a flowchart showing a method of generating energy according to one embodiment of the present invention.

[0016] FIG. 8 is a diagrammatic view of an electric heater element in one embodiment of the present invention.

DETAILED DESCRIPTION

[0017] Embodiments of the present invention may provide a steam engine device and methods of using a steam engine.

[0018] An example of a steam engine according to one embodiment of the present invention comprises a water pump system, a steam generation system, and a power generation system. The power generation system may include a piston within a cylinder, in which the piston is connected to, for example, a crankshaft. The water pump system may pump water from a water supply into the steam generation system. The steam generation system may comprise an electric heating element, adapted to rapidly heat the water, converting it to steam. In one embodiment, the heating element comprises an electric tube heater. In one embodiment, the heating element comprises an electric probe heater. In one embodiment the heating element may be powered by a battery. For example, a suitable heating element may comprise a 1700 watt electric tube heater. Other suitable heating elements may comprise heating elements up to or greater than 5000 watts. Such heating elements may rapidly convert water to pressurized steam.

[0019] The pressurized steam may be pressurized and injected into the cylinder through a steam inlet when the piston is near a first end of the cylinder. The pressurized steam exerts a force on the piston, which causes it to move towards the second end of the cylinder. The forced motion of the piston towards the second end of the cylinder is referred to as the "power stroke" because the pressurized steam may be used to generate energy capable of powering a machine. When the piston is near the second end of the

cylinder, the injector valve may be closed, which may reduce or cut off the supply of steam, and an exhaust valve at the first end of the cylinder opens. The rotational momentum of the crankshaft may push the cylinder back towards the first end of the cylinder, which may force steam out of the cylinder through the exhaust valve. The motion of the piston towards the first end of the cylinder is referred to as the "exhaust stroke" because this motion causes pressurized steam within the cylinder to be forced out of the cylinder through the exhaust valve. Once the piston is near the first end of the cylinder, the exhaust valve may close and the next power stroke may begin. An alternating series of power and exhaust strokes may be used to maintain motive energy to operate a machine, for example, to power rotation of a crankshaft. In an embodiment of the present invention, a part of the power generated by the engine may be used, by way of an alternator, to charge a battery that supplies electricity for electric heating element in the steam generation system.

[0020] Certain embodiments of the present invention may have many advantages over conventional steam engines. By eliminating a boiler, embodiments of the present invention may eliminate the safety risk of a boiler explosion. In embodiments of the present invention comprising an electric heating element, engine startup times may be greatly reduced as compared to engines having a boiler, because there is no need to boil a large quantity of water. In addition, because a large quantity of water is not heated to a boil, fuel consumption and energy loss due to cooling and reheating water may be reduced. A further advantage of the present invention is reduced emission of pollution. Embodiments of the present invention may be electrically powered and only release steam, i.e. heated water vapor, as exhaust, rather than the chemicals produced by internal combustion engines that use petroleum-based fuels. A still further advantage is that embodiments of the present invention may be made small enough to be used to power small machines, such as a lawn mower. Other embodiments of the present invention may have some or all of these advantages. Further embodiments may have none of these or may have additional advantages.

[0021] In an illustrative embodiment of such a steam engine, water may be pumped from a water tank onto a heating element in a steam generation system. In certain embodiments, the water may be pumped at a pressure of at least approximately 1000 pounds per square inch ("PSI"). The heating element may be an electric heating element powered, for example, by a battery. The heating element may convert the water into high pressure steam and inject the steam into one end of a cylinder chamber comprising a piston that may travel the length of the cylinder. The steam may be injected into the cylinder at substantially the same time the piston is nearest a first end of the cylinder from which the steam is injected. The pressure generated by the steam forces the cylinder to travel away from the first end of the cylinder towards a second, opposite end of the cylinder. The piston may be connected to a crankshaft by a connecting rod such that when the piston reaches its closest position to the second end of the cylinder, the piston stops and is forced back towards the first end of the cylinder by the rotational inertia of the crankshaft, which in turn causes steam to be forced out of the cylinder through the exhaust valve. At substantially the point, or time, at which the piston stops traveling towards the second end of the cylinder, injection of steam into the cylinder may be stopped and an exhaust valve

may be opened, which allows steam to escape from the cylinder. As pressurized steam is released from the cylinder through the exhaust valve, the piston moves back towards the first end of the cylinder. Movement of the piston toward the first end of the cylinder helps force steam out of the cylinder through the exhaust valve. When the piston nears the first end of the cylinder, the exhaust valve closes, and this cycle may be repeated, beginning with water being pumped at high pressure into the steam generation system.

[0022] In an illustrative embodiment shown in FIGS. 1 and 2, the steam engine 100 may comprise two systems: a fueling system 124 and a power generation system 125. The fueling system 124 may comprise components to pump water onto a heater element in a steam generation system 114. In the steam generation system 114, the water may be heated and converted to steam, which may be injected into the power generation system 125 at a pre-determined time. The power generation system 125 may comprise components for using pressurized steam from the fueling system 124 to generate energy capable of powering operation of a machine.

[0023] In the embodiments shown in FIGS. 1, 2 and 3, the steam generation system comprises a housing, a water injector line, an electric probe heater 114 having positive and negative electrical leads 305, 306, and a steam outlet 115. FIG. 3 shows a diagram of the steam generation system 114 of a steam engine in which an electric current is used to power the heating element. In the embodiment shown, the probe heating element 304 is capable of being heated to about 1000-1400 degrees Fahrenheit (F). Other embodiments may comprise heating elements capable of being heated to higher or lower temperatures. Embodiments may comprise heating elements configured other than as a probe heater, for example a coil heating element. The probe heating element 304 may be heated when electricity is passed from an electric power supply (not shown) through the probe heating element 304. Electricity may be supplied from the electric power supply, such as a battery, via the positive electric line 305. The electrical current flows through to the negative electrical line 306, which may be connected to the power supply.

[0024] In the embodiment shown in FIGS. 1-3, when the probe heating element 304 is operating within a temperature range of 1000-1400 degrees F., water may be injected at high pressure through the water injector line 302 such that it contacts the probe heating element 304 and is converted to pressurized steam. The steam in the steam generation system 114 may be pressurized to approximately 1000 PSI. The pressurized steam may pass out of the steam generation system 114 through the steam outlet 307. In such an embodiment, the steam outlet 307 may be configured to channel pressurized steam into the power generation system 125 of the steam engine 100. In another embodiment, the steam outlet 307 may channel steam into a pressure vessel (not shown) for later storage and injection into the power generation system 125 of the steam engine 100.

[0025] The fueling system 124 may comprise a water storage tank 101, a main water pipe 102, a pump 104, an injector valve 110, and steam generation system 114. The fueling system 124 may include other components such as a line strainer 103, an unloader valve 106, a bypass pipe 107, an accumulator 108, an injector cam 112, a pressure gauge

105 and a flow control valve **109**. Embodiments of the present invention may use fluids other than water that may be pumped under pressure and heated to create a gas capable of moving a piston. Alternatively, an embodiment may utilize a power generation mechanism that pressurizes an existing gas for moving a piston.

[0026] Embodiments of the present invention may include various combinations of the fueling system **124** components described herein. Some embodiments may comprise additional fueling system **124** components. For example, an embodiment of the present invention may comprise a pressure release valve (not shown) to allow water or steam to flow out of the steam engine if the water or steam pressure becomes greater than a threshold.

[0027] The fueling system **124** components may be interconnected and operate in combination to provide fuel to the power generation system **125**. For purposes herein, an "upstream" component is defined as a component located upstream relative to a particular component in the direction of the water tank **101**. A "downstream" component is defined as a component located downstream relative to a particular component in the direction of the power generation system **125**. For example, referring to FIG. 1, the line strainer **103** is located upstream from the pump **104**, while the pressure gauge **105** is located downstream from the pump **104**.

[0028] In the embodiment shown in FIGS. 1 and 2, the components of the fueling system **124** are interconnected. The main water pipe **102** provides a means for water to flow from the water tank **101** to the steam generation system **114**, the water tank **101** being at the upstream end of the main water pipe **102**, and the heater element **114** at the downstream end of the main water pipe **102**. Between the water tank **101** and the heater element **114**, the pump **104** is connected in-line to the main water pipe **102**. Downstream of the pump **104**, the injector valve **110** and injector valve cam **112** may be located in-line to the water pipe. The injector valve cam **112** may be configured to periodically open and close the injector valve **110**. These components are connected such that when the pump **104** is activated, water may be pumped from the water tank **101** into the main water pipe **102**, through the pump **104**, and into the injector valve **110**. The injector valve cam **112** actuates opening and closing of the injector valve to inject pressurized water into the steam generation system **114** in a manner relative to timing of movement of the piston **117** in the power generation system **125**.

[0029] Embodiments of the present invention may comprise pumps of varying size and pressure ratings. For example, in the embodiment shown, the pump **104** may be capable of pumping and maintaining a constant supply of water to the injector valve at a pressure of at least 1,000 PSI. Other embodiments may comprise pumps capable of pumping water at pressures greater than or less than 1,000 PSI. Other embodiments may comprise multiple pumps.

[0030] Embodiments of the present invention may comprise one or more accumulators. The accumulator **108** may be used to eliminate or minimize changes in water pressure within the fueling system **124** as the injector valve **110** opens and closes. During operation of an embodiment of the present invention, the accumulator **108** may be partially filled with pressurized water. Just as the injector valve **110** opens, the fueling system **124** may experience a loss in water

pressure as water exits the main water pipe **102** to enter the steam generation system **114**. To maintain a constant water pressure, the accumulator **108** may re-introduce some or all of its water into the main water pipe **102**. Further, just as the injector valve **110** is closed, the main water pipe **102** may experience an increase in water pressure as water is prevented from flowing into the steam generation system **114**. The accumulator **108** may partially or completely fill with water to reduce the pressure within the main water pipe **102**.

[0031] In one embodiment of the present invention, the water pump system may comprise a pressure gauge **105**. The pressure gauge **105** may be used to monitor pressure within the water pump, or fueling, system **124**. For example, a lower than expected pressure reading on the pressure gauge **105** may indicate a leak in the fueling system **124**. A higher than expected reading may indicate that an adjustment is needed to a component within the fueling system **124**, such as the unloader valve **106**. Further, the pressure gauge **105** may indicate when pressure in the fueling system **124** is no longer within a safe pressure range. The pressure gauge **105** may have other functions, for example, in conjunction with other components to provide an engine that is capable of self-regulation of water pressure or shutting itself off if pressure levels indicate a malfunction.

[0032] As shown in the embodiments in FIGS. 1 and 2, the fueling system **124** may further include unloader valve **106** and bypass pipe **107**. The unloader valve **106** may be connected to the main water pipe **102** downstream from the pump **104** and upstream from the injector valve **110**. The unloader valve **106** may be further connected to the bypass pipe **107**, which connects to the main water pipe **102** at a point upstream from the pump **104**. When the unloader valve **106** is open, water may flow from the main water pipe **102** into the bypass pipe **107**. Conversely, when the unloader valve **106** is closed, water is prevented from flowing from the main water pipe **102** into the bypass pipe **107**. Between the connection point of the bypass pipe **107** to the main water pipe **102** and the pump **104**, a line strainer **103** may be connected in-line to the main water pipe **102** to strain undesired impurities from the water. Downstream from the unloader valve **106**, the accumulator **108** may be connected to the main water pipe **102** between the unloader valve **106** and the injector valve **110**. The flow control valve **109** may be connected to the main water pipe **102** between the accumulator **108** and the injector valve **110**. The pressure gauge **105** may be connected between the pump **104** and the unloader valve **106**.

[0033] In the embodiments shown in FIGS. 1 and 2, the various components of the water pump system **124** operate to provide water to the steam generation system **114**, which in turn heats and converts the water into steam for injection into the power generation system **125** of the steam engine **100**.

[0034] As the embodiments of the steam engine **100** shown in FIGS. 1 and 2 operate, the injector valve cam **112** controlling the injector valve **110** rotates and periodically opens and closes the injector valve **110**. The cam **112** may have a small protrusion that, as the cam **112** rotates, contacts the injector valve **110** and displaces the injector valve **110**, causing it to open. As the protrusion rotates out of contact with the valve **110**, the valve **110** is no longer displaced and it closes. This periodic opening and closing of the injector

valve **110** creates a cyclic introduction of pressurized water into the steam generation system **114**, where steam is generated for injecting into the power generation system **125** of the steam engine **100**. Other embodiments of the present invention may use another method to open the injector valve **110**. For example, the cam **112** may cause a periodic opening and closing in a manner other than by rotation. In still other embodiments, the injector valve **110** may be periodically opened and closed by hydraulic lifters instead of the cam **112**. For example, a fluid may be periodically allowed to flow into the lifter, which then actuates the lifter with hydraulic pressure, causing the injector valve **110** to open. When the hydraulic pressure is released, the lifter returns to a rest position and the valve **110** closes.

[0035] For illustrative purposes, fueling system **124** operation is described in the context of a single cycle of the opening and closing of the injector valve **110**, comprising the following events: steady-state while the injector valve **110** is closed during the exhaust stroke; the transition state when the injector valve **110** is opening; steady state while the injector valve **110** is open during the power stroke; the transition state while the injector valve **110** is closing; and the steady state while the injector valve **110** is closed during the exhaust stroke.

[0036] During the steady state period when the injector valve **110** is closed, the pump **104** remains active and continues to pump water through the main water pipe **102**. In an alternative embodiment, the pump **104** may deactivate upon closing of the injector valve **110**. While the injector valve **110** is closed, pressure may build up within the main water pipe **102**. If pressure exceeds a pre-determined level, the unloader valve **106** may open so that water flows through the bypass pipe **107** back into the main water pipe **102** upstream from the pump **104**. This creates a closed loop through which water may flow while the injector valve **110** is closed in order to maintain a pressure within a desired range in the fueling system **124**. In addition to flowing through the bypass pipe **107**, water may flow into the accumulator **108**, where it may be stored for use on demand. Because the injector valve **110** is closed during this steady state period, no water flows into the steam generation system **114**, and hence no steam is produced in this phase.

[0037] After a predetermined period of time, the injector valve **110** may be opened by the injector valve cam **112**, allowing water to begin to flow through the injector valve **110**. During this phase, as water begins to flow through the injector valve **110**, the pressure in the main water pipe **102** begins to drop. At this point, the unloader valve **106** may close to prevent water from flowing through the bypass pipe **107**. In one embodiment, the unloader valve **106** may be responsive to pressure. In one embodiment, the unloader valve **106** may be responsive to the flow of fluid. To minimize the pressure fluctuation in the main water pipe **102**, the accumulator **108** may reintroduce a portion, or all, of its accumulated supply of water into the main water pipe **102**, helping to maintain a relatively constant water pressure in the main water pipe **102**. The flow control valve **109** may be used to regulate the volume of water that passes out of the main water pipe **102** for conversion to steam, thereby providing a throttling effect. Some embodiments of the present invention may be adapted to operate without a flow control valve. For example, in one embodiment of the present invention, the injector valve may be configured such

that it may be opened to allow varying amounts of water to pass through the valve. In such an embodiment, regulation of the volume of water that passes out of the main water pipe **103** for conversion to steam may be accomplished by adjusting the amount of water the injector valve allows to pass through it.

[0038] When the unloader valve **106** is closed to the bypass pipe **107**, water continues to flow past the unloader valve **106** and the bypass pipe **107**, through the injector valve **110**, and into the steam generation system **114** where it is converted to steam to be provided to the power generation system **125**. When the injector valve **110** closes, the unloader valve **106** reopens to allow water to flow into the bypass pipe **107**. Water may also flow into the accumulator **108**. This priming cycle in the fueling system may repeat in coordination with the operation of the power generation system while the steam engine **100** is in operation.

[0039] The power generation system **125** comprises components for generating energy from pressurized steam provided by the water pump system **124** as it is needed by the power generation system **125**. As shown in the embodiments in FIGS. 1 and 2, the power generation system **125** may comprise a piston **117** within a cylinder **123** such that the piston **117** may slide "up" and "down" within the cylinder **123**. For the purposes herein, "up" is defined as piston motion toward the first end of the cylinder **123** away from the crankshaft **121** in direction **119**, and "down" is defined as piston motion toward the second end of the cylinder **123** and the crankshaft **121** in direction **118**. "Up" and "down" are not intended to limit the orientation of a cylinder in embodiments of the present invention, but merely to provide convenient terminology for describing the motion of the piston. In embodiments of the present invention, the cylinder may be oriented in any direction.

[0040] As shown in the embodiments in FIGS. 1 and 2, the first end of the cylinder **123** may be sealed by a cover. The cover may have two openings, one of which may be controlled by an exhaust valve **116**, the other opening may be a steam inlet **115**. In an embodiment, the exhaust valve **116** may be opened and closed by an exhaust cam **113**. In another embodiment, the exhaust valve **116** may be opened and closed by hydraulic lifters. The piston **117** may be connected to a crankshaft **121** such that when the piston **117** moves up and down within the cylinder **123**, the sliding motion of the piston **117** will cause the crankshaft **121** to rotate **122**.

[0041] The power generation system **125** may operate in a single power cycle, meaning that the piston **117** is driven by pressurized steam on every downstroke **118**. In the embodiments shown in FIGS. 1 and 2, the full power cycle is shown in two phases: the power stroke in FIG. 1 and the exhaust stroke in FIG. 2. At the beginning of the power stroke, the piston **117** is near the first end of the cylinder **123** and steam from the steam generation system of the fueling system **124** is injected into the cylinder **123**. Pressurized steam may continue to be injected into the cylinder for most or all of the duration of the power stroke **123**. The pressure of the steam forces the piston **117** towards the second end of the cylinder **123**, causing the crankshaft **121** to rotate **122**. When the piston **117** has reached the point of its motion nearest the second end of the cylinder **123**, the power stroke ends and the exhaust stroke begins. Near the end of the power stroke

and the beginning of the exhaust stroke, the movement of the injector valve cam 112 closes the injector valve 110, thereby stopping the injection of steam into the cylinder 123. Simultaneously, or nearly simultaneously, with the closing of the injector valve 110, the exhaust valve 116 opens. The piston 117 is forced back towards the first end of the cylinder 123 by the rotational momentum of the crankshaft 121, and steam vents through the exhaust valve 116. When the piston 117 has reached the point of its motion nearest the first end of the cylinder 123, the exhaust stroke ends and the next power stroke begins. The exhaust valve 116 closes and pressurized steam may again be injected into the cylinder 123 from the fueling system 124 to begin the next power stroke.

[0042] In an aspect of the present invention, the steam generation system 114 of the fueling system 124 may be powered with an electrical current. For example, in an embodiment the electrical current may be provided by a battery (not shown). In such an embodiment, the battery may provide electrical power to operate the steam generation system 114 and an electric motor within the pump 104. In an embodiment of the present invention, an alternator (not shown) may be advantageously coupled to the crankshaft 121 such that a portion of the energy generated by the rotation of the crankshaft 121 may be used to recharge the battery. Such a configuration may be advantageous because it may increase the efficiency of the engine 100, by reducing the drain of power from the battery.

[0043] A further advantage of some embodiments of the present invention may be that, rather than requiring a large boiler tank as with conventional steam engines, the fueling system 124 of the present invention may utilize a small, electrically powered steam generation system 114 to provide steam to the power generation system 125. An embodiment of the present invention thus may provide safety advantages by eliminating the need for the maintenance of a large vessel containing high pressure, high temperature gas. A further advantage is that an embodiment of a steam engine according to the present invention may be more efficient because it may use less energy to generate steam than conventional steam engines. In addition, an embodiment of the present invention may be more efficient because the time required to begin generating energy in embodiments of the present invention may be less than for a steam engine comprising a boiler. Another advantage may be that the water pump system 104 and steam generation system 114 may be powered, at least in part, by the energy generated by the steam engine 100.

[0044] Embodiments of the present invention may be advantageously utilized in a variety of applications. For example, an embodiment of a steam engine of the present invention may be utilized to power a machine, such as a lawn mower or leaf blower. An embodiment may be used as an electric generator to generate electrical power. An embodiment of the present invention may be adapted to power vehicles, such as automobiles, boats, motorcycles, trucks, buses or locomotives. Additional uses of embodiments of the present invention would be apparent to one of skill in the art.

[0045] FIGS. 4 and 5 show a diagrammatic view of a steam engine in another embodiment of the present invention. The embodiment shown comprises a water pump

system (not shown) and a steam generation system comprising an electric heater element 114 configured to convert water received from the water pump system into pressurized steam substantially as the water is pumped into the steam generation system. The steam generation system in the embodiment shown in FIGS. 4 and 5 comprises an injector valve and a camshaft coupled to a cam configured to open and close the injector valve. The steam generation system is configured to receive water through a water inlet, channel water to the electric heating element, and expel pressurized steam through a steam outlet 115. The steam engine shown in FIGS. 4 and 5 further comprises a power generation system configured to receive the pressurized steam from the steam generation system and generate energy.

[0046] In such an embodiment, the steam engine may comprise a cylinder as may be configured in an internal combustion engine that has been modified to operate using pressurized steam rather than a combustible fuel/air mixture. The embodiment shown in FIGS. 4 and 5 comprises a piston 401 disposed within a cylinder 402 comprising a first end 412 and a second end 413. The piston 401 is configured to slide back and forth between the first end and the second end of the cylinder 402. The piston 401 is coupled to a crankshaft 408 by a connecting rod 409. Two exhaust valves 403, 404 near the first end 412 of the cylinder 402 are configured to be periodically contacted by camshaft lobes 406, 407 coupled to a camshaft 405. In a conventional internal combustion engine, one of valves 403 or 404 may be a fuel intake valve and the other may be an exhaust valve. However, because pressurized steam is injected into the cylinder from steam inlet 115, a valve for allowing fuel intake is not necessary and both valves may be used as exhaust valves.

[0047] The camshaft lobes 406, 407 may be oriented such that the lobes 406, 407 are approximately 180 degrees out of phase relative to each other. The camshaft may be coupled to camshaft gear 411, which is coupled to a crankshaft gear 410. As in the embodiment shown, the gear ratio of the camshaft gear 411 and crankshaft gear 410 may be 2 to 1, where the camshaft gear 411 is the larger of the two gears. Heater element 114 may be coupled to the first end of the cylinder 402 and may be configured to provide steam to the cylinder 402 through steam inlet 115.

[0048] The embodiment shown in FIGS. 4 and 5 may operate as a two-cycle engine. A two-cycle engine is an engine in which every down stroke of a piston is a power stroke. In contrast, in a four-cycle engine, every other down stroke of a piston is a power stroke. During operation, the piston 401, in the embodiment shown, slides up and down, or back and forth, within the cylinder 402. When the piston 401 is near the first end 412 of the cylinder 402, pressurized steam may be injected into the cylinder 402 through steam inlet 115, causing the piston 401 to move towards the second end 413 of the cylinder 402. When the piston 401 is near the second end 413 of the cylinder 402, pressurized steam is no longer injected into the cylinder 402 and camshaft lobe 406 contacts the exhaust valve 404, causing it to open, while the exhaust valve 403 remains closed as shown in FIG. 4. The piston 401 is then moved towards the first end 412 of the cylinder 402 by rotational momentum of the crankshaft 408. As the piston 401 moves towards the first end 412 of the cylinder 402, steam within the cylinder 402 is forced out of the cylinder 402 through the open exhaust valve 404. When the piston 401 is near the first end 412 of the cylinder 402,

the camshaft lobe **406** moves out of contact with the exhaust valve **404**, allowing it to close. Steam may then be injected into the cylinder **402**, beginning the next cycle. The next cycle proceeds like the previous cycle, however, during this cycle, camshaft lobe **407** contacts exhaust valve **403**, causing it to open, while exhaust valve **404** remains closed, as shown in FIG. 5. These cycles may be repeated to maintain rotation of the crankshaft **408**.

[0049] As described above, the exhaust valves **403**, **404** may be opened as camshaft lobes **406**, **407** contact the exhaust valves. The camshaft lobes **406**, **407** may be coupled to the camshaft **405** such that the camshaft lobes **406**, **407** rotate with the camshaft **405**. As a camshaft lobe rotates, it may contact its corresponding exhaust valve, thereby opening the valve. The camshaft **405** may be coupled to the camshaft gear **411**, and rotate with the camshaft gear **411**. The camshaft gear **411** may be rotated by the crankshaft gear **410**, which may be coupled to the crankshaft **408**. The ratio of the crankshaft gear **410** to the camshaft gear **411** determines, at least in part, the rate at which the camshaft lobes **406**, **407** open the exhaust valves **403**, **404**. In the embodiment shown, the camshaft gear **411** has approximately twice the number of teeth as the crankshaft gear **410**. Thus, for approximately every two rotations of the crankshaft gear **410**, the camshaft gear **411** will rotate approximately once. This ratio means that each exhaust valve will open once for every two crankshaft **408** rotations, or one of the exhaust valves will open for each rotation of the crankshaft gear **410**.

[0050] Other embodiments may have different ratios between the crankshaft gear **410** and the camshaft gear **411**. However, the number and placement of the camshaft lobes may be affected by the gear ratio. For example, in an embodiment where the ratio between the crankshaft gear **410** and the camshaft gear **411** is 1 to 1, the camshaft gear **411** will rotate once for every rotation of the crankshaft gear **410**. In such an embodiment, the camshaft lobes **406**, **407** may be in phase with each other, such that both lobes contact their respective exhaust valves at approximately the same time. In such an embodiment, each exhaust valve would open for every rotation of the crankshaft **408**. Various embodiments may have different gear ratios and use different numbers of valves.

[0051] The embodiment shown in FIGS. 4 and 5 comprises two exhaust valves. Other embodiments may comprise one or three or more valves. Further, while the two valves **403**, **404** in the embodiment shown in FIGS. 4 and 5 are configured to open on alternating exhaust strokes, other embodiments may have different camshaft lobe orientations and/or different camshaft gear **411** to crankshaft gear **410** ratios, that may allow both valves to open simultaneously or with different frequencies.

[0052] Some embodiments of the present invention may comprise a plurality of the cylinder configurations shown in FIGS. 4 and 5. For example, an embodiment of the present invention may comprise two cylinders. The cylinders may be coupled to the same crankshaft, or each cylinder may be coupled to its own crankshaft. In an embodiment, two cylinders, as described with respect to FIGS. 4 and 5, are coupled to the same crankshaft. The two cylinders may be configured to receive pressurized steam at substantially the same time, such that each cylinder is in its power stroke at substantially the same time as the other cylinder. In another

embodiment, the cylinders may be configured such that as one cylinder is performing its power stroke, the other cylinder is at a different position within its power stroke, or is within its exhaust stroke.

[0053] Other embodiments of the present invention may comprise more than two cylinders. For example, an embodiment of the present invention may comprise six cylinders. In such an embodiment, each cylinder may be coupled to the same crankshaft. The cylinders may also be configured such that the six cylinders operate as three pairs of substantially synchronized cylinders. In such an embodiment, for example, a first cylinder and a second cylinder may operate such that they perform a power stroke at substantially the same time, and perform an exhaust stroke at substantially the same time. In such an embodiment, a third cylinder and a fourth cylinder may comprise a second pair of substantially synchronized cylinders, and a fifth cylinder and a sixth cylinder may comprise a third pair of substantially synchronized cylinders. In such an embodiment, each cylinder within a pair of cylinders may be synchronized with the other cylinder within the pair, but each pair of cylinders may not be synchronized with any other pair of cylinders. Other embodiments may further comprise more than two cylinders and may or may not comprise pairs or other groupings of synchronized cylinders.

[0054] FIG. 6 shows a diagrammatic view of a steam turbine engine in an embodiment of the present invention. This embodiment comprises a fueling system **610** and a power generation system **611**. The fueling system **610** comprises components as described above with reference to FIGS. 1 and 2 above. Such a water pump system may include an injector valve or an injector valve cam. The fueling system **610** shown in FIG. 6 is configured to continually inject water into the heater element **114** as long as the pump **104** is operating and flow control valve **109** is open. For example, the fueling system **610** may include a water pump system. Accordingly the water pump system **610** may operate without an injector valve or an injector valve cam. The flow of water into the heater element **114** may be controlled by flow control valve **109**. Flow control valve **109** may be controlled manually or automatically. For example, flow control valve **109** may be controlled by a computer, which is configured to automatically adjust the flow control valve **109**.

[0055] In the embodiment shown in FIG. 6, the power generation system **611** may comprise a turbine **601**, an exhaust port **603** and an output shaft **602**. The turbine **601** may comprise a plurality of turbine blades and is coupled to the output shaft **602** such that as the turbine **601** rotates, it causes the output shaft **602** to rotate. In some embodiments, the turbine **601** may be directly coupled to the output shaft **602**, such that output shaft **602** rotates approximately 360 degrees for every approximately 360 degrees of turbine **601** rotation. In other embodiments, the turbine **601** may be indirectly coupled to the output shaft **602**, such that the output shaft **602** rotates approximately 360 degrees or more or less than 360 degrees for every approximately 360 degrees of turbine **601** rotation. The turbine **601** blades may be configured such that as pressurized steam entering the turbine **601** from the steam inlet **115** contacts the turbine blades, the turbine blades may be displaced and thereby cause the turbine **601**, and consequently, the turbine shaft **602**, to rotate.

[0056] During operation, pressurized steam may be forced into the turbine through steam inlet 115. The pressurized steam may force the blades of the turbine to move, thereby causing the turbine to rotate. Pressurized steam that has traveled past the turbine blades may be allowed to escape the turbine through the exhaust vent 603. By continually applying pressurized steam to the turbine blades, the rotation of the turbine may be maintained. In the embodiment shown, heater element 114 may be coupled to a battery (not shown), which may provide electric power to cause heater element 114 to heat to a sufficient temperature to convert water to high pressure steam. Additionally, flow control 109 may be adjusted to provide increased or decreased flow of water into heater element 114, which may cause increased or decreased amounts of pressurized steam to be expelled into turbine 601, which may cause turbine 601 to rotate at increased or decreased speeds.

[0057] In some embodiments of the present invention, a steam turbine engine may comprise a manifold (not shown) and a plurality of heater elements 114. For example, in one such embodiment, the plurality of heater elements may be configured to inject steam into a turbine 601. Water may be pumped from a single water pipe into the manifold, which may then distribute the water to the plurality of heater elements, creating pressurized steam, which may then be injected into a second manifold, which combines the flow of pressurized steam from the plurality of heater elements. The combined flow of pressurized steam may then be injected onto the turbine 601. Such an embodiment may be advantageous as a plurality of smaller, less expensive heater elements may be used, rather than a single, more expensive element. Such an embodiment may be advantageous as it may be capable of more efficiently turning a quantity of water into pressurized steam.

[0058] In one embodiment of the present invention, a steam engine may comprise a turbine 601 configured to generate electrical energy. For example, the steam turbine 601 may be coupled to an electric motor, such that the steam turbine 601 provides at least part of the electrical energy needed to power the electric motor. Such an embodiment may be advantageously employed to provide propulsion to a vehicle, such as an automobile or ship. A steam turbine 601 according to one embodiment of the present invention may be configured to transmit a portion of the generated electrical energy to a battery, such as a battery supplying electrical power to heater element 114. In one embodiment, the steam turbine 601 may supply electrical power to one or more batteries for storing energy for use in an electrically-powered car.

[0059] Embodiments of the present invention include certain methods, including methods of using or operating a steam engine. For example, an illustrative embodiment of the present invention may comprise providing water in a water tank, periodically pumping the water under pressure from the tank into a steam generation system, injecting steam from the steam generation system into a cylinder, driving a piston with pressurized steam to operate a machine, and exhausting steam from the cylinder. An embodiment of the present invention may further comprise the steps of providing a steam generation system comprising an electric heating element, providing electrical power to the electric heating element to heat the heating element, rapidly converting water to steam with the heating element, and

delivering steam from the electric heating element out of the steam generation system to the power generation system.

[0060] FIG. 7 is a flowchart 700 showing a method of generating energy according to one embodiment of the present invention. The method shown in FIG. 7 begins with pumping water into a steam generation system, as shown in step 701. For example, a water pump may be employed to pump water from a water tank into a steam generation system as previously described. Water pumped into the steam generation systems is then rapidly converted into pressurized steam with an electric heating element in step 702. In the embodiment shown in FIG. 7, the water is rapidly converted to pressurized steam as the water is pumped into the steam generation system. For example, the water may be sprayed onto an electric heating element. In step 703, the pressurized steam is expelled from the steam generation system into the power generation system. The pressurized steam is converted to energy in step 704. For example, the pressurized steam may cause a turbine to spin.

[0061] In one embodiment of the present invention, a method for generating energy comprises pumping water through a water inlet valve into a steam generation system and about an electric heating element disposed within the steam generation system. For example, a steam generation system may comprise a tube heater. In such an embodiment, a tube heater may be disposed within the steam generation unit and may conform to the shape of a portion of the steam generation unit. For example, steam generation unit may comprise a water inlet configured to allow water to flow into the steam generation unit at an angle of approximately 90 degrees relative to the angle at which pressurized steam is expelled from the steam generation unit. In such an embodiment, a tube heater may be employed and configured (such as by bending) to accommodate part or all of the angle. In other embodiments, the angle at which water enters the steam generation unit may be related to the angle or plane at which pressurized steam exits the steam generation unit and the relation may be any angle greater than or equal to 0 degrees. In one embodiment, tube heater may comprise a coiled shape. Such an embodiment may be advantageous because a straight tube heater may be replaced with a coiled tube heater, which may provide a more space-efficient tube-heater.

[0062] For example, FIG. 8 shows an electric heating element according to one embodiment of the present invention. FIG. 8 comprises an electric tube heater 800 having a tubular housing 801 that contains a heating element 804. Heating element 804 may be disposed within the housing such that a small space is defined between the housing 801 and the heater element 804 to allow steam to move through the electric tube heater 800 to the steam outlet. For example, in the embodiment shown in FIG. 8, the space between the heater element 804 and the housing 801 is approximately $\frac{1}{16}$ of an inch. In other embodiments, the space may be greater than or less than $\frac{1}{16}$ of an inch. The electric tube heater 800 shown in FIG. 8 further comprises a water injector line 802 through which water may be received from a water pumping system. In the embodiment shown, the water injector line has a diameter of approximately $\frac{1}{16}$ of an inch. In other embodiments, the space may be greater than or less than $\frac{1}{16}$ of an inch. In one embodiment, water may be continuously injected into the electric tube heater 800. In one embodiment, water may be periodically injected into the electric

tube heater **800**, such as, for example, through an injector valve that is opened and closed by a cam coupled to a camshaft. The electric tube heater **800** also comprises a steam outlet **803** through which pressurized steam may be expelled. In the embodiment shown in FIG. **8**, the steam outlet **803** has a diameter of approximately $\frac{1}{2}$ of an inch. In other embodiments, the steam outlet **803** may have a diameter of greater than or less than $\frac{1}{2}$ of an inch. The electric tube heater may be powered by electricity transmitted through electrical leads **805** and **806**. A portion of the electric tube heater **800** may comprise a ceramic insulator **807**, or other insulation.

[0063] In the embodiment of the electric heating element shown in FIG. **8**, electric tube heater **800** may be powered and generate heat. For example, in one embodiment electric tube heater **800** may be powered by with between approximately 12 240 volts. Other embodiments may comprise electric tube heaters powered by other voltages greater than 240 volts or less than 12 volts. In one embodiment, electric tube heater **800** may be powered by alternating current. In one embodiment, electric tube heater may be powered by direct current. In the embodiment shown, the electric tube heater may consume between approximately 250 and 2250 watts of power, though in some embodiments, electric tube heaters may consume greater than 2250 watts or power, or less than 250 watts of power. In the embodiment shown, the heating element **804** may be heated to approximately 1700 degrees Fahrenheit (1700 F.). Other embodiments may comprise electric tube heaters capable of being heated to temperatures greater than or less than 1700 F.

[0064] In the embodiment shown in FIG. **8**, water may be injected into the electric tube heater **800**, which has been heated to 1700 F. In one embodiment of the present invention, the water is not pre-heated prior to being injected into the electric tube heater **800**. In one embodiment of the present invention, the water may be pre-heated to a temperature less than 212 F. (or 100 C.) in a water injector line, or in a water tank. As the water enters the tube heater, the water may be substantially immediately, or instantly, converted to steam. The water may travel a short distance within the electric tube heater **800** after injection, however, the water may be substantially immediately converted to steam as it encounters the heating element **804**. In the embodiment shown, The steam may travel from the water inlet **802** to the steam outlet **803** because of pressure caused by the vaporization of the water. Further, as the steam moves through the electric tube heater **800**, the steam may be additionally heated, which may cause an increase in the pressure of the steam. The pressurized steam may then be expelled from the electric tube heater **800** through steam outlet **803** into a power generation system, such as a piston engine or turbine, as described in other parts of this specification.

[0065] In one embodiment, pumping water may comprise maintaining a substantially constant pressure of water in a pumping system, opening an injector valve with a camshaft coupled to a cam to allow water to flow through the water inlet, and closing the injector valve to stop water from flowing through the water inlet. In one embodiment, pumping water may comprise maintaining a substantially constant pressure of water in a pumping system; and continuously injecting water into the steam generation system. Such

embodiments may advantageously supply water at a substantially constant or uniform pressure to the steam generation system.

[0066] After pumping the water into the steam generation system and about the electric heating element, one embodiment of the present invention may comprise converting the water into pressurized steam in the steam generation system by heating the water with the electric heating element substantially immediately after pumping the water about the electric heating element. For example, water may be pumped into the steam generation unit and about the electric heating element, which may vaporize the water substantially immediately after the water contacts the electric heating element. Such an embodiment may be advantageous as high steam pressures may be generated very rapidly.

[0067] After converting the water into pressurized steam, one embodiment of the present invention comprises expelling the pressurized steam from the steam generation system into a power generation system. For example, in one embodiment, the steam generation system may comprise a cavity in which an electric heating element may be disposed. For example, the electric heating element may be disposed within the cavity and may allow for water to be pumped into the steam generation unit and about the electric heating element, and for pressurized steam to move past the electric heating element and out of the steam generation system through a steam outlet.

[0068] After expelling the pressurized steam from the steam generation system into a power generation system, one embodiment of the present invention may comprise converting the pressurized steam in the power generation system into motive energy. For example, the power generation system may comprise a piston coupled to a crankshaft. The pressurized steam may cause the piston to move, which may turn the crankshaft to generate mechanical energy or electrical. In one embodiment, the power generation system may comprise a turbine. In such an embodiment, the pressurized steam may cause the turbine to spin which may generate mechanical or electrical energy.

[0069] Some methods of generating energy according to embodiments of the present invention may comprise various combinations of the following steps: providing water in water tank; pumping water from the water tank; cycling water through the fueling system through an unloader valve and bypass pipe while an injector valve is closed; maintaining a substantially constant water pressure in the fueling system by using an accumulator; periodically opening the injector valve with an injector valve and injector valve cam; providing a steam generation system comprising an electric heating element; pumping water from the water tank; periodically opening and closing the injector valve to allow water to be pumped into the steam generation system; rapidly converting the water to steam; providing a cylinder having a first and second end; providing a piston disposed within the cylinder and configured to slide between the first and second ends of the cylinder and to cause a crankshaft to rotate; periodically injecting steam into the first end of cylinder when the piston is near the first end of the cylinder; and opening an exhaust valve when the piston is near the second end of the cylinder.

[0070] An embodiment of such a method may further comprise providing an alternator coupled to the crankshaft,

generating electricity by rotating the crankshaft, providing generated electricity to the alternator, and charging the battery using the electricity supplied to the alternator.

[0071] Embodiments of the present invention include methods of operating a steam turbine engine, such as the embodiment described with respect to FIG. 6. For example, one embodiment of the present invention may be a method for using a steam turbine engine to generate electricity to power an electric vehicle, such as an electric car. Such an embodiment may comprise a battery, an alternator, and a steam turbine engine. The method of operation may comprise starting the steam engine using electrical power from the battery, operating the steam turbine to generate electricity, using the generated electricity to operate the car, and using the alternator to recharge the battery.

[0072] Embodiments of the present invention include methods of operating a steam engine, such as the embodiment described with respect to FIGS. 4 and 5. For example, one embodiment of the present invention may be used to power a machine. Another embodiment of the present invention may be used to generate electrical power. For example, an embodiment of the present invention may comprise the steps of powering a lawn mower by using a battery to start the steam engine, coupling the steam engine to a lawn mower blade, operating the steam engine at one or more speeds, using an alternator to recharge the battery, and using the lawn mower to cut grass.

[0073] The foregoing description of the embodiments of the invention has been presented only for the purpose of illustration and description and is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Numerous modifications and adaptations thereof will be apparent to those skilled in the art without departing from the spirit and scope of the invention.

That which is claimed is:

1. A method comprising:
 - pumping water through a water inlet valve into a steam generation system and about an electric heating element disposed within the steam generation system;
 - converting the water into pressurized steam in the steam generation system by heating the water with the electric heating element substantially immediately after pumping the water about the electric heating element;
 - expelling the pressurized steam from the steam generation system into a power generation system; and
 - converting the pressurized steam in the power generation system into motive energy.
2. The method of claim 1, wherein pumping the water comprises:
 - maintaining a substantially constant pressure of water in a pumping system;

- opening an injector valve with a camshaft coupled to a cam to allow water to flow through the water inlet; and

- closing the injector valve to stop water from flowing through the water inlet.

3. The method of claim 2, wherein the substantially constant pressure is approximately 1000 PSI.

4. The method of claim 1, wherein pumping the water comprises:
 - maintaining a substantially constant pressure of water in a pumping system; and

- continuously injecting water into the steam generation system.

5. The method of claim 4, wherein the substantially constant pressure is approximately 1000 PSI.

6. A device comprising:
 - a water pumping system;

- a steam generation system configured to receive water from the water pumping system and comprising an electric heating element disposed within the steam generation system, the electric heating element configured to convert water into pressurized steam substantially immediately after water is pumped into the steam generation system and about the electric heating element; and

- a power generation system configured to receive the pressurized steam from the steam generation system and generate energy.

7. The device of claim 6, wherein the water pumping system comprises:
 - an injector valve configured to be opened and closed and to allow water to be pumped into the steam generation system when open and to substantially prevent water from being pumped into the steam generation system when closed;

- a camshaft coupled to a cam and configured to open the injector valve; and
- a spring coupled to the injector valve and configured to close the injector valve.

- a camshaft coupled to a cam and configured to open the injector valve; and

- a spring coupled to the injector valve and configured to close the injector valve.

8. The device of claim 6, wherein the steam generation system comprises a second steam generation system configured to expel the pressurized steam into the power generation system.

9. The device of claim 6, wherein the electric heating element comprises a probe heater.

10. The device of claim 6, wherein the electric heating element comprises a tube heater.

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