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(54) TURBINE ENERGY GENERATING SYSTEM

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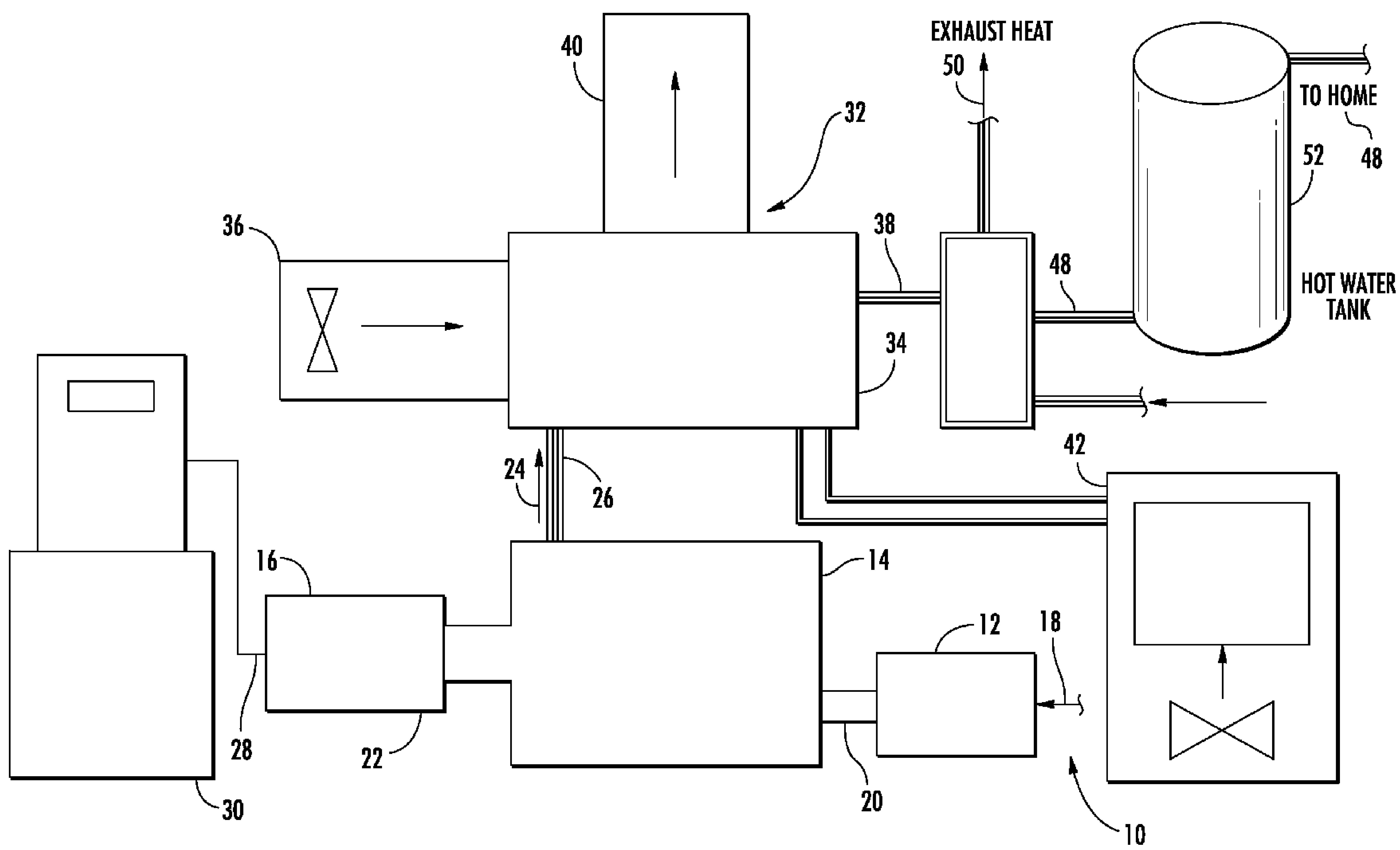
(57) ABSTRACT

A turbine energy generating system includes a combustion chamber for converting fuel into energy by igniting an air and fuel mixture, a turbine for converting energy produced by the combustion chamber into mechanical energy, and a generator for converting mechanical energy produced by the turbine into electrical energy in the range of 1 to 15 kilowatts.



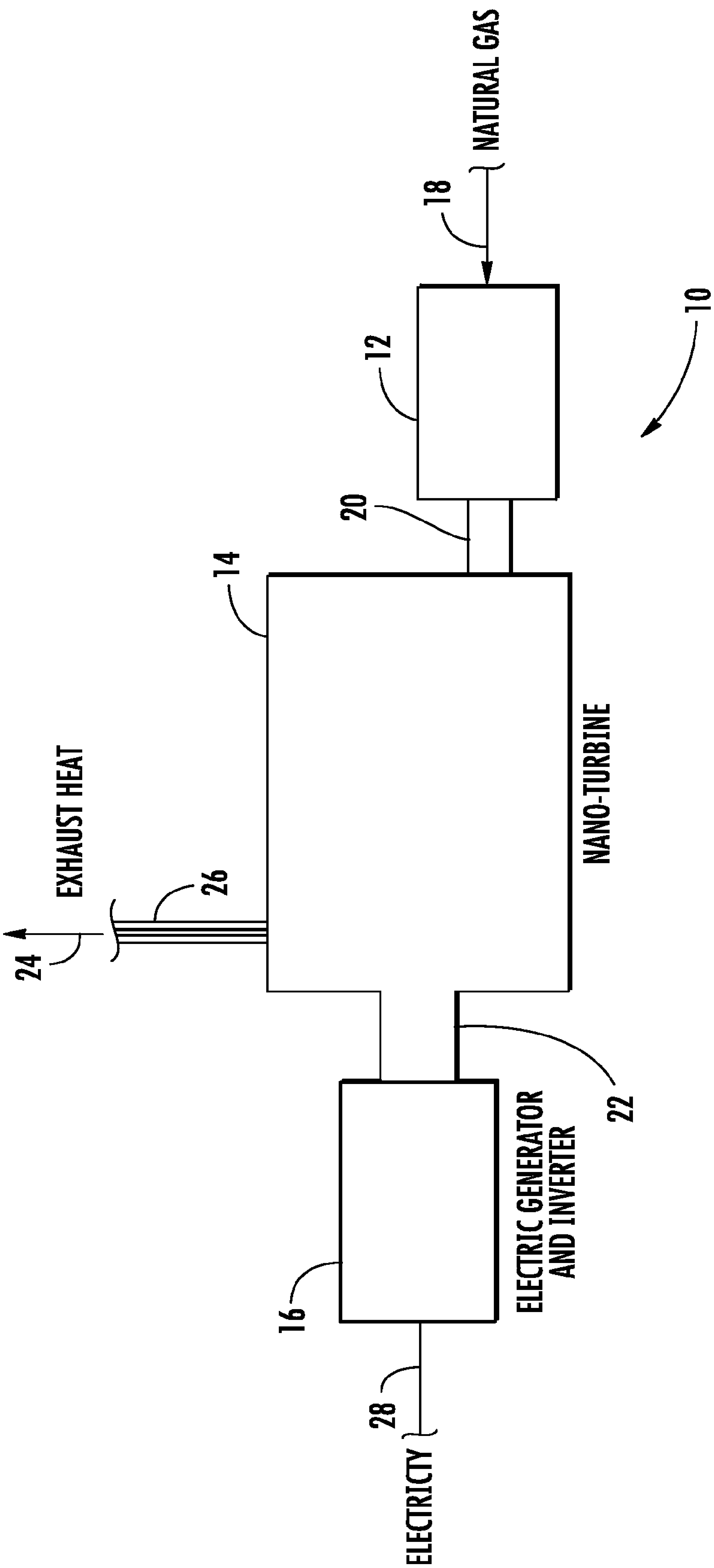

NATURAL GAS
18
12
10
20
14
NANO-TURBINE
EXHAUST HEAT
26
24
22
ELECTRIC GENERATOR AND INVERTER
16
28
ELECTRICTY

FIG. 1

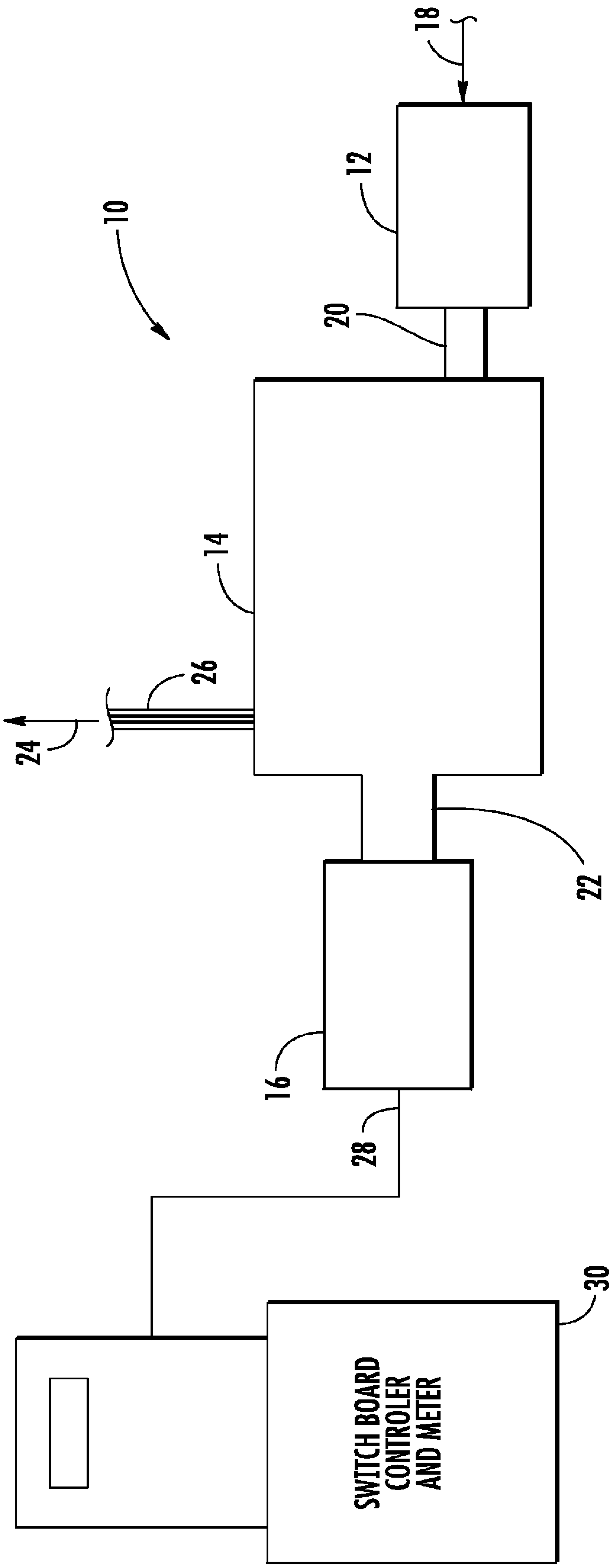

10
18
12
20
14
26
24
22
16
28
30
SWITCH BOARD
CONTROLER
AND METER

FIG. 2

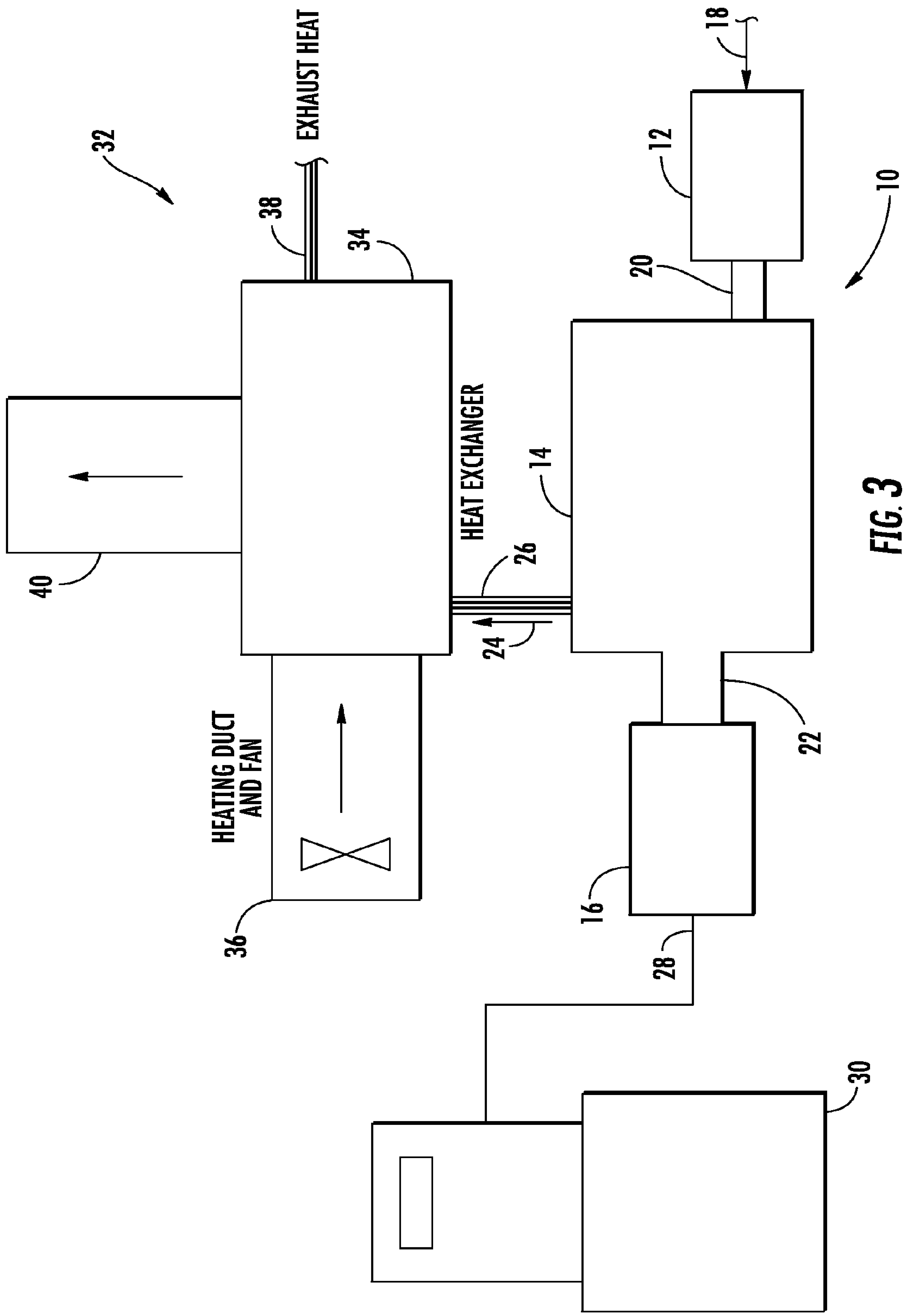

32
EXHAUST HEAT
38
34
18
12
10
20
HEAT EXCHANGER
14
26
24
40
HEATING DUCT AND FAN
36
22
16
28
30

FIG. 3

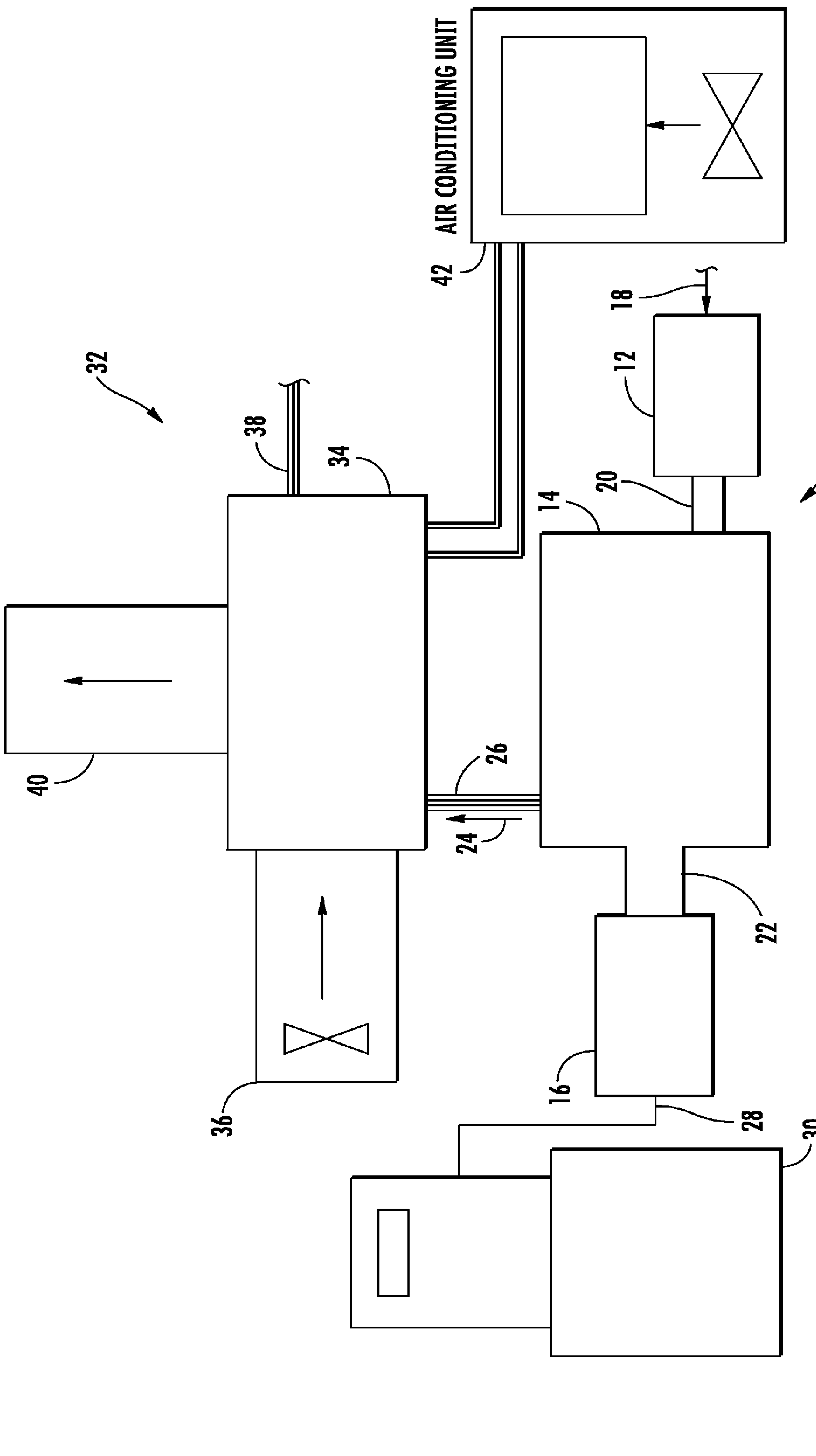

AIR CONDITIONING UNIT
42
18
12
32
38
34
10
20
14
26
40
24
22
16
36
28
30

FIG. 4

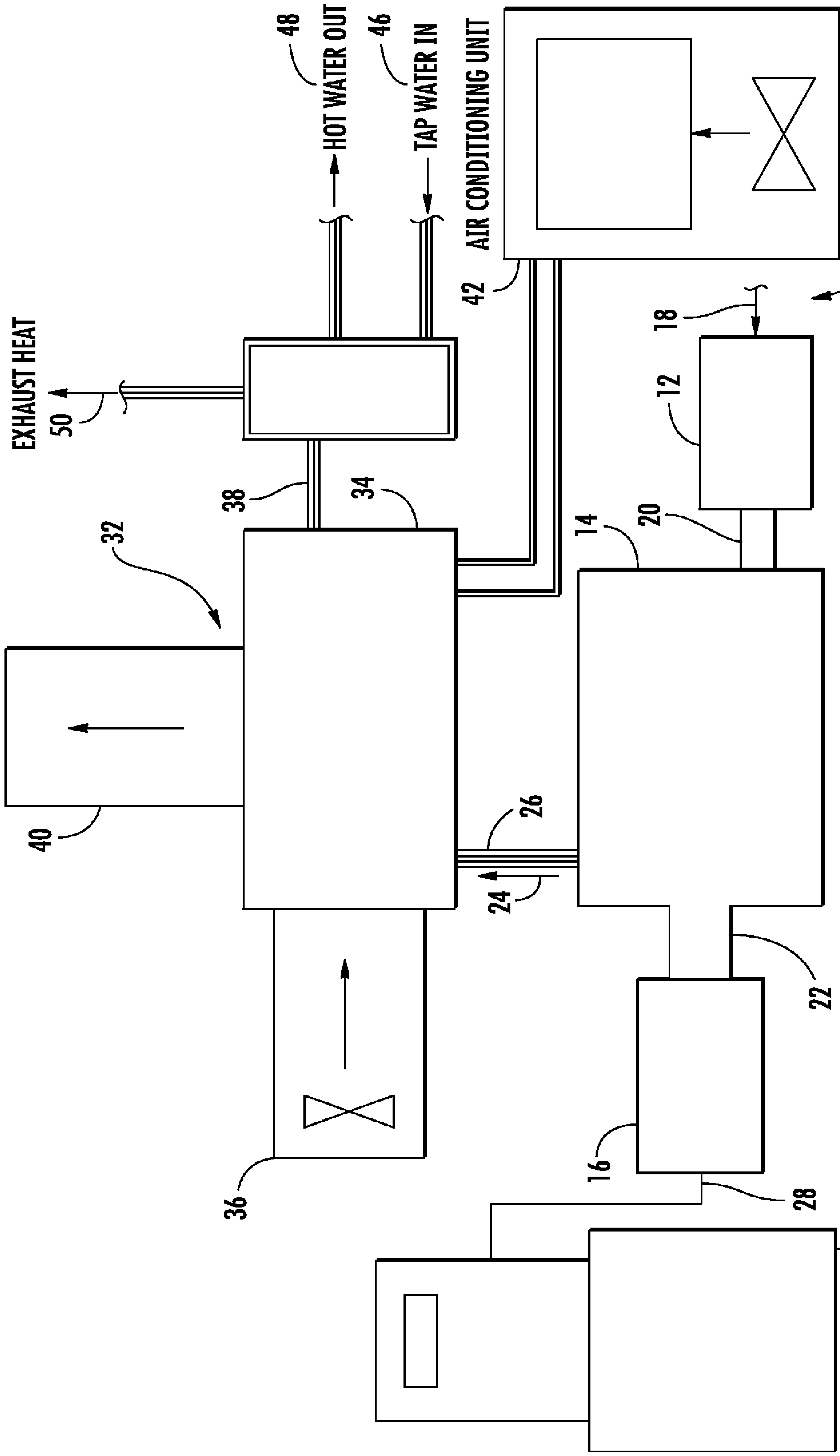

HOT WATER OUT
48
TAP WATER IN
46
AIR CONDITIONING UNIT
42
EXHAUST HEAT
50
10
18
12
20
14
34
38
32
40
26
24
22
16
28
30
36

FIG. 5

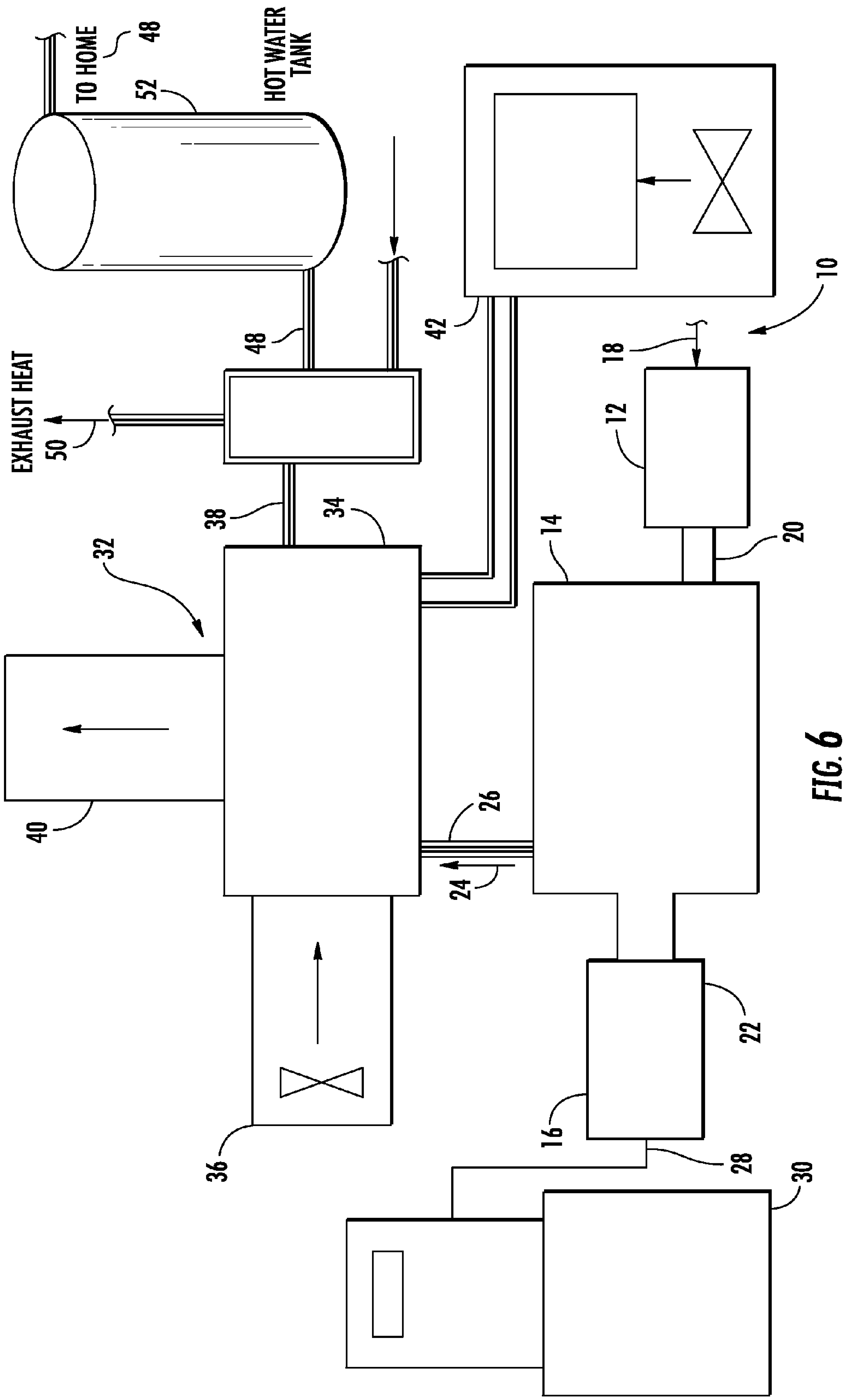

TO HOME
48
52
HOT WATER TANK
EXHAUST HEAT
50
48
42
10
18
12
38
34
32
14
20
40
26
24
22
16
36
28
30

FIG. 6

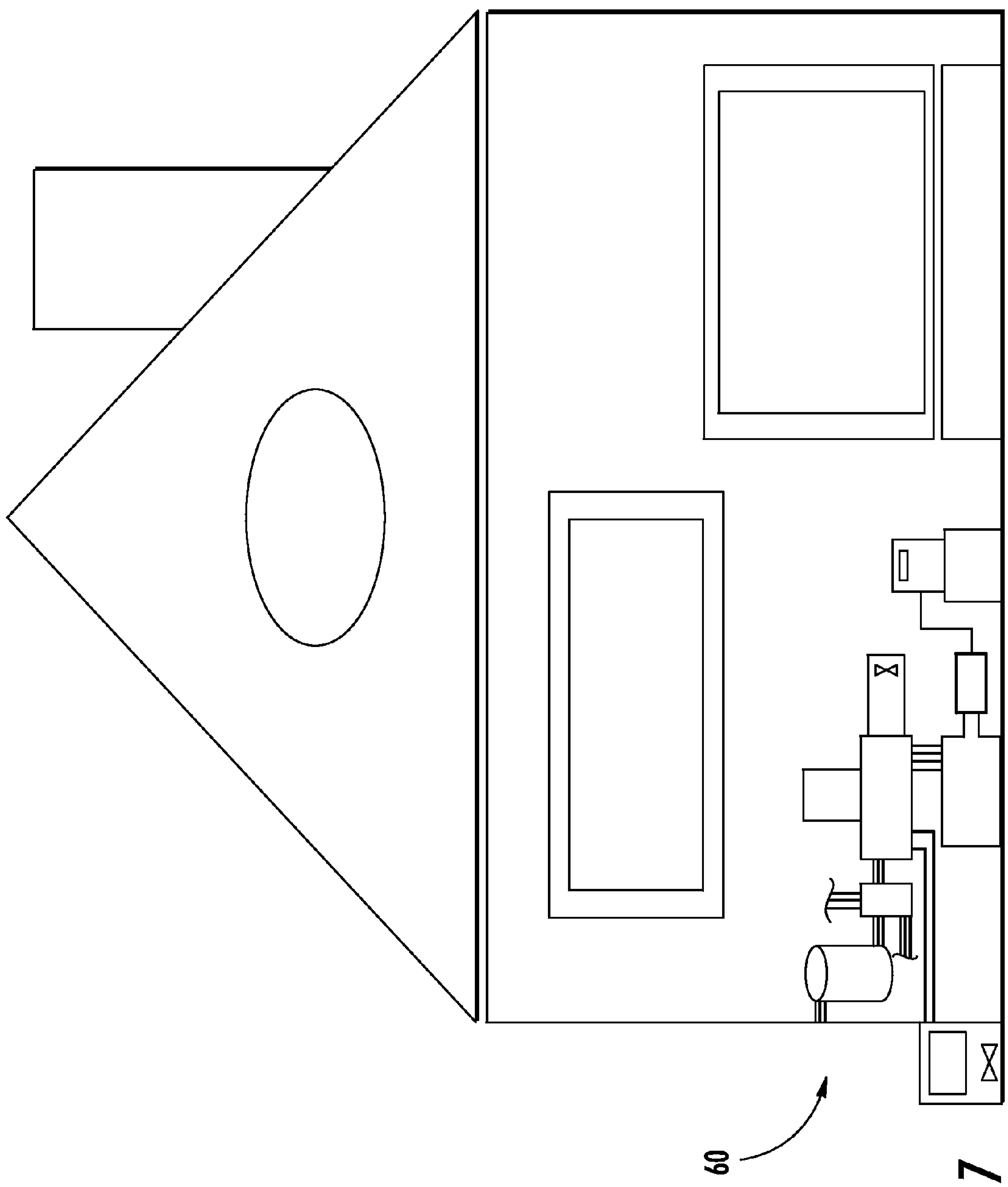


FIG. 7

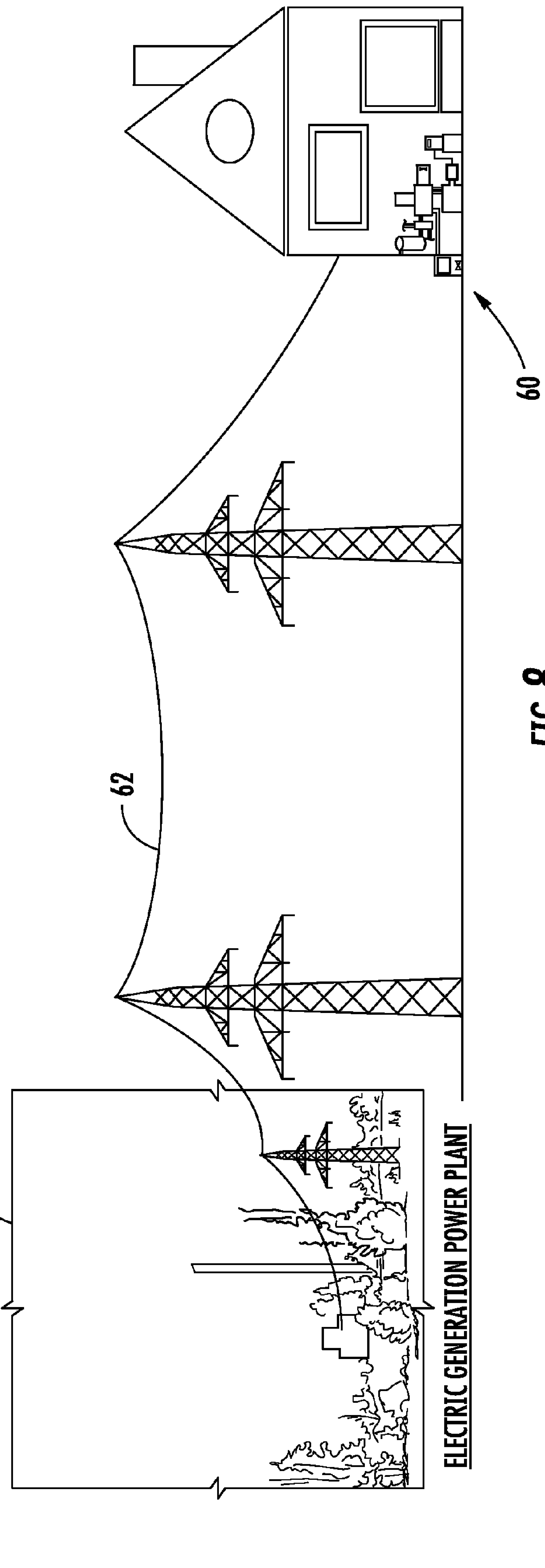


FIG. 8

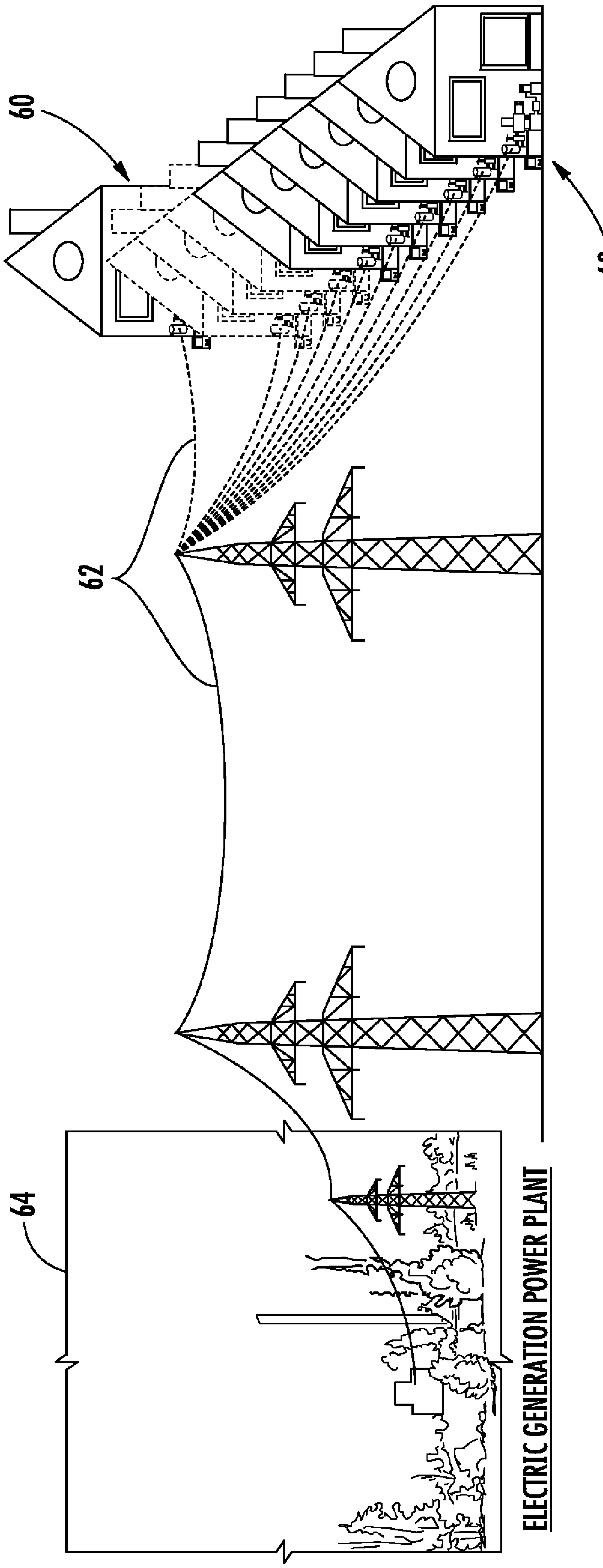
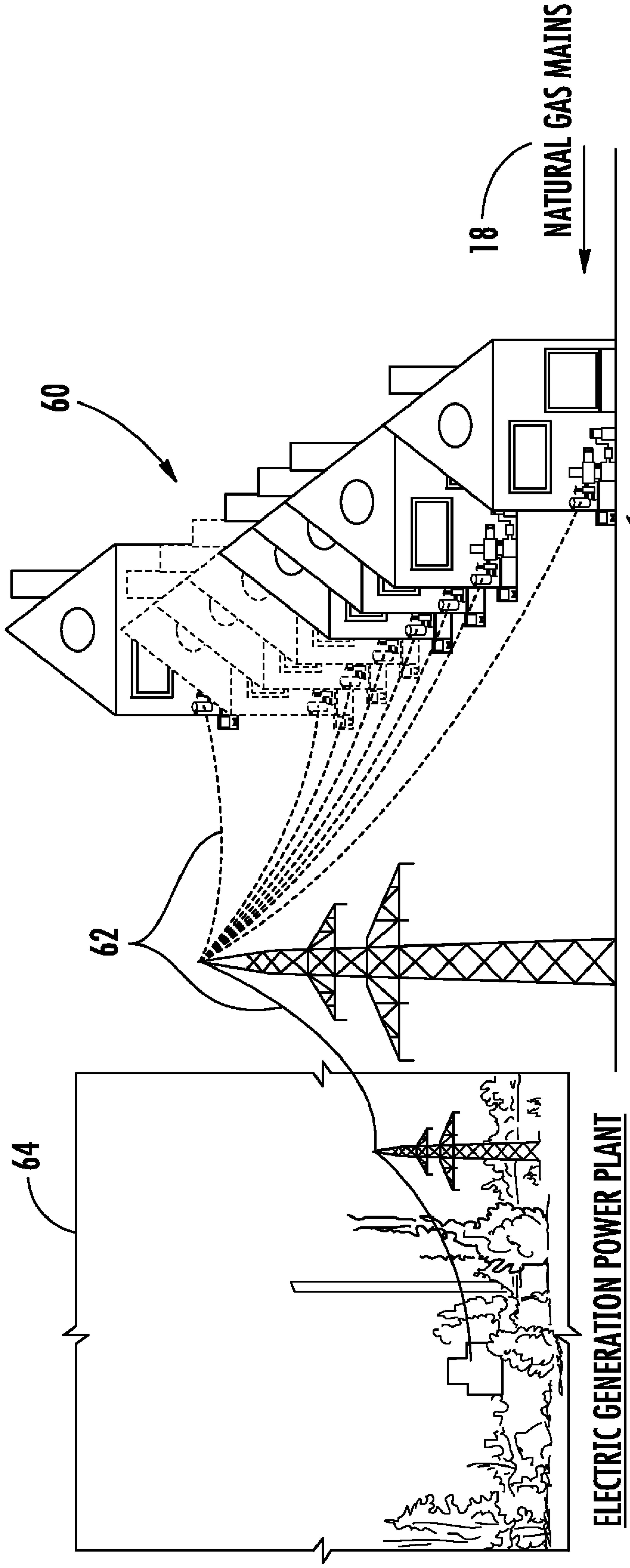


FIG. 9



18
NATURAL GAS MAINS
60
60
62
64
ELECTRIC GENERATION POWER PLANT

FIG. 10

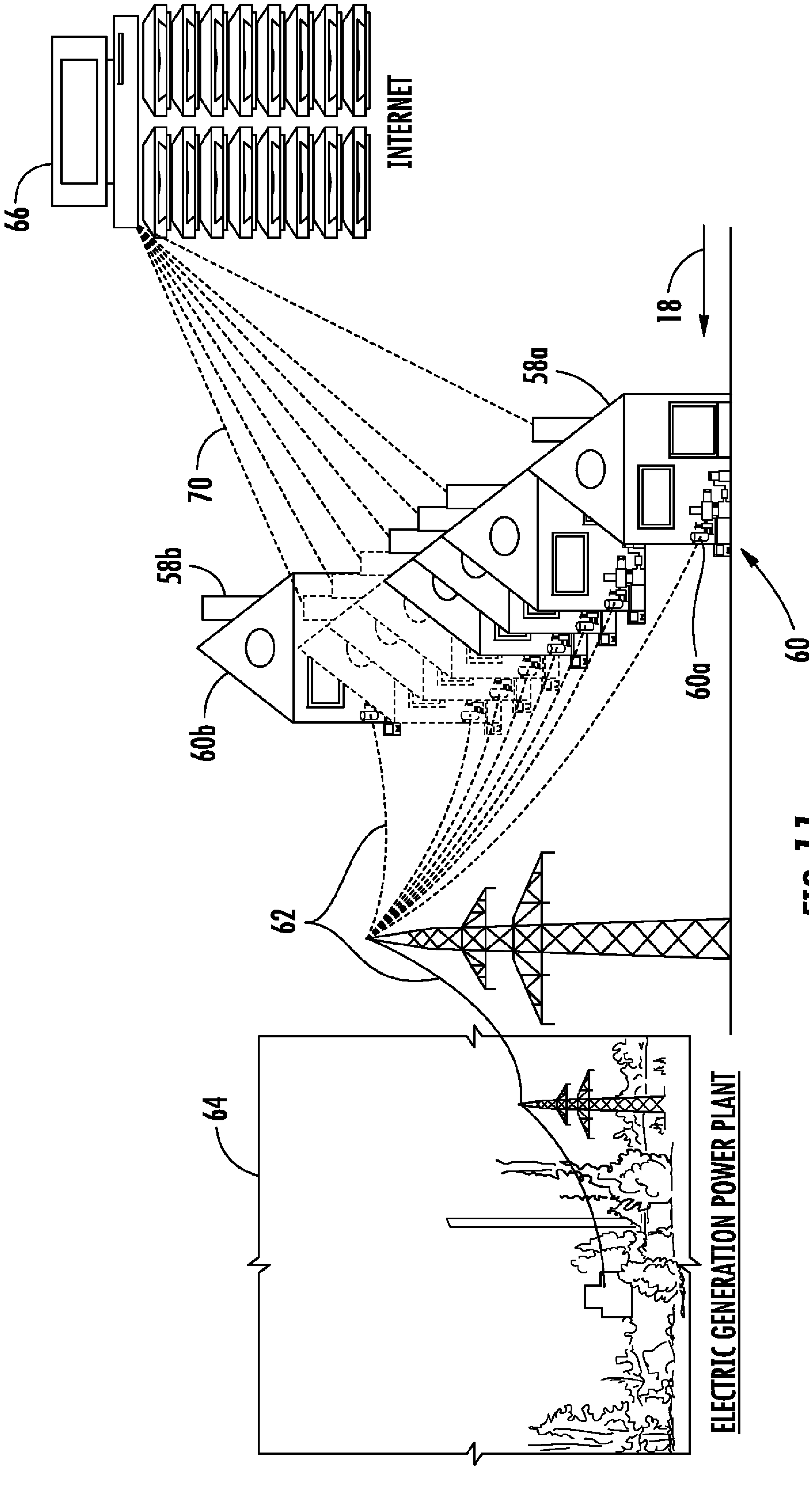

66
INTERNET
70
58a
58b
18
60b
60a
60
62
64
ELECTRIC GENERATION POWER PLANT

FIG. 11

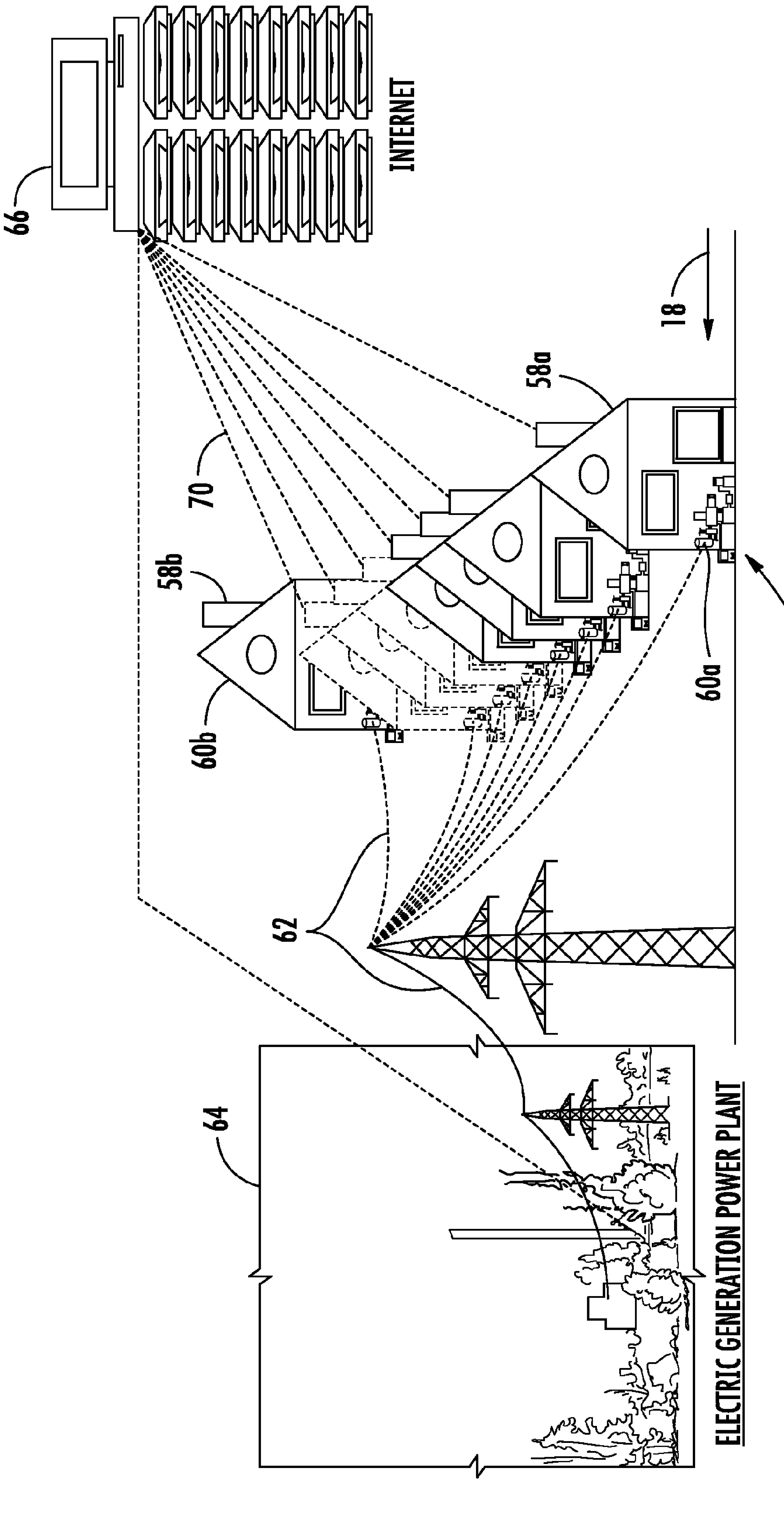
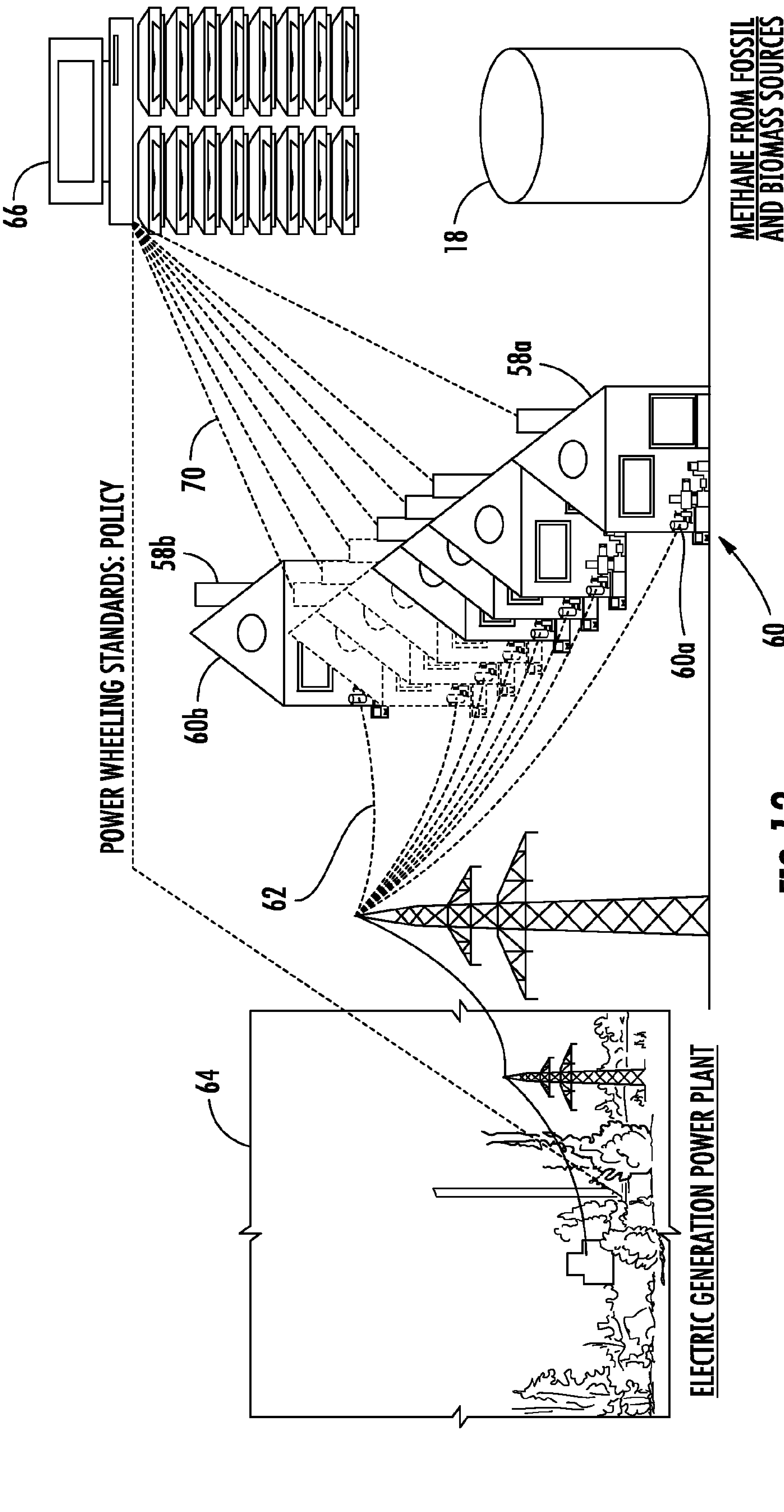

66
INTERNET
70
58b
58a
18
60b
60a
60
62
64
ELECTRIC GENERATION POWER PLANT

FIG. 12



66
POWER WHEELING STANDARDS: POLICY
70
58b
58a
60b
62
60a
60
18
METHANE FROM FOSSIL AND BIOMASS SOURCES
64
ELECTRIC GENERATION POWER PLANT

FIG. 13

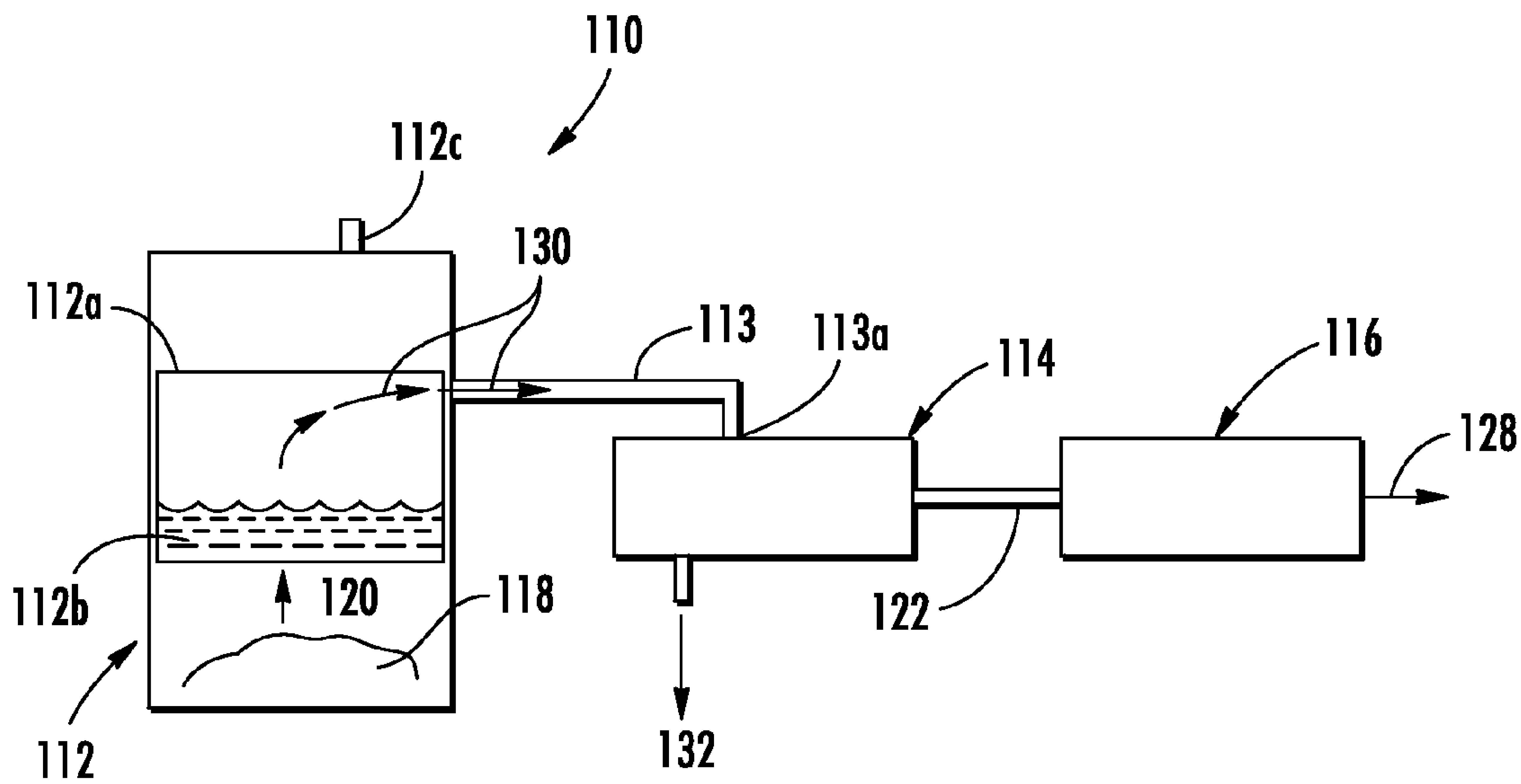


FIG. 14

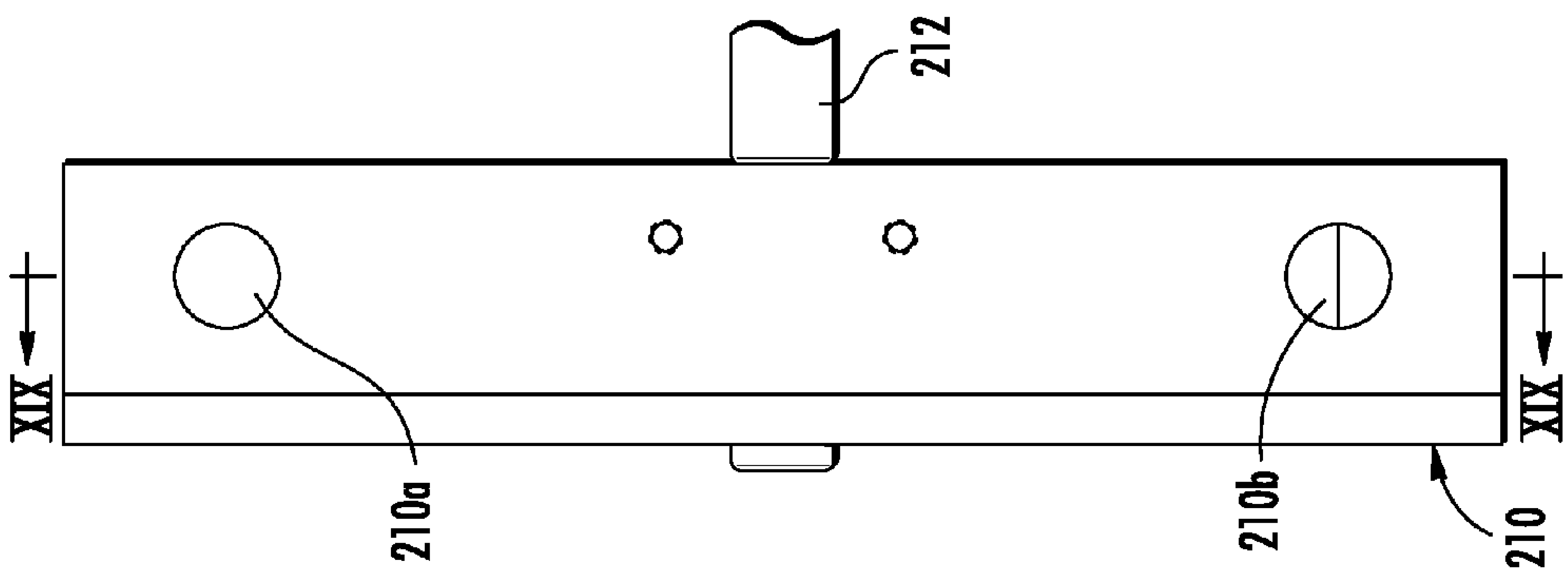

212
XIX
XIX
210a
210b
210

FIG. 15

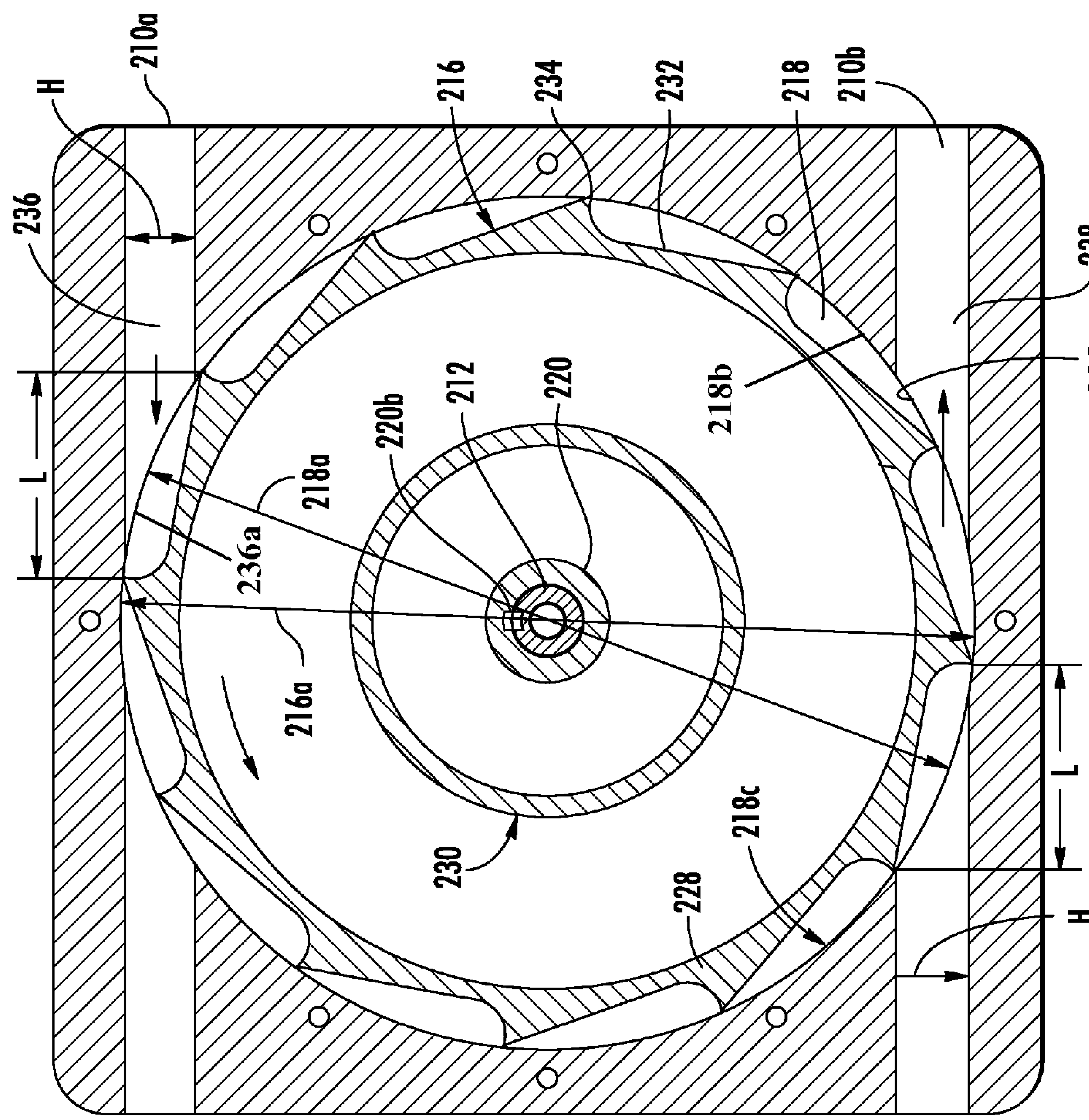

210a
H
236
216
234
232
218
210b
238
238a
218b
L
218a
220b
212
220
236a
216a
230
228
218c
L
H

FIG. 19

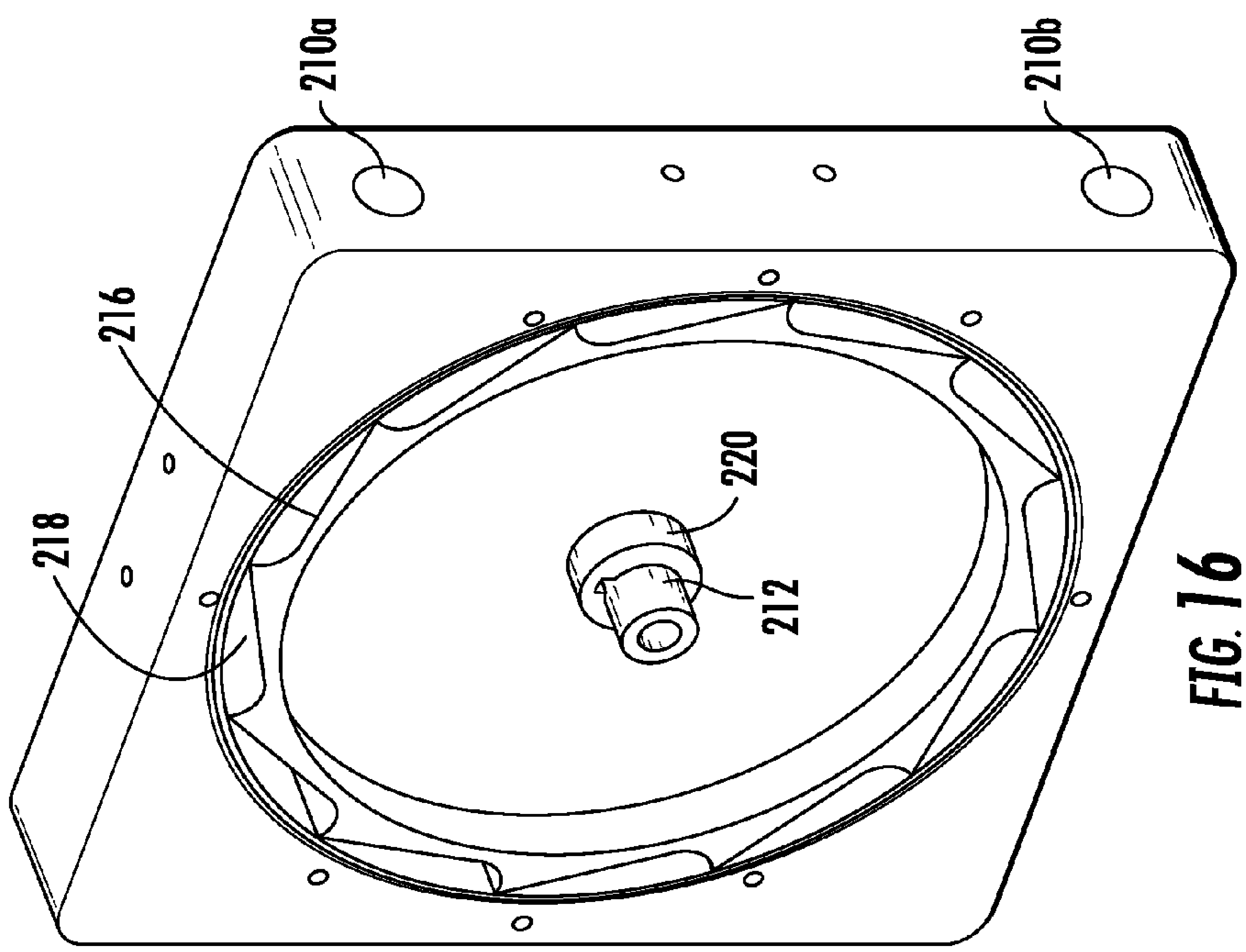


FIG. 16

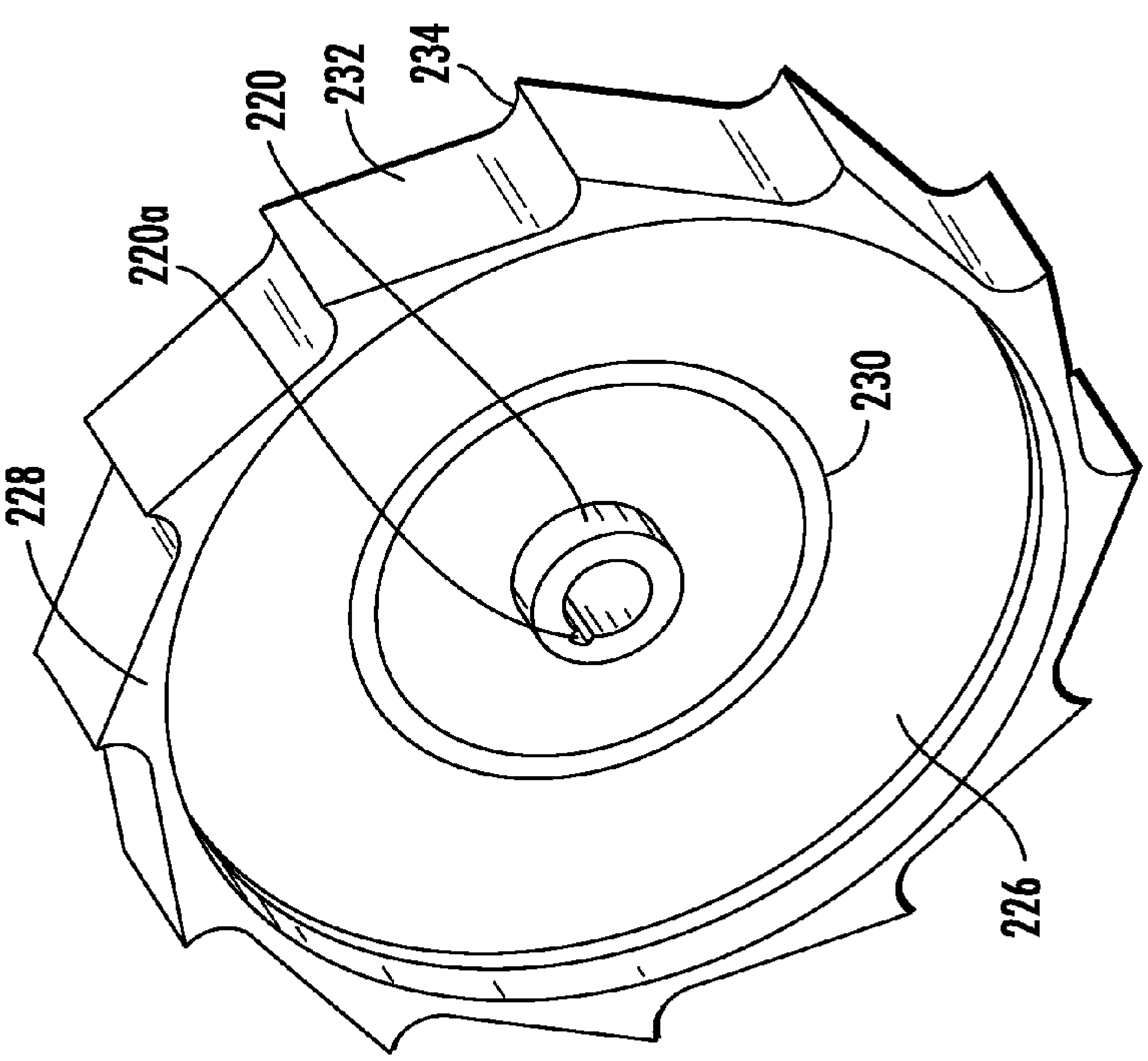


FIG. 17

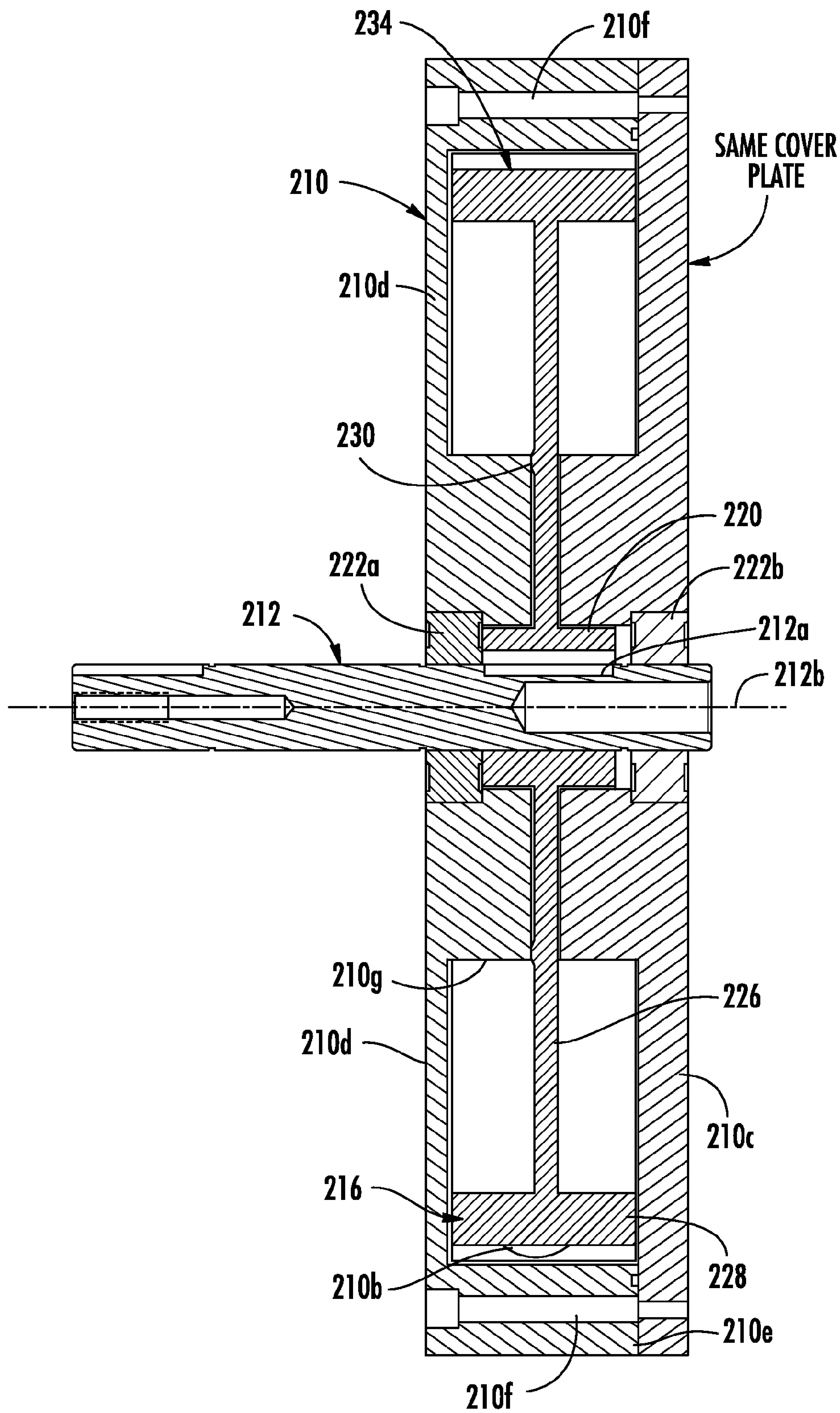

234
210f
SAME COVER PLATE
210
210d
230
220
222a
222b
212
212a
212b
210g
226
210d
210c
216
228
210b
210e
210f

FIG. 18

TURBINE ENERGY GENERATING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation of U.S. patent application Ser. No. 11/358,577, filed Feb. 21, 2006, which claims the benefit of U.S. provisional application entitled TURBINE ENERGY GENERATING SYSTEM, Ser. No. 60/655,168, filed Feb. 22, 2005, by Applicant Imad Mahawili, Ph.D, which are hereby incorporated herein by reference in their entireties.

TECHNICAL FIELD AND BACKGROUND OF THE INVENTION

[0002] The present invention relates generally to turbine energy generating systems. More specifically, the present invention relates to a turbine energy generating system that can be used in a residential setting to supplement or substitute for a conventional utility electrical supply system and, further, can be used as part of an energy supply network.

[0003] Today existing electric generating technologies include large scale steam turbines producing electricity with a relatively low efficiency rate. The large scale steam turbines often emit undesirable byproducts, such as sulfur oxides, nitrous oxides, ash, and mercury. Additionally, these large scale steam turbines emit a large amount of heat, which is generally released into lakes often disrupting the environment.

[0004] More recently it has been found that smaller scale turbines, such as micro-turbines, fueled by natural gas can operate with greater efficiency. During operation, the micro-turbines do not pollute to the same degree as large scale steam turbines and instead emit elements such as carbon dioxide and water, with only very low amounts of nitrogen oxides. Additionally, the heat recovery from operation of the micro-turbines is useful for heating water.

[0005] In many parts of the world there is a lack of electrical infrastructure. Installation of transmission and distribution lines to deliver the product to the consumer is very costly, especially in third world countries. Moreover, the electrical infrastructure in many countries is antiquated and overworked resulting in "brownouts" and "blackouts."

[0006] Consequently, there is a need for an energy generating system that can produce energy in a stand alone system or that can be integrated into existing systems.

SUMMARY OF THE INVENTION

[0007] Accordingly, the present invention provides a turbine energy generating system that can be used independently of a conventional utility electrical supply system or can be integrated into a conventional electrical supply system to supplement the system or contribute to the energy supply as part of a network.

[0008] In one form of the invention, a turbine energy generating system includes a combustion chamber for converting fuel into gaseous heat energy, such as steam, by igniting an air and fuel mixture, a turbine for converting the energy produced by the combustion chamber into mechanical energy and a generator for converting the mechanical energy produced by the turbine into electrical energy.

[0009] The turbine energy generating system could be designed to produce 1 to 15 kilowatts.

[0010] In another aspect of the invention, the generator may be an electric generator producing alternating electric current during operation of the turbine energy generating system. The fuel for the turbine energy generating system may include any of the following: diesel, gasoline, naphtha, propane, methane, natural gas, wood, coal, biomass, lawn clippings, and oil, and combustible recyclables, such as tires, plastics, paper products, biogas, and biodiesels.

[0011] According to another aspect of the invention, the turbine energy generating system further includes an exhaust passage downstream from the turbine delivering high temperature exhaust air from the turbine and a heat exchanger receiving the high temperature exhaust air for heat transfer. An air conditioning system may also be coupled to the heat exchanger. A water heating system for converting tap water into hot water may be coupled to a heat exchange exhaust for releasing lower temperature exhaust air. In one form of the invention the combustion chamber could be cooled with water with a heat exchange surface that induces water boiling into steam. Such generated steam could then be condensed yet in another heat exchanger to produce liquid potable water from a variety of initial cooling water sources. This could be quite a novel advantage for the application of such turbine electric systems, whether using steam to generate the turbine driving energy or natural gas combustion, where safe drinking water is desired.

[0012] In yet another aspect of the invention, the turbine energy generating system may include a central controller and a plurality of turbine energy generating systems connected over a network for communications. The central controller and the plurality of turbine energy generating systems may communicate information such as usage and spending through an electric grid. The central controller may communicate with at least one of the plurality of turbine energy generating systems to return power to the electric grid. Additionally, the central controller may enable a one turbine energy generating system to provide a power load to another turbine energy generating system through the electrical grid. The network may be an internet network using policy parameters from power wheeling standards.

[0013] Another aspect of the invention, the turbine energy generating system may be portable or may be compatible for integration with a plurality of energy systems to provide power to an electrical distribution system and further may be configured for integration into a heating system, a cooling system and/or a water heating system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a schematic drawing of a turbine energy generating system according to the present invention;

[0015] FIG. **2** is a schematic diagram of the turbine energy generating system of FIG. **1** attached to a switchboard controller and meter;

[0016] FIG. **3** is a schematic diagram of the turbine energy generating system of FIG. **2** attached to a heating system;

[0017] FIG. **4** is a schematic diagram of the turbine energy generating system of FIG. **3** attached to an air conditioning system;

[0018] FIG. **5** is a schematic diagram of the turbine energy generating system of FIG. **4** connected to a hot water heater;

[0019] FIG. **6** is a schematic diagram of the turbine energy generating system of FIG. **5** connected to a water system, such as a hot water tank or water boiler and condenser to produce potable water;

[0020] FIG. **7** is a schematic diagram of the turbine energy generating system according to the present invention integrated into a house;

[0021] FIG. **8** is a schematic diagram of the relationship between the house with the turbine energy generating system and an electric generation power plant;

[0022] FIG. **9** is a schematic diagram of the relationship between a plurality of houses with turbine energy generating systems, a grid, and the electric generation power plant;

[0023] FIG. **10** is a schematic diagram of the relationship between the plurality of houses with turbine energy generating systems, a grid, the electric generation power plant, and a fuel source;

[0024] FIG. **11** is a schematic diagram of the relationship between a plurality of houses with turbine energy generating systems, a grid, the electric generation power plant, and a central controller over a network;

[0025] FIG. **12** is a schematic diagram of the relationship between a plurality of houses with turbine energy generating systems, a grid, the electric generation power plant and a central controller over a network using power wheeling standards;

[0026] FIG. **13** is a schematic diagram of the system of FIG. **12** with additional sources of fuel;

[0027] FIG. **14** is a schematic drawing of another turbine energy generating system according to the present invention;

[0028] FIG. **15** is a side view of one embodiment of the turbine of FIG. **1**;

[0029] FIG. **16** is a perspective view of the turbine of FIG. **15** with the cover removed;

[0030] FIG. **17** is a perspective view of the turbine wheel;

[0031] FIG. **18** is a cross-section of the turbine; and

[0032] FIG. **19** is cross-section along line XIX of FIG. **15**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0033] Referring now to the figures, FIG. **1** is a schematic drawing of a turbine energy generating system **10** according to the present invention. As will be more fully described below, turbine energy generating system **10** of the present invention converts fuel **18** into electrical power **28** that can be used immediately, stored for later use, or delivered to a network for distribution within the network, such as an electric company grid.

[0034] Turbine energy generating system **10** includes a combustion chamber **12**, a turbine **14**, and a generator **16**, such as an electric generator and inverter. Turbine energy generating system **10** may be portable and easily transportable between locations and buildings. Turbine **14** is preferably dimensioned such that it may portable and has an output in a range to 1 to 15 kilowatts and more preferably in a range of 5 to 10 kilowatts. In addition turbine **14** may be configured to have an efficiency of at least 40%, more preferably at least 50%, and more typically, in a range of 50% to 60%. Further details of a suitable turbine **14** are provided in reference to FIGS. **15-18**. Additionally, turbine energy generating system **10** is compatible for integration with other energy systems and systems requiring energy. This will be discussed in more detail below.

[0035] Fuel **18** is provided to combustion chamber **12**, which converts the fuel into gaseous heat energy **20** by igniting an air and fuel mixture. Gaseous heat energy **20** may include steam. For example, as will be described in reference to a later embodiment, chamber **12** may include water, which is heated and then circulated to produce steam, including high pressure steam. Fuel **18** may include diesel, gasoline, naphtha, propane, methane, natural gas, wood, coal, biomass, lawn clippings, oil, combustible recyclables, such as tires, plastic, and paper products, biogas, or biodiesels.

[0036] Gaseous heat energy **20** is provided to turbine **14**, which converts the gaseous heat energy into mechanical energy **22**. In addition, during the conversion of the gaseous heat energy **20** exhaust heat **24** is also produced. Exhaust heat **24** is released out of an exhaust passage **26** downstream from turbine **14**. Exhaust heat **24** may be a high temperature exhaust air.

[0037] Generator **16** converts mechanical energy **22** into electrical energy **28**. Generator **16** may include a rotating rotor and a stator. The rotor may be a permanent magnet positioned rotatably within the stator and rotates relative to the stator during operation of turbine **14**. Mechanical energy **22** can be transferred to a shaft from turbine **14** to the rotor, so that the shaft, turbine **14** and rotor of generator **16** rotate in unison at speeds, for example, of up to 90,000 rpms or more.

[0038] Referring to FIG. **2**, turbine energy generating system **10** as illustrated in FIG. **1** may be attached to a switchboard controller and meter **30**. Switchboard controller and meter **30** assists in the distribution of electric power to a building or location. Generally, the instant load from turbine energy generating system **10** follows controller **30** of a standard home electrical box. Turbine energy generating system **10** is easily compatible with all standard configurations for electrical box controllers **30**.

[0039] As best seen in FIG. **3**, turbine energy generating system **10** of FIG. **2** may be additionally attached to heating system **32** so that exhaust heat **24** of energy generating system **10** may be used in a heating system **32**. Heating system **32** may include heat exchanger **34** coupled to a heating duct and fan setup **36**. Heat exchanger **34** may use exhaust heat **24** to provide exhaust heat **38** and/or output heat **40** for a location or building. Heat exchanger **34** receives high temperature exhaust air **24** from exhaust passage **26** downstream from turbine **14** for heat transfer. In this manner, turbine energy generating system **10** may assist with heating requirements for a location or building.

[0040] FIG. **4** is a schematic diagram of turbine energy generating system **10** as illustrated in FIG. **3** attached to air conditioning system **42**. Accordingly, turbine energy generating system **10** may satisfy or complement the cooling requirements for a location or building.

[0041] Additional components that may be added to system **10** include a water system **44**. Referring to FIG. **5** the exhaust heat of heating system **32** of FIG. **4** may be coupled to a water system **44**. For example, the water system may comprise a hot water heater or water boiler **44** and condenser to produce potable water. Water heater **44** is connected to exhaust heat **38** from heat exchanger **34**. Water heater **44** receives water **46**, and using the exhaust heat **38**, produces hot water **48** and optionally exhaust heat **50**.

[0042] Referring to FIG. **6** exhaust heat **50** of hot water heater or boiler **44** of FIG. **5**, may be connected to a hot water tank **52**, or as noted above to a condenser. Hot water tank **52** provides storage for hot water **48** from hot water heater **44** for a location or building. The condenser condenses the steam produced by the boiler into potable water. The resulting system shown in FIG. **6** herein after is referred to as home energy system **60**. It should be noted, that home energy system **60** is only illustrative and not meant to be limiting of the application of energy system **60** to houses, but may also apply to other types of buildings, structures and locations. Further, home energy system **60** may include integration of all or some of these systems: electrical system switch board and meter **30**, heating system **32**, air conditioning system **42**, water system **44**, with a hot water heater or boiler, and hot water storage tank **52** or a condenser for producing potable water, as noted above. It should be appreciated that other types of systems related to houses, buildings, locations or structures can be integrated with energy system **10**, while keeping within the spirit of the invention. The integration of home energy system **60** is discussed in further detail below.

[0043] As generally noted above, energy system **60** may be integrated into a house **58**, illustrated in FIG. **7**, to supplement or substitute an existing energy system. It should be noted that energy system **60** can be integrated into all types and sizes of buildings and structures as well as locations requiring energy. As would be understood, system **60** may either include fewer components and systems or may include additional components or systems.

[0044] Energy system **60** can integrate any one or more of the heating, cooling, water heating and electrical systems into a mobile and portable unit. As would be understood from the above description, energy system **60** is powered by fuel **18**. Using turbine energy generating system **10**, energy system **60** can fulfill the electrical, heating, cooling and/or hot water, and/or potable water needs for a location, building or structure.

[0045] The relationship between house **58**, home energy system **60**, electric generation power plant **64** and grid **62** is illustrated in FIG. **8**. Home energy system **60** can provide at least part of, if not all the electrical needs of a single location, structure or building, such as house **58**. Energy system **60** is integrated with grid **62** at a junction box or switchboard controller and meter **30** to distribute electrical load in a location. Either energy system **60** or grid **62** can be the primary system with the other system serving as an auxiliary or support system. When energy system **60** produces more electricity than required, the electrical load can be stored in a storage device, such as some type of battery, or returned back to power grid **62**. In systems that are not tied into the electric company, as a system setup located in a remote or third world location, surplus electrical load can be delivered to a specific location over a local grid **62**. Alternatively, if surplus electrical load is returned to grid **62**, house with surplus electricity can designate a specific house or location to receive the electrical load through the electric company's grid **62**. This sharing of electrical loads allows two locations to exchange electrical loads at a cost lower than purchasing from the electric company.

[0046] The relationship between a plurality of houses **58** with energy system **60**, grid **62**, and electric generation power plant **64** is illustrated in FIG. **9**. Each house **58** may have energy system **60** to satisfy the electrical needs for that home. However, grid **62** still offers access to electrical power from electric generation power plant **64** to all homes **58**. Energy system **60** enables homes to save money since power from the electrical company is often costly. Furthermore, each home **58** with energy system **60** may provide other houses **58** with power if required and desired, as described below. It should be noted that a plurality of locations, structures and building with energy system **60** can also share energy.

[0047] The relationship between a plurality of houses **58** with energy systems **60**, grid **62**, electric generation power plant **64**, and fuel source **18** is illustrated in FIG. **10**. Energy systems **60** only require fuel source **18** such as natural gas to provide electrical power, heating and cooling, and/or water heating in a small portable unit.

[0048] The relationship between houses **58** with energy systems **60**, grid **62**, electric generation power plant **64**, and central controller **66** over network **70** is illustrated in FIG. **11**. Central controller **66** communicates with houses **58** over network **70** through each house's switchboard controller and meter **30**, which is coupled to energy system **60** over network **70**. Network **70** can be the Internet, an Ethernet network, or a wireless network. Central controller **66** can access information such as usage, spending, surpluses and shortages for each energy system **60** through switchboard controller and meter **30**. Central controller **66** may control distribution of electrical power over grid **62** and communicate with each energy system **60** to determine the status of each system. Central controller **66** may be configured to track where surpluses exists and draw from surpluses that are accessible and credit houses **58** providing electrical power back to grid **62**.

[0049] Additionally, network **70** enables communication between a plurality of houses **58**. For example, a specific house **58***a* may either request or offer electricity over network **70** to another house **58***b* for direct house to house exchange and sale of electricity. The spending and usage between houses, **58***a* and **58***b*, may be monitored by central controller **66** or by each house individually. Direct distribution of power between the plurality of houses promotes faster distribution of power with lower pollution than using grid **62**.

[0050] The relationship between houses **58** with energy systems **60**, grid **62**, electric generation power plant **64** and central controller **66** over network **70** using power wheeling standards is illustrated in FIG. **12**. Central controller **66** uses network connection **72** to control distribution of electrical loads over grid **62** from power plant **64** according to the power wheeling standards and policies.

[0051] For example, house **58***a* with energy system **60***a* may provide surplus electricity to energy system **60***b* of another house **58***b* over grid **62** and facilitated by central computer **66**. Accordingly, central computer **66** may manage power distribution between plurality of energy systems **60** for faster and more efficient electric distribution and consumption according to power wheeling standards and policies.

[0052] Additionally, energy system **60***a* may provide surplus electrical load back to grid **62** facilitated by central controller **66**. Central controller **66** tracks both the usage and spending over network **70** of electric loads over grid **62**. Central computer **66** determines the amount of electrical load delivered back to grid **62** from energy system **60***a* and puts a credit on the account for house **58***a*, which provided the surplus.

[0053] The system setup of FIG. **12** with additional sources of fuel **18** is illustrated in FIG. **13**. Fuel **18** may come from methane from fossil and biomass sources. Many types of fuel **18** may be used to power turbine energy generating system **10** of energy system **60** for the production of energy and electrical loads. Energy system **60** may be especially useful in third world countries where power provided by electric generation power plants **64** is erratic and inconsistent leading to "brownouts" and "blackouts." In many parts of the world, there is a lack of electrical infrastructure of transmission and distribution lines from power plants **64**.

[0054] Energy system **60** with energy generating system **10** eliminates expensive structural costs to install and deliver products to the consumer over an electrical infrastructure. Accordingly, this invention provides an advantageous alternative to receiving electricity from central power plant **64**. Energy system **60** provides a location or plurality of locations with electricity, heating and cooling, and/or hot water, without reliance on a central plant for electricity. Energy system **60** effectively utilizes the exhaust heat from turbine energy generation system **10** to provide heat and improve the overall efficiency of the entire system.

[0055] Referring to FIG. **14**, the numeral **110** generally designates another embodiment of the turbine energy generating system of the present invention. Similar to the previous embodiments, turbine energy generating system **110** is adapted to convert fuel **118** into electrical power **128** that can he used immediately, stored for later use, or delivered to a network for distribution within the network, such as an electric company grid. In the illustrated embodiment, turbine energy generating system **110** is adapted to generate high pressure, high temperature steam energy **130**, which is directed into a turbine **114** to generate electrical power **128** and also to generate, as exhaust, hot water and steam **132**.

[0056] Turbine energy generating system **110** includes a combustion chamber **112**, a turbine **114**, and a generator **116**, such as an electric generator and inverter. In the illustrated embodiment, turbine energy generating system **110** is particularly suitable for use as a portable unit that is easily transportable between locations and buildings. Similar to system **10**, turbine **114** is configured such that it has an output in a range to 1 to 15 kilowatts and more preferably in a range of 5 to 10 kilowatts. Optionally, turbine **114** may have an efficiency of at least 40%, more preferably at least 50%, and more typically, in a range of 50% to 60%.

[0057] Fuel **118** is provided to combustion chamber **112**, which converts the fuel into gaseous heat energy **120** by igniting the air and fuel mixture. Air or an air/gas mixture is injected into chamber **112** through an inlet port (not shown) to control the rate of combustion in chamber **112**.

[0058] Similar to fuel **18**, fuel **118** may include diesel, gasoline, naphtha, propane, methane, natural gas, wood, coal, biomass, lawn clippings, oil, combustible recyclables, such as tires, plastic, and paper products, biogas, or biodiesels. Located in chamber **112** is a high pressure vessel **112*a*** that holds water **112*b***, which is heated by gaseous heat energy **120**. When gaseous heat energy **120** heats water **112*b***, water **112*b*** circulates in vessel **112*a*** and produces steam or steam energy **130**, including high pressure and high temperature steam or steam energy. The exhaust heat and gas is then exhausted from chamber **112** through outlet **112*c***, which preferably includes a filter to remove the harmful waste in the exhaust.

[0059] Chamber **112** may be an open or closed chamber. In addition, chamber **112** may be closed with the fuel located exteriorly of the chamber and ignited to produce a flame directed onto the chamber rather than in the chamber—in which case the chamber could form the high pressure vessel.

[0060] Vessel **112*a*** is in fluid communication with turbine **114** via a conduit **113**, which optionally includes a nozzle **113*a***, such an expansion nozzle, which introduces or injects steam energy **130** into turbine **114** at a higher pressure than the pressure of the steam in chamber **112*a*** or in conduit **113** to increase the output of the turbine **114** for a given steam pressure generated in vessel **112*a***. Steam energy **130** preferably only undergoes expansion after it is injected into turbine **114**.

[0061] Steam energy **130** provides steam, optionally high temperature and high energy steam, to the blades of turbine **114**, which converts the steam energy into mechanical energy **122**. In addition, during the conversion of the steam energy **130** exhaust hot water and steam **132** may also produced. Exhaust water and steam **132** is released from turbine **114**, and may be directed into a storage tank for later use or to a water heating system for recycling.

[0062] Generator **116** converts mechanical energy **122**, which it receives from turbine **114**, into electrical energy **128**. Generator **116**, like generator **16**, may include a rotating rotor and a stator. The rotor may be a permanent magnet positioned rotatably within the stator and rotates relative to the stator during operation of turbine **114**. Mechanical energy **122** can be transferred to a shaft from turbine **114** to the rotor, so that the shaft, turbine **114** and rotor of generator **116** rotate in unison at speeds, for example, of up to 90,000 rpms. In smaller portable applications though, this speed may be more typically in a range of 500 to 3000 rpms.

[0063] Additionally, like turbine energy generating system **10**, turbine energy generating system **110** is compatible for integration with other energy systems and systems requiring energy, as discussed above.

[0064] Referring to FIGS. **15**, **16**, **18**, and **19**, one suitable turbine for turbines **14** and **114** comprises a compact modular turbine that includes a housing **210**, a shaft **212**, and a paddle wheel **216**. Housing **210** includes an inlet **210*a***, an outlet **210*b***, and a chamber **218**, which is in fluid communication with inlet **210*a*** and outlet **210*b***. Paddle wheel **216** is located and enclosed in chamber **218** by housing cover **210*c*** and, further is sized such that its outermost diameter is dimensioned to contact the inner surface of chamber **218**. In other words, the outermost diameter of paddle wheel **216** is approximately equal to the diameter **218*a*** of chamber **218**.

[0065] As best seen in FIG. **18**, shaft **212** extends through housing **210** and is supported in housing wall **210*d*** and housing cover **210*c*** in bushings **222*a*** and **222*b*** and further projects outwardly from housing **210** for coupling to the shaft of the generator. Further, wheel **216** is mounted to shaft **212** in chamber **218** and captured in housing **210** closely adjacent to wall **210*d*** of housing **210** by housing cover **210*c***, which is secured to housing perimeter wall **210*e*** by fasteners that extend into respective mounting openings **210*f*** provided in housing **210**.

[0066] Paddle wheel **216** is mounted and rotatably coupled to shaft **212** by a collar **220**, which includes a keyway **220*a*** for receiving a key **220*b*** that extends into keyway **212*b*** provided on shaft **212** to thereby rotatably couple wheel **216** to shaft **212**. In this manner, when paddle wheel **216** rotates in housing **210**, shaft **212**, which is supported in housing **210**, will be driven to rotate about its longitudinal axis **212*b***.

[0067] As best seen in FIGS. **16**, **17**, and **18**, paddle wheel **216** includes a central circular plate **226** with an enlarged annular flange **228** at its outer periphery. Plate **226** further includes an annular spacer ring **230**, which is provided inwardly of flange **228** and which provides a bearing surface for wheel **226** for contacting housing wall **210** at central annular seat **210*g***. Enlarged annular flange **228** includes a plurality of flattened generally V-shaped notches **232** formed in its outer periphery to thereby form a plurality of fins **234** that form the turbine blades, which make contact with the inner surface **218*b*** of cavity **218**.

[0068] As best understood from FIGS. **16**, **18**, and **19**, cavity **218** is cylindrical in shape and intersects with the cylindrical passageways **236** and **238**, which exit housing **210** to form inlet **210***a* and **210***b*, respectively. In the illustrated embodiment, the upper right end (as viewed in FIG. **19**) of passageway **236** is open to form inlet **210***a*, while the upper left end of passageway **236** is closed. Similarly, the lower right end (as viewed in FIG. **19**) of passageway **238** is open to form outlet **210***b*, while the lower left end of passageway **238** is closed. It should be understood that outlet locations may be provided at the upper left end of passageway **236** (with both ends of passageway **238** closed) or at the lower left end of passageway **238** (with the right end of passageway **238** and left end of passageway **236** being closed). It should be understood that the references to right, left, upper, and lower are only used in the context of the relative positions in the drawings and are not intended to be limiting in anyway.

[0069] Referring again to FIG. **19**, cylindrical passageways **236** and **238** intersect cavity **218** at its outer perimeter **218***c*. Such intersections form inlet and outlet interfaces **236***a* and **238***a*, respectively. As noted above, with the illustrated inlet/outlet configuration one end of each passageway (**236**, **238**) is sealed so that when the gaseous heat energy (**20**, **120**) is directed into the inlet the gas will impinge on the fins to rotate the wheel **216** in cavity **218**, which gas is then exhausted through the end of passageway **238** that forms outlet **210***b*.

[0070] As best seen in FIG. **19**, in order to efficiently transfer the gaseous heat energy into rotational movement of wheel **216**, the spacing between fins **234** is such that fins **234** straddle the intersections of passageways **236**, **238** with cavity **218**. As a result, the spacing between the fins is proportional to the height H of the passageways and the length L of the intersection of the passageways with cavity **218**.

[0071] As previously described, the turbine shaft (**212**) of the turbine (**14** or **114**) drives the generator (**16** or **116**). In the present invention, in some applications, for example in low pressure applications, it may be preferable to reduce the drag on the generator. In these applications, the generator is constructed without an iron core. This eliminates the residual magnetism and, therefore, reduces the torque necessary to drive the generator.

[0072] Further, as would be understood, the generators (**16** or **116**) may be configured to generate DC or AC current. In both applications, the generator shaft is mounted with a plurality of magnets, such as rare earth magnets. The number of magnets and the shape of the magnets may be varied to suit each application.

[0073] In the DC application, the magnets are mounted such that the same poles (e.g. the south poles) are directed inwardly to the shaft, while the other poles (e.g. the north poles) are facing outwardly. The magnets are then located between coils, typically formed from copper wiring. Again, the size, the number of coils, and the gage of the coils may be varied depending on the application. Further, the coils may be coupled together in parallel or in series. Thus, when the generator shaft is driven, which is either coupled to the shaft of the turbine, or is formed by an extension of the shaft of the turbine, a DC current will be generated by the coils.

[0074] In order to maximize the current collection from the generator, the coils are connected in parallel and each coil circuit may include a diode, which acts as a valve to prevent current from flowing in the reverse direction.

[0075] With the AC application, the magnets are mounted to the generator shaft such that one group of magnets have their south poles directed inwardly toward the shaft and the other group has their north poles facing outwardly from the shaft.

[0076] In either application, the generator may be coupled to the end load (that is the home or energy system to which the generator is supplying energy) through a switching capacitor circuit, which reduces if not eliminates the load variation on the generator due to the variation in the power usage at the end load. The switching capacitor circuits are well known and typically include at least two capacitors, a logic controller that is coupled to the generator and to the capacitors and selectively switches between the two capacitors, a second controller that is coupled to first controller through the capacitors, and an inverter that couples the second controller to the end load. The first controller switches between the two capacitors when one of the capacitors reaches saturation. In this manner, the generator is isolated from the variation in load at the end load.

[0077] While several forms of the invention have been shown and described, other forms will now be apparent to those skilled in the art. For example, as described above, anyone of the systems could incorporate a water cooling/and or heating extraction system to cool the combustion chamber. For example, the combustion chamber may be cooled with water with a heat exchange surface that induces water boiling into steam. Such generated steam could then be condensed yet in another heat exchanger to produce liquid potable water from a variety of initial cooling water sources. This could be quite a novel advantage for the application of such turbine electric systems, whether using steam to generate the turbine driving energy or natural gas combustion, where safe drinking water is desired.

[0078] Therefore, it will be understood that the embodiments shown in the drawings and described above are merely for illustrative purposes, and are not intended to limit the scope of the invention, which is defined by the claims, which follow as interpreted under the principles of patent law including the Doctrine of Equivalents.

The embodiments of the invention in which I claim an exclusive property right or privilege are defined as follows:

1. A turbine comprising:

a housing, said housing having a chamber, an inlet passageway, and an outlet passageway, said inlet passageway forming an inlet at one end and intersecting with said chamber to form an inlet interface with said chamber wherein said inlet passageway is in fluid communication with said chamber at said inlet interface, and said outlet passageway having an outlet at one end and intersecting with said chamber to form an outlet interface with said chamber wherein said outlet passageway is in fluid communication with said chamber at said outlet interface;

a shaft rotatably supported in said housing; and

a wheel with a plurality of turbine blades supported in said chamber by said shaft for rotation with said shaft, said turbine blades defining an outer perimeter and defining gaps therebetween, each turbine blade having an impingement surface generally aligned along a radial axis extending outwardly from said shaft, each of said gaps being dimensioned for spanning said inlet interface wherein a respective pair of said turbine blades is spaced substantially equally to the length of said inlet interface such that said respective pair of turbine blades straddle said inlet interface when said respective pair of turbine blades are aligned at said inlet interface, wherein when a fluid is directed into said housing through said inlet the fluid will impinge on one of said blades of said respective pair of turbine blades and induce rotation of said wheel about said shaft.

2. The turbine according to claim **1**, wherein said wheel has an outer flange, said turbine blades formed at said outer flange.

3. The turbine according to claim **2**, wherein said wheel is closed in said chamber by a cover.

4. The turbine according to claim **3**, wherein said chamber has an inner diameter and a depth, said flange having a width approximately equal to said depth, and said wheel having an outermost diameter at said blades approximately equal to said inner diameter of said chamber wherein the gaps formed between said flange and said blades and said inner diameter of said chamber can be filled with the fluid, and when said wheel is rotated with said shaft in said housing at least a portion of the fluid may be expelled through said outlet.

5. A turbine comprising:

a housing, said housing having a chamber, an inlet passageway, and an outlet passageway, said inlet passageway having an outer periphery and an inlet at one end of said passageway, said inlet passageway intersecting with said chamber and forming an inlet interface at said chamber, said outer periphery of said inlet passageway forming a tangent with said chamber at said inlet interface, said outlet passageway having an outer periphery and an outlet at one end of said outlet passageway, said outlet passageway intersecting with said chamber and forming an outlet interface at said chamber, said outer periphery of said outlet passageway forming a tangent with said chamber at said outlet interface; and

a wheel having plurality of turbine blades supported in said chamber by a shaft for rotation in a direction about an axis of rotation, each of said turbine blades having a blade surface generally aligned along a radial axis extending from said shaft, and said inlet interface directing fluid from said inlet to said chamber in a direction generally parallel to said tangent at said inlet interface wherein when the fluid is directed into said housing through said inlet the fluid will impinge and impart a generally orthogonal force on said blade surface and induce rotation of said wheel about said axis of rotation.

6. The turbine according to claim **5**, wherein said inlet passageway is formed by a transverse passageway extending through said housing, one end of said transverse passageway being closed and the other end of said transverse passageway forming said inlet, and an intermediate portion of said transverse passageway forming said inlet interface.

7. The turbine according to claim **5**, wherein said outlet passageway is formed by a transverse passageway extending through said housing, said transverse passageway intersecting said chamber, one end of said transverse passageway being closed and the other end of said transverse passageway forming said outlet, and an intermediate portion of said transverse passageway forming said outlet interface.

8. The turbine according to claim **5**, wherein said wheel is closed in said chamber by a cover.

9. The turbine according to claim **8**, wherein said wheel has a flange at its perimeter, and said blades being formed at said flange.

10. The turbine according to claim **9**, wherein said blades are formed in said flange.

11. The turbine according to claim **10**, wherein said chamber has an inner diameter and a depth, said flange having a width approximately equal to said depth, and said wheel having an outermost diameter at said blades at least approximately equal to said inner diameter of said chamber wherein the gaps formed between said flange and said blades and said inner diameter of said chamber can be filled with said fluid, and when said wheel is rotated with said shaft in said housing the fluid may be expelled through said outlet.

12. A turbine comprising:

a housing, said housing having a chamber, an inlet passageway, and first and second outlet passageways, wherein said inlet passageway is substantially coaxial with said first outlet passageway, said inlet passageway having an end forming an inlet at said chamber, each of said first and second outlet passageways having a respective end forming first and second outlets at said chamber, wherein at least one of said first and second outlets is selectively closeable;

said chamber intersecting said inlet passageway to form an inlet interface with said inlet passageway, and said chamber intersecting said first and second outlet passageways to form respective first and second outlet interfaces with said first and second outlet passageways; and

a wheel having plurality of turbine blades supported in said chamber by a shaft for rotation in a direction about an axis of rotation, each of said turbine blades having a blade surface generally aligned along a radial axis extending from said shaft, and said inlet interface directing fluid from said inlet to said chamber in a direction generally parallel to said tangent at said inlet interface wherein when the fluid is directed into said housing through said inlet the fluid will impinge and impart a generally orthogonal force on said blade surface and induce rotation of said wheel about said axis of rotation, and when said wheel is rotated with said shaft in said housing the fluid may be expelled through one or both of said first and second outlets.

13. The turbine of claim **12**, further comprising a second inlet passageway having an end and forming a second inlet at said end of said second inlet passageway at said chamber, said chamber intersecting said second inlet passageway to form a second inlet interface with said second inlet passageway.

14. The turbine of claim **13**, wherein at least one of said inlet and said second inlet is selectively closeable,

15. The turbine of claim **13**, wherein said second inlet passageway is substantially coaxial with said second outlet passageway.

16. A turbine comprising:

a housing, said housing having a chamber, a single inlet passageway defining an inlet passageway axis, and a single outlet passageway defining an outlet passageway axis, wherein said outlet passageway axis is substantially parallel to said inlet passageway axis, said inlet passageway having an end forming an inlet at said chamber, and said outlet passageway having an end forming an outlet at said chamber;

said chamber intersecting said inlet passageway to form an inlet interface with said inlet passageway, and said chamber intersecting said outlet passageway to form an outlet interface with said outlet passageway; and

a wheel having plurality of turbine blades supported in said chamber by a shaft for rotation in a direction about an axis of rotation, each of said turbine blades having a blade surface generally aligned along a radial axis extending from said shaft, and said inlet interface directing fluid from said inlet to said chamber wherein when the fluid is directed into said housing through said inlet the fluid will impinge and impart a generally orthogonal force on said blade surface and induce rotation of said wheel about said axis of rotation.

17. The turbine of claim **16**, wherein said inlet passageway is substantially coaxial with said outlet passageway.

18. The turbine of claim **16**, wherein at least one of said inlet passageway and said outlet passageway is formed by a transverse passageway extending through said housing, said transverse passageway intersecting said chamber, one end of said transverse passageway being closed and the other end of said transverse passageway forming said inlet passageway or said outlet passageway, and an intermediate portion of said transverse passageway forming said inlet interface or said outlet interface.

19. The turbine of claim **16**, wherein said inlet passageway has an outer periphery, said outer periphery of said inlet passageway forming a tangent with said chamber at said inlet interface, said outlet passageway having an outer periphery, said outer periphery forming a tangent with said chamber at said outlet interface.

20. A turbine comprising:

a housing, said housing having a recess on one side thereof forming a housing wall and a cover over said recess for forming a chamber with said housing wall in said recess, and said housing further having an inlet passageway forming an inlet at one end of said inlet passageway and an outlet passageway forming an outlet at one end of said outlet passageway, each of said inlet passageway and said outlet passageway intersecting said chamber wherein said passageways are in fluid communication with said chamber;

a shaft rotatably supported in said housing about an axis of rotation, said inlet passageway and said outlet passageway each being positioned along respective tangent lines to said chamber at their respective intersections with said chamber, said inlet passageway being formed by a transverse passageway extending through said housing, one end of said transverse passageway being closed and the other end of said transverse passageway forming said inlet, and an intermediate portion of said transverse passageway forming said intersection of said inlet passageway with said chamber;

a central circular plate mounted to said shaft in said chamber;

a flange at an outer perimeter of said central circular plate; and

a plurality of turbine blades at said flange, each said turbine blades sandwiched between said housing wall and said cover and having a blade surface extending along a radial axis from said shaft, and when fluid is directed into said chamber through said inlet the fluid will impinge and impart a force on said blade surface and induce rotation of said shaft.

21. The turbine according to claim **20**, wherein said blades are formed in said flange.

22. The turbine according to claim **20**, wherein said outlet passageway is formed by a second transverse passageway extending through said housing, said second transverse passageway intersecting said chamber to thereby form said intersection of said outlet passageway, one end of said second transverse passageway being closed, and the other end of said second transverse passageway forming said outlet.

23. The turbine according to claim **20**, wherein said central circular plate includes an annular bearing surface radially inward of said flange, and said cover includes a central annular seat, said bearing surface of said circular plate aligning with said central annular seat.

24. The turbine according to claim **20**, wherein said chamber has an inner diameter, and said wheel having an outer diameter approximately equal to said inner diameter of said chamber.

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