US 20120255706A1

(19) United States

(12) Patent Application Publication

Tadayon et al.

(10) Pub. No.: US 2012/0255706 A1

(43) Pub. Date: Oct. 11, 2012

(54) HEAT EXCHANGE USING UNDERGROUND WATER SYSTEM

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(21) Appl. No.: **13/079,841**

(22) Filed: **Apr. 5, 2011**

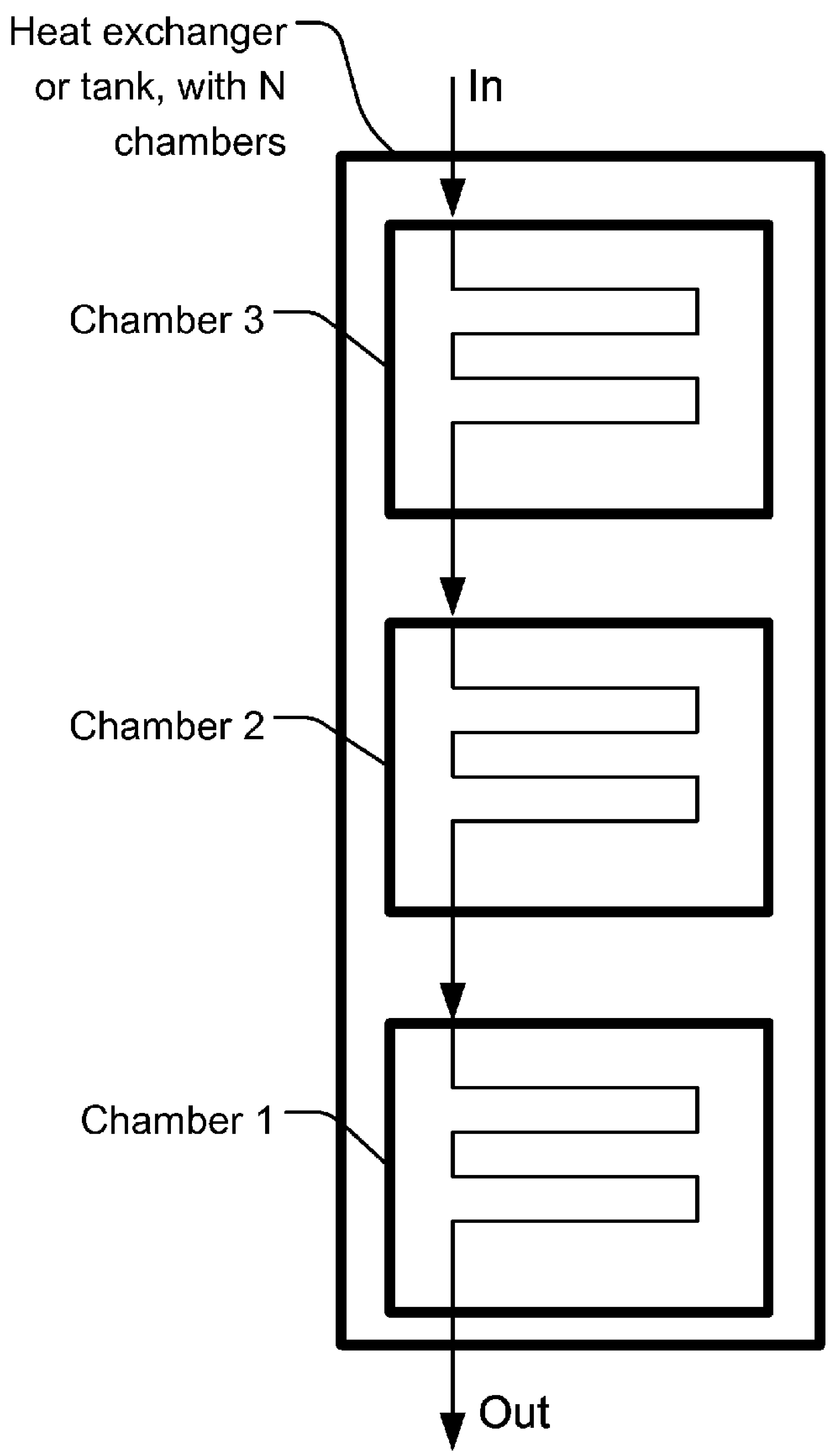
Publication Classification

(51) **Int. Cl.**
F28D 20/00 (2006.01)

(52) **U.S. Cl.** **165/47**

(57) **ABSTRACT**

In this disclosure, we have the following examples and teachings: A geothermal heating and or cooling system is introduced here which is deriving cooled or heated liquid via existing infrastructure of water pipe system in use for the houses and buildings, e.g. from the city water system or pipe network, or from the well water (or lake or river or sea or ocean or the like), piped or channeled to the buildings, through pipes or conduits or channels or closed enclosures. The system derives cooled liquid from existing underground infrastructure, including or for example, below-ground water pipes. The system gains a temperature advantage from the geothermal ground temperature, which remains roughly constant throughout the year in most regions. The system uses (e.g.) a storage tank to contain a working fluid and store thermal energy. In one example, multiple chambers and/or tanks are used for water heaters or coolers, with different connection and flow mechanisms. Other examples and designs are also discussed and shown here.



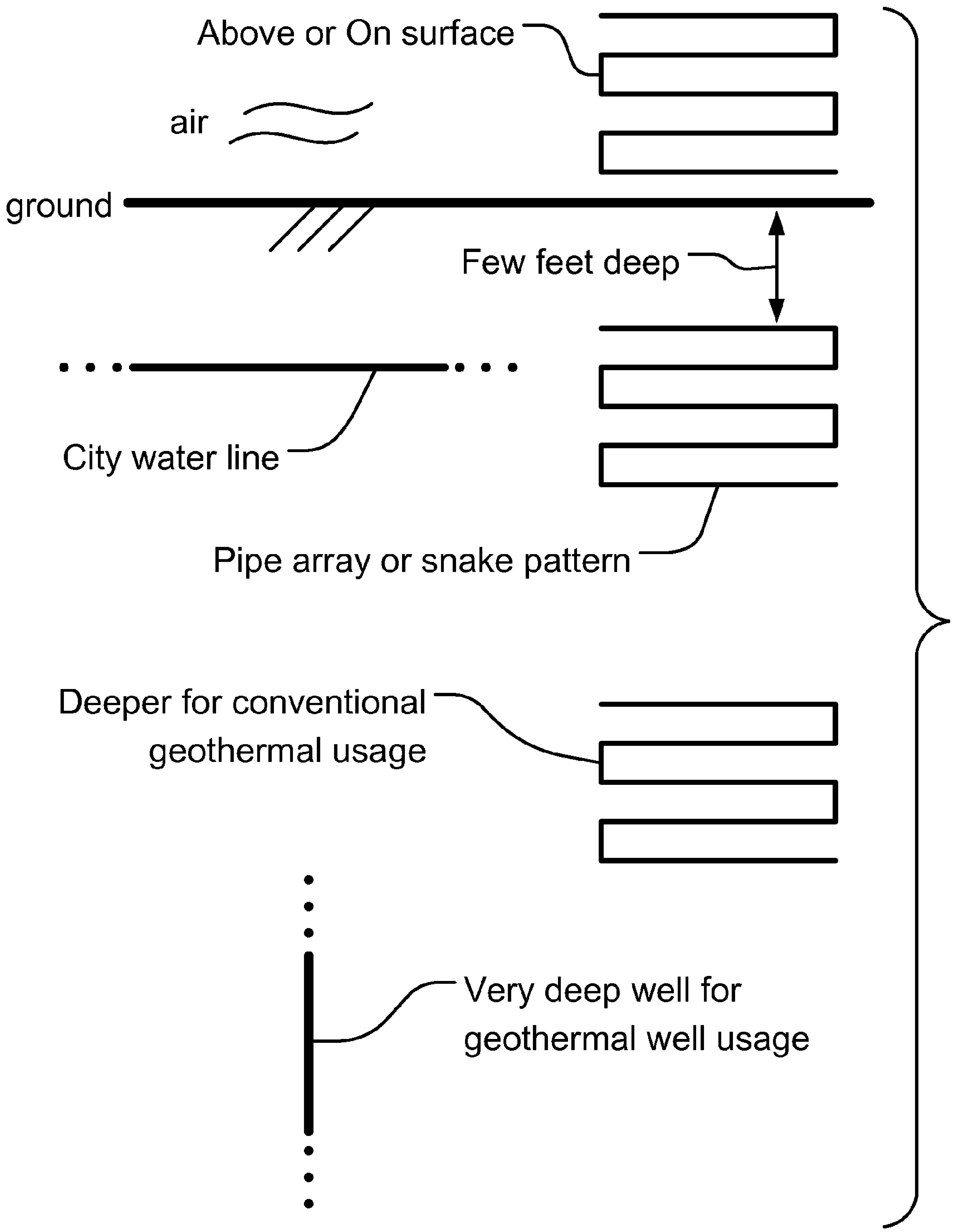

Above or On surface
air
ground
Few feet deep
City water line
Pipe array or snake pattern
Deeper for conventional geothermal usage
Very deep well for geothermal well usage

FIG 1

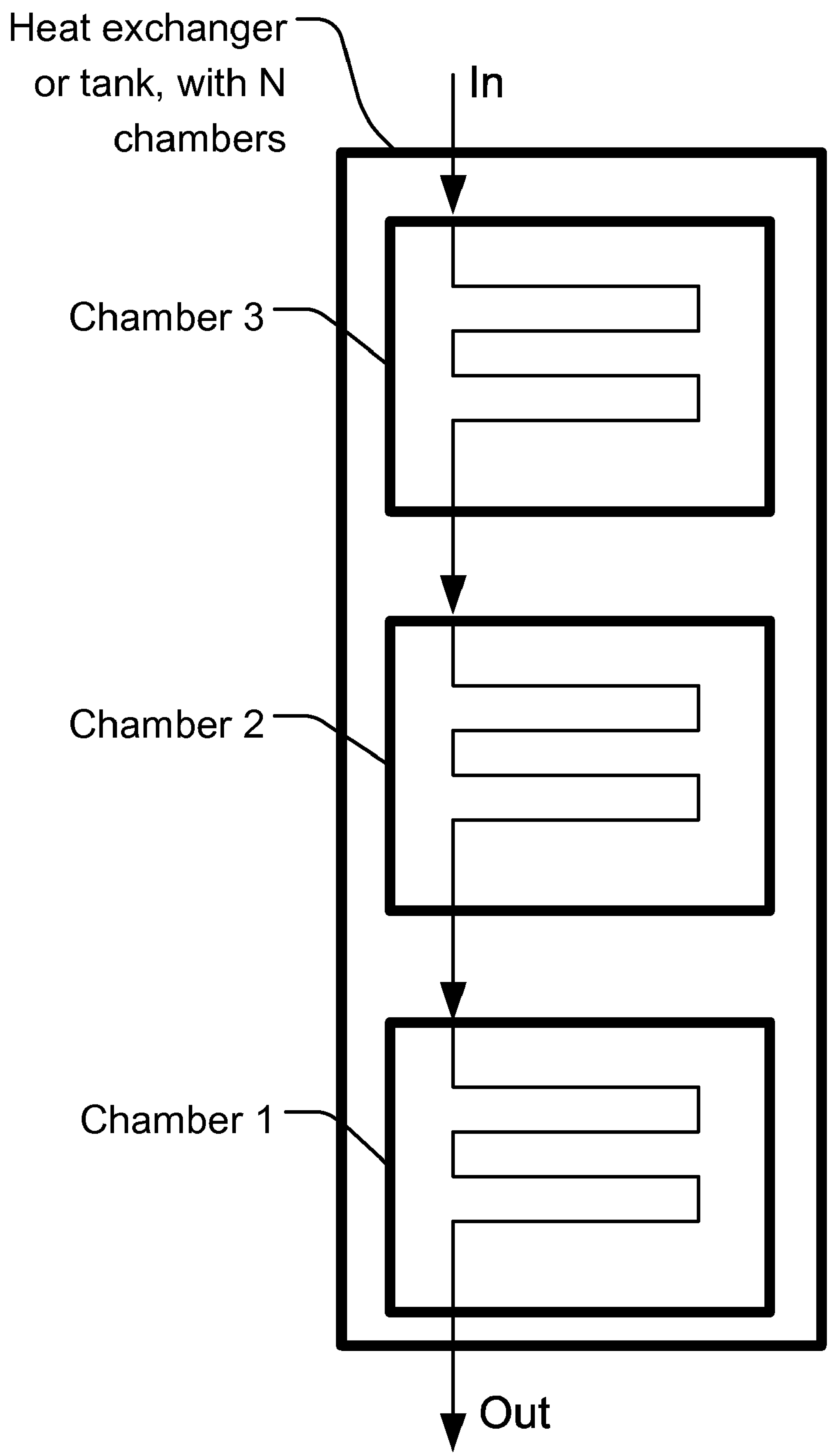

Heat exchanger or tank, with N chambers
In
Chamber 3
Chamber 2
Chamber 1
Out

FIG 2

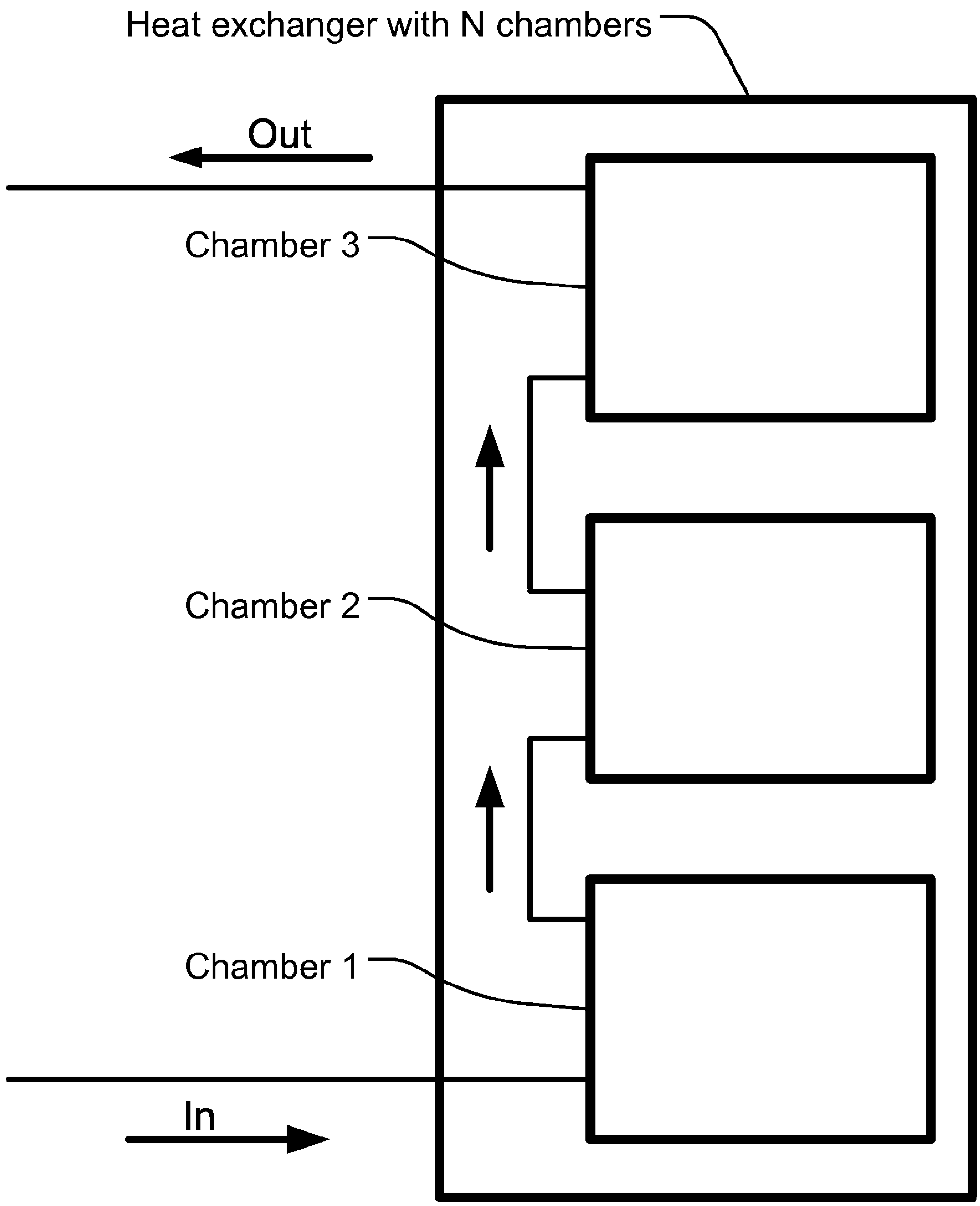
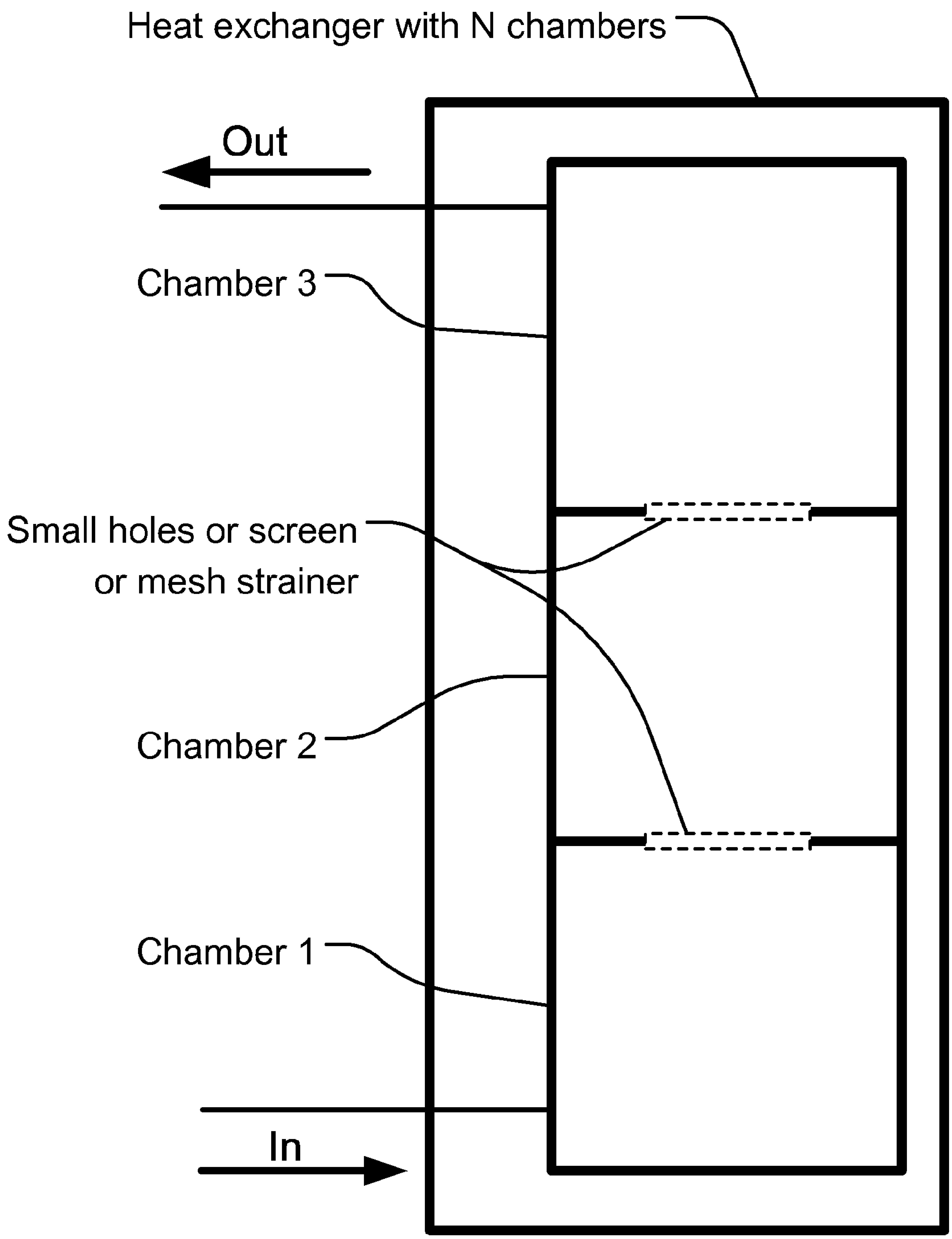

Heat exchanger with N chambers
Out
Chamber 3
Chamber 2
Chamber 1
In

FIG 3



Heat exchanger with N chambers
Out
Chamber 3
Small holes or screen
or mesh strainer
Chamber 2
Chamber 1
In

FIG 4

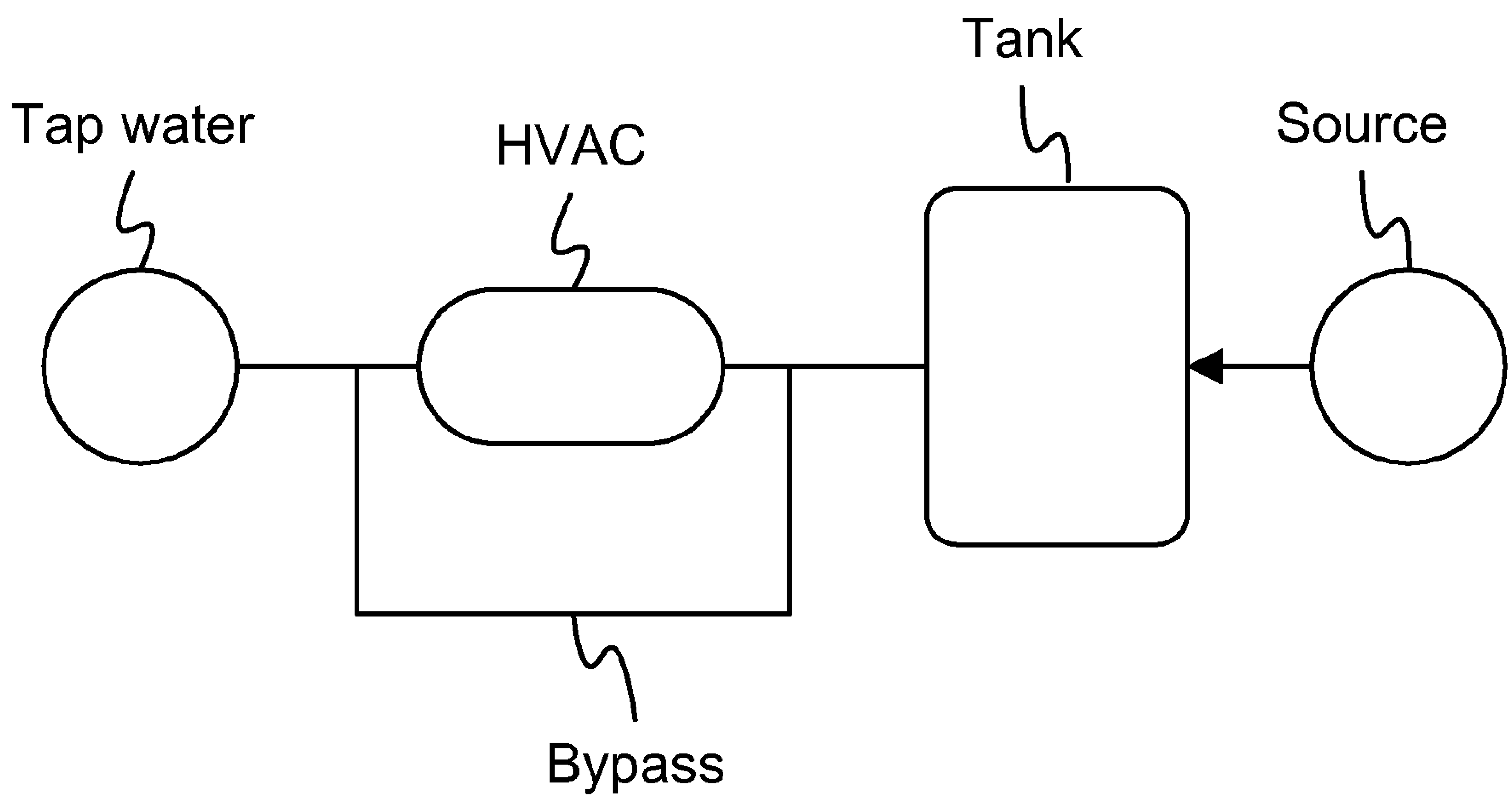


FIG 5

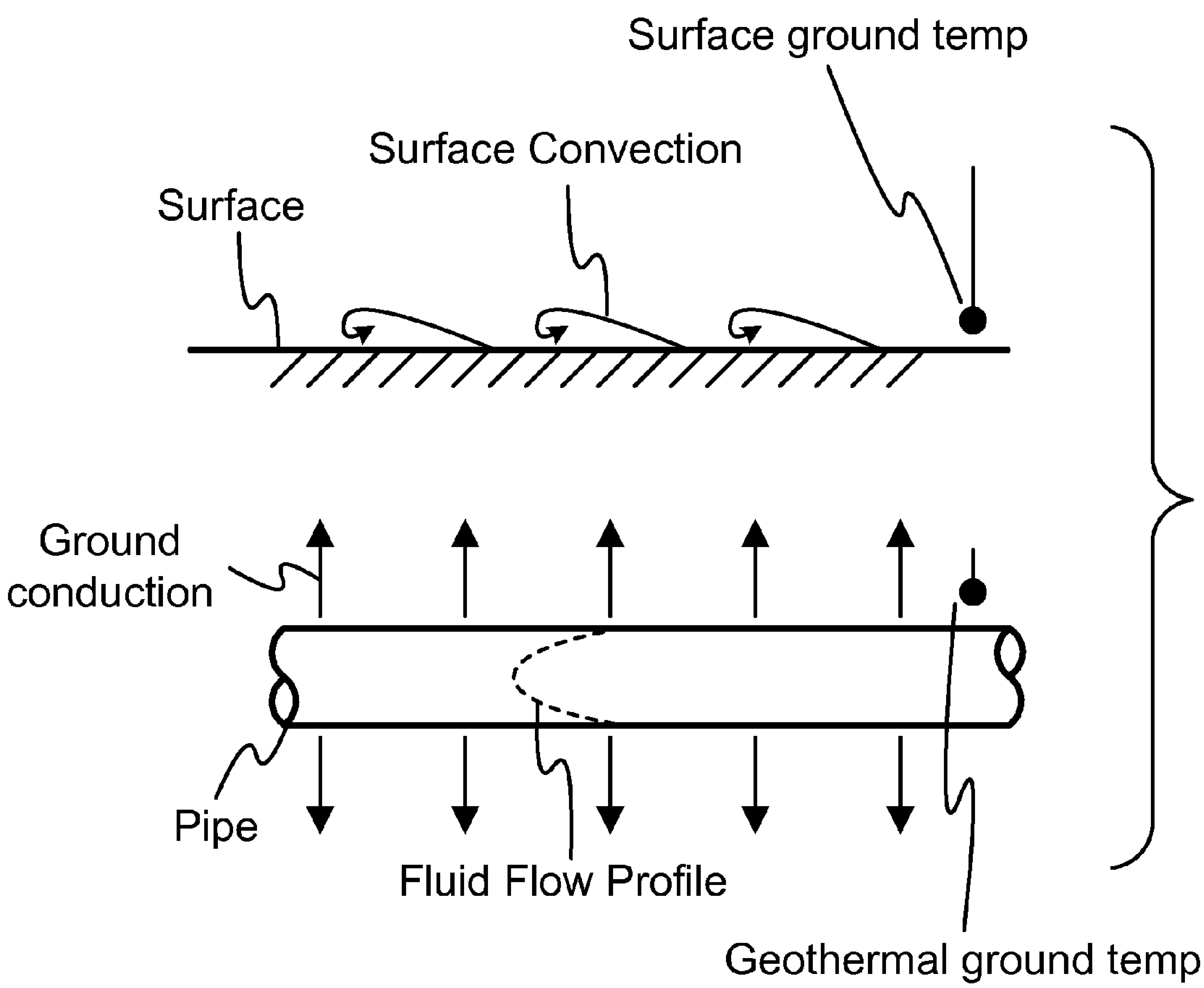

Surface ground temp
Surface Convection
Surface
Ground conduction
Pipe
Fluid Flow Profile
Geothermal ground temp

FIG 6

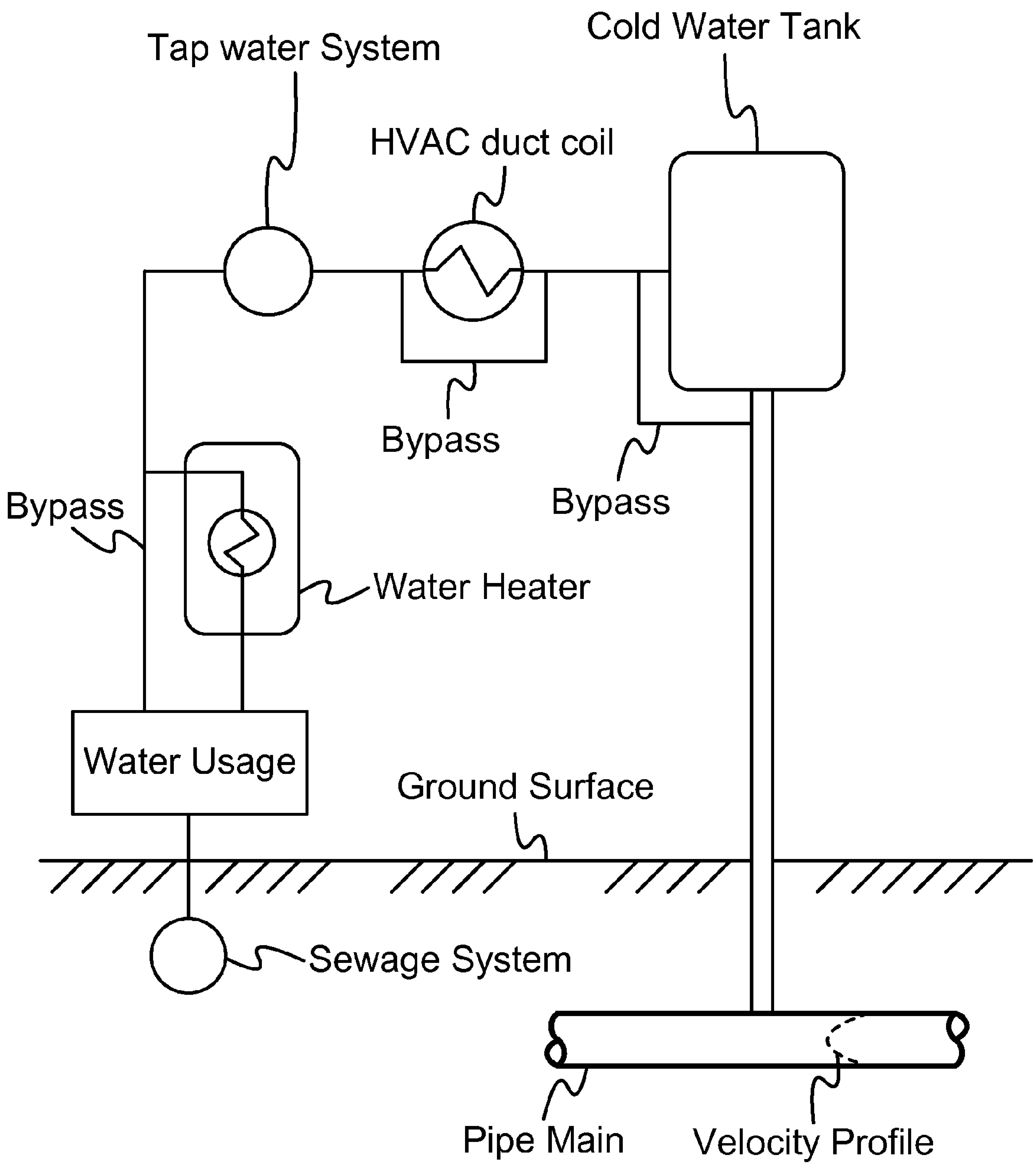

Tap water System
Cold Water Tank
HVAC duct coil
Bypass
Bypass
Bypass
Water Heater
Water Usage
Ground Surface
Sewage System
Pipe Main
Velocity Profile

FIG 7

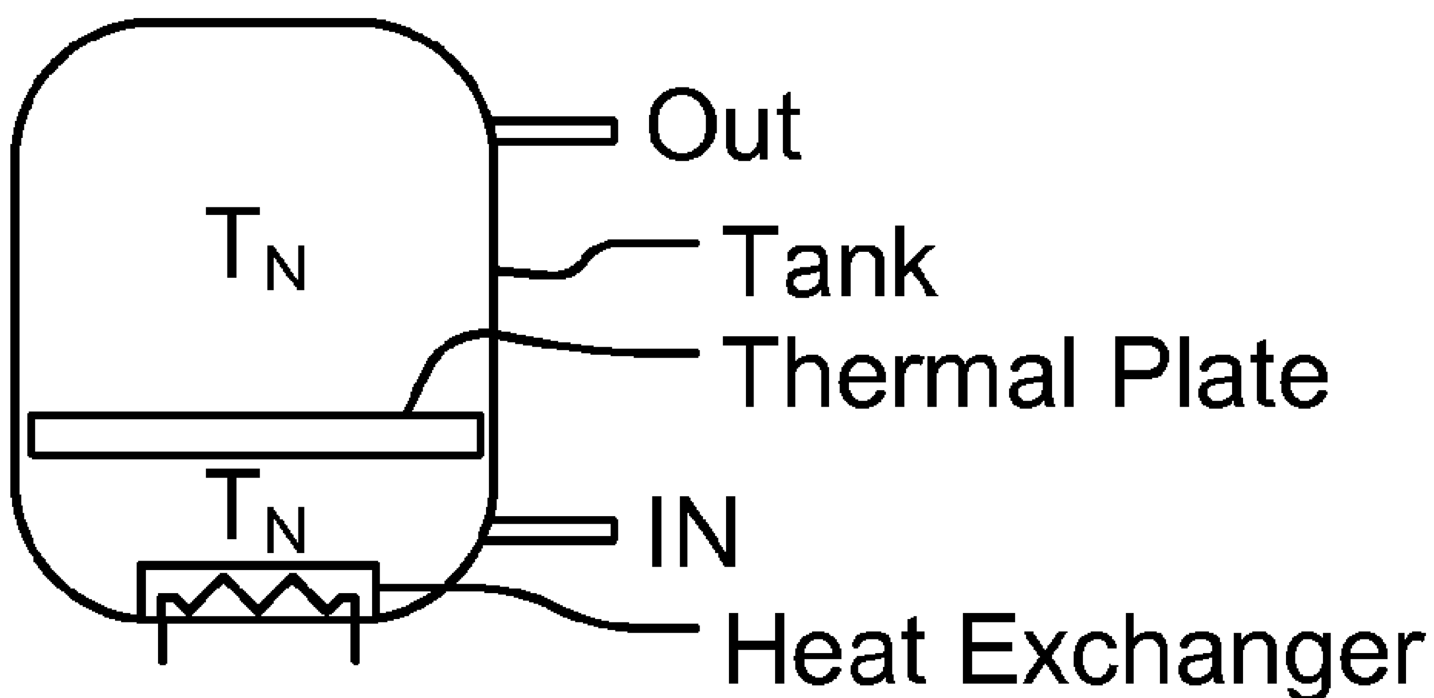


FIG 8(a)

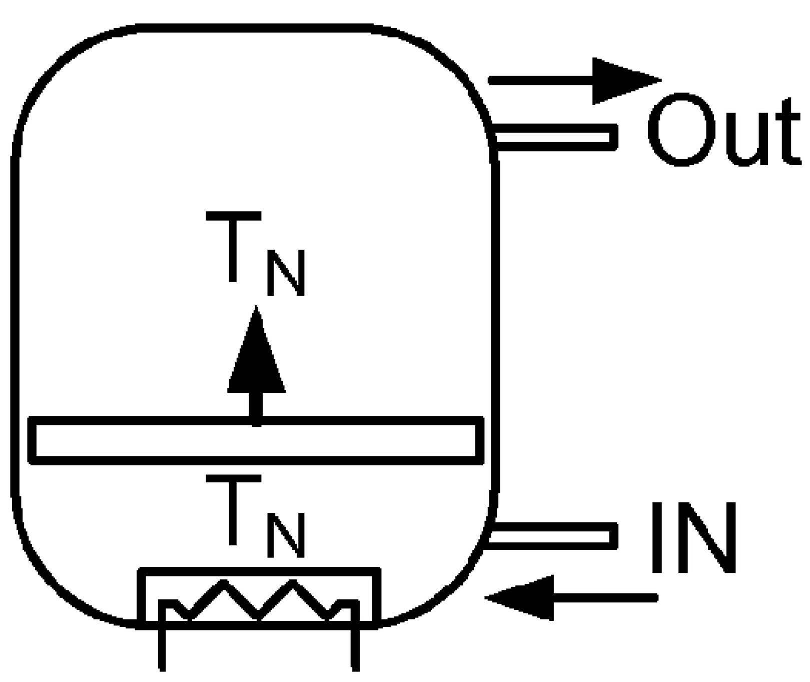


FIG 8(b)

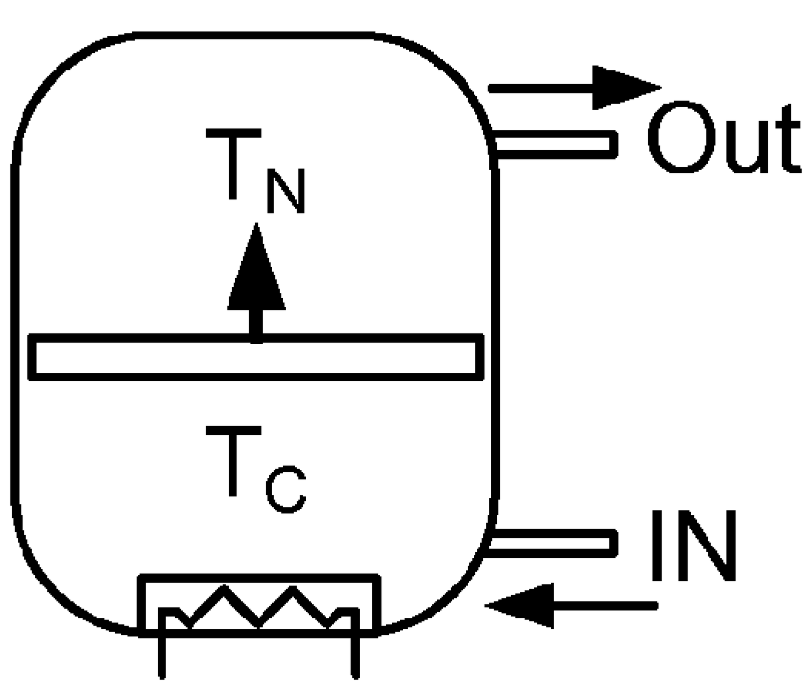


FIG 8(c)

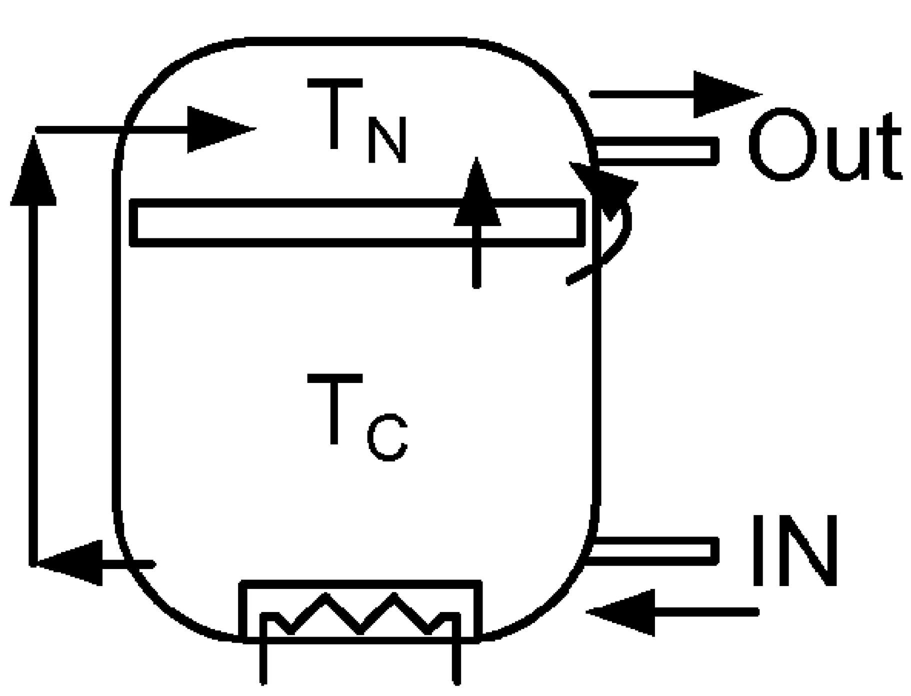


FIG 8(d)

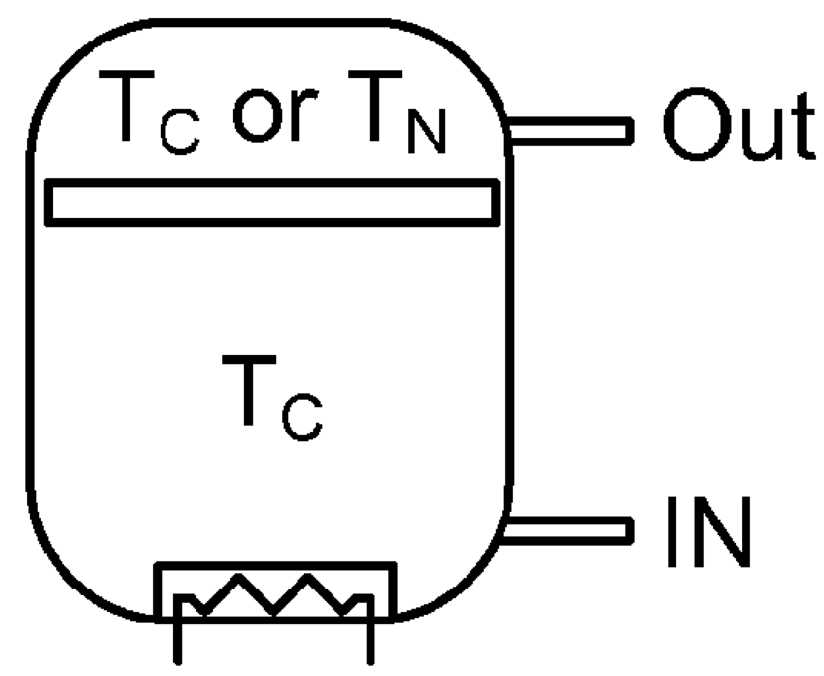


FIG 8(e)

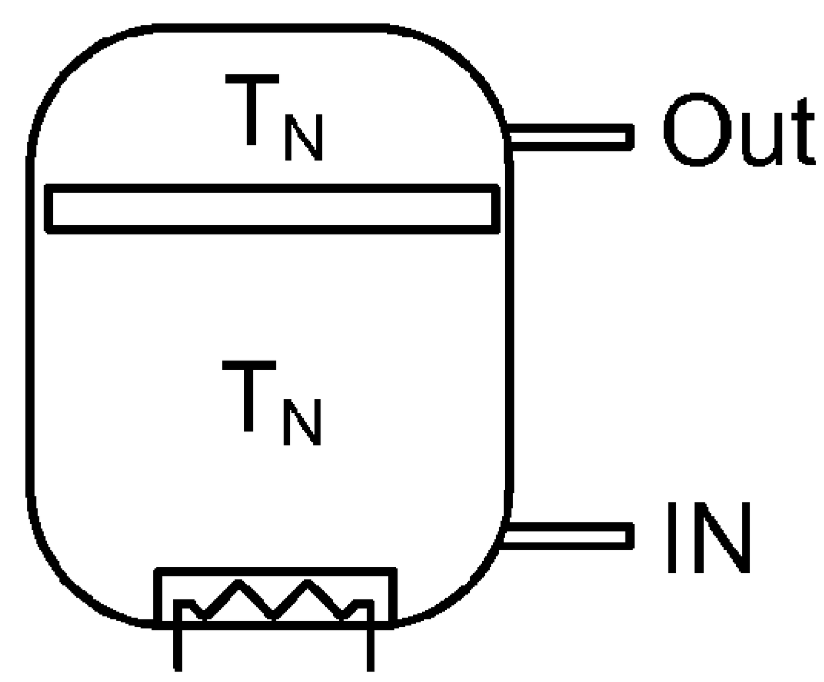


FIG 8(f)

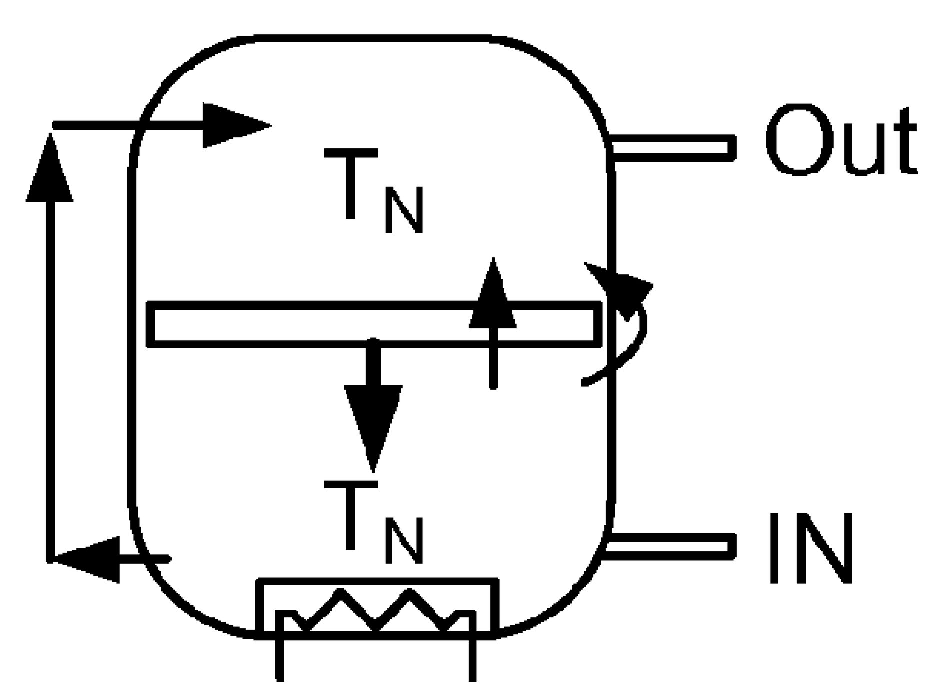


FIG 8(g)

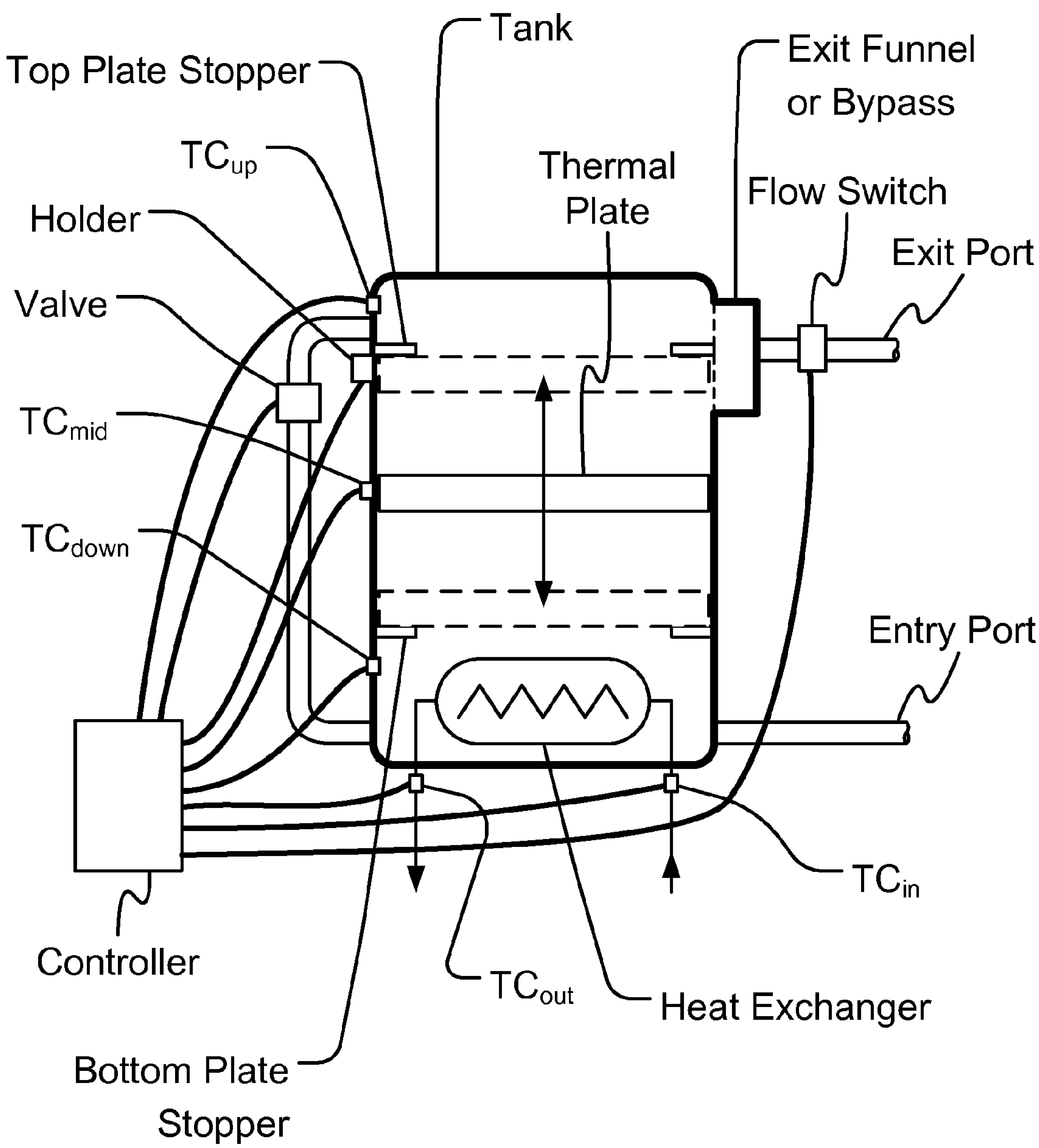

Tank
Top Plate Stopper
Exit Funnel
or Bypass
TCup
Thermal
Plate
Flow Switch
Holder
Exit Port
Valve
TCmid
TCdown
Entry Port
TCin
Controller
TCout
Heat Exchanger
Bottom Plate
Stopper

FIG 9

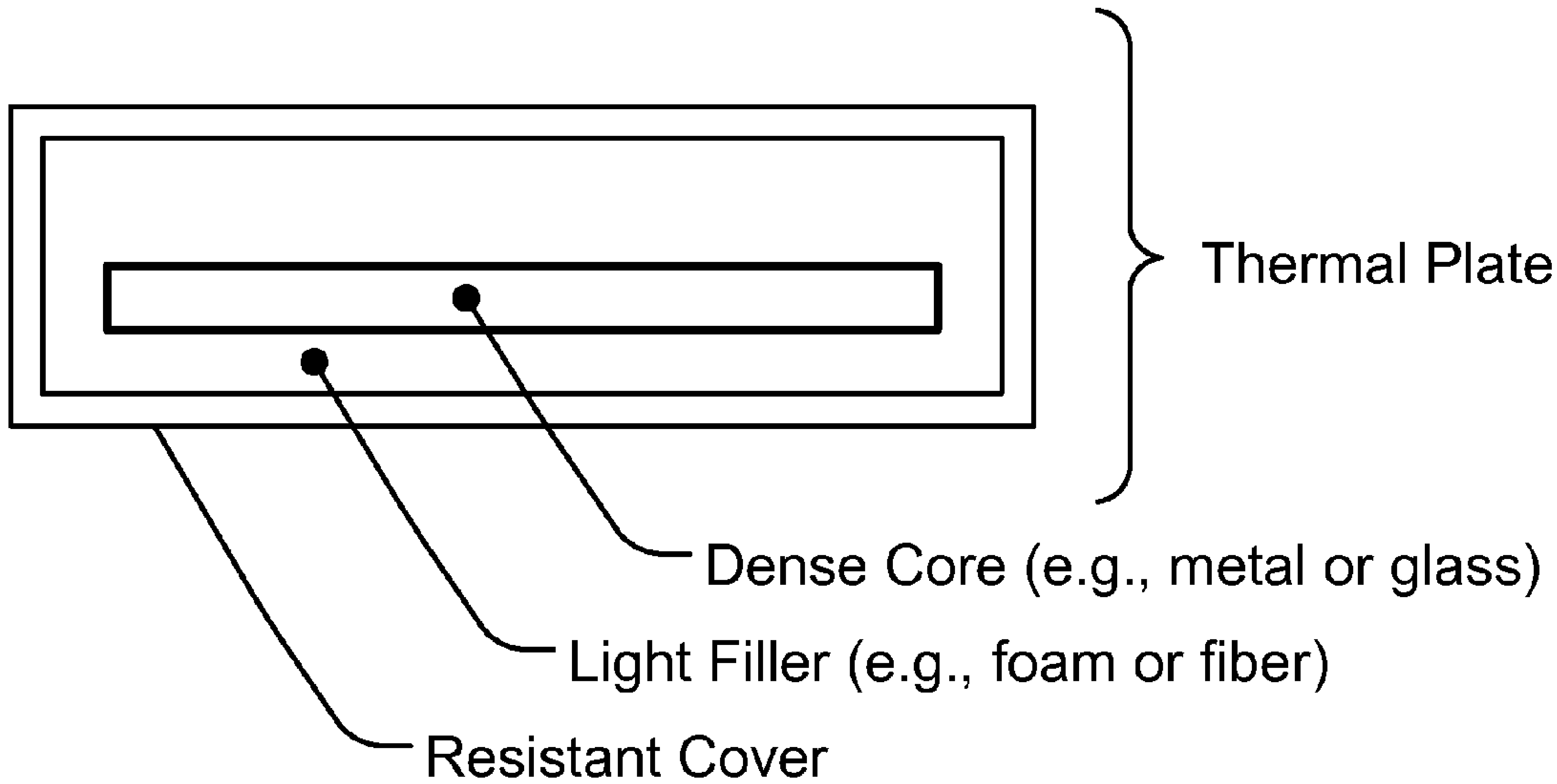


FIG 10(a)

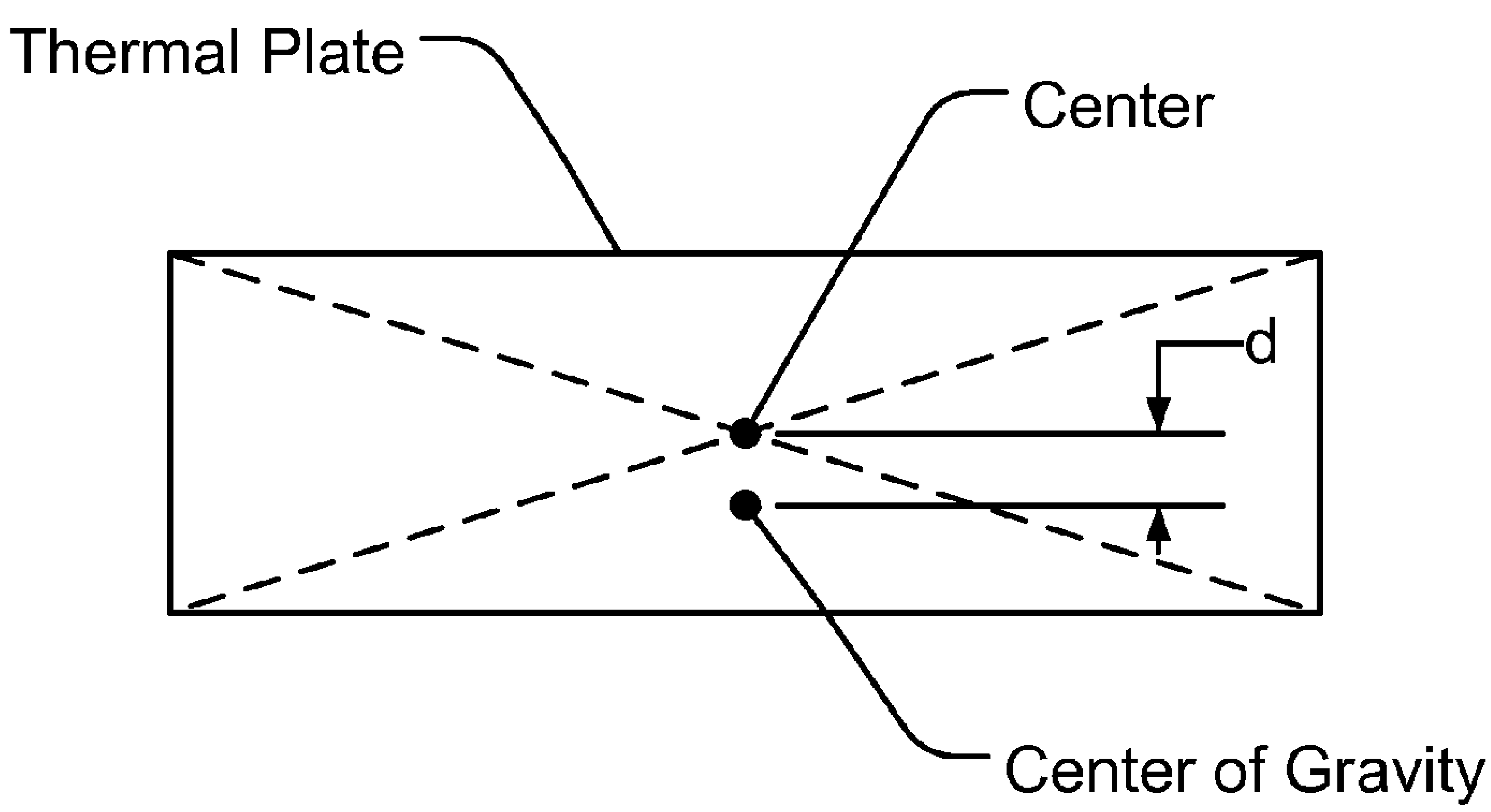


FIG 10(b)

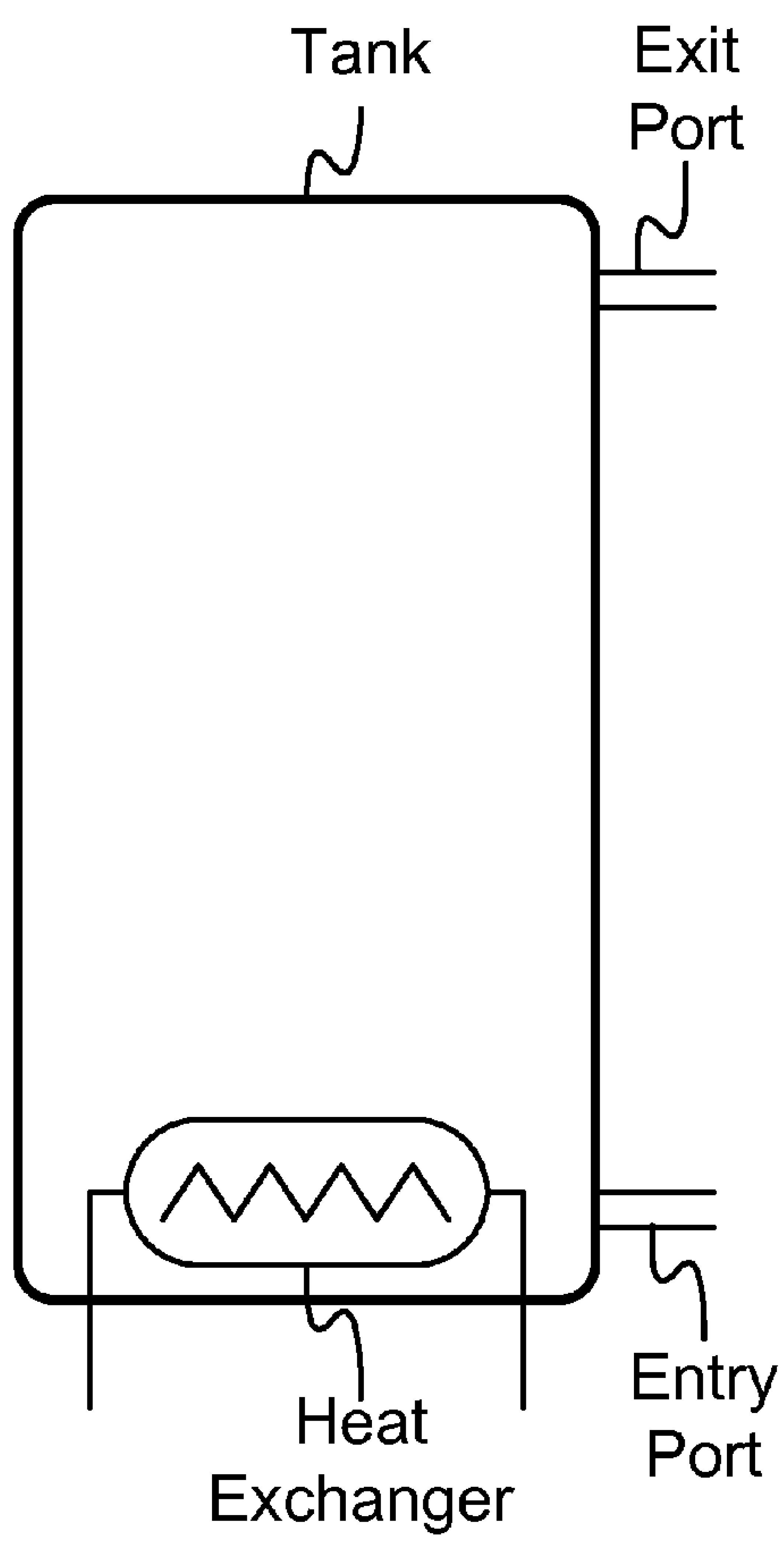


FIG 11(a)

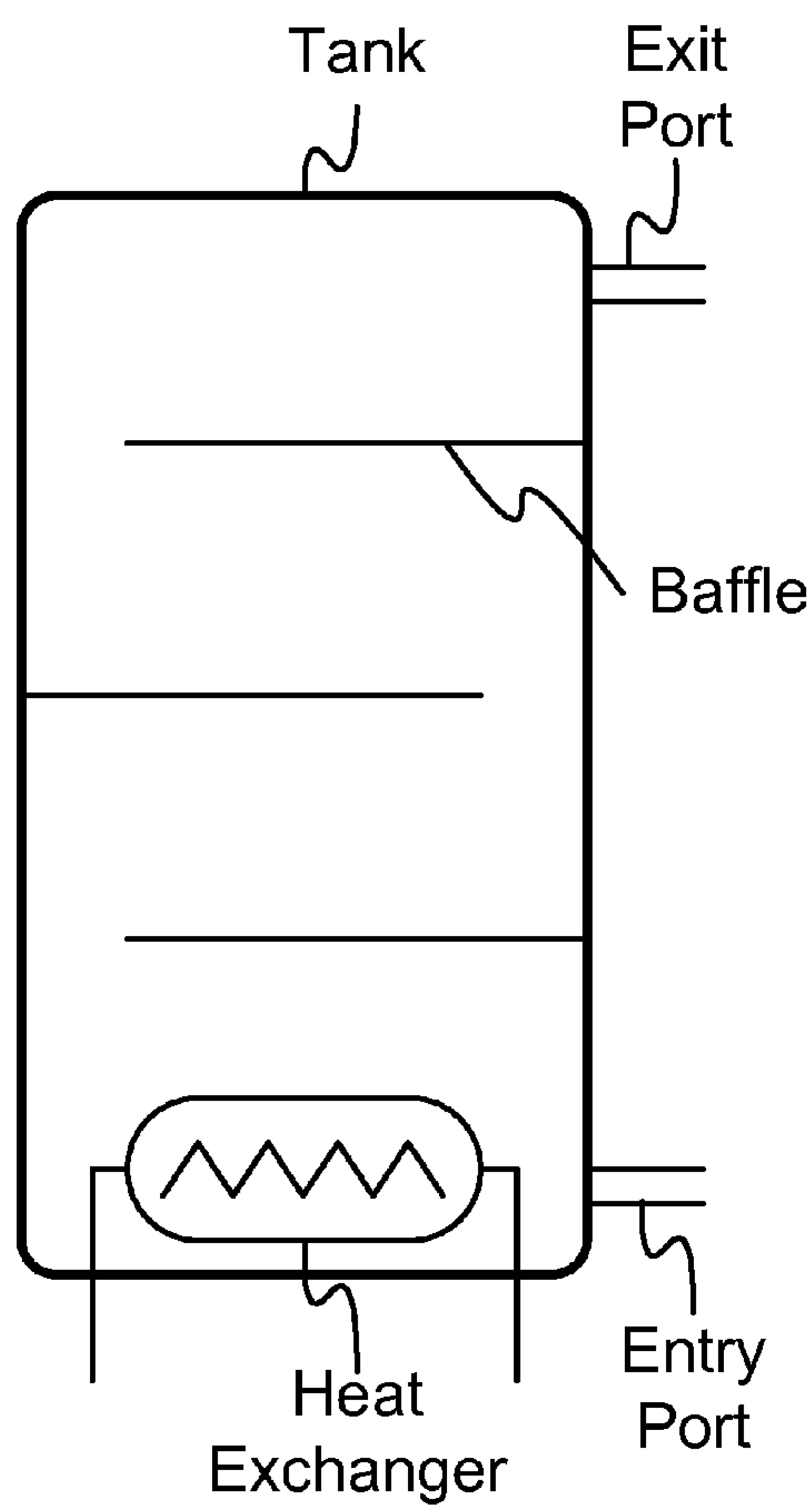


FIG 11(b)

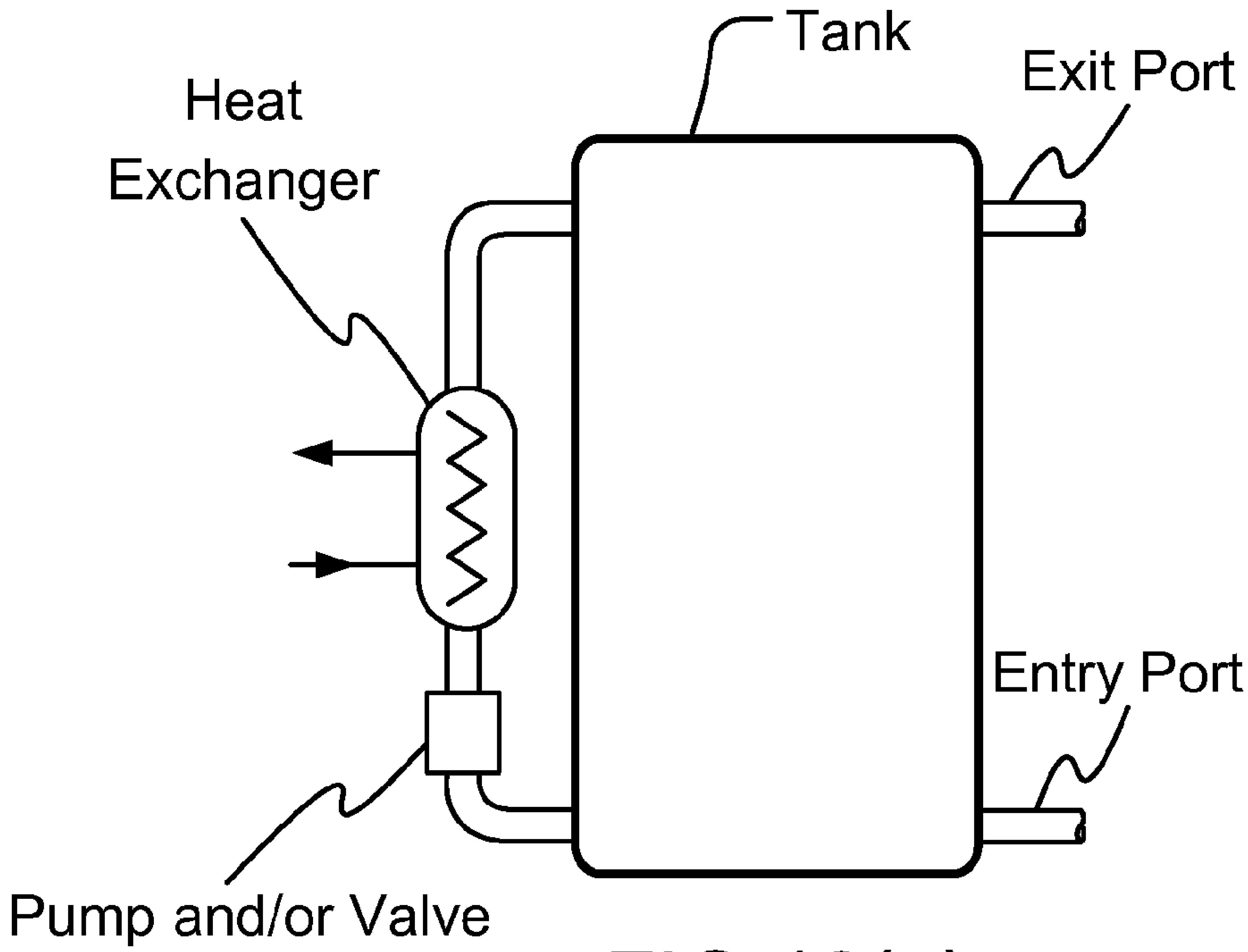


FIG 12(a)

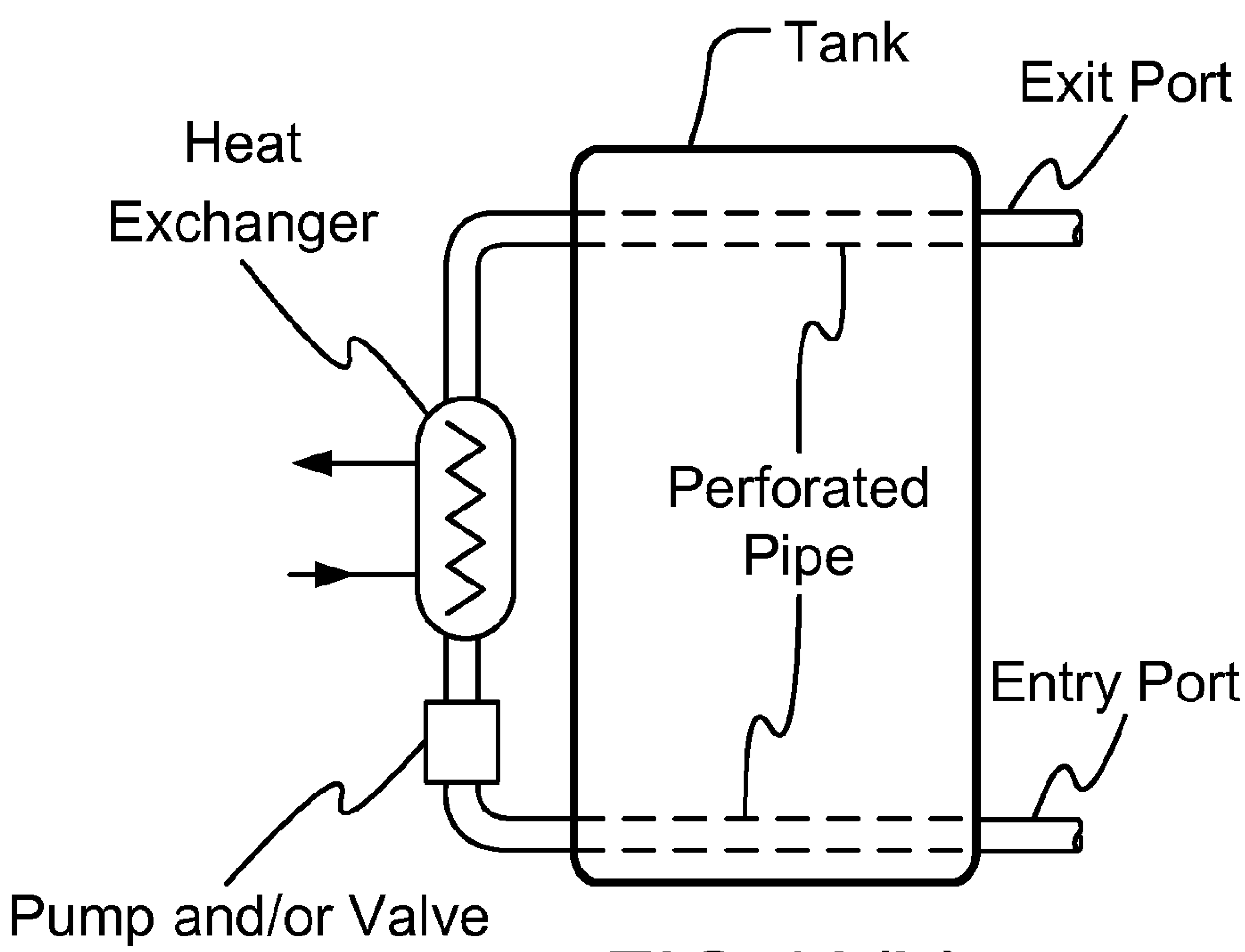


FIG 12(b)

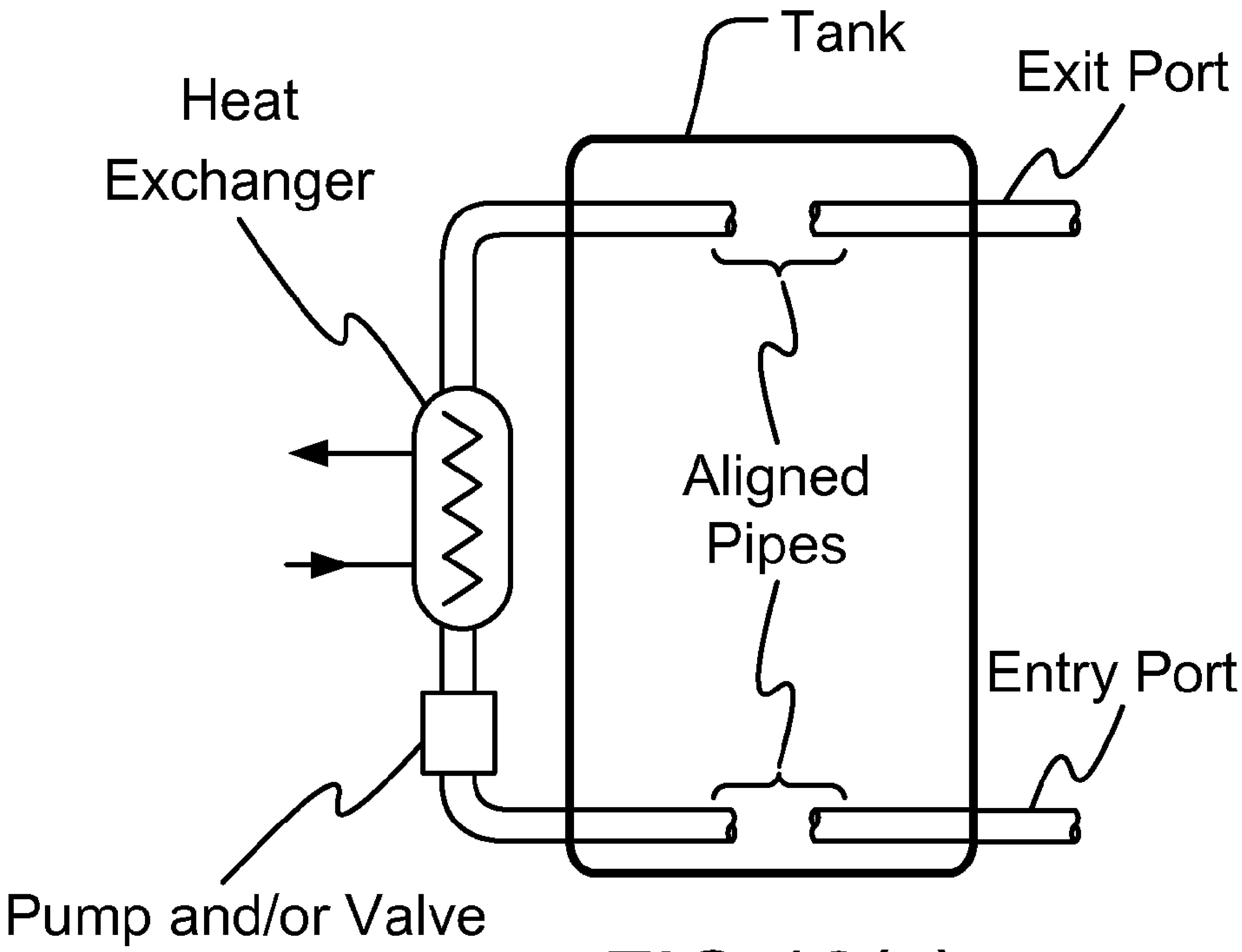


FIG 12(c)

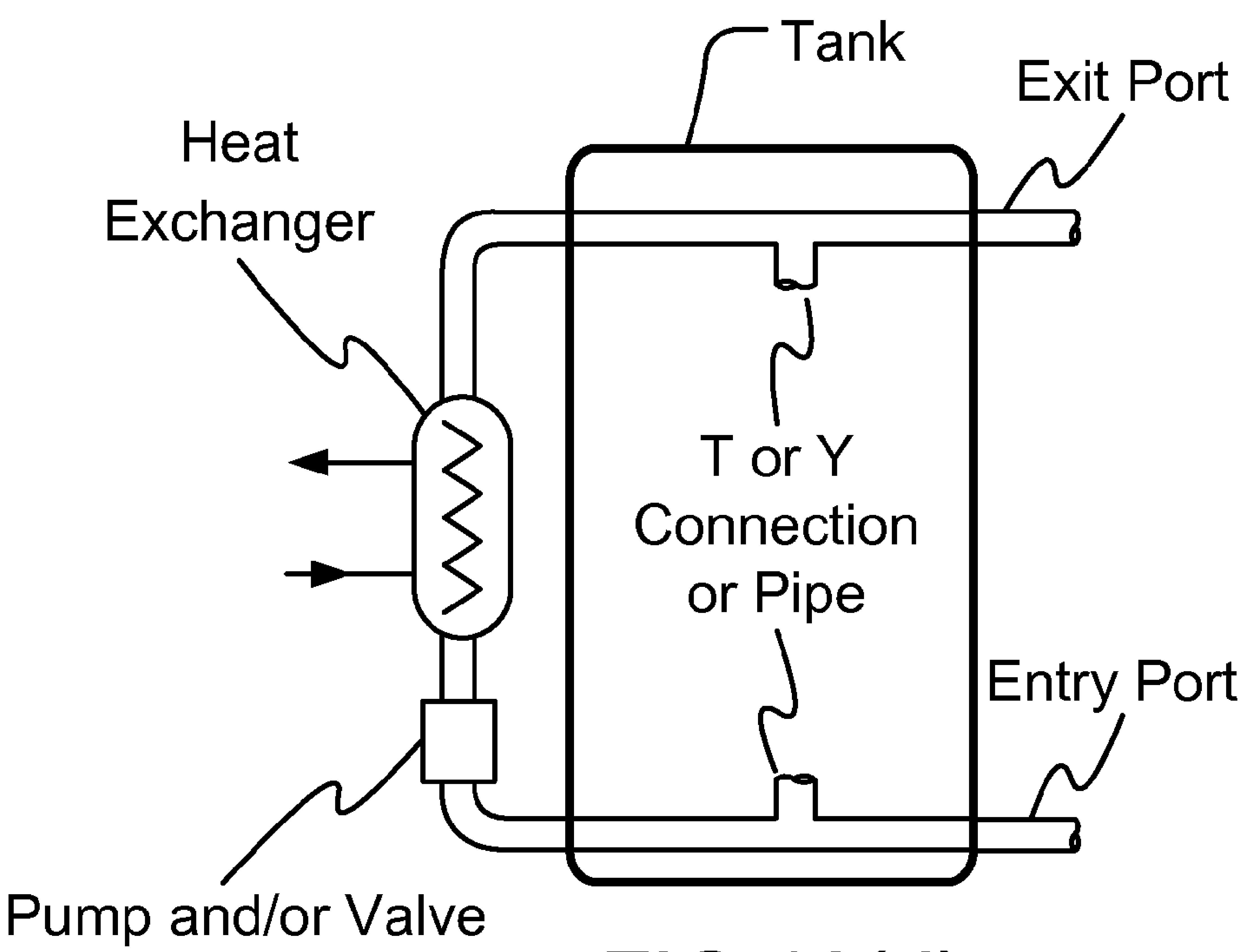


FIG 12(d)

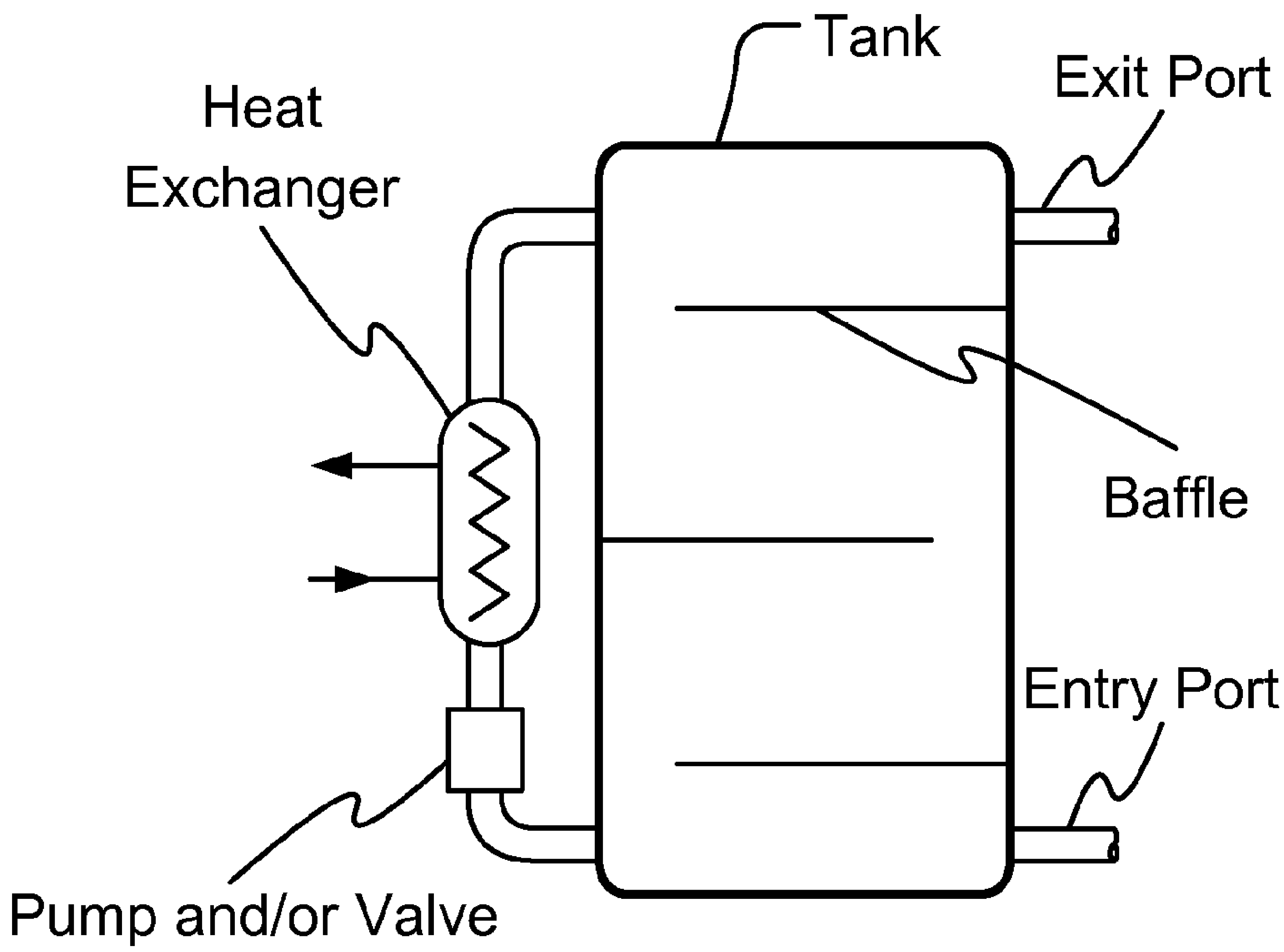


FIG 12(e)

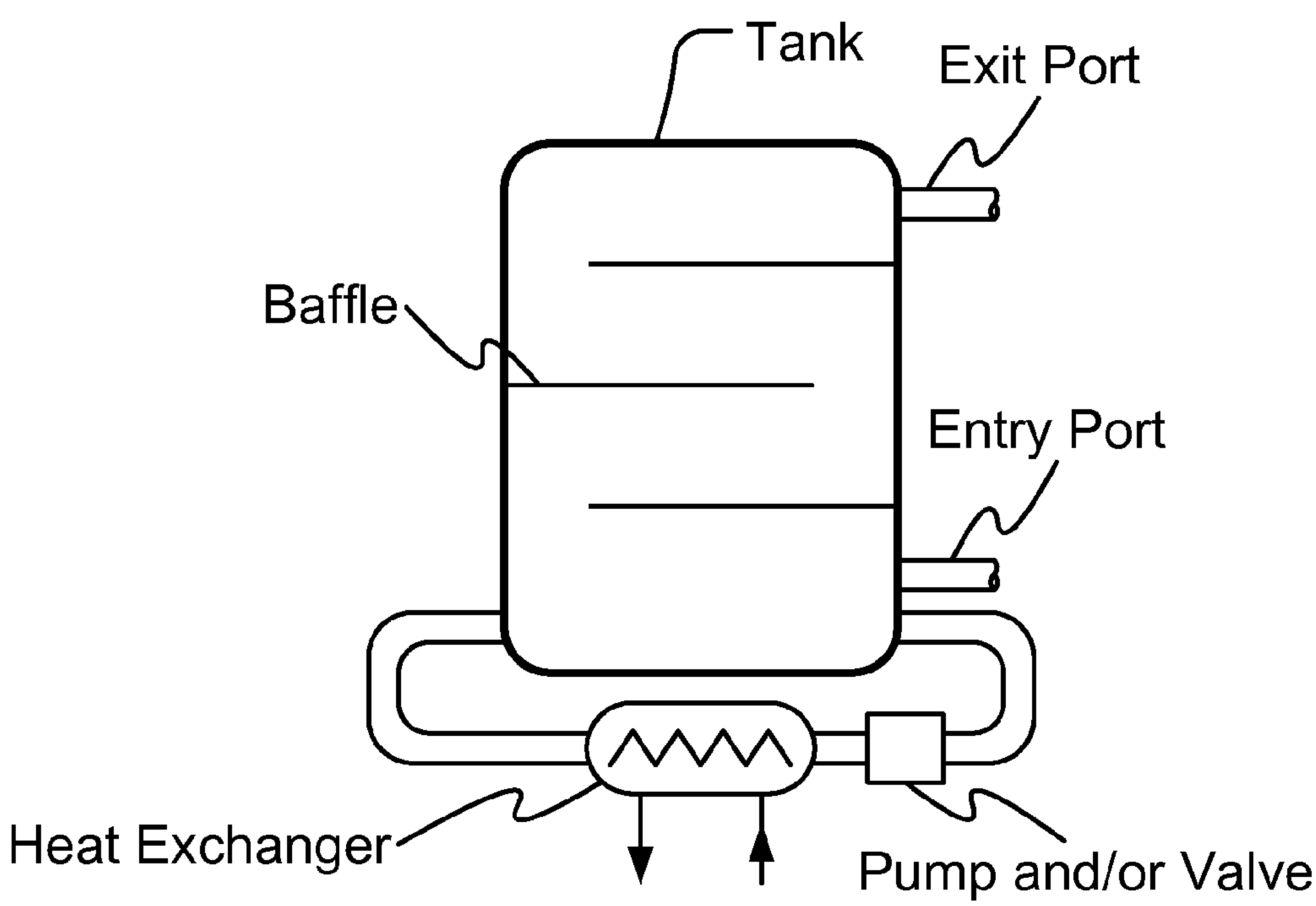


FIG 12(f)

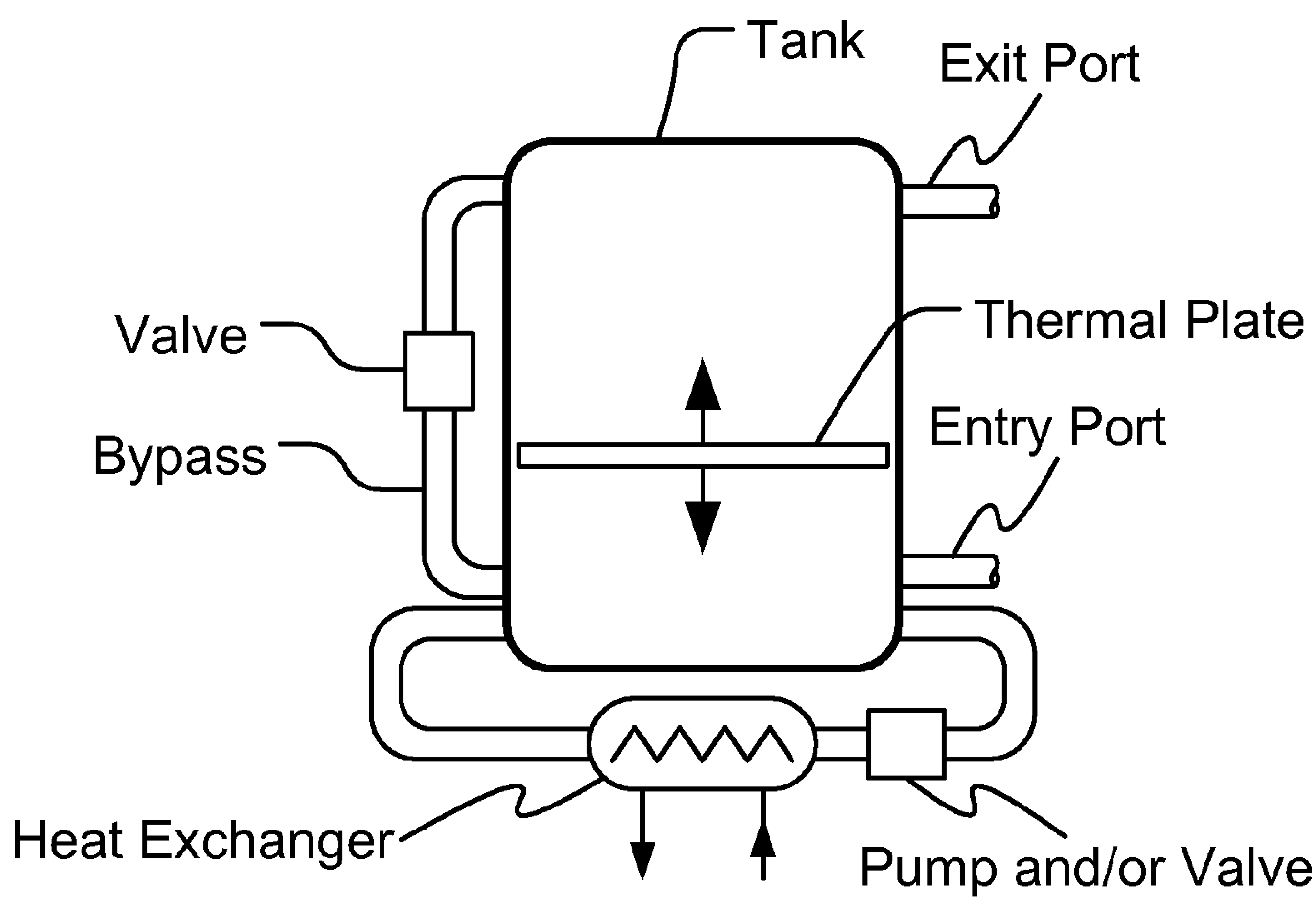


FIG 12(g)

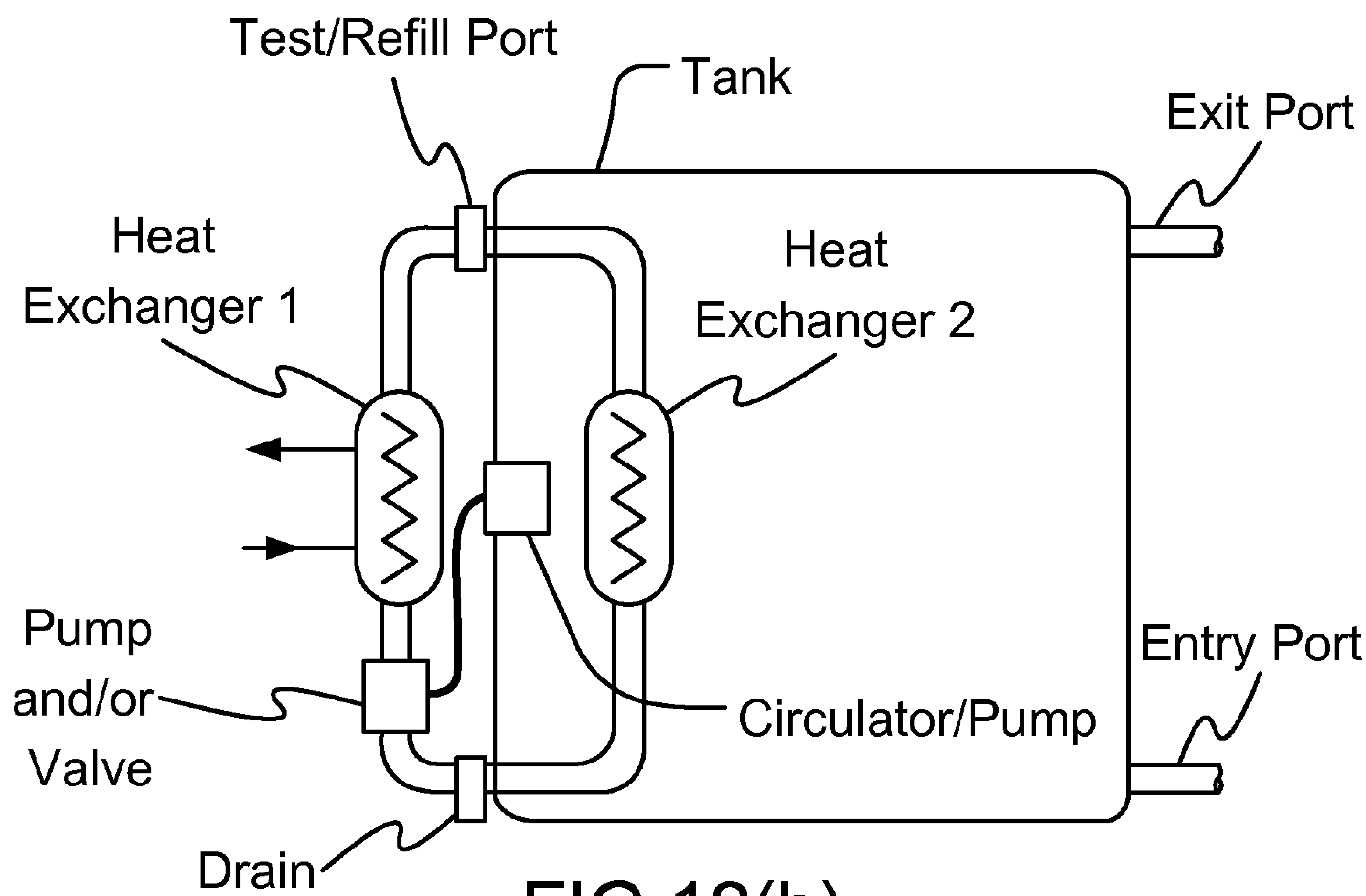


FIG 12(h)

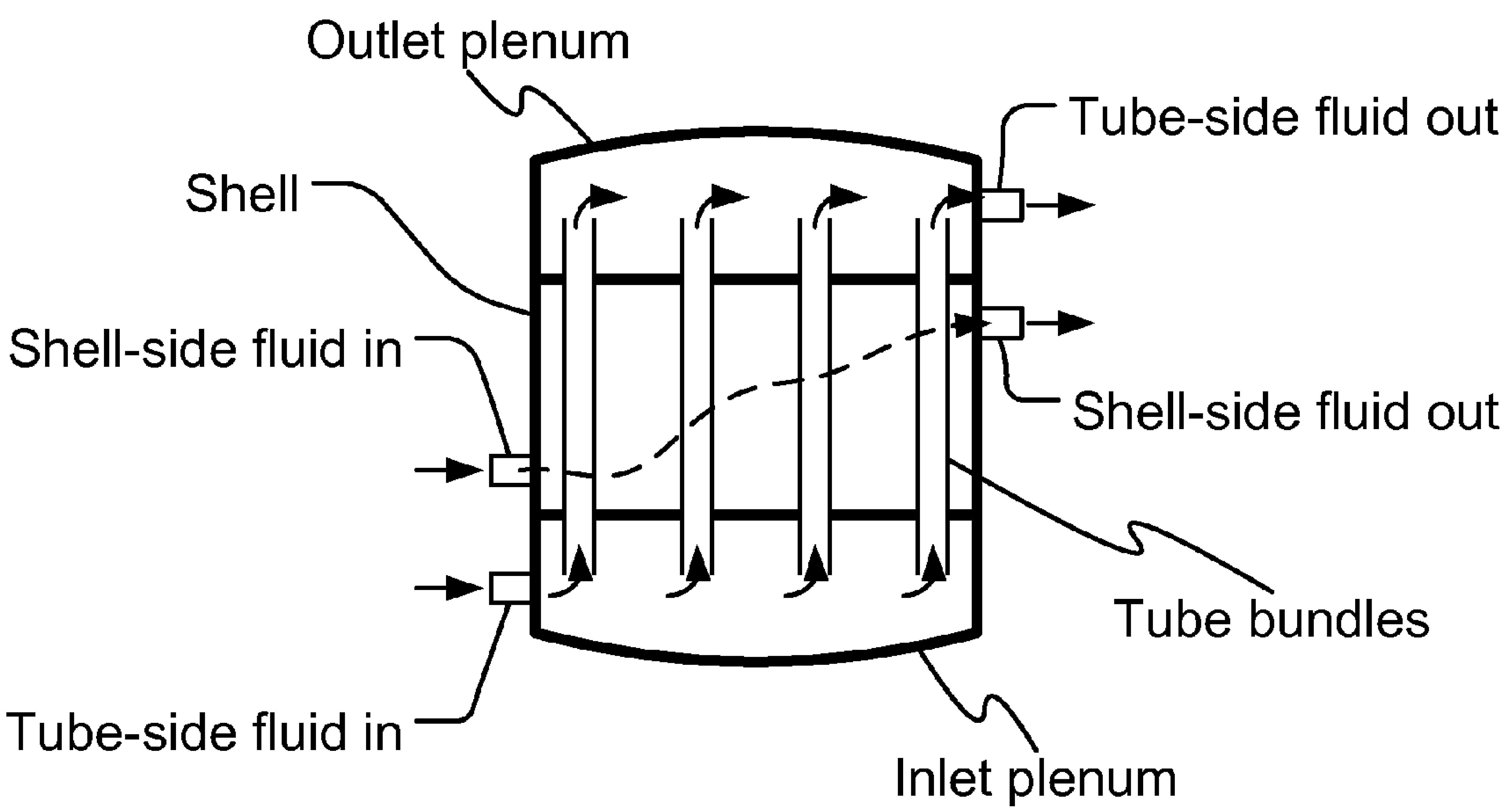


FIG 13(a)

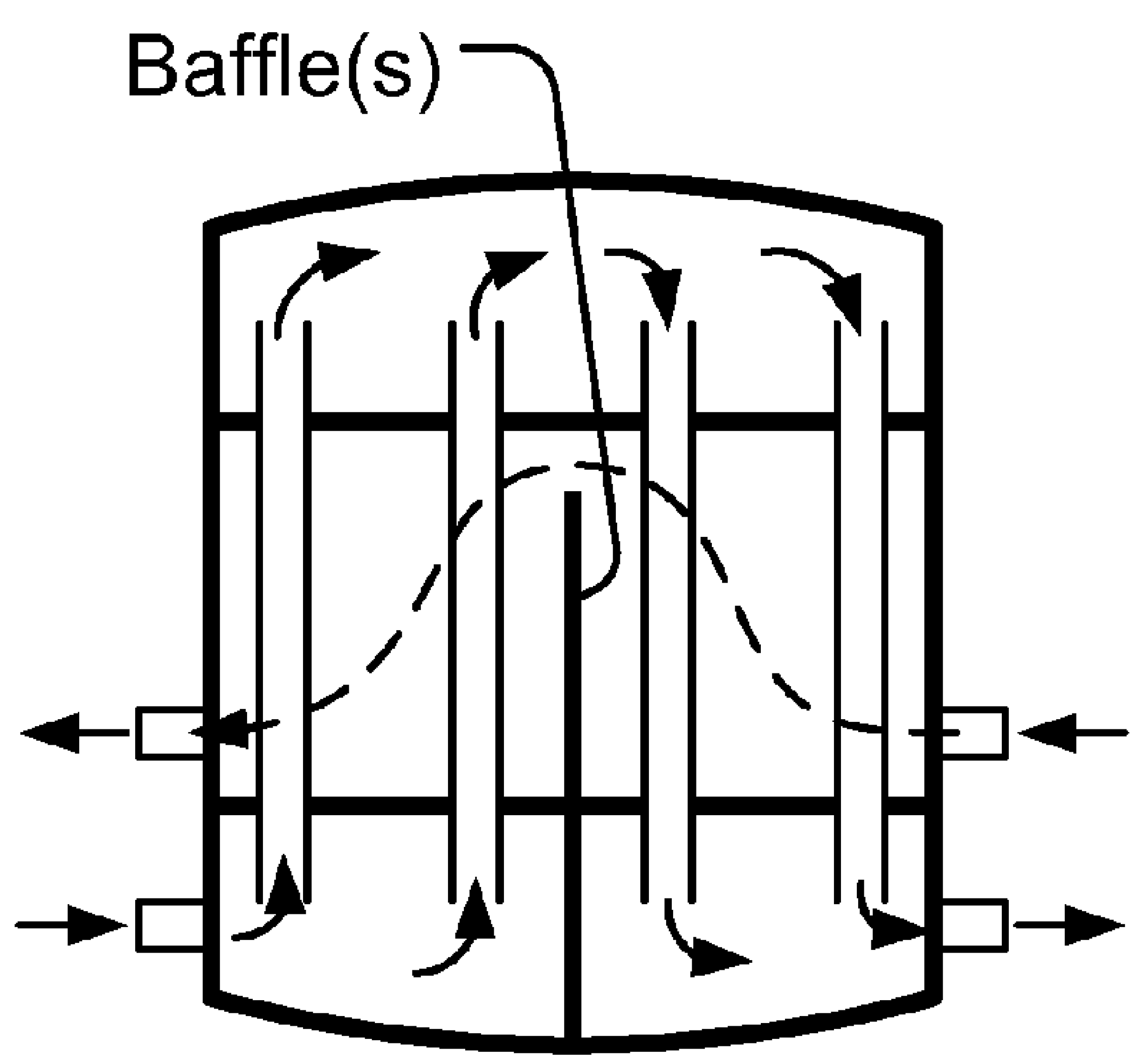


FIG 13(b)

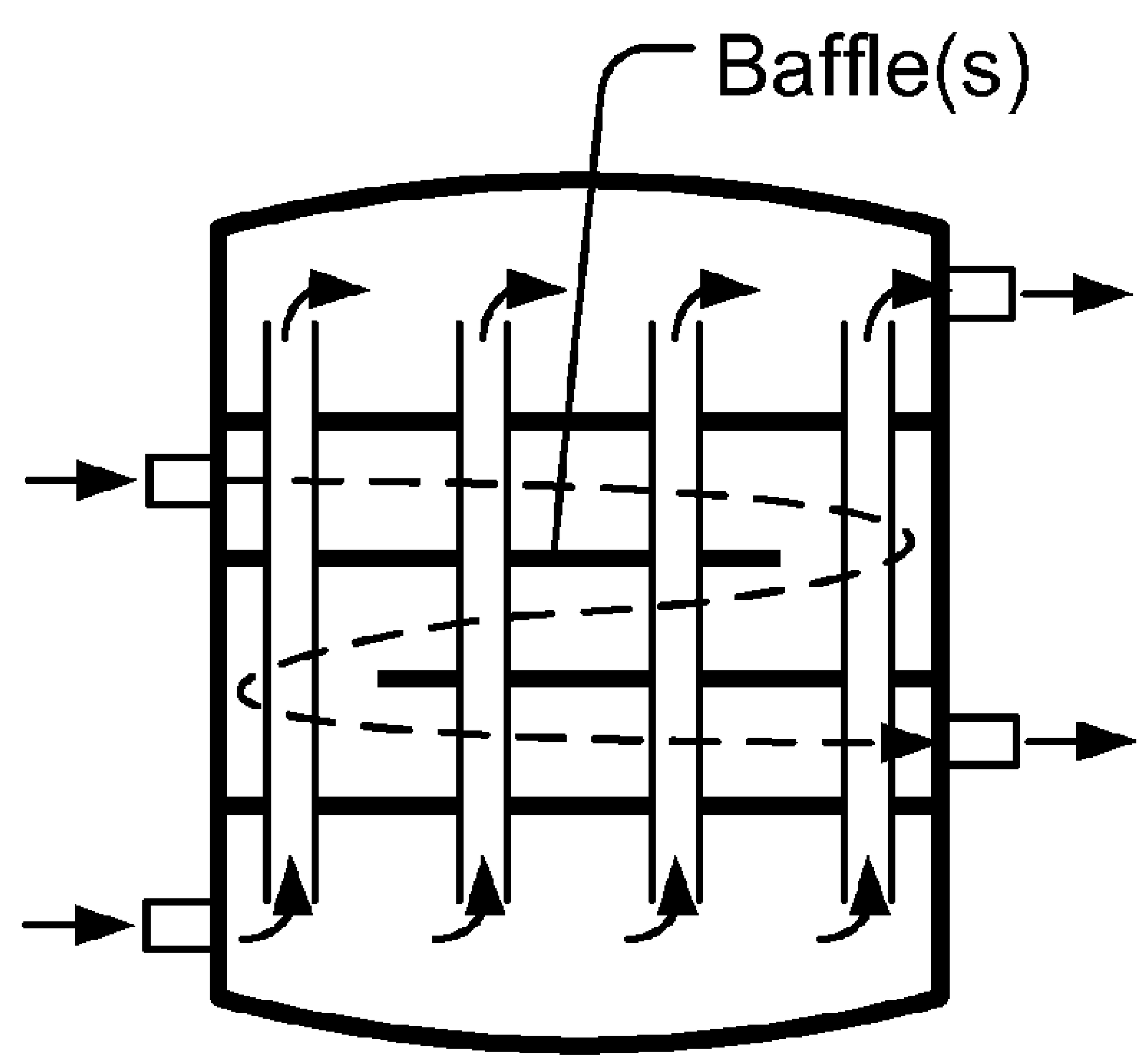


FIG 13(c)

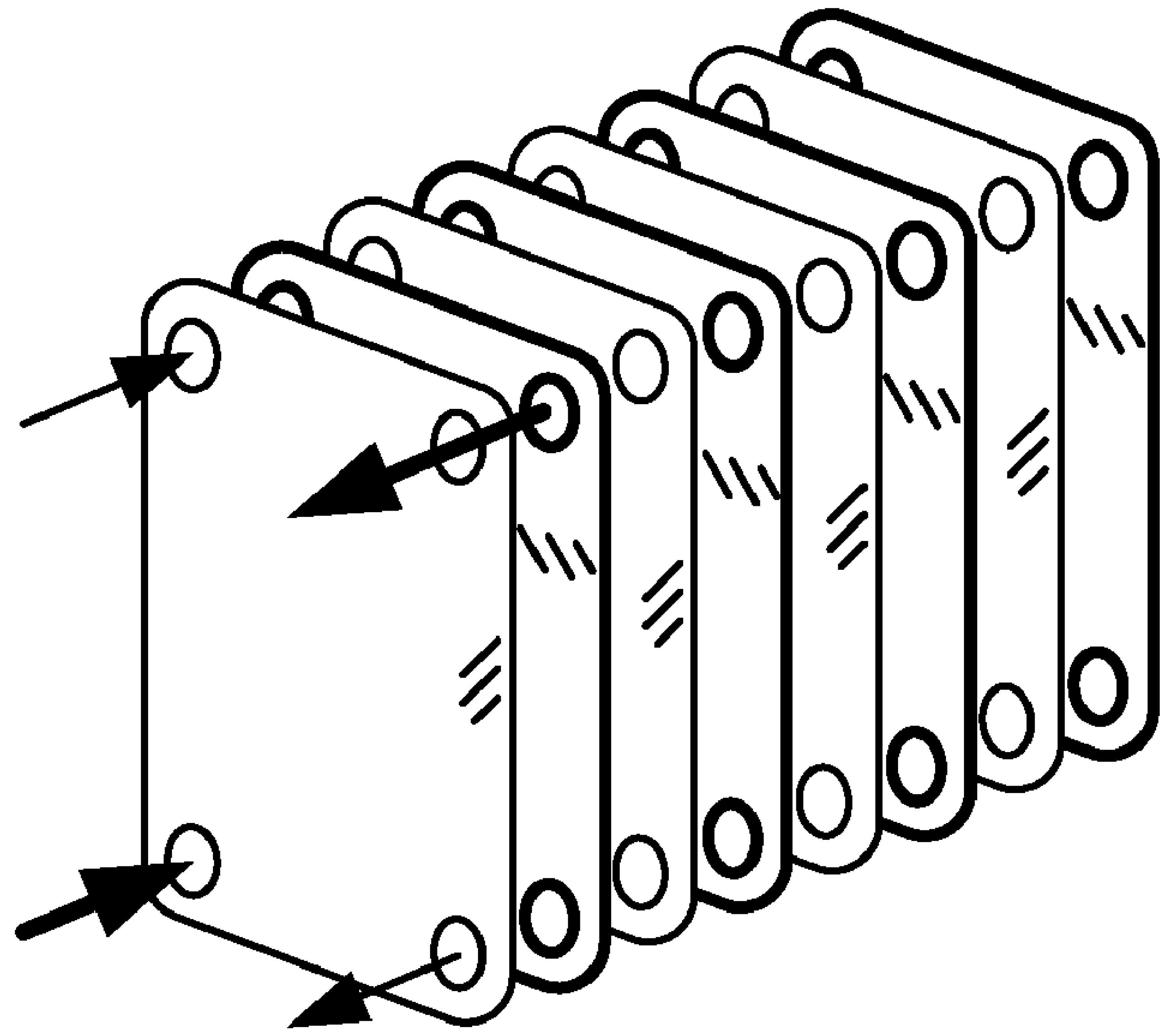


FIG 13(d)

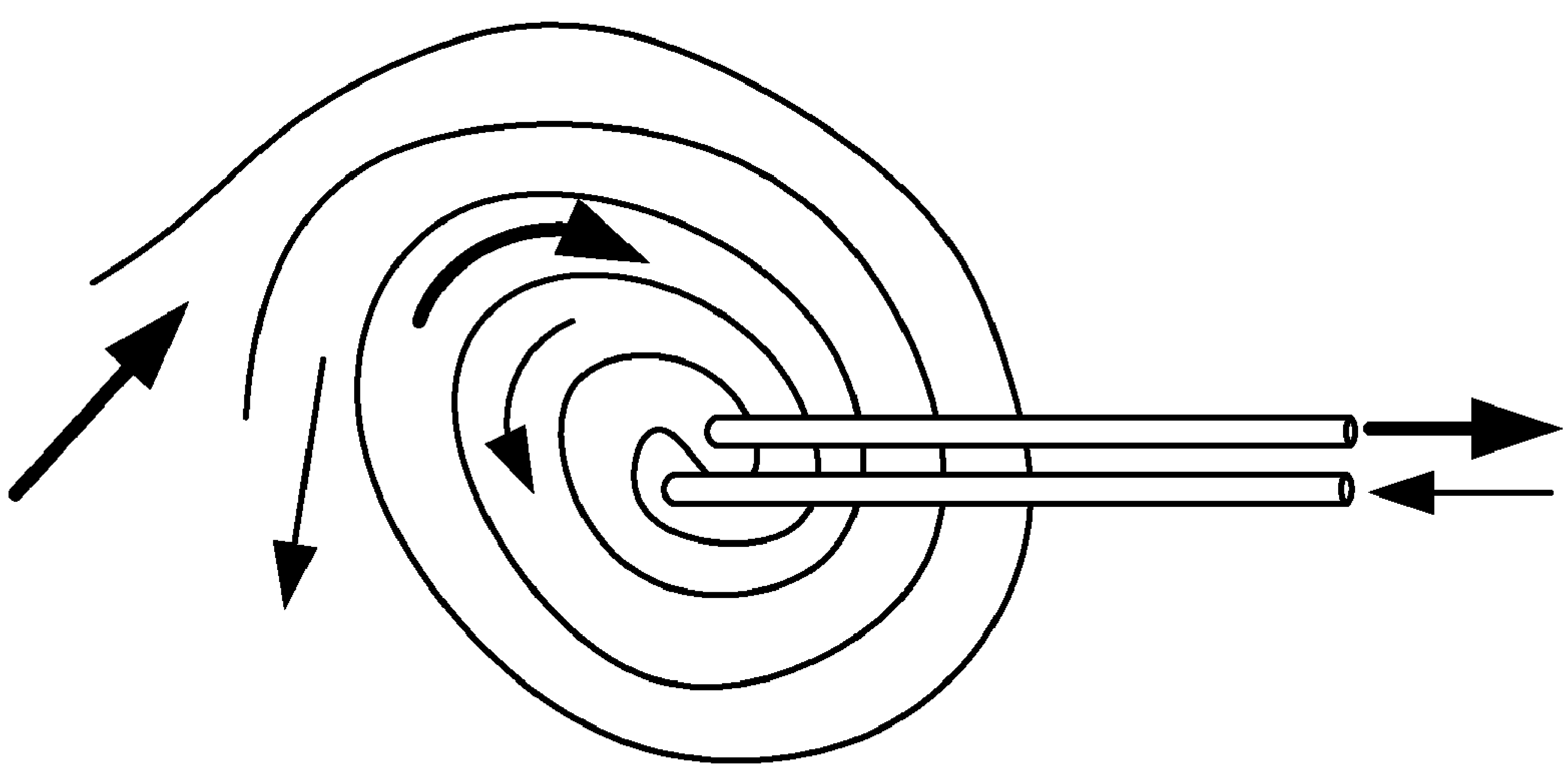


FIG 13(e)

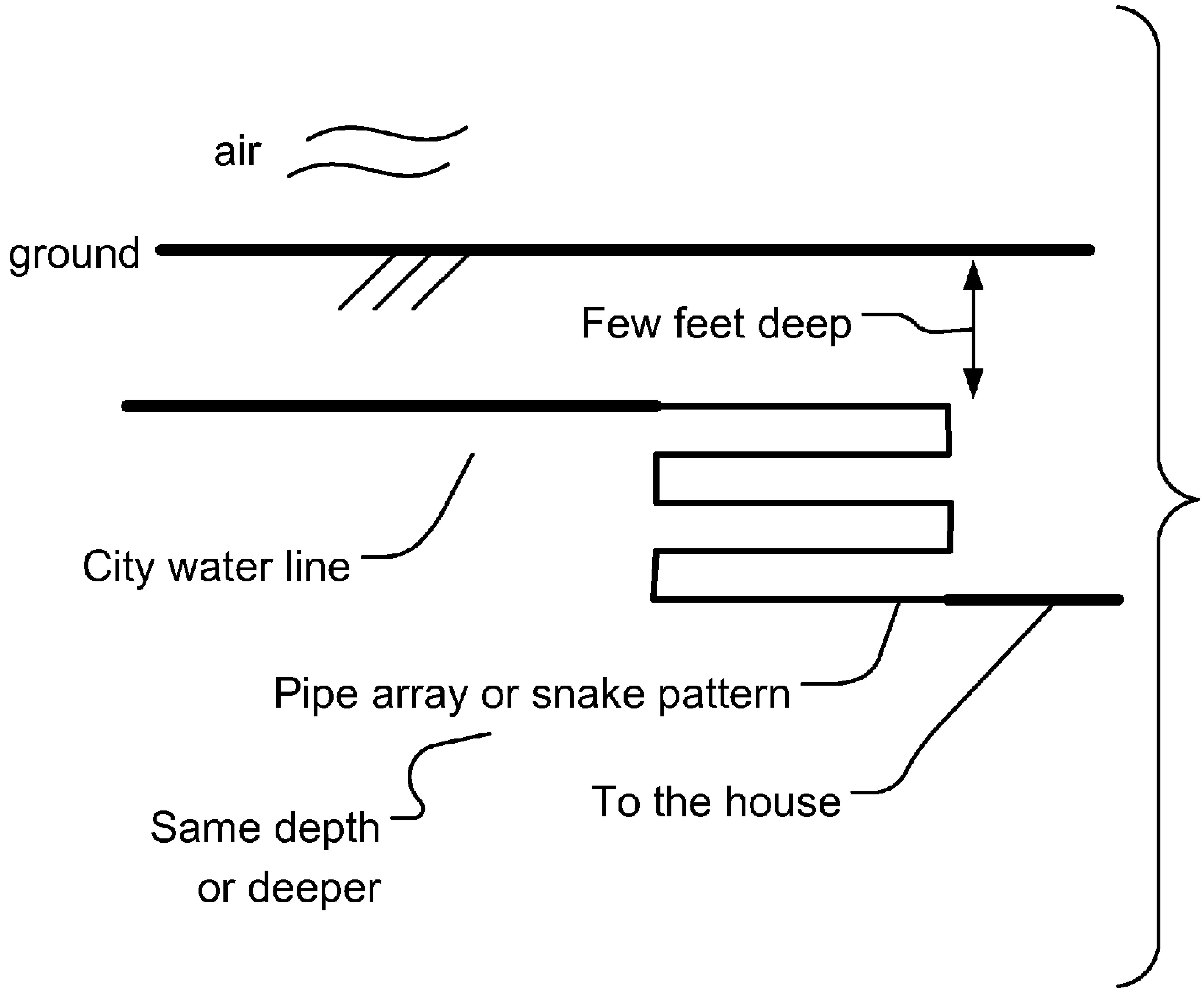

air
ground
Few feet deep
City water line
Pipe array or snake pattern
Same depth
or deeper
To the house

FIG 14

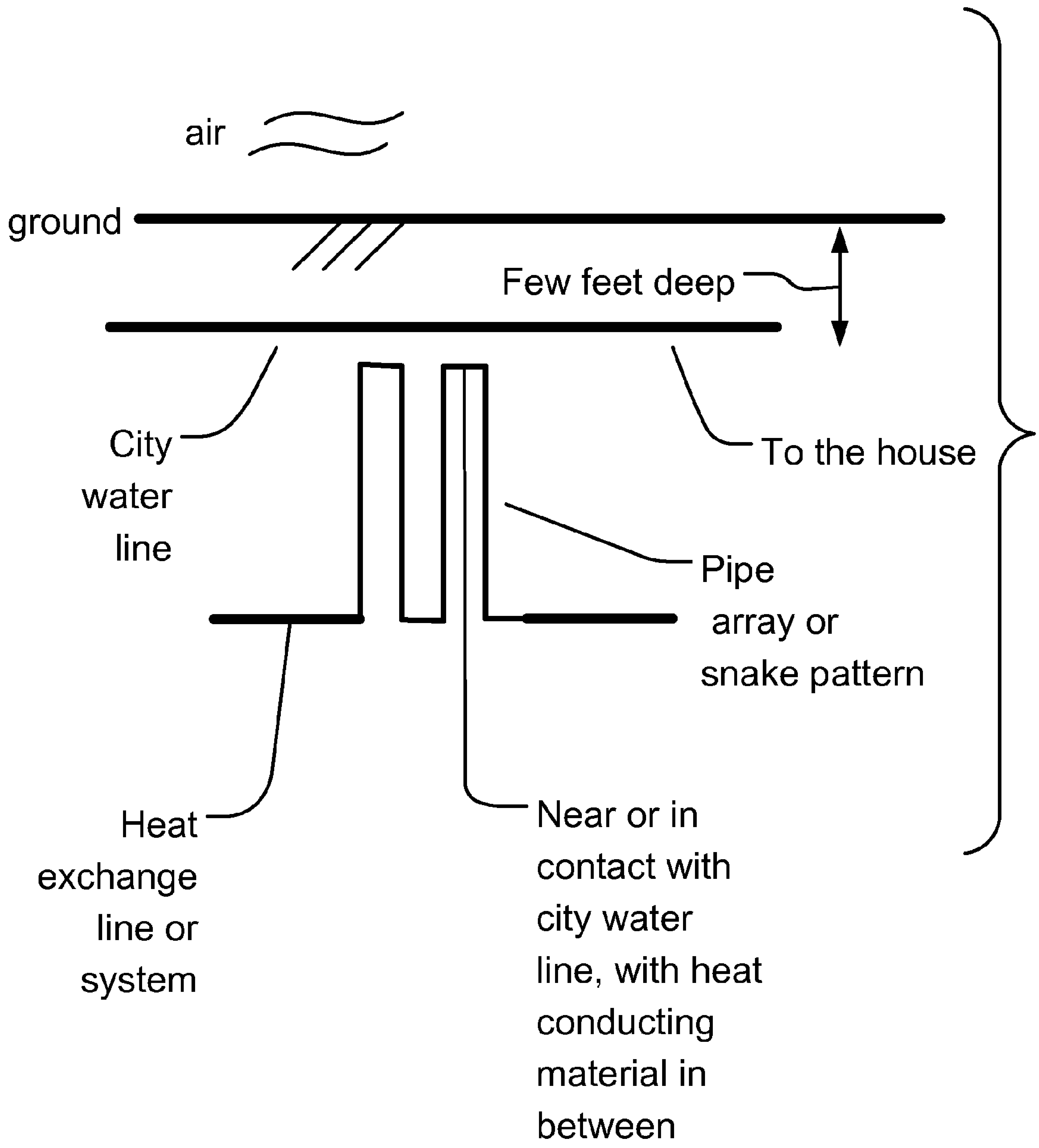

air
ground
Few feet deep
City water line
To the house
Pipe array or snake pattern
Heat exchange line or system
Near or in contact with city water line, with heat conducting material in between

FIG 15

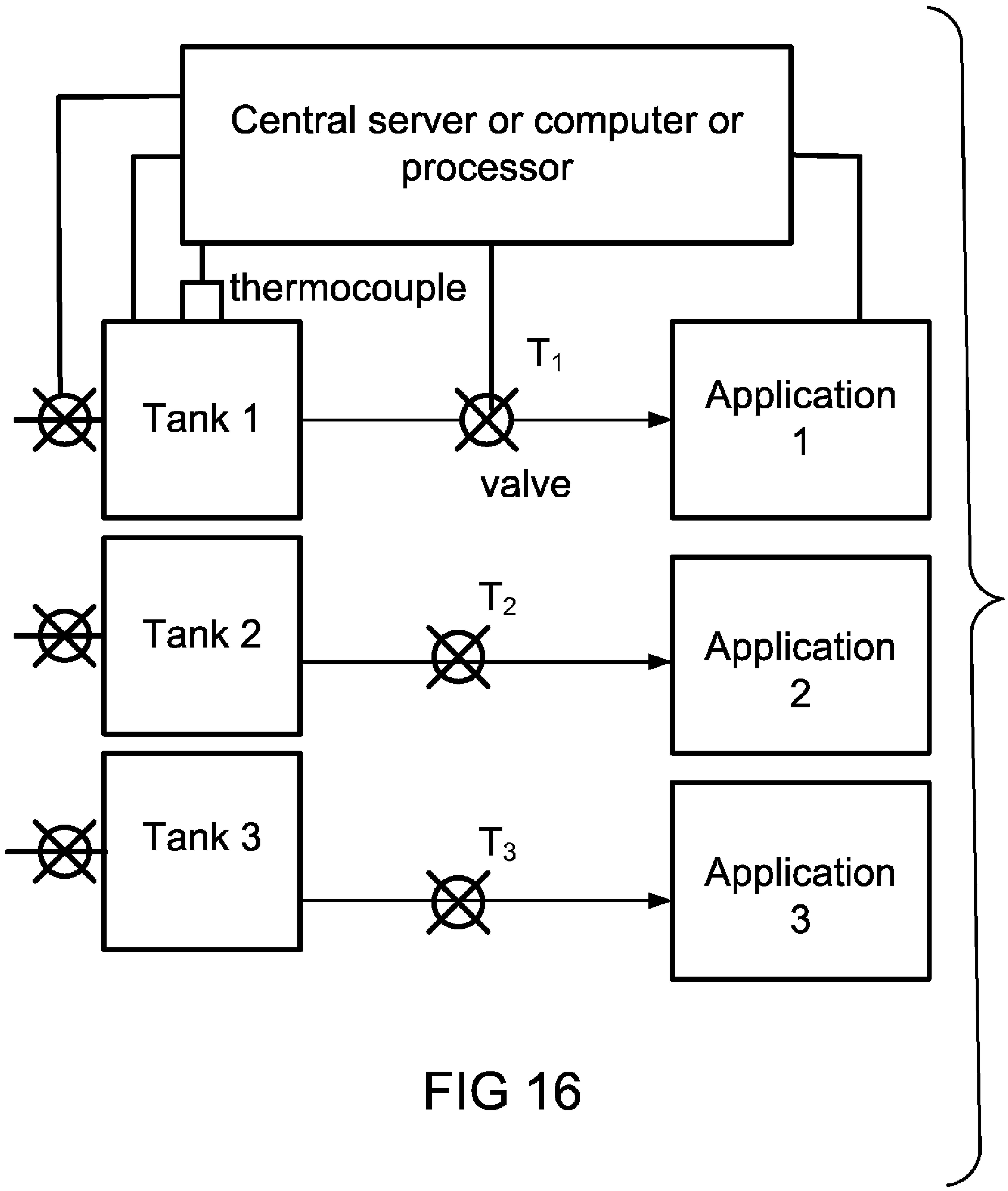

Central server or computer or processor
thermocouple
T1
Tank 1
valve
Application 1
Tank 2
T2
Application 2
Tank 3
T3
Application 3

FIG 16

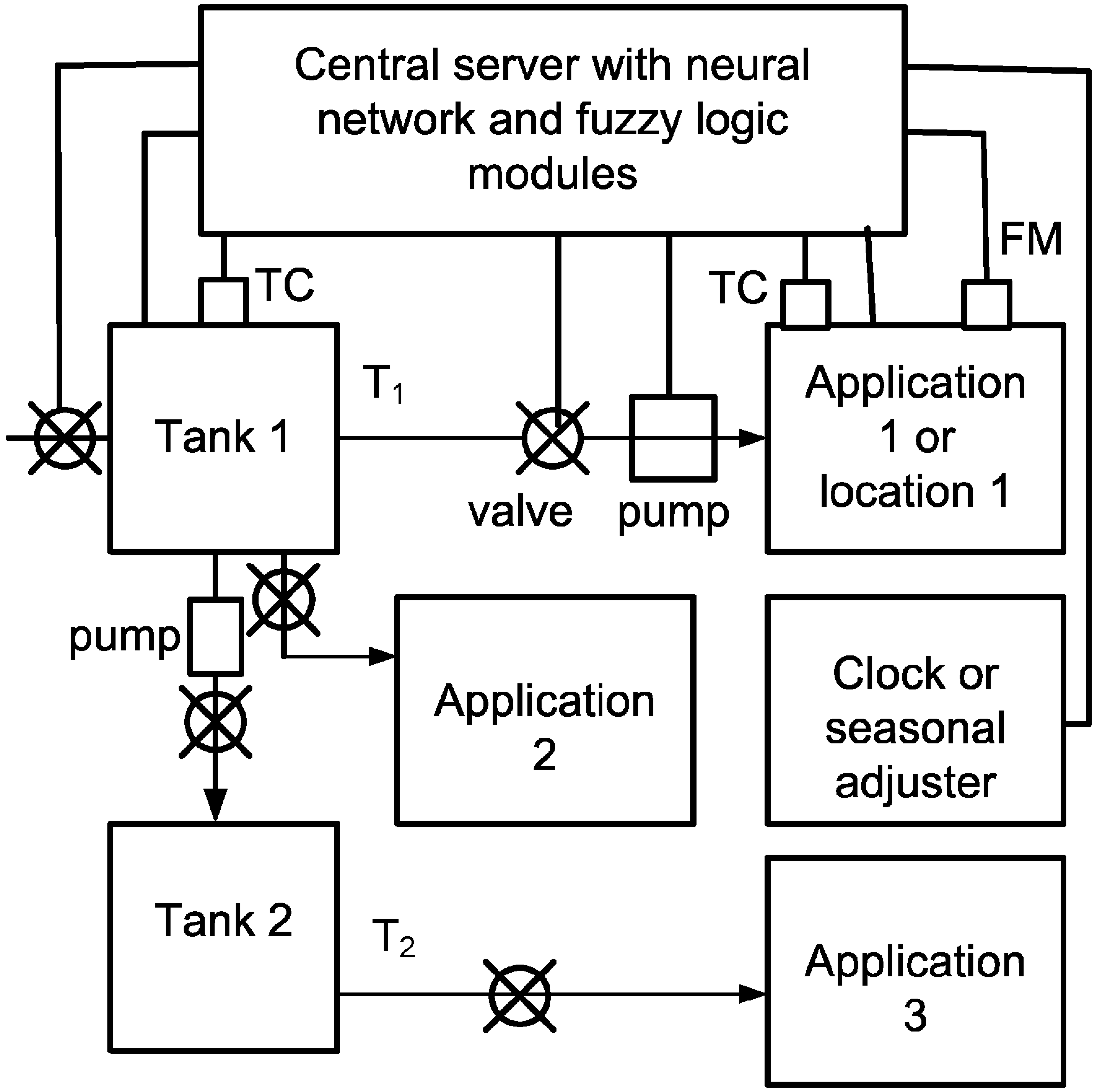
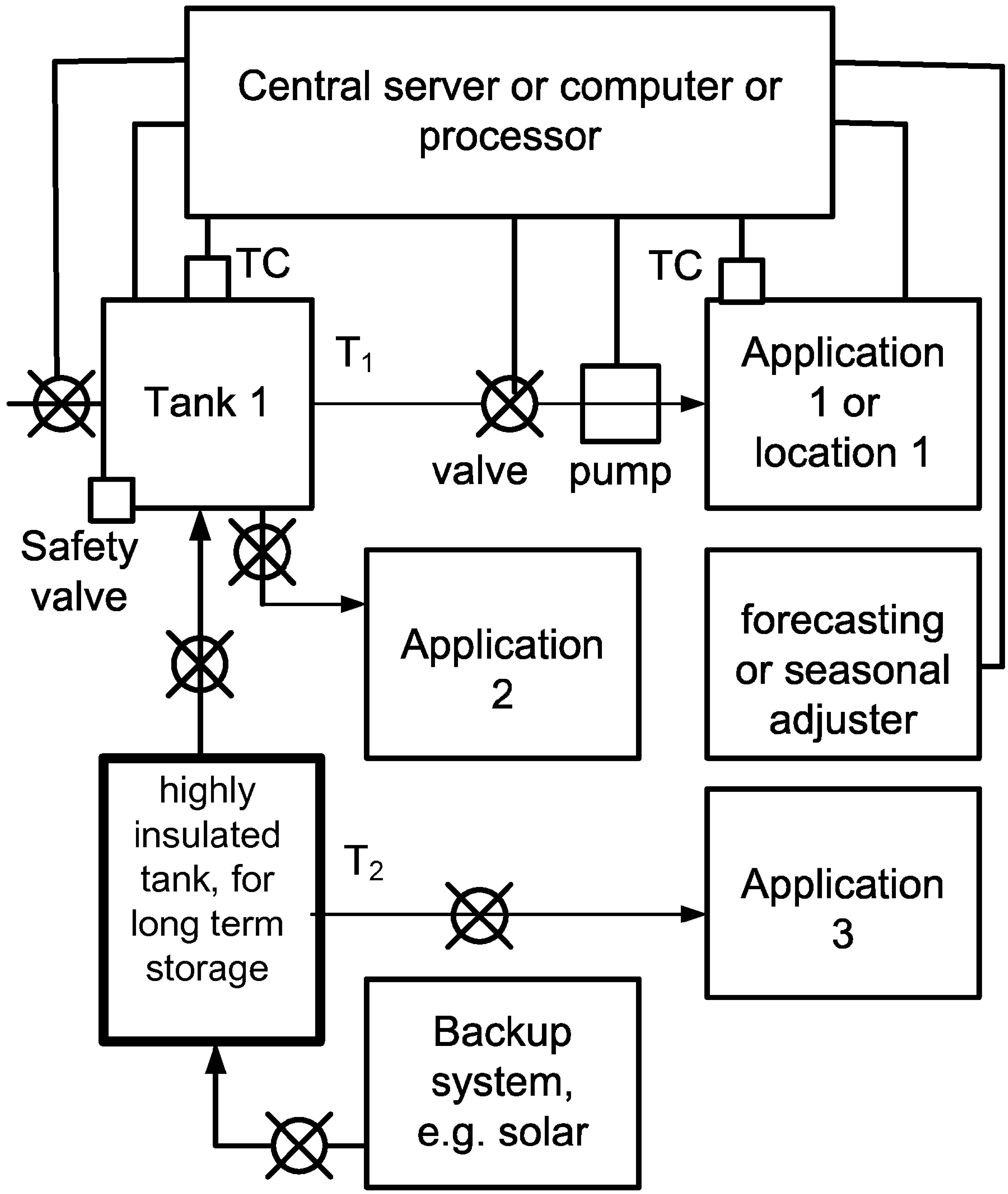
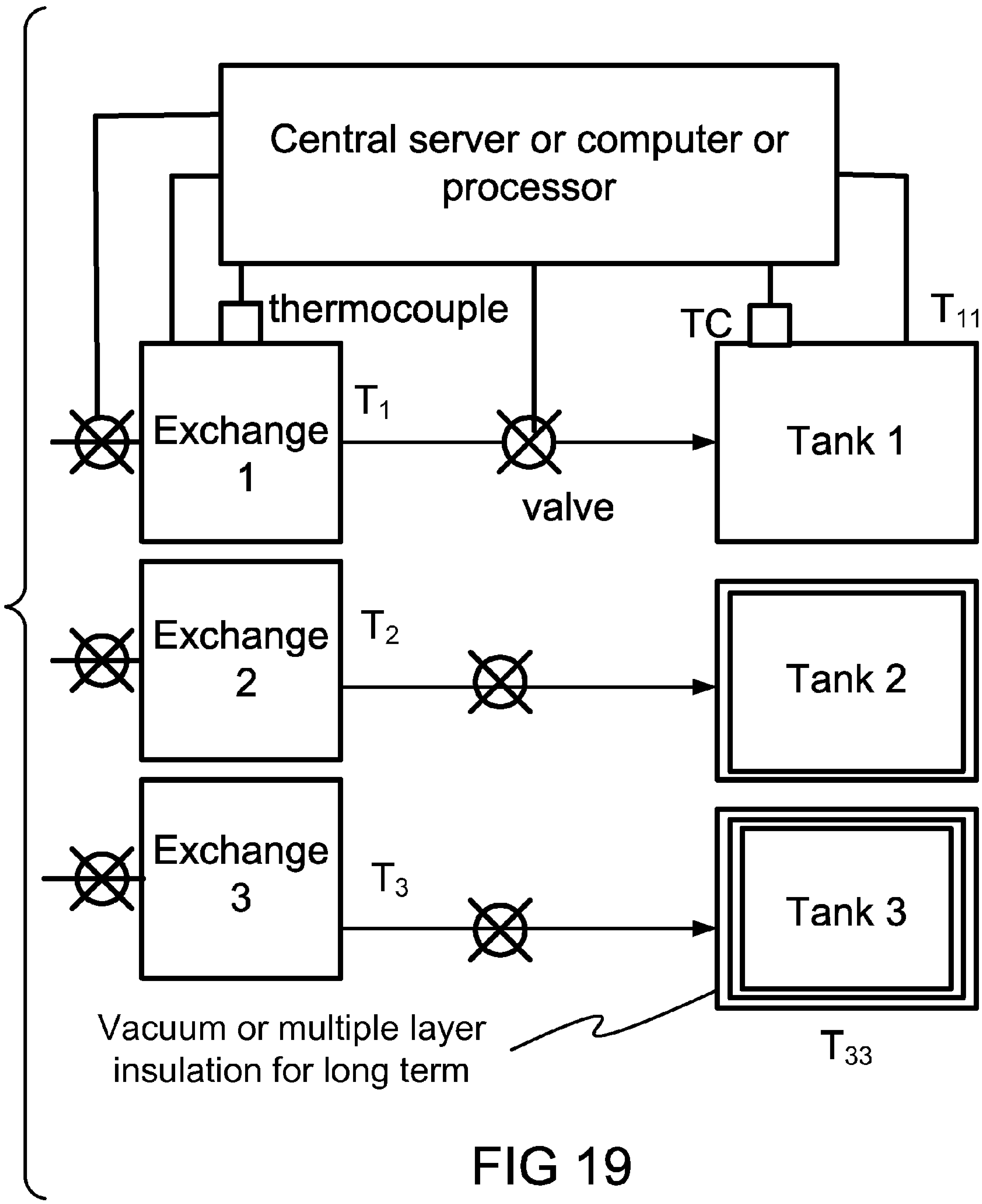

Central server with neural network and fuzzy logic modules
TC
TC
FM
Tank 1
T1
valve
pump
Application 1 or location 1
pump
Application 2
Clock or seasonal adjuster
Tank 2
T2
Application 3

FIG 17



Central server or computer or processor
TC
TC
T_1
Tank 1
valve
pump
Application 1 or location 1
Safety valve
Application 2
forecasting or seasonal adjuster
highly insulated tank, for long term storage
T_2
Application 3
Backup system, e.g. solar

FIG 18



Central server or computer or processor
thermocouple
TC
T11
Exchange 1
T1
valve
Tank 1
Exchange 2
T2
Tank 2
Exchange 3
T3
Tank 3
Vacuum or multiple layer insulation for long term
T33

FIG 19

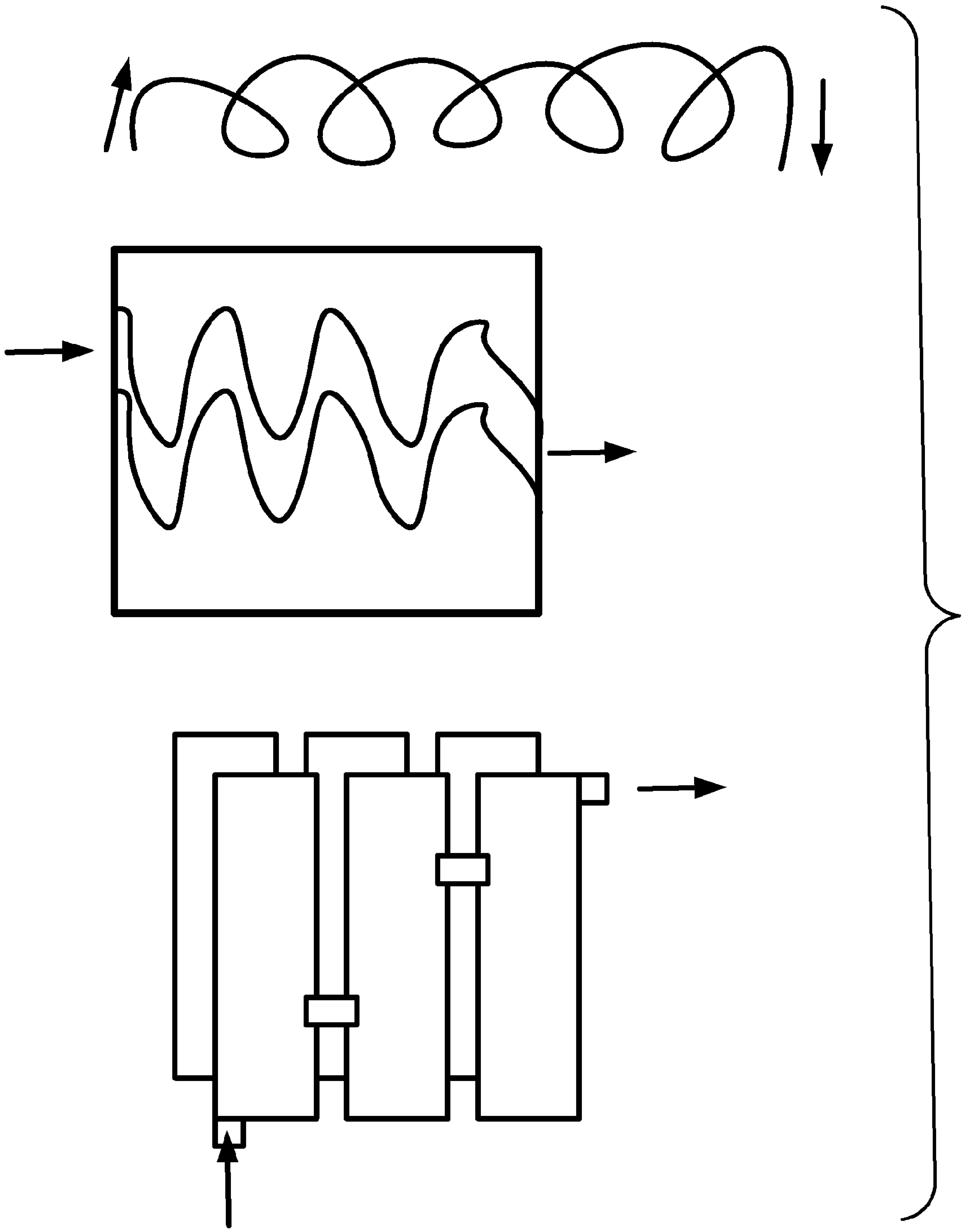


FIG 20

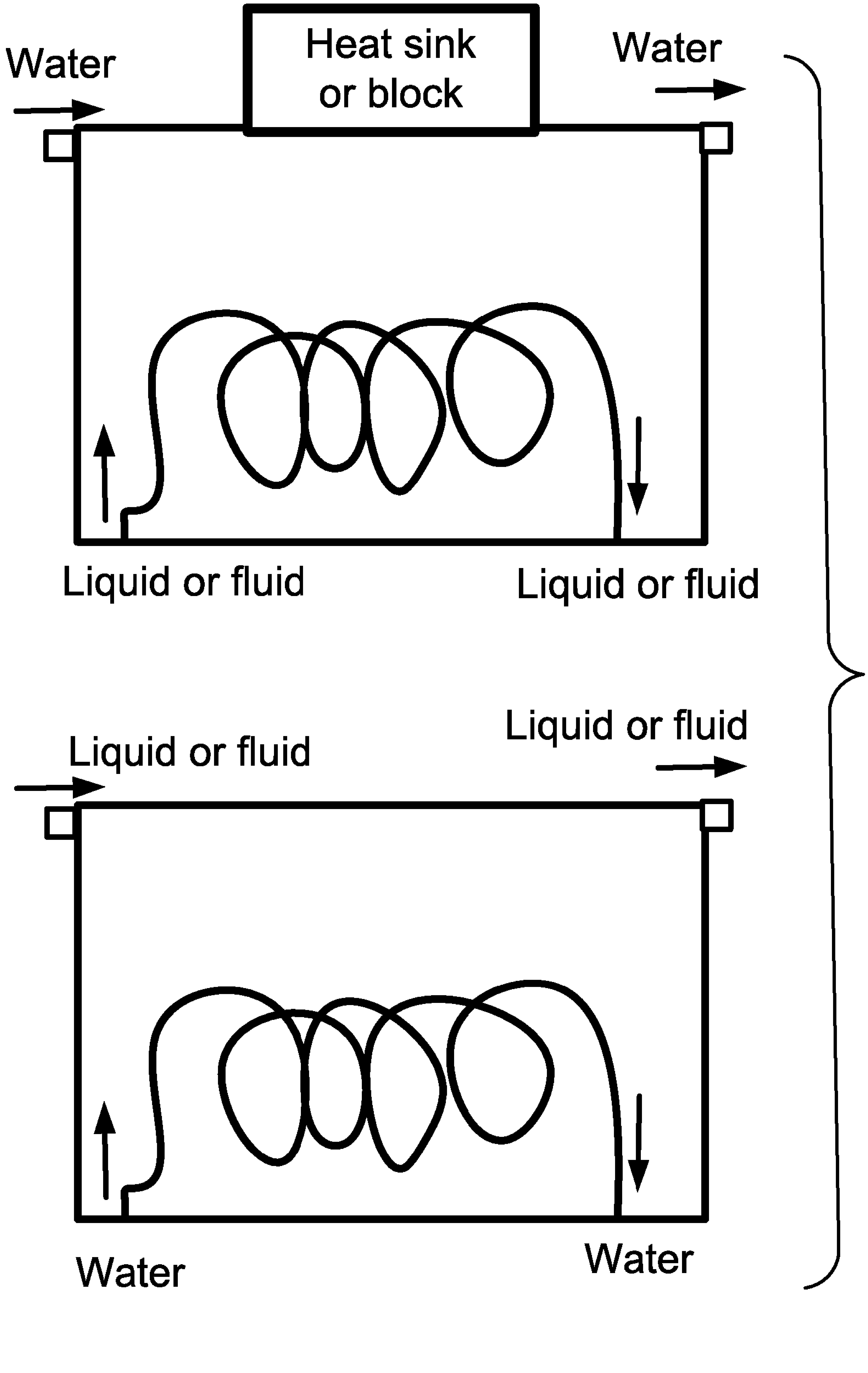

Water
Heat sink or block
Water
Liquid or fluid
Liquid or fluid
Liquid or fluid
Liquid or fluid
Water
Water

FIG 21

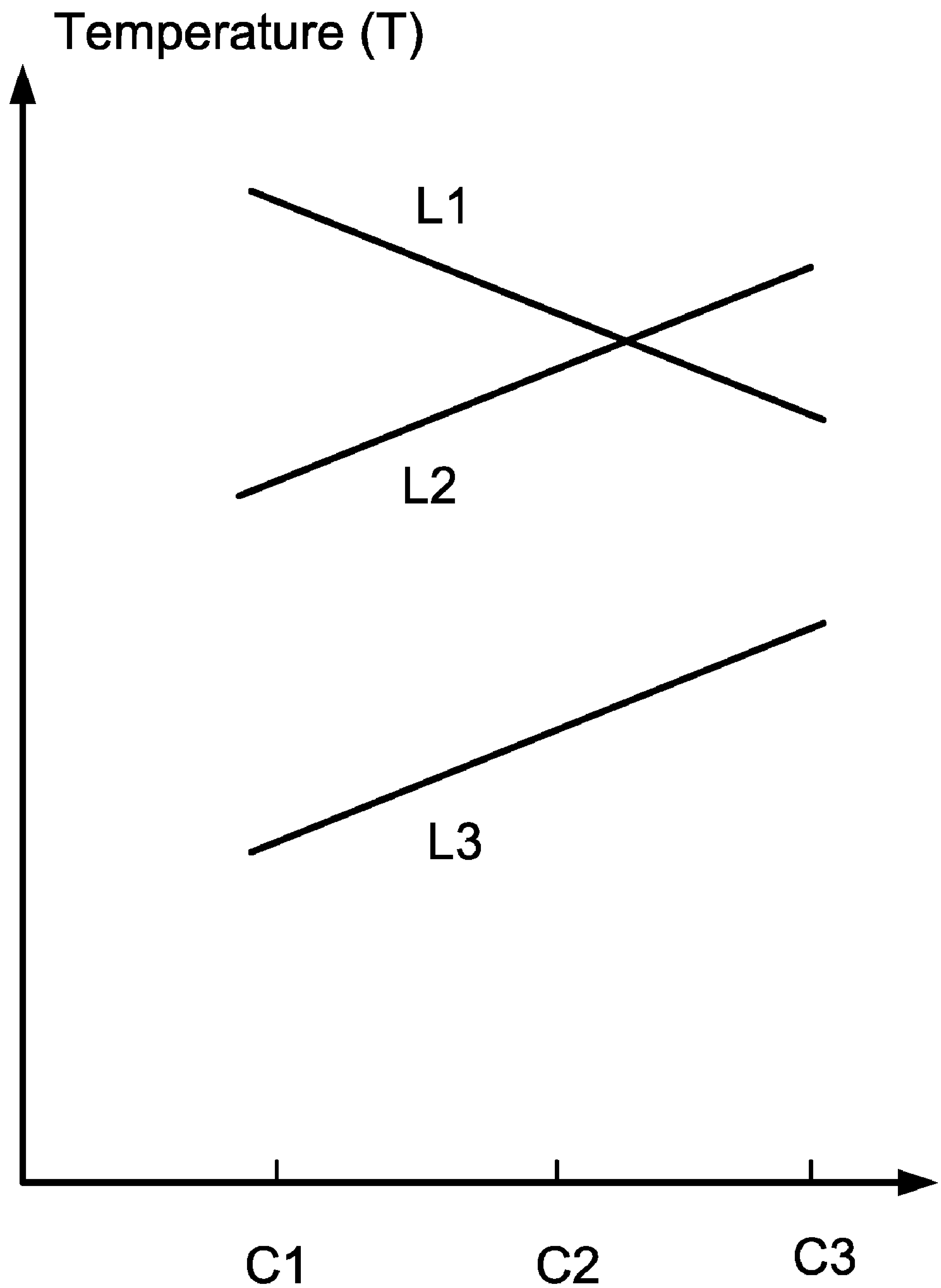


FIG 22

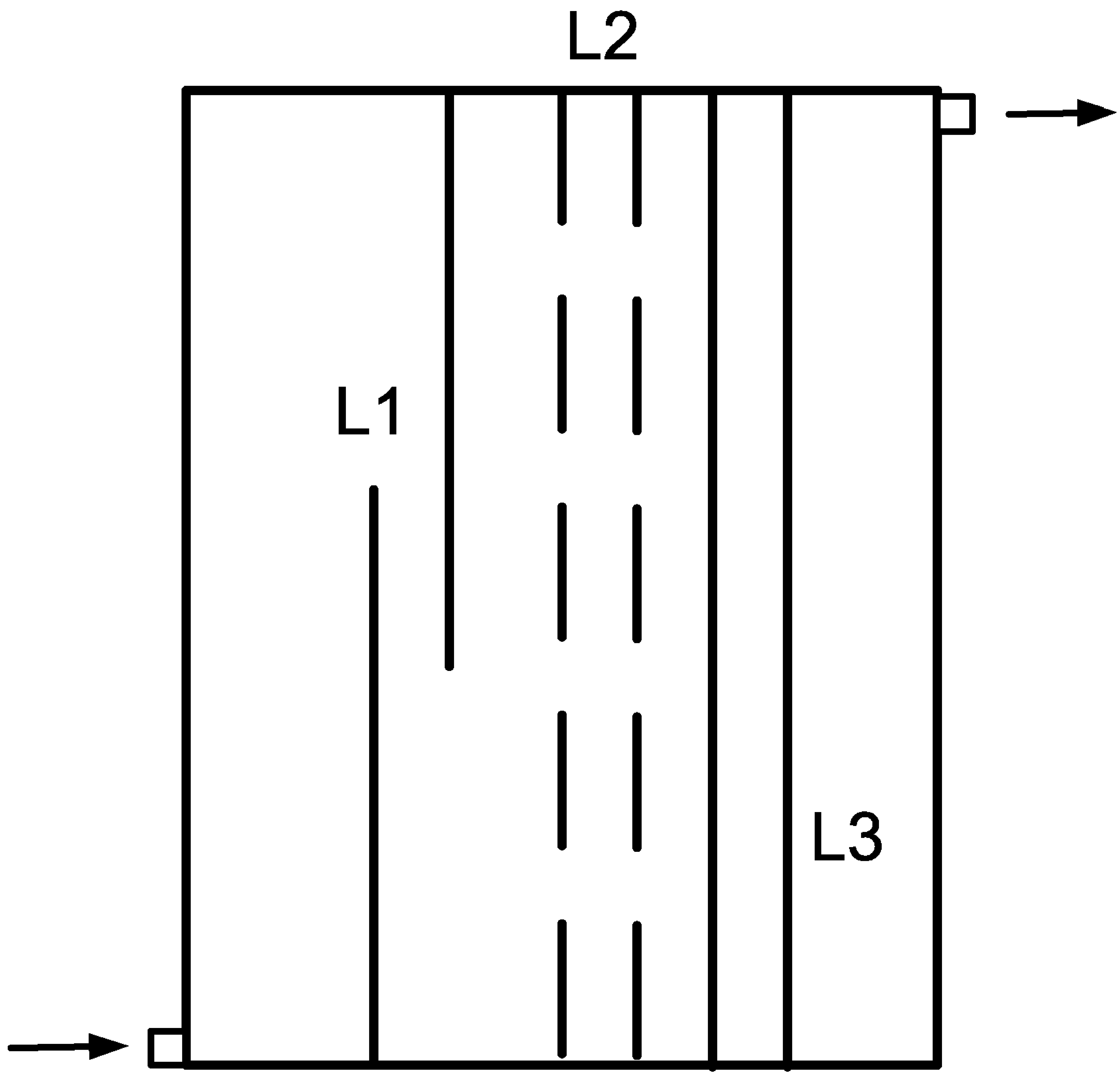


FIG 23

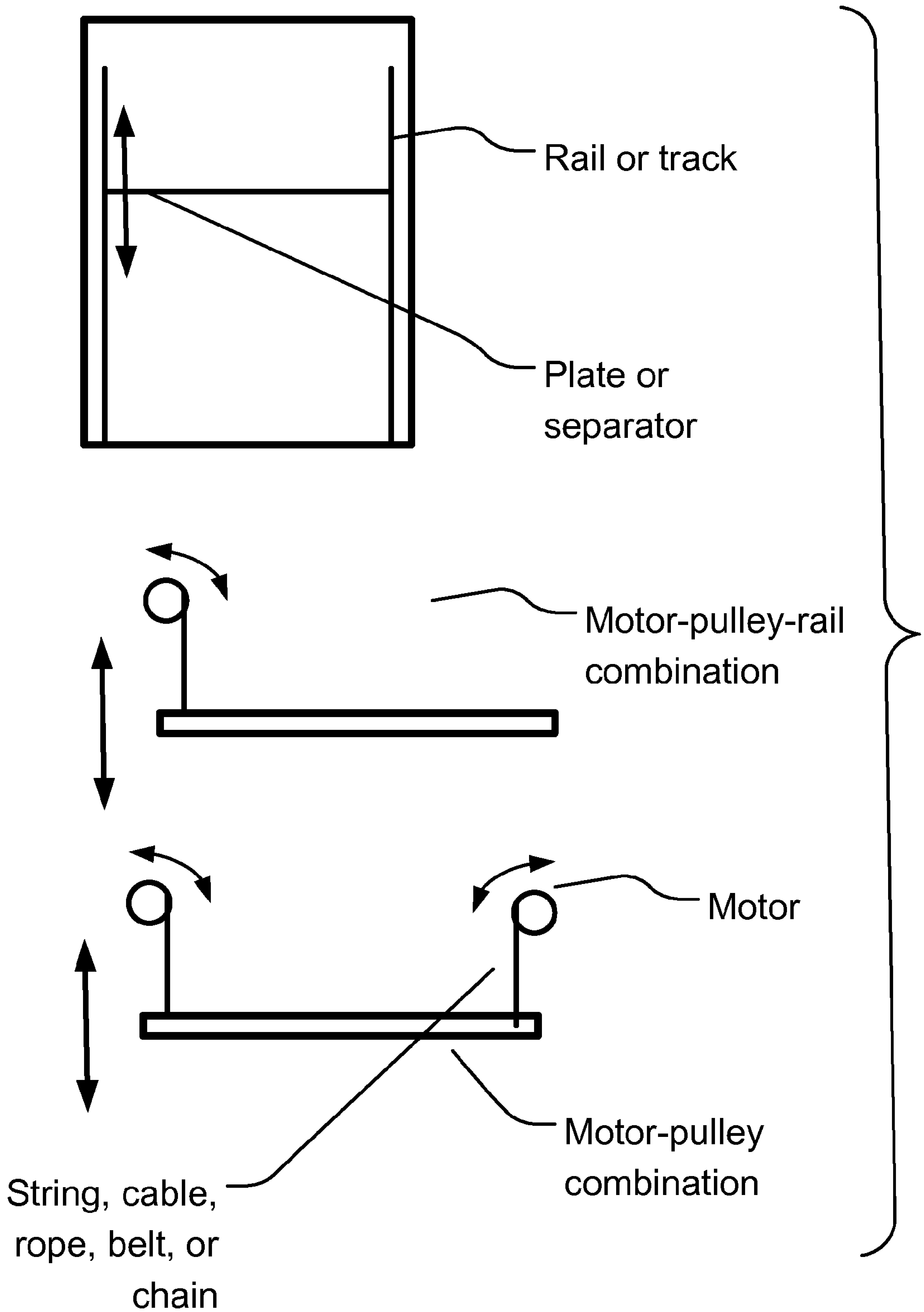

Rail or track
Plate or separator
Motor-pulley-rail combination
Motor
Motor-pulley combination
String, cable, rope, belt, or chain

FIG 24

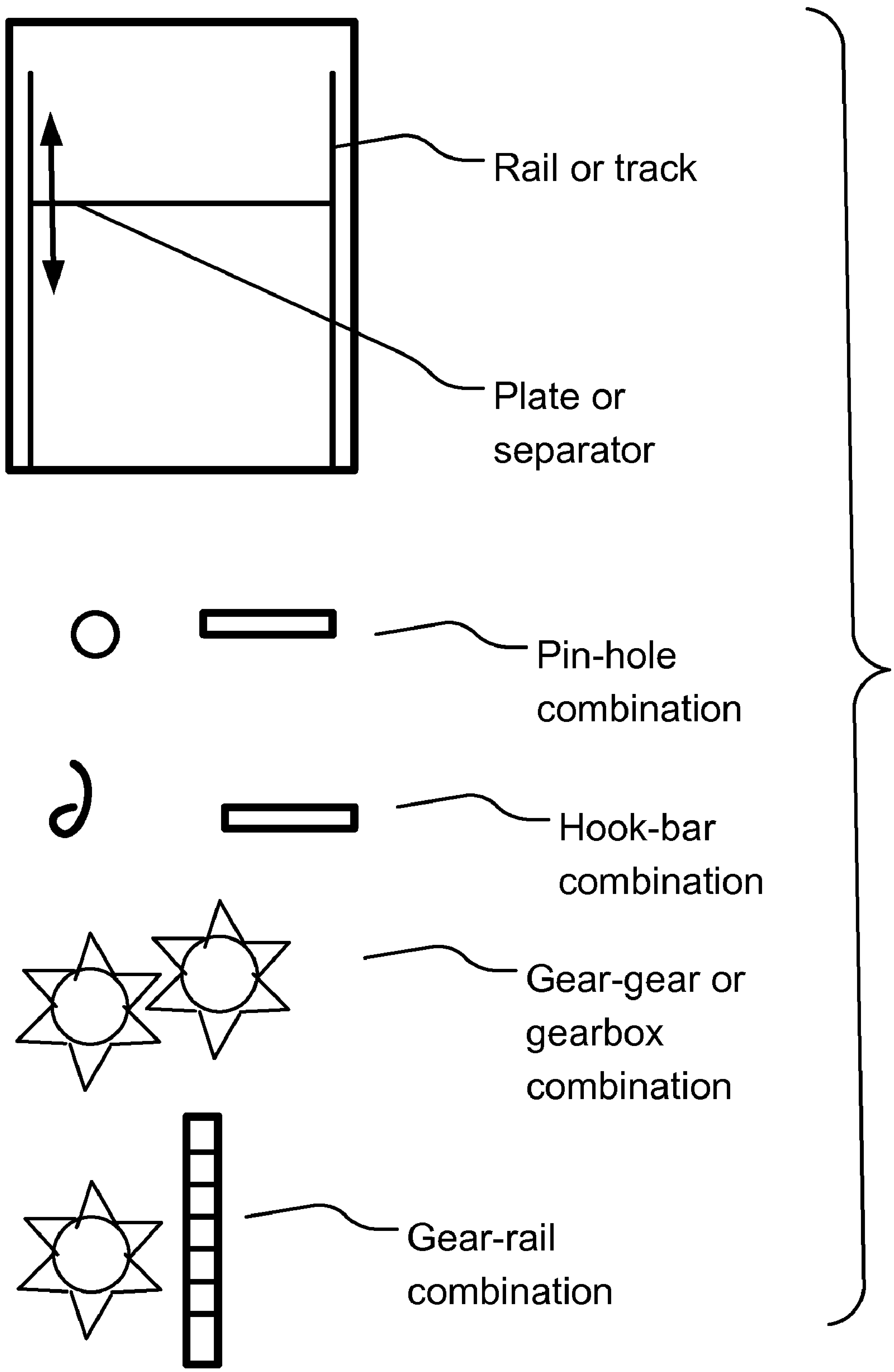

Rail or track
Plate or separator
Pin-hole combination
Hook-bar combination
Gear-gear or gearbox combination
Gear-rail combination

FIG 25

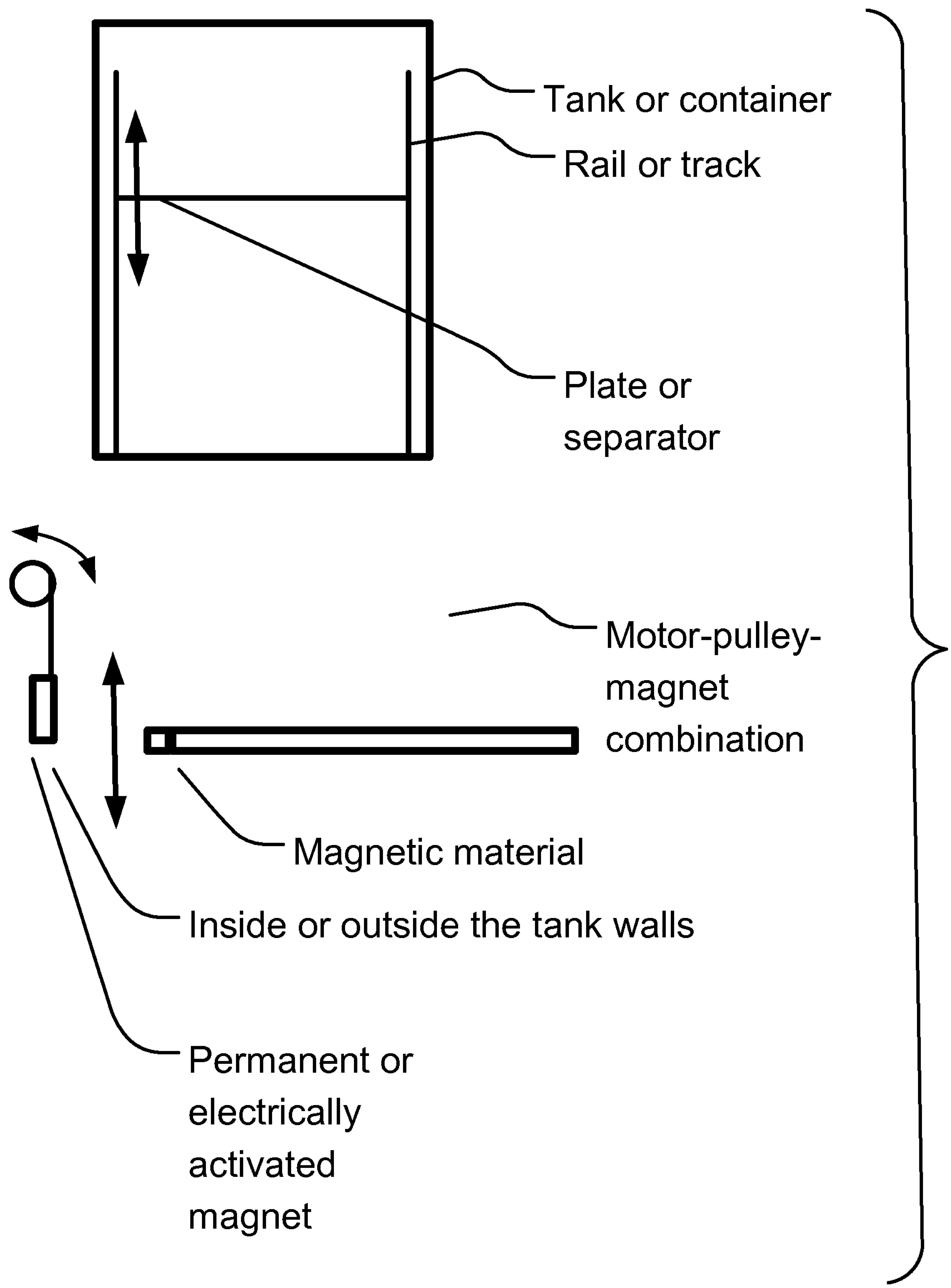

Tank or container
Rail or track
Plate or separator
Motor-pulley-magnet combination
Magnetic material
Inside or outside the tank walls
Permanent or electrically activated magnet

FIG 26

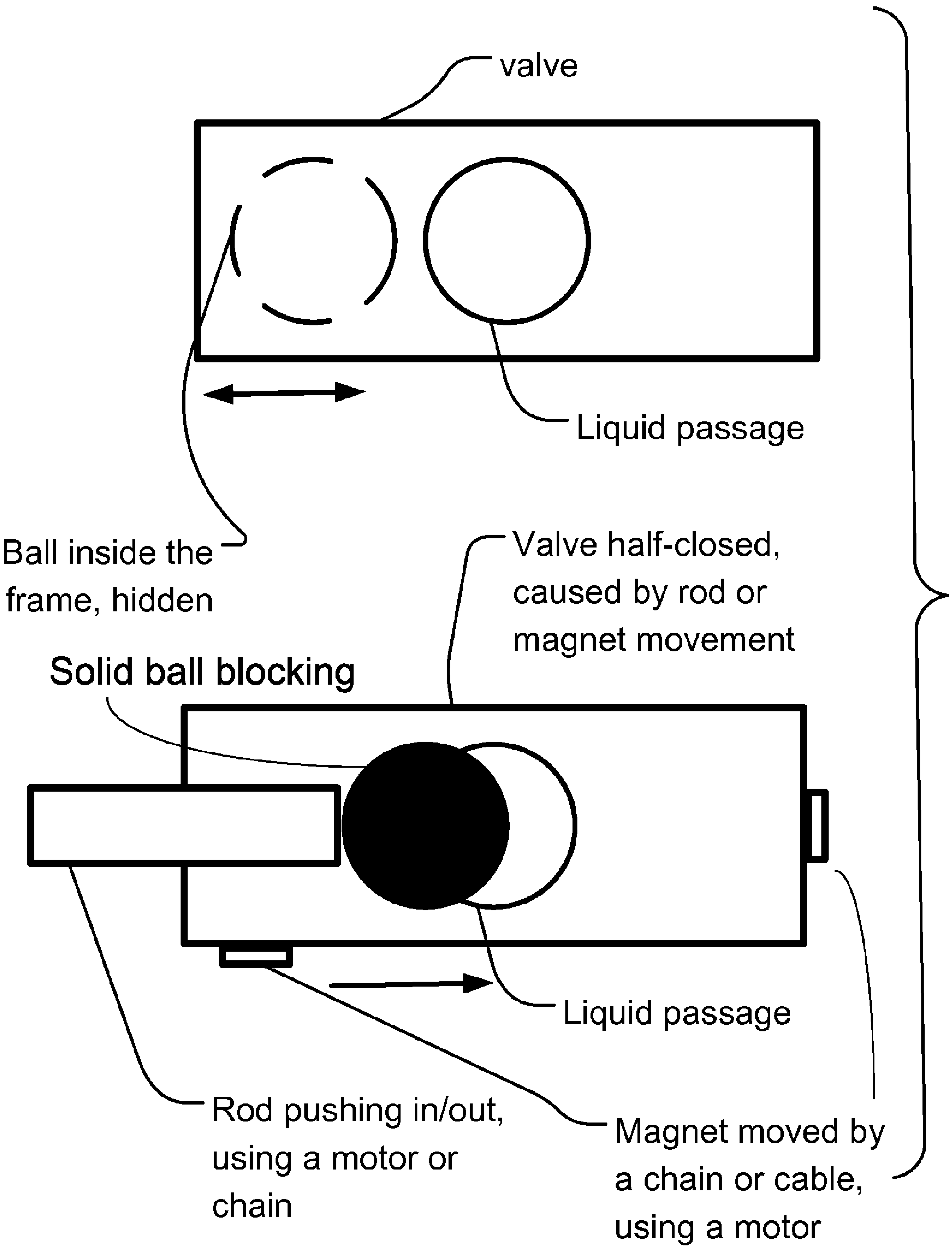

valve
Liquid passage
Ball inside the frame, hidden
Valve half-closed, caused by rod or magnet movement
Solid ball blocking
Liquid passage
Rod pushing in/out, using a motor or chain
Magnet moved by a chain or cable, using a motor

FIG 27

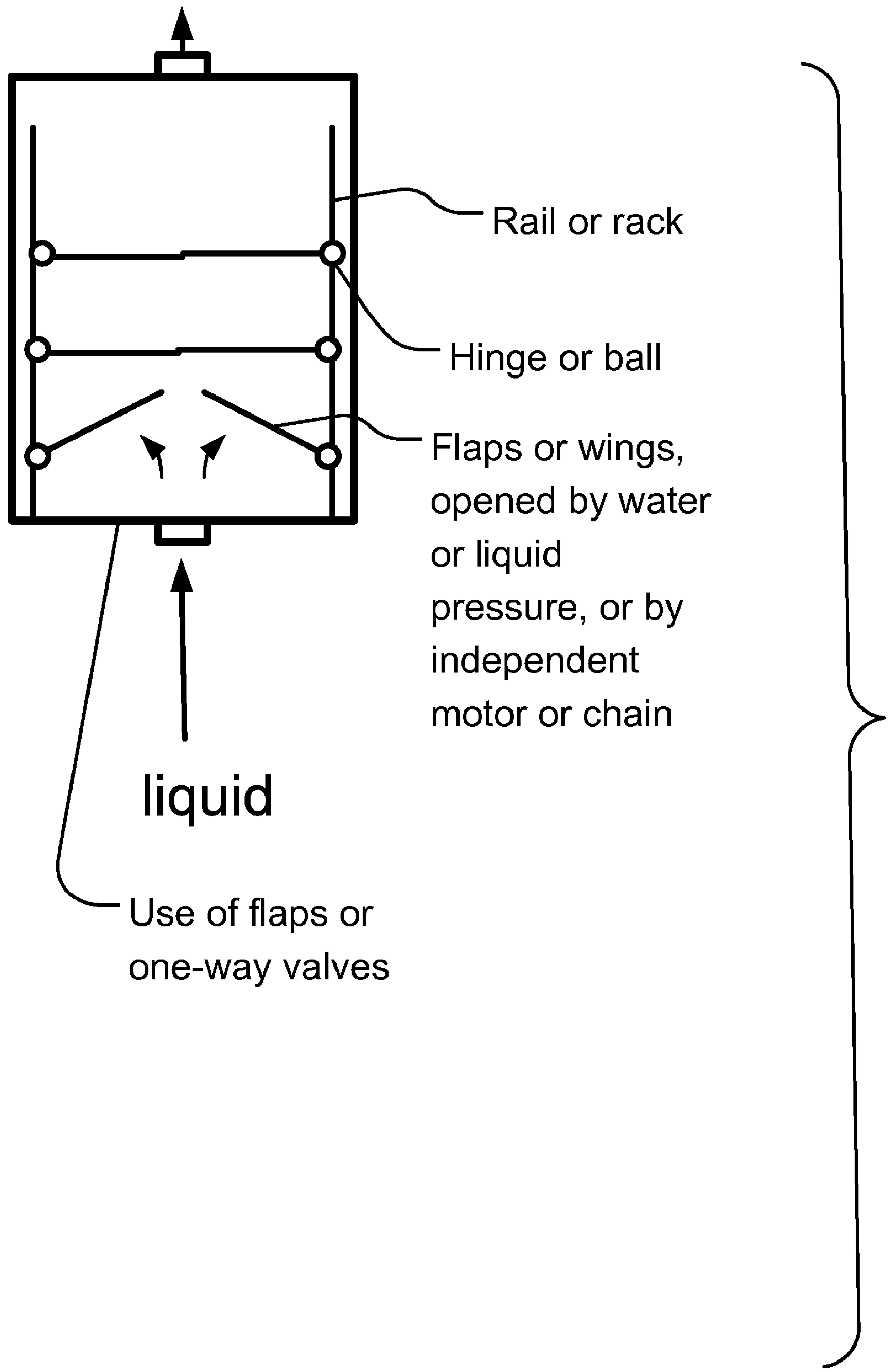

Rail or rack
Hinge or ball
Flaps or wings, opened by water or liquid pressure, or by independent motor or chain
liquid
Use of flaps or one-way valves

FIG 28

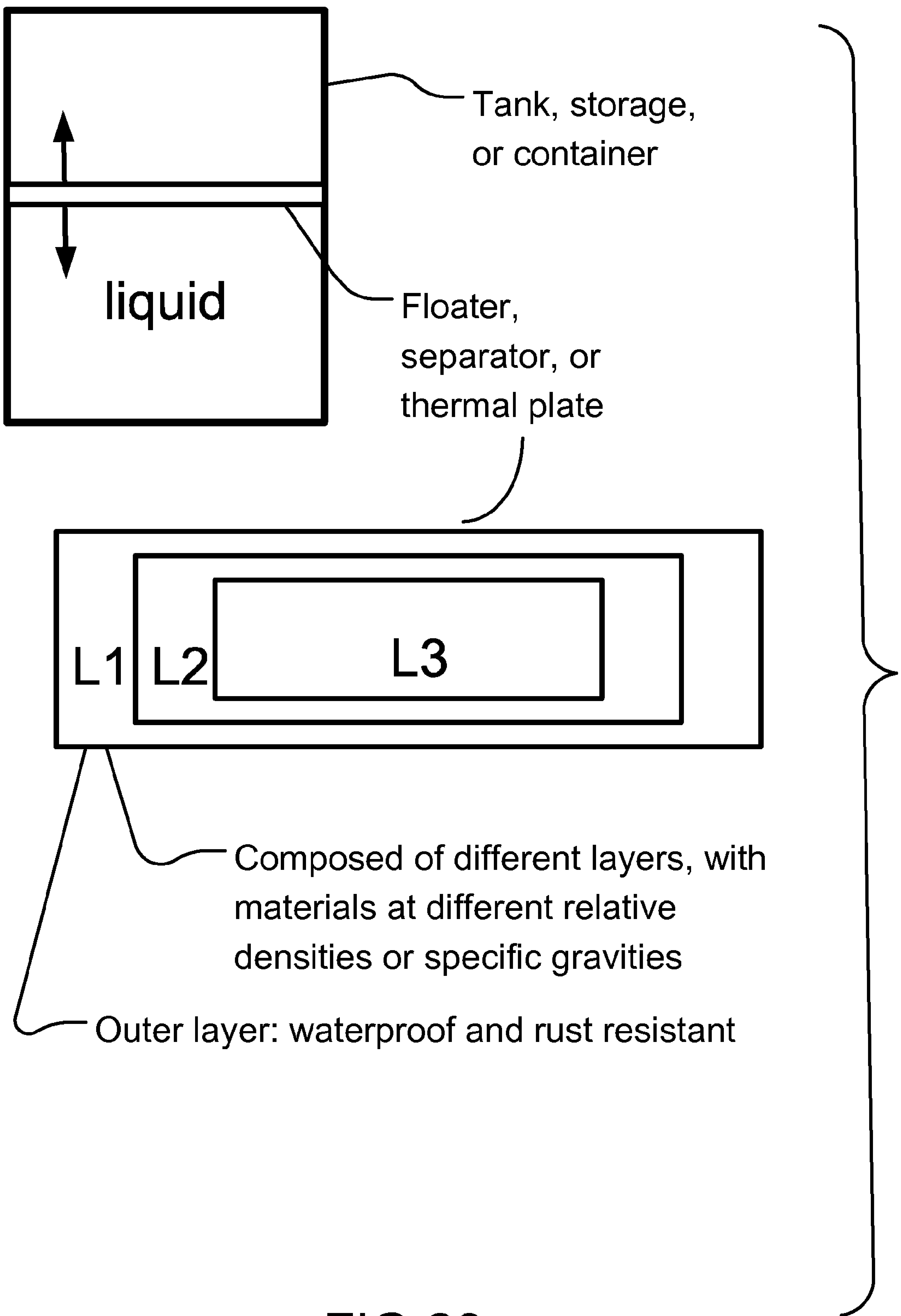

Tank, storage,
or container
liquid
Floater,
separator, or
thermal plate
L1
L2
L3
Composed of different layers, with
materials at different relative
densities or specific gravities
Outer layer: waterproof and rust resistant

FIG 29

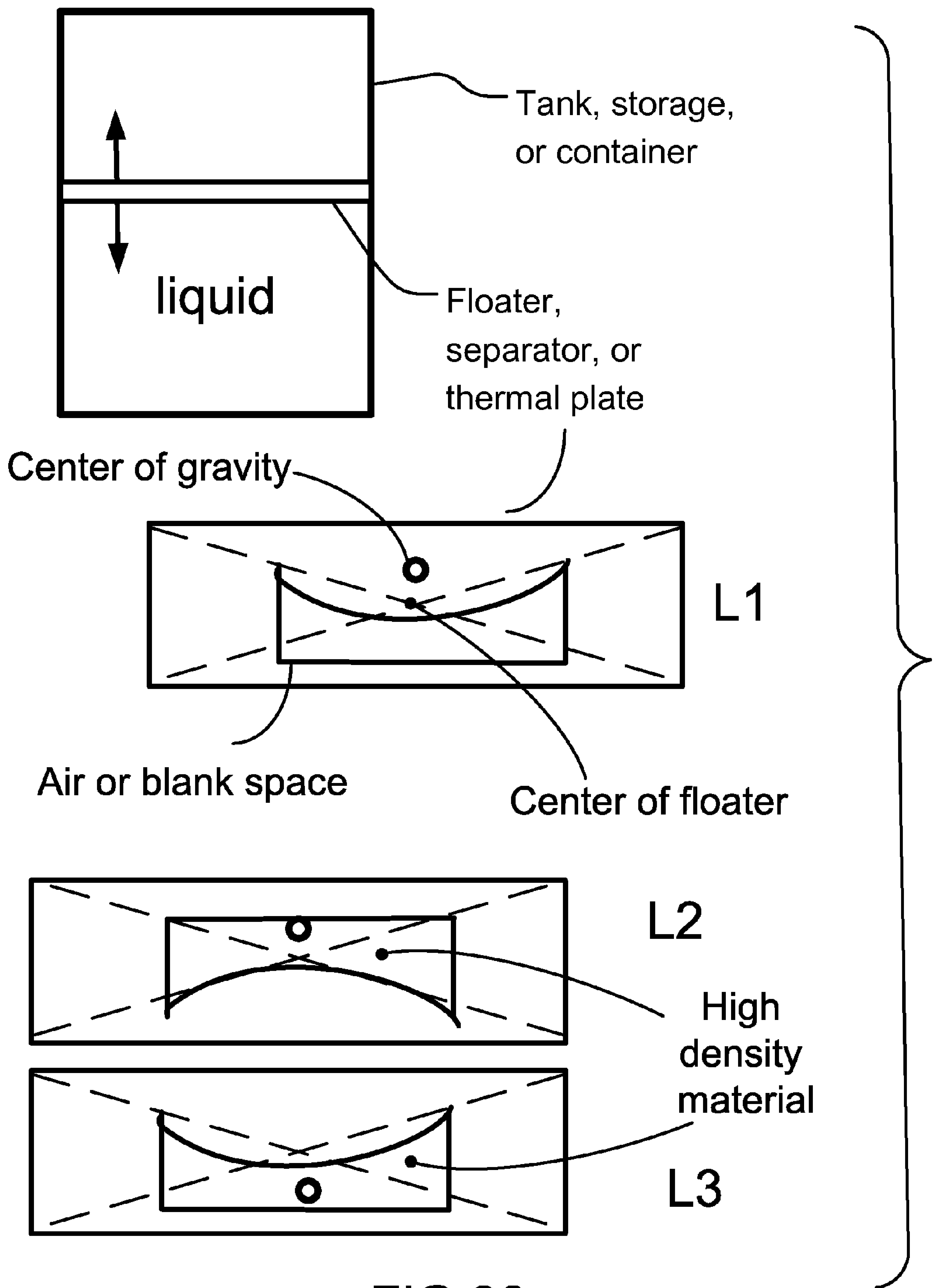

Tank, storage, or container
liquid
Floater, separator, or thermal plate
Center of gravity
L1
Air or blank space
Center of floater
L2
High density material
L3

FIG 30

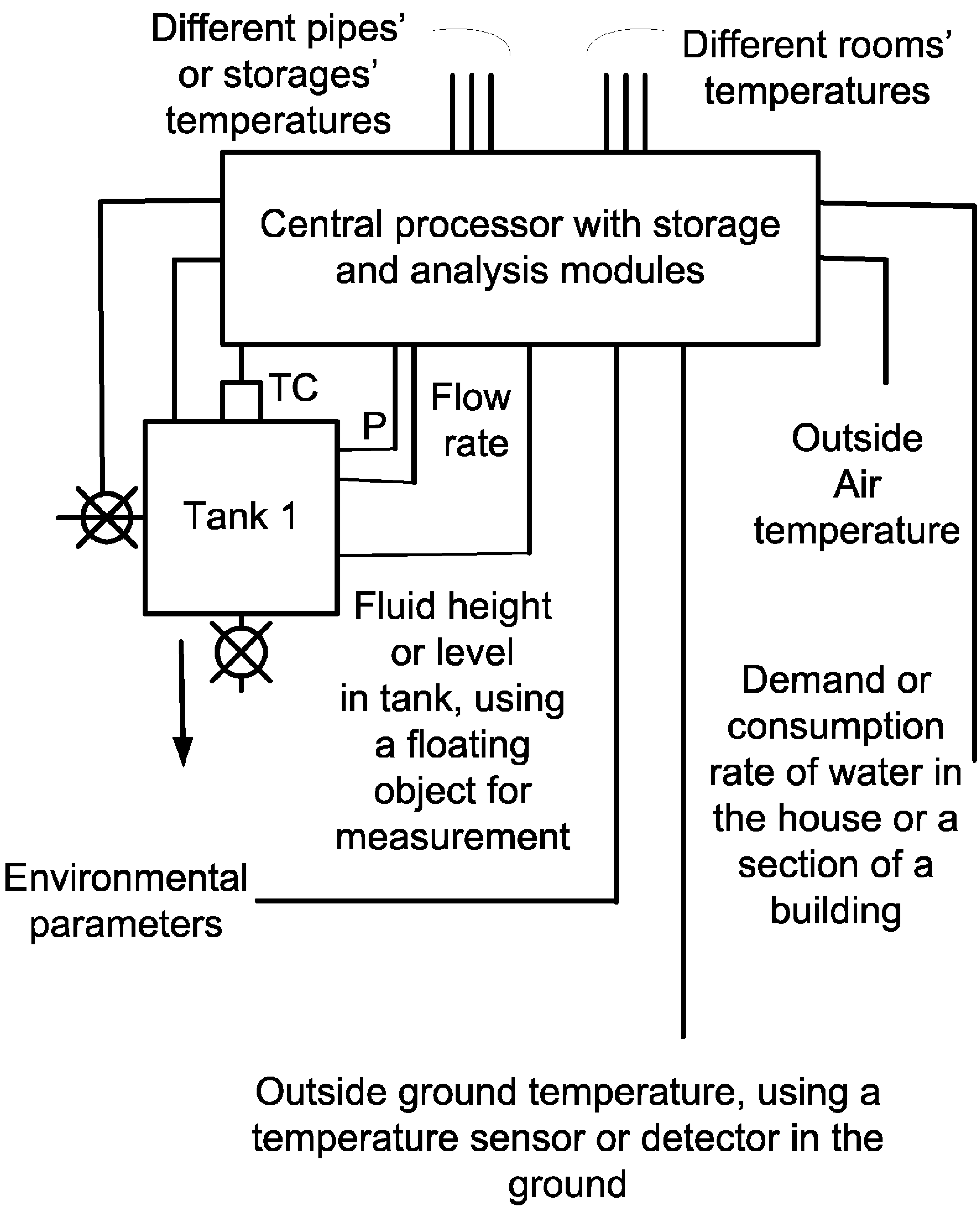

Different pipes' or storages' temperatures
Different rooms' temperatures
Central processor with storage and analysis modules
TC
P
Flow rate
Tank 1
Outside Air temperature
Fluid height or level in tank, using a floating object for measurement
Demand or consumption rate of water in the house or a section of a building
Environmental parameters
Outside ground temperature, using a temperature sensor or detector in the ground

FIG 31

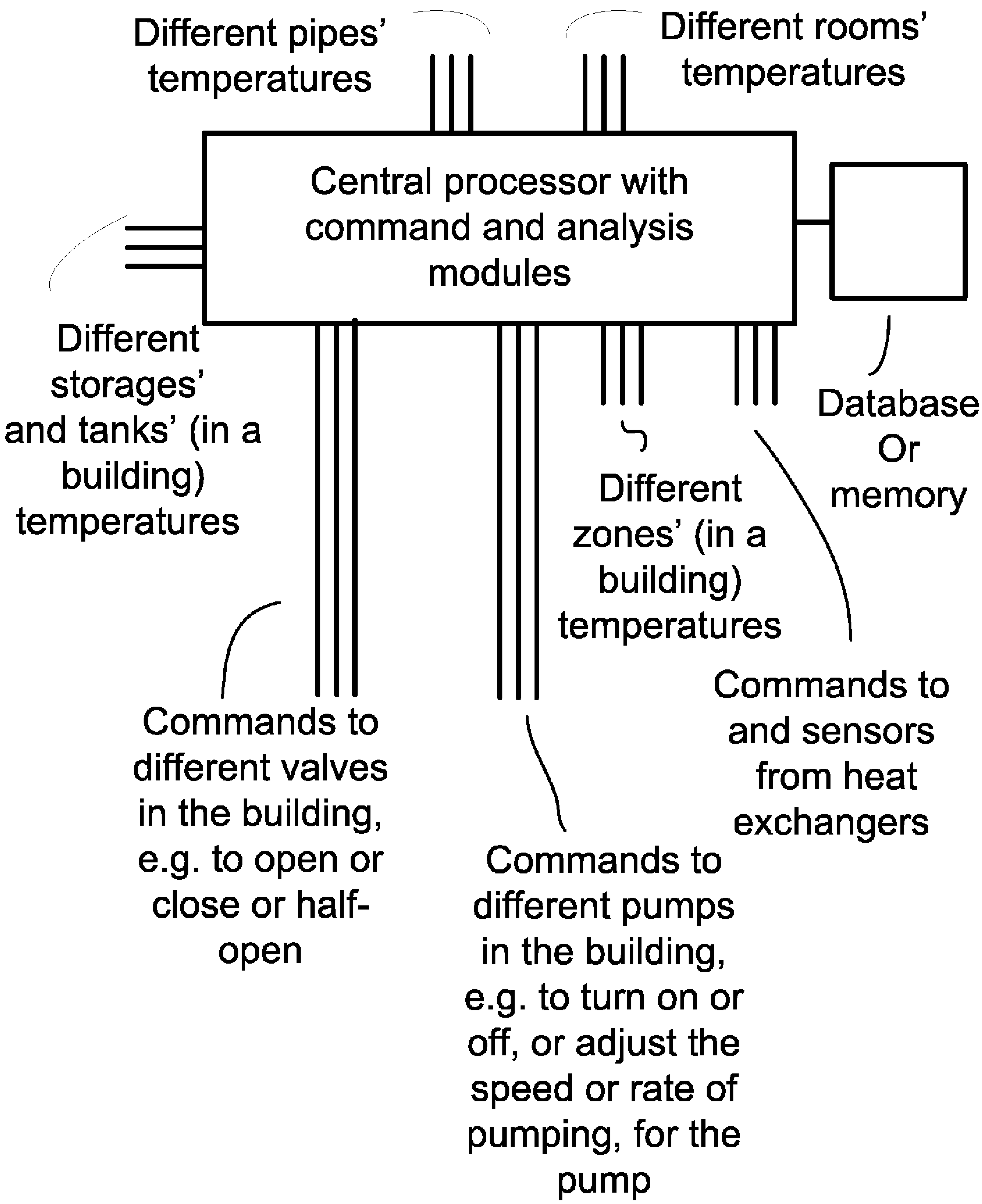

Different pipes' temperatures
Different rooms' temperatures
Central processor with command and analysis modules
Different storages' and tanks' (in a building) temperatures
Database Or memory
Different zones' (in a building) temperatures
Commands to and sensors from heat exchangers
Commands to different valves in the building, e.g. to open or close or half-open
Commands to different pumps in the building, e.g. to turn on or off, or adjust the speed or rate of pumping, for the pump

FIG 32

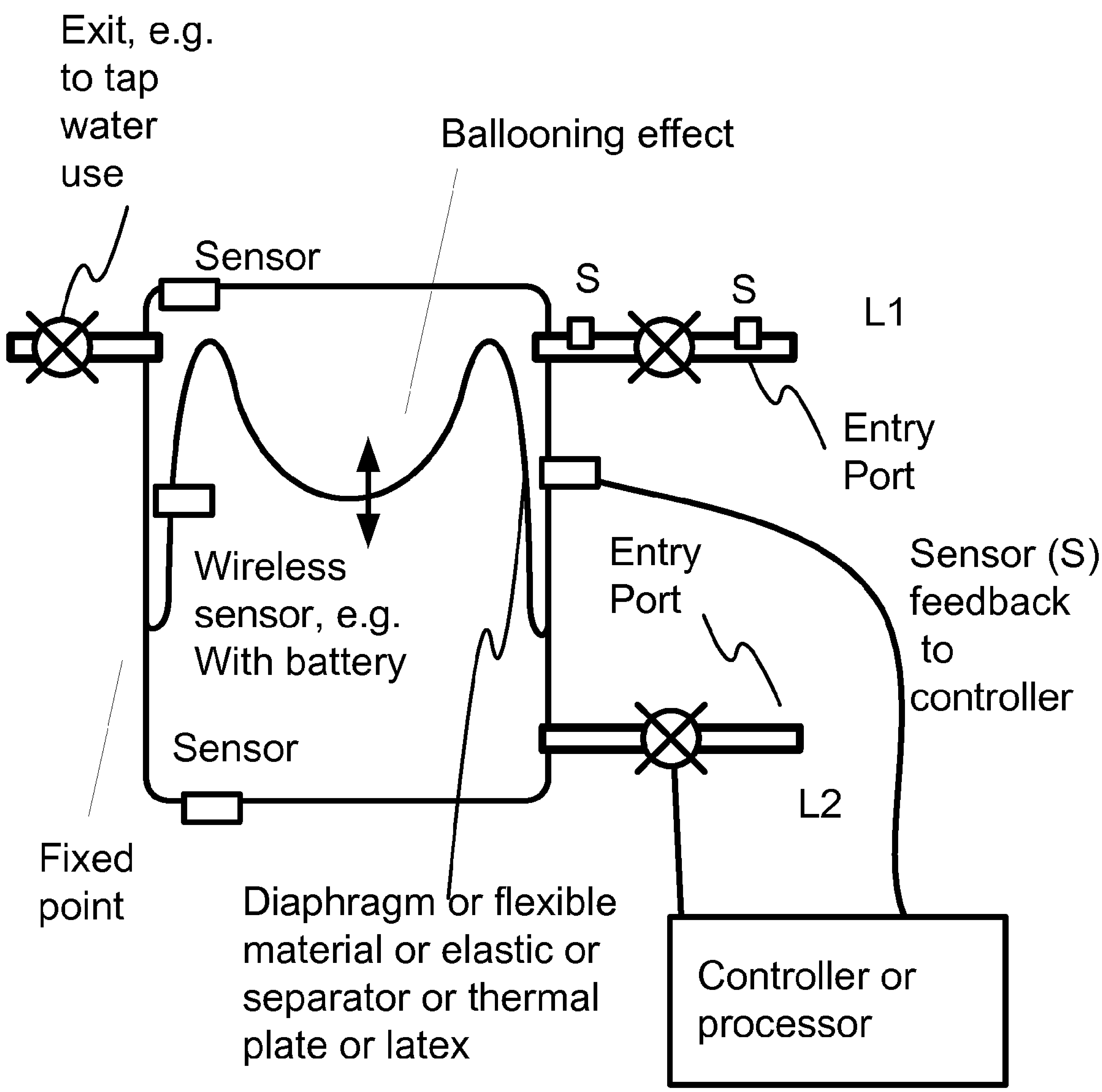

Exit, e.g.
to tap
water
use
Ballooning effect
Sensor
S
S
L1
Entry
Port
Wireless
sensor, e.g.
With battery
Entry
Port
Sensor (S)
feedback
to
controller
Sensor
L2
Fixed
point
Diaphragm or flexible
material or elastic or
separator or thermal
plate or latex
Controller or
processor

FIG 33

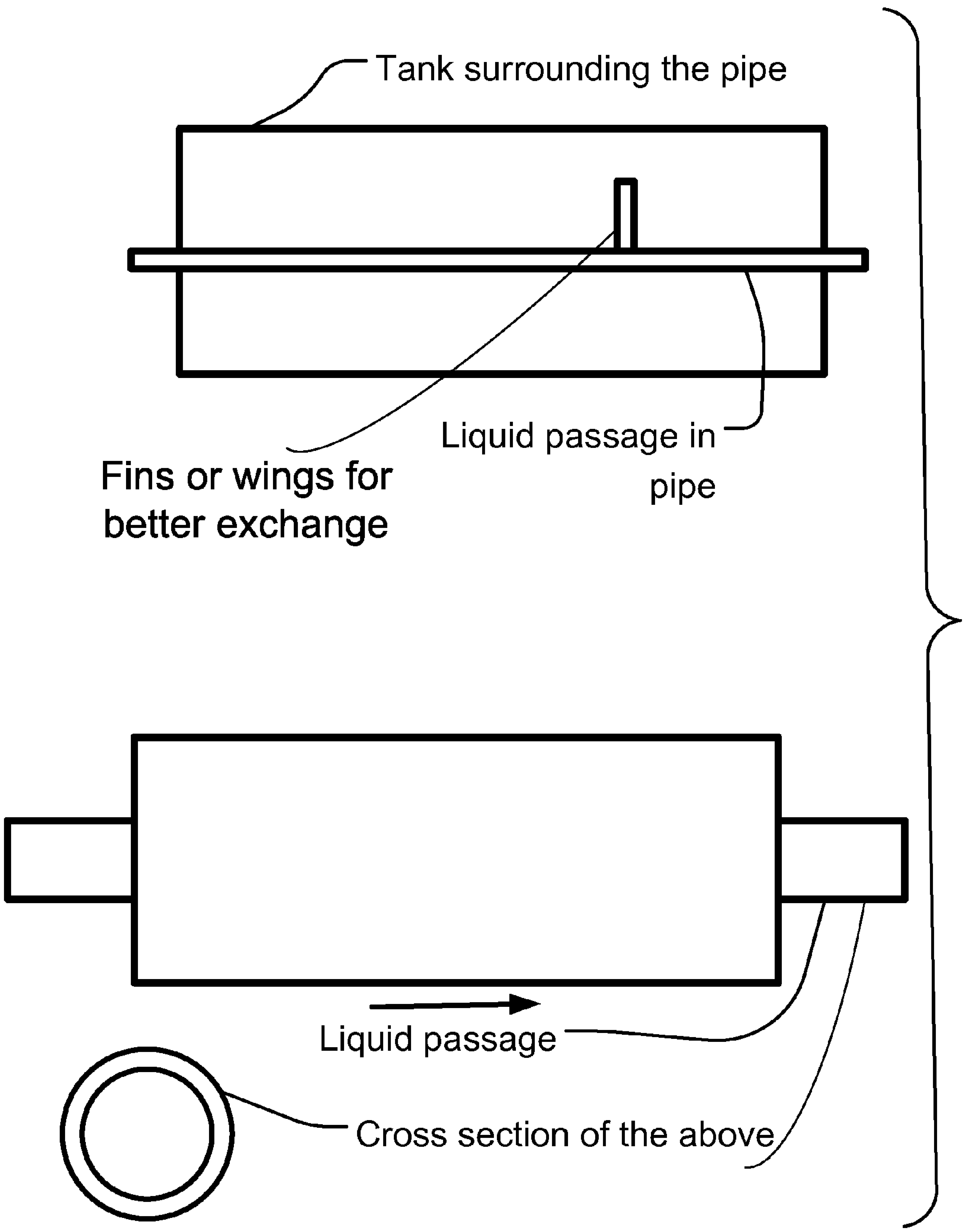
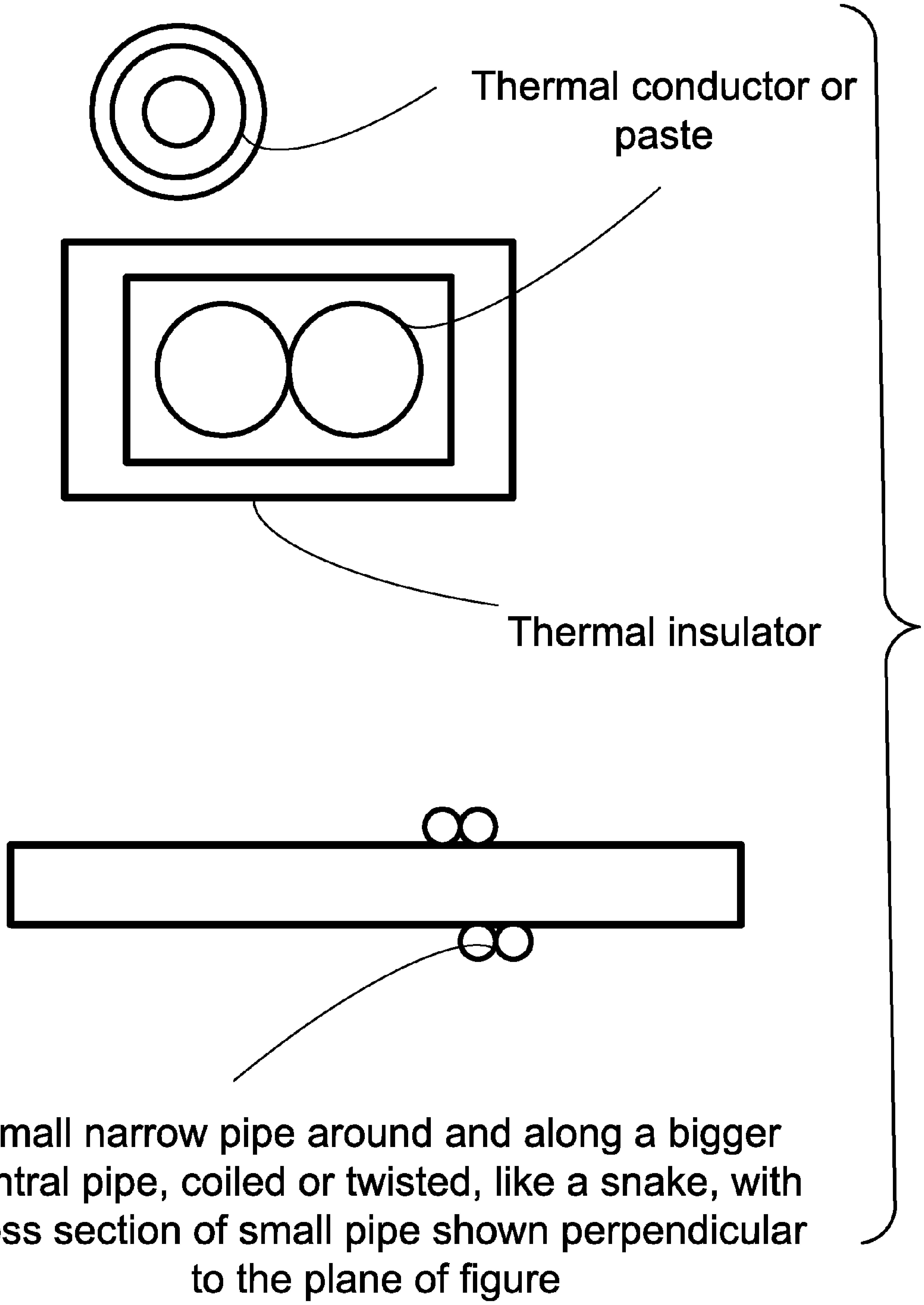

Tank surrounding the pipe
Fins or wings for better exchange
Liquid passage in pipe
Liquid passage
Cross section of the above

FIG 34



Thermal conductor or paste
Thermal insulator
Small narrow pipe around and along a bigger central pipe, coiled or twisted, like a snake, with cross section of small pipe shown perpendicular to the plane of figure

FIG 35

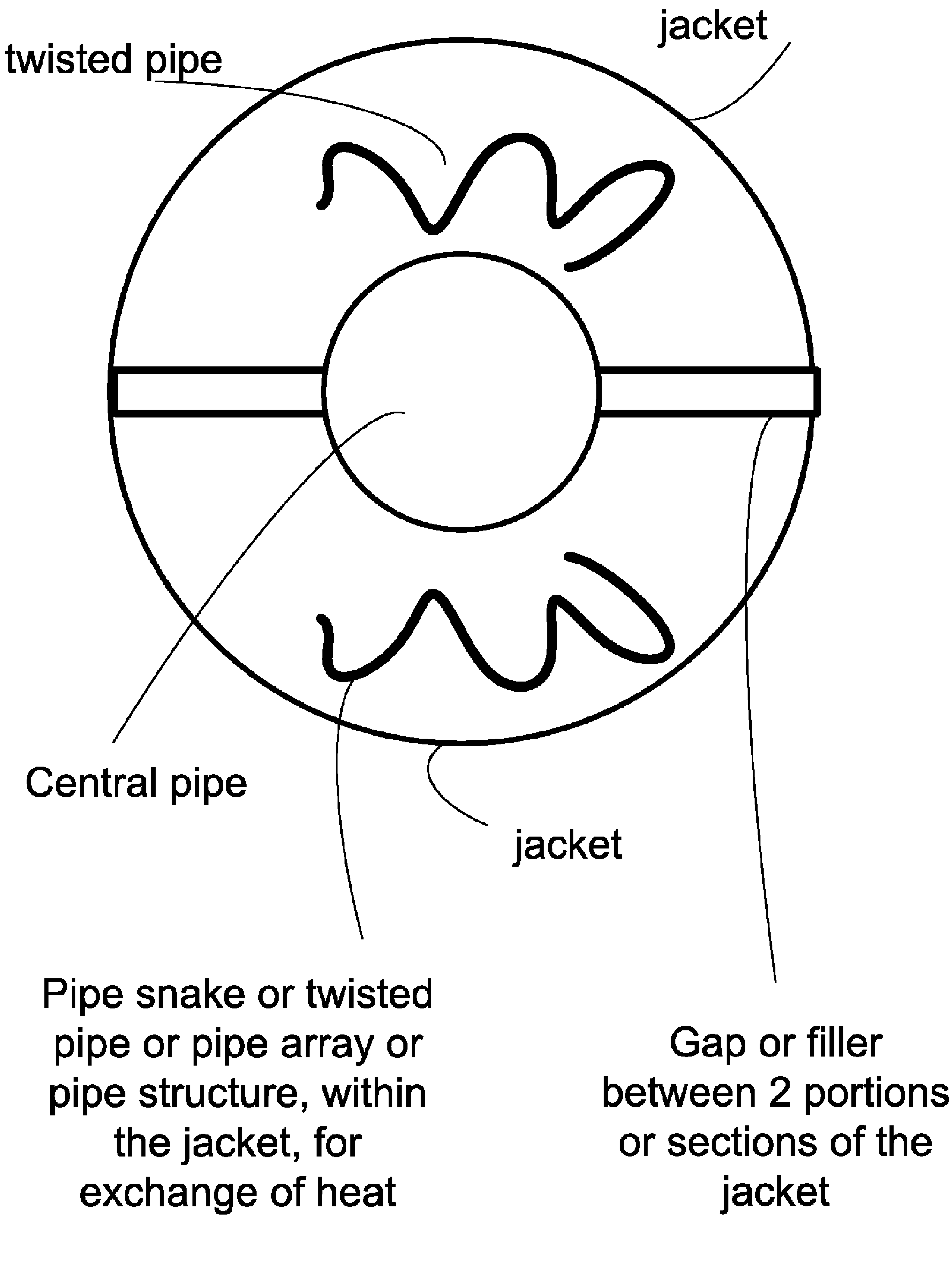

twisted pipe
jacket
Central pipe
jacket
Pipe snake or twisted pipe or pipe array or pipe structure, within the jacket, for exchange of heat
Gap or filler between 2 portions or sections of the jacket

FIG 36

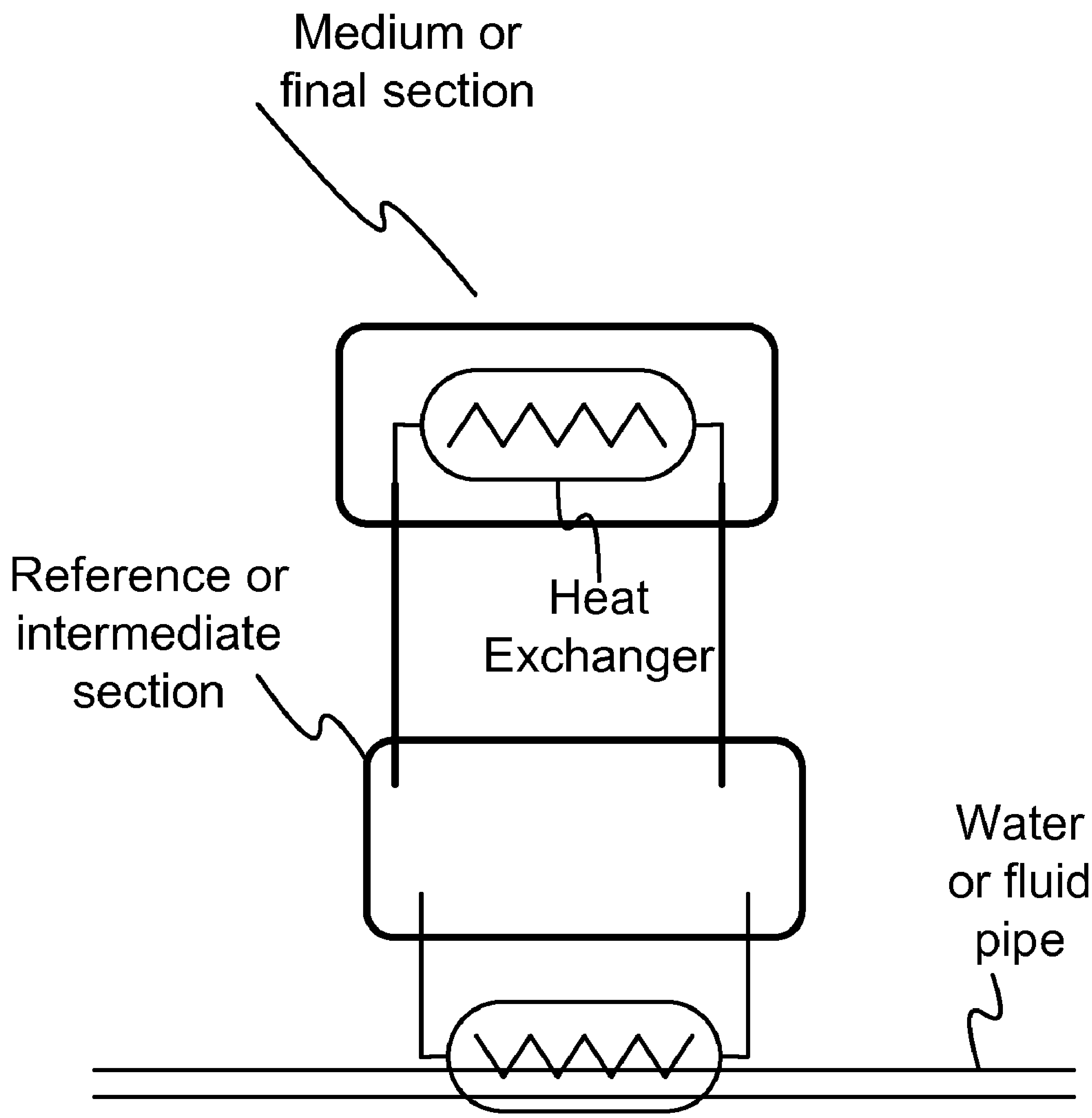

Medium or
final section
Reference or
intermediate
section
Heat
Exchanger
Water
or fluid
pipe

FIG 37

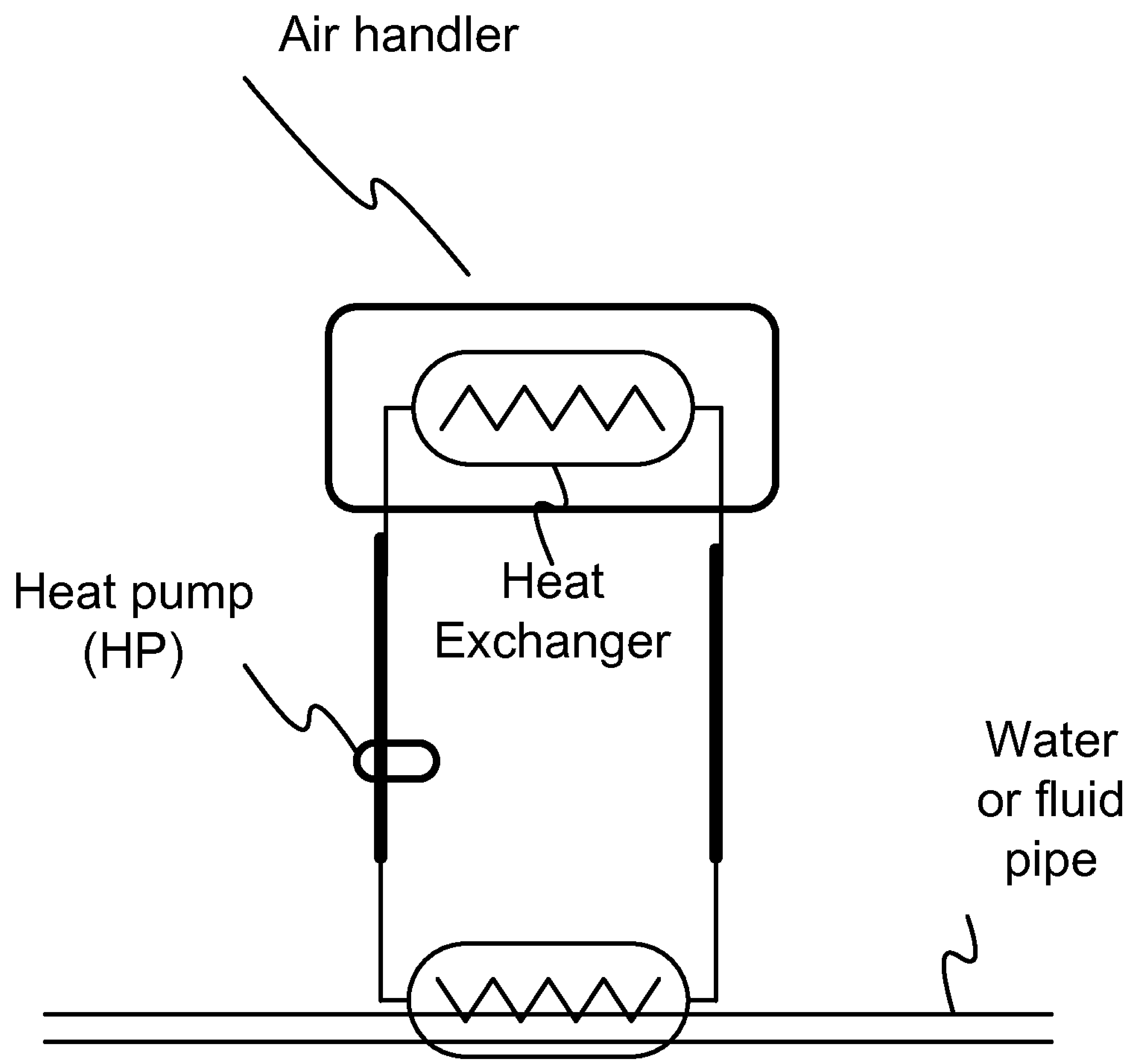


FIG 38

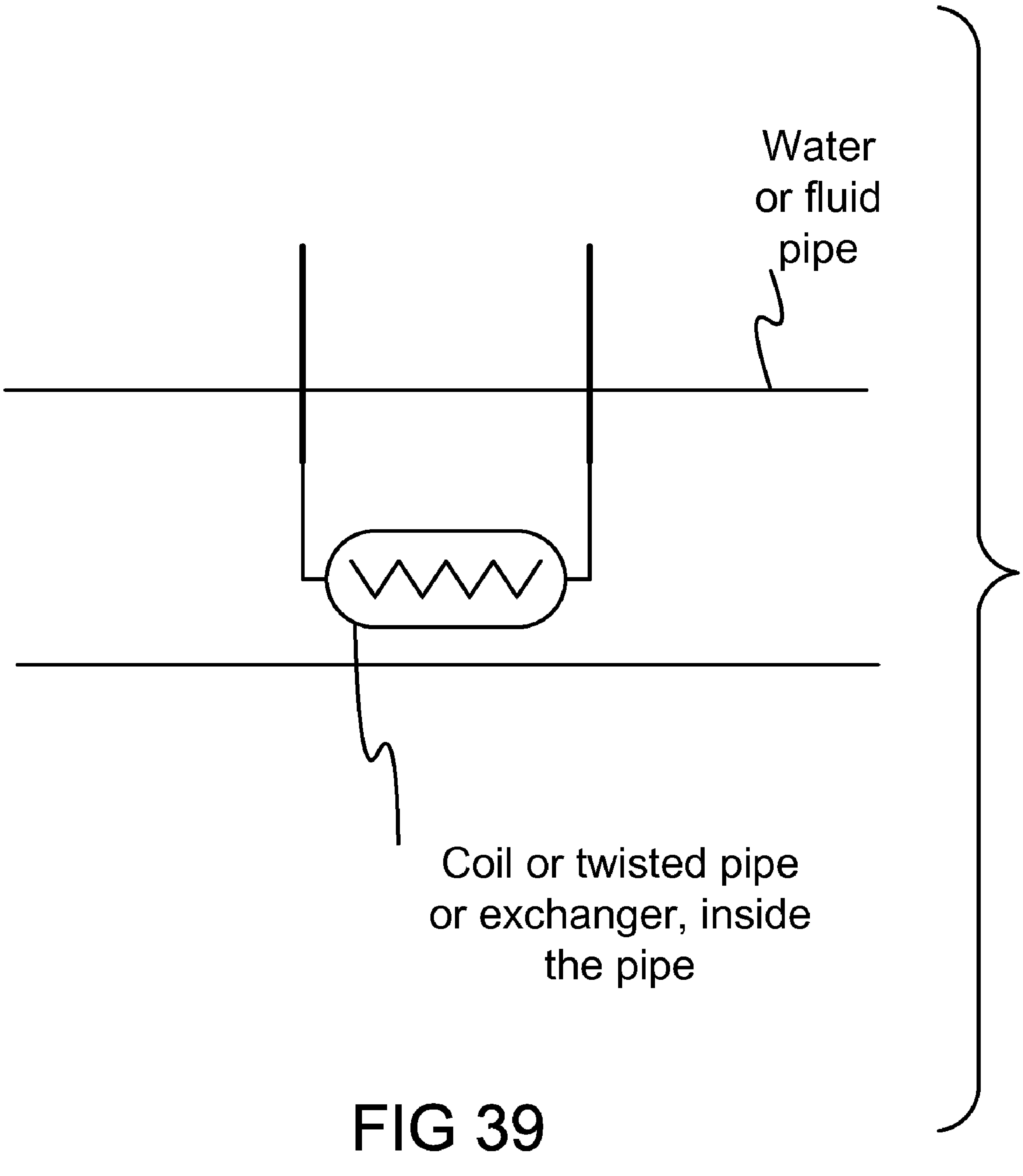

Water
or fluid
pipe
Coil or twisted pipe
or exchanger, inside
the pipe

FIG 39

HEAT EXCHANGE USING UNDERGROUND WATER SYSTEM

BACKGROUND OF THE INVENTION

[0001] This invention relates to geothermal energy. Geothermal energy is a renewable environmental-friendly energy source, which can be used with a low set-up cost all year around (day or night, and all seasons). To maintain the current energy consumption on this planet, humans have to use different renewable and environmental-friendly energy sources.

[0002] Some prior art in this field are, as US patents or applications:

[0003] U.S. Pat. No. 7,898,155 System for generating electricity using a chemical heat engine and piezoelectric material

[0004] U.S. Pat. No. 7,896,078 Method of using crosslinkable brine containing compositions

[0005] U.S. Pat. No. 7,891,440 Method and system for installing geothermal transfer apparatuses with a sonic drill and a removable or retrievable drill bit

[0006] U.S. Pat. No. 7,891,188 Apparatus for producing power using geothermal liquid

[0007] U.S. Pat. No. 7,856,839 Direct exchange geothermal heating/cooling system sub-surface tubing installation with supplemental sub-surface tubing configuration

[0008] U.S. Pat. No. 7,849,690 Self contained in-ground geothermal generator

[0009] U.S. Pat. No. 7,845,406 Enhanced oil recovery system for use with a geopressured-geothermal conversion system

[0010] U.S. Pat. No. 7,841,200 Sub-surface tubing spacer means for direct expansion heating/cooling systems

[0011] U.S. Pat. No. 7,832,220 Deep well direct expansion heating and cooling system

[0012] U.S. Pat. No. 7,827,814 Geothermal water heater

[0013] U.S. Pat. No. 7,819,207 Mobile land drilling rig and method of installation

[0014] U.S. Pat. No. 7,788,924 System and method for in-line geothermal and hydroelectric generation

[0015] U.S. Pat. No. 7,784,545 In-situ method of fracturing gas shale and geothermal areas

[0016] U.S. Pat. No. 7,776,202 Process for producing electrolytic manganese dioxide

[0017] U.S. Pat. No. 7,744,841 Sulfur removal using ferrous carbonate absorbent

[0018] U.S. Pat. No. 7,730,945 Using geothermal energy to heat a portion of a formation for an in situ heat treatment process

[0019] U.S. Pat. No. 7,654,101 Split-air stream air conditioning with desiccant dehumidification

[0020] U.S. Pat. No. 7,647,988 Method and system for installing geothermal transfer apparatuses with a sonic drill

[0021] U.S. Pat. No. 7,647,773 Ground source heat pump well field design and control strategy for large tonnage

[0022] U.S. Pat. No. 7,621,129 Power generation system

[0023] U.S. Pat. No. 7,617,697 In-ground geothermal heat pump system

[0024] U.S. Pat. No. 7,584,614 Immanuel system to produce electricity through geothermal energy

[0025] U.S. Pat. No. 7,584,610 Water cycling system with compressor motive force and with turbine electric power generator

[0026] U.S. Pat. No. 7,578,140 Deep well/long trench direct expansion heating/cooling system

[0027] U.S. Pat. No. 7,575,047 Heating and warm water supply unit and method for operating the same

[0028] U.S. Pat. No. 7,566,980 System and method for creating a geothermal roadway utility with alternative energy pumping system

[0029] U.S. Pat. No. 7,556,866 Vapour turbine

[0030] U.S. Pat. No. 7,554,223 Magnetohydrodynamic energy conversion device using a heat exchanger

[0031] U.S. Pat. No. 7,553,555 Vapour turbine

[0032] U.S. Pat. No. 7,498,087 Vapour turbine

[0033] U.S. Pat. No. 7,490,657 Double-pipe geothermal water circulating apparatus

[0034] U.S. Pat. No. 7,472,548 Solar augmented geothermal energy

[0035] U.S. Pat. No. 7,451,612 Geothermal exchange system incorporating a thermally superconducting medium

[0036] U.S. Pat. No. 7,448,214 Geothermal hydrogen production facility and method

[0037] U.S. Pat. No. 7,439,630 System and methodology for generating electricity using a chemical heat engine and piezoelectric material

[0038] U.S. Pat. No. 7,438,755 Chemically bonded phosphate ceramic sealant formulations for oil field applications

[0039] U.S. Pat. No. 7,422,798 Vapour turbine

[0040] U.S. Pat. No. 7,409,994 Drilling well with drilling fluid of fluid phase and weighting agent

[0041] U.S. Pat. No. 7,407,004 Structure utilizing geothermal energy

[0042] U.S. Pat. No. 7,401,641 Vertically oriented direct exchange/geothermal heating/cooling system sub-surface tubing installation means

[0043] U.S. Pat. No. 7,373,785 Geo-thermal heat exchanging system facilitating the transfer of heat energy using coaxial-flow heat exchanging structures installed in the earth for introducing turbulence into the flow of the aqueous-based heat transfer fluid flowing along the outer flow channel

[0044] U.S. Pat. No. 7,370,488 Geo-thermal heat exchanging system facilitating the transfer of heat energy using coaxial-flow heat exchanging structures installed in the earth for introducing turbulence into the flow of the aqueous-based heat transfer fluid flowing along the outer flow channel

[0045] U.S. Pat. No. 7,334,406 Hybrid geothermal and fuel-cell system

[0046] U.S. Pat. No. 7,331,179 System and method for production of hydrogen

[0047] U.S. Pat. No. 7,320,221 Method and apparatus for using geothermal energy for the production of power

[0048] U.S. Pat. No. 7,318,315 Method of combining wastewater treatment and power generation technologies

[0049] U.S. Pat. No. 7,308,954 Rotating diverter head

[0050] U.S. Pat. No. 7,251,938 System and method for recovering geothermal energy and for converting recovered geothermal energy into useful power

[0051] U.S. Pat. No. 7,234,314 Geothermal heating and cooling system with solar heating

[0052] U.S. Pat. No. 7,232,565 Use of endophytic fungi to treat plants

[0053] U.S. Pat. No. 7,228,696 Hybrid heating and cooling system

[0054] U.S. Pat. No. 7,224,080 Subsea power supply

[0055] U.S. Pat. No. 7,213,649 Geothermal pipe weight

[0056] U.S. Pat. No. 7,178,337 Power plant system for utilizing the heat energy of geothermal reservoirs

[0057] U.S. Pat. No. 7,165,943 Geothermal turbine

[0058] U.S. Pat. No. 7,154,190 All-weather energy and water production via steam-enhanced vortex tower

[0059] U.S. Pat. No. 7,146,823 Horizontal and vertical direct exchange heating/cooling system sub-surface tubing installation means

[0060] U.S. Pat. No. 7,124,584 System and method for heat recovery from geothermal source of heat

[0061] U.S. Pat. No. 7,124,583 Geothermal power generator

[0062] U.S. Pat. No. 7,098,802 Signal connection for a downhole tool string

[0063] U.S. Pat. No. 7,089,740 Method of generating power from naturally occurring heat without fuels and motors using the same

[0064] U.S. Pat. No. 7,082,779 Geothermal heat accumulator and air-conditioning using it

[0065] U.S. Pat. No. 7,080,524 Alternate sub-surface and optionally accessible direct expansion refrigerant flow regulating device

[0066] U.S. Pat. No. 7,065,969 Power cycle and system for utilizing moderate and low temperature heat sources

[0067] U.S. Pat. No. 7,048,037 Geothermal heating and/or cooling apparatus and method of using same

[0068] U.S. Pat. No. 7,021,060 Power cycle and system for utilizing moderate temperature heat sources

[0069] U.S. Pat. No. 6,982,384 Load-resistant coaxial transmission line

[0070] U.S. Pat. No. 6,973,792 Method of and apparatus for a multi-stage boundary layer engine and process cell

[0071] U.S. Pat. No. 6,941,757 Power cycle and system for utilizing moderate and low temperature heat sources

[0072] U.S. Pat. No. 6,932,149 Insulated sub-surface liquid line direct expansion heat exchange unit with liquid trap

[0073] U.S. Pat. No. 6,923,000 Dual pressure geothermal system

[0074] U.S. Pat. No. 6,912,853 Method of and apparatus for increasing the output of a geothermal steam power plant

[0075] U.S. Pat. No. 6,910,334 Power cycle and system for utilizing moderate and low temperature heat sources

[0076] U.S. Pat. No. 6,862,886 Method of combining wastewater treatment and power generation technologies

[0077] U.S. Pat. No. 6,860,718 Geothermal turbine

[0078] U.S. Pat. No. 6,829,895 Geothermal system

[0079] U.S. Pat. No. 6,820,421 Low temperature geothermal system

[0080] U.S. Pat. No. 6,814,866 Heating a leach field

[0081] U.S. Pat. No. 6,789,608 Thermally exposed, centrally insulated geothermal heat exchange unit

[0082] U.S. Pat. No. 6,772,605 Liquid air conditioner of ground energy type

[0083] U.S. Pat. No. 6,769,256 Power cycle and system for utilizing moderate and low temperature heat sources

[0084] U.S. Pat. No. 6,761,865 Method for synthesizing crystalline magnesium silicates from geothermal brine

[0085] U.S. Pat. No. 6,758,652 Apparatus for choking the control stage of a steam turbine and steam turbine

[0086] U.S. Pat. No. 6,751,974 Sub-surface and optionally accessible direct expansion refrigerant flow regulating device

[0087] U.S. Pat. No. 6,735,948 Dual pressure geothermal system

[0088] U.S. Pat. No. 6,724,687 Characterizing oil, gasor geothermal wells, including fractures thereof

[0089] U.S. Pat. No. 6,717,043 Thermoelectric power generator

[0090] U.S. Pat. No. 6,708,494 Device for utilizing geothermal heat and method for operating the same

[0091] U.S. Pat. No. 6,688,129 Geothermal space conditioning

[0092] U.S. Pat. No. 6,682,644 Process for producing electrolytic manganese dioxide from geothermal brines

[0093] U.S. Pat. No. 6,668,573 Geothermal heat collector to collect heat for a load by accessing deep earth temperatures without drilling, trenching, or other excavation

[0094] U.S. Pat. No. 6,668,554 Geothermal energy production with supercritical fluids

[0095] U.S. Pat. No. 6,640,575 Apparatus and method for closed circuit cooling tower with corrugated metal tube elements

[0096] U.S. Pat. No. 6,628,040 Electroactive polymer thermal electric generators

[0097] U.S. Pat. No. 6,626,249 Dry geothermal drilling and recovery system

[0098] U.S. Pat. No. 6,615,601 Sealed well direct expansion heating and cooling system

[0099] U.S. Pat. No. 6,601,391 Heat recovery

[0100] U.S. Pat. No. 6,539,718 Method of and apparatus for producing power and desalinated water

[0101] U.S. Pat. No. 6,539,717 Geothermal steam processing

[0102] U.S. Pat. No. 4,132,075 Method of producing mechanical energy from geothermal brine

[0103] U.S. Pat. No. 4,131,161 Recovery of dry steam from geothermal brine

[0104] U.S. Pat. No. 4,127,989 Method for separating metal values from brine

[0105] U.S. Pat. No. 4,127,164 Heat exchange apparatus

[0106] U.S. Pat. No. 4,123,506 Utilization of impure steam contaminated with hydrogen sulfide

[0107] U.S. Pat. No. 4,120,199 Hydrocarbon remote sensing by thermal gradient measurement

[0108] U.S. Pat. No. 4,120,158 Power conversion and systems for recovering geothermal heat

[0109] U.S. Pat. No. 4,112,745 High temperature geothermal energy system

[0110] U.S. Pat. No. 4,107,987 Geothermal well pump performance sensing system and monitor therefor

[0111] U.S. Pat. No. 4,106,562 Wellhead apparatus

[0112] U.S. Pat. No. 4,102,741 Low vapor pressure organic heat retention materials kept at atmospheric pressure used as heat storage media

[0113] U.S. Pat. No. 4,102,133 Multiple well dual fluid geothermal power cycle

[0114] U.S. Pat. No. 4,099,381 Geothermal and solar integrated energy transport and conversion system

[0115] U.S. Pat. No. 4,094,356 Geothermal heat recovery system

[0116] U.S. Pat. No. 4,092,404 Catalytic incineration of hydrogen sulfide from gas streams

[0117] U.S. Pat. No. 4,091,623 Geothermal actuated method of producing fresh water and electric power

[0118] U.S. Pat. No. 4,090,572 Method and apparatus for laser treatment of geological formations

[0119] U.S. Pat. No. 4,089,175 Process and system for recovery of energy from geothermal brines and other water containing sources by direct contact with a working fluid below the critical pressure

[0120] U.S. Pat. No. 4,088,743 Catalytic incineration of hydrogen sulfide from gas streams

[0121] U.S. Pat. No. 4,088,583 Composition and method for drilling high temperature reservoirs
[0122] U.S. Pat. No. 4,086,769 Compound memory engine
[0123] U.S. Pat. No. 4,085,795 Method for using geothermal energy
[0124] U.S. Pat. No. 4,082,140 Heat exchange method
[0125] U.S. Pat. No. 4,079,590 Well stimulation and systems for recovering geothermal heat
[0126] U.S. Pat. No. 4,077,220 Gravity head geothermal energy conversion system
[0127] U.S. Pat. No. 4,074,754 Method for producing geothermal energy and minerals
[0128] U.S. Pat. No. 4,066,891 Geochemical and geophysical exploration
[0129] U.S. Pat. No. 4,063,509 Device for stimulation of geothermal wells
[0130] U.S. Pat. No. 4,063,418 Power producing system employing geothermally heated fluid
[0131] U.S. Pat. No. 4,060,988 Process for heating a fluid in a geothermal formation
[0132] U.S. Pat. No. 4,059,959 Geothermal energy processing system with improved heat rejection
[0133] U.S. Pat. No. 4,059,156 Geothermal brine production
[0134] U.S. Pat. No. 4,057,964 Working fluids and systems for recovering geothermal or waste heat
[0135] U.S. Pat. No. 4,057,736 Electrical power generation and distribution system
[0136] U.S. Pat. No. 4,054,176 Multiple-completion geothermal energy production systems
[0137] U.S. Pat. No. 4,054,175 Geothermal power system
[0138] U.S. Pat. No. 4,052,858 Method and apparatus integrating water treatment and electrical power production
[0139] U.S. Pat. No. 4,052,857 Geothermal energy from salt formations
[0140] U.S. Pat. No. 4,051,677 Multiple-completion geothermal energy production systems
[0141] U.S. Pat. No. 4,050,517 Geothermal energy well casing seal and method of installation
[0142] U.S. Pat. No. 4,047,093 Direct thermal-electric conversion for geothermal energy recovery
[0143] U.S. Pat. No. 4,044,830 Multiple-completion geothermal energy production systems
[0144] U.S. Pat. No. 4,043,386 Energy recovery from geothermal reservoirs
[0145] U.S. Pat. No. 4,043,129 High temperature geothermal energy system
[0146] U.S. Pat. No. 4,036,764 Method of foam drilling using a sulfoacetate foaming agent
[0147] U.S. Pat. No. 4,030,303 Waste heat regenerating system
[0148] 20100301596 COUPLING FOR INTERCONNECTING AT LEAST TWO PIPES
[0149] 20100300094 SYSTEM FOR POWER GENERATION BY MEANS OF A STEAM POWER UNIT, AND METHOD THEREFOR
[0150] 20100300092 GEOTHERMAL ELECTRICITY PRODUCTION METHODS AND GEOTHERMAL ENERGY COLLECTION SYSTEMS
[0151] 20100300091 GEOTHERMAL POWER GENERATION SYSTEM AND METHOD OF MAKING POWER USING THE SYSTEM
[0152] 20100294456 GEOTHERMAL HEAT PUMP SYSTEM
[0153] 20100288466 GEOTHERMAL ENERGY EXTRACTION SYSTEM AND METHOD
[0154] 20100288465 GEOTHERMAL ENERGY SYSTEM AND METHOD OF OPERATION
[0155] 20100278703 Method to neutralize hydrogen chloride in superheated geothermal steam without destroying superheat
[0156] 20100276146 METHOD AND APPARATUS TO ENHANCE OIL RECOVERY IN WELLS
[0157] 20100276115 System and method of maximizing heat transfer at the bottom of a well using heat conductive components and a predictive model
[0158] 20100272515 METHOD OF DEVELOPING AND PRODUCING DEEP GEOTHERMAL RESERVOIRS
[0159] 20100269501 Control system to manage and optimize a geothermal electric generation system from one or more wells that individually produce heat
[0160] 20100263824 Geothermal Transfer System
[0161] 20100258449 Self-sufficient hydrogen generator
[0162] 20100258266 Modular, stackable, geothermal block heat exchange system with solar assist
[0163] 20100258251 System integration to produce concentrated brine and electricity from geopressured-geothermal reservoirs
[0164] 20100252229 GEOTHERMAL ENERGY SYSTEM
[0165] 20100252228 Geothermal System
[0166] 20100251710 SYSTEM FOR UTILIZING RENEWABLE GEOTHERMAL ENERGY
[0167] 20100243017 SYSTEM AND METHOD FOR THE THERMAL MANAGEMENT OF BATTERY-BASED ENERGY STORAGE SYSTEMS
[0168] 20100242517 Solar Photovoltaic Closed Fluid Loop Evaporative Tower
[0169] 20100242474 MULTI-HEAT SOURCE POWER PLANT
[0170] 20100236749 Modular, stackable, geothermal block system
[0171] 20100236266 Geothermal Heating and Cooling System
[0172] 20100230072 GEOTHERMAL SYSTEM FOR HEATING A HOME OR BUILDING
[0173] 20100230071 Geothermal Water Heater
[0174] 20100224408 EQUIPMENT FOR EXCAVATION OF DEEP BOREHOLES IN GEOLOGICAL FORMATION AND THE MANNER OF ENERGY AND MATERIAL TRANSPORT IN THE BOREHOLES
[0175] 20100223171 Modular Geothermal Measurement System
[0176] 20100212316 Thermodynamic power generation system
[0177] 20100200191 GEOTHERMAL HEATING AND COOLING SYSTEM AND METHOD
[0178] 20100199668 AIR POWER GENERATOR TOWER
[0179] 20100193152 Sawyer-singleton geothermal energy tank
[0180] 20100181044 Geothermal Air-Conditioner Device
[0181] However, our invention is different from all of these prior art, as shown below.

[0182] The classification of the sources for geothermal are usually done as follows:

[0183] High grade sources: above 400 degrees F., and can go as high as 1300 F. They are usually found in Western states of US and Hawaii (for US).

[0184] Medium grade sources: between 300-400 F, usually in southwestern US (for US).

[0185] Low grade sources: between 212 and 300 F, found anywhere.

[0186] To tap into deep wells, one should apply high strength pipes, to withstand the pressure and steam or high temperatures. The sediment coming up with water should be filtered or separated. Other elements (some toxic) may come, as well, for example: H_2S, CO_2, As, or mercury. The flow rate and pressure should be monitored and adjusted based on the demand level.

[0187] The dry steam power plants use dry (or direct) steam reservoirs with huge manifolds of very hot steam or water, at low pressure, or sometimes at high pressure. One can add turbine and generator to get electricity from the energy obtained. Flash steam (single or dual, which has a higher thermodynamics efficiency) power plants use liquid heat reserves. Binary cycle power plants have liquid sources below 360 F, with 2 independent closed loop systems, with lower efficiency, namely, injection well loop and the generator loop. Geothermal energy can be used directly, e.g. for heating fish farm, green houses, dried fruit, heating houses, heating sidewalks or walls, or similar locations or applications. The direct steam and binary hybrid can also be used.

[0188] The heat pumps can be used, as the one used in the conventional heating or cooling units for the houses and buildings, e.g. air-source heat pumps, as in the stand-alone HVAC systems, or ground-source heat pumps, using the earth as the heat exchange medium. The conventional heat pump has low efficiency for extreme hot and cold weather. But, the ground-source heat pump has more efficiency, because at about 6 ft depth, ground temperature stays around 50 F for all seasons, which is much higher than air temperature in winter, and for southern states, the ground can go as high as 70 F for most seasons.

[0189] One should consider the air emission impacts, surface-water impacts, and land-use impacts, as described in Proceedings of IEEE, Vol. 81, No. 3, March 1993, page 434, by Braun et al., as a good review paper.

[0190] Braun et al. teaches a typical direct steam plant, with cooling tower, power house turbine generator condenser, and wellhead equipment, with one set per well, with silencer and in-line particulate remover. It also shows a single flash plant, with wellhead flash tank separator (for reinjection), again having cooling tower, power house turbine generator condenser, and wellhead equipment, with one set per well.

[0191] It also shows a double flash plant, with HP (high pressure) separator/flash and LP (low pressure) flasher (as the separator-flasher unit, placed between power house and wellhead units), plus having cooling tower, power house turbine generator condenser, and wellhead equipment, with one set per well.

[0192] It also shows a binary plant, having cooling tower, power house turbine generator condenser, vapor generator, and production and reinjection wells. It also shows a geothermal preheat hybrid fossil/geothermal power plant, with low pressure turbine, reheater, intermediate pressure turbine, reheater, and high pressure turbine, plus steam generator, together with feedwater heaters, deaerator, condenser, and geothermal heat exchanger. It also shows a natural gas combined cycle/geothermal hybrid plant.

SUMMARY OF THE INVENTION

[0193] A geothermal heating and or cooling system is introduced here which is deriving cooled or heated liquid via existing infrastructure of water pipe system in use for the houses and buildings, e.g. from the city water system or pipe network, or from the well water (or lake or river or sea or ocean or the like), piped or channeled to the buildings, through pipes or conduits or channels or closed enclosures. The system derives cooled liquid from existing underground infrastructure, including or for example, below-ground water pipes. The system gains a temperature advantage from the geothermal ground temperature, which remains roughly constant throughout the year in most regions. The system uses (e.g.) a storage tank to contain a working fluid and store thermal energy. In one example, multiple chambers and/or tanks are used for water heaters or coolers, with different connection and flow mechanisms. Other examples and designs are also discussed and shown here.

BRIEF DESCRIPTION OF THE DRAWINGS

[0194] The following figures are just some examples/embodiments, to explain better (with some figures having multiple variations and embodiments shown on the same drawing):

[0195] FIG. **1** shows an example of the pipe, shaped as coil, pattern, structure, snake, array, series, zig-zag, foiled, bent, or matrix, for heat exchange in various depths and for various setups.

[0196] FIG. **2** shows the heat exchanger with multiple separate chambers (N) (e.g. 3), in sequence or in parallel, or combination of both, stacked together.

[0197] FIG. **3** is the same system as FIG. **2**, in one embodiment, showing how the chambers are connected, and how the fluid (2^{nd} fluid) moves from one chamber to another, around the array of pipes in each chamber, shown in FIG. **2**.

[0198] FIG. **4** shows similar system as the one in FIG. **3**, except that the chambers are connected via small holes, screen, mesh, or strainer structure (not a regular pipe, as in FIG. **3**).

[0199] FIG. **5** shows an example of the system of the invention, with source supplying the tank, going through the HVAC system (or bypass that), to the tap water system, for usage.

[0200] FIG. **6** shows a typical pipe with fluid in ground, with ground conduction, with surface temperature higher, with exchange at the surface with air through surface convection, as well, showing an example of the thermodynamics of our system.

[0201] FIG. **7** shows a system, comprising a pipe underground for water supply, e.g. city water system, with its velocity profile within the pipe, connected to a cold water tank (or bypass that), then connecting to a HVAC duct coil.

[0202] FIG. **8***a-g* shows a tank with a heat exchanger, with a plate separating the tank into 2 different sections (or more sections, using more plates, dividers, separators, sliding plate, plate on a rail, partitioning plate, floater, floating device, thermal plate, or the like).

[0203] FIG. **9** shows one tank design, as an example.

[0204] FIG. **10***a-b* shows different thermal plates.

[0205] FIG. **11***a-b* shows different tanks

[0206] FIG. **12***a-h* shows different tanks

[0207] FIG. 13*a-e* shows different heat exchange schemes, methods, systems, and devices.

[0208] FIG. **14** shows the city water line connected to a house or building through a pipe array or snake pattern.

[0209] FIG. **15** shows the city water line passing near another pipe loop (not connected by fluid or water) to exchange heat underground.

[0210] FIG. **16** shows a central computer or controller controlling and getting data from various tanks (N tanks, e.g. 3 tanks) and applications.

[0211] FIG. **17** shows a controller or server, connected to thermocouples (TC) and flow meters (FM), in addition to pumps, motors, valves, switches, tanks, applications, and locations within the building or pipe system.

[0212] FIG. **18** shows a controller or server, connected to forecasting or seasonal adjuster or real-time data from weather stations.

[0213] FIG. **19** shows a controller or server, connected to different exchangers at different temperatures.

[0214] FIG. **20** shows various pipes, plates, hoses, matrices, layers, combinations, radiators, stacks, or arrays, to move the fluid through them.

[0215] FIG. **21** shows various heat exchange schemes.

[0216] FIG. **22** shows temperature versus distance, or locations in the tank or pipe (indicating temperature gradients, or rate of change of temperature versus distance), for various heat exchange schemes.

[0217] FIG. **23** shows different types of plates or barriers or baffles in the tank.

[0218] FIG. **24** shows different mechanisms to move the plate, separator, or diaphragm, up or down, inside a tank.

[0219] FIG. **25** shows different mechanisms to move or hold the plate or separator in a tank.

[0220] FIG. **26** also shows another mechanism, with a motor running a pulley (or multiple motors running multiple pulleys from multiple sides of the plate), to drive the plate up and down, or from one side to the other side, in the tank.

[0221] FIG. **27** is (an example) a valve for passage of liquid or fluid or water.

[0222] FIG. **28** is (an example) a series of the flaps that are opened by the force of the water or by a motor on its hinge, and closes by the gravity force (or motor on the hinge, or lack of pressure from water flowing).

[0223] FIG. **29** shows examples of floater, separator, or thermal plate.

[0224] FIG. **30** shows examples of floater, separator, or thermal plate.

[0225] FIG. **31** is (an example) a system with a central processor (connected to a storage and analysis module), controlling and connecting to different rooms, pipes, storages, tanks, and heat exchangers.

[0226] FIG. **32** is (an example) a system with a central processor, connected to the pipes, rooms, storages, valves, pumps, zones in a building, tanks, sensors, and exchangers.

[0227] FIG. **33** is (an example) a system with a central processor or controller, controlling and connected to valves at different locations and sensors (S) at different locations.

[0228] FIG. **34** shows a system (different examples and variations) of heat exchange between a tank or thermal reservoir and the pipe within, passing through, inside tank.

[0229] FIG. **35** shows pipes and jacket around a pipe, as multiple embodiments.

[0230] FIG. **36** shows a heat exchange between a middle central pipe and two upper and lower semicircle jackets.

[0231] FIG. **37** shows a system of a pipe exchanging heat with a reference or middle object, which in turn exchanges with a medium outside.

[0232] FIG. **38** shows a system of a pipe exchanging heat with an air handler, through a heat pump, as in conventional HVAC system.

[0233] FIG. **39** shows a system of a first pipe exchanging heat with another separate pipe, coiled and submerged inside the fluid, inside the first pipe.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0234] Here are some of the embodiments/examples of the current invention:

[0235] The source of the energy can be from the following sources, or through the following medium or phenomenon: dry steam hydrothermal, hot water hydrothermal, hot dry rock, geopressurized geothermal, magma, volcanic lava, activities, or chambers, hot springs, springs, water fountains, undercurrent rivers in ocean, underground water basins, rivers, or currents, high pressure steam or gasses trapped underground or in Earth cavities, cavities caused by oil, gas, or mineral explorations or mining, caverns or caves, cavities under rivers, ground, or seas, natural or human-made tunnels, gaps or structures caused by earthquakes on the surface or depth of the planet Earth, geysers (such as that in Yellowstone Park in US), waterfalls, rivers, wind, surface or ground water supplies, man-made water containers or reservoirs, flood-prevention reservoirs, agricultural reservoirs, fish or algae reservoir for fish farms or pools, natural lakes, man-made lakes, swimming pools, tide-related currents, or any exchange of the heat in either directions, or heat generated through chemical reactions, involving powder, liquid, fluid, solid, gas (e.g. pressurized gas or hot gas), hydrogen, helium, CO_2, CO, natural gas, gasoline, heating oil, crude oil, spray, mist, humidity, or air, or combination thereof, or compounds, mixtures, or solutions (in stable, transitional, final, or unstable states (thermodynamically, chemically, atomically, or physically)).

[0236] To cool down, e.g. in Summer, for room/air or water, e.g. for living space (air) or bathing/shower (water), one can use the ice or snow deposits naturally-happening in many parts of the world, in a heat-exchange apparatus, medium, device, or setup.

[0237] The underground caves or underground floors (or basements) in the buildings are usually naturally kept at a very constant temperature range (in a small range of temperatures), throughout the year, making it easier or more comfortable for humans or animals survive or live in that environment or space. This makes the energy needed for cooling or heating the air or water for usage for humans or animals very minimal, if any at all. Thus, using Earth's heat capacity and natural condition, we can save a lot on energy usage for all usual living needs and applications, throughout the year.

[0238] To facilitate the exchange of heat, one can use pressurized or non-pressurized gas, fluid, liquid, gas mixture, oil, water, liquid mixture, hydrogen, nitrogen, air, powder, compounds, solutions, materials as heat sinks, a block of material with high heat capacity, polymers, or similar materials. This can be done using gravity, chain reactions, or chemical reactions (naturally, by itself). For example, the oil or water would heat up and cool down, as a cycle, to expand and contract, to change the density of the material, going up and down by gravity or difference or differential on density, or heated material or fluid rising to the top, by convection or natural cycling or movement.

[0239] Another way is to use an external force or device to facilitate the exchange of heat, for example, using a heat pump, pump, compressor, wheel (e.g. with spoons or buckets or blades to move the fluid(s) up or down), heat engine, pressurized device, compressed gas tanks or cylinders, liquid nitrogen or the like, or similar devices or methods, to speed up the heat exchange, or increase efficiency of the heat exchange.

[0240] Hot rocks or gaps close to the surface of the Earth or geothermal wells are some of the sources we can use. One can drill long wells, to reach thousands of feet down, to the hot rocks, to pump the water down and bring it back up again, through gaps and reservoirs down there, to produce hot water or steam, to spin a turbine or wheel to generate electricity, or generate mechanical energy to do some function (or charge a battery or moving a heavy flywheel or spring-loaded wheel, e.g. like winding the clock, as a potential energy storage, for future usage), for a house, factory, school, hospital, or the like.

[0241] This technology can be combined with the heat pumps, power plants, and exploration and mapping for rock fracturing and drilling. This technology can also be combined with thermoacoustic engines and refrigerators, in which researchers have harnessed acoustic processes in gases to make reliable inexpensive engines and cooling devices with no moving parts and a significant fraction of Carnot's efficiency (such as the work/overview described by Gregory Swift, from Los Alamos National Lab, in New Mexico, e.g. in the July 1995 issue of Physics Today). Swift describes a thermoacoustic engine that converts some heat from a high-temperature heat source into acoustic power, rejecting waste heat to a low temperature heat sink. It also describes a heat driven electrical generator in this setup.

[0242] The heat exchanger for this invention can also be combined with a solar hot water system, to increase efficiency or redundancies, e.g. as a backup system at home. Basically, we have a collector or heat exchanger unit, which gets the energy or exchanges heat in either directions, when needed, similar to a heat pump, or similar to solar hot water collectors on the roofs (using anti-freeze solutions in the rooftop solar collectors). We can have this collector in common to both systems, or as 2 units exchanging heat in a bigger system, or combined in a third exchange unit for synergy between 2 systems (i.e. solar hot water system and system of our current invention).

[0243] In one embodiment, the collector or collectors or heat-exchangers are connected to a controller and/or pump (s), which control the temperature and the flow/flow rate of the liquid through the system. The controller and pump combination is connected to a tank, having a lengthy pipe in it, to supply the shower and other user units, directly or indirectly. The tank is also connected to a backup system, such as solar system unit or electrical or gas/conventional heating unit, for a back up or increase the output, if needed. There is also a storage unit with huge capacity, with good insulation for heat, to store water or liquid for a long time at a constant temperature, connected to the tank or backup system, or both. We can also add a pressure safety valve at the manifold, for high pressure release, and an anti-scald valve, for hot water supply, for safety purposes.

[0244] In one embodiment, the blackwater and greywater recycling for water can also be added to our system here, to separate or re-use the toilet water, toxic water, soap water, shower water, and similar water. The used water (pipes), which is usually hotter than the surroundings, can be used as a heat exchange, to get its energy, before recycling or dumping the water. This can be done by attaching or setting the pipes close to another pipe or heat sink, for transferring the energy from high-temperature pipe to the lower temperature item or object or pipe. The transfer can be improved using fan or pump for air around the pipe or fluid inside the pipe circulations, to improve the exchange efficiency.

[0245] In one embodiment, the spike and non-uniformity in water usage can be controlled or accommodated during the day or seasons, using the controller, which controls the speed of flow of water or liquid/fluid, for heat exchange, in the geothermal well or inside the house or tank, using a pump(s) and valve(s) to control the flow/speed/rate of flow/supply of water or fluid or oil, to ramp the rate(s) up during periods of high usage or extreme cold weather outside, as an example. A fuzzy logic unit can be added to the controller for smooth transitions and rate adjustments, with a neural network controller, to train the system according to the locality and the user's preferences, based on the past behavior or predictions, e.g. for weather forecasts and seasons adjustments.

[0246] In one embodiment, a storage unit can supply the needed water during the periods of high demands, e.g. kept at a very high temperature at one or more storage units, and mixed with a lower temperature water supply, to provide the right temperature for usage. In one embodiment, multiple storage units are used to keep the storage water at different temperatures, for different periods, with different insulation R-values, for insulating the storages against heat exchange (e.g. using vacuum jackets or multiple walls, for better insulations), for different purposes, in future. So, we will have an array of heat exchangers and water/fluid storages, for each application or temperature range, controlled by the controller or central processor or computer/server, centrally or locally or remotely.

[0247] In one embodiment, the fluid usage, such as oil or soap water, is intended, instead of water usage. The systems described here in this invention apply to any fluid other than water, as well, including gas and liquid, or mixtures or solutions.

[0248] In one embodiment, the variable size tanks are used, with different compartments opened during the high usage periods, with a valve, by a controller, from a central computer. The same thing can be done using a diaphragm or flap, e.g. made of metal, plastic, elastic, fabric, polymers, or the like, to separate or partition the spaces within the tank, for full or partial usages. The diaphragm (e.g.) can be elastic, flexible, rigid on a rail inside the tank, rigid on a spring inside a tank, flexible with a screw adjusting the bulge and its curvature (using a motor or manual adjustments, by a user or operator), or adjustable on a frame (and using screws or rails or rods, adjusting the position of the frame(s), with respect to the tank, to adjust the usable volume, manually or computer controlled). The diaphragm can be insulating in one embodiment, or heat conducting in another embodiment.

[0249] In one embodiment, the heat exchange is done through diaphragm or flap. In one embodiment, the heat exchange is done through contacting **2** surfaces, such as pipes or metal solid blocks or metal hollow containers. In one embodiment, the heat exchange is done through forced or free air or fluid between the two or more discrete or continuous surfaces, by convection. In one embodiment, the heat exchange is done through radiation through electromagnetic radiation or photons from 2 surfaces, or any combinations of the above, or chemical reactions caused by solutions or compounds, to generate or exchange heat or energy. In one embodiment, the heat exchange is done through actual direct contacts, and possible mixing, of 2 liquids or fluids. In one embodiment, the heat exchange is done through walled or containers containing 2 or more liquids or fluids, not mixing any of the fluids or liquids.

[0250] In one embodiment, the heat exchange is done through parallel or concentric pipes or elements or plates, non-parallel plates or arrays of pipes or elements, concentric shaped cylinders, cones, cubes, rectangles, frames, ovals, meshes, array of pipes, or spheres, or any geometrical shapes in 2 or 3 dimensional space/objects, with enough exposure of surfaces for exchanging heat between 2 or more objects, with any of the methods mentioned above. In one embodiment, the plates can be interleaved or mixed or sandwiched together. In one embodiment, the plates have grooved surface(s) for maximum heat exchange or efficiency.

[0251] The flow for fluid can be controlled by valve, switch, needle valve, manifold, diaphragms, or flaps, or combination of the above, as some examples.

[0252] Cooling costs compose a significant portion of electric bills in most southern states. Virtually all residential and commercial buildings use a condensing cycle to cool ambient air, running either an air conditioner or heat pump to cool. However, a very significant source of free geothermal cooling is readily available and already entering homes. The water pipes supplying our tap water are normally kept at depths of at least 3 feet to avoid freezing, so that they may benefit from the constant ground temperatures that geothermal heat pumps make use of. This water enters with a temperature in the mid-50's year round, varying by location. This innovative system can cool a building. For many instances, the cooling capacity of the cold water is sufficient to cover most, and often all, of a buildings cooling load. Employing these methods additionally reduces hot water heating bills, as a side effect, by raising cold water temperature.

[0253] Several challenges have prevented previous technology from using this great resource. The demand for water and the demand for household cooling vary drastically throughout the day, rarely acting in step. So, for a large building (e.g. office building) with many users, this averages out, and the spikes in usage will more or less flattens during the day. For smaller buildings, one can use a tank for storage, or multiple tanks, to store the water or liquid at different intermediate temperatures, to be used for various applications for different users, according to the users' specification or preference or appliance's spec or manufacturer's ratings.

[0254] A controller with a central computer, with local thermocouples or thermometers, plus valves on pumps on various lines, can redirect and adjust the flow of water and fluid in various parts of the building, to optimize the best usage of the resources or storage tanks and exchanger units, located throughout the pipe network in the building.

[0255] For one application, it is strongly desirable that the cold water temperature be raised no further. Therefore, it is desirable to use the cold water quickly, and keep it separate from warmer water until it has heated up. Therefore, water enters the building when cooling demand calls for it, instead of when tap water demand is giving. The moderately warmer cool water is then kept in a storage tank until cold water demand is given. Several embodiments of the design are shown here.

[0256] For one application/example, the municipal tap water entering the house is used to also provide cooling for a building. In traditional systems, tap water is sent throughout the building either as is or is heated up for warmer applications including showers, dish washing, warm sink water, etc. Water pipes, situated underground, experience an approximately constant temperature year-round, when situated adequately underground. This placement at depth is a municipal tap water system commonality, originally designed to prevent winter freezing by putting pipes at similar depth as for instance geothermal heat pump systems. For instance, the geothermal temperature and thus approximate tap water temperature in an area in Maryland may be near 58 degrees Fahrenheit year-round. Most of this water in typical residences will be heated for various applications, which is a waste of energy as the cooling ability is not only unused, but additional energy is used to heat the tap water up. The cooling capacity of the average annual tap water use is comparable in magnitude to residence needed cooling capacity, adequate to supplement or replace current cooling systems. The system therefore significantly reduces energy spent in cooling, with the added bonus of reduced water heating energy.

[0257] In several embodiments of the invention, the method of cooling capacity delivery can be a single or combination of forced air (i.e. an air blower and ductwork), radiant cooling, or conjunction with a heat pump or other device. A heat exchanger can take fluid from the system of our invention and transfer it to another medium. For instance, a heat exchanger could transfer heat from the pipes into the air in a forced air or ductwork system, which then could be delivered to rooms of a building or another location with cooling demand. An intermediary working fluid could be used, taking heat from the tap water and exchanging it into another medium, including a forced air system. Another alternative is exchanging heat with a fluid that will treat a needed cooling or heating load. For instance, thermal properties could be transferred to a fluid that would use radiant heating or cooling to control the temperature of a room or device. Radiant cooling would delivery cooling or heating capacity typically without a forced-air system, although airflow can be used at times to improve heat transfer. Again, an intermediary working fluid may be used.

[0258] In a radiant system, the radiant heat energy is exchanged with that which needs to be heated or cooled via an exposed radiator or panels with significant pipe length to enable radiation. In some applications where a large mass must be heated or cooled, conduction may be used to transfer heat. In materials with poor conduction coefficients, metal plates, metal bars, and other shapes may be place in contact or embedded in the medium to experience temperature change to enhance heat transfer. An intermediary for all these variations is the inclusion of a heat pump. A heat pump is advantageous as it uses a condensing cycle to move heat by taking advantage of the vapor cycle of a working fluid and how a fluid changes temperature when forced to experience changes in pressure. A heat pump as the intermediary between the cold or hot water source and the place it must be delivered, allows for a larger temperature difference than without it, allowing for more rapid heat transfer, and the ability to treat heating or cooling loads that could otherwise not be done effectively with the system.

[0259] Heat exchange by radiation, convection, conduction, or their combination can be used, as taught by various prior art, and used for tanks or heat exchangers for this purpose. An additional method of cooling delivery would be with the conjunction of a heat pump into the system. The heat pump could move fluid to or away from the main working fluid.

[0260] The system must be properly controlled to ensure intelligent use of source fluid heating or cooling capacity. The controls of the system in one embodiment is computer controlled via software, in another, it is controlled by a thermostat, and in another embodiment, a single or multiple control modules dictate the actions of the system. In some embodiments, automatic mechanical control of the system can be actuated by mechanical devices that change state based on pressure or flow rate, such as a floating balloon actuating a component, or pressure-dependent valves. Various measurements are necessary to monitor the system, although like most heating and cooling systems, a wide variety of sensor inputs can be set up to get circumstantially equivalent information. Measurements to be taken include a subset of temperature, pressure, flow rate, humidity, fluid level, fluid demand, or fluid height level in tank. These measurements are taken at a subset of locations which include the geothermal source itself, the source fluid, different levels in any tanks, pipes in the system, indoor and outdoor air, and fluid exits.

[0261] The system will have valves for shutting on and off the flow of water. It also is necessary to have shut off valves for emergency and maintenance, to stop flow for servicing, repair, system modification, or component replacement. Other (optional) components are computer controlled valves, flow meter, automatic monitors, pressure dependent valves, temperature triggered valves, water level dependent valves, floating switches or valves, or devices monitoring the demand for tap water, to control the flow of fluid(s) and heat transfer or exchange.

[0262] Embodiments of this invention are applicable to an array of sources with advantageous thermal properties. The geothermal temperature properties of the source fluid is generated from either municipal or other tap water, a deep or shallow, a geyser or hot spring, a natural or manmade body of water including a lake, pond, river, a rain collection system, ocean sourced, an above or below ground storage tank, tidal water, empty mine flooded, tidal, sewer, any pipes carrying any fluid or chemical (oil pipeline, gas pipeline), swimming pool, ice or frozen substances (e.g. permafrost), compost pile heating, nuclear waste, power plant waste heat, or heat exchange with a solid mass such as a buried object or through ground itself. In another embodiment, a composite of any of the above sources is used, which can include multiple of the same source, i.e. multiple pipes.

[0263] To have the maximum heat exchange, we need more surface area, with respect to a given volume of fluid. So, we need more pipes, with small thickness, but lengthy, and snake-like, so that they fold and fold, to have more exposure or surface for heat exchange.

[0264] In one embodiment of the design, the system uses a tank to store a fluid for use in heating and cooling. The fluid, referred to as the source fluid, has advantageous geothermal temperature properties to heat or cool. In several embodiments, the temperature of the tank may be intentionally stratified, meaning differentiated by temperature in different regions in the tank. A temperature stratification may be highly advantageous in heating or cooling, allowing for the working fluid drawn from the tank to have a larger temperature difference from that of the device or region the cooling is being delivered, providing superior heating or cooling capacity. Additionally, in embodiments where the water is being delivered back into the tank after providing heating or cooling capacity for future use as tap water, separating the unused and used fluid prevents temperature mixing that would cause a disadvantageous temperature differential.

[0265] Multiple chambers or tanks may be used to further stratify the water. In one embodiment, the fluid that has not yet been used is stored in a separate tank from the fluid whose temperature and humidity properties have already been taken advantage of There may also be a tank system with tanks running in conjunction and parallel to one another.

[0266] The system can be used to heat and cool for multiple situations. One application or use is household heating and cooling loads. The system, however, can be applied with a combination of household use, refrigeration use, municipal water treatment, and household water heating.

[0267] The system requires heat exchanges, and in multiple places, depending on the application or use. In an application with a forced air or ducted system, a water-to-air heat exchanger is necessary. Such a heat exchanger must maximize surface area contact between working fluid and air, typically by a tight coil or a winding back and forth of a significant length of pipe. Metal or other highly conductive material would ideally be used in the pipes. Fins, or conductive flanges (similar to home heating radiators), may be used to increase surface area and thus improve heat transfer. In applications where liquids must exchange heat, a similar heat exchanger may be used, for instance, a coil of pipe within a tank.

[0268] Other heat exchangers include pipes coiled around one another, alternating pipes enclosed in a conductive structure, and parallel plates of alternating liquids. Such a system may be aided by a pump in various applications, or designed to operate without one. Concentric cylinders of alternating liquids may also be used as a heat exchanger. Pads with arrays or pipes in 2 or 3 dimensional space (or objects), or as array of parallel planes, or planes or arrays interleaved between two exchanging surfaces, at every other plane or array, to increase the contact and exposure, can be used, as well. This can be combined with forced air, fluid, gel, solid, powder, or liquid, between the planes or arrays, to improve the exchange, in parallel or perpendicular directions (or mixed directions). Any combination of the aforementioned heat exchanges are used in various embodiments of the invention.

[0269] Several material choices must be made, including those for the pipes, valves, insulation, and any tanks or other components in the system. The material choices for the pipes may be fairly flexible, with options including plastic, metal, PVC, elastic, hose, or ceramic materials. Copper is an especially ideal material for pipes, as it is easy to assemble via sweating, and parts are readily available. The tank may be made out of plastic, metal, ceramic, or PVC, but because a tank needs to be sturdy and able to support a significant amount of weight and pressure, metal is recommended, with steel being of primary consideration. Other material or design in prior art are also included here.

[0270] Various embodiments of the system may use different fluids, which refers to any of a gas, liquid, nano-liquid, liquefied gas, or molten salt. Gases in consideration include hydrogen, various inert glasses, such as Helium, Argon, Nitrogen, or Carbon Dioxide, and also steam, possibly with concentrations of other fluids.

[0271] The primary liquid in consideration for the system is water or a water with diluted chemicals (e.g. salts or solutions). These chemicals include antifreeze and other substances to increase the operating range of the system by depressing the freezing point and/or increasing the boiling point. Chemicals that decrease viscosity or other types of internal friction are also desired, as well as chemicals that reduce corrosion. Choice options include ethylene glycol, diethylene glycol, propylene glycol, Polyalkylene Glycol, or similar chemicals, which significantly increase the operating temperature range of the system. Other diluted components may be alumina, metal oxides including those of copper and titanium, and silica or carbon. Various oils may be used as a fluid in the system, as well, including Mineral Oils, Silicone Oils, and Fluorocarbon oils. Typically, oils have the advantage of being usable in different temperature ranges than liquid water, and may have lower viscosity and pumping resistance, making them ideal in some embodiments of the invention. Other chemicals including refrigerants may be used.

[0272] In some applications of the device, liquid salts or liquid metals may be used as a fluid, including combinations of Sodium, Lithium, Potassium, Beryllium, Boron, Chloride, and Fluoride. Liquid metals include combinations of mercury, the above listed metals, as well as bismuth, lead, and other metals.

[0273] In other embodiments, liquefied gases, or molecules typically gas at room temperature, but made to be liquid through a combination of raised pressure and decreased temperature, may be employed.

[0274] For some situations and conditions, one can use the Dittus-Boelter heat transfer correlation for fluids (in turbulent flow), for calculations for the forced convection mode of heat transfer.

[0275] For the conduction heat transfer, one can use the formula:

$$Q=\lambda((T_2-T_1/L)St$$

[0276] Where Q is the quantity of heat transferred through a layer of substance of thickness L, with cross sectional area S, with temperature difference (T_2-T_1) and during time t, with thermal conductivity of λ. The thermal conductivity is expressed as, e.g., (KiloCal/(m·hr·degree)) or (Cal/(cm·sec·degree)) unit.

[0277] With some approximations, for some ranges of operations, the wall heat transfer coefficient for a pipe, h, can (approximately) be calculated using the following expression:

$$h=2k/(d_i \ln(d_o/d_i))$$

[0278] where d_i and d_o are the inner and outer diameters of the pipe, respectively, and k is the effective thermal conductivity of the wall material.

[0279] For combining heat transfer coefficients, for two or more heat transfer processes acting in parallel, heat transfer coefficients will add up:

$$h=h_1+h_2+h_3+$$

[0280] For two or more heat transfer processes in series, heat transfer coefficients will inversely add up:

$$(1/h)=(1/h_1)+(1/h_2)+(1/h_3)+$$

[0281] Systems with an alternative means of heating or cooling may be much more flexible when combined with the current invention. If the heating or cooling load may be treated by other means, as well, the invention can be used to increase the efficiency of the system, or may be applied in simpler ways in combination with this invention. For instance, if a heat pump is being used, an alternative piping setup may allow it to transfer heat to and from the source fluid, which in the instance of cooling a building, via dumping heat in tap water, may also aid in heating that water for residential hot water use. In other variation, it may divide the cold and hot water (as separate), or actively designate the system's water as hot water or regular tap water, via a control system. In applications, when used in the conjunction of another device that may supplement cooling loads, or when the water demand (and thus, water heat capacity) greatly exceed thermal demand, a tank may not be necessary for the system, which can then operate solely via valves and a control system, or operate passively, by just freely flowing through heat exchanges.

[0282] In one embodiment, a very large heat exchanger may serve as a storage tank, in that its thermal mass is significant enough to contain a large amount of thermal energy. For instance, a very lengthy amount of pipe with significant fluid storage may serve as the thermal energy storage device for the system.

[0283] In one embodiment, tank operates on natural differentiation of temperature levels, or stratification, organized in layers, layer over layer. In one embodiment, water is taken out of the main municipal pipe, and then put right back into it. In one embodiment, water can also be deliberately cooled further via a geothermal well.

[0284] In one embodiment, a diaphragm partitions the tank. In one embodiment, two tanks or more tanks are used to partition or separate the water. In one embodiment, a plate or series of plates is used to separate water of different temperatures.

[0285] In one embodiment, when the valve is open, gravity makes the plate fall slowly to the bottom of the tank. The water displaced by the plate's downward motion is pushed through the bypass.

[0286] In one embodiment, the specific density of diaphragm is similar to that of the water, e.g. made of foam and metal, sandwiched together in layers, of high density and low density items, with an overall average of about the specific density of the water, so that the diaphragm or floating unit stays at the same location within the depth of the tank, in the water, without sinking to the depth or surfacing to the top, in the tank, in a semi-equilibrium situation. In one embodiment, layers for water resistant or waterproof materials can be used. For example, a metal sandwiched over foam or plastic object, or a hollow object, can be used. See for example FIG. **8** and the corresponding descriptions.

[0287] See also FIG. **29**, with multiple layers or components, for a thermal plate in a tank, with desired relative density or specific gravity, with respect to the fluid or water in the tank, as designed and fixed before (or changed in real time, with different components of different densities, e.g. by a mechanical arm or robot or a user, as a modular object, with sliding the fitted components in and out of the shell, to get the desired (relative) density), with the weighted average density of all components as the final density of the whole object or thermal plate. The outer layer can be waterproof or water resistant, to protect the inside of the thermal plate or to protect the water quality.

[0288] FIG. **30** shows different variations of the plate in a tank, e.g. using blank space or gas or air (or filled with another fluid or liquid) within the plate (L**1** structure) to move the center of gravity above the geometrical center of the plate, as an example, and change the average density of the plate, as a whole. In L**2**, we do the same, by using a high density material within the plate, relative to the rest of the plate, located on the upper portion of the plate thickness or cross section, to move the center of gravity above the geometrical center of the plate. The L**3** combination structure is the reverse of L**2** structure, by using a high density material within the plate, relative to the rest of the plate, located on the lower portion of the plate thickness or cross section, to move the center of gravity below the geometrical center of the plate, e.g. to have a better rotational stability of the plate within the tank, to guide the plate better in the tank, up and down, without too much rotation.

[0289] In one embodiment, to avoid tilting of the diaphragm (or floating unit or plate or shutter or flap or cap or separator or disc or regulator or needle valve) in the water or fluid tank, one can use rails to keep it straight, or grooves on the sides of the tank to keep it straight (or flat or horizontal position). In one embodiment, to avoid tilting of the diaphragm (or floating unit or plate) in the water or fluid tank, one can use a proper weight distribution of plate to keep it straight (or flat or horizontal position). For example, it can be like a pendulum, with the center of mass below the point of rotation, causing a state of equilibrium in that position. In one embodiment, to bring the diaphragm back in the place, one can use a motor, or pressure difference, or draw of water from the tank (for the demand side, causing water to drop).

[0290] In one embodiment, the tank plate moves up and down with the aid of a motor. Small actuators open and close holes or valves in the plate, to allow or prevent the flow of water. In one embodiment, cold water can be taken in, based upon the cooling demand of the house, and the cold water is stored in a volume-changing tank. In one embodiment, the heat exchange is with another fluid. In one embodiment, the heat exchange is with the same type of fluid. In one embodiment, the heat exchange is with intermixing and/or direct contact of the fluids. In one embodiment, the heat exchange is without intermixing and/or direct contact of the fluids. In one embodiment, the heat exchange is done with multiple chambers or multiple tanks, e.g. to begin filling other tanks with auxiliary tanks, in series or in parallel, e.g. with different shapes. The tanks or chambers are selected and operated on, using computer or remote or central controller, or alternatively, using manual operations by a user, to monitor parameters and control valves and other functions in the water tank or exchanger.

[0291] In one embodiment, the water tank or exchanger is any conventional one used in the prior art. Multiple pipes, e.g. same or different pipes, in terms of shape or material, can be used. In one embodiment, we can do the opposite, in a different environment, i.e. cooling tap water.

[0292] In one embodiment, the fluid movement is done by (force of) gravity, pressure differential, pump, motor, heat (e.g. expansion, or lower or differential viscosity, or lower or differential relative density or specific gravity, to move the fluid in one direction), tidal or wave movement, mechanical sources, or the like.

[0293] In one embodiment, the water pipe system from the city symbolizes an open system, as it brings new supply of water in to the system (pipes), and the water is used by the user(s), continuously (and the new supply replaces the used portion). The system of our invention can be placed both before or after the water meter, installed by the water company. During the cold months, if it goes below 0 C, to avoid freezing, the surface pipes, if any, are drained and closed, until the weather gets warmer.

[0294] In one embodiment, we are using a diaphragm or floating unit or flap in the tank (e.g. as a separator, in a water tank or exchanger unit), similar to the concept used in a typical water expansion tank for conventional water heater. An expansion tank or expansion vessel is a small tank used in closed water heating systems and domestic hot water systems to absorb excess water pressure, which can be caused by thermal expansion as water is heated, or by water hammer. The vessel itself is a small container divided in two by a rubber diaphragm. One side is connected to the pipe work of the heating system, and therefore, contains water. The other, the dry side, contains air under pressure, and also, normally a car-tire type valve stem, for checking pressure and adding air. When the heating system is empty, or at the low end of the normal range of working pressure, the diaphragm will be pushed against the water inlet. As the water pressure increases, the diaphragm moves, compressing the air on its other side. The compressibility of the air cushions the pressure shock, and relieves pressure in the system, that could otherwise damage the plumbing system.

[0295] When expansion tanks are used in domestic hot water systems, the tank and the diaphragm must conform to drinking water regulations, and must be capable of accommodating the required volume of water, as explained in great details in Wikipedia site, for this technology, expansion tanks, as a good reference and review article.

[0296] As an example, consider a system or tank with diaphragm, with water on top enclosure and air or nitrogen cushion at the bottom enclosure, with diaphragm separating the 2 enclosures. When system is filled, the water does not come to the tank, when cushion and water pressure are in equilibrium. Then, as temperature increases, the diaphragm moves to accept expanded water. Then, when water rises to the maximum, we get to the full expansion state. The same diaphragm concept is used in one embodiment of our invention.

[0297] In addition, for a multi-chamber tank, one can use multiple diaphragms (or flaps) (e.g. solid and rigid, or flexible) to separate each section from others. In one embodiment, we are using a diaphragm which is air tight and solid, with no holes, and no mixing. In one embodiment, we are using a diaphragm which has small holes, for slight passage of the fluid or water, to be able to mix the water slightly, but in a very limited fashion (for proper heat exchange), and still have a gradual water flow through the tank.

[0298] For Post-Use Heat Recovery: After use of tap water, the new thermal properties acquired through use can be taken advantage of in this system, prior to its disposal as wastewater. Direct reuse of said water may be hazardous due to waste, so specialized heat exchangers using this water may be processed differently. Namely, greywater and blackwater heat exchangers have different limitations, with blackwater waste causing risk of material clogging, and thus requiring heat exchangers with minimal bending.

[0299] Waste water that has not significantly exchanged thermal properties with ambient temperatures can be used interchangeably with the aforementioned systems, as a source for geothermal heating or cooling. Such processes will be effective, if adequately small time combined with adequate thermal resistance provides for an adequate temperature change.

[0300] Different applications for the invention are also possible with wastewater whose temperature has been modified, including cooled and especially heated water. Heated waste water exiting boilers, showers, or heating appliances (including dishwashers and clothes washers, etc) can be recovered and exchanged with thermal hot water tanks, to the tanks directly, or to heat up incoming water to the hot water tanks

[0301] Heat recovery of wastewater that has achieved ambient or near ambient temperatures can also be highly beneficial. Such waste water can pre-treat water entering use, including that entering thermal reservoirs, and also can be exchanged near areas with large cooling or heating loads, to reduce those loads. Advantageous locations include building exteriors, facades, and other high HVAC load regions, as well as kitchens, data centers, regions with equipment-caused heat, and regions or locations with large cooling loads for lighting, and other applications.

[0302] For smart system, for sensing temperature and exchanging heat: An intelligent sensory system measures and analyzes temperature and other properties of outgoing wastewater to exchange heat to thermal reservoirs. Sensor measurements of flow rate and temperature can combine with a logic "brain", to decide when to use a combination of valves, pumps, or thermal contact heat exchangers to move heat to and from the thermal reservoirs.

[0303] In other embodiment, more simplistic models use fewer sensors. Applications with consistent temperatures may remove some or all temperature sensors, and many applications can remove use of direct flow rate, with timers and logic controls.

[0304] Multiple heat exchangers at different points in a system can be employed, some before the combination of different waste water streams. For example, hot body high-use-only applications, such as boilers, showers, dishwashers, and similar items, can have separate heat exchanger systems, to exchange favorable thermal properties, before rejection as wastewater.

[0305] In one embodiment of the invention, there is no tank at all, i.e. a tankless system, with no reservoir or storage. For example, the city water pipe system directly exchanges heat with the application or room or apparatus, e.g. with the room, heat pump, or cooling tower, e.g. to cool down the room in Summer or hot season. More variations are shown below, in the following figures and corresponding descriptions.

[0306] The figures show some examples, for better understandings:

[0307] FIG. **1** shows an example of the pipe, shaped as coil, pattern, structure, snake, array, series, zig-zag, foiled, bent, or matrix, so that the heat exchange can be done more efficiently. The structure or array can be laid on or above the surface, for which winter or ice may cause leaking or breaking problem. Thus, for cold areas, that must be drained for safety, during the ice and winter season. They can be laid a few feet under ground level, in the same level as regular city water lines. For conventional geothermal, one can go deeper in ground, and set the array of pipes a few feet deeper (of course, with more cost). For deep wells, one goes much deeper, with pumps, motors, fans, and exchangers, with pressure behind it, and circulation of water or liquid (at much higher costs).

[0308] FIG. **2** shows the heat exchanger with multiple separate chambers (N) (e.g. 3), in sequence or in parallel, or combination of both, stacked together (e.g. in this figure, 3 chambers located in series), with each chamber having its own structure or piping or internal geometry, possibly different than others in some examples, or the same as others in other embodiments. The fluid (first fluid) comes in from chamber **3**, and goes out from chamber **1**, in this example, through array of pipes in each chamber.

[0309] FIG. **3** is the same system as FIG. **2**, in one embodiment, showing how the chambers are connected, and how the fluid (2^{nd} fluid) moves from one chamber to another, around the array of pipes in each chamber, shown in FIG. **2**, exchanging heat/energy with the pipes inside each chamber, carrying another fluid (in general). It can also be the same fluid, in some examples, e.g. water. For example, the supply of the first or 2^{nd} fluid (above) can be water from the city. Here, the 2^{nd} fluid goes the reverse of the first fluid, i.e. the 2^{nd} fluid coming in from chamber **1**, and going out from chamber **3** (or N), in this example. The location of connection of pipes between chambers are fixed, in one example, as shown.

[0310] In another embodiment, both liquids go in the same direction, with respect to each other, e.g. both starting or entering chamber **1**, first.

[0311] The locations of connection of pipes between chambers are not fixed, in another example. For example, they are on a sliding rail, with flexible or extendable pipes, e.g. elastic or plastic (e.g. similar to those used for shower, with moveable shower head or shower handle, used in the bath room), to be able to move up and down, along the wall or side of the chambers, to change the pattern of movement of the second fluid, between the chambers, for optimization of the heat exchange, depending on delta or difference of temperature between the 2 fluids, at the entrance and exit for each chamber, for higher efficiency for exchange.

[0312] FIG. **4** shows similar system as the one in FIG. **3**, except that the chambers are connected via small holes, screen, mesh, or strainer structure (not a regular pipe, as in FIG. **3**). The size or density or number of the mesh or screen affects or changes the flow and rate of the fluid between chambers, which changes the heat exchange rate and amount.

[0313] In one embodiment, one can close off some or parts of the screen or holes between chambers (e.g. using a shutter, rotating shutter around a hinge, cap, partial cap, plate, parallel plate to the screen plane, sliding plate, rotating plate, a block on an arm, or similar devices), so that the flow increases or decreases, between chambers, for different exchange rate, for efficiency, depending on the temperature of chambers and pipes recorded and analyzed by a processor, using sensors and detectors for temperature and flow meter, for monitoring, as some examples.

[0314] FIG. **5** shows an example of the system of the invention, with source supplying the tank, going through the HVAC system (or bypass that), to the tap water system, for usage, e.g. by humans, in a building (commercial or residential). The residential buildings usually are active in usage for most of 24 hours in a day.

[0315] For the big commercial buildings, the usage is so large that at any given minute, there is one user using the water for some purpose. Thus, statistically, there is always a user, and the flow and usage or rate can be plotted and estimated for future, with a good degree of certainty. Thus, our system can predict and adjust the flow and temperatures more accurately and uniformly, with more efficiency. Generally speaking, the larger the building and more number of users and usages or applications, the better the statistics and prediction will be (e.g. a Normal Distribution with a Gaussian shape), for higher efficiency and uniform service throughout the building, with proper size tanks, storages, and exchangers for all hours of operations.

[0316] Any spike or anomalies will produce shortages or causes overdesigning the resources, causing general inefficiencies in either direction. Thus, to make the usage uniform and design proper (not too much or too little), one has to have a big system of users, e.g. big building (with a distributed usage with good statistical accuracy), or use storages with good insulations, to keep the liquid or water as a constant temperature at different temperatures, separately, as a heat or energy storages (or cold water for cold water usage or cooling living space, for summer, as an example), at different locations in the ground or throughout the building, for immediate or future usages, to uniformly distribute the resources or break the spike usages.

[0317] FIG. **6** shows a typical pipe with fluid in ground, with ground conduction, with surface temperature higher, with exchange at the surface with air through surface convection, as well, showing an example of the thermodynamics of our system.

[0318] FIG. **7** shows a system, comprising a pipe underground for water supply, e.g. city water system, with its velocity profile within the pipe, connected to a cold water tank (or bypass that), then connecting to a HVAC duct coil (for air or room or space temperature adjustment or comfort living) (or bypass that), then connecting to the tap water system, followed by a water heater, to water usage or users or applications (or bypass that), and finally, to the sewage system (or recycling system or separation system or septic tank or field or well).

[0319] FIG. **8** shows a tank with a heat exchanger, with a plate separating the tank into 2 different sections (or more sections, using more plates, dividers, separators, sliding plate, plate on a rail, partitioning plate, floater, floating device, thermal plate, or the like). The fluid comes in and out of the tank. In one example, the thermal plate is heat conductive. In one example, the thermal plate is not heat conductive, and very much insulated, to keep the temperature of the 2 partitions or sections separate from each other.

[0320] Thermal Plate isolates new entering cooled water in a region with a heat exchanger that connects to the cooling load, to be treated. The moving plate helps to reduce the intermixing of the old water and the new incoming water, while allowing for the continuous flow of the water through the system.

[0321] As an example, in FIG. **8***a*, the bottom section has a temperature TN, similar to the top section, after it has been sitting there for a long time, as stabilized, or exchanged heat with the surrounding of the tank. Then, in FIG. **8***b*, the water goes in from the bottom pipe, and pushes the plate up. The temperature of the new water in the tank, e.g. coming from underground, is TC, e.g. cool temperature, or reflecting ground temperature (a few feet down), which is different from the top (or other) section's temperature (TN), as in FIG. **8***c*. Then, the heat exchanger in the bottom section (or first section) of the tank exchanges heat with TC from water or fluid (new water), to (e.g.) cool down the room in Summer season. The thermal plate gives a chance for this heat exchange, so that the "new" and "old" water do not get mixed yet, as they are still separated in 2 sections in the tank. The value of TC can be higher or lower than TN, depending on the season and environment of the tank.

[0322] Now, in FIG. **8***d*, as the water usage continues, and to supply water to the second or top section of the tank, coming from the IN pipe or first section of the tank, we need to connect the 2 sections for a while, until the water usage ceases or reduces. This can be done by multiple methods and techniques:

[0323] Technique or Solution or Method 1: a pipe connects the 2 sections, as shown on the left side of the tank in FIG. **8***d*. That pipe can have an optional valve and an optional pump (added to the pipe), to control the flow rate in that pipe, to connect and mix the fluids in 2 sections (flow rate control, controlled by a controller or central or remote processor).

[0324] Method 2: a cap or flap or opening door on a hinge, connecting the 2 sections, when needed, controlled by the controller, using a rod, cable, string, chain, belt, magnet, or the like, to open or close the cap.

[0325] Method 3: a small connector opening, at the edge of the tank, as shown on the right side of the tank in FIG. **8***d*. The opening can have a flap, door, or cap, as well, as optional, with similar mechanism as described in Method 2 above.

[0326] As shown in FIG. **8***e*, as the water usage reduces or stops, the temperature of section **1** is at TC, and the temperature of section **2** is somewhere between TC and TN. As the time passes with more usage, the temperature of section **2** approaches TC. (As another embodiment, one can add another heat exchange unit at the section **2**, as well, which can operate some of the time, depending on the temperature of section **2**, with respect to the application usage temperature.)

[0327] As the time passes, with no more usage of water (no water flow), as shown in FIG. **8***f*, the 2 sections settle at temperature TN, in equilibrium with the tank surroundings.

[0328] The IN and OUT pipes have optional valves and pumps, as well, controlled by the controller, centrally, to close off or control the flow rate, by a user or by a computer.

[0329] To repeat the full cycle, one has to go back to the situation shown at FIG. **8***a*, at the beginning of the described cycle, above. So, we use the step shown in FIG. **8***g*. The thermal plate is pushed down, using a motor, rod, cable, string, chain, belt, magnet, rail, lever, or the like, by user, or motor, controlled by the controller. As one embodiment, to facilitate this, the flow from section **1** to section **2** is performed, via one of the 3 methods similar to those described on FIG. **8***d*, above (shown on FIG. **8***g*, as well). At the end, the status of FIG. **8***a* is reached again, for the beginning of the next cycle, as it continues like this.

[0330] As one embodiment, thermal plate has a lower density than the water (or fluid) in the tank, and the step of plate moving up in the tank is automatic, as time passes (with no external drive or forces needed, unless one wants to speed up the process). As another embodiment, thermal plate has a higher density than the water (or fluid) in the tank, and the step of plate moving down in the tank is automatic, as time passes. As another embodiment, thermal plate has a very similar density (average as a whole), compared to the water (or fluid) in the tank, and the step of plate moving up or down in the tank is not automatic, as time passes. Thus, either motor, magnet, rod, chain, or similar actions are needed, as external forces, as explained elsewhere in this disclosure, as well, or water motion pushing in or out of the pipes (IN or OUT) provides the force needed for such a motion (the step of plate moving up or down in the tank).

[0331] Note that the cycle described above can be done while the consumption of the water is small, and the thermal plate does not fully swing up and down, as its full range of movement in the tank being limited. However, the concept and steps are exactly the same as above.

[0332] FIG. **9** shows one tank design, as an example. Thermal Plate isolates new entering cooled water in region with a heat exchanger that connects to the cooling load to be treated. Entry port and exit port may have an optional flow switch, valve, or flow meter (FM). Exit funnel or bypass is an example of Method 3 mentioned above for FIG. **8***d*. Thermal plate moves up and down, within some height range, using one or more mechanical stops or limiters or magnets or tongues or bars or blocks, to stop the plate at some height (the stopper, e.g. located at top and bottom). However, in another embodiment, for horizontal configuration, the plate is positioned vertically, and moves left to right, and vice versa. Different switches, valves, motors, and mechanical functions are controlled and coordinated by the controller or processor unit(s).

[0333] The temperatures of different locations (e.g. at locations: exit, entry, up, down, in, out (for exchanger), mid, different pipes, and plate), TC, are measured and sent to the controller and database, for comparison, storage, analysis, neural network trainings, predictions, and decisions. The holder can be a mechanical (such as a pin or bar or stopper) or magnetic holder (e.g. permanent or electrically activated magnet), to hold the plate at the specific height(s) (e.g. at the top, for example, when the thermal plate is heavier than the water in the tank, and thus, normally will sink in the tank, toward bottom, if there is no force or object holding that up, at a specific location(s)).

[0334] The valve and the pipe on the left side of FIG. **9** is an example of Method 1 mentioned above for FIG. **8***d*, as an option or solution for connecting the 2 sections of the tank, presented alone, or in combination of other Methods, mentioned above, for FIG. **8***d*. Heat exchanger(s) at the bottom, section **1** of the tank, has IN and OUT connections, with optional corresponding valves, thermocouples, sensors, detectors, measurement equipment, manifolds, switches, flow meters, and similar devices. The general function of the system in FIG. **9** was described above in FIG. **8**.

[0335] Thermal plate can be of homogenous material, e.g. of the same material. Or, it can be of different materials as combination or mixture. For example, FIG. **10***a* shows a thermal plate, with multiple components. It can be any shape that fits and matches the cross section of the tank. In FIG. **10***a* example, the inner core is dense and heavy, and outer one is light, with some waterproof or water-resistant or rust-resistant cover, floating in the tank. The density and volume of the components can be changed or designed, to produce a desired density of the thermal plate, with respect to the water density in the tank, for optimal operation, such as sinking, going up or down, or rising in the tank, as explained in FIG. **8** operational cycle.

[0336] In addition, if the center of gravity is below the geometrical center of the thermal plate, then the plate has the tendency to swing back to its middle position, for better stability in the tank, while floating or going up or down, as shown in FIG. **10***b*.

[0337] To show the self-stratifying tank, as an example, we can compare FIGS. **11***a* and **11***b*, with FIG. **11***b* having layers or baffles positioned in the tank, as layers in front of the direct or straight water flow.

[0338] To show a Semi-closed system, we refer to FIG. **12**. The incoming water in the tank provides a longer term reservoir exchange with the exchanger, with an optional circulation pump, which is normally open to allow forced water flow through the heat exchanger, as in FIG. **12***a*.

[0339] Several example cases or variations: One can use a perforated pipe to bring the incoming (portion of) water to the exchanger, if the exchanger allows the flow, as in FIG. **12***b*. One can use aligned pipes (similar concept as perforated), as in FIG. **12***c*. One can use Y or T connection pipes, as in FIG. **12***d*. One can use baffles, as in FIG. **12***e*. The heat exchanger can be positioned 90 degree, or perpendicular, of the position shown in previous figures, with respect to the tank or baffles, as in FIG. **12***f*. In other embodiments, in general, the pipes for FIGS. **12***d* and **12***c* are not aligned (facing in front of each other), and can be staggered or shifted, to make it harder for the flow to go directly from one pipe to the other one.

[0340] FIG. **12***g* shows a tank with a bypass pipe and a valve (optional), with exchanger at the bottom, with pump or valve, with its own loop (pipe forming a loop).

[0341] FIG. **12***h* shows a tank with 2 exchangers, with their own loops, with their valves and pumps connected electrically (and both controlled by the controller). It has a test or re-fill station or port or valve or manifold, for testing the quality of the water, for contaminants or heavy metals detection (e.g. toxicity measurement). A toxic detection unit can be added at this point, connected to the controller. If some level of contamination or bacteria is detected, the water may still be good for bathing, but not drinking. The controller sounds a siren or light, or other methods, to warn the users or operator. The drain or filter at the bottom is a place for cleaning up the system or pipes, periodically, or during repairs.

[0342] FIGS. **13**(*a*-*b*-*c*) show other variations, e.g. shell and tube heat exchanger, with or without baffles in shell, running parallel or crossing the tubes. For example:

[0343] FIG. **13** (a & c): one-pass tube-side.

[0344] FIG. **13** (*b*): two-pass tube side.

[0345] Note the direction of the fluids or water for shell and tube in each configuration.

[0346] FIG. **13**(*d*) shows a Plate heat exchanger. FIG. **13**(*e*) shows a Spiral heat exchangers (in cylindrical or spherical shapes). Other types of heat exchangers (not shown): Adiabatic wheel heat exchanger, Plate fin heat exchanger, Pillow plate heat exchanger, and Phase-change heat exchangers (with steam and condensate). Other varieties are: Straight-tube heat exchanger and Bent or U-tube heat exchanger. Each of these examples can be incorporated into our system or subsystem, e.g. in each tank or exchanger unit, shown in our other embodiments or figures or examples.

[0347] FIG. **14** shows the city water line connected to a house or building through a pipe array or snake pattern, for better exchange with ground and soil, with array positioned vertically or horizontally, or somewhere in between, at an angle.

[0348] FIG. **15** shows the city water line passing near another pipe loop (not connected by fluid or water) to exchange heat underground, with the loop having a pipe array for better exchange, with array positioned vertically or horizontally, or somewhere in between, at an angle, at same level or higher or lower than (depth of) the city water line, for different embodiments.

[0349] FIG. **16** shows a central computer or controller controlling and getting data from various tanks (N tanks, e.g. 3 tanks), applications (users or appliances, e.g. shower or water heater), thermocouples (TC), and valves, e.g. temperatures T**1**, T**2**, and T**3**.

[0350] FIG. **17** shows a controller or server, connected to thermocouples (TC) and flow meters (FM), in addition to pumps, motors, valves, switches, tanks, applications, and locations within the building or pipe system. The clock or seasonal adjuster database or module adjusts for seasonal temperature variations for optimum performance and higher comfort level in the building. Tank **1** supports multiple applications or usages, e.g. shower, bathroom, and kitchen sink. Tank **1** and Tank **2** are in series, which means that Tank **1** is supporting Tank **2**, e.g. as an intermediate temperature for a final temperature at Tank **2**, to supply the final temperature to application **3** or location **3** in the building. All the valves and pumps are adjusted by the controller(s) throughout the building (e.g. one main controller controls all local controllers), based on the temperatures and other parameters measured throughout the system or building, or outside, e.g. in ground measurements.

[0351] FIG. **18** shows a controller or server, connected to forecasting or seasonal adjuster or real-time data from weather stations, to adjust or estimate the temperatures and other parameters, e.g. related to weather and pressure and humidity and the like, for optimum system performance and efficient heat exchangers. Tanks may have safety valves to release extra pressure. Another energy system, such as grid or solar panels on the roof, may supplement or complement or back up our system here. The solar panel can supply a tank, e.g. as intermediate or long-term storage, e.g. with good insulation, which can supply or support other applications and tank **1**, in our system.

[0352] FIG. **19** shows a controller or server, connected to different exchangers at different temperatures (T**1**, T**2**, T**3**), connected to different tanks at different temperatures (T**11**, T**22**, T**33**), with different insulation R values or degrees, to keep water for different time periods at different temperatures, all located in one big unit or distributed around the building, connected by pumps, switches, and valves, and controlled by the central controller, for all supplies throughout the building.

[0353] FIG. **20** shows various pipes, plates, hoses, matrices, layers, combinations, radiators, stacks, or arrays, to move the fluid through them, for heat exchange, through radiation, convection, and conduction, with surroundings and other objects, e.g. in ground or in a heat exchanger.

[0354] FIG. **21** top figure shows a fluid or liquid going through a pipe or twisted or multiple curved pipe, surrounded by a flowing water container, which has an optional large heat sink or block, e.g. a metal block, to store energy or bring an object to a specific temperature or equalize the temperature between 2 objects. FIG. **21** bottom figure shows water going through a pipe or twisted or multiple curved pipe, surrounded by a flowing fluid or liquid container, for heat exchange. In one embodiment, the fluid or liquid is water. However, in that case, water in the pipe and water in the container are not connected as one source of water. For example, one of them can be for drinking water, and the other one for other purposes, i.e. not as clean as the other one.

[0355] Referring to FIG. **21**, the directions of the flow for water and fluid can be the same ("SAME" directions) (as shown in top and bottom figures, both going from left side to right side, for both water and fluid), or in other embodiment, reverse of each other (only one of fluid or water going from right side to left side of the figure, i.e. reverse of what shown in FIG. **21**) ("REVERSE" directions). Then, for heat exchange between fluid and water, the temperature gradients within pipe and container, from left to right of the FIG. **21** (corresponding to the C**1**, to C**2**, to C**3** direction, in FIG. **22**), are reverse of each other, for the 2 cases mentioned above (i.e. "SAME" direction situation and "REVERSE" direction situation). In one case ("SAME" directions), the gradients are represented by the curves L**2** and L**3** (in FIG. **22**), for temperature variations in the pipe and container, and in the second situation ("REVERSE" directions), the gradients are represented by the curves L**1** and L**3**. Depending on the applications or usages, and depending on the relative positions of the curves L**1** and L**2**, with respect to L**3**, one may choose "SAME" direction situation or "REVERSE" direction situation. However, in one example, for the "REVERSE" direction situation, we have a better efficiency of the heat exchange.

[0356] Note that the above variations correspond to parallel flows and counter flows for pipe and container (or tank). One can mix them up, with multiple pipes and containers, having both "REVERSE" direction situation and "SAME" direction situation, in the system, as a mixed solution or system.

[0357] Referring to FIG. **23**, one can add different types of plates or barriers or baffles to the tank for exchange or flow slow down (or a flow-directing vane or panel in a vessel, such as for shell and tube heat exchangers). Examples are: L**1** with staggered positions, L**2** configuration or setup with mesh or strainer or matrix or filter positioning or arrangements, and L**3** with partially or fully blocking plates, for partitioning or redirecting the fluid flow in the tank, with plates covering some or almost all of the cross section of the tank in one direction, as shown in FIG. **23**, as perpendicular plates, also perpendicular to the fluid flow.

[0358] Referring to FIG. **24**, one can use different mechanisms to move the plate, separator, or diaphragm, up or down, inside a tank. For example, one can use a side rail or track(s) to guide the separator (or see thermal plate in FIG. **8**), as shown on the top figure. For example, one can use a motor to rotate a pulley, to pull or push a cable or chain up and down, connected to the separator plate, to guide and move the separator, as shown on the middle figure. For example, one can use multiple motors to rotate pulleys, to pull or push a cable or chain up and down, connected to the separator plate, to guide and move the separator, as shown on the bottom figure, in FIG. **24**.

[0359] Note that, instead of rail, one can use corrugated metal, lip, tongue, niche, slot, recess, groove, hook, loop, or the like, to attach one object to the other, to hold the plate in a position in the tank. One can also use a step motor and/or a latch to make the direction of the movement of the plate in only one specific direction, or keep or move the plate in/to a fixed position.

[0360] FIG. **25** shows different mechanisms to move or hold the plate or separator in a tank. For example, pin and hold, in which pin is pushed into a hole or one of the holes, to hold the separator in a specific position or height in the tank. The action can be done by the user, or computer, automatically, e.g. using magnetic mechanism or coupling (e.g. 2

permanent magnets coupled, one driving the other, in and out of the hole, with one connected to the pin, or being the same as the pin), electrical mechanism (e.g. pin driven by an inductor or coil, located inside in the center of the coil, with electrical current determining the signal, or the force to drive the pin), and/or by a motor, pushing or pulling the pin in place, directly connected to the pin, or through a bar, cable, chain, or the like (indirectly). Note that each of the pin and hole are located at one of the plate and tank (or rail on a tank), to hold the plate in a specific position or height in the tank.

[0361] FIG. **25** also shows the similar mechanism using hook and bar, where bar is pushed into the hook or loop, and holds the plate in place, as each of the hook and bar are connected to one of the plate and tank (or rail on a tank). The driving mechanism is described elsewhere in this disclosure.

[0362] FIG. **25** also shows the gear to gear or gearbox combination mechanism, as an embodiment, optionally connected to a rail or chain or bar or shaft, or directly engaging each other, to move or hold the plate in place in the tank, as each of the gears (or connecting devices to the gears, e.g. bar or tongue or groove connected to a gear) are connected to one of the plate and tank (or rail on a tank). The driving mechanism is described elsewhere in this disclosure.

[0363] FIG. **25** also shows the gear and rail (or grooves or holes or niches or recess) combination mechanism, as an embodiment, to move or hold the plate in place in the tank, as each of the gear and rail are connected to one of the plate and tank. The driving mechanism is described elsewhere (similar) in this disclosure.

[0364] FIG. **26** also shows another mechanism, with a motor running a pulley (or multiple motors running multiple pulleys from multiple sides of the plate), with a cable or chain connected to a magnet (all installed on the tank), coupled with another magnet connected or inside the plate (or thermal plate), to drive the plate up and down, or from one side to the other side, in the tank, optionally on a rail on a tank, to guide the plate, to partition the 2 sides of the tank, with different variable volumes, as described before. The other driving mechanisms are described elsewhere (similar) in this disclosure.

[0365] FIG. **27** is (an example) a valve for passage of liquid or fluid or water, with a ball or cylinder or cone acting as the barrier to partially or fully close the valve and stop the flow of the water. The ball can be pushed in or out using a rod from one side or both sides of the valve (left and right on the figure), or using chain, or rail, or cable, or motor, or magnetic coupling (by moving one magnet to drive another magnet), or combinations of the above, to block or open the flow or opening. The other driving mechanisms are described elsewhere (similar) in this disclosure.

[0366] FIG. **28** is (an example) a series of the flaps that are opened by the force of the water or by a motor on its hinge, and closes by the gravity force (or motor on the hinge, or lack of pressure from water flowing). In one embodiment, the hinge goes or rotates in one direction, and optionally, has a spring action, with spring located on the hinge, to go back to the original position. But, in another embodiment, the hinge can rotate in either directions, e.g. up and down, or left and right, e.g. with the rotating action coming from the motor or a shaft attached to a motor or chain or cable or the like. The whole assembly can be on the tank's wall, or on a rail or rack attached to the wall. In another embodiment, one uses multiple one-way valves, instead of the flaps. The flaps act as a barrier or flow directing apparatus.

[0367] In another embodiment, one uses flaps with different shapes and cross sections, e.g. circular, curved, airplane wing curved, flaps with strainer or holes, or the like, to redirect the flow direction in the tank, and change the speed or flow rate, for liquid or water in the tank, for better and more efficient or more time for heat exchange.

[0368] FIG. **31** is (an example) a system with a central processor (connected to a storage and analysis module), controlling and connecting (and getting data from, e.g. temperature readings, or sending commands to do an action, e.g. opening the valves or changing temperature settings) to different rooms, pipes, storages, tanks, and heat exchangers, including pumps, sensors, motors, alarms, computers, memory, thermocouples (TC), pressure sensors (P), flow meters for flow rates, or recording devices, e.g. to measure outside ground or air temperatures or other environmental parameters, such as wind speed or wind chill factor, to adjust e.g. the fluid position or the floater position in the tank, using the historical or estimation data and analyzer component or module (connected to the central processor or distributed processors), based on the demand or usage of water in different parts of the building, e.g. distributing more or less water to a part of the building, or storing for high-demand period of the day, later on, e.g. using real time data, e.g. using a flow meter in each part of the building or piping section.

[0369] FIG. **32** is (an example) a system with a central processor, connected to the pipes, rooms, storages, valves, pumps, zones in a building, tanks, sensors, and exchangers, with databases, memory units, command modules, and analysis modules, within or connected to the processor(s), sending commands and causing actions, e.g. opening valves, or receiving data or readings from the sensors or tracking devices, from or to various locations within the building system.

[0370] FIG. **33** is (an example) a system with a central processor or controller, controlling and connected to valves at different locations and sensors (S) at different locations, with feedback to the controller, having options L**1** and L**2** as entry ports, or both L**1** and L**2**, with a diaphragm or a flexible material as separator in the tank, fixed at the two or all sides, and variable position in the middle of diaphragm, as ballooning effect, going up and down, for variable volume in the tank, partitioning the tank in 2 sections. The balloon can have an optional sensor, with wireless connection or battery or RFID embedded, as optional, on the diaphragm, to monitor the position of the balloon at any given time, to analyze at the controller, for optimum heat exchange in the tank, based on the tank partitioning scheme described elsewhere in this disclosure, for optimum or efficient operation.

[0371] FIG. **34** shows (top figure) a system of heat exchange between a tank or thermal reservoir and the pipe within, passing through, inside tank, but no liquid connection to the tank, with tank full of another liquid or fluid or solid material, for conduction, with optional fins or wings on the pipe for better exchange. Middle figure shows a pipe within another bigger diameter pipe, or **2** concentric cylinders, one as the jacket, outer skin, or shell for another one, with each carrying different and separate materials or fluid, for exchange of heat, with the cross section shown at the bottom figure, for both pipes.

[0372] FIG. **35** shows (top figure) with 2 concentric pipes, or one jacket around a pipe at center, in the cross section, similar to FIG. **34**, with an added thermal conductor or material or paste or glue or liquid for better conduction and exchange between the 2 pipes. FIG. **35** shows (middle figure) (an example) cross section of 2 pipes in parallel, with conducting paste around, in the box around both of them, covered altogether by an optional insulating skin or cover, for exchange of heat. FIG. **35** shows (bottom figure) (an example) cross section of 2 pipes, one twisted around the other one, like a snake, for more area, for better exchange. The whole thing can be enclosed by heat conducting paste, and then by an insulating skin, as well, as described above, as an example.

[0373] FIG. **36** shows a heat exchange between a middle central pipe and two upper and lower semicircle jackets, covering the middle pipe from both sides. The jackets can have their own structures, e.g. internal piping and twisted piping network within each jacket.

[0374] FIG. **37** shows a system of a pipe exchanging heat with a reference or middle object, which in turn exchanges with a medium outside.

[0375] FIG. **38** shows a system of a pipe exchanging heat with an air handler, through a heat pump, as in conventional HVAC system.

[0376] FIG. **39** shows a system of a first pipe exchanging heat with another separate pipe, coiled and submerged inside the fluid, inside the first pipe.

[0377] Note that each chamber, tank, storage, reservoir, or exchanger, described here, can have its own internal structure, such as twisted pipe or snake-like pipe, as described elsewhere in this disclosure. One can use an array of plates, pipes, tubes, wings, extensions, or fins, for better exchange and larger area of exposure.

[0378] In one embodiment, one uses one or more controllers, processors, chambers, tanks, storages, reservoirs, or exchangers, as modularized units, that can be stacked or connected or synchronized together, as a large system. The modular tanks or exchangers can increase the capacity of the system in a building, very easily and fast, with minimal disruption and delay in installation and integration. The integration can be parallel or in series or mixed combination, for the individual chambers, tanks, storages, reservoirs, or exchangers, shown above. For example, in series, for tanks, one tank feeds anther tank. And, in parallel, one tank feeds multiple tanks at the same time, connecting the output of the first tank to the input of the next multiple tanks

[0379] Any variations of the above teaching are also intended to be covered by this patent application.

1. A system for heat or energy exchange with an underground water supply, said system comprising:

a heat exchanger unit or section; and

a tank or container;

wherein said tank or container exchanges heat or energy with said underground water supply, through said heat exchanger unit or section;

wherein said tank or container comprises two or more compartments or chambers;

wherein said underground water supply is a city or public water pipe network.

2. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said two or more compartments or chambers are connected serially, with a first compartment or chamber supplying a second compartment or chamber.

3. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said two or more compartments or chambers are connected in parallel, with a first compartment or chamber supplying a second compartment or chamber and a third compartment or chamber simultaneously.

4. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein each of said two or more compartments or chambers has an energy exchanging unit or section.

5. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said heat exchanger unit or section comprises one or more of following: a coiled pipe, twisted pipe, zig-zag pipe, snake-shaped pipe, array of pipes, matrix of pipes, pipe structure, pipes-in-parallel, plate, array of plates, plates-in-parallel, radiator-structure, spiral-structure, concentric structure, cylindrical structure, rectangular structure, cubical structure, spherical structure, elliptical structure, sinusoidal structure, corrugated structure, curved structure, multi-layered structure, shell structure, jacket structure, or multi-shell structure.

6. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said system comprises matrix or array of holes, screen, mesh structure, or strainer structure.

7. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said system is placed in or attached to a HVAC system, water heater, heat pump, or building water supply.

8. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said two or more compartments or chambers have variable volume or size.

9. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said two or more compartments or chambers are separated by a diaphragm, elastic material, plastic material, balloon, separator, thermal plate, plate, moveable plate, sliding plate, plate-on-rail, disc, partitioning device, shield, floater, or slider.

10. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said two or more compartments or chambers are separated by a fixed or rigid object.

11. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said two or more compartments or chambers are separated by a moveable or flexible object.

12. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said system is controlled by a server, central controller, controller, computer, processor, microprocessor, central processor, remote processor, automated controller, user, command unit, analyzing unit, multiple processors, computer network, Internet, remote access, or distributed processors.

13. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said two or more compartments or chambers are separated by a multi-component separator, thermal plate, plate, disc, floater, or slider.

14. The system for heat or energy exchange with an underground water supply as recited in claim **13**, wherein said multi-component separator, thermal plate, plate, disc, floater, or slider has at least a part with different or non-uniform relative density or specific gravity, with respect to other parts of said multi-component separator, thermal plate, plate, disc, floater, or slider.

15. The system for heat or energy exchange with an underground water supply as recited in claim **13**, wherein said multi-component separator, thermal plate, plate, disc, floater, or slider has its center of gravity positioned higher than its geometrical center.

16. The system for heat or energy exchange with an underground water supply as recited in claim **13**, wherein said multi-component separator, thermal plate, plate, disc, floater, or slider has its center of gravity positioned lower than its geometrical center.

17. The system for heat or energy exchange with an underground water supply as recited in claim **13**, wherein relative density or specific gravity of said multi-component separator, thermal plate, plate, disc, floater, or slider is higher than relative density or specific gravity of water or fluid in said tank or container.

18. The system for heat or energy exchange with an underground water supply as recited in claim **13**, wherein relative density or specific gravity of said multi-component separator, thermal plate, plate, disc, floater, or slider is lower than relative density or specific gravity of water or fluid in said tank or container.

19. The system for heat or energy exchange with an underground water supply as recited in claim **13**, wherein relative density or specific gravity of said multi-component separator, thermal plate, plate, disc, floater, or slider is the same as the relative density or specific gravity of water or fluid in said tank or container.

20. The system for heat or energy exchange with an underground water supply as recited in claim **1**, wherein said system comprises baffle, flow diverter, flow blocker, nozzle, funnel, or pipe reducer, for fluid flow diversion, slow-down, or reduction.

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