

CLAIMS

1. A heat pump including

a fluid circuit including

a first heat exchanger;

a second heat exchanger;

a third heat exchanger;

an expansion valve and

a driver for driving fluid about the fluid circuit; and

a control arrangement having one or more modes of operation;

wherein the first heat exchanger is arranged to exchange heat between the fluid of the fluid circuit and further fluid; and the control arrangement is configured to in at least one of the modes of operation control a flow control mechanism to control a flow rate of the further fluid of the first heat exchanger, wherein the expansion valve is located between the second heat exchanger and the third heat exchanger, and the expansion valve is dynamically adjusted based on the temperature of the refrigerant at the inlet of the driver

2. The heat pump of claim 1 further comprises a temperature sensor located on the inlet side of the driver for sending a signal representative of the temperature of the refrigerant on the inlet side of the driver to the control arrangement for operating the expansion valve so as to maintain temperature of the fluid of the fluid circuit as the fluid enters the driver above a saturation temperature of the fluid of the fluid circuit.

3. The heat pump of claim 2 wherein the expansion valve is controlled by the control arrangement to maintain a temperature, of the fluid of the fluid circuit as it enters the driver, at or above about 5°C above a saturation temperature of the fluid of the fluid circuit.

~~24.~~ The heat pump of claim 1 wherein the control of the flow rate of the further fluid of the first heat exchanger is dependent on a parameter characterising the further fluid of the first heat exchanger.

~~35.~~ The heat pump of claim 2 wherein the parameter is temperature.

~~46~~. The heat pump of claim ~~2~~ 4 or ~~3~~ 5 wherein the control arrangement is configured to when in another mode of operation to substantially stop the flow of the further fluid of the first heat exchanger.

~~57~~. The heat pump of claim 1 wherein the control of the flow rate of the further fluid of the first heat exchanger is substantially stopping the flow of the further fluid of the first heat exchanger.

~~68~~. The heat pump of claim 1 further including a sensor, for sensing a parameter characterising the fluid of the fluid circuit, in communication with the control arrangement.

~~79~~. The heat pump of claim ~~6~~ 8 wherein the parameter is temperature.

~~810~~. The heat pump of claim ~~6~~ 8 or ~~7~~ 9 wherein the control of the flow rate of the further fluid of the first heat exchanger is dependent upon the parameter.

~~911~~. The heat pump of any one of claims 1 to ~~8~~ 10 wherein the second heat exchanger is arranged to exchange heat between the fluid of the fluid circuit and further fluid; and

the control arrangement is configured to in at least one of the modes of operation control a flow control mechanism to control a flow rate of the further fluid of the second heat exchanger.

~~4012~~. The heat pump of claim ~~9~~ 11 wherein the control of the flow rate of the further fluid of the second heat exchanger is dependent on a or the parameter of the fluid of the fluid circuit.

~~4413~~. The heat pump of any one of claims 1 to ~~40~~ 12 wherein

the third heat exchanger is arranged to exchange heat between the fluid of the fluid circuit and further fluid; and

the control arrangement is configured to in at least one of the modes of operation control a flow control mechanism to control a flow rate of the further fluid of the third heat exchanger.

~~12~~14. The heat pump of claim ~~11~~13 wherein the control of the flow rate of the further fluid of the third heat exchanger is dependent on a or the parameter of the fluid of the fluid circuit.

~~13~~15. The heat pump of any one of claims 1 to ~~12~~14 wherein

the driver and the first heat exchanger are spaced along a first portion of the fluid circuit;

the second heat exchanger and the third heat exchanger are spaced along a second portion of the fluid circuit; and

the first and second fluid circuit portions are connected by a valve arrangement configured to, in response to the control arrangement, reverse a direction of flow about the second fluid circuit portion.

~~14~~. The heat pump of any one of claims ~~1~~ to ~~13~~ including an expansion valve along the fluid circuit and between the second heat exchanger and the third heat exchanger.

~~15~~. The heat pump of claim ~~14~~ wherein the expansion valve is controlled by the control arrangement to maintain a temperature, of the fluid of the fluid circuit as it enters the driver, above a saturation temperature of the fluid of the fluid circuit.

~~16~~. The heat pump of claim ~~14~~ wherein the expansion valve is controlled by the control arrangement to maintain a temperature, of the fluid of the fluid circuit as it enters

~~the driver, at or above about 5°C above a saturation temperature of the fluid of the fluid circuit.~~

~~47~~16. The heat pump of any one of claims 1 to ~~46~~15 wherein the further fluid of the first heat exchanger is water.

~~48~~17. The heat pump of any one of claims 1 to ~~47~~16 wherein the further fluid of the second heat exchanger is air and the second heat exchanger is arranged to at least one of accept heat from and reject heat to an environment external to a dwelling.

~~49~~18. The heat pump of any one of claims 1 to ~~48~~17 wherein the further fluid of the third heat exchanger is air and the third heat exchanger is arranged to at least one of heat and cool an interior of a or the dwelling.

~~20~~19. The heat pump of any one of claims 1 to ~~49~~18 wherein the fluid of the fluid circuit is at least predominantly hydrocarbon.

~~24~~20. The heat pump of any one of claims 1 to 19 wherein the fluid of the fluid circuit is at least predominantly propane.

~~22~~21. The heat pump of any one of claims 1 to ~~24~~20 further including one or more photovoltaic devices for powering the driver and the control arrangement.

~~23~~22. The heat pump of claim 22 further including a device for storing electrical energy from the photo voltaic devices;

wherein the control arrangement is configured to monitor the amount of energy stored in the device for storing electrical energy and activate the driver in response thereto.

~~24~~23 The heat pump of any one of claims 1 to ~~24~~22 wherein the control arrangement is configured to monitor the amount of energy stored in a device for storing electrical energy from one or more photo voltaic devices activate the driver in response thereto.

~~25. A heat pump substantially as described herein.~~

~~26. A method of pumping heat substantially as described herein.~~

~~27~~24. A method of managing demand for electricity in an electricity supply system including one or more generators for supplying electricity to geographically spaced consumers of energy, the method including in response to a sensed or predicted reduction in demand from the consumers for electricity, activating energy storage devices associated with the consumers to consume electricity, wherein one or more of the energy storage devices includes the heat pump in accordance with any one of claims 1 to 23.

~~28~~25. The method of claim ~~27~~24 wherein the consumers include dwellings which each include one or more of the energy storage devices.

~~29. The method of claim 27 or 28 wherein one or more of the energy storage devices includes the heat pump of any one of claims 1 to 25.~~

~~30~~26. The method of any one of claims ~~27~~24 to ~~29~~25 wherein one or more of the energy storage devices are configured to heat water to store energy.

~~31~~27. An energy storage device including a communication mechanism for receiving an activation signal from a geographically distal controller, wherein the energy storage device includes the heat pump in accordance with any one of claims 1 to 23.

~~32 The device of claim 31 including the heat pump of any one of claims 1 to 25.~~

~~33~~28. The device of claim ~~31 or 32~~27 being configured to heat water to store energy.