Claims

[Claim 1]. A modular reactor device for carrying out a chemical or biological reaction having an outer housing, and a plurality of components contained within the outer housing, the components including:

a reaction chamber;

a fluid pathway connected to the reaction chamber; and

a valve arranged to control flow of fluid within the modular reactor device,

wherein the outer housing has a plurality of connection ports providing connections from the exterior of the modular reactor device to the interior, the connection ports including:

a fluid input and a fluid output;

an electrical input; and

a pneumatic input;

wherein either the electrical input or the pneumatic input is connected to the valve by an electrical connector or a pneumatic connector running from the electrical input or the pneumatic input on the exterior of the housing to the valve to provide for control of the valve, and

either the fluid input or the fluid output is connected to the reaction chamber or the fluid pathway.

[Claim 2]. A modular reactor device according to claim 1 wherein the plurality of components further includes a storage compartment and the fluid pathway connects the storage compartment and the reaction chamber.

[Claim 3]. A modular reactor device according to claim 1 or claim 2 wherein at least one of the components includes a reagent for a chemical or biological reaction.

[Claim 4]. A modular reactor device according to any one of the preceding claims wherein the plurality of connection ports also includes an optical input or output and/or a thermal input.

[Claim 5]. A modular reactor device according to any one of the preceding claims wherein the components include a plurality of valves which are arranged to control flow of fluid to/from the one reaction chamber; and/or along the fluid pathway.

[Claim 6]. A modular reactor device according to any one of the preceding claims wherein the components include a sensor.

[Claim 7]. A modular reactor device according to claim 6 wherein the plurality of connection ports includes a sensor output which is connected to the sensor to allow information from the sensor to be communicated externally to the modular reactor device.

[Claim 8]. A kit including at least two modular reactor devices for carrying out chemical or biological reactions according to any one of the preceding claims, wherein the arrangement of the components contained within the outer housing is different in each of the modular reactor devices, and the arrangement of the connection ports is identical in each of the modular reactor devices.

[Claim 9]. A kit according to claim 8 wherein the outer housing of each of the modular reactor devices is identical in size and shape.

[Claim 10]. A base station arranged to engage with a modular reactor device according to any one of claims 1 to 9 and having:

a docking portion arranged to receive the modular reactor device;

a plurality of connectors arranged in a predetermined configuration to enable connection to a predetermined configuration of connection ports on the modular reactor device when the modular reactor device is received in the docking portion, the connectors including:

a fluid output and a fluid supply;

an electrical connector; and

a pneumatic connector;

a processor arranged to control the supply of one or more of: fluid, electrical power or signals and pneumatic pressure or signals, so as to cause the modular reactor device to carry out a chemical or biological reaction within the modular reactor device.

[Claim 11]. A base station according to claim 10 wherein the connectors further include a thermal connector and the processor is arranged to control the supply of a heating or cooling medium to the modular reactor device.

[Claim 12]. A base station according to claim 10 or claim 11 wherein the connectors further include an optical connector and the processor is arranged to control the supply of optical power or signals to the modular reactor device and/or to receive optical signals from the modular reactor device.

[Claim 13]. A base station according to any one of claims 10 to 12 wherein the processor is arranged to control the reaction carried out by the modular reactor device by supplying electrical power or signals, or pneumatic pressure or signals to the modular reactor device so as to cause the modular reactor device to repeatedly process small volumes of fluid through components in the modular reactor device.

[Claim 14]. A base station according to any one of claims 10 to 13 wherein the processor is arranged to control the reaction based on signals received from the modular reactor device.

[Claim 15]. A kit including at least one modular reactor device for carrying out chemical or biological reaction according to any one of claims 1 to 9 and a base station according to any one of claims 10 to 14.

[Claim 16]. A method of manufacturing a modular reactor device for performing a reaction to produce a chemical or biological product, the method including the steps of:

determining at least one reagent required for the performance of the reaction;

selecting, from a limited range of predetermined components, components for inclusion in the modular reactor device and determining an arrangement of said selected components within the modular reactor device to enable the reaction to be performed;

producing, by an additive manufacturing process, a modular reactor device having: an outer housing having a plurality of ports in fixed positions through which fluid, electrical power or signals, and pneumatic pressure or signals, can be supplied to the modular reactor device;

said selected components arranged within the outer housing in the determined arrangement and connected to each other and/or to one or more of the ports; and

said at least one reagent stored within at least one of the selected components

wherein said selected components include:

a valve;

a reactor chamber; and

a fluid pathway,

and further wherein the determined arrangement includes:

said fluid pathway connecting at least one of said plurality of ports to the reactor chamber; and

a port on the outer housing for supplying electrical power or signals, or a port on the outer housing for supplying pneumatic pressure or signals, being connected to said valve by an electrical connector or a pneumatic connector running from the port to the valve to provide for control of the valve.

~~[~~Claim 17~~]~~. A method according to claim 16, wherein the outer housing further includes ports through which heating or cooling medium, and optical power or signals can be supplied to the modular reactor device.

~~[~~Claim 18~~]~~. A method of manufacturing a modular reactor device according to any one of claim 1 to 9 for performing a reaction to produce a chemical or biological product, the reaction requiring at least one reagent, the method including the steps of:

receiving computer-coded instructions for the manufacture of the modular reactor device;

producing ~~a~~ the modular reactor device using an additive manufacturing process, the additive manufacturing process being controlled by a processor which uses the received computer-coded instructions for manufacture, the modular reactor device having

said at least one reagent stored within at least one component of the modular reactor device.

~~[~~Claim 19~~]~~. A method of manufacturing a chemical or biological product, the method including the steps of:

receiving a modular reactor device according to any one of claims 1 to 9 and specifically designed to produce said chemical or biological product and computer-coded instructions arranged to control the operation of said modular reactor device;

connecting the received modular reactor device to a base station which is arranged to supply fluid, electrical power or signals, and pneumatic pressure or signals to the modular reactio~~r~~n device through a plurality of connectors which are arranged in a fixed arrangement to enable connection to a predetermined configuration of connection ports on the modular reactio~~r~~n device; and

running the computer-coded instructions on a processor in said base station thereby causing the base station to supply one or more of: fluid, electrical power or signals, and/or pneumatic pressure or signals to the modular reactor device and thereby control the modular reactor device to cause it to carry out steps to produce said chemical or biological product.

[Claim 20]. A method of manufacturing a chemical or biological product, the method including the steps of:

receiving a modular reactor device according to any one of claims 1 to 9 and specifically designed to produce said chemical or biological product and computer-coded instructions arranged to control the operation of said modular reactor device wherein the modular reactor device includes at least one sensor arranged to monitor a characteristic of a reagent or a reaction in the modular reactor device; and is designed to allow performance of a plurality of alternative reaction pathways to produce a chemical or biological product,

running the computer-coded instructions on a processor in said modular reactor device thereby causing the modular reactor device to control one or more of: fluid flows, electrical power or signals, and/or pneumatic pressure or signals in the modular reactor device and thereby cause the modular reactor device to carry out steps to produce said chemical or biological product;

receiving a signal from said sensor and selecting, based on the received signal, one of the alternative reaction pathways that is to be followed; and

controlling the modular reactor device accordingly to cause the modular reactor device to follow the selected reaction pathway.

[Claim 21]. A method of manufacturing a chemical or biological product, the method including the steps of:

receiving a modular reactor device according to any one of claims 1 to 9 and specifically designed to produce said chemical or biological product and computer-coded instructions arranged to control the operation of said modular reactor device; and

running the computer-coded instructions on a processor in said modular reactor device thereby causing the modular reactor device to control one or more of: fluid flows, electrical power or signals, and/or pneumatic pressure or signals in the modular reactor device and thereby cause the modular reactor device to carry out steps to produce said chemical or biological product,

wherein the computer-coded instructions are arranged to cause the processor to control the modular reactor device to perform a plurality of operations on a regular cycle, the plurality of operations each causing predetermined quantities of fluids within the modular reactor device to be processed in different parts of the reactor at the same time.

[Claim 22]. A method of manufacturing a chemical or biological product, the method including the steps of:

receiving computer-coded instructions for the manufacture of a modular reactor device specifically designed to produce said chemical or biological product and computer-coded instructions arrange to control the operation of said modular reactor device;

producing a the modular reactor device according to any one of claims 1 to 9 using an additive manufacturing process, the additive manufacturing process being controlled by a processor which uses the received computer-coded instructions for manufacture;

connecting the manufactured modular reactor device to a base station which is arranged to supply fluid, electrical power or signals, and pneumatic pressure or signals, to the modular reactiorn device through a plurality of connectors which are arranged in a fixed arrangement to enable connection to a predetermined configuration of connection ports on the modular reactiorn device; and

running the computer-coded instructions for control on a processor in said base station thereby causing the base station to supply one or more of: fluid, electrical power or signals, and/or pneumatic pressure or signals to the modular reactor device and thereby control the reactor to cause it to carry out steps to produce said chemical or biological product.