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ABSTRACT

A control system in which a mobile communication device, such as the Apple i-Phone, Apple i-Pad, Android device, or the like is adapted to run an Application to control and manage the functional elements of a spa, swim spa or the like, each said functional element operating, essentially, on a stand-alone basis and provided with a discrete control unit, the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory, and signal output generation; said discrete control units receiving command and control signals transmitted wirelessly from said mobile communication device via several forms of local and remote communication system together with, where applicable, signals from sensors associated with their operation.

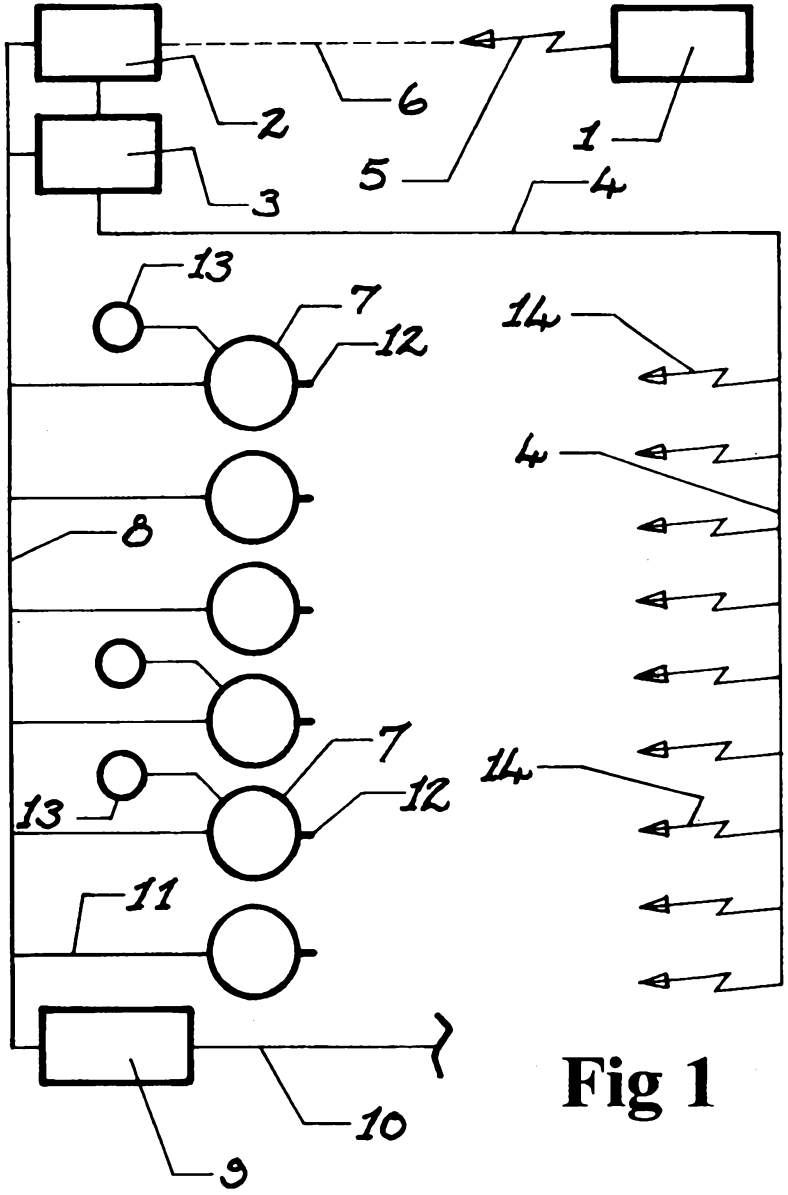
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Fig 1

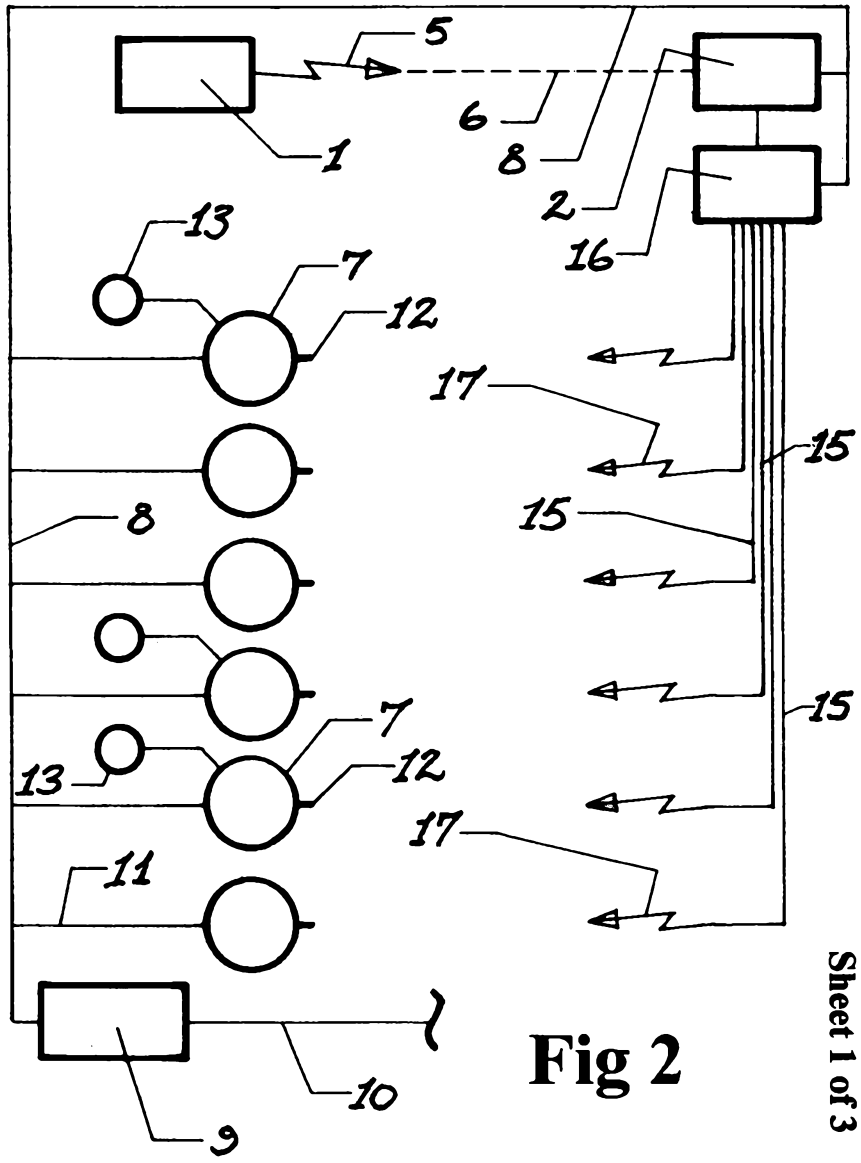
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Fig 2

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ORIGINAL

Australia

Patents Act 1990

Complete Specification for the Invention Entitled

REMOTE CONTROL SYSTEM

The invention is described in the following statement:

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REMOTE CONTROL SYSTEM

This invention relates generally to systems for the control of diverse operational functions in a system. In particular, it relates to a system embodying multiple, electrically-operated functional elements, the operational parameters of which are set, controlled and monitored through the use of a mobile communication device, such as the Apple i-Phone, Apple i-Pad, Android device, or the like, which is capable of connection to the internet via the cellular telephone system and capable of local communication via Bluetooth of wifi.

In the operation of smaller systems, for example, those employing no more than 20 electrically-operated functional elements, it was hitherto common practice to hard wire all of the functional elements to a control panel through which they were controlled and monitored. Monitoring was by way of electrically-operated devices indicating voltage, current flow, temperature, rotational speed, pressure, volume flow and the like, or lights warning of the fact that such operational parameters were outside desired tolerances, inputs to which were generated by sensors that were also hard wired to said control panel.

More recently, such functional elements have been controlled and monitored by means of a single microprocessor-based control unit. Operational parameters for a particular device are set in said control unit and control signals are transmitted to said device via signal conductors. In the case, for example, of the speed of a pump, said control signals initiate changes in a local electronic control unit incorporated into the pump

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driving motor, said local control unit controlling voltage, wave form, switching of current to coils or the like to regulate the rotational speed of said motor. Control inputs have been made to said microprocessor-based control unit by means of hard-wired control pads or control pads communication with said control unit via a radio-frequency, infra-red or like communication system. Said microprocessor-based control unit may continuously monitor the performance of a controlled device and any operational parameter outside the pre-set range will trigger a warning of some sort and/or an action, such as system shutdown.

The advent of mobile communications devices, such as the Apple i-Phone, Apple i-Pad, Android devices, or the like, with their large processing capabilities and memories, offers the ability, acting locally or remotely, to control and monitor individual electrically-operated functional elements. Many applications are now offered which permit such devices to be employed to control elements of the domestic situation, including lighting, heating, entertainment systems, appliances, curtains, garage doors, and many others.

The same capability can be employed to provide a simplified method of setting, controlling and monitoring of multiple functional elements forming a system. Communications devices can be used remotely or locally and, where functional elements were hitherto controlled as part of an integrated system, can now be controlled individually with reference to the operational status of other elements in the system. Typical of such systems are spas, swim spas and the like, in

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which the operation of water pumps is to be initiated or terminated or their speed of operation varied; in which the operation of air pumps is to be initiated or terminated; in which valves controlling the flow of water to water jets are to be opened or closed; in which lighting means are to be turned on or off; in which heating means are to be turned on or off and set to maintain specific temperatures; and in which sanitisation and filtration functions are to be initiated or terminated; any of which functional changes may be set to occur or cease on pre-set days and at pre-set times.

The ability to address functional elements of a system on an individual basis eliminates the requirement for a central control unit, eliminates the requirement for signal conductors connecting said central control unit to said functional elements, simplifies the replacement of existing said functional elements and/or the addition of new or replacement said functional element.

A first object of the present invention is to provide an Application to be run on a mobile communications device, said Application generating a display that depicts the operational elements of a system in symbolic form and, allowing the status of each to be appreciated. Acting locally or remotely via said mobile communication device, said Application and its display, an operator is able to intuitively generate command signals for the purpose of setting, controlling or monitoring the operational parameters of said operational elements. A second object of the present invention is to provide an Application to be run on a mobile communications device that will identify a replaced said operational element or an additional said

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operational element added to an existing system and permit the operator to accept or reject them. A third object of the present invention is to provide an Application to be run on a mobile communications device that will sense whether the device is in proximity to or remotely from the system and will automatically adjust its mode of communication. A fourth object of the present invention is to provide an Application to be run on a mobile communications device that will automatically alert an operator or, if necessary, separate service personnel, to the need for maintenance or repair of an operational element of said system.

According to the present invention, functional elements of a spa, swim spa or the like, including water pumps, air pumps, valves controlling flow to water jets, lighting means, heating means, sanitisation and filtration means are each supplied with electrical power via a plug connection to a cabling loop passing appropriately around the interior structure and housing of the spa, swim spa or the like, power being supplied to said loop, as required, by transforming and/or rectification means. Each said functional element is provided with a discrete control unit, the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory and signal output generation. Said control unit receives command signals from said mobile communication device in one or more ways and, as appropriate, signals from sensors associated with its operation. In response to said command signals, said control unit generates signals to regulate the operation of its host functional element and, as appropriate, feedback and alerting signals

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to said mobile communication device or to independent service personnel. The operator of said mobile communication device is able to call up an Application that generates a display depicting the operational elements of a system in symbolic form and allowing the status of each to be appreciated. Acting locally or remotely via said mobile communication device, said Application and its display, said operator is able to intuitively generate command signals for the purpose of setting, controlling or monitoring the operational parameters of said operational elements.

The various aspects of the present invention will be more readily understood by reference to the following description of preferred embodiments given in relation to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a first embodiment of the present invention in which control signals are transmitted via fibre-optic means;

Figure 2 is a schematic diagram of a second embodiment of the present invention in which control signals are transmitted via fibre-optic means;

Figure 3 is a schematic diagram of a third embodiment of the present invention in which control signals are transmitted via fibre-optic means;

Figure 4 is a schematic diagram of an embodiment of the present invention in which control signals are transmitted via a local area network over the power cabling;

Figure 5 is a schematic diagram of an embodiment of the

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present invention in which control signals are alternatively transmitted via Bluetooth or wifi means or via an internet connection;

In the present invention, a mobile communication device, such as the Apple i-Phone, Apple i-Pad, Android devices, or the like is adapted to run an Application to control and manage the functional elements of a spa, swim spa or the like. Said functional elements include water pumps, air pumps, valves controlling flow to water jets, lighting means, heating means, sanitisation and filtration means. Each said functional element is supplied with electrical power via a plug connection to a cabling loop passing appropriately around the interior structure and housing of the spa, swim spa or the like, power being supplied to said loop, as required, by transforming and/or rectifying means. Each said functional element operates, essentially, on a stand-alone basis and is provided with a discrete control unit, the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory and signal output generation. Said control units receive command signals from said mobile communication device via several forms of local and remote system communication means together with, where applicable, signals from sensors associated with their operation. In response to said command signals, each said control unit generates signals to regulate the operation of its host functional element and, where appropriate, feedback and alerting signals to said mobile communication device or to independent service personnel. To control any of said functional

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elements, the operator of said mobile communication device calls up the Application (not shown) which generates a screen display depicting all of the functional elements of a system in symbolic form and allows the operational status of each to be appreciated. Acting locally or remotely via said mobile communication device, using said Application and said display, the operator generates command signals for the purpose of setting, controlling or monitoring the operational parameters of said functional elements. Said display comprises a number of discrete, individually-generated layers, the highest of which, the access display, presents a representation of all functional elements of said system in the form of virtual buttons, each said button identifying its related functional element in symbolic form and indicating its operational status by means of symbols or numbers. Touching on the button representing a said functional element brings up a sub-layer of said display, the operational display, for that particular functional element. Said operational display offers virtual buttons that are employed to set or control the operational parameters and functions of said functional element, together with one or more displays of time and date of commencement or termination of a function, duration of a function and the operational values required. Final touching a button to execute said selections causes said operational display to disappear and said access display to be reinstated. The lowest layer of said display is the alert display which is generated automatically if data is received indicating variance between set and actual operational parameters or when routine maintenance is required. Said alert display identifies the functional

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element experiencing said operational abnormality or requiring maintenance. Additionally, the current draw upon said transforming and/or rectifying means by said functional elements connected to said loop is optionally continuously transmitted to said mobile communication device and compared to the expected current draw by the said functional elements in operation at a particular moment. Any discrepancy within a predetermined tolerance also triggers generation of said alert display. In the preferred embodiment, said expected current draw values are stored in a look-up table in a memory associated with said Application. Said Application incorporates software for generation of said display, generation of operational commands in response to operator inputs via said display and the processing of all data transmissions to and from said functional element control units and, where appropriate, the generation of alerts in relation to operational abnormalities or maintenance requirements.

Upon first calling up of said Application by the operator of said mobile communication device, said access display is generated with said virtual buttons in dimmed form. Said Application generates an initial data transmission which, effectively, announces its presence. Where said mobile communication device is within range of said local system communication means, said initial data transmission is transmitted to and received by said control units of all said functional elements. In response, said control units each generate response data transmissions which are sequenced according to a hierarchy established randomly at initialisation

of the system. Said response data transmissions indicate normal operational status or operational abnormality and are relayed to said mobile communication unit by said local system communication means. As said response data transmissions indicating normal operational status are received by said mobile communication device, the appropriate said virtual buttons of said access display are lit, indicating to the operator normal operational status. Should a said response data transmission indicating an operational abnormality be received, said virtual button for the appropriate said functional element remains dimmed and said alert page is displayed giving details of the abnormality. Should a new or replacement said functional element have been installed in said system prior to said initial data transmission, a new virtual button appears on said access display, said button flashing until being touched by the operator of said mobile communication device to signify acceptance. In an alternative embodiment, where a said response data transmission indicating an operational abnormality has been received, said virtual button for the appropriate said functional element remains dimmed and said alert page is not displayed until said dimmed button has been touched by the operator of said mobile communication device.

Where said mobile communication device is not within range of said local system communication means, no said response data transmissions are received in response to said initial data transmission. After a predetermined time interval, said Application generates an internet connection via the cellular telephone system to said remote system

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communication means and, when said connection is confirmed, again generates said initial data transmission which is transmitted to and received by said control units of all said functional elements. In response, said control units each generate response data transmissions which are sequenced according to a hierarchy established randomly at initialisation of the system. Said response data transmissions indicate normal operational status or operational abnormality and are relayed to said mobile communication unit by said remote system communication means. Said functional elements of said system are thereby under the control of said mobile communication device.

With reference to Figure 1, in a spa, swim spa or the like, in a first, simplified embodiment of the present invention, mobile communication device 1 communicates with said local communication means in the form of a Bluetooth receiver 2 employed to drive the infrared illuminator 3 of a solid-core, side-emitting, PMMA or PE fibre optic cable 4 of suitable diameter positioned appropriately around the interior structure and housing of the spa, swim spa or the like. The transmission path 6 of signal 5 (depicted symbolically) from said mobile communication device to said Bluetooth receiver is indicated in broken line. Said infrared illuminator is of suitable power and, in the preferred embodiment, said fibre optic cable takes the form of a closed loop passing appropriately around the interior structure and housing of the spa, swim spa or the like, both ends of said loop terminating at said illuminator. In an alternative embodiment (not shown), said illuminator is connected to two runs of said fibre optic cable

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more or less of equal length which are positioned appropriately around the interior structure and housing of said spa, swim spa or the like, both free ends being closed with reflective caps. Functional elements of said spa, swim spa or the like, depicted symbolically as 7, include water pumps, air pumps, valves controlling flow to water jets, lighting means, heating means, sanitisation and filtration means. Said functional elements are supplied with electrical power via a plug connection 11 to a cabling loop 8 passing appropriately around the interior structure and housing of the spa, swim spa or the like, power being supplied to said loop, as required, by transforming and/or rectifying means 9 supplied with electrical current via mains connection 10. Said functional elements are each provided with a control unit in the form of a suitable microcontroller (not shown), the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory and signal output generation. Said control units receive command signals from said mobile communication unit via said fibre optic cable and a small IR receiver module 12. Said microcontroller and IR receiver module are well known in the art and require no elucidation. Said control units optionally receive input signals from sensors 13 which may, for example, provide feedback in relation to temperature, pressure, flow rate or position, as required for the proper operation of a said host functional element. In response to said command signals, a said control unit generates signals to regulate the operation of its said host functional element. Digital data in the form of pulses of infrared light 14 are emitted from said fibre optic cable

throughout its length and are received by all said small IR receiver modules. Packets of said digital data are each preceded by an address coding which is specific to only one of said functional elements, said data therefore being processed by said microcontroller of only one said functional element. In an alternative embodiment, said Bluetooth communication means are replaced by wifi communication means.

With reference to Figure 2, in an alternative embodiment, said fibre optic cable is made in the form of a plurality of end-emitting, solid-core cables 15 of smaller diameter, all of which are illuminated by a single suitable illuminator 16 and which terminate close to each IR receiver module 12. Digital data in the form of pulses of infrared light 17 are emitted from the ends of said fibre optic cables and are received by specific said small IR receiver modules. Packets of said digital data are each preceded by an address coding which is specific to only one of said functional elements, said data therefore being processed by said microcontroller of only one said functional element.

In another alternative embodiment (not shown), said end-emitting fibre optic cables each take the form of a bundle of small fibre-optic fibres and are of the type exemplified by the 3M HL High Luminance Light Fibre supplied by the 3M Company, St Paul 55144-1000, USA. In the foregoing described embodiments employing fibre-optic means, no provision is made for transmission of data from said functional elements to said mobile communication device and the dimmed form of said virtual buttons in said access display and said initial data transmission are

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therefore not employed. Similarly, no provision is made for alerting the operator of said mobile communication device to the existence of an operational abnormality. Alerts relating to maintenance requirements are generated within said Application and are therefore retained.

With reference to Figure 3, in a second embodiment, a system is employed similar to those now commonly installed in automobiles. In this embodiment, mobile communication device 1 communicates via Bluetooth receiver 2 with local communication means 18 in the form of an interface unit of the type exemplified by the Gateway 500S BT unit supplied by Dension Audio Systems of H-1116 Budapest, Hungary. Said interface unit is connected to an optical receiver/transmitter 19 of each said microcontroller of said functional elements by a plastic optical fibre 20 passing appropriately around the interior structure and housing of the spa, swim spa or the like. Digital data in the form of light pulses is injected by means of a light-emitting diode or injection laser-diode or resonant cavity LED into said optical fibre, said receiver/transmitter associated with each said microcontroller forming a node in said optical fibre. Digital data in the form of pulses of infrared light is transmitted by said optical fibre throughout its length and is received by said receivers of all said microcontrollers. Packets of said digital data are each preceded by an address coding which is specific to only one of said functional elements, said data therefore being processed by said microcontroller of only one said functional element. In response to said command signals, said control unit generates signals to regulate the operation of its said host

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functional element. In this embodiment, provision is optionally made to transmit data back to said mobile communication unit via a transmitter incorporated into said microcontroller, said optical fibre and said interface unit and thence via the Bluetooth link between said mobile communication unit and said interface unit. Such data optionally relates to such factors as water temperature, confirmation of settings or operational status, requirements for repair or servicing or the like. Fibre optic cabling, connection means, encoding means (transmitters), decoding means (receivers) and Bluetooth to fibre-optic adaptors are well known in the art and widely used in industrial control applications. They require no elucidation. In an alternative embodiment, said Bluetooth communication means are replaced by wifi communication means.

With reference to Figure 5, in a third embodiment, mobile communication device 1 communicates directly with functional elements 7 of said system, locally and remotely, via Bluetooth. In this embodiment, said functional elements are each provided with a control unit (not shown) in the form of a suitable Bluetooth-enabled microcontroller, the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory and signal output generation. Bluetooth-enabled microcontrollers are well known in the art. Upon first calling up of said Application by the operator of said mobile communication device, said access display is generated with said virtual buttons in dimmed form. Said Application generates an initial data transmission which, effectively, announces its presence. The transmission

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path 21, 25, 26 of signal 5 (depicted symbolically) from said mobile communication device to said receivers of said Bluetooth-enabled microcontrollers is indicated in broken line. Where said mobile communication device is within Bluetooth range, said initial data transmission is received by said control units of all said functional elements. In response, said control units each generate response data transmissions which are sequenced according to a hierarchy established randomly at initialisation of the system. Said response data transmissions indicate normal operational status or operational abnormality and are received by said mobile communication device. As said response data transmissions indicating normal operational status are received by said mobile communication device, the appropriate said virtual buttons of said access display are lit, indicating to the operator normal operational status. Should a said response data transmission indicating an operational abnormality be received, said virtual button for the appropriate said functional element remains dimmed and said alert page is displayed giving details of the abnormality. Should a new or replacement said functional element have been installed in said system prior to said initial data transmission, a new virtual button appears on said access display, said button flashing until being touched by the operator of said mobile communication device to signify acceptance.

Where said mobile communication device is not within Bluetooth range, no said response data transmissions are received in response to said initial data transmission. After a predetermined time interval, said

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Application generates an internet connection via the cellular telephone system to remote system communication means 24 in the form of a Bluetooth access server of the type exemplified by the Bluegiga 229Xis wireless router supplied by Bluegiga Technologies Oy, 02630 Espoo, Finland. Said wireless router supports up to 21 Bluetooth connections. When said connection is confirmed, said Application again generates said initial data transmission which is transmitted to and received by said control units of all said functional elements. In response, said control units each generate response data transmissions which are sequenced according to a hierarchy established randomly at initialisation of the system. Said response data transmissions indicate normal operational status or operational abnormality and are relayed to said mobile communication unit by said remote system communication means. Said functional elements of said system are thereby under the control of said mobile communication device. The cellular telephone transmission path is depicted symbolically in broken line as 22 and the internet is depicted symbolically as 23. The transmission path 25, 26 between said Bluetooth access server and said receivers of said Bluetooth-enabled microcontrollers is indicated symbolically in broken line.

With continued reference to Figure 5, in a fourth embodiment, mobile communication device 1 communicates with functional elements 7 of said system via wifi. In this embodiment, said functional elements are each provided with a control unit (not shown) in the form of a suitable wifi-enabled microcontroller, the functions of which include any of power

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supply, signal receiver, signal processing to generate control outputs, memory and signal output generation. Wifi-enabled microcontrollers are well known in the art. Upon first calling up of said Application by the operator of said mobile communication device, said access display is generated with said virtual buttons in dimmed form. Said Application generates an initial data transmission which, effectively, announces its presence. The transmission path 21, 25, 26 of signal 5 from said mobile communication device to said receivers of said wifi-enabled microcontrollers is depicted symbolically in broken line. Where said mobile communication device is within wifi range, said initial data transmission is transmitted to and received by said control units of all said functional elements. In response, said control units each generate response data transmissions which are sequenced according to a hierarchy established randomly at initialisation of the system. Said response data transmissions indicate normal operational status or operational abnormality and are relayed to said mobile communication unit by said local system communication means. As said response data transmissions indicating normal operational status are received by said mobile communication device, the appropriate said virtual buttons of said access display are lit, indicating to the operator normal operational status. Should a said response data transmission indicating an operational abnormality be received, said virtual button for the appropriate said functional element remains dimmed and said alert page is displayed giving details of the abnormality. Should a new or replacement said functional element have

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been installed in said system prior to said initial data transmission, a new virtual button appears on said access display, said button flashing until being touched by the operator of said mobile communication device to signify acceptance.

Where said mobile communication device is not within wifi range, no said response data transmissions are received in response to said initial data transmission. After a predetermined time interval, said Application generates an internet connection via the cellular telephone system to remote system communication means in the form of a suitable modem and wifi router of the type exemplified by the Linksys Model N600 supplied by Cisco Systems, Inc, San Jose, CA 95134, USA. When said connection is confirmed, said Application again generates said initial data transmission which is transmitted to and received by said control units of all said functional elements. In response, said control units each generate response data transmissions which are sequenced according to a hierarchy established randomly at initialisation of the system. Said response data transmissions indicate normal operational status or operational abnormality and are relayed to said mobile communication unit by said remote system communication means. Said functional elements of said system are thereby under the control of said mobile communication device. The cellular telephone transmission path is depicted symbolically in broken line as 22 and the internet is depicted symbolically as 23. The transmission path 25, 26 between said modem and wifi router and said receivers of said wifi-enabled microcontrollers is depicted symbolically in

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broken line.

In a fifth embodiment (not shown), said mobile communication device communicates with said functional elements of said system via telnet in place of wifi, functionality of this embodiment being largely as described for the use of wifi. Devices for use with telnet are well known in the art and do not require elucidation.

With reference to Figures 4 and 5, in a sixth embodiment, mobile communication device 1 operates the Netgear Genie application and communicates with functional elements 7 of said system via Ethernet over cabling loop 8 via a powerline adaptor 21 of the type exemplified by the DHP-1321 unit supplied by Netgear, Inc, San Jose, CA 95134-1911, USA. Said Netgear Genie application provides wireless (wifi) communication between said mobile communication device and said powerline adaptor. In this embodiment, said functional elements are each provided with a control unit (not shown) in the form of a suitable ethernet-enabled microcontroller, the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory and signal output generation. Ethernet-enabled microcontrollers are well known in the art. Upon first calling up of said Application by the operator of said mobile communication device, said access display is generated with said virtual buttons in dimmed form. Said Application generates an initial data transmission which, effectively, announces its presence. Where said mobile communication device is within wifi range, said initial data transmission is transmitted to and received by said control units of all

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said functional elements. In response, said control units each generate response data transmissions which are sequenced according to a hierarchy established randomly at initialisation of the system. Said response data transmissions indicate normal operational status or operational abnormality and are relayed to said mobile communication unit by said power line adaptor. As said response data transmissions indicating normal operational status are received by said mobile communication device, the appropriate said virtual buttons of said access display are lit, indicating to the operator normal operational status. Should a said response data transmission indicating an operational abnormality be received, said virtual button for the appropriate said functional element remains dimmed and said alert page is displayed giving details of the abnormality. Should a new or replacement said functional element have been installed in said system prior to said initial data transmission, a new virtual button appears on said access display, said button flashing until being touched by the operator of said mobile communication device to signify acceptance.

Where said mobile communication device is not within wifi range, no said response data transmissions are received in response to said initial data transmission. After a predetermined time interval, said Application generates an internet connection via the cellular telephone system to said powerline adaptor. When said connection is confirmed, said Application again generates said initial data transmission which is transmitted to and received by said control units of all said functional elements. In response, said control units each generate response data transmissions which are

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sequenced according to a hierarchy established randomly at initialisation of the system. Said response data transmissions indicate normal operational status or operational abnormality and are relayed to said mobile communication unit by said remote system communication means. Said functional elements of said system are thereby under the control of said mobile communication device. The transmission paths of said Ethernet signals are actually via cable loop 8 and plug connections 11 and are depicted symbolically in broken line as 8a, 11a.

In an alternative embodiment, provision is made to provide password access to the use of said Application.

In simplified alternative embodiments, said internet connection is deleted and only local control of said functional elements by means of said mobile communication device is permitted.

Provision is optionally made for a remotely or manually-controlled master switch to interrupt the electrical power supply to all said functional elements. Similar provisions are made to interrupt the electrical power supply to individual said functional elements.

In situations in which signals have not been received by a said functional element from said mobile control unit for a predetermined time period, said functional element will revert to its default state. Said default state may, in the case of a light, simply be off (de-powered). In the case of a pump, the default state may be a pre-set routine, such as running for a specified time period in each hour for filtration purposes or, in the case of a heater, may be the maintenance of a pre-set water temperature.

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Said Application optionally stores in memory data about utilisation of said spa, swim spa or the like, said information being accessible via said Application and said access display. In the preferred embodiment, said Application continuously compares said utilisation data with a range of operational thresholds and, should a threshold have been exceeded, generates said alert display and/or generates an advisory or alerting text message which is transmitted to third-party maintenance personnel or other third party. Similarly, any detection of a fault in any said functional element generates said alert display and/or generates an advisory or alerting text message.

In the preferred embodiment, said Application and display is adapted to receive unsolicited messages promoting the services of maintenance operators; the availability of new model spas, swim spas or the like, or any related and appropriate product or service.

Obviously, the present invention is readily adaptable for use with any small system comprising a plurality of electrically-operated units numbering between two and in excess of 20.

The present invention should be taken to include any feasible combination of the disclosed aspects, features or elements.

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CLAIMS

1. A control system in which a mobile communication device, such as the Apple i-Phone, Apple i-Pad, Android device, or the like is adapted to run an Application to control and manage the functional elements of a spa, swim spa or the like, said functional elements including water pumps, air pumps, valves controlling flow to water jets, lighting means, heating means, sanitisation and filtration means and the like; each said functional element being supplied with electrical power via a plug connection to a power cabling loop passing around the interior structure and housing of said spa, swim spa or the like, power being supplied to said power cabling loop, as required, by suitable transforming and/or rectifying means; each said functional element operating, essentially, on a stand-alone basis and provided with a discrete control unit, the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory, and signal output generation; said discrete control units receiving command and control signals transmitted wirelessly from said mobile communication device via several forms of local and remote communication system together with, where applicable, signals from sensors associated with their operation; in response to said command and control signals, each said discrete control unit generating signals to regulate the operation of its host functional element and, where appropriate, feedback and alerting signals to

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said mobile communication device or to independent service personnel; said functional elements being controllable by the operator of said mobile communication device by the calling up of said Application which generates a multi-layered screen display depicting all of the functional elements of a system in symbolic form, thereby allowing the operational status of each to be appreciated; said Application and said screen display incorporating virtual controls permitting said operator to communicate with said discrete control units via said mobile communication device, acting locally via a said local communication system or remotely via a said remote communication system and several pathways within said spa, swim spa or the like, transmitting command and control signals for the purpose of setting, controlling or monitoring the operational parameters of said functional elements.

2. The control system of Claim 1 in which said mobile communication device communicates directly with said discrete control units, acting locally via a said local communication system or remotely via a said remote communication system.

3. The control system of Claim 1 in which said mobile communication device communicates indirectly with said discrete control units, acting locally via a said local communication system or remotely via said remote communication system to a receiver unit driving the illuminator of a fibre optic cable, master control unit communicating with said discrete control units.

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4. The control system of Claim 1 in which said local communication system takes the form of a Bluetooth or WiFi communication system or other suitable short-range communication system.

5. The control system of Claim 1 in which said remote communication system takes the form of a wireless internet connection to a master control unit of said spa, swim spa or the like, said master control unit being connected to the internet via a fixed-line or wirelessly and communicating with said discrete control units.

6. The control system of Claim 1 in which said screen display comprises a number of discrete, individually-generated layers, the highest of which, the Access Display, presents a representation of all functional elements of said system in the form of virtual buttons, each said button identifying its related functional element in symbolic form and indicating its operational status by means of symbols or numbers, touching of the said virtual button representing a specific said functional element bringing up a sub-layer of said screen display, the Operational Display, for that particular functional element, said Operational Display offering virtual buttons which are employed to set or control the operational parameters and functions of the said functional element, together with one or more displays of pre-set time and date of commencement or termination of a function and its duration and pre-set operational values; final touching of a button to execute

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said selections causing the selected said Operational Display to disappear and said Access Display to be reinstated; the lowest layer of said screen display being the Alert Display which is generated automatically if data is received indicating variance between set and actual operational parameters or when routine maintenance is required, said Alert Display identifying the functional element experiencing said operational abnormality or requiring maintenance and providing prompts of the action required.

7. The control system of Claims 1 and 6 in which the current draw upon said transforming and/or rectifying means by said functional elements connected to said power cabling loop is optionally continuously transmitted to said mobile communication device and compared to the expected current draw by the said functional elements in operation at a particular moment, any discrepancy within a predetermined tolerance also triggering generation of said Alert Display; said expected current draw values being stored in a look-up table in a memory associated with said Application; said Application incorporating software for generation of said Alert Display, generation of operational commands in response to operator inputs via said Alert Display, processing of all data transmissions to and from said discrete control units and, where appropriate, generation of said alerts in relation to operational abnormalities or maintenance requirements.

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8. The control system of Claims 1 and 6 in which, upon first calling up of said Application by said operator of said mobile communication device, said Access Display is generated with said virtual buttons in dimmed form, said Application automatically generating a first initial data transmission which, effectively, announces its active presence in relation to said system; where said mobile communication device is within range of a said local communication system, said first initial data transmission is transmitted to and received by said discrete control units of all said functional elements, in response, said discrete control units each generating response data transmissions which are sequenced according to a randomly-established hierarchy, said response data transmissions indicating normal operational status or operational abnormality and are relayed to said mobile communication unit by said local communication system, receipt of said response data transmissions indicating normal operational status received by said mobile communication device causing the appropriate said virtual buttons of said Access Display to be lit, thereby indicating to said operator normal operational status of the related said functional elements and the fact that they are under the control of said mobile communication device; receipt of a said response data transmission indicating an operational abnormality causing said virtual button for the appropriate said functional element to remain dimmed and immediate display of said Alert Page giving details of

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said abnormality; where a new or replacement said functional element has been installed in said control system prior to said first initial data transmission, a new virtual button is caused to appear on said Access Display, said virtual button flashing until touched by said operator of said mobile communication device to signify its acceptance.

9. The control system of Claim 8 in which, where said mobile communication device is not within range of said local communication system, it receives no response data transmissions in response to said first initial data transmission; following elapse of a predetermined time interval, said Application automatically generates a wireless internet connection via the cellular telephone system to said remote communication system and, when said connection is confirmed, generates a second initial data transmission which is transmitted to and received by said discrete control units of all said functional elements; in response to said second initial data transmission, said discrete control units each generating response data transmissions which are sequenced according to a randomly-established hierarchy, said response data transmissions indicating normal operational status or operational abnormality being relayed to said mobile communication unit by said remote communication system; the lighting up of a particular said virtual button on said Access Display indicating to said operator normal operational status of the related said functional

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element and the fact that it is under the control of said mobile communication device; receipt of a said response data transmission indicating an operational abnormality causing said virtual button for the appropriate said functional element to remain dimmed and immediate display of said Alert Page giving details of said abnormality.

10. The control system of Claims 8 and 9 in which, where a said response data transmission indicating an operational abnormality is received by said mobile communication device, said virtual button for the appropriate said functional element remains dimmed and said Alert Page is not displayed until said dimmed button has been touched by said operator.

11. The control system of Claim 1 in which said mobile communication device communicates with said discrete control units via said local or remote communication system to a receiver unit driving the infrared illuminator of a solid-core, side-emitting, PMMA or PE fibre optic cable of suitable diameter positioned around the interior structure and housing of the spa, swim spa or the like, said infrared illuminator being of suitable power and said fibre optic cable taking the form of a closed loop, both ends of which terminate at said illuminator.

12. The control system of Claim 11 in which said illuminator is connected to two runs of said fibre optic cable more or less of equal length which are positioned around the interior structure and

housing of said spa, swim spa or the like, both free ends being closed with reflective caps.

13. The control system of Claim 1 in which said discrete control units of said functional elements take the form of suitable microcontrollers.

14. The control system of Claims 3 and 11 in which said mobile communication device transmits command and control signals via said local or remote communication systems to a receiver unit driving the infra-red illuminator of said fibre optic cable to a small IR receiver module of each said discrete control unit; said discrete control units optionally also receiving input signals from said associated sensors providing feedback in relation to temperature, pressure, flow rate or position, as required for the proper operation of a said host functional element; in response to said command and control signals, a said discrete control unit generating signals to regulate the operation of its said host functional element; digital data in the form of pulses of infrared light being emitted from said fibre optic cable throughout its length and received by all said small IR receiver modules, packets of said digital data each being preceded by an address coding specific to a particular said functional element such that said data is processed only by said microcontroller of said particular functional element.

15. The control system of Claims 3 and 14 in which said fibre optic cable is made in the form of a plurality of end-emitting, solid-core

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cables of smaller diameter, all of which are illuminated by a single suitable illuminator and which terminate close to each said small IR receiver module, digital data in the form of pulses of infrared light being emitted from the ends of said fibre optic cables and received by specific said small IR receiver modules; packets of said digital data each being preceded by an address coding which is specific to a particular said functional element, such that said data is processed only by said microcontroller of said particular functional element.

16. The control system of Claim 15 in which said end-emitting fibre optic cables each take the form of a bundle of small fibre-optic fibres and are of the type exemplified by the 3M HL High Luminance Light Fibre supplied by the 3M Company, St Paul 55144-1000, USA.

17. The control system of Claims 14, 15 and 16 in which no provision is made for transmission of data from said functional elements to said mobile communication device, the dimmed form of said virtual buttons in said Access Display, said initial data transmissions and provision for alerting the operator of said mobile communication device to the existence of an operational abnormality therefore not being employed; alerts relating to maintenance requirements, generated within said Application, being retained.

18. The control system of Claim 3 in which said mobile

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communication device communicates via a Bluetooth local communication system to a receiver and interface unit of the type exemplified by the Gateway 500S BT unit supplied by Dension Audio Systems of H-1116 Budapest, Hungary, said interface unit being connected to an optical receiver/transmitter of said microcontroller of each said functional element by a plastic optical fibre passing around the interior structure and housing of said spa, swim spa or the like, digital data in the form of infra-red light pulses being injected by means of a light-emitting diode, injection laser-diode or resonant cavity LED into said optical fibre; said receiver/transmitter associated with each said microcontroller forming a node in said optical fibre; said digital data being transmitted by said optical fibre throughout its length and received by said receivers of all said microcontrollers, packets of said digital data each being preceded by an address coding which is specific to a particular said functional element, such that said data is processed only by said microcontroller of said particular functional element, said control unit generating signals to regulate the operation of its said host functional element; provision optionally being made to transmit data back to said mobile communication unit via a transmitter incorporated into said microcontroller, said optical fibre and said interface unit and thence via said Bluetooth link between said mobile communication unit and said interface unit, such data optionally

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relating to such factors as water temperature, confirmation of settings or operational status, requirements for repair or servicing or the like.

19. The control system of Claims 3 and 4 in which said mobile communication device communicates directly with functional elements of said system, locally and remotely, via Bluetooth, said functional elements each being provided with a control unit in the form of a suitable Bluetooth-enabled microcontroller, the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory and signal output generation; upon first calling up said Application by said operator of said mobile communication device, said Access Display is generated with said virtual buttons in dimmed form, said Application automatically generating a first initial data transmission which, effectively, announces its active presence in relation to said system; where said mobile communication device is within range of a said local system communication system, said first initial data transmission is transmitted to and received by said discrete control units of all said functional elements, in response, said discrete control units each generating response data transmissions which are sequenced according to a randomly established hierarchy, said response data transmissions indicating normal operational status or operational abnormality and are relayed to said mobile communication unit by said Bluetooth

system, receipt of said response data transmissions indicating normal operational status received by said mobile communication device causing the appropriate said virtual buttons of said Access Display to be lit, thereby indicating to said operator normal operational status of the related said functional elements and the fact that they are under the control of said mobile communication device; receipt of a said response data transmission indicating an operational abnormality causing said virtual button for the appropriate said functional element to remain dimmed and immediate display of said Alert Page giving details of said abnormality; where a new or replacement said functional element has been installed in said control system prior to said initial data transmission, a new virtual button is caused to appear on said Access Display, said virtual button flashing until touched by said operator of said mobile communication device to signify acceptance;

20. The control system of Claim 19 in which, where said mobile communication device is not within range of said Bluetooth system, it receives no response data transmissions in response to said first initial data transmission; following elapse of a predetermined time interval, said Application automatically generates a wireless internet connection via the cellular telephone system to said remote communication system and, following confirmation of said internet connection, generates a second initial

data transmission which is transmitted to and received directly by said discrete control units of all said functional elements via said remote communication system, said remote communication system taking the form of a Bluetooth access server of the type exemplified by the Bluegiga 229Xis wireless router supplied by Bluegiga Technologies Oy, 02630 Espoo, Finland which typically supports up to 21 Bluetooth connections; in response to said second initial data transmission, said discrete control units each generating response data transmissions which are sequenced according to a randomly established hierarchy, said response data transmissions indicating normal operational status or operational abnormality and relayed to said mobile communication unit via said Bluetooth access server and said remote communication system;

21. The control system of Claims 19 and 20 in which said mobile communication device communicates with said functional elements via WiFi, said functional elements each being provided with a discrete control unit in the form of a suitable WiFi-enabled microcontroller, the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory, and signal output generation; where said mobile communication device is not within WiFi range, said Application automatically generating a wireless internet connection via the cellular telephone system, communicating with said discrete

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control units via a said remote communication system in the form of a suitable modem and WiFi router of the type exemplified by the Linksys Model N600 supplied by Cisco Systems, Inc, San Jose, CA 95134, USA.

22. The control system of Claims 19 and 20 in which said mobile communication device communicates with said functional elements via telnet or other suitable bi-directional communication system.

23. The control system of Claim 1 in which said mobile communication device operates the Netgear Genie Application and communicates with said functional elements via Ethernet over said power cabling loop and via said plug connections a powerline adaptor of the type exemplified by the DHP-1321 unit supplied by Netgear, Inc, San Jose, CA 95134-1911, USA, said Netgear Genie application providing wireless (WiFi) communication between said mobile communication device and said powerline adaptor; said functional elements each being provided with a control unit in the form of a suitable ethernet-enabled microcontroller, the functions of which include any of power supply, signal receiver, signal processing to generate control outputs, memory, and signal output generation; upon first calling up said Application by said operator of said mobile communication device, said Access Display is generated with said virtual buttons in dimmed form, said Application automatically generating a first initial data

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transmission which, effectively, announces its active presence in relation to said system; where said mobile communication device is within WiFi range, said initial data transmission is transmitted to and received by said control units of all said functional elements, in response, said control units each generating response data transmissions which are sequenced according to a randomly established hierarchy, said response data transmissions indicating normal operational status or operational abnormality and are relayed to said mobile communication unit via said power line adaptor and WiFi link; the lighting up of a particular said virtual button on said Access Display indicating to said operator normal operational status of the related said functional element and the fact that it is under the control of said mobile communication device; receipt of a said response data transmission indicating an operational abnormality causing said virtual button for the appropriate said functional element to remain dimmed and immediate display of said Alert Page giving details of said abnormality; should a new or replacement said functional element have been installed in said system prior to said initial data transmission, a new virtual button appears on said Access Display, said button flashing until being touched by the operator of said mobile communication device to signify acceptance.

24. The control system of Claim 1 in which, where said mobile communication device is not within WiFi range, no said response

data transmissions are received in response to said first initial data transmission; following elapse of a predetermined time interval, said Application generating a wireless internet connection via the cellular telephone system to said powerline adaptor connected to the internet wirelessly or by landline; upon confirmation of said connection, said Application generating a second said initial data transmission which is transmitted to and received by said control units of all said functional elements, said control units each generating response data transmissions which are sequenced according to a randomly established hierarchy, said response data transmissions in the form of Ethernet signals indicating normal operational status or operational abnormality being relayed to said mobile communication unit via said plug connections, said power cabling loop and said WiFi link; the lighting up of a particular said virtual button on said Access Display indicating to said operator normal operational status of the related said functional element and the fact that it is under the control of said mobile communication device; receipt of a said response data transmission indicating an operational abnormality causing said virtual button for the appropriate said functional element to remain dimmed and immediate display of said Alert Page giving details of said abnormality.

25. The control system of Claim 1 in which provision is made to provide password access to the use of said Application.

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26. The control system of Claim 1 in which said remote communication system is not used and only local control of said functional elements by means of said mobile communication device is possible.

27. The control system of Claim 1 in which provision is made for a remotely or manually-controlled master switch to interrupt the electrical power supply to individual or all said functional elements.

28. The control system of Claim 1 in which, in a situation in which signals have not been received by a said functional element from said mobile communication device for a predetermined period of time, said functional element reverts to a default state; said default state typically being, for a light, switched off (de-powered); for a pump, a pre-set routine, such as running for a specified time period in each hour for filtration purposes or, for a heater, the maintenance of a pre-set water temperature.

29. The control system of Claim 1 in which said Application optionally stores in memory data about utilisation of said spa, swim spa or the like, said information being accessible via said Access Display of said mobile communication device; said Application continuously comparing said utilisation data with a range of operational thresholds and, should a threshold be exceeded, generates said Alert Display and/or generates an advisory or alerting text message which is transmitted to third-

party maintenance personnel or other third party; detection of a fault in any said functional element causing generation of said Alert Display and/or the generation of a said advisory or alerting text message.

30. The control system of Claim 1 in which said Application and said Access Display is adapted to receive unsolicited messages promoting the services of maintenance operators, the availability of new model spas, swim spas or the like, or any related and appropriate product or service.

31. The control system of Claim 1 which is adapted for use with any small system comprising a plurality of electrically-operated functional elements numbering between two and in excess of 20.

32. The control system of Claims 1 to 31 incorporating any feasible combination of the claimed aspects, features or elements.

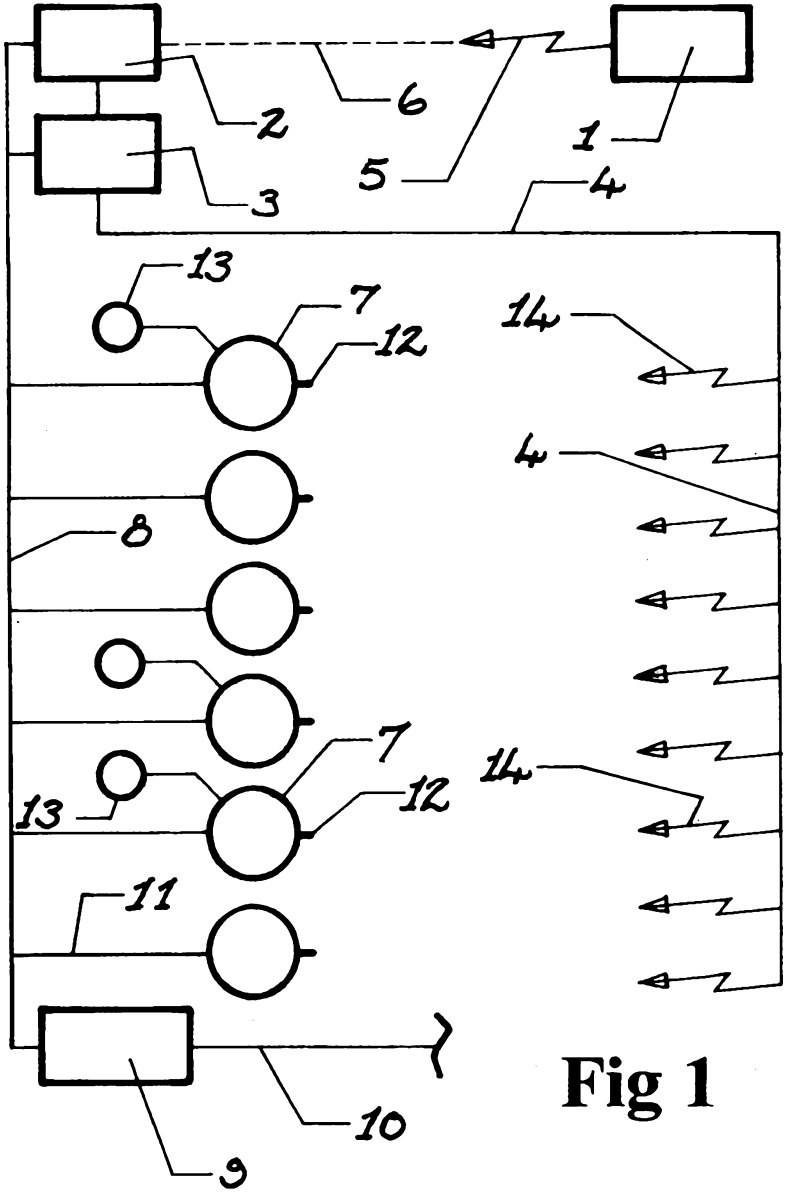
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Fig 1

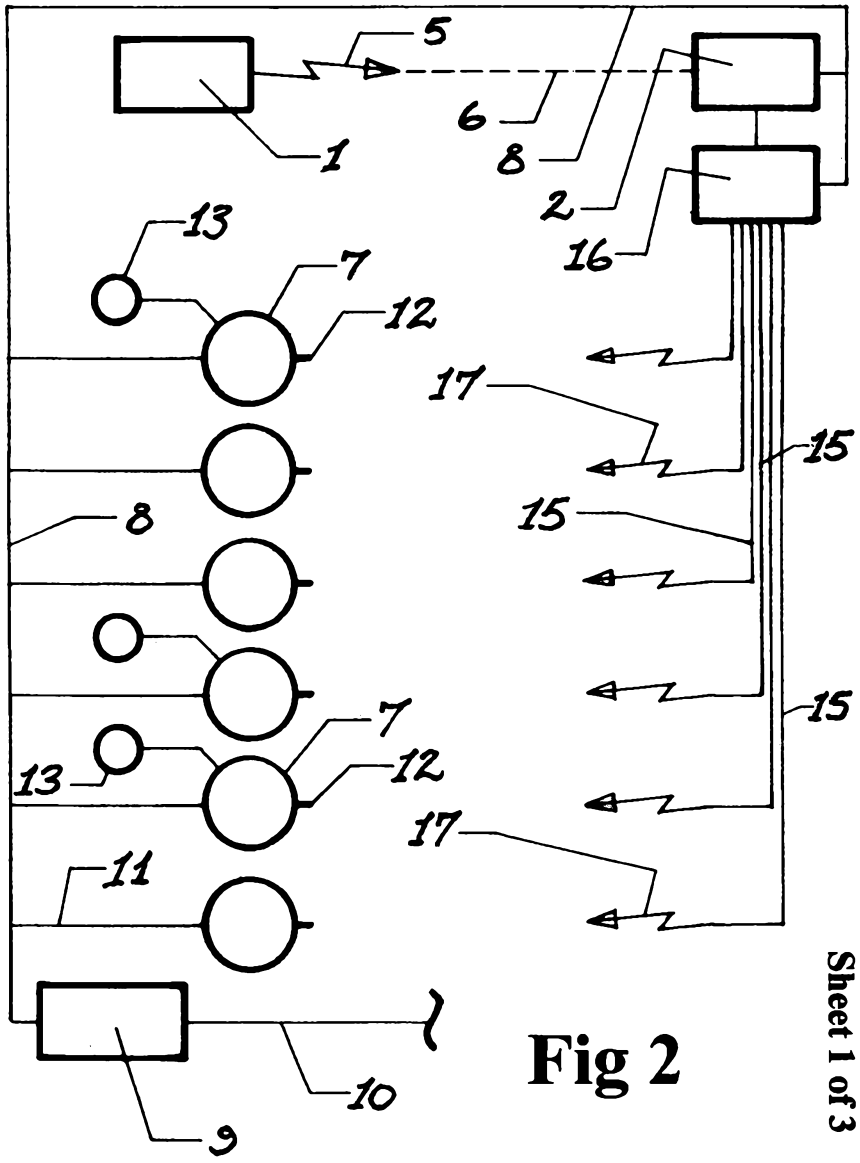
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Fig 2

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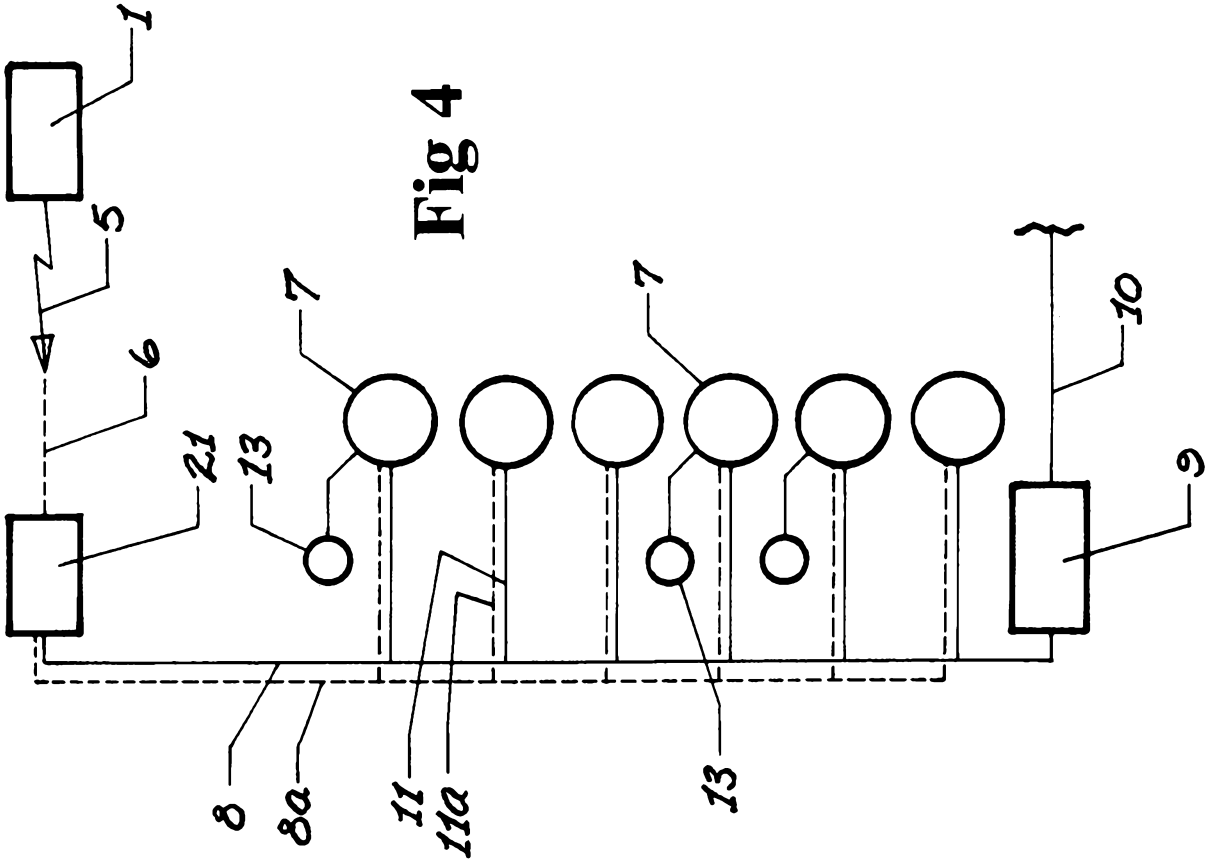

Fig 4

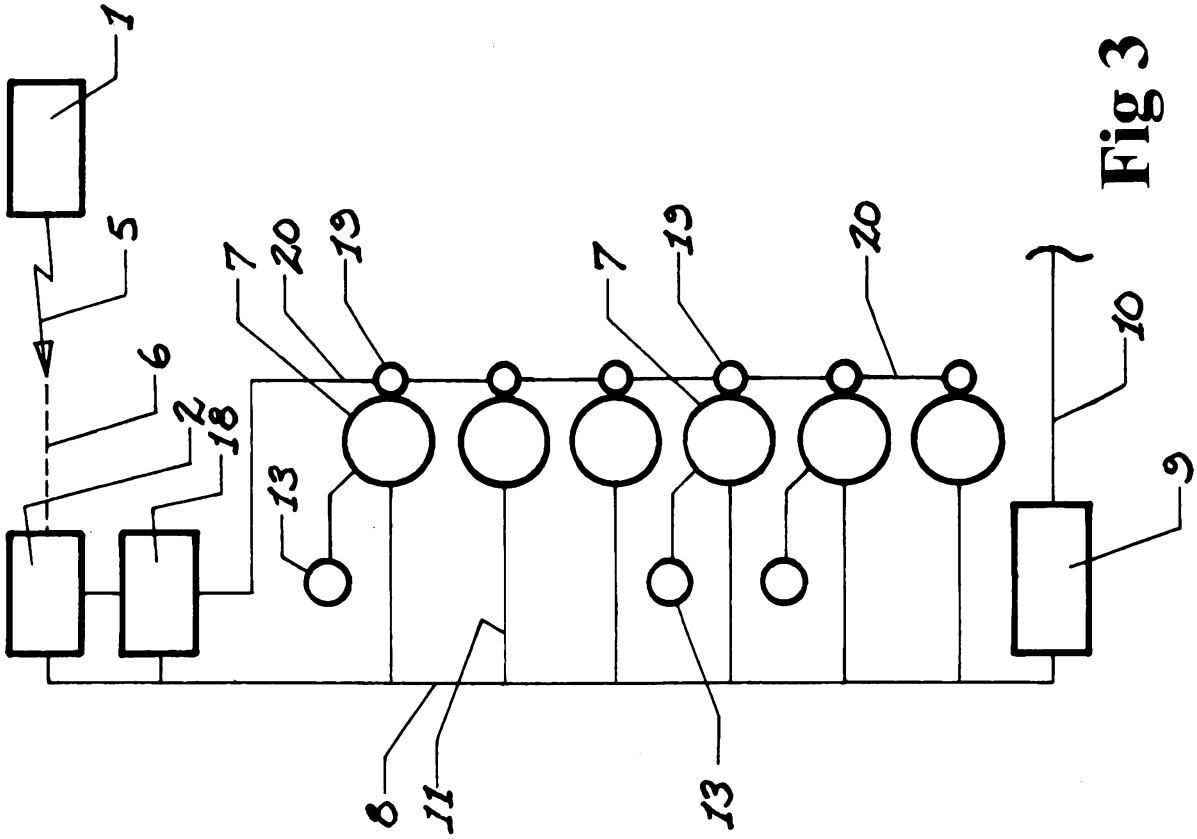

Fig 3

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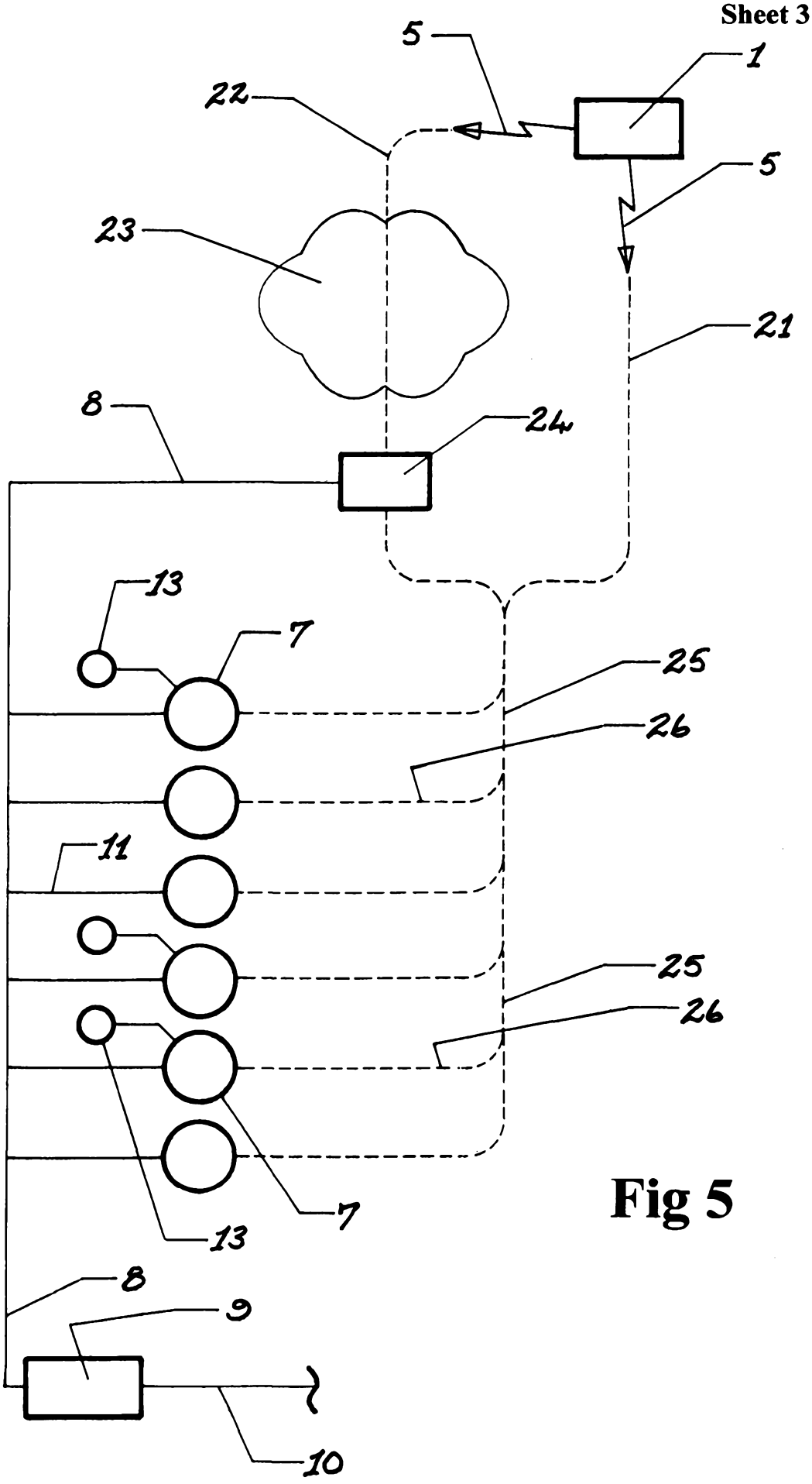

Fig 5