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(54) SYSTEM AND METHOD FOR REGULATING A BATHING POOL, SUCH AS A SWIMMING POOL OR A SPA

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(57) **ABSTRACT**

A regulation system including a temperature sensor which measures a current temperature of the water, a generator of renewable electricity, pool equipment including a heat pump with adjustable electric power, electrical measuring devices which determine powers corresponding to the power produced by the generator and to the power consumed by the heat pump, respectively, and a control system suitable for regulating the power consumed by the heat pump and for operating the pool equipment selectively in a hybrid mode, where a collective network and the generator supply, and in a renewable mode, where the generator supplies without the pool equipment supplied by the collective network, by sending any excess to a domestic network. The control system is configured to control the pool equipment on the basis of the current temperature and of the powers.

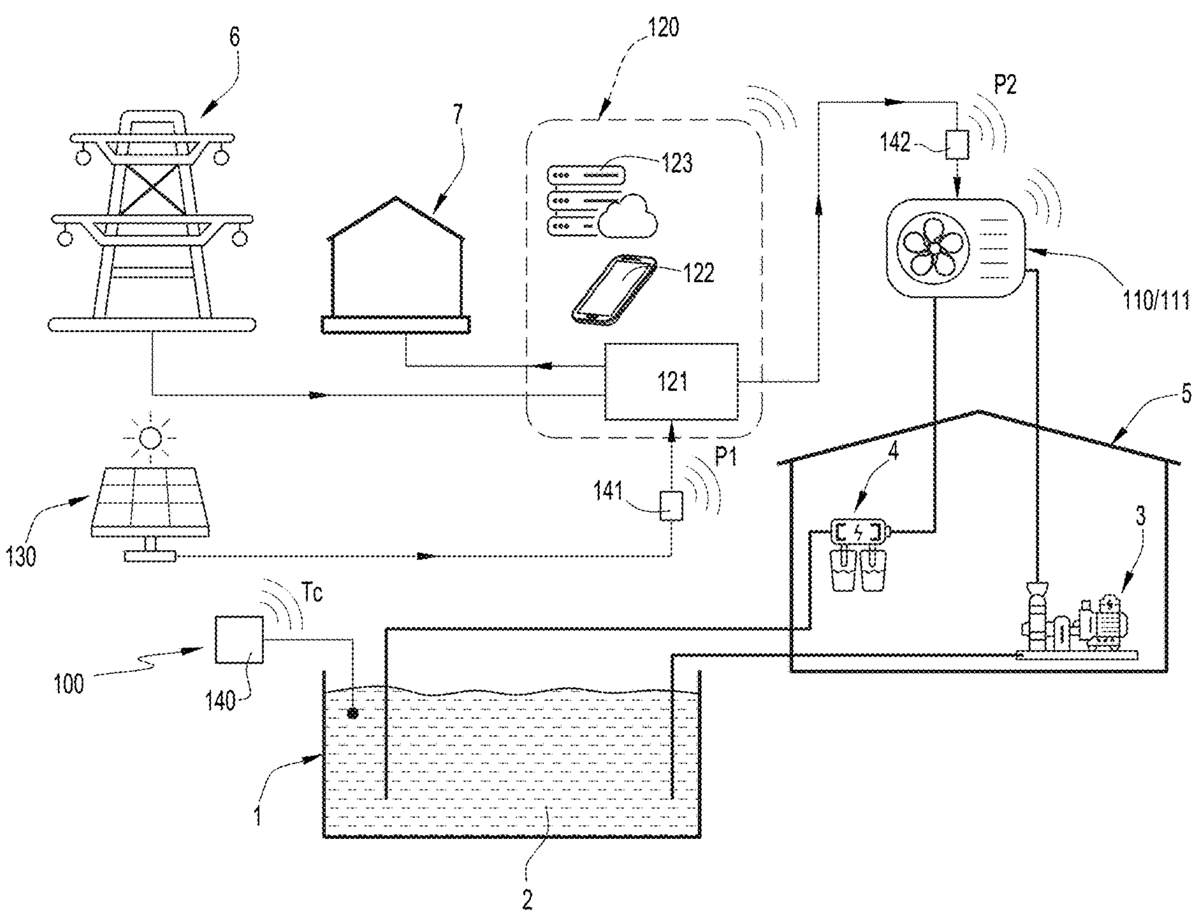
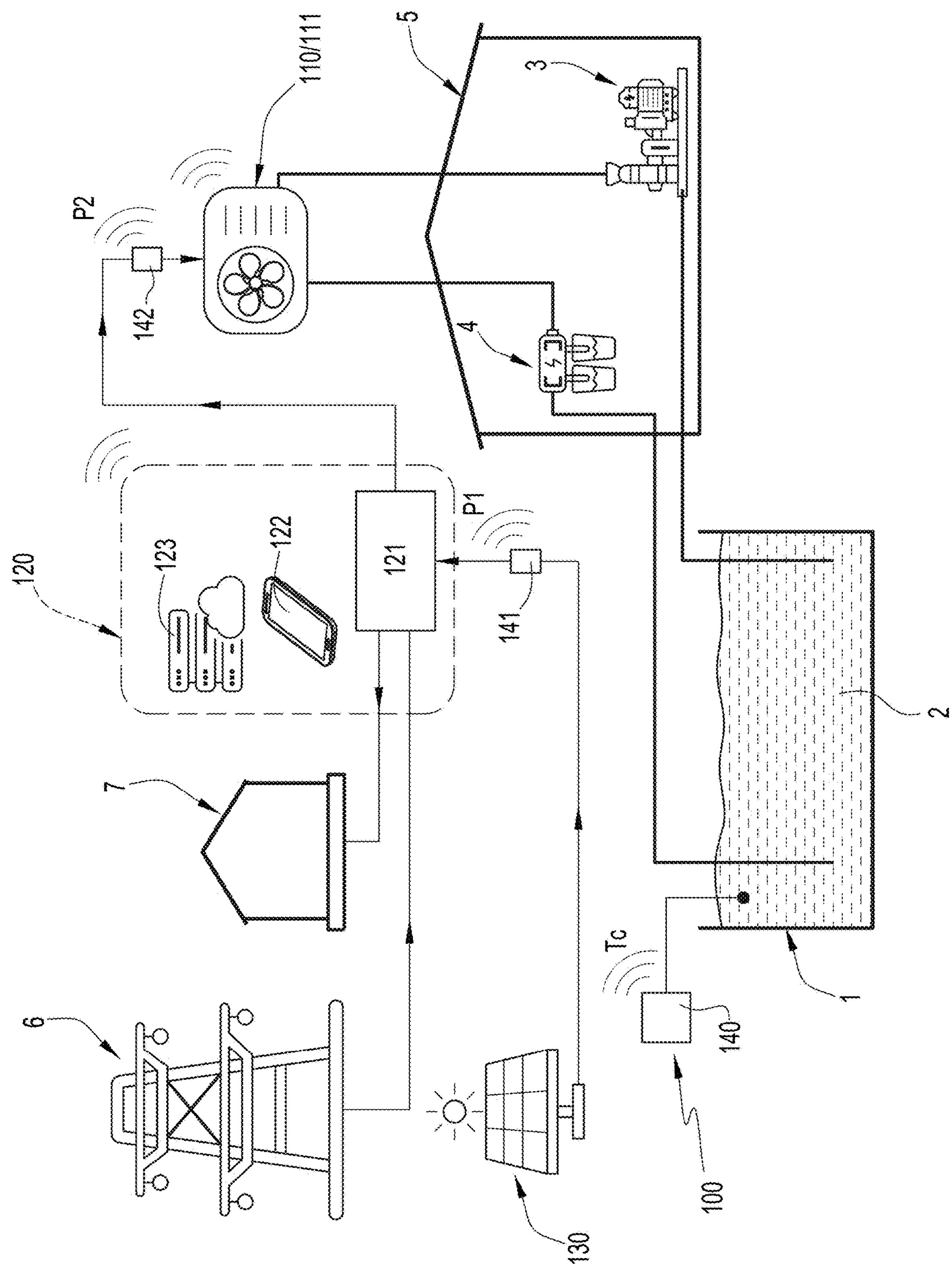


FIG.1



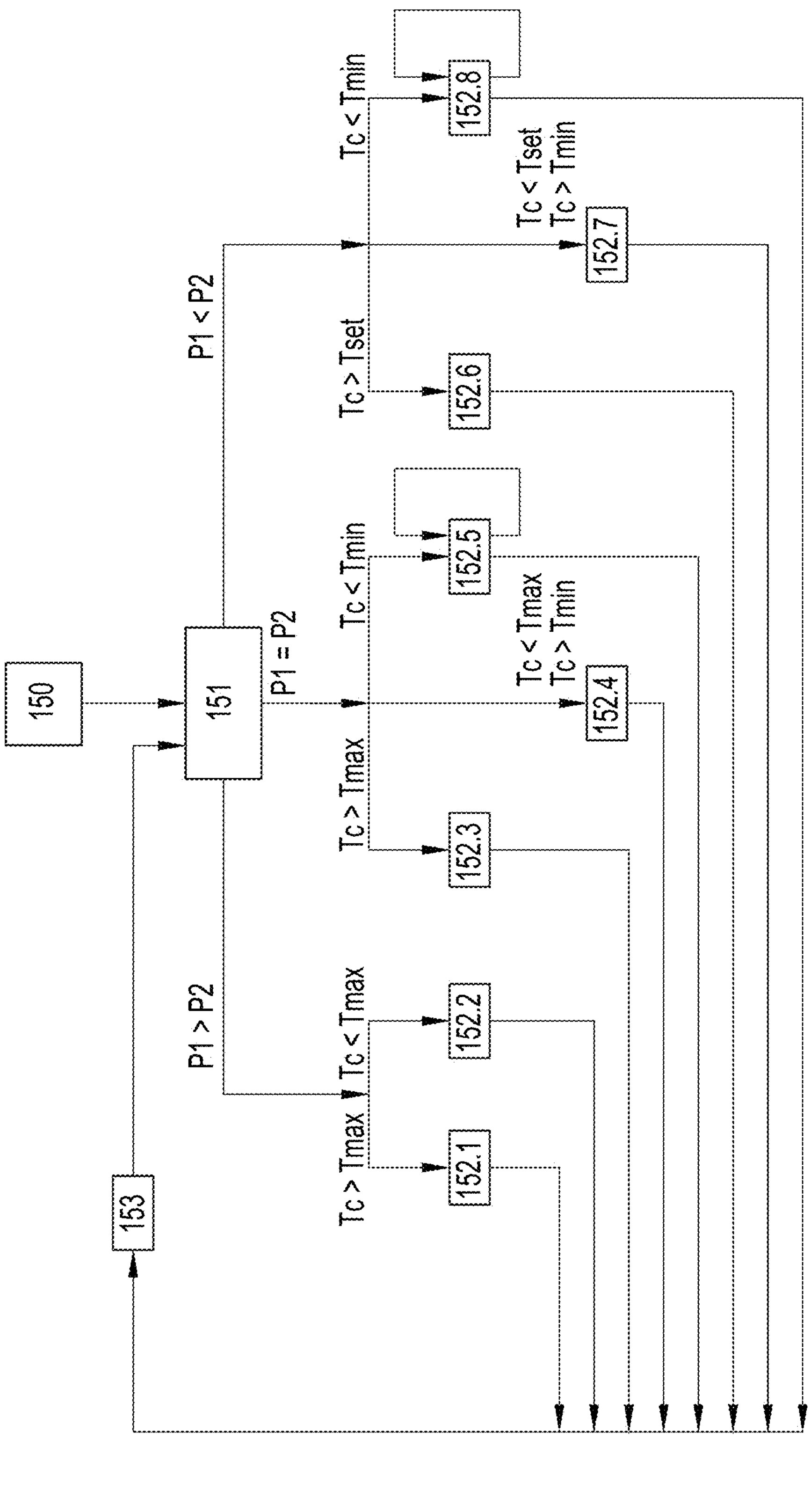

150
151
P1 > P2
P1 = P2
P1 < P2
Tc > Tmax
Tc < Tmax
Tc > Tmax
Tc < Tmin
Tc < Tmax
Tc > Tmin
Tc > Tset
Tc < Tmin
Tc < Tset
Tc > Tmin
152.1
152.2
152.3
152.4
152.5
152.6
152.7
152.8
153

FIG.2

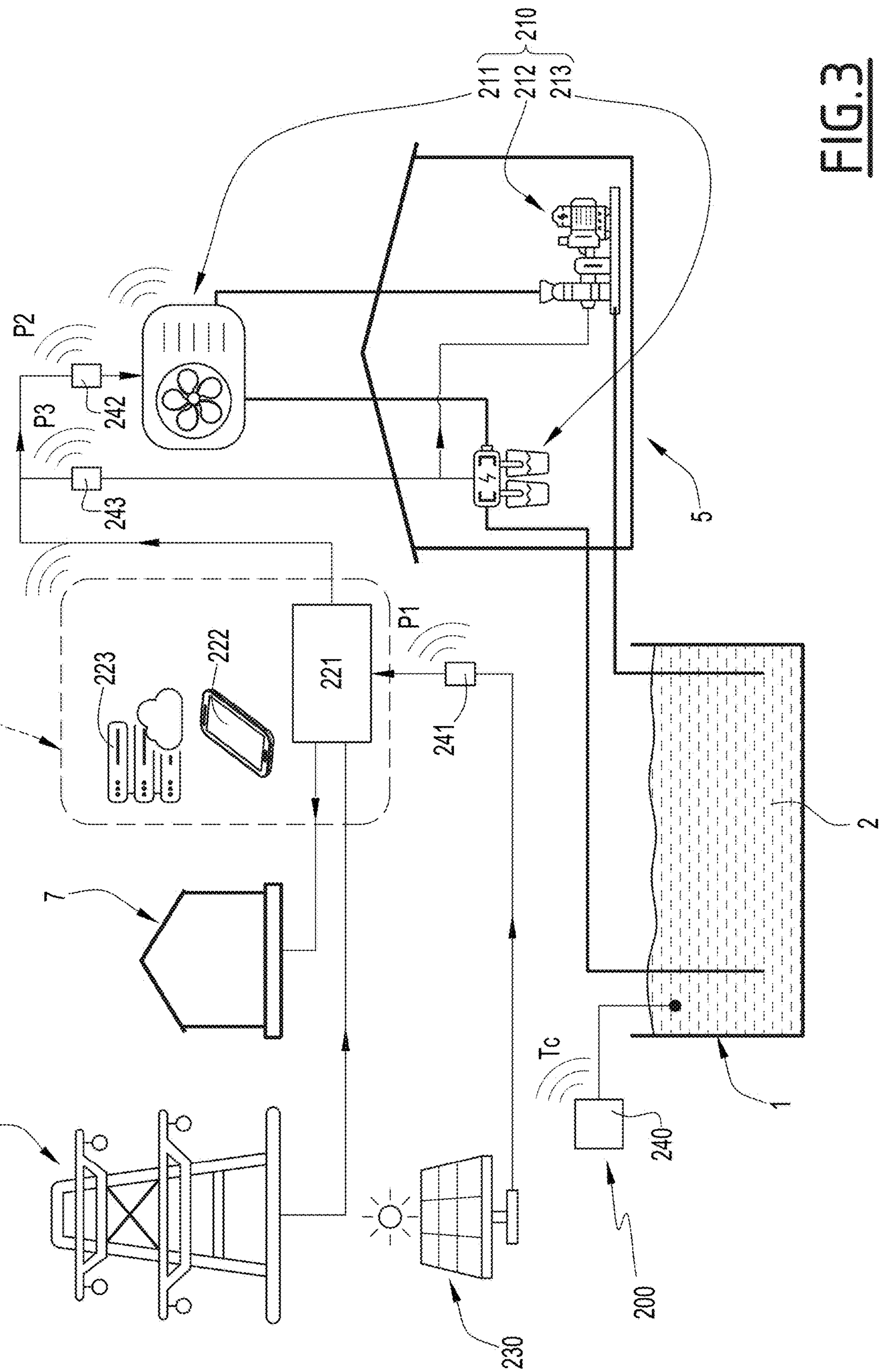

210
211
212
213
P2
P3
242
243
5
220
223
222
221
P1
241
7
6
2
Tc
1
240
200
230

FIG.3

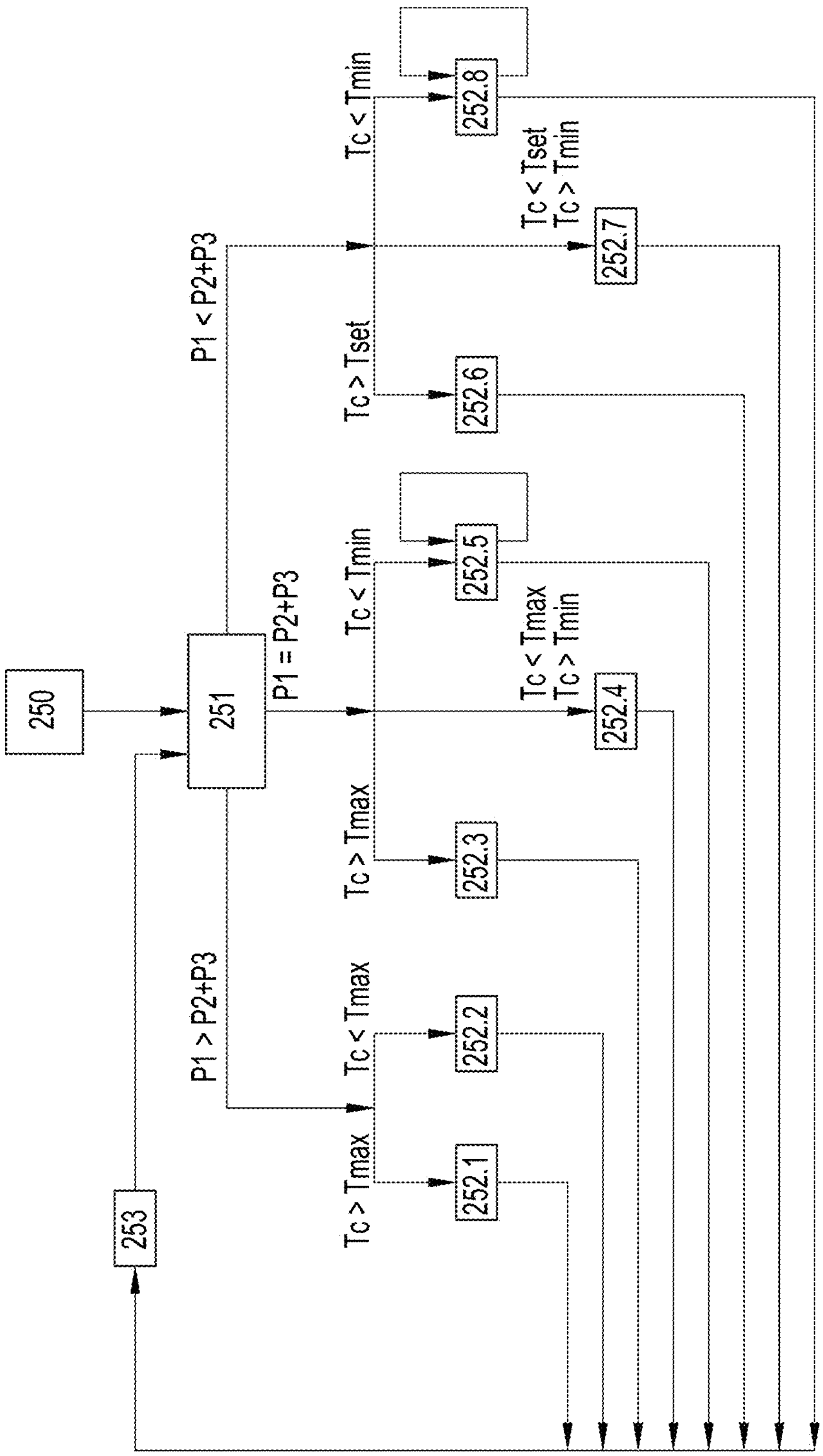

250
251
253
P1 > P2+P3
P1 = P2+P3
P1 < P2+P3
Tc > Tmax
Tc < Tmax
Tc > Tmax
Tc < Tmax
Tc > Tmin
Tc < Tmin
Tc > Tset
Tc < Tset
Tc > Tmin
Tc < Tmin
252.1
252.2
252.3
252.4
252.5
252.6
252.7
252.8

FIG. 4

SYSTEM AND METHOD FOR REGULATING A BATHING POOL, SUCH AS A SWIMMING POOL OR A SPA

REFERENCE TO RELATED APPLICATION

[0001] This application is a U.S. non-provisional application claiming the benefit of French Patent Application No. 24 01552 filed on Feb. 16, 2024, the contents of which are incorporated herein by reference in their entirety.

TECHNICAL FIELD OF THE INVENTION

[0002] The present invention relates to a system for regulating a bathing pool, such as a swimming pool or a spa. Same also relates to a method for regulating a bathing pool.

BACKGROUND OF THE INVENTION

[0003] To heat the water of a bathing pool, in particular an individual one, it is increasingly common to use a heat pump, typically a so-called air-to-water heat pump that allows the water of the bathing pool to be heated directly by transferring heat thereto from the air. In practice, the heat pump is electrically connected to a collective network from which same draws the electrical power the pump consumes during the operation thereof, in particular for heating water. The heat pump is usually regulated according to the current temperature of the water in the bathing pool: for example, as soon as the current temperature is below a setpoint temperature, the heat pump is activated to heat the water, and as soon as the current temperature rises above the setpoint temperature, the heat pump is deactivated to stop heating the water. Such approach is satisfactory for the thermal comfort of the user of the bathing pool but induces substantial energy consumption from the collective grid and hence high operating costs, as well as a significant carbon footprint since the electricity of the collective grid is not low-carbon.

[0004] To improve such situation, it is now proposed on the market to combine the heat pump with an individual renewable electricity generator, typically solar panels, e.g. installed on the roof of a pool house adjacent to the bathing pool or installed on the ground near the bathing pool. The user can then carry out self-consumption of electricity, i.e. make the heat pump consume the power produced by the generator, replacing at least partially, or even totally, the power drawn from the collective network. Such solution has a real advantage in terms of cost and carbon footprint, but remains subject to certain constraints, in particular fluctuations or even intermittent electricity production by the generator, e.g. in connection with sunlight, which is of course intermittent due to the alternation of day/night, but also fluctuating due to changing weather conditions.

SUMMARY OF THE INVENTION

[0005] The goal of the present invention is to propose a new system and a new method for regulating a bathing pool, which reconcile low-carbon energy and economic performance with thermal comfort for the user of the bathing pool.

[0006] To this end, the subject matter of the invention is a regulation system of a bathing pool, which system comprises:

[0007] a temperature sensor which measures a current temperature corresponding to the temperature of the water contained in a bathing pool,

[0008] an individual generator, which is suitable for producing renewable electricity,

[0009] a first electrical measuring device, which is suitable for determining a first power corresponding to the electrical power produced by the generator,

[0010] pool equipment, including a heat pump, which has adjustable electric power and is suitable for heating water,

[0011] a second electrical measuring device, which is suitable for determining a second power corresponding to the electrical power consumed by the heat pump,

[0012] in the case where the pool equipment includes one equipment item or equipment, other than the heat pump, a third electrical measuring apparatus which is suitable for determining a third power corresponding to the electrical power consumed by the equipment item or equipment, the third power being considered zero in the case where the pool equipment includes only the heat pump, and

[0013] a control system, which is suitable for regulating the power consumed by the heat pump when the heat pump heats the water, as well as for operating the pool equipment selectively:

[0014] in a hybrid mode, wherein the control system supplies the pool equipment jointly by a collective network and by the generator, by making the pool equipment consume the entire power produced by the generator, and

[0015] in a renewable mode, wherein the control system causes the pool equipment to be supplied by the generator without the pool equipment being supplied by the collective grid, by sending to a domestic grid any excess between the power produced by the generator and the power consumed by the pool equipment,

and wherein the control system is configured to repeatedly control, at successive instants during a steady operating state of the control system, the pool equipment at each of said instants from the current temperature and the first, second and third powers, each of said current temperature and the first, second and third powers being either measured at the instant considered or averaged over a predetermined time interval ending at the instant considered, so that:

[0016] when (i) the first power is both greater than the third power and less than or equal to the sum of the second and third power and (ii) the current temperature is less than a predetermined minimum temperature, the control system operates the pool equipment in hybrid mode and controls the heat pump to heat the water, adjusting the power consumed by the heat pump to a maximum rated value, as long as the current temperature does not exceed the minimum temperature,

[0017] when (i) the first power is both greater than the third power and less than or equal to the sum of the powers and (ii) the current temperature is greater than the minimum temperature, the control system operates the pool equipment in renewable mode and controls the heat pump to selectively:

[0018] heat the water, adjusting the power consumed by the heat pump to a first value determined by the control system, which is less than or equal to the difference between the first power and the third power, and

[0019] not heat the water,

[0020] when (i) the first power is greater than the sum of the second and third power and (ii) the current temperature is greater than a predetermined maximum temperature, which is greater than the minimum temperature, the control system operates the pool equipment in renewable mode and controls the heat pump not to heat the water, and

[0021] when (i) the first power is greater than the sum of the second and third power and (ii) the current temperature is less than the maximum temperature, the control system operates the pool equipment in renewable mode and controls the heat pump to heat the water, adjusting the power consumed by the heat pump to a second value determined by the control system, which is less than or equal to the difference between the first power and the third power.

[0022] A further subject matter of the invention is a method of regulating a bathing pool, wherein are arranged:

[0023] a temperature sensor which measures a current temperature corresponding to the temperature of a water contained in a bathing pool,

[0024] an individual generator, which is suitable for producing renewable electricity,

[0025] a first electrical measuring device, which is suitable for determining a first power corresponding to the electrical power produced by the generator,

[0026] pool equipment, including a heat pump, which has adjustable electric power and is suitable for heating water,

[0027] a second electrical measuring device, which is suitable for determining a second power corresponding to the electrical power consumed by the heat pump, and

[0028] in the case where the pool equipment includes one equipment item or equipment, other than the heat pump, a third electrical measuring apparatus which is suitable for determining a third power corresponding to the electrical power consumed by the equipment item or equipment, the third power being considered zero in the case where the pool equipment includes only the heat pump, and

wherein pool equipment is operated selectively:

[0029] in a hybrid mode, wherein the pool equipment is supplied jointly by a collective network and by the generator, making the pool equipment consume all the power produced by the generator, and

[0030] in a renewable mode, wherein the pool equipment is supplied by the generator without the pool equipment being supplied by the collective network, by sending to a domestic network any excess between the power produced by the generator and the power consumed by the pool equipment,

and wherein, repeatedly at successive times during a steady operating state, the pool equipment is controlled at each of said times from the current temperature and the first, second and third powers, each of said current temperature and said first, second and third powers being either measured at the instant in question or averaged over a predetermined time interval ending at the instant in question, so that:

[0031] when (i) the first power is both greater than the third power and less than or equal to the sum of the second and third power and (ii) the current temperature is less than a predetermined minimum temperature, the pool equipment is operated in hybrid mode and the heat pump is controlled to heat the water, adjusting the power consumed by the heat pump to a maximum rated value, as long as the current temperature does not exceed the minimum temperature,

[0032] when (i) the first power is both greater than the third power and less than or equal to the sum of the powers and (ii) the current temperature is greater than the minimum temperature, the pool equipment is operated in the renewable mode and the heat pump is controlled to selectively:

[0033] heat the water, adjusting the power consumed by the heat pump to a first value that is less than or equal to the difference between the first power and the third power, and

[0034] not heat the water,

[0035] when (i) the first power is greater than the sum of the second and third power and (ii) the current temperature is greater than a predetermined maximum temperature, which is greater than the minimum temperature, the pool equipment is operated in the renewable mode and the heat pump is controlled so as not to heat the water, and

[0036] when (i) the first power is greater than the sum of the second and third power and (ii) the current temperature is less than the maximum temperature, the pool equipment is operated in the renewable mode and the heat pump is controlled to heat the water, adjusting the power consumed by the heat pump to a second value which is less than or equal to the difference between the first power and the third power.

[0037] One of the ideas underlying the invention is to combine, for the purpose of regulating a bathing pool, an individual generator of renewable electricity, in particular a solar and/or wind generator, and pool equipment including a heat pump which has a variable electric power. Such a heat pump is commonly referred to in the field as an "inverter" heat pump, as explained in greater detail thereafter. The invention takes advantage of the fact that the power consumed by the heat pump can be modulated, in order to regulate in real time, i.e. with a predetermined operating frequency of a few seconds or minutes, the operation of the pool equipment depending not only upon the current temperature of the water in the bathing pool, but also of instantaneous and/or averaged measurements of a plurality of electrical powers, namely the power produced by the generator and the power consumed by the heat pump, and, when the pool equipment includes one or a plurality of equipment items others than the heat pump, the power consumed by the equipment item(s). Thereby, as explained in greater detail thereafter, when the power produced by the generator is "low", in particular with respect to the needs of the bathing equipment, and when the current temperature of the water is "too low", in particular with respect to the level of comfort desired by the user, the pool equipment operates in a hybrid mode, where the pool equipment is supplied jointly by the collective network and the generator, consuming all the power, zero where appropriate, produced by the generator, and the heat pump is controlled to heat the water by bringing to the "maximum" the consumed power thereof, and in that the current temperature of the water rises sufficiently, typically to a level of comfort acceptable for the user. Conversely, and as also explained in more detail thereafter, when the power produced by the generator is "high", in particular compared to the needs of the pool equipment, the pool equipment operates in a renewable mode, where the pool equipment is supplied by the generator without being supplied by the collective network, and the heat pump is controlled so as, according to the current temperature of the water, to either to heat the water, by modifying the power consumed by the heat pump to what is actually available, or not heating the water, while providing, in any cases, that any surplus between the power produced by the generator and power consumed by the pool equipment is sent to a domestic network, typically an individual electrical network of the household of the user of the bathing pool, in particular to supply electrical appliances forming loads of the domestic network. It is thereby possible to "superheat" the water without consuming power drawn from the collective grid, which amounts to using the water of the bathing pool as a means of storing heat, the heat thereby stored serving thereafter, despite a subsequent gradual cooling of the water, e.g. due to the reduction or even the stopping of the electricity production by the generator, to maintain the water of the bathing pool at a level of comfort acceptable to the user. Moreover, when the power produced by the generator is "low" but the current temperature of the water is not "too low", the pool equipment also operates in renewable mode and the heat pump is controlled to either heat the water or not heat the water, in particular according to the current temperature and depending on whether the pool equipment includes an equipment items or equipment other than the heat pump, as discussed in detail thereafter.

[0038] In all cases, the system and the method according to the invention make it possible to take maximum advantage of the power produced by the renewable electricity generator, by providing, in the renewable mode, to modulate in time the power consumed by the heat pump, in order to adapt in real time to the actual production of the generator and to the current temperature of the water. The system and the method according to the invention thereby make it possible to maximize a low-carbon self-consumption, while guaranteeing the control of the thermal comfort of the user of the bathing pool.

[0039] According to advantageous additional features of the system and/or of the method according to the invention, taken individually or according to all technically possible combinations:

- **[0040]** Said first value and/or said second value are equal to the difference between the first power and the third power.
- **[0041]** The control system is configured to further control, at each of said instants, the pool equipment so that:
  - **[0042]** when (i) the first power is both greater than the third power and equal to the sum of the second and third power and (ii) the current temperature is both greater than the minimum temperature and less than the maximum temperature, the control system controls the heat pump to heat the water, adjusting the power consumed by the heat pump to said first value, and
  - **[0043]** when (i) the first power is both higher than the third power and equal to the sum of the second and third power and (ii) the current temperature is higher than the maximum temperature, the control system controls the heat pump so as not to heat the water.
- **[0044]** The control system is configured to further control, at each of said instants, the pool equipment so that:
  - **[0045]** when (i) the first power is both greater than the third power and equal to the sum of the second and third power and (ii) the current temperature is both greater than the minimum temperature and less than a predetermined intermediate temperature, which is comprised between the minimum temperature and the maximum temperature, the control system controls the heat pump to heat the water, adjusting the power consumed by the heat pump to said first value, and
  - **[0046]** when (i) the first power is both greater than the third power and less than the sum of the second and third power and (ii) the current temperature is greater than the intermediate temperature, the control system controls the heat pump to selectively:
    - **[0047]** heat the water, adjusting the power consumed by the heat pump to said first value, and
    - **[0048]** not heat the water.
- **[0049]** The maximum and minimum temperature are calculated by the control system from a setpoint temperature, which is entered in the control system and which is comprised between the maximum and minimum temperature.
- **[0050]** The intermediate temperature is equal to the setpoint temperature.
- **[0051]** The pool equipment includes only the heat pump.
- **[0052]** The pool equipment includes, as equipment other than the heat pump, a filtration pump and/or a water treatment device.
- **[0053]** The control system is configured to further control, at least some of said instants, the pool equipment, on the basis of a weather forecast.

BRIEF DESCRIPTION OF THE DRAWINGS

[0054] The invention will be better understood upon reading the following description, given only as an example and making reference to the drawings, wherein:

[0055] FIG. **1** is a diagram of a first embodiment of a regulation system of a bathing pool;

[0056] FIG. **2** is a flowchart of a method of regulation implemented by the regulation system shown in FIG. **1**;

[0057] FIG. **3** is a view similar to FIG. **1**, illustrating a second embodiment of a regulation system of the bathing pool; and

[0058] FIG. **4** is a view similar to FIG. **2**, illustrating a flowchart of a regulation method implemented by the regulation system shown in FIG. **3**.

DETAILED DESCRIPTION OF THE INVENTION

[0059] FIG. **1** shows a bathing installation comprising an individual or collective bathing pool **1**, e.g. an individual swimming pool. The bathing pool **1** contains water **2** wherein one or more users of the bathing pool **1** can bathe. The specific features of the bathing pool **1** are not limiting, e.g. the bathing pool may be buried, semi-buried or above ground.

[0060] In the example considered in FIG. **1**, the bathing installation further comprises a filtration pump **3**, which makes it possible to suck the water **2** from the bathing pool **1** and to pass same through a filter integrated into the filtration pump **3** before returning the water to the bathing pool **1**. The bathing installation shown in FIG. **1** further comprises a water treatment device **4**, which makes it possible to automatically control and correct the quality of the water **2**, typically by electrolysis and/or mixing with chemical agents and/or etc. The filtration pump **3** and the water treatment device **4** are herein installed in a pool house **5** adjoining the bathing pool **1**. The specificities of the filtration pump **3** and of the water treatment device **4** are not limiting, such equipment being well known in the field.

[0061] In all cases, the bathing installation of FIG. **1** comprises a regulation system **100** making it possible to control and regulate at least one physical quantity relating to the bathing pool **1**. In the embodiment shown in FIG. **1**, the regulation system **100** thereby serves to control and regulate the temperature of the water **2**, as explained in detail hereinafter.

[0062] The regulation system **100** comprises pool equipment **110** which, in the embodiment of FIG. **1**, consists of a heat pump **111** apt to heat the water **2**. The heat pump **111** is e.g. a so-called air-water heat pump which is suitable for heating the water **2** by transferring heat from the air to the latter. In the example illustrated in FIG. **1**, the water entering the heat pump **111** to be heated by the latter comes from the filtration pump **3**, which sucks the water **2** directly from the bathing pool **1**, and the water leaving the heat pump **111** is sent to the bathing pool **1** via the water treatment device **4**. Other arrangements are conceivable.

[0063] In all cases, the electrical power of the heat pump **111** can be modulated. The heat pump **111** can also be considered as "modulating" or "speed-regulated". In the field, such a heat pump with electrical power that can be modulated, is commonly referred to by the English term "inverter". Specifically, the electrical power consumed by the heat pump **111** for the purposes of the operation thereof is designed to be adjustable by varying in a controlled manner at least one operating parameter of one or a plurality of components of the heat pump **111**. For example, the heat pump **111** includes a compressor, the operating speed of which is variable in a controlled manner, and/or a fan, the operating speed of which is variable in a controlled manner, and/or an expansion valve, the pitch of which is variable in a controlled manner. Of course, depending on the specific nature of the heat pump **111**, one component or components of the latter, other than same just mentioned hereinabove, can be controlled to vary at least one of the operating parameters thereof, so as to make the power consumed by the heat pump **111** apt to be modulated, in other words variable.

[0064] Whatever the embodiment of the heat pump **111**, it should be understood that the heat pump **111** is thereby selectively controllable to heat the water **2**, in which case the heat pump **111** consumes a power adjustable to a value that can be set, and to not heat the water **2**, in which case the heat pump **111** consumes a minimum power, which may be considered as zero but which, in practice, is not zero while being low, because of the need to maintain a power supply to certain components, in particular electronic, of the heat pump **111**, even when the latter is not activated to heat the water **2**.

[0065] In order to control the power consumed by the heat pump **111**, the regulation system **100** comprises a control system **120** which is designed to regulate the power consumed by the heat pump **111** when the latter heats the water **2**. The control system **120** thereby controls the heat pump **111** to selectively heat the water, by adjusting the power consumed by the heat pump **111** to a value controlled by the control system **120**, and not to heat the water **2**. To this end, the control system **120** communicates with the heat pump **111**, in particular in order to transmit control instructions to the component(s) of the latter, the power consumed of which can be modulated. In practice, as discussed again thereafter, such exchange of data is carried out indifferently in a wired or wireless manner, via an ad hoc communication module of the heat pump **111**.

[0066] The control system **120** also makes it possible to control what electrically supplies the pool equipment **110**, herein the heat pump **111**, for the purpose of operating the pool equipment **110**. More precisely, the control system **120** is suitable for operating the pool equipment **110**, herein the heat pump **111**, selectively in a hybrid mode and in a renewable mode.

[0067] In the hybrid mode, the control system **120** makes the pool equipment **110**, herein the heat pump **111**, be supplied jointly by a collective grid **6**, which includes a collective electricity source and which is typically a low-voltage distribution grid, and by an individual generator **130**, which belongs to the regulation system **100** and which, in service, produces renewable electricity, such as solar electricity and/or wind electricity. As an example, the generator **130** includes one or a plurality of photovoltaic panels and thereby forms a photovoltaic generator, as illustrated schematically in FIG. **1**. Alternatively or additionally, the generator **130** includes one or a plurality of wind turbines and thereby forms a wind generator. Regardless of the embodiment of the collective network **6** and of the generator **130**, the control system **120** is designed, in hybrid mode, to make the pool equipment **110** consume all the power produced by the generator **130**, in order to minimize the power drawn from the collective network **6**, with the proviso that the instantaneous power produced by the generator **130** is potentially zero because of the conditions under which the generator **130** operates, more particularly depending upon the weather conditions.

[0068] In the renewable mode, the control system **120** makes the pool equipment **110**, herein the heat pump **111**, to be supplied by the generator **130** without the pool equipment being supplied by the collective network **6**. In addition, the control system **120** is designed to send, in the renewable mode, any excess power between the power produced by the generator **130** and the power consumed by the pool equipment **110**, herein the heat pump **111**, to an individual domestic network **7**. The domestic network **7** is typically the network of a building adjoining the bathing pool **1**, e.g. the electrical network of a household of the user of the bathing pool **1**. The domestic network **7**, the embodiment of which is not limiting, typically includes loads including e.g. domestic appliances, such as lighting, household appliances, etc. The loads of the domestic network **7** advantageously include the filtration pump **3** and/or the water treatment device **4**. Of course, in practice, in order for the domestic network **7** to be supplied with electricity in all circumstances, the collective network **6** is connected to the domestic network **7** directly, i.e. independently of the regulation system **100**, the connection not being shown in FIG. **1** for the sake of simplification.

[0069] In order to operate the pool equipment **110**, herein the heat pump **111**, selectively in hybrid mode and in renewable mode, the control system **120** comprises an electrical connection unit **121** by which the generator **130**, the collective network **6** and the domestic network **7**, as well as the pool equipment **110**, herein the heat pump **111**, are electrically connected to each other. To this end, the electrical connection unit **121** comprises e.g. a connection terminal block and/or relays, advantageously associated with appropriate electrical protections. The embodiment of the electrical connection unit **121** is not limiting as long as same ensures a flow of current suitable for the hybrid or renewable mode, wherein the control system **120** operates the pool equipment **110**, herein the heat pump **111**, more particularly for making the pool equipment **110**, herein the heat pump **111**, be supplied by the generator **130** and/or the collective network **6** depending on whether the pool equipment **110** is to be operated selectively in the hybrid mode and in the renewable mode.

[0070] To control the operation and supply of the pool equipment **110**, herein the heat pump **111**, the control system **120** is configured to take into account a plurality of physical quantities within the regulation system **100**, namely the temperature of the water **2**, the electrical power produced by the generator **130** and the electrical power consumed by the heat pump **111**, in other words, herein, the electrical power consumed by the pool equipment **110**. For this purpose, as shown in FIG. **1**, the regulation system **100** includes:

- **[0071]** a temperature sensor **140**, which measures a current temperature, denoted subsequently by Tc, corresponding to the water temperature **2**, and which transmits the current temperature Tc thereby measured, to the control system **120**,
- **[0072]** a wattmeter **141** which measures a power, denoted P**1** thereafter, corresponding to the electric power produced by the generator **130**, and which transmits the power P**1** thereby measured to the control system **120**, and
- **[0073]** a wattmeter **142**, which measures a power, denoted P**2** thereafter, corresponding to the electrical power consumed by the heat pump **111**, and which transmits the power P**2** thereby measured to the control system **120**.

[0074] The specificities of the temperature sensor **140** and the wattmeters **141** and **142** are not limiting, each of the components belonging a technology known per se. More particularly, the transmission of the measurements from the temperature sensor **140** and the wattmeters **141** and **142** to the control system **120** is carried out indifferently in a wired or wireless manner. As a practical example, but not limited to, the sensor **140** is integrated into the heat pump **111** and the measurements thereof are transmitted to the control system **120** via the communication module of the heat pump, whereas the power meters **141** and **142** are integrated into the electrical connection unit **121** while being in wired communication, typically via a bus, with the communication module of the heat pump **111** for transmission to the control system **120**.

[0075] Regardless of the embodiment of the temperature sensor **140** and the wattmeters **141** and **142**, it should be noted that the measurements made by such components and the transmission thereof to the control system **120** are carried out in real time, i.e. with a sufficiently high operating frequency to inform the control system **120** with the values Tc, P**1** and P**2** which, at the moment when the control system receives the values, are representative, within usual tolerances, of the effective temperature of the water **2**, of the power actually produced by the generator **130** and of the power actually consumed by the heat pump **111**.

[0076] Also to control the operation and the supply of the pool equipment **110**, herein the heat pump **111**, the control system **120** is suitable for taking into account predetermined temperature values, which are e.g. defined by the user of the bathing pool, namely a maximum temperature, which is denoted by Tmax, a minimum temperature, which is denoted by Tmin and which is lower than the maximum temperature Tmax, and which is denoted by Tset and which is comprised between the maximum temperature Tmax and the minimum temperature Tmin and which may be equal to one or the other of the latter. According to a preferential implementation, the user defines the setpoint temperature Tset and the control system **120** deduces therefrom the maximum temperature Tmax and the minimum temperature Tmin by calculation: for example, the maximum temperature Tmax is calculated by adding to the setpoint temperature Tset a predetermined or user-defined higher deviation, and the minimum temperature Tmin is calculated by subtracting from the setpoint temperature Tset a predetermined or user-defined lower deviation, with the proviso that the lower deviation can be equally well equal or different from the upper deviation. As a numerical example, but not limited to, the user can thereby define the setpoint temperature Tset as being equal to 28° C., the upper deviation as being equal to 2° C., and the lower deviation as being equal to 1° C.: in such case, the maximum temperature Tmax is calculated by the control system **120** as being equal to 30° C. and the minimum temperature Tmin is calculated by the control system **120** as being equal to 27° C. Alternatively, the setpoint temperature Tset, the maximum temperature Tmax and minimum temperature Tmin are each defined independently of each other. In any case, the control system **120** advantageously comprises an interface **122** enabling the user to enter into the control system **120** the information necessary for defining the setpoint temperature Tset, the maximum temperature Tmax and the minimum temperature Tmin. As an example, in FIG. **1**, the interface **122** is provided by a smartphone, in wireless communication with the rest of the control system **120**; alternatively, not shown, the interface **122** is integrated into the heat pump **111** and connected to the rest of the control system **120** via the communication module of the heat pump **111**.

[0077] Taking into account the foregoing, it will be understood that the control system **120** includes a local hardware part, including in particular the electrical connection unit **121** and the interface **122**. The processing, by the control system **120**, of the measurement signals coming from the temperature sensor **140** and from the wattmeters **141** and **142**, as well as the generation of control signals, by the control system **120**, to control the operation and the supply of the pool equipment **110**, herein the heat pump **111**, are performed by a computer part of the control system **120**, which, in the embodiment illustrated in the figures, is at least partly implemented as a software application which is implemented on a remote computer means **123**, such as a server, in particular a remote computer, such as a mobile computer-based on a computer or a computer-cloud-based means, such as a server, in particular dematerialized in a cloud, or mobile, such as a smartphone or a tablet; the computer means **123** being in wireless communication with the local equipment part of the control system **120**. In a variant, the data processing part of the control system **120** is produced, in part or even in full, by electronic components integrated into the local equipment part of the control system **120**, e.g. arranged in the electrical connection unit **121**.

[0078] In any case, the control system **120** is configured to implement a method of regulation of the bathing pool **1** shown in FIG. **1**. Steps of the regulation method are illustrated in FIG. **2**.

[0079] The regulation method thereby includes an initial step **150** during which the regulation system **100** is started. During the initial step **150**, the pool equipment **110**, herein the heat pump **111**, as well as the generator **130**, more particularly, are started, in other words activated. The practical specificities of the initial step **150** are not limiting as long as the initial step **150** lasts long enough for the regulation system **100** to reach an operating state that is stable, in other words a steady operating state. The duration of the initial step **150** is e.g. several tens of seconds. The initial step **150** ends at the end of said duration, the latter being able to be preset and thereby counted down by the control system **120** or else considered to have been reached at the moment when the control system **120** receives a signal representative of the aforementioned steady state.

[0080] In any cases, at the end of the initial step **150**, the regulation method passes from the initial step **150** to an acquisition and processing step **151** during which the control system **120** acquires the current temperature Tc and the powers P**1** and P**2**, as measured by the temperature sensor **140** and the wattmeters **141** and **142**, respectively, at the instant in question, and processes the current temperature Tc and the powers P**1** and P**2** to deduce therefrom a step by which the regulation method continues, chosen from a plurality of possible steps **152**.**1** to **152**.**8**.

[0081] Before discussing in detail each of the steps **152**.**1** to **152**.**8** of the regulation method, it should be noted that each of the steps **152**.**1** to **152**.**8** loops to the acquisition and processing step **151** via a time-delay step **153** during which the control system **120** counts down a predetermined duration, maintaining unchanged the operating state of the pool equipment **110**, as obtained at the end of the step considered among the steps **152**.**1** to **152**.**8**. The time-delay step **153** thereby serves to add in a time interval between two successive repeated occurrences of the acquisition and processing step **151** and thus, during the aforementioned steady operating state, to repeat the acquisition and processing step **151** at successive instants which are separated from one another by the duration of the time-delay step **153**. In practice, the duration of the time-delay step **153** is preprogrammed in the control system **120**, being modifiable, where appropriate if need be, or even adjustable, if need be. Such duration may be constant whatever the step **152**.**1** to **152**.**8** which precedes the counting down of the duration at the time-delay step **153**, or it may be different depending on the step, among the steps **152**.**1** to **152**.**3**, which precedes the counting down of the duration at the time-delay step **153**.

[0082] Considerations relating to steps **152**.**1** to **152**.**8**, respectively, will now be described in detail hereinafter.

[0083] When, during the acquisition and processing step **151**, the control system **120** determines, within a tolerance, e.g. 10% or 5%, that the power P**1** is greater than the power P**2** and that the current temperature Tc is greater than the maximum temperature Tmax, the regulation method moves from the acquisition and processing step **151** to step **152**.**1**, before moving without delay to the time-delay step **153**. In step **152**.**1**, the control system **120** is programmed to operate the pool equipment **110**, herein the heat pump **111**, in the renewable mode and to control the heat pump **111** so as not to heat the water **2**: in this way, the heat pump **111** is not used to heat the water **2** of the bathing pool **1** further, since the water **2** is considered to be already hot enough, and a maximum of the power produced by the generator **130** is sent to the domestic network **7** to maximize self-consumption by the domestic network **7**, more particularly for supplying the pump **3** and the water treatment device **4** without needing, if possible, to draw from the collective network **6**.

[0084] When, during the acquisition and processing step **151**, the control system **120** determines, to within the aforementioned tolerance, that the power P**1** is greater than the power P**2** and that the current temperature Tc is less than the maximum temperature Tmax, the regulation method moves from the acquisition and processing step **151** to step **152**. **2**, before moving without delay to the time-delay step **153**. In step **152**.**2**, the control system **120** is programmed to operate the pool equipment **110**, herein the heat pump **111**, in the renewable mode and to control the heat pump **111** to heat the water **2**, by adjusting the power consumed by the heat pump **111** to a value which is determined by the control system **120** to be equal to the power P**1**: in this way, the power consumed by the heat pump **111** is modulated upwards to correspond substantially to the entire power produced by the generator **130**. Self-consumption is thereby maximized for heating the water **2** and, as soon as the current temperature Tc is higher than the setpoint temperature Tset, the water **2** thereby "overheated" with respect to the setpoint temperature Tc, is used as a means of storing heat.

[0085] When, during the acquisition and processing step **151**, the control system **120** determines, to within the aforementioned tolerance, that the power P**1** is equal to the power P**2** and that the current temperature Tc is greater than the maximum temperature Tmax, the method moves from the acquisition and processing step **151** to step **152**.**3**, before moving without delay to the time-delay step **153**. In step **152**.**3**, the control system **120** is programmed to operate the pool equipment **110**, herein the heat pump **111**, in renewable mode and to control the heat pump **111** not to heat the water **2**: the considerations relating to the step **152**.**3** being similar to same for step **152**.**1**.

[0086] When, during the acquisition and processing step **151**, the control system **120** determines, to within the aforementioned tolerance, that the power P**1** is equal to the power P**2** and that the current temperature Tc is both greater than the minimum temperature Tmin and less than the maximum temperature Tmax, the regulation method moves from the acquisition and processing step **151** to step **152**.**4**, before moving without delay to the time-delay step **153**. In step **152**.**4**, the control system **120** is programmed to operate the pool equipment **110**, herein the heat pump **111**, in the renewable mode and to control the heat pump **111** to heat the water **2**, by adjusting the power consumed by the heat pump **111** to a value which is determined by the control system **120** to be equal to the power P**1**: in this way, the power consumed by the heat pump **111** is modulated in stabilization to correspond to substantially all the power produced by the generator **130**. The effects of the step **152.4** are similar to the effects of step **152.2**.

[0087] When, during the acquisition and processing step **151**, the control system **120** determines, to within the aforementioned tolerance, that the power P**1** is equal to the power P**2** and that the current temperature Tc is lower than the minimum temperature Tmin, the regulation method moves from the acquisition and processing step **151** to step **152.5**. In step **152.5**, the control system **120** is programmed to operate the pool equipment **110**, herein the heat pump **111**, in the hybrid mode and to control the heat pump **111** to heat the water **2**, adjusting the power consumed by the heat pump **111** to a maximum nominal value which is independent of the power P**1**: in this way, the electrical consumption of the heat pump **111** is not restricted or limited, but is increased to the nominal maximum to heat the water **2** as intensely as possible, so that the temperature **2** increases as rapidly as possible. Step **152.5** thereby serves to provide the thermal comfort of the user of the bathing pool **1**, by calling on the collective network **6** in order to heat the water **2** by the heat pump **111** as soon as the current temperature Tc becomes too cold. Also in step **152.5**, the current temperature Tc, as measured by the temperature sensor **140**, is, at regular intervals, acquired and processed by the control system **120** so that, as long as the current temperature Tc does not become greater than the minimum temperature Tmin, step **152.5** loops on itself, whereas, as soon as the current temperature Tc returns above the minimum temperature Tmin, the regulation method moves without delay from step **152.5** to the time-delay step **153**: in this way, as soon as the thermal comfort is reinstated, the regulation method reconsiders to cease calling upon the collective network **6**.

[0088] When, during the acquisition and processing step **151**, the control system **120** determines, to within the aforementioned tolerance, that the power P**1** is less than the power P**2** and that the current temperature Tc is greater than the setpoint temperature Tset, the regulation method moves from the acquisition and processing step **151** to step **152**. **6**, before moving without delay to the time-delay step **153**. In step **152.6**, the control system **120** is programmed to operate the pool equipment **110**, herein the heat pump **111**, in renewable mode and to control the heat pump **111** to heat the water **2**, by adjusting the power consumed by the heat pump **111** to a value which is determined by the control system **120** to be equal to the power P**1**: in this way, the power consumed by the heat pump **111** is modulated downwards to correspond to substantially all the power produced by the generator **130**. Self-consumption is thereby maximized for heating the water **2** and, despite the relative weakness of the power produced by the generator, it is sought to maintain the thermal comfort of the user without calling upon the collective network **6**.

[0089] When, during the acquisition and processing step **151**, the control system **120** determines, to within the aforementioned tolerance, that the power P**1** is lower than the power P**2** and that the current temperature Tc is both lower than the setpoint temperature Tset and higher than the minimum temperature Tmin, the regulation method moves from the acquisition and processing step **151** to step **152.7**, before moving without delay to the time-delay step **153**. In step **152.7**, the control system **120** is programmed to operate the pool equipment **110**, herein the heat pump **111**, in renewable mode and to control the heat pump **111** to heat the water, adjusting the power consumed by the heat pump **111** to a value that is determined by the control system **120** to be equal to the power P**1**: thereby, the considerations relating to step **152.7** are similar to same relating to step **152.6**.

[0090] Finally, when, during the acquisition and processing step **151**, the control system **120** determines, to within the aforementioned tolerance, that the power P**1** is less than the power P**2** and that the current temperature Tc is less than the minimum temperature Tmin, the regulation method moves from the acquisition and processing step **151** to step **152**. **8**. In step **152.8**, the control system **120** is programmed to operate the pool equipment **110**, herein the heat pump **111**, in the hybrid mode and to control the heat pump **111** to heat the water **2**, by adjusting the power consumed by the heat pump to the aforementioned maximum nominal value: the considerations relating to step **152.8** are thereby similar to same relating to step **152.5**. Also in a similar manner to step **152.5**, step **152.8** loops on itself as long as the current temperature Tc does not become higher than the minimum temperature Tmin, before moving without delay to the time-delay step **153** when the current temperature Tc rises above the minimum temperature Tmin.

[0091] Thereby, under a steady operating state, the regulation method illustrated in FIG. **2** takes into account in real time both the current temperature Tc and the powers P**1** and P**2** in order to determine, between the hybrid mode and the renewable mode, the mode in which to operate the pool equipment **110**, herein the heat pump **111**, and to control the power consumed by the heat pump **111**. As a result, it is possible to take maximum advantage of the power produced by the generator **130**, while maintaining the level of thermal comfort for the user of the bathing pool **1**.

[0092] In order to understand the advantages of the regulation method, two examples of situations of common use are envisaged hereinbelow, considered while the regulation system **100** is in a steady state.

[0093] According to a first example, at a given instant of the steady state, there is full sunshine so that the power P**1** is high, e.g. equal to 1500 W, the heat pump **111** consumes 1000 W and the water **2** of the bathing pool **1** has a temperature comprised between the minimum temperature Tmin and the maximum temperature Tmax:

- **[0094]** the method then implements what is provided for in step **152.2**, namely that the pool equipment **100**, herein the heat pump **111**, operates in the renewable mode (i.e. that if the pool equipment **100** was, just before the instant in question, already in the renewable mode, same remains therein while if the pool equipment **100** was, just before the instant in question, in the hybrid mode, same switches to the renewable mode) and the power consumed by the heat pump **111** is modulated upwards to reach 1500 W so as to heat more the water **2**;
- **[0095]** at the next instant, i.e. at the end of the duration of the time-delay step **153**, and considering that the current temperature Tc is still comprised between the minimum temperature Tmin and the maximum temperature Tmax and that the sunshine has not changed, the regulation method then implements what is provided for in step **152.4**, namely that the pool equipment **110** continues to operate in the renewable mode and the power consumed by the heat pump **111** is modulated in stabilization to stay at 1500 W so as to continue to heat the water **2**;

[0096] at each of the following instants and as long as the sunshine does not change, the regulation method continues to implement what is provided for in step **152.4**, as long as the current temperature remains between the minimum temperature Tmin and the maximum temperature Tmax;

[0097] if, at the next instant, the current temperature Tc is greater than the maximum temperature Tmax while the sunshine is unchanged, the regulation method implements what is provided for in step **152.3** so that the heat pump **111** stops heating the water **2** and all the power produced by the generator **130** is sent to the domestic network **7**.

[0098] According to a second example, at a given instant of the steady state, the sunshine conditions are poor so that the power P**1** is low, e.g. equal to 750 W, the PAC **111** consumes 1000 W and the current water temperature **2** is comprised between the minimum temperature Tmin and the setpoint temperature Tset:

[0099] the method then implements what is provided for in step **152.7**, namely that the pool equipment **110**, herein the heat pump **111**, operates in the renewable mode and the power consumed by the heat pump **111** is modulated downwards to reach 750 W so as to continue heating the water **2** but less intensely than at the preceding instant;

[0100] at the next instant, and considering that the current temperature is still between the minimum temperature Tmin and the setpoint temperature Tset and that the sunshine conditions have not changed, the method implements what is provided for in step **152.4**, namely that the pool equipment **110** continues to operate in the renewable mode and the power consumed by the heat pump **111** is modulated in stabilization to remain at 750 W so as to continue heating, a little, the water **2**;

[0101] at each of the following instants and as long as the sunshine conditions are the same, the regulation method continues to implement what is provided for in step **152.4**, as long as the current temperature remains comprised between the minimum temperature Tmin and the setpoint temperature Tset;

[0102] if, at the next instant, the current temperature Tc is lower than the minimum temperature Tmin while the sunshine conditions are unchanged, the regulation method implements what is provided for in step **152.5** so that the pool equipment **110**, herein the heat pump **111**, switches to hybrid mode and the power consumed by the heat pump **111** is modulated to the nominal maximum thereof, e.g. 2500 W, so as to heat the water **2** intensely.

[0103] According to a variant of the regulation method illustrated in FIG. **2**, each of the respective values of the current temperature Tc and of the powers P**1** and P**2**, which are considered at each occurrence of the acquisition and processing step **151**, may not be the instantaneous value corresponding to the instant considered, but a value averaged over a predetermined time interval ending at the instant considered. In practice, such time interval preferentially corresponds to the duration of the time-delay step **153**. Such an averaged value is particularly advantageous for the power P**1**, in order to smooth out the potential instantaneous variations linked to the conditions under which the generator **130** operates, more particularly depending upon the meteorological conditions.

[0104] According to another variant of the regulation method illustrated in FIG. **2**, potentially cumulative with the preceding variant, it is provided that, in step **152.2** and/or in step **152.4** and/or in step **152.6** and/or in step **152.7**, the value at which the power consumed by the heat pump **111** is modulated by the control system **120** is not equal to the power P**1**, but is less than the power P**1**. It should be understood that the implementation of each of the steps **152.2**, **152.4**, **152.6** and **152.7** according to such variant leads to only a part of the power produced by the generator **130** being consumed by the heat pump **111** for the purpose of heating the water **2**, the rest of the power produced by the generator **130** being sent to the domestic network **7** since the pool equipment **110**, herein the heat pump **111**, then operates in the renewable mode. Such variant thus makes it possible to distribute the power produced by the generator **130** between the heating of the water **2** by the heat pump **111** and the electrical consumption by the loads of the domestic network **7**.

[0105] The variant described just above may in particular be of interest when the control system **120** takes into account at least one parameter other than the current temperature Tc and the powers P**1** and P**2** to control the pool equipment **110**. More particularly, according to an advantageous option, the control system **120** is configured so as, at least at certain instants of the aforementioned steady state, to control the pool equipment **110**, herein the heat pump **111**, on the basis of data representative of a weather forecast. As a result, it is possible to adapt the operation of the pool equipment **110** to the upcoming weather. As a first example, if the weather forecast is that strong sunshine is expected during the next six hours, a possibility of programming the control system **120** is, during the next two hours starting from the present instant, to set at less than the power P**1** the value at which the power consumed by the heat pump **111** is modulated by the control system **120** during steps **152.2**, **152.4**, **152.6** and **152.7**, while providing that, from the third hour on starting from the present instant, the aforementioned value will be brought to the power P**1** so that, if need be, the water **2** is sufficiently heated by the heat pump **111** during the steps **52.2**, **152.4**, **152.6** and **152.7** due to the entire power then produced by the generator **130**. As a second example, if the weather forecast is that strong sunshine is expected only for the next three hours, a possibility of programming the control system **120** is, during the next three hours starting from the present instant, to set at the power P**1** the value at which the power consumed by the heat pump **111** is modulated by the control system **120** during steps **152.2**, **152.4**, **152.6** and **152.7**, in order to heat the water **2** as much and quickly as possible by means of all the power then produced by the generator **130**.

[0106] FIG. **3** shows a bathing installation including the bathing pool **1** and a regulating system **200** according to an alternative embodiment to the regulation system **100**.

[0107] The regulation system **200** includes a generator **230**, a temperature sensor **240** and a wattmeter **241**, which are functionally or even structurally similar to the generator **130**, the temperature sensor **140** and the wattmeter **141**, respectively.

[0108] The control system **200** also includes a pool equipment **210**, including a heat pump **211** which is functionally or structurally similar to the heat pump **111**, as well as a power meter **242** associated with the heat pump **211**, which is functionally or structurally similar to the power meter **142**.

[0109] Unlike the pool equipment **110** which includes only the heat pump **111**, the pool equipment **210** includes, in addition to the heat pump **211**, one or a plurality of other equipment items, namely, herein, a filtration pump **212** and a water treatment device **213**. Considered in isolation, the filtration pump **212** is functionally, or even structurally, similar to the filtration pump **3** of the installation shown in FIG. **1**. Similarly, considered in isolation, the water treatment device **213** is functionally, or even structurally, similar to the water treatment device **4** of the installation shown in FIG. **1**. The filtration pump **212** and the water treatment device **213** are e.g. arranged in the pool house **5**. However, in the installation shown in FIG. **3**, the filtration pump **212** and the water treatment device **213** are designed to operate selectively in the hybrid mode and in the renewable mode, defined hereinabove in connection with the collective network **6** and the domestic network **7**.

[0110] To this end, following considerations similar to same described hereinabove for the control system **120**, a control system **220** of the regulation system **200** makes it possible to operate, selectively in the hybrid mode and in the renewable mode, the pool equipment **220**, in other words, herein, the heat pump **211**, the filtration pump **212** and the water treatment device **213**. Functionally, the control system **220** makes it possible to control the pool equipment **210** not only on the basis of the current temperature Tc and of the powers P**1** and P**2**, but also from the power consumed by the equipment of the pool equipment **210**, other than the heat pump **211**, in other words, herein, consumed by both the filtration pump **212** and the water treatment device **213**. To this end, the regulation system **200** includes a wattmeter **243** which measures a power, denoted P**3** thereafter, corresponding to the electrical power consumed by the equipment of the pool equipment **210**, other than the heat pump **211**, and which transmits the power P**3** thereby measured to the control system **220**. In practice, technical considerations similar to same discussed hereinabove in relation with the wattmeters **141** and **142** apply to the wattmeter **243**. Structurally, the control system **220** is advantageously similar to the control system **120**: as an example illustrated in FIG. **3**, the control system **220** comprises a local material part, including an electrical connection unit **221** and an interface **222**, which are similar to the electrical connection unit **121** and to the interface **122**, respectively, and a computer part, typically a software application, implemented on a remote computer means **223**, such as a dematerialized server, the computer part being similar to the aforementioned computer part of the control system **120**.

[0111] The control system **220** is configured to implement a method of regulation of the bathing pool **1** shown in FIG. **3**. Steps of the regulation method are illustrated in FIG. **4**.

[0112] The regulation method includes an initial step **250** which is similar to the initial step **150**.

[0113] At the end of the initial step **250**, the regulation method passes from the initial step **250** to an acquisition and processing step **251** during which the control system **220** acquires the current temperature Tc and the powers P**1**, P**2** and P**3**, as measured by the temperature sensor **240** and the wattmeters **241**, **242** and **243**, respectively, at the instant in question, and processes the current temperature Tc and the powers P**1**, P**2** and P**3** to deduce therefrom a step by which the regulation method continues, chosen from a plurality of possible steps **252.1** to **252.8**. Before describing each of the steps **252.1** to **252.8**, it should be noted that each of the latter loops to the acquisition and processing step **251** via a time-delay step **253** which is similar to the time-delay step **153**.

[0114] When, during the acquisition and processing step **251**, the control system **220** determines, within a tolerance, e.g. 10% or 5%, that the power P**1** is greater than the sum of the second and third powers P**2** and P**3** and that the current temperature Tc is greater than the maximum temperature Tmax, the regulation method moves from the acquisition and processing step **251** to step **252**. **1**, before moving without delay to the time-delay step **253**. In step **252.1**, the control system **220** is programmed to operate the pool equipment **210** in the renewable mode and to control the heat pump **211** so as not to heat the water **2**: in this way, the heat pump **211** is not used to further heat the water **2** of the bathing pool **1**, since the water **2** is considered to be already hot enough, and the production by the generator **230** maintains the electrical supply of the filtration pump **212** and the water treatment device **213**, any surplus of the production being sent to the domestic network **7** in order to maximize the self-consumption by the domestic network **7**.

[0115] When, during the acquisition and processing step **251**, the control system **220** determines, to within the aforementioned tolerance, that the power P**1** is greater than the sum of the second and third powers P**2** and P**3** and that the current temperature Tc is less than the maximum temperature Tmax, the regulation method moves from the acquisition and processing step **251** to step **252**. **2**, before moving without delay to the time-delay step **253**. In step **252.2**, the control system **220** is programmed to operate the pool equipment **210** in the renewable mode and to control the heat pump **211** to heat the water **2**, by adjusting the power consumed by the heat pump **211** to a value which is determined by the control system **220** to be equal to the difference between the power P**1** and the power P**3**: in this way, the power consumed by the heat pump **211** is modulated upwards to correspond to substantially all the power produced by the generator **230**, minus the power consumed by the power consumed by the filtration pump **212** and the water treatment device **213**. Self-consumption is thereby maximized for heating the water **2** and, as soon as the current temperature Tc is higher than the setpoint temperature Tset, the water **2** thereby "overheated" with respect to the setpoint temperature Tc, is used as a means of storing heat.

[0116] When, during the acquisition and processing step **251**, the control system **220** determines, to within the aforementioned tolerance, that the power P**1** is equal to the sum of the second and third powers P**2** and P**3** and that the current temperature Tc is greater than the maximum temperature Tmax, the method moves from the acquisition and processing step **251** to step **252.3**, before moving without delay to the time-delay step **253**. In step **252.3**, the control system **220** is programmed to operate the pool equipment **210**, herein the heat pump **211**, in renewable mode and to control the heat pump **211** not to heat the water **2**: the considerations relating to the step **252.3** are similar to same for step **252.1**.

[0117] When, during the acquisition and processing step **251**, the control system **220** determines, to within the aforementioned tolerance, that the power P**1** is equal to the sum of the second and third powers P**2** and P**3** and that the current temperature Tc is both greater than the minimum temperature Tmin and less than the maximum temperature Tmax, the regulation method moves from the acquisition and processing step **251** to step **252.4**, before moving without delay to the time-delay step **253**. In step **252.4**, the control system **220** is programmed to operate the pool equipment **210** in the renewable mode and to control the heat pump **211** to heat the water **2**, by adjusting the power consumed by the heat pump **211** to a value which is determined by the control system **220** to be equal to the difference between the power P**1** and the power P**3**: in this way, the power consumed by the heat pump **211** is modulated under stabilization to correspond to substantially all the power produced by the generator **230**, minus the power consumed by the power consumed by the filtration pump **212** and the water treatment device **213**. The effects of the step **252.4** are similar to the effects of step **252.2**.

[0118] When, during the acquisition and processing step **251**, the control system **220** determines, to within the aforementioned tolerance, that the power P**1** is equal to the sum of the second and third powers P**2** and P**3** and that the current temperature Tc is lower than the minimum temperature Tmin, the regulation method moves from the acquisition and processing step **251** to step **252.5**. In step **252.5**, the control system **220** is programmed to operate the pool equipment **210**, in the hybrid mode and to control the heat pump **211** to heat the water **2**, adjusting the power consumed by the heat pump **211** to a maximum nominal value which is independent of the powers P**1** and P**3**: in this way, the electrical consumption of the heat pump **211** is not restricted or limited, but is increased to the nominal maximum to heat the water **2** as intensely as possible, so that the temperature **2** increases as rapidly as possible. Step **252.5** thereby serves to provide the thermal comfort of the user of the bathing pool **1**, by calling on the collective network **6** in order to heat the water **2** by the heat pump **211** as soon as the current temperature Tc becomes too cold. Also in step **252.5**, the current temperature Tc, as measured by the temperature sensor **240**, is, at regular intervals, acquired and processed by the control system **220** so that, as long as the current temperature Tc does not become greater than the minimum temperature Tmin, step **252.5** loops on itself, whereas, as soon as the current temperature Tc returns above the minimum temperature Tmin, the regulation method moves without delay from step **252.5** to the time-delay step **253**: in this way, as soon as the thermal comfort is reinstated, the regulation method reconsiders to cease calling upon the collective network **6**.

[0119] When, during the acquisition and processing step **251**, the control system **220** determines, to within the aforementioned tolerance, that the power P**1** is both greater than the power P**3** and less than the sum of the second and third powers P**2** and P**3** and that the current temperature Tc is greater than the setpoint temperature Tset, the regulation method moves from the acquisition and processing step **251** to step **252.6**, before moving without delay to the time-delay step **253**. In step **252.6**, the control system **220** is programmed to operate the pool equipment **210** in the renewable mode and to control the heat pump **211** so as not to heat the water **2**: in this way, the heat pump **211** is not used to heat further the water **2** of the bathing pool **1**, since the water **2** is considered to be already sufficiently hot with respect to the setpoint temperature, and a maximum of the power produced by the generator **230** is, despite the relative weakness of the latter, sent into the domestic network **7** to maximize the self-consumption by the domestic network **7**, while favoring the aptitude to maintain the electrical power supply to the filtration pump **212** and to the water treatment device **213** by the generator **230**.

[0120] When, during the acquisition and processing step **251**, the control system **220** determines, to within the aforementioned tolerance, that the power P**1** is both greater than the power P**3** and less than the sum of the second and third powers P**2** and P**3** and that the current temperature Tc is both less than the setpoint temperature Tset and greater than the minimum temperature Tmin, the regulation method moves from the acquisition and processing step **251** to step **252.7**, before moving without delay to the time-delay step **253**. In step **252.7**, the control system **220** is programmed to operate the pool equipment **210** in the renewable mode and to control the heat pump **211** to heat the water **2**, by adjusting the power consumed by the heat pump **211** to a value which is determined by the control system **220** to be equal to the difference between the power P**1** and the power P**3**: in this way, the power consumed by the heat pump **211** is modulated downwards to correspond to substantially all the power produced by the generator **230**, minus the power consumed by the power consumed by the filtration pump **212** and the water treatment device **213**. Self-consumption is thereby maximized both in order to maintain the electrical power supply of the filtration pump **212** and of the water treatment device **213** by the generator **230** and in order to heat the water **2** and, despite the relative weakness of the power produced by the generator, it is sought to maintain the thermal comfort of the user without calling upon the collective network **6**.

[0121] Finally, when, during the acquisition and processing step **251**, the control system **220** determines, to within the aforementioned tolerance, that the power P**1** is both greater than the power P**3** and less than the sum of the second and third powers P**2** and P**3** and that the current temperature Tc is lower than the minimum temperature Tmin, the regulation method moves from the acquisition and processing step **251** to step **252.8**. In step **252.8**, the control system **220** is programmed to operate the pool equipment **210**, herein the heat pump **211**, in the hybrid mode and to control the heat pump **211** to heat the water **2**, by adjusting the power consumed by the heat pump to the aforementioned maximum nominal value: the considerations relating step **252.8** are thereby similar to same relating to step **252.4**. Also in a similar manner to step **252.4**, step **252.8** loops on itself as long as the current temperature Tc does not become higher than the minimum temperature Tmin, before moving without delay to the time-delay step **253** when the current temperature Tc rises above the minimum temperature Tmin.

[0122] Thereby, under a steady operating state, the regulation method illustrated in FIG. **4** takes into account in real time both the current temperature Tc and the powers P**1**, P**2** and P**3** in order to determine, between the hybrid mode and the renewable mode, the mode in which to operate the pool equipment **210**, in other words herein both the heat pump **211**, the filtration pump **211**, while making it possible to maintain the electrical power supply of the filtration pump **212** and of the water treatment device **213** by the generator **230**. As a result, it is possible to take maximum advantage of the power produced by the generator **230**, while maintaining the level of thermal comfort for the user of the bathing pool **1**.

[0123] In practice, the activation/deactivation of the filtration pump **212** can be controlled either by a control means distinct from the control system **220**, e.g. a manual control means or an automatic control means independent of the control system **220**, or by the control system **220**. The same applies to the activation/deactivation of the water treatment device **213**. In the case where the activation/deactivation of the filtration pump **212** and/or of the water treatment device **213** is controlled by the control system **220**, the regulation performed makes it possible to control and regulate, in addition to the temperature of the water **2**, the quality of the water **2** according to at least one physical quantity relating to the quality; moreover, the activation/deactivation can also be integrated into steps **252.1** to **252**. **8**, as well as being implemented by one or distinct steps which are programmed in the control system **220**. In any case, it will be understood that the regulation method advantageously provides, when the power P**1** is lower than the power P**3**, for the pool equipment **210** to operate in the hybrid mode in order to guarantee in all circumstances a sufficient electrical power supply to the filtration pump **212** and to the water treatment device **213**.

[0124] Furthermore, the two variants which have been envisaged hereinabove with regard to the regulation method illustrated in FIG. **2** are obviously applicable to the regulation method illustrated in FIG. **4**.

[0125] Thereby, according to such a first variant, each of the respective values of the current temperature Tc and of the powers P**1**, P**2** and P**3**, which are considered at each occurrence of the acquisition and processing step **251**, may not be the instantaneous value corresponding to the instant considered, but a value averaged over a predetermined time interval, typically the duration of the time-delay step **253**, ending at the instant considered.

[0126] According to such a second variant, provision is made that, in step **252**.**2** and/or in step **252**.**4** and/or in step **252**.**6** and/or in step **252**.**7**, the value at which the power consumed by the heat pump **211** is modulated by the control system **220** is not equal to the difference between the powers P**1** and P**3**, but is less than the difference between the powers P**1** and P**3**. As explained hereinabove, such variant may be of particular interest when the control system **220** takes into account, in addition to the current temperature Tc and the powers P**1**, P**2** and P**3**, at least one other parameter, more particularly data representative of a weather forecast.

[0127] It should be noted that the regulation systems **100** and **200** may be defined in identical terms provided that the regulation system is defined as including, in the case where the pool equipment includes one equipment item or equipment other than the heat pump, a wattmeter, such as the wattmeter **243**, i.e. a wattmeter which measures a power corresponding to the electrical power consumed by the equipment item or the equipment, the power measured by the wattmeter being considered as zero in the case where the pool equipment includes only the heat pump, as for the pool equipment **110**. Furthermore, taking into account and generalizing the foregoing regarding the control methods illustrated in FIGS. **2** and **4**, a control method for the bathing pool **1** of the installations shown in FIGS. **1** and **3** can be defined as providing that:

[0128] pool equipment, such as pool equipment **110** and **210**, is selectively operated, in particular through a control system such as control systems **120** and **220**:

[0129] in a hybrid mode, wherein the pool equipment is supplied jointly by a collective grid, such as the collective grid **6**, and by a renewable electricity generator, such as the generators **130** and **230**, making the pool equipment consume all the power produced by the generator, and

[0130] in a renewable mode, wherein the pool equipment is supplied by the generator without the pool equipment being supplied by the collective network, by sending to a domestic network, such as the domestic network **7**, any excess between the power produced by the generator and the power consumed by the pool equipment; and

[0131] repeatedly at successive instants during a steady operating regime, the pool equipment is controlled, in particular by means of the aforementioned control system, at each of said instants from the current temperature Tc and the powers P**1**, P**2** and P**3**, each of said current temperature Tc and of the powers P**1**, P**2** and P**3** being either measured at the instant considered or averaged over a predetermined time interval ending at the instant considered, so that:

[0132] when (i) the power P**1** is both greater than the power P**3** and less than or equal to the sum of the powers P**2** and P**3** and (ii) the current temperature Tc is less than a predetermined minimum temperature, such as the minimum temperature Tmin, the pool equipment is operated in hybrid mode and the heat pump, such as the heat pumps **111** and **211**, is controlled to heat the water **2**, adjusting the power consumed by the heat pump to a maximum nominal value, as long as the current temperature Tc does become higher than the minimum temperature,

[0133] when (i) the power P**1** is both greater than the power P**3** and less than the sum of the powers P**2** and P**3** and (ii) the current temperature Tc is greater than the minimum temperature, the pool equipment is operated in the renewable mode and the heat pump is controlled to selectively:

[0134] heat the water **2**, adjusting the power consumed by the heat pump to a value that is less than or equal to the difference between the powers P**1** and P**3**, and in particular:

[0135] when the power P**1** is both higher than the power P**3** and equal to the sum of the powers P**2** and P**3** and the current temperature Tc is both higher than the minimum temperature and lower than a maximum temperature, such as the maximum temperature Tmax,

[0136] or when the power P**1** is both higher than the power P**3** and lower than the sum of the power P**2** and P**3** and the current temperature Tc is both higher than the minimum temperature and lower than a predestined intermediate temperature, which is comprised between the minimum and maximum temperatures,

[0137] or else when the power P**1** is both higher than the power P**3** and lower than the sum of the powers P**2** and P**3** and the current temperature Tc is higher than the intermediate temperature, more particularly in the case where the pool equipment includes only the heat pump,

[0138] do not heat water **2**, and in particular:

[0139] when the power P**1** is both higher than the power P**3** and equal to the sum of the powers P**2** and P**3** and the current temperature Tc is higher than the maximum temperature,

[0140] or when the power P**1** is both higher than the power P**3** and lower than the sum of the powers P**2** and P**3** and the current temperature is higher than the intermediate temperature, more particularly in the case where the pool equipment includes at least one equipment other than the heat pump,

[0141] When (i) the power P**1** is greater than the sum of the powers P**2** and P**3** and (ii) the current temperature Tc is greater than the maximum temperature, the pool equipment is operated in the renewable mode and the heat pump is controlled so as not to heat the water, and

[0142] when (i) the power P**1** is greater than the sum of the powers P**2** and P**3** and (ii) the current temperature Tc is less than the maximum temperature, the pool equipment is operated in the renewable mode and the heat pump is controlled to heat the water **2**, adjusting the power consumed by the heat pump to a value that is less than or equal to the difference between the powers P**1** and P**3**.

[0143] Finally, various layouts and variants of the regulation systems and regulation methods, which were described hitherto; are further conceivable. Examples include:

[0144] in addition to receiving control instruction data from the control system **120** or **220**, the heat pump **111** or **211** advantageously communicates with the control system by sending thereto regularly the operating parameters thereof, which enables the control system **120** or **220** to control, in other words monitor the operation of the heat pump **111** or **211**; in this way, the control system **120** or **220** is apt to take into account the actual state of the heat pump **111** or **211** in order to control the best possible the component or components the consumed power of which can be modulated;

[0145] in addition to or as a replacement for the filtration pump **212** and/or the water treatment device **213**, the pool equipment **210** may include, in addition to the heat pump **211**, one equipment item or other equipment; and/or

[0146] each of the powers P**1** and P**2**, as well as, where appropriate, the power P**3** can be determined by various types of electrical measuring apparatus; thereby, each of the powers can be measured by a wattmeter, such as the wattmeters **141**, **142**, **241**, **242** and **243** envisaged in the embodiments illustrated, but also by a voltmeter and an ammeter, the respective measurements of which serve to calculate the power, or else by only an ammeter considering that the voltage is preset e.g. at 230 volts.

1. A regulation system of a bathing pool, comprising:

a temperature sensor measuring a current temperature corresponding to the temperature of water contained in a bathing pool;

a generator, producing renewable electricity;

a first electrical measuring device determining a first power corresponding to the electrical power produced by said generator;

pool equipment, comprising a heat pump which has adjustable electric power and heats the water;

a second electrical measuring device determining a second power corresponding to the electrical power consumed by said heat pump;

in the case where said pool equipment comprises an equipment item other than said heat pump, a third electrical measuring apparatus determining a third power corresponding to the electrical power consumed by said equipment item, the third power being considered zero in the case where said pool equipment includes only said heat pump; and

a control system regulating the power consumed by said heat pump when said heat pump heats the water, as well as for operating said pool equipment selectively:

in a hybrid mode, wherein the control system controls a supply of said pool equipment jointly by a collective network and by said generator, making said pool equipment consume the entire power produced by said generator, and

in a renewable mode, wherein the control system makes said pool equipment be supplied by said generator without said pool equipment being supplied by the collective network, by sending to a domestic network any excess between the power produced by said generator and the power consumed by said pool equipment,

and wherein the control system repeatedly controls, at successive instants during a steady operating state of the control system, said pool equipment at each of the instants from the current temperature and the first, second and third powers, each of the current temperature and the first, second and third powers being either measured at the instant considered or averaged over a predetermined time interval ending at the instant considered, so that:

when (i) the first power is both greater than the third power and less than or equal to the sum of the second and third power, and (ii) the current temperature is less than a predetermined minimum temperature, the control system operates said pool equipment in the hybrid mode and controls said heat pump to heat the water, by adjusting the power consumed by said heat pump to a maximum nominal value, as long as the current minimum temperature does not become higher than the minimum temperature,

when (i) the first power is both greater than the third power and less than or equal to the sum of the powers, and (ii) the current temperature is greater than the minimum temperature, the control system operates said pool equipment in renewable mode and controls said heat pump to selectively:

heat the water, adjusting the power consumed by said heat pump to a first value determined by the control system, which is less than or equal to the difference between the first power and the third power, and

not heat the water,

when (i) the first power is greater than the sum of the second and third power, and (ii) the current temperature is greater than a predetermined maximum temperature, which is greater than the minimum temperature, the control system operates said pool equipment in the renewable mode and controls said heat pump so as not to heat the water, and

when (i) the first power is greater than the sum of the second and third powers, and (ii) the current temperature is less than the maximum temperature, the control system operates said pool equipment in renewable mode and controls said heat pump to heat the water, adjusting the power consumed by said heat pump to a second value determined by the control system, which is less than or equal to the difference between the first power and the third power.

2. The regulation system as claimed in claim **1**, wherein the first value and/or the second value are equal to the difference between the first power and the third power.

3. The regulation system according to claim **1**, wherein said control system further controls, at each of the instants, said pool equipment such that:

when (i) the first power is both greater than the third power and equal to the sum of the second and third powers, and (ii) the current temperature is both greater than the minimum temperature and less than the maximum temperature, said control system controls said heat pump to heat the water, by adjusting the power consumed by said heat pump to the first value, and

when (i) the first power is both higher than the third power and equal to the sum of the second and third powers, and (ii) the current temperature is higher than the maximum temperature, said control system controls said heat pump so as not to heat the water.

4. The regulation system according to claim **1**, wherein said control system further controls, at each of the instants, said pool equipment such that:

when (i) the first power is both greater than the third power and equal to the sum of the second and third powers, and (ii) the current temperature is both greater than the minimum temperature and less than a predetermined intermediate temperature, which is comprised between the minimum temperature and the maximum temperature, said control system controls said heat pump to heat the water, adjusting the power consumed by said heat pump to the first value, and

when (i) the first power is both greater than the third power and less than the sum of the second and third powers and (ii) the current temperature is greater than the intermediate temperature, said control system controls the heat pump to selectively:

heat the water, adjusting the power consumed by said heat pump to the first value, and

not heat the water.

5. The regulation system according to claim **4**, wherein the maximum temperature and the minimum temperature are calculated by said control system from a setpoint temperature which is entered into said control system and which is comprised between the maximum temperature and the minimum temperature.

6. The regulation system according to claim **5** taken together, wherein the intermediate temperature is equal to the setpoint temperature.

7. The regulation system according to claim **1**, wherein said pool equipment comprises only said heat pump.

8. The regulation system according to claim **1**, wherein said pool equipment comprises, as equipment other than said heat pump, a filtration pump and/or a water treatment device.

9. The regulation system according to claim **1**, wherein said control system is configured to further control, at at least certain of said instants, said pool equipment based on a weather forecast.

10. A regulation method for a bathing pool, wherein is arranged:

a temperature sensor which measures a current temperature corresponding to the temperature of water contained in a bathing pool,

an individual generator which produces renewable electricity,

a first electrical measuring device determining a first power corresponding to the electrical power produced by the generator,

pool equipment, including a heat pump which has an adjustable electric power and is suitable for heating the water,

a second electrical measuring device determining a second power corresponding to the electrical power consumed by the heat pump, and

in the case where the pool equipment includes an equipment item, other than the heat pump, a third electrical measuring apparatus which determines a third power corresponding to the electrical power consumed by the equipment item, the third power being considered zero in the case where the pool equipment includes only the heat pump, and wherein the pool equipment is operated selectively:

in a hybrid mode, wherein the pool equipment is supplied jointly by a collective network and by the generator, making the pool equipment consume the entire power produced by the generator, and

in a renewable mode, wherein the pool equipment is made to be supplied by the generator without the pool equipment being supplied by the collective network, by sending to a domestic network any excess between the power produced by the generator and the power consumed by the pool equipment,

and wherein, repeatedly at successive times during a steady operating state, the pool equipment is controlled at each of the times from the current temperature and the first, second and third powers, each of the current temperature and the first, second and third powers being either measured at the instant in question or averaged over a predetermined time interval ending at the instant in question, so that:

when (i) the first power is both greater than the third power and less than or equal to the sum of the second and third power, and (ii) the current temperature is less than a predetermined minimum temperature, the pool equipment is operated in the hybrid mode and the heat pump is controlled to heat the water, adjusting the power consumed by the heat pump to a maximum nominal value, as long as the current minimum temperature does not become higher than the minimum temperature,

when (i) the first power is both greater than the third power and less than or equal to the sum of the powers, and (ii) the current temperature is greater than the minimum temperature, the pool equipment is operated in the renewable mode and the heat pump is controlled, to selectively:

heat the water, adjusting the power consumed by the heat pump to a first value that is less than or equal to the difference between the first power and the third power, and

not heat the water,

when (i) the first power is greater than the sum of the second and third powers, and (ii) the current temperature is greater than a predetermined maximum temperature which is greater than the minimum temperature, the pool equipment is operated in the renewable mode and the heat pump is controlled not to heat the water, and

when (i) the first power is greater than the sum of the second and third powers, and (ii) the current temperature is less than the maximum temperature, the pool equipment is operated in renewable mode and the heat pump is controlled to heat the water, adjusting the power consumed by the heat pump to a second value which is less than or equal to the difference between the first power and the third power.

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