(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 June 2015 (11.06.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/083103 A1

(51) International Patent Classification:
H02J 3/38 (2006.01) *H02J 13/00* (2006.01)
H02J 3/32 (2006.01)

(21) International Application Number:
PCT/IB2014/066560

(22) International Filing Date:
3 December 2014 (03.12.2014)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
VR2013U000055 4 December 2013 (04.12.2013) IT

(71) Applicant: **DRIVES AND MOTORS D.O.O.** [HR/HR]; Kovarska, 3, 52223 Rasa (HR).

(72) Inventor: **BERTOTTO, Ezio**; c/o Drives & Motor Technology, Carpaneda, 25, I-36050 Bolzano Vicentino (Vicenza) (IT).

(74) Agent: **FELTRINELLI, Secondo Andrea**; c/o APTA S.r.l., Via Ca' di Cozzi, 41, I-37124 Verona (IT).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

WO 2015/083103 A1

(54) Title: SYSTEM FOR GENERATING AND DELIVERING ELECTRIC ENERGY DERIVED PREFERABLY FROM RENEWABLE SOURCES

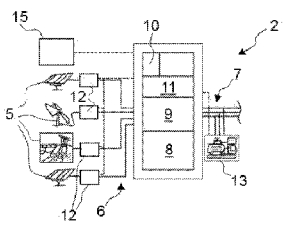

FIG.2

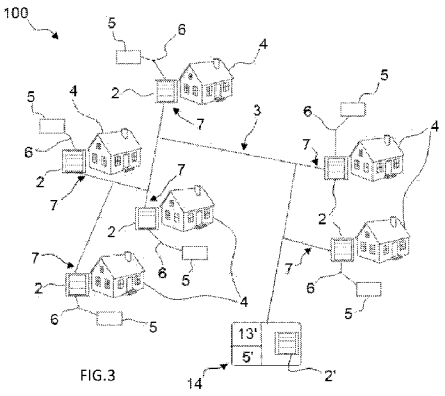

FIG.3

(57) Abstract: Distribution network (1, 100) of electric energy comprising at least one module (2) for generating and distributing electric energy connected to the distribution network (1, 100) through wiring (3), the at least one module (2) for generating and distributing electric energy being connected to respective appliances, that can be powered by electricity, wherein at least one module (2) comprises at least one generator (5) of current supplied through renewable sources of energy.

SYSTEM FOR GENERATING AND DELIVERING ELECTRIC ENERGY DERIVED PREFERABLY FROM RENEWABLE SOURCES

Designated inventors: Ezio Bertotto

TECHNICAL FIELD OF THE INVENTION

The present invention refers to a network for generating and delivering electric energy.

In particular, the present invention refers to a network for generating and distributing renewable electric energy, preferably obtained from renewable sources, which can be easily implemented in areas that are not covered by an electric distribution network or to support electric distribution networks that are not capable of ensuring stable electric energy with regular continuity.

STATE OF THE ART

As known, dispensing electric energy for the operation of appliances, indeed supplied electrically, occurs through a distribution network that is more or less of the capillary type.

The electric energy initially produced at a power plant is then dispensed to the individual appliances.

In order to provide a distribution network it is necessary for there to be a large investment of money for laying the infrastructure, for example for the installation in the ground, raceways, ducts, etc. or installing pylons, making secondary stations, for widely branching off a line coming from a power plant, etcetera.

In areas with low-density population, the economic investment required for making a distribution network is not very profitable because there is a low number of

appliances to be supplied with power, and therefore, the initial investment greatly exceeds the economic return.

In the cases the appliances to be supplied with power are confined to areas that are difficult to be reached, like for example islands, mountain areas, or the like, or having low-density population, small stations are usually used for producing electric energy comprising electrogen groups.

With reference in particular to appliances for domestic use, or in any case with limited power requirements, in the order of some kilowatts, it is possible to use electrogen groups that are supplied through hydrocarbons so as to generate the required electrical current.

Such a solution, although being able to be installed practically in any location, requires however, the supplying or the storing of fuel in special tanks, in order to ensure a satisfactory operation autonomy.

The size of such tanks, of course, depends upon the hours of operation foreseen as well as the required power.

However, providing an electric distribution network that is exclusively based upon the use of electrical power generators such as the electrogen groups, has some drawbacks, among which: the difficulty of procuring the fuel for supplying the electrogen groups, the pollution produced during their operation with the emission of combusted fumes let out into the atmosphere and noise pollution.

There is thus the need to avoid the drawbacks indicated above with particular reference to the making of a power supplying network, with small sizes, in areas that have a low population density or that are isolated and therefore are difficult to reach.

There is, moreover, the need to make a network for generating and distributing electric energy that can be easily implemented and that makes it possible to provide

all the electric energy required by the appliances connected to it or possibly makes it possible to supplement the energy provided by an unstable electrical distribution network and/or characterised by having a discontinuous supplying of electric energy.

PURPOSES OF THE INVENTION

One purpose of the present invention is to improve the state of the art.

One further purpose of the present invention is that of proposing a network for generating and distributing electric energy that can be easily implemented in places that are isolated and/or that are difficult to reach with a conventional electrical distribution network.

Another purpose of the present invention is that of proposing a network for generating and distributing electric energy of the modular type, i.e. that is suitable for easily adapting to the variations in the energy requirements of the appliances that are connected to it.

A further purpose of the present invention is that of proposing a network for generating and distributing electric energy that acts as a support to a pre-existing electrical distribution network.

According to one aspect of the present invention it is foreseen for there to be a network for generating and distributing electric energy according to claim 1.

The dependent claims refer to preferred and advantageous embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the present invention shall become clearer from the detailed description of a preferred, but not exclusive embodiment of a network for generating and distributing electric energy, which is illustrated as an indication and not for limiting purposes, in the attached drawing tables, in which:

figure 1 is a schematic view of a distribution network of electric energy according to the present invention;

figure 2 is a schematic view of the wiring of the components of a module for generating and distributing electric energy according to the present invention;

figure 3 is a schematic view of a further version of a distribution network of electric energy according to the present invention.

EMBODIMENTS OF THE INVENTION

With reference to the attached figures, a distribution network of electric energy according to the present invention is wholly indicated with reference number 1.

The distribution network 1 comprises a plurality of modules 2 for generating and distributing electric energy that are wired to one another, through a wiring 3, so as to define the distribution network 1.

With reference to the version illustrated in figure 1, as a non-limiting example, the distribution network 1 comprises six modules 2 for generating and distributing electric energy that are suitable for supplying power to the appliances of just as many buildings 4.

However, as it is easy to understand, a distribution network 1 according to the present invention can comprise a higher or lower number of modules 2 for generating and distributing electric energy with respect to the one illustrated in figure 1, without for this reason departing from the scope of protection of the present invention.

The number of modules 2 for generating and distributing electric energy varies as a function of the number of appliances/buildings 4 which are intended to be supplied with the distribution network 1.

Each module 2, is preferably suitable for supplying electric energy to one building 4.

However, as shall be made clearer in the rest of the description, through the

distribution network 1 a module 2 for generating and distributing electric energy can, possibly, provide electric energy also to a building 4 that is different with respect to that to which it is associated.

In the rest of the description the term "appliance" is used to indicate one or more devices that are supplied with electricity.

The implementation of a distribution network 1 according to the present invention is particularly advantageous in isolated areas and/or areas that have a low population density or that are difficult to reach with a conventional distribution network.

In isolated areas such as, for example, islands out at sea or mountain areas, which are far from industrialised residential areas, it is possible to ensure an effective generation and distribution of electric energy through the modules 2 for generating and distributing electric energy that are connected to one another through the distribution network 1.

According to one aspect of the present invention, the distribution network 1 can be implemented, in series, to support an unstable pre-existing distribution network, which is not therefore capable of ensuring a continuous and/or constant supply of electric energy.

Again, according to a further version of the present invention, the distribution network 1 can be implemented so as to support a pre-existing distribution network, so as to allow a user to be able to use an amount of electric energy that is greater than that provided by the pre-existing network.

As schematically illustrated in the attached figures, the distribution network 1 comprises at least one generator of electric energy 5 that is supplied through a renewable source of energy.

As a non-limiting example, the generator of electric energy 5 can be of the type

belonging to the group of wind-actuated generators, for example a wind turbine or the like, of the photovoltaic type, with geothermal actuation, with hydroelectric actuation, for example a mechanical turbine of the Pelton or Francis or Kaplan type or similar.

At least one power generator 5 is connected to each module 2 for generating/distributing electric energy.

According to one version of the present invention, at least two electric energy generators 5 are connected to each module 2 for generating and distributing electric energy.

The electric energy generators 5 connected to each module 2 for generating and distributing electric energy can be of the same type, i.e. actuated by the same energy vector (kinetic wind or water energy, thermal energy, solar energy, etc.) or of the different type from one another without any limitation.

As an example, a module 2 for generating and distributing electric energy could comprise a wind generator 5 and a photovoltaic generator 5, each wired in an independent manner to the module 2 for generating and distributing electric energy itself.

In a further version of the present invention, a module 2 for generating and distributing electric energy could comprise two or more wind generators 5, or two or more photovoltaic generators 5, etc.

In particular, it should be noted the fact that the possibility of connecting more than one generator 5 to each module 2 for generating and distributing electric energy ensures that the distribution network 1 has high modularity according to the present invention.

In particular, such a modularity is not limited to the possibility of connecting

different types of generators 5 to each module 2 for generating and distributing electric energy.

Indeed, it is possible to connect generators 5 having different power to each module 2 for generating and distributing electric energy.

In such a manner, it is possible to modulate the power generated by each module 2 for generating and distributing electric energy as a function of the power required by the appliances supplied through the distribution network 1.

Each module 2 for generating and distributing electric energy comprises first connection means 6 and second connection means 7.

In particular, the first connection means 6 are provided for the connection of the at least one generator 5 in input to each module 2 for generating and distributing electric energy.

The second connection means 7, on the other hand, make it possible to connect each module 2 for generating and distributing electric energy to the wiring 3, so as to distribute the electric energy produced through the generators 5 to the single appliances.

The module 2 for generating and distributing electric energy can comprise an inverter 8, so as to modify the electric energy produced by the single generators 5 according to the specific usage requirements of the final appliances.

The operation of one inverter 8 is given as known and it shall not be therefore described any further.

According to one aspect of the present invention, the distribution network 1 comprises at least one accumulation device 9, which is suitable for storing the electric energy produced by the at least one generator of energy 5 of a module 2 for generating and distributing electric energy and for subsequently giving it up to the

distribution network 1 according to the requirements.

The at least one accumulation device 9 makes it possible to store the electric energy that is produced through the at least one generator of energy 5 and that is not used by the appliances, and to make it available in a following moment.

According to one version of the present invention, the at least one accumulation device 9 can be directly connected to a module 2 for generating and distributing electric energy.

According to a further version of the present invention, each module 2 for generating and distributing electric energy can be connected to at least one accumulation device 9.

Therefore, the number of modules 2 for generating and distributing electric energy and the number of accumulation devices 9 can be the same or different, without any limitation.

According to one version of the present invention, the at least one accumulation device 9 comprises one or more batteries or similar accumulation devices.

According to one further version of the present invention, which is not illustrated in the figures, the at least one accumulation device 9 comprises at least one hydraulic pump that is suitable for pumping water in a basin at a certain height from which it is subsequently possible to obtain hydroelectric energy with devices that are known in the field.

According to one further version of the present invention, the at least one accumulation device 9 can comprise means for storing compressed air, which are not illustrated in the figures.

If the appliances, to which one specific module 2 for generating and distributing electric energy is connected, are not operating or the energy produced by the

generators 5 is greater than the amount required by the appliances, the generators 5 can be kept operative until the accumulation device 9 is completely charged.

At this point, it is then possible to deactivate the operation of the at least one generator 5, so as to preserve its integrity, with particular reference to generators comprising moving mechanical members, subsequently reactivating it if needed.

Each module 2 for generating and distributing electric energy can then comprise a communication interface 10 that is suitable for displaying, to a user, messages concerning the status and/or the operation of a specific module 2.

According to one version of the present invention the communication interface 10 can comprise a display, which is not illustrated in the figures, through which it can display the operation status of the module 2 for generating and distributing electric energy and/or alarm messages or for maintenance of the module 2 itself or of its components.

According to a further version of the present invention, the communication interface 10 can comprise means for emitting radio signals, which are not illustrated in the figures, which are suitable for sending a wi-fi signal or through the Bluetooth data transmission protocol, to a mobile device 15, such as for example a mobile phone, a smartphone, a tablet, a notebook or a similar device or to a remote device according to modalities that are known in the field.

The module 2 for generating and distributing electric energy comprises a management unit 11.

The management unit 11 is suitable for controlling and for managing the operation of the individual generators 5 which are wired to the module 2 as a function of the power requested by the wired appliances from the distribution network 1.

In practice, the management unit 11 compares the amount of electric energy that is

produced by the individual generators 5 connected to the module 2 for generating and distributing electric energy to the amount of electric energy required by the appliances connected to the module 2 itself.

In the case the amount of electric energy produced is greater than that required, the management unit 11 provides for sending the amount in excess to the at least one accumulation device 9.

If the generators 5 connected to a module 2 for generating and distributing electric energy are not capable of producing a sufficient amount of electric energy for the request of the appliances connected to the module 2 itself, such electric energy can be drawn from the at least one accumulation device 9.

In order to avoid the depletion of the electric energy stored inside the at least one accumulation device 9 it is possible to provide for recharging the at least one accumulation device 9 itself by the generators 5 of a second module 2 connected to the distribution network 1.

Therefore, through the distribution network 1 and the modules 2 for generating and distributing electric energy implemented in it, it is possible to distribute and ensure the procurement of electric energy to all the wired appliances to the distribution network 1 itself.

Indeed, if, the at least one generator 5 of a module 2 for generating and distributing electric energy is not capable of providing the electric energy that is required by the appliances connected to such a module 2, it is possible to draw the energy produced by other modules 2 for generating and distributing electric energy from the distribution network 1.

Therefore, each module 2 for generating and distributing electric energy that is wired to the distribution network 1 can be considered as a production node of electric

energy and, possibly, if it is not capable of generating electric energy, as an electric energy consumption node.

The management unit 11 of each module 2 for generating and distributing electric energy can activate/deactivate the operation of the single generators 5 connected to the module 2 itself, according to the demand of electric energy of the wired appliances in the distribution network 1.

In such a way, it is possible to optimise the operation of the generators 5 themselves.

In particular, since each module 2 for generating and distributing electric energy can comprise one or more generators 5 these can be optimised by foreseeing an operation at optimal work conditions.

With reference to generators of electric energy of the type comprising moving mechanical members, for example comprising a shaft that is set in rotation, the optimal work condition substantially corresponds to the rotation condition for which about 70%-80% of the energy production with respect to the maximum power that can be dispensed by the energy generator itself, is reached.

Such a normal work condition is lower than the maximum production. Therefore, when comprising moving mechanical members, the generator 5 undergoes less wearing, thus requiring less maintenance and allowing greater duration over time thereof.

Each module 2 for generating and distributing electric energy can comprise a special filter 12, of the type known in the field, between the single generators 5 and the module 2 itself, which are suitable for modulating the energy produced by the individual generators 5.

With the unit 11 for managing each module 2 for generating and distributing electric energy it is possible to ensure a constant power supply, without sudden changes in

voltage, to the appliances connected to the distribution network 1.

According to one version of the present invention, illustrated in figure 2, the distribution network 1 comprises at least one supplementary generator 13, that is supplied through non-renewable energy sources, which are connected to at least one module 2 for generating and distributing electric energy.

The supplementary generator 13 can be, as an example but not for limiting purposes, an electrogen group, a fuel cell, a sofc cell or similar devices.

The supplementary generator 13 can supplement the instantaneous incapability of one or more modules 2 for generating and distributing electric energy of operating correctly or of providing the amount of electric energy required by the appliances.

If, for example it is necessary to carry out maintenance work by sectioning a module 2 for generating and distributing electric energy from the distribution network 1, it is in any case possible to ensure that the appliances served by such a module 2 are supplied with power through the supplementary generator 13 connected to it.

Furthermore, one or more supplementary generators 13 can supplement the temporary lack of production of electric energy for a malfunctioning of the generators 5 present in the distribution network 1 or, again, when the accumulation devices of the modules 2 for generating and distributing electric energy are almost depleted.

Figure 3 illustrates, with reference numeral 100, a further embodiment of an energy distribution network according to the present invention.

In the rest of the description, the same numbering to indicate the components corresponding to those of the previous embodiment is used.

The distribution network 100 differs from the previous embodiment for the presence of a central unit 14 for providing electric energy.

The central unit 14 similarly to what has been previously described with reference to the single building 4, comprises a module 2' for generating and distributing electric energy to which at least one generator 5' of electric energy is connected.

The operation of the present embodiment is the same as that described previously.

In particular, the installation of the distribution network 100 is preferably made in places in which it is possible to have a de-centred installation of the central unit 14.

Since the latter must completely or partially supplement the request of electric energy of all the wired appliances to the distribution network 100, the at least one generator 5' connected to it is characterised by a power and, consequently, by greater dimensions than those of the generators 5 which are associated with the modules 2 for generating and distributing electric energy.

Thanks to the presence of the central unit 14 it is possible to foresee the installation of generators 5 of lower power or at least, for storing less energy, with respect to those of the previous embodiment, since the greater supply of energy to the single modules 2 for generating and distributing electric energy is indeed provided by the central unit 14.

In a further version of the present invention the central unit 14 can comprise a supplementary generator 13' to integrate the electric energy provided by the at least one generator 5'.

The central unit 14 thus acts as a central supply node of electric energy to which all the modules 2 of the distribution network 100 are connected.

The modularity of the distribution network 1, 100 according to the present invention makes it possible for there to be an effective implementation in areas that are not easily reached by conventional electric distribution networks.

Moreover, since each module 2 comprises many generators of electric energy 5 it is

possible to modulate, according to the energy requirements of the appliances connected to the distribution network 1, 100, the electric energy produced thus avoiding putting excessive strain on the generators themselves.

The electric energy that is produced in excess with respect to what is required by the appliances of the distribution network 1, 100, can be stored in special accumulation devices 9 so as to allow it to be used at a later moment, for example when the generators 5 are not capable of meet the energetic requests of the single appliances.

Each module 2 for generating and distributing electric energy can, actually, produce electric energy for appliances connected to it, or for appliances of other modules 2 for generating and distributing electric energy, thus ensuring the correct operation of all the wired appliances to the distribution network 1, 100.

Furthermore, the distribution network 1, 100 according to the present invention can act as a support to a pre-existing distribution network, for integrating the electric energy that is produced and distributed by the latter, as shall be explained in greater detail in the rest of the description.

In particular, it should be noted that the connection between the distribution network 1, 100 and a pre-existing distribution network occurs by connecting the terminals of the pre-existing network, which are normally wired to a power supply cable or to a meter of a building 4, to the first connection means 6 of the at least one module 2 for generating and distributing electric energy.

Indeed, therefore, the electric energy that is distributed from a pre-existing distribution network is introduced, in inlet, in the at least one module 2 for the generation and the distribution of electric energy.

As previously described, the managing unit 11 of the at least one module 2 for generating and distributing the electric energy compares the inlet electric energy into

the module 2 itself with the amount of electric energy that is required by the appliances connected to it.

If the pre-existing distribution network, wired with the distribution network 1, 100, is not capable of dispensing the amount of electric energy that is required, due to an interruption of the supply of electric energy, or dispensing of electric energy in an unstable manner, i.e. with a significant variation in the voltage (sudden differences in voltage), the management unit 11 provides for ensuring in any case to the appliance that is connected to the at least one module 2 a constant and stable supply of electric energy, which is generated through the at least one generator 5 and/or the at least one supplementary generator 13.

According to one further version of the present invention, the distribution network 1, 100 can be implemented to a pre-existing support a distribution network, so as to allow a user to exploit an amount of electric energy that is greater than that provided, indeed from the pre-existing distribution network.

The wiring between the distribution network 1, 100 and a pre-existing distribution network occurs in the same way as described previously.

In such a case, if the appliances that are connected to the at least one module 2 require an amount of electric energy that is greater than that which can normally be dispensed by the pre-existing distribution network, the management unit 11 of the at least one module 2 for managing and distributing electric energy provides the aforementioned amount of required energy taking it from the at least one generator 5 and/or the accumulation device 9 and/or, if present, from other modules 2 of the distribution network 1, 100.

The invention thus conceived can undergo numerous modifications and variants all covered by the same inventive concept.

Moreover, all the details can be replaced by technically equivalent elements. In practice, the materials used, as well as the contingent shapes and sizes, can be any according to the requirements without for this reason departing from the scope of protection of the following claims.

CLAIMS

1. Distribution network (1, 100) of electric energy comprising at least one module (2) for generating and distributing electric energy connected to said distribution network (1, 100) through wiring (3), said at least one module (2) for generating and distributing electric energy being connected to respective appliances, capable of being supplied with electricity, **characterised in that** at least one of said at least one module (2) comprises at least one generator (5) of current supplied through renewable sources of energy.

2. Distribution network (1, 100) of electric energy according to claim 1, wherein said at least one module (2) for generating and distributing electric energy comprises at least two generators (5) of current that can be powered by electricity through the same renewable source of energy or through renewable sources of energy different from one another.

3. Distribution network (1, 100) of electric energy according to claim 1 or 2, wherein said at least one module (2) for generating and distributing electric energy comprises first connection means (6) of said at least one module (2) for generating and distributing electric energy to said at least one generator (5), and second connection means (7) of said module (2) for generating and distributing electric energy to said distribution network (1, 100).

4. Distribution network (1, 100) of electric energy according to claim 1 or 2, comprising at least one supplementary generator (13) connected to at least one of said at least one module (2) for generating and distributing electric energy.

5. Distribution network (1, 100) of electric energy according to claim 1, wherein said at least one module (2) for generating and distributing electric energy comprises a unit (11) for managing the operation of the at least one generator

(5) connected to said at least one module (2) for generating and distributing electric energy.

6. Distribution network (1, 100) of electric energy according to any one of the previous claims, comprising at least one accumulation device (9) of said electric energy generated by said generators (5).

7. Distribution network (1, 100) of electric energy according to any one of the previous claims, wherein said at least one module (2) for generating and distributing electric energy comprises a communication interface (10) for viewing the status of said at least one module (2) for generating and distributing electric energy.

8. Distribution network (100) of electric energy according to claim 1, comprising a central unit (14) for producing electric energy to be provided to each of said modules (2) wired to said distribution network (100).

9. Distribution network (100) of electric energy according to the previous claim, wherein said central unit (14) comprises at least one generator (5') of electrical current supplied through a renewable source of energy.

10. Distribution network (100) of electric energy according to claim 5 or 6, wherein said central unit (14) comprises at least one supplementary generator (13') supplied through a non-renewable source of energy.

11. Distribution network (1, 100) of electric energy according to any one of the previous claims, characterised in that it can be implemented, in series, to support a pre-existing distribution network of electric energy.

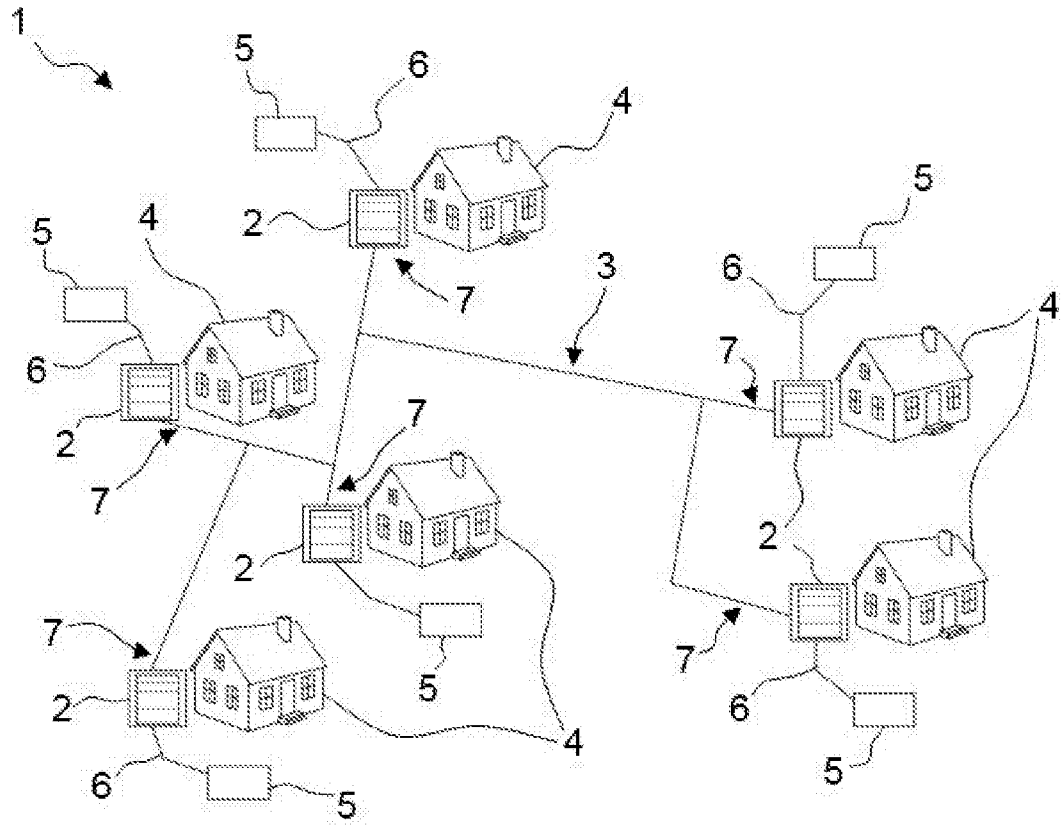

FIG.1

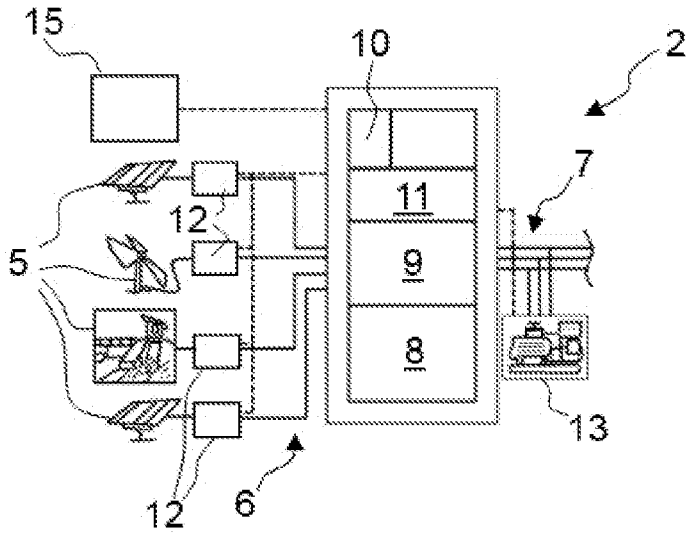

FIG.2

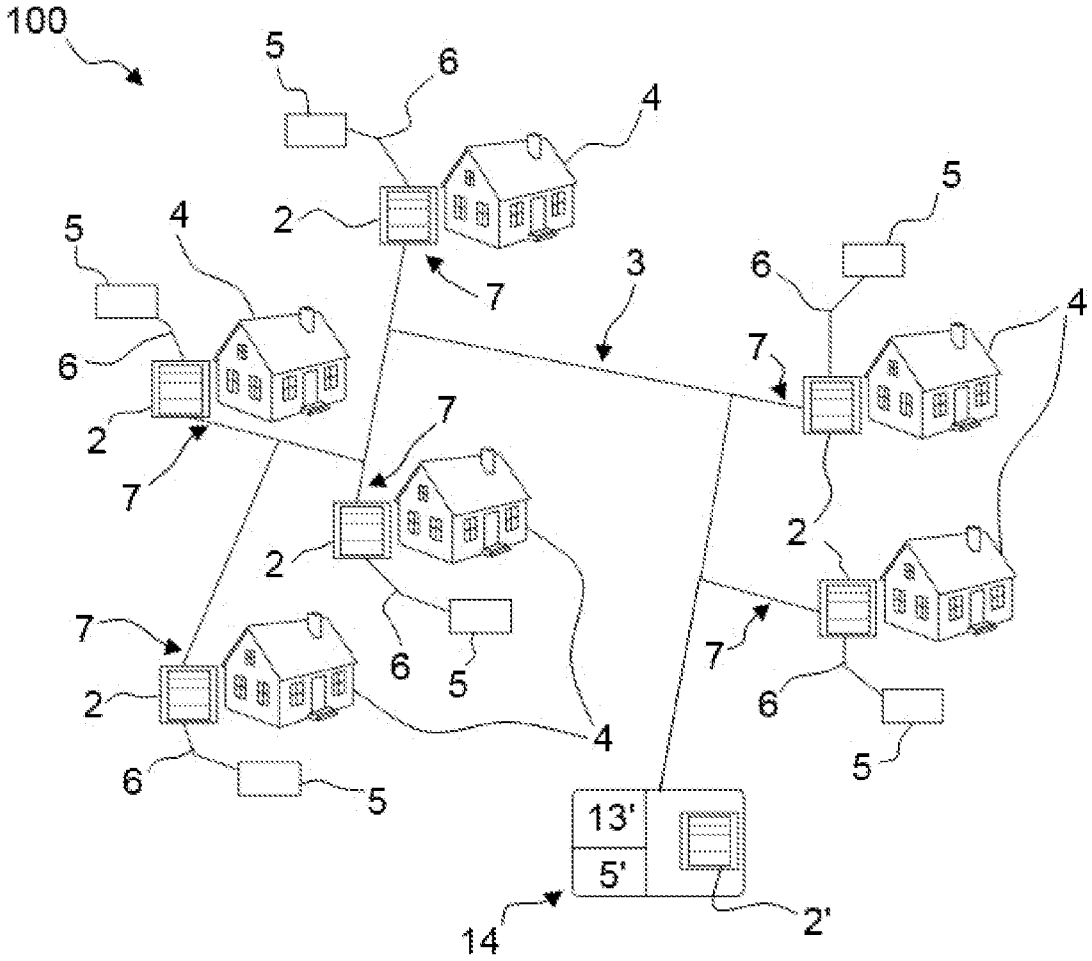

FIG.3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/066560

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02J3/38
ADD. H02J3/32 H02J13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/193987 A1 (SIGLOCK JOHN V [US]) 2 August 2012 (2012-08-02) abstract figures 5-8 paragraphs [0003] - [0020], [0031] - [0053], [0057]	1-8
X	EP 2 416 464 A2 (BRITO DOS SANTOS ALFONSO ALBERTO [PT]) 8 February 2012 (2012-02-08) abstract figures 1-3,5,6 paragraphs [0007] - [0017], [0051] - [0074]	1-7,9,11
X	US 2010/145532 A1 (GREGORY DANIEL CONSTANTINE [US] ET AL) 10 June 2010 (2010-06-10) abstract; figures 1-2	1-11

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 March 2015	13/03/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Hartmann, Martin

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/066560

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/029720 A1 (CHERIAN SUNIL [US] ET AL) 2 February 2012 (2012-02-02) abstract; figures 1,2	1-11
X	DE 10 2009 040091 A1 (VOLTWERK ELECTRONICS GMBH [DE]) 10 March 2011 (2011-03-10) abstract; figures 1-3	1-9,11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/066560

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012193987 A1	02-08-2012	AU 2012212484 A1	19-09-2013
		CA 2827709 A1	09-08-2012
		CN 103503265 A	08-01-2014
		EP 2671301 A1	11-12-2013
		JP 2014504145 A	13-02-2014
		US 2012193987 A1	02-08-2012
		WO 2012106252 A1	09-08-2012
EP 2416464 A2	08-02-2012	EP 2416464 A2	08-02-2012
		PT 105189 A	09-01-2012
US 2010145532 A1	10-06-2010	NONE	
US 2012029720 A1	02-02-2012	EP 2599182 A1	05-06-2013
		US 2012029720 A1	02-02-2012
		WO 2012015507 A1	02-02-2012
DE 102009040091 A1	10-03-2011	DE 102009040091 A1	10-03-2011
		EP 2293409 A2	09-03-2011
		US 2011080044 A1	07-04-2011