



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.03.2016 Bulletin 2016/12

(51) Int Cl.:
G06Q 50/06 (2012.01)

(21) Application number: **14185000.8**

(22) Date of filing: **16.09.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **Atos IT Solutions and Services GmbH**
81739 München (DE)

(72) Inventor: **Kraus, Rudi**
68165 Mannheim (DE)

(74) Representative: **Patentanwaltskanzlei WILHELM & BECK**
Prinzenstraße 13
80639 München (DE)

(54) **Energy balancing**

(57) A method for controlling an energy consuming system with at least one energy consumer comprises steps of receiving a request for energy from a consumer, determining a current priority of the request, determining

a current price for provisioning energy to the system and granting the energy request on the basis of the priority and the price.

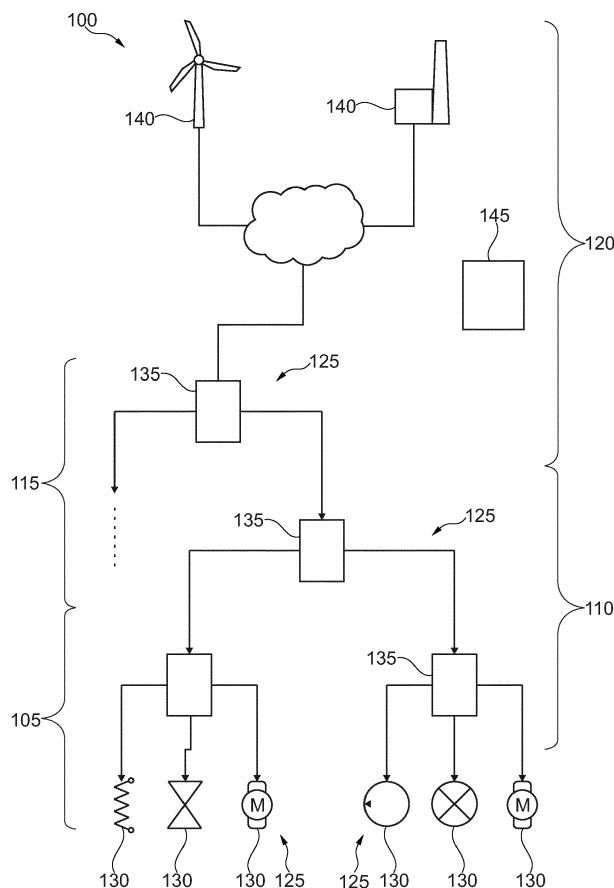


Fig. 1

Description

[0001] Present invention concerns a technique for energy balancing. More specifically, present invention concerns energy balancing in a network with several consumers, producers, or prosumers.

[0002] An energy network comprises at least one energy provider and a plurality of energy consumers and optionally energy storage systems or energy buffer systems. The network may especially concern an electric network.

[0003] Traditional electricity networks are portioned in a high voltage grid a medium-voltage power grid and low voltage grid. The mix of central and distributed power stations which are connected to a high voltage grid and block heat and power plants, solar, or wind parks are connected to low or medium voltage grids. This can lead to an oversupply or a shortage of energy in a distribution area. The decentralization of energy production and the usage of renewable energy which is not all ways in the same capacity available is a problem for traditional energy distribution.

[0004] On the other side industrial and private consumers have no information about the energy situation in their distribution area and cannot adapt their consumption in a way to reduce the cost for production and distribution and to avoid avalanche effects.

[0005] The invention helps to reduce the cost for energy production and energy distribution in total and to support differentiated price models for different customer types and energy consumption models.

[0006] The invention differentiate between production cost production capacity and distribution cost and distribution capacity for energy and the market price at a definite time because of offer and demand. In addition the consumer can influence the type of energy production, coal, atomic, gas, solar, wind. On the other side the market price can go negative for some time slots on the electricity exchange, but not the cost for energy to produce and to distribute. The invention allows to combine individual comfort and saving strategies, lifestyle, work times, holidays and weekends. With this information a group of consumers and producers can be influenced such as to optimize energy consumption, energy production and energy storage (or short time buffering) and thereby help to avoid avalanche effects in energy consumption changes. The invention may help to adapt the logistics for energy production and energy distribution of centralized and decentralized energy production and distribution.

[0007] Largely speaking, energy is consumed on the consumer side at a time an application like a dishwasher or a heating requires it and the provider tries to adapt the amount of provided energy to a present or forecast overall demand. One means of balancing the proposal and demand of energy is through energy capacity management on production, distribution, consumption and short time buffer level, together with differentiated price models. If

energy demand goes up for a lot of consumers at the same time, the production cost for energy goes up, because additional power stations have to be started in a short time and the total distribution capacity of the network have to be designed for peak load capacity, that means higher network cost in total over time.

[0008] With the advent of so-called smart meters, additional data about an energy consumed by a given consumer may be collected and evaluated. The energy provider may thus adapt the amount of energy provided to propose a better service. Overcapacities and undersupply may thus be reduced.

[0009] However, on the side of the energy consumer very little influence on a total cost of energy may be exercised with actual distribution and production and price models for consumers.

[0010] The invention helps to change this because the group of consumers can influence the cost for production and distribution if they can adapt their energy consumption dynamically and in a flexible way. In this, the whole of the producers and consumers can be treated like a swarm, making use of so-called swarm intelligence. Electricity devices have typical consumption curves in dependency of the selected program. One part of the invention helps to decouple the peak consumptions on a local site and in a pool of devices in a district or area. The different priorities of the devices and the decoupling helps to restart a landscape with electricity devices after power blackout or in other cases to avoid blackouts.

[0011] The inventions defines a technique to detect automatically peak load in the local area network and can absorb this with time shifts and decoupling strategies in the local area. On the other side in case of overcapacity in the connected distribution area additional consumers can be activated to stabilize the distribution network. Auctions and blackboards support this in a smart way.

[0012] The invention sets out to provide a technique for better energy distribution. The invention therefore provide methods and a control unit according to the features of the independent claims. Dependent claims give advantageous embodiments.

[0013] According to the invention, a method for controlling an energy consuming system with at least one energy consumer comprises steps of receiving a request for energy from a consumer, determining a current priority of the request, determining a current price and/or availability of distribution and/or production capacity for provisioning energy to the system and granting the energy request dependent on or on the basis of the priority and at least one of the price, a capacity work order, a capacity level, a type of energy or another condition.

[0014] The energy network may for instance comprise an electric grid, a local electric wiring or an electric connection system inside an apparatus. Any task that controls energy may be modelled as the system, e.g. an apparatus, a household, an industrial production process. According to the invention, the system may be controlled in such a way that requests for energy which follow the

rules may be accounted separately to requests which work against the rules. All requests may be granted right away but some requests may be delayed so that energy consumption of the system will be more level over time. This may help energy providers to deliver a more cost optimized amount of energy over time. A request with a high priority may be served sooner than those with a lower priority. If the priority is high enough, the request may be granted regardless of the current energy price.

[0015] According to another embodiment an energy consumer and/or an energy provider may publish a production and/or consumption rule so that other providers and/or consumers may adjust their needs to the overall provisioning or consumption. Also, a buffer or storage space may be quoted. Each information may refer to a given time range. Forecasts for different time ranges may also be given.

[0016] It is furthermore possible to run the method in hierarchically cascaded systems. One system as explained may act like an energy consumer to another, more comprehensive system. Thus, the method may for instance be executed in cascade on a device level, on a household level, on a local level, on a regional level and on a wide area level. The energy price may be determined independently on different levels. This may allow for local energy providers and help to level energy consumption both over time and over a group of systems. As each system will act to avoid high cost, the method may help reduce the total energy consumed. Economical cost and environmental pollution by an energy provider due to changes in the amount of energy provided may be reduced.

[0017] It is furthermore possible to pool several systems together such that they will effectively represent one superordinate system as described above.

[0018] In one embodiment, the request is granted if the priority exceeds the price. For this, both the priority and the price may be scaled with appropriate factors. This decision making scheme may be easy to implement and easy to understand by a human so that human intervention or human behaviour that gives reason for the energy consumption may be more easily adapted. Also, user acceptance of the proposed method may be increased this way.

[0019] Cost may refer to a monetary amount of some currency associated to a predetermined amount of energy or cost may concern an arbitrary different measure, for instance a purely abstract measure that reflects an effort required to provide the energy. Generally speaking, the cost runs reciprocal to an availability of energy, a distribution capacity or a production capacity.

[0020] In another embodiment, an amount of energy is requested and the request is granted if the priority exceeds a linear combination of price and amount. Price, amount and priority may be scaled with appropriate factors for this decision making scheme. Through the scheme, large volume energy consumption will more likely take place only when the price is low and small volume

energy consumption is less critically judged. This way, processes that employ consumers with low energy requirements may be preferred to run. If a service that builds upon several consumers is run on the system, it is less likely that the process is stopped when tasks that are associated to lightweight energy consumption will be preferred. On the other hand, cost intensive processes may be delayed until the price is low.

[0021] A request that cannot be granted may be held pending. This way, it is not necessary for the consumer to reissue a request after the request has been rejected (or not granted), instead, the request may automatically be re-evaluated until it can be granted. A pending request may be revoked by the consumer or by the decision making process.

[0022] In another embodiment, priority of a pending request is automatically increased over time. In this, different schemes may be applied so that priority may be increased e.g. in a linear or an exponential fashion. This way it may be less likely that a given consumer that is associated a low priority must wait infinitely long for its request to be granted.

[0023] In yet another embodiment an amount of energy is requested and an amount of energy of pending requests is provided to an energy provider. In other words, a total of energy corresponding to not-granted requests may be provided. Alternatively, a total of the amount of energy according to a current consumption and of pending requests may be provided. Both variants may allow the energy provider to better determine energy requirements or prepare a better forecast of requirements. Additional request information, such as priority, amount of requested energy and current local price may also be provided.

[0024] In yet another embodiment, energy consumption of a consumer is stopped if a decision criterion that led to the grant of the corresponding request is no longer met. This may allow to interrupt a consumer if the price rises while the consumer consumes energy. In another embodiment a request, once granted, will not be revoked, regardless of the energy price. This may help completing tasks once they have started.

[0025] The priority may be determined on the basis of a consumer kind. That is, there may be fixed assignments of priorities to consumers and an assigned priority may be dependent on the kind of consumer. For instance, consumers that charge batteries or other energy deposits may be assigned a first priority, while consumers for illumination may be assigned a second, higher priority. This allows for critical consumers or applications so they are not outpaced by another consumers or appliance.

[0026] The priority may also be determined on the basis of a consumption history of the consumer. Should a consumption history for instance suggest that a heating or cooling service follows a certain rhythm, priority of the service may be increased before a rise of energy consumption is due so that a peak energy consumption of the system is flattened. On the other hand, should the

service for instance comprise keeping a temperature on a predetermined level, control of said temperature may be relaxed by lowering priority of the service during a forecast disturbance of the temperature. This may for instance apply for a refrigerating or a water heating appliance as energy consumers.

[0027] Generally speaking, it is preferred that priorities of requests are adjusted such as to level a system energy consumption over time. Priorities of both pending and granted requests may be manipulated.

[0028] According to another aspect of the invention, a control unit for controlling an energy consuming system, the system comprising at least one energy consumer, is adapted to perform the above described method.

[0029] According to yet another aspect of the invention, a computer program product comprises program code means for carrying out above described method when the computer program product is run on a control unit or stored on a computer readable medium.

[0030] According to one more aspect of the invention, a method for controlling an energy provider, the provider being adapted to provide energy to at least one energy consumer, comprises steps of receiving information about a desired amount of energy consumption that exceeds the consumer's current energy consumption, of determining a current price for energy and of adjusting, on the basis of the price and the desired energy, an amount of energy provided by the provider.

[0031] This way, the energy provider may adapt its output to energy requests that have not yet been granted, that is, to future needs of customers. This way, speculation about future energy demands of a consuming system can be replaced by processing actual intentions of the system. The provided amount of energy may thus better suit the system's current or future energy demands.

[0032] In a preferred embodiment, the price for energy is determined on the basis of proposal and demand. As mentioned above, determination of price may be done on any level of a hierarchical set of systems and price may be defined in other ways than financially.

[0033] Present invention may comprise an architecture that provides the ability to create and maintain multiple instances of pools in a hierarchical structure. In one embodiment, a pool in the lowest hierarchy consists of at least one component which is responsible for the physical devices and system instances which can be identified as energy consumers, producers or energy storages. The consumers and producers of a distribution area may define at least one pool with one or more groups of identified resources with known managed devices or service instances and in the groups the undefined objects. The identified objects in the pool can be grouped, categorized and classified automatically through discovery and detection rules and in addition manually. In other cases it is an advantage to define groups for managed objects and unmanaged objects in the same pool. Several pools can be framed in other hierarchical objects zones, districts or areas.

[0034] A system may be considered another logical object that represents at least one or several physical resources or service instances which can belong all to one pool or to several pools. A dishwasher for example may represent on one hand side a physical resource and on the other hand side a system for dishwashing. The system consists of several services like a heater and a pump that together form the system. The dishwasher is a system with several energy consumption service instances, i.e. the heating service and the pumping service. For every system normally exists one or more task planes which define a workflow with start times and end times for every service instance. Every service instance in a defined workflow normally has a typical consumption profile. The consumption profile of every service instance comprises a maximum capacity value and a timeline for consumption after start. The addition the capacity values of several services in distinct or identical timeslots of operation may define the maximum capacity and the total capacity between the start time and end time for a system or a physical object together with the type of task plane. The addition of instance profile built together the consumption profile for a system or device.

[0035] The schedule of the service instances of a system can be fixed for some task planes or variables. That means that each device in the pool is manageable to a certain degree in case of energy consumption and needed capacity and shift able start and end times. To manage and optimize the energy consumption process for each device and system, object or service instance are object statuses available. For instance a device can be off, on, or on standby. A system has statuses to manage the process. Statuses may comprise ready for work, starting, heating, pumping etc. Some machines like a washing machine may need a manual process to prepare the machine before it can be integrated into the automated energy balancing process.

[0036] The consumer can prepare his washing and cleaning machine in the morning, so that the renewable energy could be used. An industrial consumer like a steel forge who needs a lot of energy can adapt the start time of his production process so that he can use renewable energy.

[0037] Another example comprises a datacentre with two physical sites. The two site datacentre is a logical system with a number of devices (servers, storage systems, network devices, cooling...). The two datacentres are located in two different facilities. The facilities have a physical distance to each other so that each datacentre is located for instance in a different district.

[0038] The electricity distribution is partitioned in segments, so in the meaning of the invention the two side datacentre in total is one logical system. The load in the datacentre may be moved between the two datacentres in dependency of a load management, a disaster management or in dependency of the energy situation in the distribution area where the datacentre is located or the local power and cooling situation in the datacentre.

[0039] Present invention shows a method to influence (adapt) the energy consumption for different energy distribution areas. The green electricity energy depends on season times and different weather situations. To balance the oscillating of green electricity the invention makes consumer responsive and adaptable in the usage of electricity.

[0040] Auctions on different pool hierarchy levels can manage production type solar, wind, coal, atomic distributed or central and blackboards on the pool level can publish energy consumption, production, store or buffer rules, so management components on the device level can adapt their energy usage. For this, a so-called blackboard may be provided. The blackboard works like a familiar weather map but shows the actual energy status and forecast for the next time ranges, for example hours or days. If the weather is sunny in the next few days the forecast shows high energy capacity for renewable energy for the next day between 10:30 and 15:00 o'clock. Providers and consumers may use the blackboard for improved planning of energy provisioning and/or consumption. According to information from the blackboard, a local management unit may autonomously adapt its energy consumption to get the best result in dependency of published energy usage profiles.

[0041] The proposed method helps to reduce the power production costs and power distribution costs in general for all consumers in a distribution area and to reduce the individual consumption of electricity for all devices in a pool or logical systems like a household, datacentre or industrial plant, or production site through power saving profiles in a management unit which integrates the individual lifestyle or business process in a production environment, season time, outside temperature, indoor temperature and schedules like work time, week days, or holidays to reduce the energy consumption in combination with power consumption rules from the power distributor.

[0042] The invention will now be described in more detail with reference to the enclosed figures in which:

- Fig. 1 shows an energy distribution system;
- Fig. 2 shows a method for controlling an energy consumer in the system of Fig. 1;
- Fig. 3 shows a method for controlling an energy provider in the system of Fig. 1;
- Fig. 4 shows a graph for an exemplary decision making process in a control unit for an energy consumer according to Fig. 1 and
- Fig. 5 shows a graph for another decision making process in the control unit for an energy consumer according to Fig. 1.

[0043] Fig. 1 shows an exemplary energy network 100. The network 100 may be intersected into several hierarchical layers like e.g. an apparatus layer 105, a household or industrial production site or plant layer 110, a regional layer 115 and an area layer 120.

[0044] In the given example, on the apparatus layer 105 there is at least one system 125 comprising one or several energy consumers 130 and a control unit 135. The control unit 135 accepts requests for energy from the energy consumers 130 and grants or holds the requests through a process that will be described in more detail below. In another embodiment, the control unit 135 also has information about storage capacities of storage units and their logical or physical positions in the network 100 or forecasts for energy consumptions or productions of devices and systems. Such forecasts may be provided as timetables or profiles. More information may comprise an energy production capacity of a local site and from a higher level entity.

[0045] A comparable scheme may be carried out on the next higher level in the hierarchy, for instance the household level 110. The system 125 is connected to a super-system 125 with a further control unit 135 and acts like an energy consumer 130 to the further control unit 135. Thus, the control unit 135 on household layer 110 and the systems 125 on the apparatus layer 105 together form another system 125 on which energy distribution can be handled in the same way as in the system 125 on apparatus layer 105. Of course, several systems 125 of the apparatus layer 105 may be grouped to a super-system 125 on the next higher household layer 110 and the grouping may be done differently than depicted in Fig. 1.

[0046] Several systems 125 can be logically stacked on top of each other so that a hierarchy of systems 125 emerges. Depicted on the topmost area level 120 in Figure 1 there may be one or more energy providers 140 that provide energy from sources like for instance fossil fuel, atomic energy, wind or water. However, it must be noted that to the systems 125 on lower levels 105 - 115, a control unit 135 on the next higher level also acts like an energy provider 140. It should furthermore be noted that an energy provider 140 may also be instituted on a lower logical level 105 - 115. A photovoltaic installation on the roof of a residential house may for instance be connected to the control unit 135 that is shared by household layer 110 and regional layer 115. This particular control unit 135 will act as an energy provider 140 to the control units 135 on apparatus level 105 and as an energy consumer 130 to the next higher control unit 135 that is shared between regional layer 115 and area layer 120.

[0047] Focussing now on a system 125 on the apparatus level 105. The apparatus or device level consists of more or less manageable devices with known or unknown task plans in a defined time range and known or unknown energy consumption plans and profiles. The control unit ideally can be located near or in a smart meter, or can expand a data router. On a production site or in a housing estate it can be advantageous to have a dedicated computing unit for this purpose. The component responsible for a local network has rules to discover the devices in the network and to create the consumption profiles for every device, preferably with definable gran-

ularity.

[0048] It is proposed that the energy consumers 130 are not simply switched on or off on the basis of demand but that each energy consumer 130 first files a request for energy at the attached control unit 135 and the control unit 135 determines, on the basis of a priority of the request and a current price for energy, if and possibly when the request is granted. The consumer 130 will only be able to show a desired increased activity if the request is granted. In one example a washing machine may request additional energy for centrifuging the washing after cleaning it. Unless the request is granted, centrifuging does not take place.

[0049] Through this scheme, the cost of energy is by preference determined on the basis of proposal and demand, especially between providers 140 and consumers 130, and there may be a market place 145 for determining the price. The price may be expressed in money or any other unit that is in any way reciprocal to an availability of energy. In one embodiment, the price may be expressed in an emission footprint and reflect how much emission, for instance CO₂, is associated to the provision of a certain amount of energy. The market place 145 may be associated to one or more of the layers 105 - 120 and there may be several market places 145 that may be associated to different layers 105 - 120. In one embodiment, a separate market place 145 is associated to each layer 105 - 120.

[0050] In an example, the system 125 on the right hand side of Fig. 1 may represent a refrigerator. Among the consumers 130 of the refrigerator may be a cooling compressor (shown at left in Fig. 1), an illumination (middle) and an air recirculation pump (right). When the door of the refrigerator is opened, the light should come on. A corresponding request to the control unit 135 for energy to drive the light will comprise a high priority as lightless operation of the refrigerator is undesirable. In fact, the request's priority may be so high that it is always granted. The cooling compressor is normally turned on as soon as the temperature inside the refrigerator climbs over a predetermined threshold. Depending on the goods inside the refrigerator, however, it may be tolerable to allow the interior temperature to rise a little further before the cooling pump is activated. Therefore, a request to the control unit 135 for energy may have a lower priority than that of the light.

[0051] If the used capacity in the local network is high and the currently available energy is low, the request may not be granted immediately and the cooling compressor may therefore not be activated right away. Should the capacity be high enough or become high enough later on, the cooling compressor will be activated at the appropriate time. Should, on the other hand, the temperature inside the refrigerator rise over a second threshold, priority of the pending request of the cooling compressor may be increased so that the cooling compressor may be operated even at a lower energy availability level. Priority of the pending request for energy for the cooling

compressor may in one embodiment be increased automatically on the basis of a waiting time of the request or on the basis of the temperature difference between the first threshold and a current temperature inside the refrigerator. The availability level of energy usually runs reciprocal to a price for energy so that the described scheme may also be expressed with reference to price instead of availability level.

[0052] The same kind of procedure can be carried out on other systems 125, for instance an electrically propelled car whose batteries need charging, a tumble drier or an electric washing machine. Systems 125 on the apparatus level 105 may also be used professionally and be controlled in the same way. The system 125 on the left side of Fig. 1 may for instance correspond to an industrial manufacturing process of some goods. Different energy consumers 130 may here correspond to e.g. a heating, a flow control valve or an electric motor. Priorities associated to requests for energy for the different energy consumers 130 may vary according to the process or application running on the system 125. Features given above with respect to other systems 125 may apply.

[0053] The decision is made in dependency of the load in the local electricity network, the calculated capacity needed to fulfil the requirement and possibly a global rule on the blackboard.

[0054] Fig. 2 shows a method 200 for controlling an energy consumer 130 in the system 125 of Fig. 1. The method 200 is adapted to be carried out on the control unit 135 that is part of the system 125. It is to be noted that method 200 may be run on different levels 105 - 120 in energy network 100 of Fig. 1 and it is especially preferred that different instances of method 200 are run in cascade on control units 135 of different levels 105 - 120.

[0055] In a first step 205, an energy request is determined. The energy request is usually issued by the consumer 130 itself or by a controlling item such as a switch, a control unit or other.

[0056] In an optional following step 210, an amount of requested energy is determined. The amount may comprise an electric current and/or an expected on-time of the consumer 130. It may for instance be known that the recirculation pump of the refrigerator in above-described example is supposed to be running the whole time and that its energy consumption is constant. An appropriate request may concern a certain time interval.

[0057] In a succeeding step 215, an energy price is determined. The energy price may especially be determined from the market place 145 and on the basis of current or projected proposal and demand for energy.

[0058] In a step 220, a priority that is associated with the request is determined. In an optional step 225, the priority may be adjusted. Adjustment in priorities may especially be carried out when other requests for energy are pending and grant of the requests may be done in a time shifted manner such as to level energy consumption of the system 125 over time. Once it is determined which request should go first, its priority may be increased or

priority of another request may be reduced.

[0059] In a step 230 it is determined whether or not the request is granted. The determination is by preference done at least on the basis of energy price and priority. Optionally, the amount of requested energy may also play a role. Different decision making processes are explained in more detail below.

[0060] If it is found that the request should be granted, the consumer 130 associated with the request is turned on in a step 235 and method 200 may loop back to step 205 for reiteration.

[0061] There may be a database or other storage in which the pending and/or the granted requests may be kept. Granted requests are by preference removed from the database when the associated energy consumption has terminated. Pending requests may be automatically re-evaluated as is explained in more detail below. A consumer 130 whose request has been granted may later be interrupted and turned off if the available capacity for energy decreases, if other requests with higher priorities are determined or if the priority of the request itself is reduced. If a consumer 130 is temporarily turned off this way, its associated request may be considered pending again. Pending requests may be re-evaluated on a periodical or event-driven basis. Alternatively, a request that cannot be granted may be considered rejected and not kept in any database. In this case, the energy consumer 130 itself will have to re-issue a request for energy in order to be allowed energy consumption.

[0062] In an optional step 240, pending requests may be provided, for instance, to an energy provider 140 or the marketplace 145. That is, data concerning pending and/or granted requests in the database may be published, transmitted or made available. Of the requests, summary information such as only an accumulated amount of requested and not-granted energy may be provided. More detailed information may comprise requested energy amounts, consumer types, priorities and other information for each request. Said information is by preference made available to an energy provider 140 or the next higher control unit 135. Any control unit 135 may relay such information from a lower to a higher level 105 - 120.

[0063] In an optional step 245 a predetermined time passes. In a step 250, which is also optional, a priority of pending requests may be automatically increased. The increase may be done for instance on a linear or exponential basis. Then method 200 loops back to step 230 where pending requests and optionally granted requests are re-evaluated. It is to be noted that the sequence of steps 230 - 250 may be run through independently and possibly concurrently with steps 205 - 235.

[0064] Fig. 3 shows a method 300 for controlling an energy provider 140 and the system 125 of Fig. 1. Method 300 is adapted to be carried out on a control unit that is attached to the energy provider 140. This control unit may be a control unit 135 of one of the systems 125 of Fig. 1.

[0065] In a first step 305 a request for energy is received. Next, in a step 310, a price for energy is determined. This is done by preference via the market place 145. Then, on the basis of the price and the energy requests or several energy requests that have accumulated, the provided energy may be adjusted in a step 315. Depending on the type of energy provider 140, adjusting the amount of provided energy may be easier or harder. Associated thresholds for the decision made in step 315 may thus be required.

[0066] After that, method 300 may loop back to step 305 and run through again.

[0067] Fig. 4 shows a graph 400 for an exemplary decision making process in a control unit 135 for an energy consumer 130 according to Fig. 1. The process described herein is especially adapted to be carried out in step 230 of method 200 of Figure 2. There are shown two diagrams, both of which depict time in a horizontal direction. In the upper diagram, there is shown a priority 405 of an example request and an example price 410 for energy over time. In the lower diagram, energy grant 415 to the energy consumer 130 is depicted; a high value corresponds to a consumer 130 that is turned on and a low value to the consumer 130 turned off.

[0068] In a first interval 420 energy price 410 is low, in a second interval 425 it is medium and in a third interval 430 it is high. Price 410 and priority 405 are scaled such that the consumer 130 is turned on when the priority 405 exceeds the price 410 and turned off otherwise. During the first interval 420, when the price is low, consumer 130 is therefore turned on the whole time no matter how high the priority of the request is. When the price is medium, in second interval 425, grant of energy depends on the current priority of the request and energy is granted part of the time. When the price is high in third interval 430, consumer 130 is turned off the whole time. It is to be noted that in present example the same progression of priority over time is used for intervals 420, 425 and 430.

[0069] By appropriate selection of scaling factors, priority 405 and price 410 may be advantageously adjusted so that consumer 130 is by preference only supplied energy when the price 410 is low or the priority 405 is high. In order to make sure that the process that is associated with consumer 130 can run properly, priority 405 of a pending request may be automatically increased periodically. Also, priority 405 may be automatically decreased periodically when the associated request is granted. Decrease and increase velocities may differ.

[0070] Fig. 5 shows a graph 500 for another decision making process in the control unit 135 of an energy consumer 130 according to Fig. 1. The procedure discussed in the following is adapted to be carried out in step 230 of method 200 of Fig. 2.

[0071] A criterion 505 is displayed as a function of the price 410 for energy and amount 510 of energy requested. The criterion 505 equals the price 410 multiplied by the amount 510, although both price 410 and amount 510 may have been multiplied with appropriate factors

beforehand. The criterion 505 may then be compared to the priority 405 as described above with reference to Fig. 4. Should the priority 405 exceed the criterion 505, an associated request for energy may be granted. Otherwise, energy may be turned off to the associated consumer 130.

Reference List

[0072]

100 energy network
 105 apparatus layer
 110 household layer
 115 regional layer
 120 area layer

 125 system
 130 energy consumer
 135 control unit
 140 energy provider
 145 marketplace

 200 method (consumer side)
 205 determine power request
 210 determine amount
 215 determine energy price
 220 determine priority
 225 adjust priority
 230 grant?
 235 turn consumer on
 240 provide pending requests
 245 sleep
 250 increase priority

 300 method (provider side)
 305 receive energy request
 310 determine price for energy
 315 adjust provided energy

 400 graph
 405 priority
 410 price
 415 power grant
 420 first interval (price low)
 425 second interval (price medium)
 430 third interval (price high)

 500 graph
 505 criterion
 510 amount

Claims

1. Method (200) for controlling a pool of energy consuming systems (125) with at least one energy consumer (130), the Method (200) comprising steps of:

- receiving (205) a request for energy from a consumer (130);
 - determining (220) a current priority (405) of the request;
 - determining (215) a current price (410) for provisioning energy to the system (125) and
 - granting (235) the energy request on the basis of the priority (405) and the price (410).

2. Method (200) according to claim 1, wherein the request is granted if the priority (405) exceeds the price (410).
3. Method (200) according to claim 1, wherein an amount of energy (510) is requested and the request is granted if the priority (405) exceeds a linear combination (505) of price (410) and amount (510).
4. Method (200) according to one of the above claims, wherein a request that cannot be granted is held pending.
5. Method (200) according to claim 4, wherein priority (405) of a pending request is automatically increased (250) over time.
6. Method (200) according to claim 4 or 5, wherein an amount (510) of energy is requested and an amount of energy of pending requests is provided (240) to an energy provider (140).
7. Method (200) according to one of the above claims, wherein energy consumption of a consumer (130) is stopped if a decision criteria that led to grant of the corresponding request is no longer met.
8. Method (200) according to one of the above claims, wherein the priority (405) is determined on the basis of a consumer (130) kind.
9. Method (200) according to one of the above claims, wherein the priority (405) is determined on the basis of a consumption history of the consumer (130).
10. Method (200) according to claim 9, wherein priority (405) of a request is reduced on the basis of the consumption history.
11. Method (200) according to one of the above claims, wherein priorities (405) of requests are adjusted (225) such as to level a system (125) energy consumption over time.
12. Control unit (135) for controlling an energy consuming system (125), the system (125) comprising at least one energy consumer (130), the control unit (135) being adapted to perform a method (200) according to one of the above claims.

13. Computer program product with program code means for carrying out a method (200) according to one of claims 1 to 11 when the computer program product is run on a control unit (135) or stored on a computer readable medium. 5
14. Method (300) for controlling an energy provider (140), the provider (140) being adapted to provide energy to at least one energy consumer (130), the method comprising steps of: 10
- receiving (305) information on a desired amount of energy consumption that exceeds the consumer (130)'s current energy consumption; 15
 - determining (310) a current price (410) for energy and
 - adjusting (315), on the basis of the price (410) and the desired energy, an amount of energy provided by the provider (140). 20
15. Method (300) according to claim 14, wherein the price (410) for energy is determined (310) on the basis of proposal and demand. 25
- 30
- 35
- 40
- 45
- 50
- 55

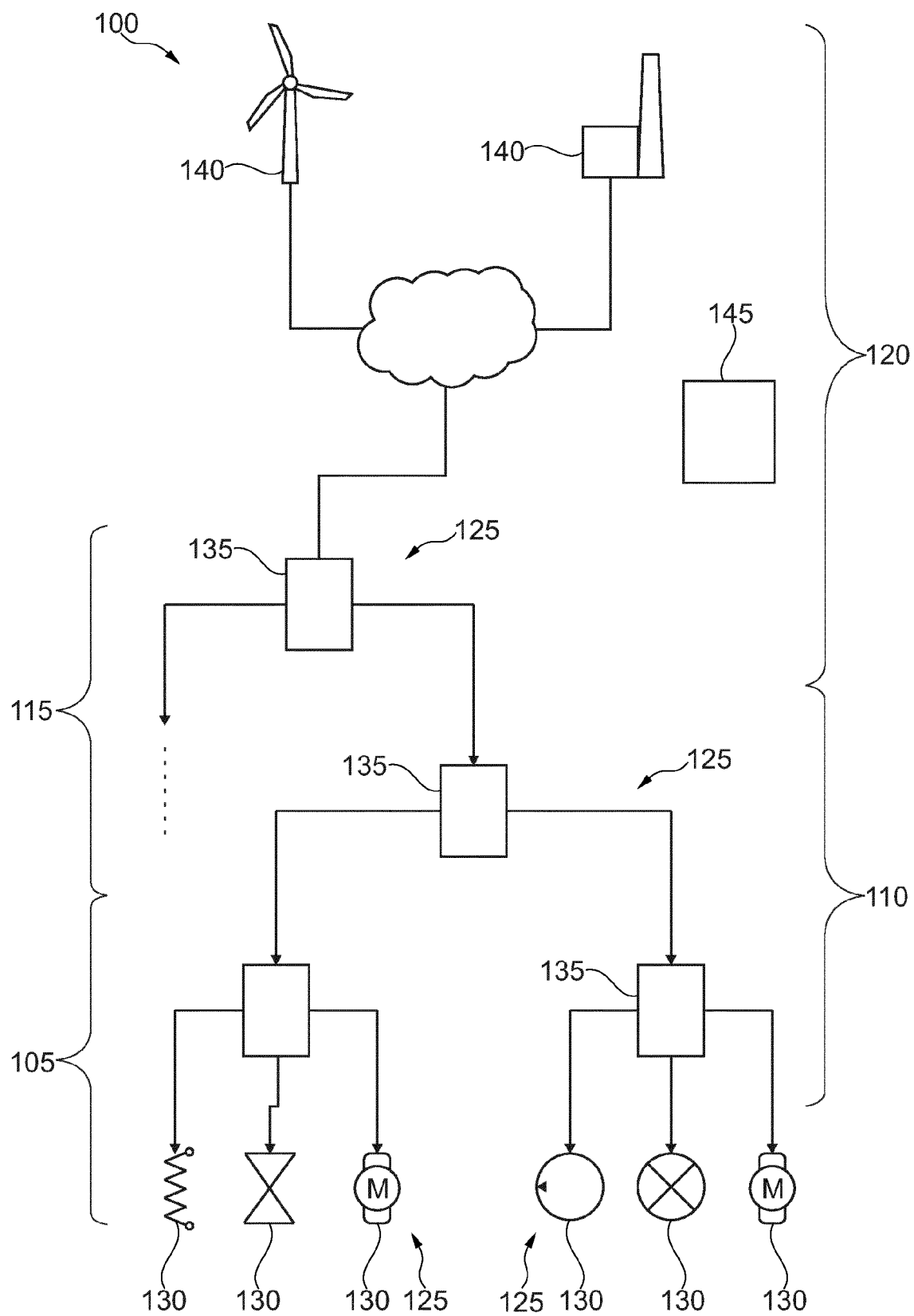


Fig. 1

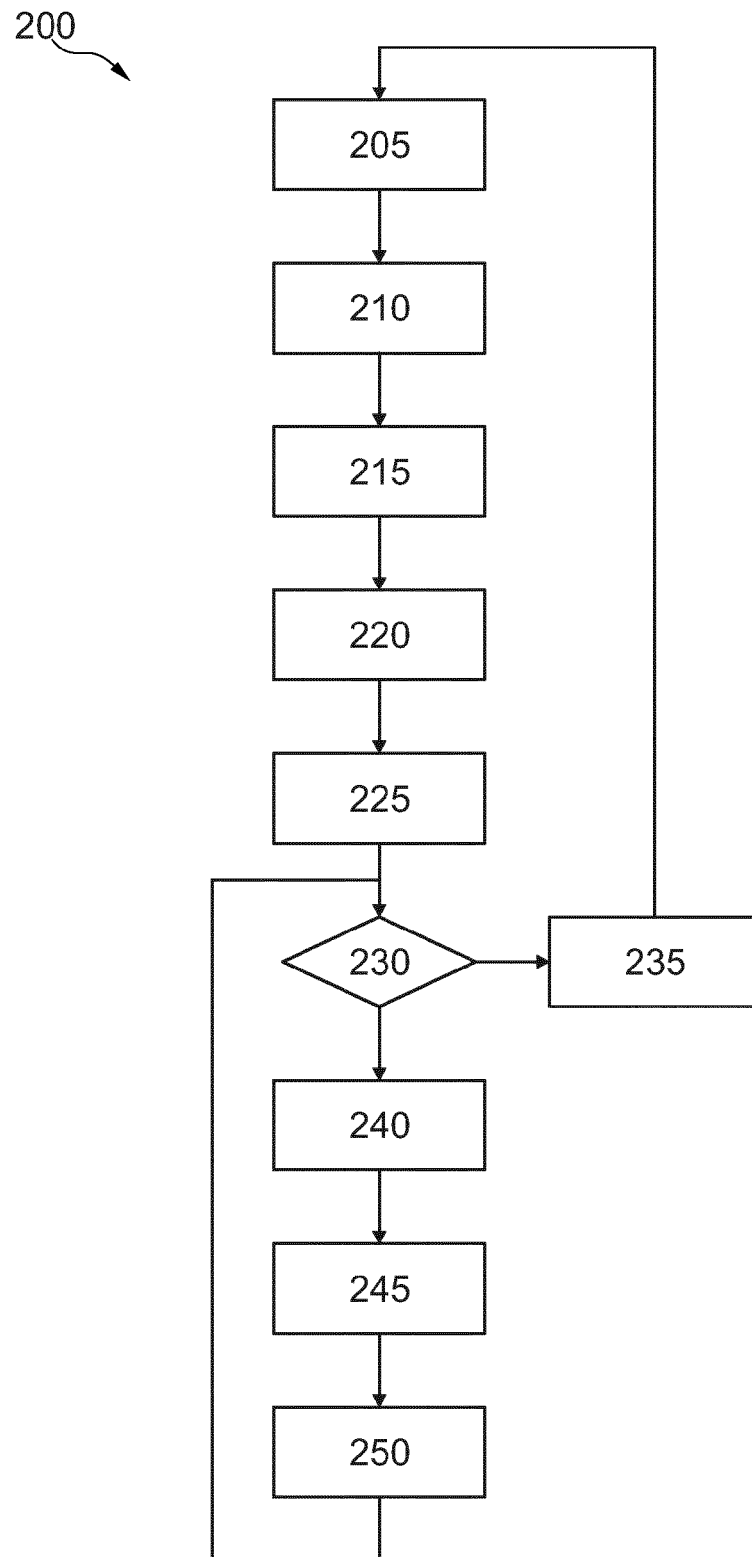


Fig. 2

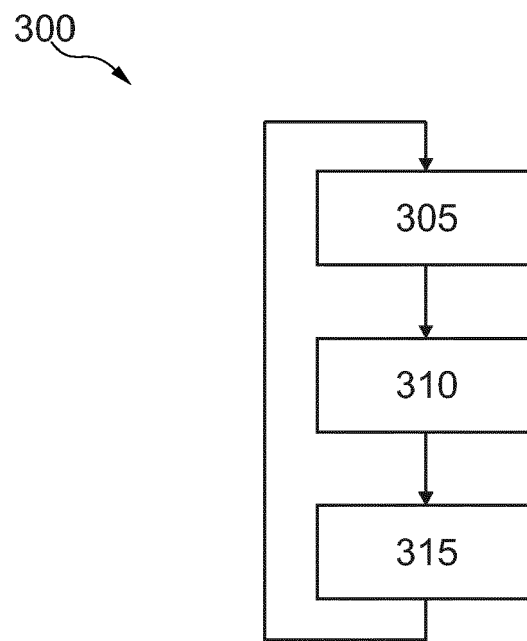


Fig. 3

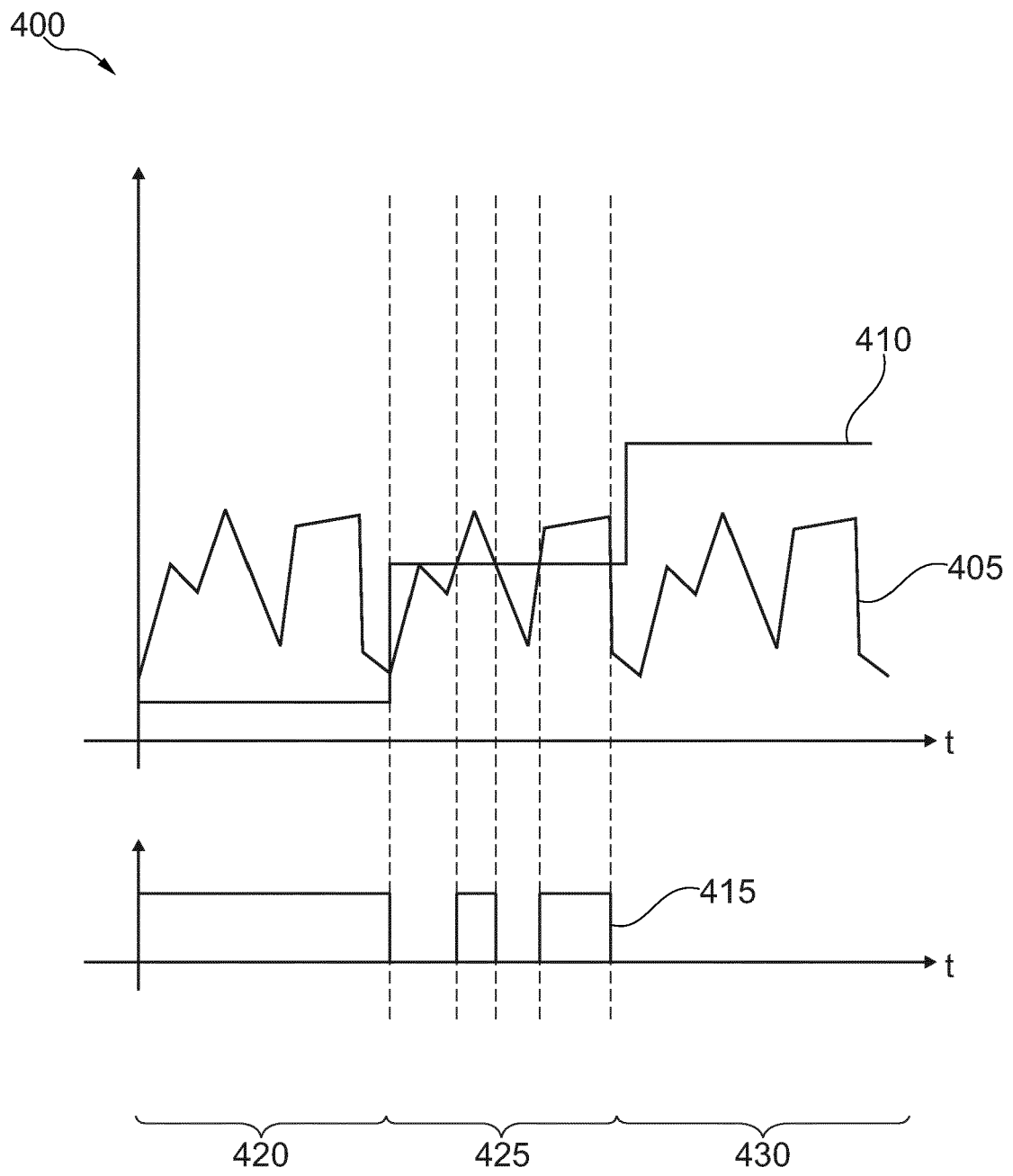


Fig. 4

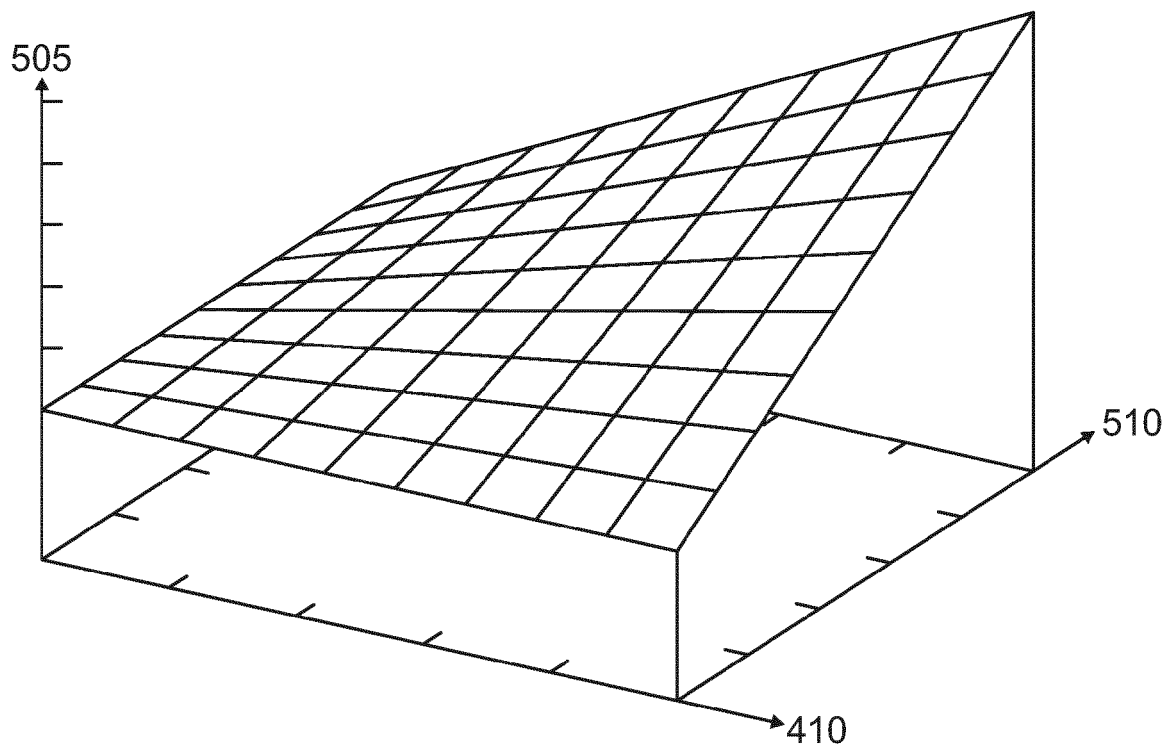


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 14 18 5000

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
L	EPO: "Mitteilung des Europäischen Patentamts vom 1. Oktober 2007 über Geschäftsmethoden = Notice from the European Patent Office dated 1 October 2007 concerning business methods = Communiqué de l'Office européen des brevets, en date du 1er octobre 2007, concernant les méthodes dans le domaine des activités", JOURNAL OFFICIEL DE L'OFFICE EUROPEEN DES BREVETS.OFFICIAL JOURNAL OF THE EUROPEAN PATENT OFFICE.AMTSBLATT DES EUROPÄISCHEN PATENTAMTS, OEB, MÜNCHEN, DE, vol. 30, no. 11, 1 November 2007 (2007-11-01), pages 592-593, XP007905525, ISSN: 0170-9291 * The claimed subject matter, with due regard to the description and drawings, relates to processes comprised in the list of subject matter and activities excluded from patentability under Art.52(2) and (3) EPC. The applicant is advised that in accordance with the established practice of the EPO, no search need be performed in respect of those aspects of the claimed invention. The only identifiable technical aspects of the claimed invention relate to the use of conventional, general-purpose data processing technology for processing data of an inherently non-technical nature. The information technology employed is considered to have been generally known as it was widely available to everyone at the date of filing/priority of the present application. The notoriety of such prior art cannot reasonably be contested. No documentary evidence was therefore considered required. *	1-15	INV. G06Q50/06
			TECHNICAL FIELDS SEARCHED (IPC)
			G06Q
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		23 February 2015	Falierou, Christina
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

Application Number
EP 14 18 5000

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim

		TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims		
Place of search	Date of completion of the search	Examiner
The Hague	23 February 2015	Falierou, Christina
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		