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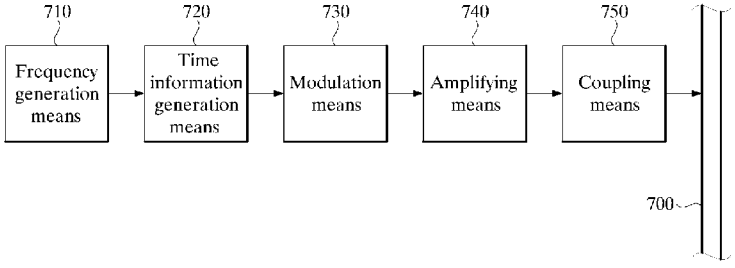
(54) Title: TRANSMITTING/RECEIVING APPARATUS OF TIME INFORMATION BROADCASTING USING MULTIPLE MODULATION SIGNAL, METHOD USING THE SAME

FIG 1



(57) Abstract: The present invention relates to a time information broadcasting apparatus using a power line and a method thereof, in which since power line broadcasting uni-directionally transmits a small amount of data such as time information, whereas power line communication needs a carrier wave of a high frequency band in order to bi-directionally transmit a large amount of data, a carrier wave of a low frequency band can be used, and thus long distance power line broadcasting can be easily performed.

Description

Title of Invention: TRANSMITTING/RECEIVING APPARATUS OF TIME INFORMATION BROADCASTING USING MULTIPLE MODULATION SIGNAL, METHOD USING THE SAME

Technical Field

[1] The present invention relates to an apparatus for transmitting and receiving a time information broadcast signal using a plurality of modulation signals and a method using the same, and more specifically, to a time information broadcasting apparatus using a power line, in which the time information broadcast signal is overlapped with a power signal of 59 to 60 Hz and transferred to an electronic device or the like.

Background Art

[2] Communication is a terminology referring to all actions for transmitting and receiving or exchanging information such as symbols, sounds, images and the like between two or more points. Among the communications, power line communication (PLC) is a technique for loading and communicating voices and data on a power signal using a power line for supplying power as a medium.

[3]

[4] Broadcasting is a concept contrasting to the communication, and the broadcasting refers to distributing various types of information such as entertainment, intelligence, education and the like so that the unspecified general public having an appropriate receive apparatus may simultaneously view or listen to the information.

[5]

[6] The invention disclosed in the specification uses a power line, like the power line communication. However, it can be defined as power line broadcasting(PLB) in that a small amount of data is uni-directionally transmitted and the unspecified general public receives the data. Particularly, the present invention relates to a time information broadcasting apparatus for loading and transmitting a time information broadcast signal on a power signal of a power line to a variety of devices, and this can be defined as power line time broadcasting (PLTB).

[7]

[8] Unlike the power line communication, the power line broadcasting can perform long distance transmission using a power line based on a low frequency, and if uni-directional information transfer is the only object, the power line broadcasting can further effectively achieve the object compared with conventional power line commu-

nication.

[9]

[10] The concept and technique of the power line broadcasting described above need to be introduced due to the following characteristics that the power line communication has.

[11]

[12] Since the power line communication is a wired communication using a power line as a medium, it may affect other wireless facilities due to leakage of radio waves, and a frequency band for exchanging a large amount of data can be a frequency band limited by the radio regulation law in some cases.

[13]

[14] In addition, the power line used for power line communication is not a communication line comprising a single device for a single purpose like a telephone line or an asymmetric digital subscriber line(ADSL), but is connected to a variety of devices such as a refrigerator, a TV, and the like at home.

[15]

[16] Accordingly, since the noise level of a circuit is extremely high and signals are frequently distorted or disconnected, there is a limit in that the power line is inappropriate as a data communication line. Particularly, it is difficult to transfer data through limited signal power, overcoming special environments such as high load, interference, varying impedance, attenuation of signal, and the like.

[17]

[18] <Necessities of time information broadcasting>

[19] In modern life, time is a physical quantity that can be measured most accurately. Owing to its accuracy, time information is sufficiently valuable to be utilized in the whole field of industry, and it is important to manage and accurately maintain the time information for its utilization.

[20]

[21] Among various types of time information, there are standard times managed and maintained by a number of countries for each country, as well as the International Atomic Times (TAI) and Universal Time Coordinated (UTC). In addition, a reference time of an atomic clock mounted on a satellite of a global positioning system (GPS) is utilized as time information.

[22]

[23] As a method for obtaining time information in the current stage, a UTCK program can be downloaded and used through the Internet, or the time information can be obtained by connecting to a time server in each country through a modem. In addition, the time information can be obtained from long-wave broadcasting or shortwave broadcasting.

[24]

[25] The long-wave or shortwave broadcasting loads and broadcasts information such as a one pulse per second(1PPS), a binary coded decimal(BCD) time code, an audio tone or the like on a carrier frequency. However, since communication of the shortwave broadcasting mainly uses a space wave, it is difficult to receive the space wave indoor, and receive sensitivity is degraded depending on the state of the ionosphere and the installation location of a receive antenna.

[26]

[27] Furthermore, even the methods for obtaining time information, such as information on national standard time, through an Internet network or a telephone network are indirect or limited in providing the time information to a variety of electronic products, facilities of a factory, measuring instruments in a laboratory or the like.

[28]

[29] Accordingly, it is required to provide a technique for transmitting time information without separately installing dedicated wires, measuring power consumption from a meter in real-time while using previously installed electric facilities as are, executing home automation, and utilizing time information for an industrial site having various measuring instruments or system equipments, a home aide robot, a variety of electronic devices used in the army, and a situation where GPS signals cannot be directly received such as inside a vessel.

Disclosure of Invention

Technical Problem

[30] Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a time information broadcasting apparatus using a power line, in which a small amount of data can be uni-directionally broadcasted to a long distance over a power line using a carrier wave of a low frequency band, whereas power line communication needs a carrier wave of a high frequency band in order to bi-directionally transmit a large amount of data.

Solution to Problem

[31] To accomplish the above object, according to one aspect of the present invention, there is provided an apparatus for transmitting a time information broadcast signal using a plurality of modulation signals, the apparatus comprising: a frequency generation means 710 for generating a reference frequency; a time information generation means 720 for generating the time information broadcast signal encoded in a digital signal using the reference frequency; a modulation means 730 for generating the modulation signals having different frequencies by modulating the generated time information broadcast signal in a predetermined modulation method; an amplifying

means 740 for amplifying the modulation signals; and a coupling means 750 for coupling the amplified modulation signals to a power line 700 through electromagnetic inductive coupling.

[32]

[33] According to another aspect of the present invention, there is provided an apparatus for receiving a time information broadcast signal using a plurality of modulation signals, the apparatus comprising: a decoupling means 810 for decoupling a plurality of carrier waves from a power line 700 which transmits a power signal and the plurality of carrier waves of different frequencies; a filter means 820 for detecting the plurality of carrier waves; a control means 830 for sequentially receiving the plurality of carrier waves and examining integrity of the signals; a demodulation means 840 for generating an encoded time information broadcast signal by demodulating a certain carrier wave among the plurality of carrier waves based on a signal of the control means 830; and a decoding means 850 for decoding the time information broadcast signal and extracting time information.

[34]

[35] According to another aspect of the present invention, there is provided a method for transmitting a time information broadcast signal using a plurality of modulation signals, the method comprising the steps of: generating the time information broadcast signal encoded in a digital signal using a reference frequency generated by a frequency generation means 710, by a time information generation means 720 S610; generating the plurality of modulation signals of different frequencies by modulating the time information broadcast signal in a predetermined modulation method, by a modulation means 730 S620; amplifying the plurality of modulation signals, by an amplifying means 740 S630 and coupling the plurality of amplified modulation signals to a power line 700 through electromagnetic inductive coupling, by a coupling means 750 S640.

[36]

[37] According to another aspect of the present invention, there is provided a method for receiving a time information broadcast signal using a plurality of modulation signals, the method comprising the steps of: decoupling a plurality of carrier waves modulated at different frequencies from a power line 700, by a decoupling means 810 S710; detecting the plurality of carrier waves, by a filter means 820 S720; sequentially receiving the plurality of carrier waves and examining integrity of the signals, by a control means 830 S730; generating an encoded time information broadcast signal by demodulating a certain carrier wave among the plurality of carrier waves based on a signal of the control means 830, by a demodulation means 840 S740; and decoding the time information broadcast signal and extracting time information, by a decoding means 850 S750.

[38]

[39] According to another aspect of the present invention, there is provided an apparatus for transmitting a time information broadcast signal using a plurality of modulation signals, the apparatus comprising: a frequency generation means 910 for generating a reference frequency; a time information generation means 920 for generating basic time information encoded in '0' and '1' using the reference frequency, and generating additional time information by re-encoding the basic time information based on a time frame of the basic time information; a modulation means 930 for generating a plurality of different modulation signals by modulating the generated basic time information and additional time information in a predetermined modulation method; an amplifying means 940 for amplifying the plurality of modulation signals; and a coupling means 950 for coupling the plurality of amplified modulation signals to a power line 900 through electromagnetic inductive coupling.

[40]

[41] According to another aspect of the present invention, there is provided a method for transmitting a time information broadcast signal using a plurality of modulation signals, the method comprising the steps of: generating basic time information encoded in '0' and '1' using a reference frequency generated by a frequency generation means 910, by a time information generation means 920 S810; generating additional time information by re-encoding the basic time information based on a time frame of the generated basic time information, by the time information generation means 920 S820; generating a plurality of different modulation signals by modulating the basic time information and the additional time information in a predetermined modulation method, by a modulation means 930 S830; amplifying the plurality of modulation signals, by an amplifying means 940 S850; and coupling the plurality of amplified modulation signals to a power line 900 through electromagnetic inductive coupling, by a coupling means 950 S860.

Advantageous Effects of Invention

[42] According to a preferred embodiment of the present invention described above, since power line broadcasting transmits a small amount of data such as time information unidirectionally, long-range power line broadcasting can be easily performed using a carrier wave of a low frequency band.

[43]

[44] Furthermore, according to the present invention, since a time information broadcast signal is transmitted using a plurality of modulation signals, a receiver side can receive the time information broadcast signal stably without being affected by interference of analogous frequencies on receiving the time information broadcast signal.

[45]

[46] Furthermore, according to the present invention, since the receiver side down-converts the time information broadcast signal, resolution (capability of detecting time information broadcast signals) of a digital filter can be improved.

[47]

[48] In addition, according to the present invention, since parts of a BCD time code in the IRIG-H format are selectively re-encoded, current time information can be rapidly obtained when the time information broadcast signal is received.

Brief Description of Drawings

[49] The above and other objects, features and advantages of the present invention will be apparent from the following detailed description of the preferred embodiments of the present invention in conjunction with the accompanying drawings.

[50] FIG. 1 is a view showing the configuration of an apparatus for transmitting a time information broadcast signal using a plurality of modulation signals according to a first embodiment of the present invention.

[51] FIG. 2 is a view showing a BCD time code of a standard frequency station, which is a method of distributing a time frequency standard using wireless communication according to a first embodiment of the present invention.

[52] FIG. 3 is a view showing a signal modulated by a modulation means according to a first embodiment of the present invention.

[53] FIG. 4 is a view showing the configuration of an apparatus for receiving a time information broadcast signal using a plurality of modulation signals according to a second embodiment of the present invention.

[54] FIG. 5 is a view showing the configuration of a filter means in detail according to a second embodiment of the present invention.

[55] FIG. 6 is a flowchart sequentially illustrating a method for transmitting a time information broadcast signal using a plurality of modulation signals according to a first embodiment of the present invention.

[56] FIG. 7 is a flowchart sequentially illustrating the step of generating a plurality of modulation signals according to a first embodiment of the present invention.

[57] FIG. 8 is a flowchart sequentially illustrating a method for receiving a time information broadcast signal using a plurality of modulation signals according to a second embodiment of the present invention.

[58] FIG. 9 is a flowchart sequentially illustrating the step of examining integrity of a signal according to a second embodiment of the present invention.

[59] FIG. 10 is a view showing the configuration of an apparatus for transmitting a time information broadcast signal using a plurality of modulation signals according to a

third embodiment of the present invention.

[60] FIG. 11 is a view showing output time of a high level according to a third embodiment of the present invention.

[61] FIG. 12 is a view showing basic time information encoding additional time information according to a third embodiment of the present invention.

[62] FIG. 13 is a view showing additional time information modulated by a modulation means according to a third embodiment of the present invention.

[63] FIG. 14 is a view showing basic time information and additional time information modulated by a modulation means according to a third embodiment of the present invention.

[64] FIG. 15 is a flowchart sequentially illustrating a method for transmitting a time information broadcast signal using a plurality of modulation signals according to a third embodiment of the present invention.

[65] FIG. 16 is a flowchart sequentially illustrating the step of generating a plurality of modulation signals according to a third embodiment of the present invention.

Mode for the Invention

[66] The preferred embodiments of the present invention will be hereafter described in detail, with reference to the accompanying drawings. The present invention may, however, be embodied in different forms and should not be constructed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those skilled in the art.

[67]

[68] As shown in FIG. 1, an apparatus for transmitting a time information broadcast signal using a plurality of modulation signals according to a first embodiment of the present invention roughly comprises a frequency generation means 710, a time information generation means 720, a modulation means 730, an amplifying means 740, and a coupling means 750.

[69]

[70] Being provided with the configuration described above, a time information broadcast signal is transmitted in combination with a power signal of the power line 700. Hereinafter, the configuration of the apparatus for transmitting a time information broadcast signal using a plurality of modulation signals according to the present invention will be described in detail with reference to FIGs. 1 to 3.

[71]

[72] As shown in FIG. 1, if a power plug is only connected to an outlet of the power line 700 according to a first embodiment of the present invention without an additional

LAN cable or wireless communication device, the power line 700 can transmit a time information broadcast signal on a low frequency signal. Although an existing power line 700 for supplying power can be used as is and the power signal of the power line 700 generally uses a frequency of 60 Hz, a frequency lower or higher than 60 Hz (e.g., 40 to 70 Hz) can be used.

[73]

[74] The frequency generation means 710 according to a first embodiment of the present invention is a means for generating a reference frequency using a crystal(X-tal), an oscillator, or the like. The reference frequency is, for example, a frequency of 5 or 10 MHz, which is a means for being directly used or multiplied to provide a reference clock(frequency).

[75]

[76] The time information generation means 720 according to a first embodiment of the present invention generates a time information broadcast signal encoded in a digital signal using the reference frequency generated by the crystal or oscillator described above. At this point, in an embodiment of the encoded time information broadcast signal, a BCD time code of an IRIG-H format can be used as shown in FIG. 2.

[77]

[78] The modulation means 730 according to a first embodiment of the present invention generates a plurality of modulation signals of different frequencies by modulating the time information broadcast signal encoded in a BCD time code using a predetermined modulation method, thereby generating a carrier wave that can be loaded on the power line 700.

[79]

[80] Describing an example of the plurality of modulation signals(three types of modulation signals) in further detail with reference to FIG. 3, high level output duration time corresponding to digital signal '0' encoded in a BCD time code is 200[ms], and low level output duration time is 800[ms].

[81]

[82] At this point, as shown in FIG. 3, a frequency corresponding to the high level is an upper frequency of 77.5 KHz, and a frequency corresponding to the low level is a lower frequency of 72.5 KHz. That is, the lower frequency is a frequency apart from the upper frequency by 5 KHz. A signal modulated at the frequencies of 77.5 KHz and 72.5 KHz is referred to as a first modulation signal. Here, the first modulation signal generates a frequency corresponding to 77.5 KHz for 200[ms] and a frequency corresponding to 72.5 KHz for 800[ms].

[83]

[84] In addition, second and third modulation signals can be generated by changing only

the frequencies in a method the same as that of the first modulation signal. That is, the second modulation signal has an upper frequency of 87 KHz and a lower frequency of 82 KHz. In the same manner, the third modulation signal has an upper frequency of 97 KHz and a lower frequency of 92 KHz.

[85]

[86] On the other hand, although a modulation signal corresponding to digital signal '1' is generated to be the same as a modulation signal corresponding to digital signal '0', frequencies corresponding to 77.5 KHz and 72.5 KHz are generated for 500[ms], respectively.

[87]

[88] On the other hand, if the BCD time code format is a binary serial code of one minute period, output duration time of a pulse wave signal corresponding to '0'is 200[ms], output duration time of a pulse wave signal corresponding to '1' is 500[ms], and output duration time of a pulse wave signal for recognizing a starting point is 800[ms].

[89]

[90] Accordingly, the modulation means 730 performs pulse width modulation on the first, second, and third modulation signals according to the BCD time code formats(output duration time of pulse wave signals corresponding to 0, 1, and recognition of a starting point) described above. In addition, the modulation means 730 performs amplitude modulation in order to couple the first, second, and third modulation signals to the power line 700. At this point, amplitude of the lower frequency modulated using the amplitude modulation is preferably about 30% of the amplitude of the upper frequency.

[91]

[92] The BCD time code format is a binary serial code of one minute interval, in which output duration time of a pulse wave signal corresponding to '0' is 200[ms], output duration time of a pulse wave signal corresponding to '1' is 500[ms], and output duration time of a pulse wave signal for recognizing a starting point is 800[ms] (corresponding to a, b, and c of FIG. 2, respectively). It is apparent that the time information can be encoded in a variety of formats other than the IRIG-H format described above.

[93]

[94] Since the amplitude of the lower frequency is maintained to be about 30% of the amplitude of the basic frequency as described above, a signal at a low level can be clearly distinguished from a signal generated by noise. In addition, conventionally, since it is difficult to distinguish a noise signal from a low level signal, integrity is examined only for high level signals. However, according to the present invention, integrity is examined for low level signals, as well as high level signals, and thus

integrity of a signal can be correctly examined. Accordingly, it is possible to avoid interference of analogous frequencies that can be induced in the power line 700 by transmitting the first, second, and third modulation signals to the receiver side.

[95]

[96] The first, second, and third modulation signals described above are only for describing an embodiment of the present invention, and a variety of frequencies can be used. It is apparent that a plurality of modulation signals further more or further less than the three modulation signals can be used.

[97]

[98] The coupling means 750 according to a first embodiment of the present invention couples a carrier wave amplified by the amplifying means 740 to the power signal of the power line 700 through electromagnetic inductive coupling. At this point, since the power line 700 is three-phase, the carrier wave is coupled to each of the phases through electromagnetic inductive coupling. Accordingly, the same time information can be obtained at any phase of the three-phase AC signal, from the time information broadcast signal coupled to each phase through electromagnetic inductive coupling.

[99]

[100] <Transmission method of first embodiment>

[101] FIG. 6 is a flowchart sequentially illustrating a transmission method according to the configuration of a first embodiment. Hereinafter, a method for transmitting a time information broadcast signal using a plurality of modulation signals according to the present invention will be described in detail with reference to FIGs. 6 and 7.

[102]

[103] First, as shown in FIG. 6, the time information generation means 720 performs the step of generating a time information broadcast signal encoded in a digital signal using a reference frequency generated by the frequency generation means 710 S610.

[104]

[105] Next, the modulation means 730 performs the step of generating a plurality of modulation signals of different frequencies by modulating the time information broadcast signal in a predetermined modulation method S620. The plurality of modulation signals generated at this point is the first, second, and third modulation signals described above.

[106]

[107] The first, second, and third modulation signals are generated in the steps described below. The modulation means 730 performs the step of generating a first modulation signal of an upper frequency 77.5 KHz corresponding to a high level of a digital signal and a lower frequency 72.5 KHz corresponding to a low level of the digital signal S621.

[108]

[109] Next, the modulation means 730 performs the step of generating a second modulation signal of a frequency different from that of the first modulation signal S623, and if there are two or more modulation signals, the modulation means 730 may generate further more modulation signals as needed through the steps described above.

[110]

[111] Next, the amplifying means 740 performs the step of amplifying the gain of the modulation signal S640.

[112]

[113] Finally, the coupling means 750 performs the step of coupling the amplified modulation signal to the power line 700 through electromagnetic inductive coupling S650.

[114]

[115] <Configuration of second embodiment>

[116] As shown in FIG. 4, an apparatus for receiving a time information broadcast signal using a plurality of modulation signals according to a second embodiment of the present invention roughly comprises a decoupling means 810, a filter means 820, a control means 830, a demodulation means 840, and a decoding means 850.

[117]

[118] Being provided with the configuration described above, a plurality of modulation signals transmitted from a sender side according to the present invention is received, and thus a time information broadcast signal can be received through a power line 700. Hereinafter, the configuration of an apparatus for receiving a time information broadcast signal using a plurality of modulation signals according to a second embodiment of the present invention will be described in detail with reference to FIGs. 4 and 5.

[119]

[120] As shown in FIG. 4, the filter means 820 according to a second embodiment of the present invention receives carrier waves from the decoupling means 810 which decouples, from the power line 700, a plurality of carrier waves having different frequencies transmitted from the sender side, and detects the first, second, and third modulation signals using filters appropriate to respective carrier frequencies.

[121]

[122] The filter means 820 includes an analog band-pass filter 821, a gain control means 823, an analog-digital converter 825, and a digital filter 827. At this point, the analog band-pass filter 821 is configured using band-pass filters appropriate to the first, second, and third modulation signals. That is, if there are three modulation signals, the analog band-pass filter 821 is configured with three band-pass filters.

[123]

[124] After filtering each modulation signal firstly in this manner, the gain control means 823 automatically amplifies and outputs the signal attenuated by the analog band-pass filter 821.

[125]

[126] The plurality of amplified modulation signals is outputted to the analog-digital converter 825, and the first, second, and third modulation signals converted into digital signals are secondly filtered by the digital filter 827. The digital filter 827 outputs the filtered modulation signals to the control means 830.

[127]

[128] As another embodiment of the filter means 820 described above, a mixer means 828 and a low-pass filter 829 are further provided between the gain control means 823 and the analog-digital converter 825, and the modulation signals are down-sampled at a low frequency less than 20 KHz. Therefore, since a processing frequency band is lowered, performance of hardware can be improved.

[129]

[130] That is, the mixer means 828 receives signals outputted from an oscillator for generating a certain frequency and outputted from the gain control means 823 and generates an intermediate frequency. The generated intermediate frequency is a low frequency less than about 20 KHz, and a signal of a desired band is extracted from the intermediate frequency using the low-pass filter 829. The extracted signal is outputted to the analog-digital converter 825.

[131]

[132] The control means 830 according to a second embodiment of the present invention sequentially receives a plurality of carrier waves extracted by the filter means 820 and examines integrity of the signals. Examining integrity of a signal at a receiver side is examining whether or not the frequencies of the receiver side are the same as the upper and lower frequencies corresponding to the high and low levels of the sender side. If the transmitted signal is normal, the first modulation signal is decoded, and if the transmitted signal is abnormal, integrity of the second or the third modulation signals is sequentially examined, and a normal signal is decoded, and thus interference of analogous frequencies can be avoided. The control means 820 can be implemented, for example, by a microprocessor or an analog logic circuit.

[133]

[134] The demodulation means 840 according to a second embodiment of the present invention extracts the encoded time information broadcast signal by performing de-modulation in the same manner as the modulation method performed at the sender side. That is, if a signal of 77.5 KHz is inputted for 200[ms] and a signal of 72.5 KHz

is inputted for 800[ms], it is recognized as digital signal '0' as shown in FIG. 2.

[135]

[136] The decoding means 850 according to a second embodiment of the present invention is a means for extracting time information that can be recognized by a user by decoding the encoded time information broadcast signal. Although the time information includes at least one of second, minute, hour, day, month, and year, it is preferable that the time information includes second, minute, hour, and day basically.

[137]

[138] <Receive method of second embodiment>

[139] FIG. 8 is a flowchart sequentially illustrating a receive method according to the configuration of a second embodiment. Hereinafter, a method for receiving a time information broadcast signal using a plurality of modulation signals according to the present invention will be described in detail with reference to FIGs. 8 and 9.

[140]

[141] First, as shown in FIG. 8, the decoupling means 810 performs the step of decoupling a plurality of carrier waves modulated at different frequencies from the power line 700 S710.

[142]

[143] Next, the filter means 820 performs the step of detecting the plurality of carrier waves S720. At this point, the filter means 820 preferably configured with three filter means 820 in order to detect the first, second, and third modulation signals.

[144]

[145] Next, the control means 830 performs the step of sequentially receiving the plurality of carrier waves and examining integrity of the signals S730. At this point, the step of examining integrity performs the steps described below in detail.

[146]

[147] First, the control means 830 performs the step of receiving the first modulation signal of an upper frequency 77.5 KHz corresponding to a high level of a digital signal and a lower frequency 72.5 KHz corresponding to a low level S731.

[148]

[149] Next, the control signal 830 performs the step of examining integrity of the first modulation signal S733. At this point, examining integrity of the signal is examining whether or not the frequency of the signal is the same as the frequency of the first modulation signal modulated at the sender side. Next, if the first modulation signal is normal, the first modulation signal is outputted to the demodulation means 840, and thus the time information broadcast signal is obtained by demodulating and decoding the first modulation signal.

[150]

[151] Here, if the first modulation signal is abnormal, the control signal 830 performs the step of detecting a normal carrier wave by repeating steps S731 and S733 as many times as the number of the plurality of carrier waves in order to receive the second modulation signal having a frequency different from that of the first modulation signal S735.

[152]

[153] Next, after performing step S730, the demodulation means 840 performs the step of generating an encoded time information broadcast signal by demodulating a certain carrier wave among the plurality of carrier waves based on a signal of the control means 830 S740. The signal demodulated at this point is any one of the first, second, and third modulation signals that have passed the integrity examination.

[154]

[155] Next, the decoding means 850 may transfer time information to a user by performing the step of decoding the time information broadcast signal and extracting the time information S750.

[156]

[157] <Configuration of third embodiment>

[158] As shown in FIG. 10, an apparatus for transmitting a time information broadcast signal using a plurality of modulation signals according to a third embodiment of the present invention may roughly comprise a frequency generation means 910, a time information generation means 920, a modulation means 930, an amplifying means 940, and a coupling means 950.

[159]

[160] Being provided with the configuration described above, additional time information is transmitted in combination with a power signal of the power line 900. At this point, a receiver side receiving a time information broadcast signal may further rapidly obtain time information by selectively encoding a part of the BCD time code corresponding to basic time information. Hereinafter, the configuration of an apparatus for transmitting a time information broadcast signal using a plurality of modulation signals according to the present invention will be described in detail with reference to FIGs. 10 and 11.

[161]

[162] As shown in FIG. 10, since the power line 900 and the frequency generation means 910 according to a third embodiment of the present invention are the same as described above, they will not be described.

[163]

[164] The time information generation means 920 according to a third embodiment of the present invention generates basic time information, which is a digital signal of '0' and '1', using a reference frequency generated by the crystal or the oscillator described

above. At this point, as an example of the basic time information, a BCD time code of an IRIG-H format can be used as shown in FIG. 2. Information included in the BCD time code as time information may be at least one of second, minute, hour, day, month, and year, and it is preferable that the time information basically includes second, minute, hour, and day.

[165]

[166] Here, the BCD time code format is a binary serial code of one minute interval, in which output duration time of a pulse wave signal corresponding to '0' is 200[ms], output duration time of a pulse wave signal corresponding to '1' is 500[ms], and output duration time of a pulse wave signal for recognizing a starting point is 800[ms] (corresponding to a, b, and c of FIG. 2, respectively). It is apparent that the time information can be encoded in a variety of formats other than the IRIG-H format described above.

[167]

[168] On the other hand, the time information generation means 920 generates additional time information by encoding at least one second, minute, hour, day, month, and year included in the BCD time code of the basic time information.

[169]

[170] That is, as shown in FIG. 11, a high level output signal of a pulse wave is outputted for 500[ms] for '1' of the BCD time code. At this point, since a binary serial code having a time period of 0.16[s] (at this point, the time period of each bit is 0.02[s]) is included in the time period of 500[ms] as shown in FIG. 12, the receiver side can acquire the additional time information transmitted from the sender side more rapidly. Although it is described that the output duration time of each bit is 0.02[s], the output duration time can be modified in a variety of ways as needed.

[171]

[172] On the other hand, a high level output signal of a pulse wave is outputted for 200[ms] for '0' of the BCD time code. At this point, ten digital bits in maximum, each having a time period of 0.02[s], can be included in the time period of 200[ms], and the ten digital bits to be transmitted may express, within 200[ms], a time code corresponding to 'minute' of the BCD time code shown in FIG. 2.

[173]

[174] The modulation means 930 according to a third embodiment of the present invention generates a plurality of different modulation signals by modulating the additional time information and basic time information, which are encoded and have an output duration time of 0.02[s], in a predetermined modulation method.

[175]

[176] Describing an example of the plurality of modulation signals (three types of

modulation signals) in further detail with reference to FIG. 13, a frequency corresponding to '1' of the additional time information is referred to as an upper frequency, and a frequency corresponding to '0' is referred to as a lower frequency. At this point, if the modulation means 930 modulates the additional time information in a frequency shift keying method, the upper frequency corresponding to the first modulation signal becomes 77.5 KHz, and the lower frequency corresponding to the first modulation becomes 72.5 KHz.

[177]

[178] That is, since the digital bit stream of the additional time information shown in FIG. 12 is '10111011', a frequency of 77.5 KHz corresponding to '1' is outputted for 0.02[s], and a frequency of 72.5 KHz corresponding to '0' is outputted for 0.02[s].

[179]

[180] On the other hand, the first modulation signal has a frequency different from those of the second and third modulation signals as described above. That is, the second modulation signal has an upper frequency of 87 KHz and a lower frequency of 82 KHz. In the same manner, the third modulation signal has an upper frequency of 97 KHz and a lower frequency of 92 KHz.

[181]

[182] On the other hand, the first, second, and third modulation signals are transmitted after the additional time information is modulated within 200ms or 500ms of the basic time information in a frequency shift keying method, and amplitude modulation is performed on the basic time information to couple the basic time information to the power line 900.

[183]

[184] At this point, a frequency corresponding to the high level output duration time of the basic time information becomes the upper frequency described above, and a frequency corresponding to the low level output duration time becomes the lower frequency. Here, amplitude of the lower frequency modulated using the amplitude modulation is preferably about 30% of the amplitude of the upper frequency.

[185]

[186] Since the amplitude of the lower frequency is maintained to be about 30% of the amplitude of the basic frequency as described above, a signal at a low level can be clearly distinguished from a signal generated by noise. In addition, conventionally, since it is difficult to distinguish a noise signal from a low level signal, integrity is examined only for high level signals. However, according to the present invention, integrity is examined for low level signals, as well as high level signals, and thus integrity of a signal can be correctly examined. Accordingly, it is possible to avoid interference of analogous frequencies that can be induced in the power line 900 by

transmitting the first, second, and third modulation signals to the receiver side.

[187]

[188] On the other hand, the additional time information may include at least one of second, minute, hour, day, month, and year, and it is preferable to include 'second and minute' basically.

[189]

[190] On the other hand, the 'dummy information' of FIG. 2 preferably transmits, if needed, a signal including information on the position of the time information broadcast signal coupled to the power line 900, leap second, daylight saving time, weather, disaster, and the like, together with time information such as second, minute and the like described above. In this case, a Korean Electric Power Corporation's (KEPCO's) code can be inserted as the position information coupled to the power line 900, and the inserted KEPCO's code can be efficiently used for a smart grid.

[191]

[192] The first, second, and third modulation signals described above are only for describing an embodiment of the present invention, and a variety of frequencies can be used. It is apparent that a plurality of modulation signals further more or further less than the three modulation signals can be used. In addition, it is apparent that a phase shift keying method, other than the frequency shift keying method, can be used.

[193]

[194] The coupling means 950 according to a third embodiment of the present invention couples a plurality of modulation signals amplified by the amplifying means 940 to the power signal of the power line 900 through electromagnetic inductive coupling. At this point, since the power line 900 is three-phase, the modulation signals are coupled to each of the phases through electromagnetic inductive coupling.

[195]

[196] Accordingly, the same time information can be obtained at any phase of the three-phase AC signal, from the basic time information or the additional time information coupled to each phase through electromagnetic inductive coupling.

[197]

[198] It is apparent that if the sender side uses the phase shift keying method for the additional time information, instead of the frequency shift keying method, the receiver side uses the phase shift keying method correspondingly.

[199]

[200] <Transmission method of third embodiment>

[201] FIG. 15 is a flowchart sequentially illustrating a method of transmitting a time information broadcast signal using a plurality of modulation signals according to a third embodiment. Hereinafter, the method for transmitting a time information broadcast

signal using a plurality of modulation signals according to the present invention will be described in detail with reference to FIGs. 15 and 16.

[202]

[203] First, as shown in FIG. 15, the time information generation means 920 performs the step of generating basic time information encoded in '0' and '1', using a reference frequency generated by the frequency generation means 910 S810.

[204]

[205] At this point, the generated basic time information is a BCD time code of an IRIG-H format described above, in which information such as second, minute, hour, day, month, and year is expressed as a digital signal of '0' and '1'. A high level output duration signal of a pulse wave is continued for 500[ms] for '1', and a high level output duration signal of a pulse wave is continued for 200[ms] for '0'.

[206]

[207] Next, the time information generation means 920 performs the step of generating additional time information by re-encoding any one piece of information included in the basic time information based on the time frame of the generated basic time information S820.

[208]

[209] That is, for example, a high level output duration signal of a pulse wave is continued for 200[ms] for '0' of the BCD time code. At this point, ten digital bits in maximum, each having a time period of 0.02[s], can be included in the time period of 200[ms], and the ten digital bits to be transmitted as encoded additional time information may express, within 200[ms], a time code corresponding to 'minute' of the BCD time code shown in FIG. 2. For example, as shown in FIG. 12, the time information broadcast signal may configure a bit stream of '10111011'.

[210]

[211] Next, the modulation means 930 performs the step of generating a plurality of different modulation signals by modulating the additional time information and the basic time information in a predetermined modulation method S830. The plurality of modulation signals generated at this point is, for example, the first, second, and third modulation signals of the additional time information described above, and, as well, a plurality of signals of an upper frequency corresponding to a high level output duration time and a lower frequency corresponding to a low level output duration time of the basic time information, modulated using amplitude modulation. However, it is apparent that a plurality of modulation signals further more or further less than the three modulation signals can be generated.

[212]

[213] On the other hand, as shown in FIG. 16, the first, second, and third modulation

signals are generated in the steps described below. First, if frequency shift keying is used, the modulation means 930 performs the step of generating a first modulation signal of an upper frequency corresponding to '1' and a lower frequency corresponding to '0' of the additional time information using a frequency shift keying method S831.

[214]

[215] Next, the modulation means 930 performs the step of generating a second modulation signal of a frequency different from that of the first modulation signal S833, and the modulation means 930 may generate further more modulation signals as needed through the steps described above.

[216]

[217] Here, if phase shift keying, not the frequency shift keying, is used, the modulation means 930 performs the step of generating a first phase modulation signal of a basic phase of a first frequency of any one of the plurality of modulation signals, corresponding to '1' of the additional time information, and a phase different from the basic phase, corresponding to '0' of the additional time information S831'. At this point, the first frequency may be any one of 77.5 KHz, 87 KHz, and 97 KHz described above.

[218]

[219] Accordingly, as shown in FIG. 14, the additional time information is modulated using the frequency shift keying or the phase shift keying to be included in 200 ms or 500 ms of the basic time information modulated using the amplitude modulation, and the modulated additional time information is transmitted to the receiver side through the power line. The receiver side may rapidly acquire desired additional time information in addition to the basic time information by demodulating such a modulation signal.

[220]

[221] Next, the modulation means 930 performs the step of generating a second phase modulation signal of a basic phase of a second frequency different from the first frequency, corresponding to '1' of the additional time information, and a phase different from the basic phase, corresponding to '0' of the additional time information S833' Here, the second frequency is any one of frequencies different from the first frequency.

[222]

[223] For example, the first phase modulation signal is a signal whose phase is modulated for 77.5 KHz, and the second phase modulation signal is a signal whose phase is modulated for 87 KHz.

[224]

[225] Next, the amplifying means 940 performs the step of amplifying the gain of the plurality of modulation signals or the gain of a modulation signal of the basic time in-

formation S840.

[226]

[227] Finally, the coupling means 950 performs the step of coupling the plurality of modulation signals or the modulation signal of the basic time information to the power line 900 through electromagnetic inductive coupling S850.

[228]

[229] While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by the embodiments but only by the appended claims. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.

Claims

[Claim 1] Transmission apparatus. An apparatus for transmitting a time information broadcast signal using a plurality of modulation signals, the apparatus comprising:
a frequency generation means 710 for generating a reference frequency; a time information generation means 720 for generating the time information broadcast signal encoded in a digital signal using the reference frequency; a modulation means 730 for generating the modulation signals having different frequencies by modulating the generated time information broadcast signal in a predetermined modulation method; an amplifying means 740 for amplifying the modulation signals; and a coupling means 750 for coupling the amplified modulation signals to a power line 700 through electromagnetic inductive coupling.

[Claim 2] The apparatus according to claim 1, wherein the time information broadcast signal includes at least one of year, month, day, hour, minute, and second.

[Claim 3] The apparatus according to claim 1, wherein the time information generation means720 generates pulse wave signals respectively corresponding to '0' and '1'and a pulse wave signal for recognizing a starting point in order to generate the time information broadcast signal, in which if a time frame of the time information broadcast signal is one minute, a high level output duration time and a low level output duration time of the pulse wave signal corresponding to '0' are 200[ms] and 800[ms] respectively, a high level output duration time and a low level output duration time of the pulse wave signal corresponding to '1'are 500[ms] and 500[ms] respectively, and a high level output duration time and a low level output duration time of the pulse wave signal for recognizing a starting point are 800[ms] and 200[ms] respectively.

[Claim 4] The apparatus according to claim 3, wherein the modulation means 730 generates a certain upper frequency corresponding to a high level and a certain lower frequency corresponding to a low level, the lower frequency being apart from the upper frequency, and modulates the generated frequencies using amplitude modulation.

[Claim 5] Receive apparatus. An apparatus for receiving a time information broadcast signal using a plurality of modulation signals, the apparatus

comprising:

a decoupling means 810 for decoupling a plurality of carrier waves from a power line 700 which transmits a power signal and the plurality of carrier waves of different frequencies; a filter means 820 for detecting the plurality of carrier waves; a control means 830 for sequentially receiving the plurality of carrier waves and examining integrity of the signals; a demodulation means 840 for generating an encoded time information broadcast signal by demodulating a certain carrier wave among the plurality of carrier waves based on a signal of the control means 830; and a decoding means 850 for decoding the time information broadcast signal and extracting time information.

[Claim 6] The apparatus according to claim 5, wherein examining integrity of the signal is examining whether or not the signal is the same as a predetermined modulation signal corresponding to a high level or a low level of a sender side.

[Claim 7] The apparatus according to claim 5, wherein the filter means 820 includes:

an analog band-pass filter 821 for detecting the plurality of carrier waves; a gain control means 823 for controlling a gain of a signal outputted from the analog band-pass filter 821; an analog-digital converter 825 for converting a signal outputted from the gain control means 823; and a digital filter 827 for detecting the plurality of carrier waves based on a signal of the analog-digital converter 825.

[Claim 8] The apparatus according to claim 7, further comprising:

a mixer means 828 for receiving and down-converting an output signal of the gain control means 823; and a low-pass filter 829 for receiving an output of the mixer means 828, passing a frequency of a predetermined band, and outputting the frequency to the analog-digital converter 825.

[Claim 9] Transmission method. A method for transmitting a time information broadcast signal using a plurality of modulation signals, the method comprising the steps of:

generating the time information broadcast signal encoded in a digital signal using a reference frequency generated by a frequency generation means 710, by a time information generation means 720 S610;

generating the plurality of modulation signals of different frequencies by modulating the time information broadcast signal in a predetermined modulation method, by a modulation means 730 S620; amplifying the

plurality of modulation signals, by an amplifying means 740 S630; and coupling the plurality of amplified modulation signals to a power line 700 through electromagnetic inductive coupling, by a coupling means 750 S640.

[Claim 10] The method according to claim 9, wherein step S620 includes the steps of:

generating an upper frequency corresponding to a high level of the digital signal and a lower frequency corresponding to a low level of the digital signal, and generating a first modulation signal modulated using amplitude modulation, by the modulation means 730 S621; and generating a second modulation signal of a frequency different from that of the first modulation signal, by the modulation means 730 S623.

[Claim 11] Receive method. A method for receiving a time information broadcast signal using a plurality of modulation signals, the method comprising the steps of:

decoupling a plurality of carrier waves modulated at different frequencies from a power line 700, by a decoupling means 810 S710; detecting the plurality of carrier waves, by a filter means 820 S720; sequentially receiving the plurality of carrier waves and examining integrity of the signals, by a control means 830 S730; generating an encoded time information broadcast signal by demodulating a certain carrier wave among the plurality of carrier waves based on a signal of the control means 830, by a demodulation means 840 S740; and decoding the time information broadcast signal and extracting time information, by a decoding means 850 S750.

[Claim 12] The method according to claim 11, wherein step S730 includes the steps of: receiving a first modulation signal of an upper frequency corresponding to a high level of a digital signal and a lower frequency corresponding to a low level of the digital signal, by the control means 830 S731; examining integrity of the first modulation signal, by a control means 830 S733; and outputting the first modulation signal to the demodulation means 840 if the first modulation signal is normal, and detecting a normal carrier wave by repeating steps S731 and S733 as many times as the number of the plurality of carrier waves in order to receive a second modulation signal of a frequency different from that of the first modulation signal if the first modulation signal is abnormal S735.

[Claim 13] Transmission apparatus. An apparatus for transmitting a time in-

formation broadcast signal using a plurality of modulation signals, the apparatus comprising:

a frequency generation means 910 for generating a reference frequency; a time information generation means 920 for generating basic time information encoded in '0' and '1' using the reference frequency, and generating additional time information by re-encoding the basic time information based on a time frame of the basic time information; a modulation means 930 for generating a plurality of different modulation signals by modulating the generated basic time information and additional time information in a predetermined modulation method; an amplifying means 940 for amplifying the plurality of modulation signals; and a coupling means 950 for coupling the plurality of amplified modulation signals to a power line 900 through electromagnetic inductive coupling.

[Claim 14] The apparatus according to claim 13, wherein the basic time information or the additional time information is a BCD time code including at least one of year, month, day, hour, minute, and second.

[Claim 15] The apparatus according to claim 13, wherein the time information generation means 920 generates pulse wave signals respectively corresponding to '0' and '1' and a pulse wave signal for recognizing a starting point in order to generate the time information broadcast signal, in which if a time frame of the time information broadcast signal is one minute, a high level output duration time and a low level output duration time of the pulse wave signal corresponding to '0' are 200[ms] and 800[ms] respectively, a high level output duration time and a low level output duration time of the pulse wave signal corresponding to '1' are 500[ms] and 500[ms] respectively, and a high level output duration time and a low level output duration time of the pulse wave signal for recognizing a starting point are 800[ms] and 200[ms] respectively.

[Claim 16] The apparatus according to claim 15, wherein the additional time information is generated by encoding at least one piece of certain information included in the basic time information based on the high level output duration time.

[Claim 17] The apparatus according to claim 13, wherein the modulation means 930 modulates the additional time information into the plurality of modulation signals using a frequency shift keying method or a phase shift keying method.

[Claim 18] The apparatus according to claim 17, wherein the frequency shift

keying method generates a certain upper frequency corresponding to '1' of the additional time information and a certain lower frequency corresponding to '0' of the time information broadcast signal, the lower frequency being apart from the upper frequency.

[Claim 19] The apparatus according to claim 13, wherein the modulation means 930 modulates the basic time information using amplitude modulation.

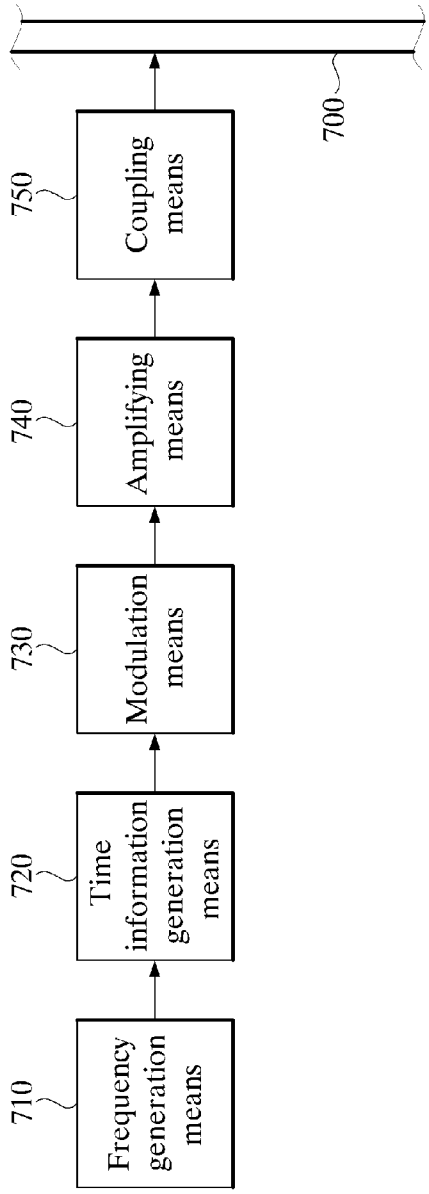
[Claim 20] Transmission method. A method for transmitting a time information broadcast signal using a plurality of modulation signals, the method comprising the steps of:
generating basic time information encoded in '0' and '1' using a reference frequency generated by a frequency generation means 910, by a time information generation means 920 S810; generating additional time information by re-encoding the basic time information based on a time frame of the generated basic time information, by the time information generation means 920 S820; generating a plurality of different modulation signals by modulating the basic time information and the additional time information in a predetermined modulation method, by a modulation means 930 S830; amplifying the plurality of modulation signals, by an amplifying means 940 S850; and coupling the plurality of amplified modulation signals to a power line 900 through electromagnetic inductive coupling, by a coupling means 950 S860.

[Claim 21] The method according to claim 20, wherein step S830 includes the steps of:
generating a first modulation signal of an upper frequency corresponding to '1' of the additional time information and a lower frequency corresponding to '0' of the additional time information using a frequency shift keying method, by the modulation means 930 S831; and generating a second modulation signal of a frequency different from that of the first modulation signal, by the modulation means 930 S833.

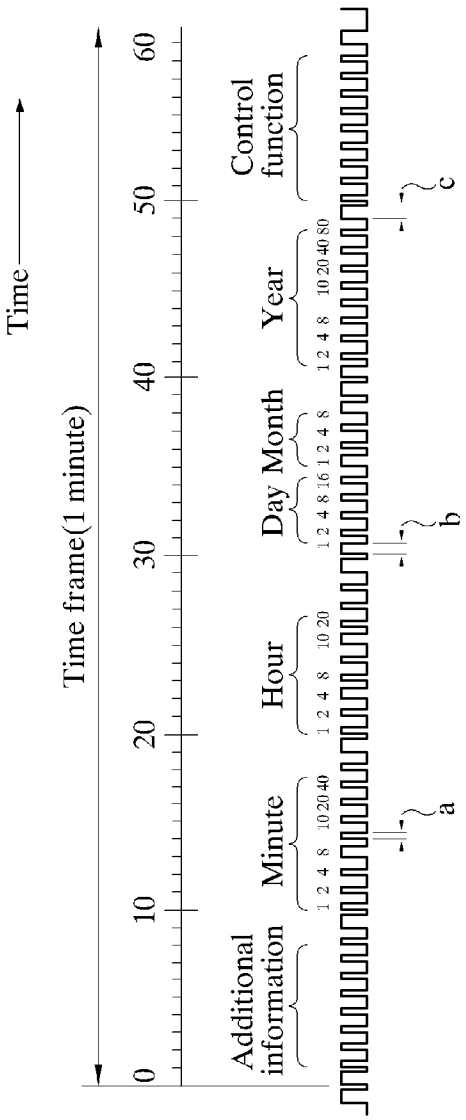
[Claim 22] The method according to claim 20, wherein step S830 includes the steps of:
generating a first phase modulation signal of a basic phase of a first frequency of any one of the plurality of modulation signals, the basic phase being corresponding to '1' of the additional time information, and a phase different from the basic phase, the different phase being corresponding to '0' of the additional time information, using a phase shift

keying method, by the modulation means 930 S831'; and generating a second phase modulation signal of a basic phase of a second frequency different from the first frequency, the basic phase being corresponding to '1' of the additional time information, and a phase different from the basic phase, the different phase corresponding to '0' of the additional time information, by the modulation means 930 S833'.

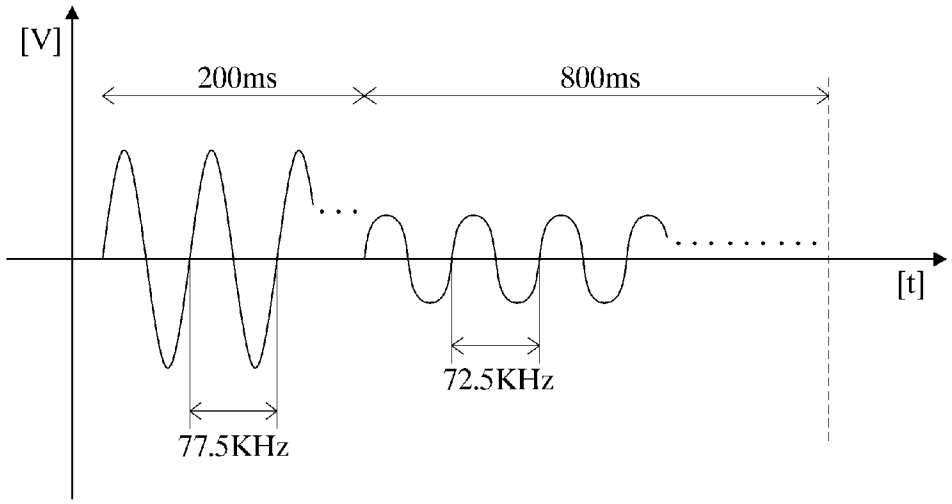
[Fig. 1]


700
750
Coupling means
740
Amplifying means
730
Modulation means
720
Time information generation means
710
Frequency generation means

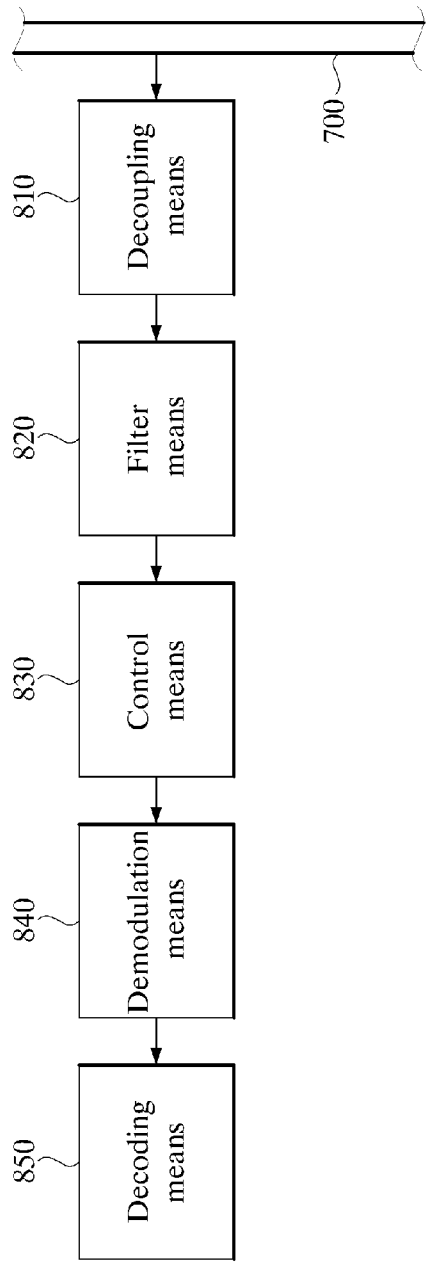
[Fig. 2]


Time
Time frame(1 minute)
0
10
20
30
40
50
60
Additional information
Minute
1 2 4 8 10 20 40
Hour
1 2 4 8 10 20
Day Month
1 2 4 8 16
1 2 4 8
Year
1 2 4 8 10 20 40 80
Control function
a
b
c

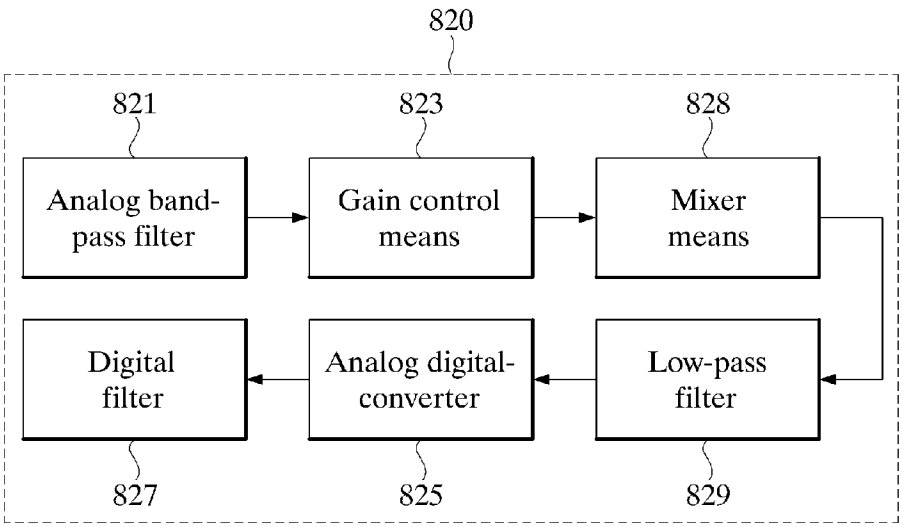
[Fig. 3]


[V]
200ms
800ms
[t]
77.5KHz
72.5KHz

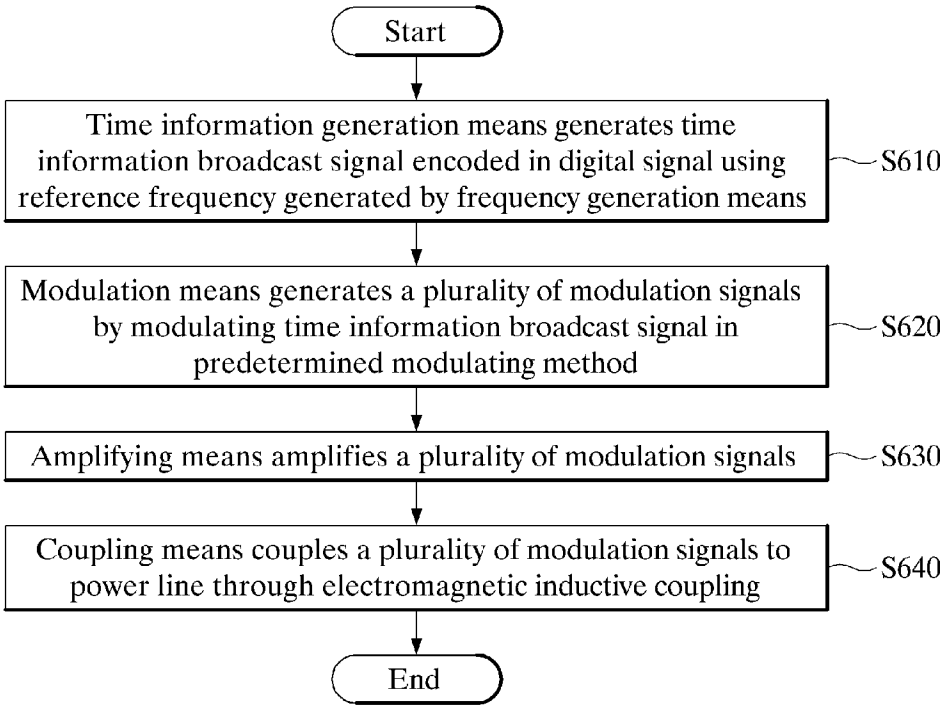
[Fig. 4]


700
810
Decoupling means
820
Filter means
830
Control means
840
Demodulation means
850
Decoding means

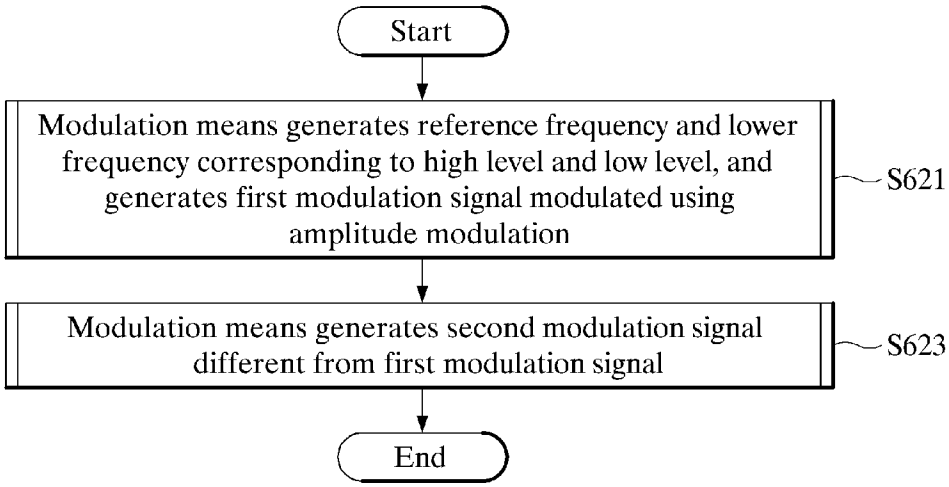
[Fig. 5]


820
821
Analog band-pass filter
823
Gain control means
828
Mixer means
Digital filter
Analog digital-converter
Low-pass filter
827
825
829

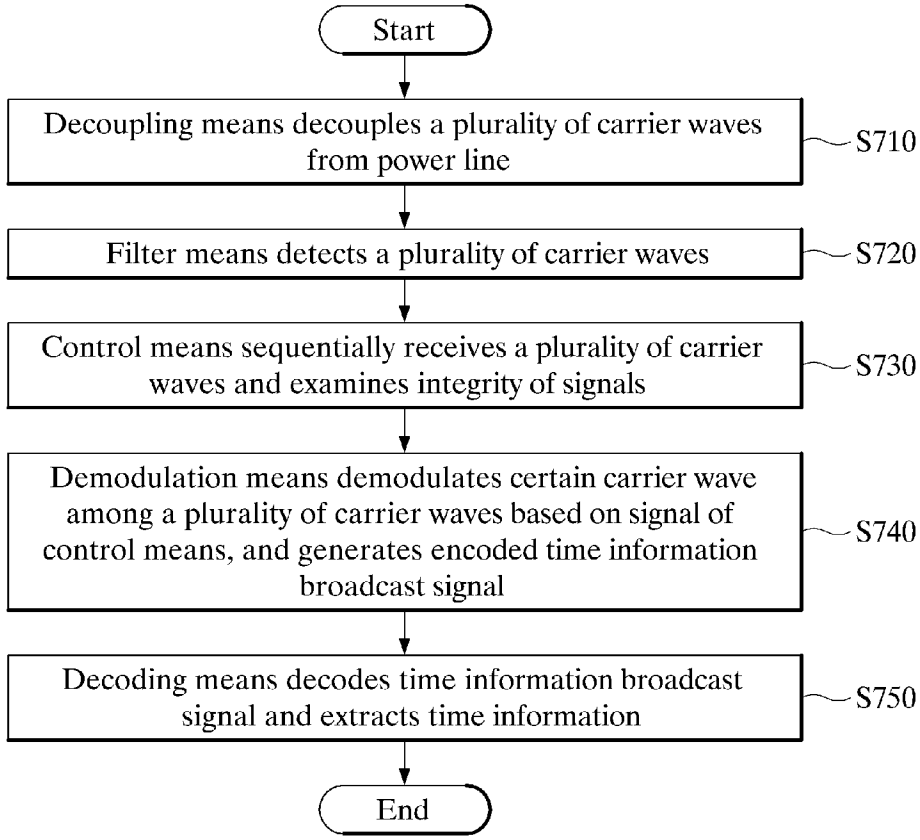
[Fig. 6]


Start
Time information generation means generates time information broadcast signal encoded in digital signal using reference frequency generated by frequency generation means
S610
Modulation means generates a plurality of modulation signals by modulating time information broadcast signal in predetermined modulating method
S620
Amplifying means amplifies a plurality of modulation signals
S630
Coupling means couples a plurality of modulation signals to power line through electromagnetic inductive coupling
S640
End

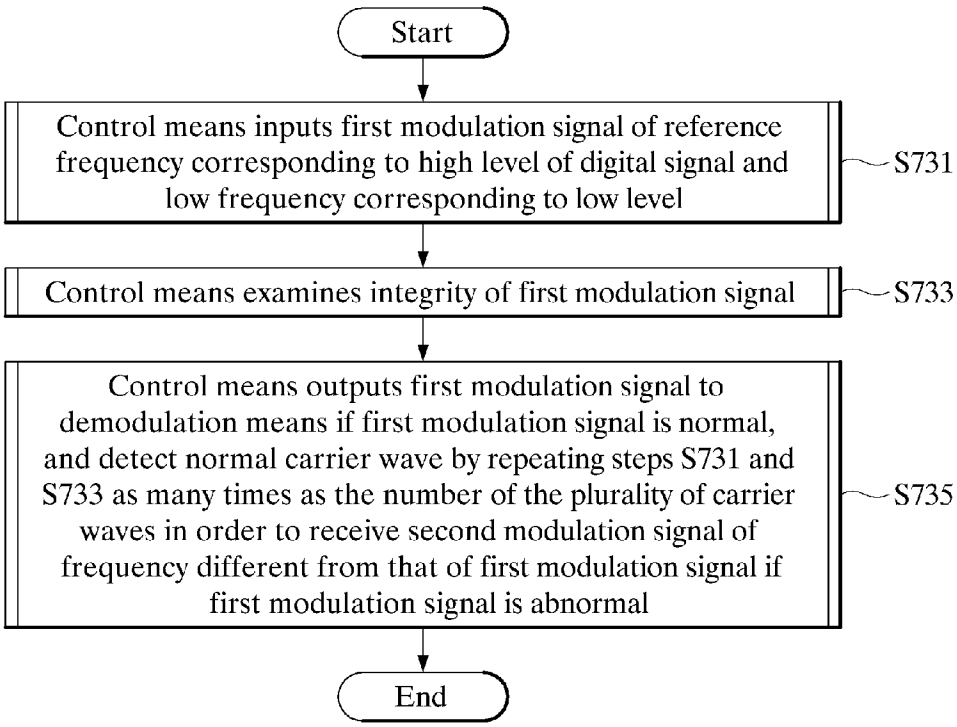
[Fig. 7]


Start
Modulation means generates reference frequency and lower frequency corresponding to high level and low level, and generates first modulation signal modulated using amplitude modulation
S621
Modulation means generates second modulation signal different from first modulation signal
S623
End

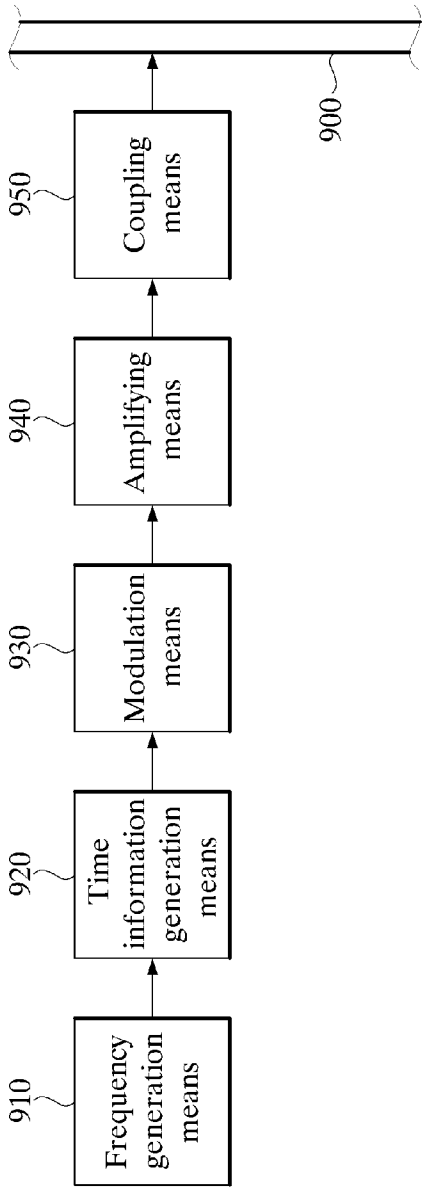
[Fig. 8]


Start
Decoupling means decouples a plurality of carrier waves from power line
S710
Filter means detects a plurality of carrier waves
S720
Control means sequentially receives a plurality of carrier waves and examines integrity of signals
S730
Demodulation means demodulates certain carrier wave among a plurality of carrier waves based on signal of control means, and generates encoded time information broadcast signal
S740
Decoding means decodes time information broadcast signal and extracts time information
S750
End

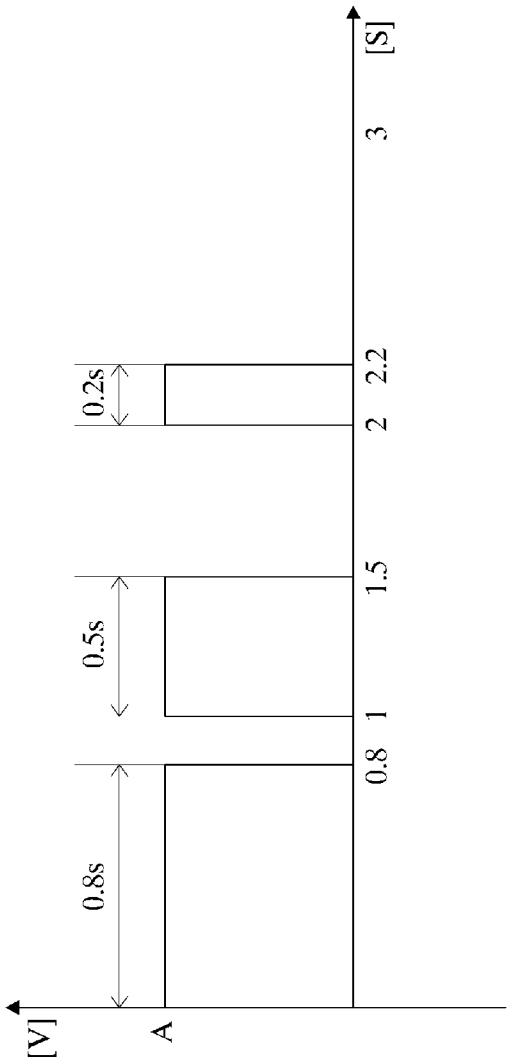
[Fig. 9]


Start
Control means inputs first modulation signal of reference frequency corresponding to high level of digital signal and low frequency corresponding to low level
S731
Control means examines integrity of first modulation signal
S733
Control means outputs first modulation signal to demodulation means if first modulation signal is normal, and detect normal carrier wave by repeating steps S731 and S733 as many times as the number of the plurality of carrier waves in order to receive second modulation signal of frequency different from that of first modulation signal if first modulation signal is abnormal
S735
End

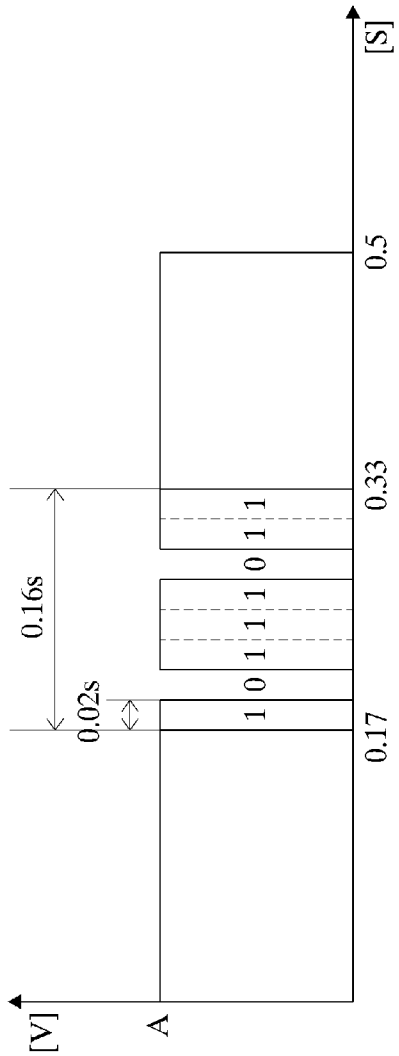
[Fig. 10]


900
950
Coupling means
940
Amplifying means
930
Modulation means
920
Time information generation means
910
Frequency generation means

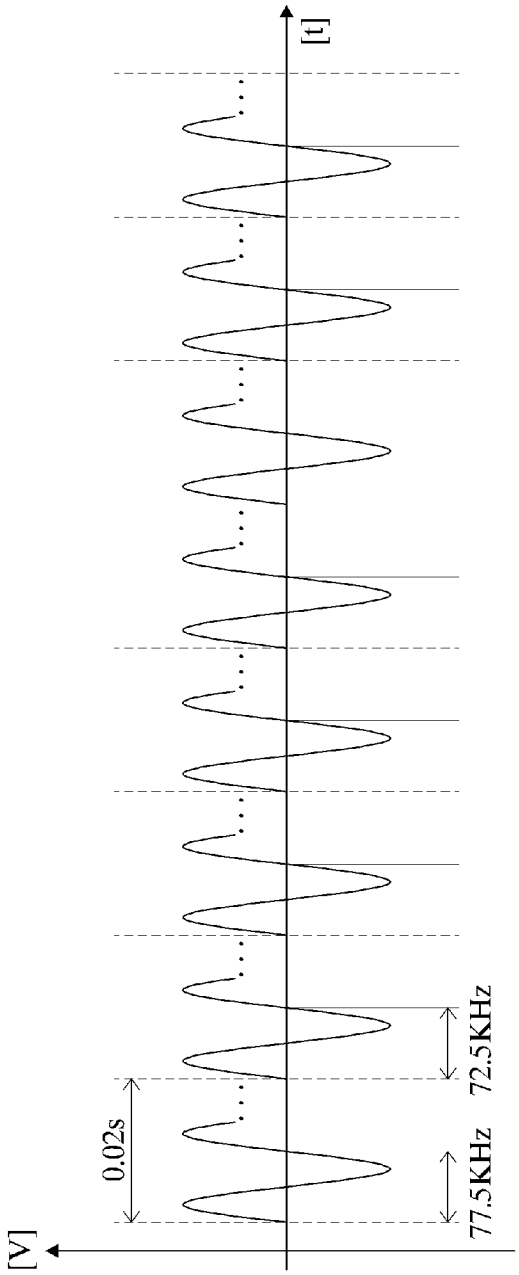
[Fig. 11]



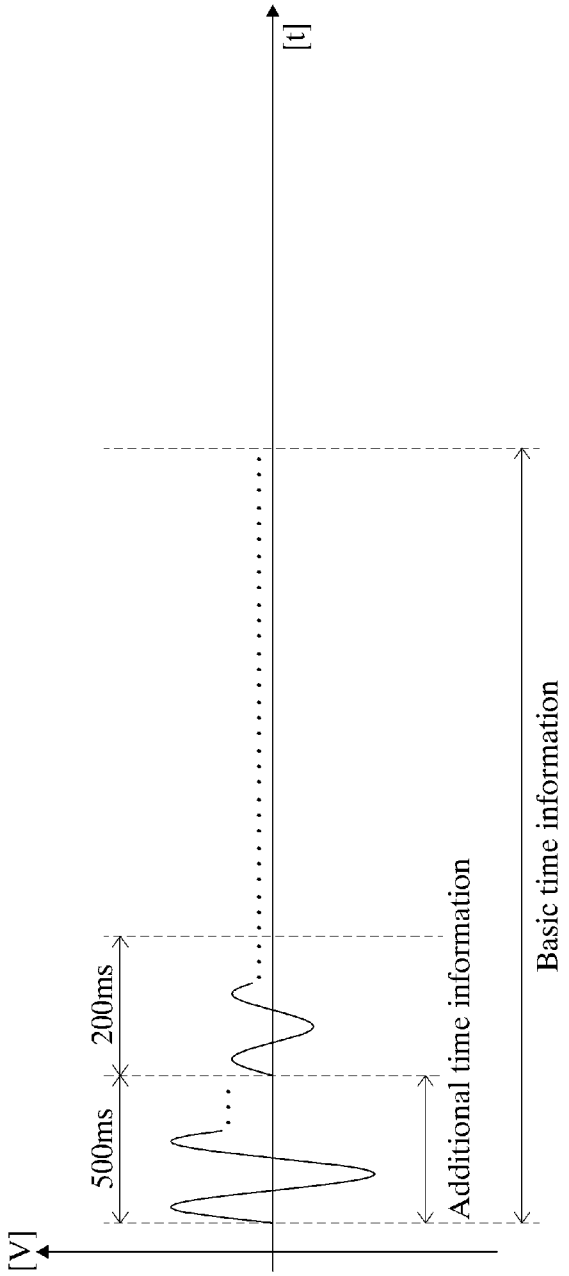
[Fig. 12]



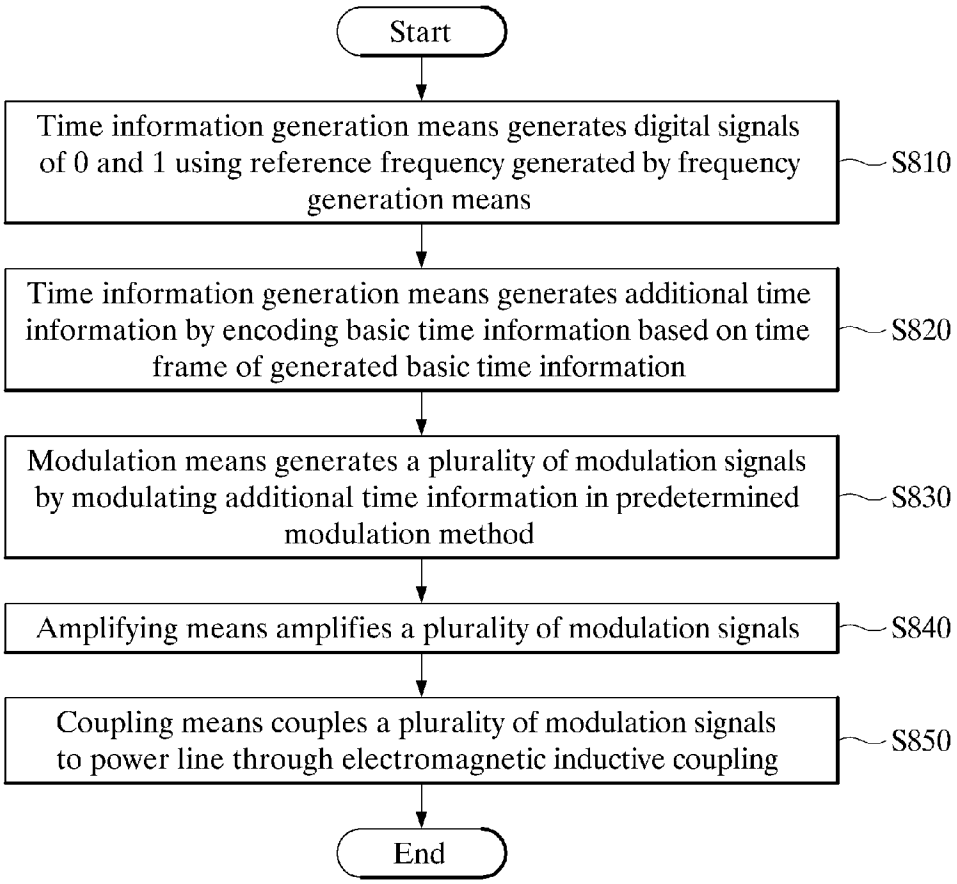
[Fig. 13]



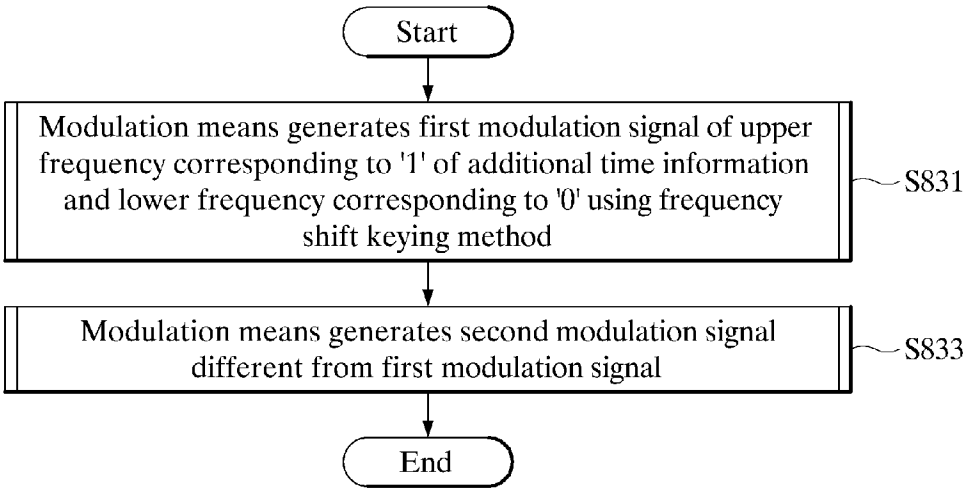
[Fig. 14]


[t]
[V]
200ms
500ms
Additional time information
Basic time information

[Fig. 15]


Start
Time information generation means generates digital signals of 0 and 1 using reference frequency generated by frequency generation means
S810
Time information generation means generates additional time information by encoding basic time information based on time frame of generated basic time information
S820
Modulation means generates a plurality of modulation signals by modulating additional time information in predetermined modulation method
S830
Amplifying means amplifies a plurality of modulation signals
S840
Coupling means couples a plurality of modulation signals to power line through electromagnetic inductive coupling
S850
End

[Fig. 16]


Start
Modulation means generates first modulation signal of upper frequency corresponding to '1' of additional time information and lower frequency corresponding to '0' using frequency shift keying method
S831
Modulation means generates second modulation signal different from first modulation signal
S833
End

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2011/006390

A. CLASSIFICATION OF SUBJECT MATTER

H04H 20/76(2008.01)i

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)

H04H 20/76; H04B 7/26; H04B 3/54; H04J 11/00; G04G 5/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: time information, power line, frequency Keying

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011-016689 A2 (KOREA RESEARCH INSTITUTE OF STANDARDS AND SCIENCE et al.) 10 February 2011 See abstract, figures 1,2,4,8, pages 10-14,18-20.	1-22
A	KR 10-1029121 B1 (KOREA RESEARCH INSTITUTE OF STANDARDS AND SCIENCE) 13 April 2011 See abstract, claims 1,4,8, description [53],[55],[57],[61].	1-22
A	JP 2004-150892 A (NEIKUSU:KK) 27 May 2004 See abstract, claims 1,4, description [48],[50].	1-22
A	JP 2009-225470 A (PANASONIC CORP) 01 October 2009 See abstract, description [2].	1-22

☐ Further documents are listed in the continuation of Box C.

☒ 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

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"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
31 MAY 2012 (31.05.2012)	**31 MAY 2012 (31.05.2012)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Kwon, Sung Lark Telephone No. 82-42-481-5646

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2011/006390

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011-016689 A2	10.02.2011	KR 10-1029117 B1	13.04.2011
		KR 10-1029121 B1	13.04.2011
		KR 10-1052082 B1	27.07.2011
		KR 10-1052083 B1	27.07.2011
		WO 2011-016689 A3	19.05.2011
KR 10-1029121 B1	13.04.2011	KR 10-1029117 B1	13.04.2011
		KR 10-1052082 B1	27.07.2011
		KR 10-1052083 B1	27.07.2011
		WO 2011-016689 A2	10.02.2011
JP 2004-150892 A	27.05.2004	None	
JP 2009-225470 A	01.10.2009	JP 4766157 B2	07.09.2011