Title: METHOD AND SYSTEM FOR ADJUSTING THE LUMINOUS FLUX OF LAMPS

Abstract: According to the present invention, the luminous flux emitted by lamps (4), in particular discharge lamps, is adjusted by using a remote electronic control unit (2) and at least one local electronic control unit (3,8) in one-way communication with each other through the electric power line (5), used as a communication means; the information to be communicated is associated with variations in the root-mean-square value of the power voltage. Typically, the remote electronic control unit (2) is dedicated to a plurality of lamps (4), whereas the local electronic control unit (3,8) is dedicated to one lamp (4) only; therefore, there is typically a plurality of local electronic control units (3,8); the remote unit (2) and the local units (3,8) are connected to one another through electric power lines (5).
METHOD AND SYSTEM FOR ADJUSTING THE LUMINOUS FLUX OF LAMPS

DESCRIPTION

The present invention relates to a method and a system for adjusting the electric power supplied to lamps, in particular discharge lamps, and thus the luminous flux emitted by said lamps.

The present invention especially applies to the field of public lighting.

Discharge lamps, which practically cover all public lighting applications, cannot be connected directly to the public 230VAC electric power distribution network; instead, they are connected through a ballast. Inductive-type electromagnetic ballasts were used in the past; at present, electronic ballasts are increasingly widespread.

Electronic ballasts are well known to those skilled in the art, and essentially comprise an AC/DC converter converting alternating current into direct current (which receives electric power for the lamp) and a DC/AC converter converting direct current into alternating current (which supplies electric power to the lamp), connected in cascade to the AC/DC converter. Thanks to an electronic control unit provided inside the electronic ballast, it is possible to adjust the electric power transferred to the lamp and consequently the luminous flux emitted by it.

Besides allowing the lamp to be coupled to the distribution network, electronic ballasts also allow to compensate for any voltage variations of the mains. In fact, in Italy for example, the public electric company guarantees a voltage of the mains having a root-mean-square value of 230VCA with an error of ± 10 %, i.e. from a minimum value of about 210V to a maximum value of about 250V; moreover, according to the Italian regulations, voltage drops of max. 5 % may occur along the electric line that supplies a lamp, i.e. a maximum drop of approximately 10V; this means that the lamp ballast can receive a sinusoidal alternating voltage having a root-mean-square value between approx. 200V and approx. 250V. The electronic ballast is thus designed to supply the lamp as if it constantly received the lamp rated...
voltage, e.g. 230VAC; it follows that the luminous flux of the lamp is substantially independent from the input voltage of the electronic ballast. In general, it is useful to have the possibility of adjusting the luminous flux of lamps in order to suit the user's needs. By adjusting the luminous flux, one can also optimize the energy consumption and the life of the lamp.

In public lighting applications, for example, the luminous flux of a lamp is advantageously reduced with respect to its rated luminous flux in the night, whereas it is not reduced in the early evening and early morning. It is now worth recalling that the European standard CEN 13201 and the Italian standard UNI 10439 allow, for energy saving purposes, to change the road lighting as a function of traffic.

In the public lighting field, essentially two categories of solutions for adjusting the luminous flux of lamps are known:

A) adjustment carried out by a local electronic unit based on control signals received by the local electronic unit;

B) adjustment carried out by a remote electronic unit, which supplies several lamps through a single power line, according to a control logic stored therein, by reducing the power voltage supplied to every lamp by the remote electronic unit.

In case A, solutions are known wherein the luminous flux control signals are received through a transmission means (e.g. electric cable, data bus or radio waves) dedicated to the transmission (e.g. cable or radio transmission) of control signals. There are also solutions wherein the luminous flux control signals are received through the lamp power cable, i.e. the lamp power line, in the form of conveyed waves; in this case, the power signal and data signal are both sent over the same cable.

None of these solutions is fully satisfactory, partly because of circuit complexity (and costs) and partly due to inadequate effectiveness and flexibility of the adjustment.

It is worth pointing out that in case B, which is quite simple to implement and relatively cheap, all lamps should be set to the same luminous flux; actually, however, there may be luminous flux differences among the various lamps,
due for example to voltage drops along the power line, i.e. the line that connects the remote electronic unit to the lamps.

It is the general object of the present invention to overcome the drawbacks of the prior art by providing a lighting system, in particular suitable for public lighting applications, which allows to adjust the luminous flux of lamps and which is simple, effective and flexible.

Said object is achieved through the method, the electronic ballast and the system incorporating the features set out in the appended claims, which are intended as an integral part of the present description.

The present invention is based on the idea of controlling the luminous flux by using a remote electronic control unit and at least one local electronic control unit in one-way communication from the remote unit to the local unit through the electric power line, used as a communication means; the information to be communicated is associated with variations in root-mean-square value of the power voltage.

In particular, the remote electronic control unit generates the appropriate power voltage and supplies it to the local electronic control unit, and then adjusts the luminous flux of the lamps indirectly by means of the local electronic control unit based on the information provided.

Typically, though not necessarily, the remote electronic control unit according to the present invention is dedicated to a plurality of lamps, whereas the local electronic control unit according to the present invention is dedicated to one lamp only; therefore, there is typically a plurality of local electronic control units; the remote unit and the local units are connected to one another through electric power lines.

The present invention will become more apparent from the following description of a few embodiment examples thereof and from the annexed drawings, wherein:

Fig. 1 is a very simplified block diagram of an adjustment system according to the present invention connected to various discharge lamps (three of which are shown),

Fig. 2 is a very simplified block diagram of an electronic ballast according to
the present invention (as used in the system of Fig. 1) connected to a discharge lamp,

Fig. 3 shows a first variation of power voltage which can be used in a method according to the present invention,

Fig. 4 shows a second variation of power voltage which can be used in a method according to the present invention,

Fig. 5 shows a third variation of power voltage which can be used in a method according to the present invention, and

Fig. 6 shows a possible power voltage pattern used in the system of Fig. 1.

Said description and said drawings are to be considered as non-limiting examples.

In Fig. 1, reference number 1 designates a whole an adjustment system according to the present invention connected to several discharge lamps 4, only three of which are shown.

System 1 of Fig. 1 comprises:

- a remote electronic luminous flux control unit 2 connected on the input side to an electric power source (note the two electric leads on the right of the corresponding block) and adapted to provide a typically voltage-stabilized electric supply to lamps 4,

- a power cable 5, or power line, consisting of two electric leads, i.e. a first electric lead 51 (phase lead) and a second electric lead 52 (neutral lead), connected to two output terminals of electronic unit 2,

- one electronic ballast 3 (according to the present invention, as described below) for each lamp 4; ballast 3 has a first input terminal 31 connected to first electric lead 51 of power cable 5 and a second input terminal 32 connected to second electric lead 52 of power cable 5, so that it receives electric power from remote electronic control unit 2; moreover, ballast 3 has two output terminals connected to two respective terminals of lamp 4 in order to supply regulated power to lamp 4;

in the illustration, leads 51 and 52 of cable 5 are interrupted to indicate that they proceed further in order to connect electrically additional ballasts 3 and lamps 4.
Electronic unit 2 generates the appropriate power voltage and supplies it to ballast 3, in particular to electronic unit 8 thereof, and then adjusts the luminous flux of lamps 4 indirectly by means of electronic units 8 based on the information provided to units 8 by unit 2.

Electronic unit 2 will typically be a programmable unit based, for example, on a microcontroller or a microprocessor.

Fig. 2 shows an electronic ballast according to the present invention as used in the system of Fig. 1, connected to a discharge lamp 4; this ballast has two input terminals, i.e. a first input terminal 31 and a second input terminal 32; in particular, terminal 31 must be connected to lead 51, while terminal 32 must be connected to lead 52.

Electronic ballasts (both "fixed" and "dimmable" ones) are well known to those skilled in the art, therefore only the innovative aspects of the ballast according to the present invention will be described below.

Electronic ballast 3 of Fig. 2 essentially comprises an AC/DC converter 6 (converting alternating current into direct current), a DC/AC converter 7 (converting direct current into alternating current) connected in cascade to AC/DC converter 6, an electronic control unit 8, and a detection circuitry 9; converter 6 is connected to the input (terminals 31 and 32) and receives electric power for lamp 4; converter 7 is connected to lamp 4 for supplying it appropriately.

Electronic unit 8 controls the ballast circuitry in such a way as to adjust the electric power (obtained from the input) supplied to lamp 4 as required and/or desired (as clarified below); this allows to adjust the luminous flux emitted by lamp 4; circuitry 9 is connected to the input (terminals 31 and 32) of the electronic ballast, and is adapted to detect the input power voltage, in particular the root-means-square value of the power voltage or RMS value, and to provide said value (or a suitable processing thereof) to electronic unit 8.

According to the present invention, electronic unit 2 generates an appropriate power signal for lamps 4 (as required and/or desired, as clarified below) and sends it to ballasts 3 over cable 5; electronic unit 2 can generate said power
signal because it is connected to an external power source, generally the public electric power distribution network.

Electronic unit 8 will typically be a programmable unit based, for example, on a microcontroller or a microprocessor.

According to a first operating condition, said power signal is a sinusoidal wave having a frequency of 50 Hz and a root-mean-square value of the voltage of about 230V; in such a condition, lamps 4 are supplied by ballasts 3 in such a manner as to draw the rated power thereof, thus substantially emitting their rated luminous flux; moreover, as is well known in the art, every lamp is subject to aging, for example, so that the rated power draw does not always correspond to the emission of the rated luminous flux.

There may be gradually increasing voltage drops along power line 5; therefore, one of ballasts 3 may receive a power signal having a root-mean-square value lower than 230V, e.g. 215V. Electronic ballast 3 (according to the present invention) drives lamp 4 in such a way that the latter draws the rated power, thus substantially emitting its rated luminous flux, even if the power voltage is lower or higher than 230V RMS; this allows to compensate for normal oscillations in the voltage of the mains.

In particular, according to the example of Fig. 1, Fig. 2 and Fig. 6, electronic ballast 3 (according to the present invention) ensures that the rated electric power is outputted by associated lamp 4 for any input power voltage having a root-mean-square value between approx. 200V and approx. 250V. This is useful in order to take into account the fact that electronic unit 2 may receive a voltage of 230VRMS (i.e. root-mean-square value) ± 10 % from the public power network, so that it may generate a correspondingly variable power signal for ballasts 3 (and thus for lamps 4); this is also useful in order to take into account possible voltage drops along the power line connecting unit 2 to ballasts 3.

In other words, the electric power supplied by a ballast 3 and drawn by an associated lamp 4 will be equal to the rated value, if 200 < VRMS < 250 .

It is clear that the above-mentioned voltage values are merely exemplificative and cannot therefore limit the scope of the present invention; for example, to
be more conservative, the lower limit of 200V may be changed to a value of 195V, and the upper limit of 250V may be changed to a value of 255V.

According to the example of Fig. 1, Fig. 2 and Fig. 6, if electronic ballast 3 receives a power voltage having a root-mean-square value lower than 200V, it will interpret such a condition as a command for adjusting the electric power to be supplied to and drawn by associated lamp 4 (i.e. a command for adjusting the luminous flux emitted by lamp 4), said command being generated by electronic unit 2.

According to such an example, electronic unit 2 and electronic units 8 of electronic ballasts 3 will use two threshold values: Vthl, corresponding to a root-mean-square value of the power voltage on line 5 of approximately 200V, and Vth2, corresponding to a root-mean-square value of the power voltage on line 5 of approximately 180V; of course, these are two preferred but exemplificative values, which may for example be changed to 170V (Vthl) and/or 195V (Vth2). If 180 < VRMS < 200, the electric power supplied by a ballast 3 and drawn by a lamp 4 will be lower than the rated power of the lamp; in particular, it will be highest and substantially corresponding to the rated value at 200V, and it will be lowest and corresponding, for example, to 20% or 30% or 50% of the rated power at 180V; this of course will affect the luminous flux emitted by lamp 4. The link between the power voltage of ballast 3 and the electric power supplied to lamp 4 by ballast 3 may be either linear or non-linear; for instance, it may depend on a multiplicative factor corresponding to (VRMS-180)/(200-180).

Referring now to the example of Fig. 6, which is a time-based diagram of the root-mean-square voltage at the beginning of line 5, i.e. at the output of electronic unit 2, it can be seen that lamps 4 are turned on at 18:00 (electronic unit 2 generates a voltage having a root-mean-square value of 230V), and the adjustment system keeps lamps 4 at the rated power until 21:00 (electronic unit 2 continues to generate a voltage having a root-mean-square value of 230V), reduces the electric power of lamps 4 by half at 21:00 (electronic unit 2 gradually decreases the root-mean-square value of the voltage to 190V), keeps lamps 4 at half rated power until 07:00 (electronic unit 2 continues to
generate a voltage having a root-mean-square value of 190V), and subsequently increases the electric power of lamps 4 up to the rated luminous flux at 07:00 (electronic unit 2 gradually increases the root-mean-square value of the voltage to 230V); though this step is not shown in the drawing, lamps 4 will then be turned off, for example, at 9:00.

This operation is obtained thanks to electronic unit 8 of each electronic ballast 3; in fact, by using circuitry 9 said electronic units 8 can detect the value (e.g. the root-mean-square value) of the power voltage and any variations thereof. Based on the power voltage value and/or variation, each electronic unit 8 drives, for example, converters 6 and/or 7 appropriately to obtain the desired electric power for lamp 4.

In the diagram of Fig. 6, it can be seen that at about 18:30, i.e. after approx. 30 minutes have elapsed since the lamps were turned on, electronic unit 2 sends to electronic units 3 a variation of power voltage having a particular form and a particular duration as shown in Fig. 3; in the course of said variation, for example, the root-mean-square value is slowly decreased from 230V to 210V in 30 seconds (section A3-B3), slowly increased from 210V to 220V in 30 seconds (section B3-C3), kept constant at 220V for 30 seconds (section C3-D3), and then slowly increased from 220V to 230V in 30 seconds (section D3-E3). Through said (optional) predetermined variation, electronic unit 2 tells electronic units 3 that it will afterwards send them commands for adjusting the luminous flux of lamps 4, i.e. like a sort of "communication start cycle". There may also be a "communication end cycle", or electronic units 8 of electronic ballasts 3 may automatically regard the operational communication phase between unit 2 and units 8 as completed after a predetermined time has elapsed, e.g. between 24 and 25 hours.

The system of Fig. 1 may advantageously provide a predetermined variation in the voltage (e.g. root-mean-square voltage) over line 5 in order to cause a voltage drop along electric power line 5 between unit 2 and each ballast 3. Said variation may for example be as shown in Fig. 4, according to which, for example, the root-mean-square value is slowly decreased from its natural value to a predetermined value of 210V in 30 seconds (section A4-B4), is
kept at 210V for 60 seconds (section B4-C4), and is then slowly increased from 210V to its natural value in 30 seconds (section C4-D4). During the 60 seconds when the power voltage is kept constant, each electronic unit 8 can measure with relatively high precision the root-mean-square value of the root-mean-square voltage being present at the input of its associated electronic ballast 3 and thus obtain by difference the voltage drop along the line; for example, if unit 8 detects a voltage of 205V instead of 210V, it will deduce that the voltage drop between unit 2 and ballast 3 is 5V or 5/210*100 = 2.4%.

Once unit 8 has determined the voltage drop along line 5 between unit 2 and associated ballast 3, it can use this information also as a corrective addend during the adjustment of the luminous flux of associated lamp 4; for example, when unit 8 detects a root-mean-square power voltage of 190V, it will set the electric power of the lamp to 75% (200-190+5/200-180=0.75) rather than to 50% (200-190/200-180=0.5).

Though this feature has not been implemented in the system of Fig. 1, the present invention also allows to provide a cycle for setting the electric power of the lamps (corresponding to variations in the power voltage); said cycle is carried out every time it is desirable to set the lamps to a different power value.

Fig. 5 shows a power voltage variation A5-B5-C5-D5-E5-F5 conceived for carrying out both the function of determining the voltage drop along the line and the function of setting the electric power; in particular, a first section (e.g. B5-C5) is used for carrying out the function of determining the voltage drop along the line, whereas a second section (e.g. D5-E5) is used for setting the electric power; thus, the electric power setting step follows the voltage drop determination step almost immediately and can therefore be very accurate. In the case of Fig. 5, section B5-C5 will always remain at 210V, whereas section D5-E5 will have a value depending on the desired electric power.

As aforementioned, the present invention features three distinct but correlated aspects:
- a method for adjusting the electric power and thus (indirectly) the luminous flux of a lamp,
- an electronic ballast for a lamp, and
- a system for adjusting the electric power and thus (indirectly) the luminous flux emitted by lamps.

This is reflected in the claims appended to the present description.

According to the first aspect of the present invention, in general, the method for adjusting the luminous flux of a lamp, in particular a discharge lamp, according to the present invention provides for supplying the lamp through an electronic ballast; the electronic ballast receives electric power from a remote electronic control unit over an electric cable, and is fitted with a local electronic control unit; according to the invention, the local electronic control unit detects the input power voltage and reduces the electric power supplied by the ballast and then drawn by the lamp with respect to a rated electric power, if the input power voltage falls below a first predetermined threshold; said threshold may be expressed, for example, in terms of root-mean-square voltage.

The local electronic control unit may cause a reduction in the electric power supplied to the lamp which is substantially proportional to the difference between a value, e.g. the root-mean-square value, corresponding to said first predetermined threshold and a value, e.g. the root-mean-square value, of the input power voltage. Advantageously, the local electronic control unit may cause a reduction in the electric power supplied to the lamp which is substantially proportional to the ratio between the difference between a value, e.g. the root-mean-square value, corresponding to said first predetermined threshold and a value, e.g. the root-mean-square value, of the input power voltage and the difference between a value, e.g. the root-mean-square value, corresponding to said first predetermined threshold and a value, e.g. the root-mean-square value, corresponding to a second predetermined threshold which is lower than said first predetermined threshold.

More specifically, the local electronic control unit may supply said lamp with electric power corresponding to a maximum luminous flux (typically the rated...
one) when said input power voltage corresponds to said first predetermined threshold, and to a minimum luminous flux when said input power voltage corresponds to a second predetermined threshold which is lower than said first predetermined threshold.

The local electronic control unit may be adapted to supply no electric power to the lamp, thus causing no luminous flux (i.e. turning off the lamp), if the input power voltage falls below a second predetermined threshold which is lower than said first predetermined threshold; the thresholds may be expressed, for example, in terms of root-mean-square voltage.

The local electronic control unit may be adapted to keep constant the electric power supplied to the lamp if the input power voltage is higher than said first predetermined threshold.

The local electronic control unit may be adapted to set the electric power supplied to the lamp repeatedly, in particular periodically. In such a case, the local electronic control unit may set the electric power supplied to the lamp when its power input receives a predetermined voltage variation.

The local electronic control unit may be adapted to enter an operational communication phase when its power input receives a predetermined voltage variation; during said operational communication phase, luminous flux adjustment commands are received from a remote electronic control unit. In this case, the local electronic control unit may exit said operational communication phase after a predetermined time has elapsed since the start of said operational phase, in particular after a time between 24 and 25 hours; the local electronic control unit may stay in said operational communication phase, if it is already in said operational communication phase, when its power input receives said predetermined voltage variation.

The automatic exit of the electronic ballast from the operational communication phase after a predetermined time is advantageous, for example, in the event that the remote electronic control unit is malfunctioning; in fact, the electronic ballast can thus resume its normal operation and set the rated electric power.

It is conceivable that the local electronic control unit reduces the electric
power supplied to the lamp with respect to a rated power only when it is in
said operational communication phase.
The local electronic control unit may be adapted to calculate a voltage drop
on its power line based on a voltage variation detected at the power input. In
such a case, the local electronic control unit may calculate a voltage drop on
its power line on the basis of the difference between a voltage variation
detected at the power input and a predetermined voltage variation, in
particular on the basis of the difference between a time portion of the
detected variation and a time portion of the predetermined variation.
If a detection of the voltage drop on the power line is provided, the local
electronic control unit may be adapted to cause a reduction in the electric
power supplied to the lamp by taking into account said voltage drop on its
power line.
According to the method of the present invention, one or more or all
variations in the power voltage of the electronic ballast may be generated by
a remote electronic control unit, as is generally the case.
Based on the above, the method according to the present invention generally
provides one-way communication from a remote electronic control unit to at
least one local electronic control unit (typically a plurality of units) for
controlling the luminous flux of lamps; the various units are connected
through an electric power line; the information to be communicated is
associated with variations in the root-mean-square value of the power voltage
(of the local electronic unit and the associated electronic ballast). Said
communication method may include one or more of the following cycles:
- a "communication start cycle" for starting the communication between
  the remote unit and the local unit,
- a "communication end cycle" for ending the communication between
  the remote unit and the local unit,
- a "determination cycle" for determining the voltage drop along the
  power line between the remote unit and the local unit,
- a "setting cycle" for setting the luminous flux of the lamps;
said cycles correspond to predetermined power voltage variations (in the
local electronic unit and the associated electronic ballast).

According to the second aspect of the present invention, in general, the electronic ballast for a lamp, in particular a discharge lamp, according to the present invention is adapted to receive at its input electric power for the lamp and to output electric power to the lamp; it comprises a local electronic control unit adapted to detect the input power voltage and to reduce the electric power supplied to the lamp with respect to a rated power when the input power voltage falls below a first predetermined threshold; said predetermined threshold may be expressed, for example, in terms of root-mean-square voltage.

The features of the method according to the present invention as defined and described above also apply to the electronic ballast according to the present invention.

It is worth pointing out that, by appropriately choosing the technical characteristics of the ballast according to the present invention, the latter can operate properly even if the remote electronic control unit is absent or faulty, or if the remote electronic control unit is in the so-called "by-pass" mode, i.e. intentionally non-operating; in fact, as long as the power voltage remains above the first predetermined threshold, there will be no particular novelty in the operation of the electronic ballast.

Furthermore, it is advantageous that the ballast according to the present invention carries out the adjustment of the electric power supplied to the lamp connected thereto only when it receives, for example, a "communication start cycle", which may also be called "adjustment start cycle".

According to the third aspect of the present invention, in general, the system for adjusting the luminous flux emitted by lamps, in particular discharge lamps, according to the present invention is particularly suitable for public lighting applications and comprises:

- a remote electronic control unit connected to an electric power source and adapted to supply (indirectly) electric power to the lamps,

- at least one electronic ballast for at least one associated lamp, said electronic ballast being connected to the remote electronic control unit.
through an electric cable to receive electric power and being adapted to
supply electric power (directly) to said at least one lamp;
said at least one electronic ballast comprises a local electronic control unit in
order to control the luminous flux emitted by said associated lamp, in
particular by adjusting the electric power supplied to said lamp.
In this system, one, several or all electronic ballasts may have the
aforementioned technical characteristics.
Said system may also be adapted to implement the method having the above-
mentioned technical characteristics.
The present invention can be implemented in many different ways.
In this regard, it is worth noting that in the above-described embodiment the
adjustment of the electric power supplied to the lamps is carried out
continuously from a minimum value to a maximum value. Alternatively,
there may be a predetermined number of electric power values, e.g. four (or
even just two or three) corresponding to 100% of the rated power (e.g. for
190 < VRMS < 195), 80% of the rated power (e.g. for 185 < VRMS < 190),
60% of the rated power (e.g. for 180 < VRMS < 185), 40% of the rated power
(e.g. for 175 < VRMS < 180).
In conclusion, it should be pointed out that some of the possibilities offered
by the present invention set a number of constraints on the performance of the
remote electronic control unit (reference number 2 in Fig. 1); for example, it
must ensure a certain degree of effectiveness (e.g. higher than 98.5%), it must
allow to increase the input voltage of the mains (e.g. in order to ensure that
the local electronic control units will always receive at least 230 VRMS), and
it must ensure a certain degree of accuracy in the output power voltage (e.g.
higher than 1% or 2%).

* * * * *
CLAIMS

1. Method for adjusting the luminous flux of a lamp (4), in particular a discharge lamp, supplied by an electronic ballast (3), said electronic ballast (3) receiving (31,32) electric power from a remote electronic control unit (2) through an electric cable (5) and being fitted with a local electronic control unit (8), characterized in that said local electronic control unit (8) detects the input power voltage (31,32) and reduces the electric power supplied to said lamp (4) with respect to a rated power when said input power voltage (31,32) falls below a first predetermined threshold (Vthl).

2. Method according to claim 1, characterized in that said local electronic control unit (8) causes a reduction in the electric power supplied to said lamp (4) which is substantially proportional to the difference between a value corresponding to said first predetermined threshold (Vthl) and a value of the input power voltage (31,32).

3. Method according to claim 2, characterized in that said local electronic control unit (8) causes a reduction in the electric power supplied to said lamp (4) which is substantially proportional to the ratio between the difference between a value corresponding to said first predetermined threshold (Vthl) and a value of the input power voltage (31,32) and the difference between a value corresponding to said first predetermined threshold (Vthl) and a value corresponding to a second predetermined threshold (Vth2) which is lower than said first predetermined threshold (Vthl).

4. Method according to claim 1 or 2 or 3, characterized in that said local electronic control unit (8) supplies said lamp (4) with electric power corresponding to a maximum luminous flux, in particular a rated one, when said input power voltage (31,32) corresponds to said first predetermined threshold (Vthl), and to a minimum luminous flux when said input power voltage (31,32) corresponds to a second predetermined threshold (Vth2) which is lower than said first predetermined threshold (Vthl).

5. Method according to any of the preceding claims, characterized in that said local electronic control unit (8) supplies no electric power to said lamp (4), thus causing said lamp (4) to emit no luminous flux, if said input power
voltage (31,32) falls below a second predetermined threshold (Vth2) which is lower than said first predetermined threshold (Vth1).

6. Method according to any of the preceding claims, characterized in that said local electronic control unit (8) keeps constant the electric power supplied to said lamp (4) if said input power voltage (31,32) is higher than said first predetermined threshold (Vth1).

7. Method according to any of the preceding claims, characterized in that said local electronic control unit (8) sets the electric power supplied to said lamp (4) periodically.

8. Method according to claim 7, characterized in that said local electronic control unit (8) sets the electric power supplied to said lamp (4) periodically.

9. Method according to claim 7 or 8, characterized in that said local electronic control unit (8) sets the electric power supplied to said lamp (4) when said power input (31,32) receives a predetermined voltage variation.

10. Method according to any of the preceding claims, characterized in that said local electronic control unit (8) enters an operational communication phase when it receives a predetermined voltage variation at said power input (31,32), luminous flux adjustment commands being received from a remote electronic control unit (2) during said operational communication phase.

11. Method according to claim 10, characterized in that said local electronic control unit (8) exits said operational communication phase after a predetermined time has elapsed since the start of said operational phase, in particular after a time between 24 and 25 hours.

12. Method according to claim 10 or 11, characterized in that said local electronic control unit (8) stays in said operational communication phase if it receives said predetermined voltage variation at said power input (31,32) while being already in said operational communication phase.

13. Method according to claim 10 or 11 or 12, characterized in that said local electronic control unit (8) reduces the electric power supplied to said lamp (4) with respect to a rated electric power only if it is in said operational communication phase.

14. Method according to any of the preceding claims, characterized in that
said local electronic control unit (8) calculates a voltage drop on its power line (5) on the basis of a voltage variation detected at said power input (31,32).

15. Method according to claim 14, characterized in that said local electronic control unit (8) calculates a voltage drop on its power line (5) on the basis of the difference between a voltage variation detected at said power input (31,32) and a predetermined voltage variation, in particular on the basis of the difference between a time portion of said detected variation and a time portion of said predetermined variation.

16. Method according to claim 14 or 15, characterized in that said local electronic control unit (8) causes a reduction in the electric power supplied to said lamp (4) by taking into account said voltage drop on its power line (5).

17. Method according to one or more of the preceding claims, characterized in that one or several or all variations in the power voltage of said electronic ballast (3) are generated by said remote electronic control unit (2).

18. Method according to one or more of the preceding claims, characterized in that it provides a one-way communication from said remote electronic control unit (2) to said local electronic control unit (8) in order to control the luminous flux of lamps (4).

19. One-way communication method from a remote electronic control unit (2) to at least one local electronic control unit (8) in order to adjust the luminous flux of lamps, said units (2, 8) being connected through an electric power line (5), characterized in that the information to be communicated is associated with variations in the root-mean-square value of the power voltage.

20. Method according to claim 19, characterized by comprising one or more of the following cycles:

- a communication start cycle for starting the communication between the remote unit (2) and the local unit (8),
- a communication end cycle for ending the communication between the remote unit (2) and the local unit (8),
- a determination cycle for determining the voltage drop along the power line (5),
- a setting cycle for setting the luminous flux of the lamps (4);
said cycles corresponding to predetermined power voltage variations.

21. Electronic ballast (3) for a lamp (4), in particular a discharge lamp, adapted to receive at the input (31,32) electric power for said lamp (4) and to supply at the output electric power to said lamp (4), characterized by comprising a local electronic control unit (8) adapted to detect (9) the input power voltage (31,32) and to reduce the electric power supplied to said lamp (4) with respect to a rated electric power when said input power voltage (31,32) falls below a first predetermined threshold (Vthl).

22. Electronic ballast (3) according to claim 21, characterized in that said local electronic control unit (8) is adapted to cause a reduction in the electric power supplied to said lamp (4) which is substantially proportional to the difference between a value corresponding to said first predetermined threshold (Vthl) and a value of the input power voltage (31,32).

23. Electronic ballast (3) according to claim 22, characterized in that said local electronic control unit (8) is adapted to cause a reduction in the electric power supplied to said lamp (4) which is substantially proportional to the ratio between the difference between a value corresponding to said first predetermined threshold (Vthl) and a value of the input power voltage (31,32) and the difference between a value corresponding to said first predetermined threshold (Vthl) and a value corresponding to a second predetermined threshold (Vth2) which is lower than said first predetermined threshold (Vthl).

24. Electronic ballast (3) according to claim 21 or 22 or 23, characterized in that said local electronic control unit (8) is adapted to supply said lamp (4) with electric power corresponding to a maximum luminous flux, in particular a rated one, when said input power voltage (31,32) corresponds to said first predetermined threshold (Vthl), and to a minimum luminous flux when said input power voltage (31,32) corresponds to a second predetermined threshold (Vth2) which is lower than said first predetermined threshold (Vthl).
25. Electronic ballast (3) according to any of the preceding claims from 21 to 24, characterized in that said local electronic control unit (8) is adapted to supply no electric power to said lamp (4), thus causing said lamp (4) to emit no luminous flux, if said input power voltage (31,32) falls below a second predetermined threshold (Vth2) which is lower than said first predetermined threshold (Vth1).

26. Electronic ballast (3) according to any of the preceding claims from 21 to 25, characterized in that said local electronic control unit (8) is adapted to keep constant the electric power supplied to said lamp (4) if said input power voltage (31,32) is higher than said first predetermined threshold (Vth1).

27. Electronic ballast (3) according to any of the preceding claims from 21 to 26, characterized in that said local electronic control unit (8) is adapted to set the electric power supplied to said lamp (4) repeatedly.

28. Electronic ballast (3) according to claim 27, characterized in that said local electronic control unit (8) is adapted to set the electric power supplied to said lamp (4) periodically.

29. Electronic ballast (3) according to claim 27 or 28, characterized in that said local electronic control unit (8) is adapted to enter an operational communication phase when it receives a predetermined voltage variation at said power input (31,32), luminous flux adjustment commands being received from a remote electronic control unit (2) during said operational communication phase.

30. Electronic ballast (3) according to any of the preceding claims from 21 to 29, characterized in that said local electronic control unit (8) is adapted to enter an operational communication phase when it receives a predetermined voltage variation at said power input (31,32), luminous flux adjustment commands being received from a remote electronic control unit (2) during said operational communication phase.

31. Electronic ballast (3) according to claim 30, characterized in that said local electronic control unit (8) is adapted to exit said operational communication phase after a predetermined time has elapsed since the start of said operational phase, in particular after a time between 24 and 25 hours.

32. Electronic ballast (3) according to claim 30 or 31, characterized in that said local electronic control unit (8) is adapted to stay in said operational
communication phase if it receives said predetermined voltage variation at said power input (31,32) while being already in said operational communication phase.

33. Electronic ballast (3) according to claim 30 or 31 or 32, characterized in that said local electronic control unit (8) is adapted to reduce the electric power supplied to said lamp (4) with respect to a rated electric power only if it is in said operational communication phase.

34. Electronic ballast (3) according to any of the preceding claims from 21 to 33, characterized in that said local electronic control unit (8) is adapted to calculate a voltage drop on its power line (5) on the basis of a voltage variation detected at said power input (31,32).

35. Electronic ballast (3) according to claim 34, characterized in that said local electronic control unit (8) is adapted to calculate a voltage drop on its power line (5) on the basis of the difference between a voltage variation detected at said power input (31,32) and a predetermined voltage variation, in particular on the basis of the difference between a time portion of said detected variation and a time portion of said predetermined variation.

36. Electronic ballast (3) according to claim 34 or 35, characterized in that said local electronic control unit (8) is adapted to cause a reduction in the electric power supplied to said lamp (4) by taking into account said voltage drop on its power line (5).

37. System (1) for adjusting the luminous flux emitted by lamps (4), in particular discharge lamps, particularly suitable for public lighting applications, comprising:

- a remote electronic control unit (2) connected to an electric power source and adapted to supply electric power to said lamps (4),
- at least one electronic ballast (3) for at least one respective lamp (4), said electronic ballast (3) being connected to said remote electronic control unit (2) through an electric cable (5) to receive electric power and being adapted to supply at the output electric power to said at least one lamp (4); characterized in that said at least one electronic ballast (3) comprises a local electronic control unit (8) in order to control the luminous flux emitted by
said associated lamp (4), in particular by adjusting the electric power supplied to said lamp (4).

38. System (1) according to claim 37, characterized in that said at least one electronic ballast (3) has the technical characteristics set out in any of claims 21 to 36.

39. System (1) according to claim 37 or 38, characterized by being adapted to implement the method according to any of claims 1 to 20.

40. Method for adjusting the luminous flux of a lamp, electronic ballast for a lamp and system for adjusting the luminous flux emitted by lamps according to the innovative teachings of the present description and of the annexed drawings, which represent preferred and advantageous embodiments thereof.

41. Remote electronic control unit (2) adapted to be connected to an electric power source on the input side and to one or more electronic ballasts (3) for lamps on the output side, characterized by being adapted to output a voltage which is lower than a first predetermined threshold (Vthl) in order to reduce the electric power drawn by one or more lamps (4) below the rated electric power of said one or more lamps (4), said first predetermined threshold (Vthl) being lower than a rated power voltage of said source.

42. Electronic unit according to claim 41, characterized by being adapted to output a voltage lower than a first predetermined threshold (Vthl) and higher than a second predetermined threshold (Vth2) in order to adjust the electric power drawn by one or more lamps (4) below the rated electric power of said one or more lamps (4), said first predetermined threshold (Vthl) being lower than a rated power voltage of said source, and said second predetermined threshold (Vth2) being lower than said first predetermined threshold (Vthl) and greater than zero.

43. Electronic unit according to claim 41 or 42, characterized by being adapted to output a predetermined voltage variation to said one or more electronic ballasts (3) in order to adjust the electric power...
drawn by one or more lamps (4) below the rated electric power of said one or more lamps (4).

44. Electronic unit according to claim 41 or 42 or 43, characterized by being adapted to output a predetermined voltage variation to said one or more electronic ballasts (3) in order to start an operational communication phase, luminous flux adjustment commands being sent to said one or more electronic ballasts (3) during said operational communication phase.

45. Electronic unit according to claim 41 or 42, characterized by being adapted to output predetermined voltage variations to said one or more electronic ballasts (3) for one or more of the following cycles:
   - a communication start cycle for starting the communication between the unit (2) and the ballast (3),
   - a communication end cycle for ending the communication between the unit (2) and the ballast (3),
   - a determination cycle for determining the voltage drop along a power line (5) connecting the unit (2) to the ballast (3),
   - a setting cycle for setting the luminous flux of lamps (4).

46. Electronic unit according to any of claims 41 to 45, characterized by being adapted to allow for the implementation of the method according to any of claims 1 to 18.

47. Electronic unit according to any of claims 41 to 46, characterized by being adapted to be used in the system according to claim 37 or 38 or 39.