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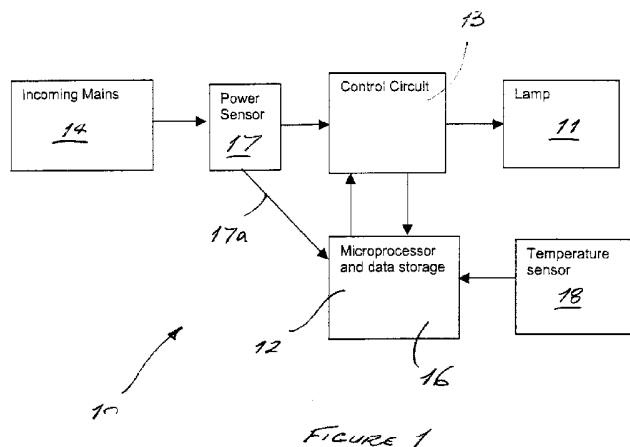
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GB 2403357 A **GB 2372160 A**
EP 1414278 A1 **US 6333602 B1**

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(54) Abstract Title: **Electronic control gear for monitoring and controlling lamps**

(57) An electronic control gear, for one or more lamps, comprises a memory device 12 and a microprocessor configured to acquire and store data relating to one or more of the following parameters of operation of one or more said lamps: (i) the electrical power consumption 17 of the or each lamp, during a period of operation; (ii) the duration of operation of one or more lamps during a period; (iii) the duration of operation of one or more lamps at each of a plurality of power consumption levels or bands; or (iv) the operating temperature 18 of one or more components of a circuit in which a said lamp is connected. The microprocessor may include an electronic ballast that controls the supply of electrical power to one or more said lamps. The electronic control gear may include a temperature sensor to record the temperature surrounding the microprocessor.



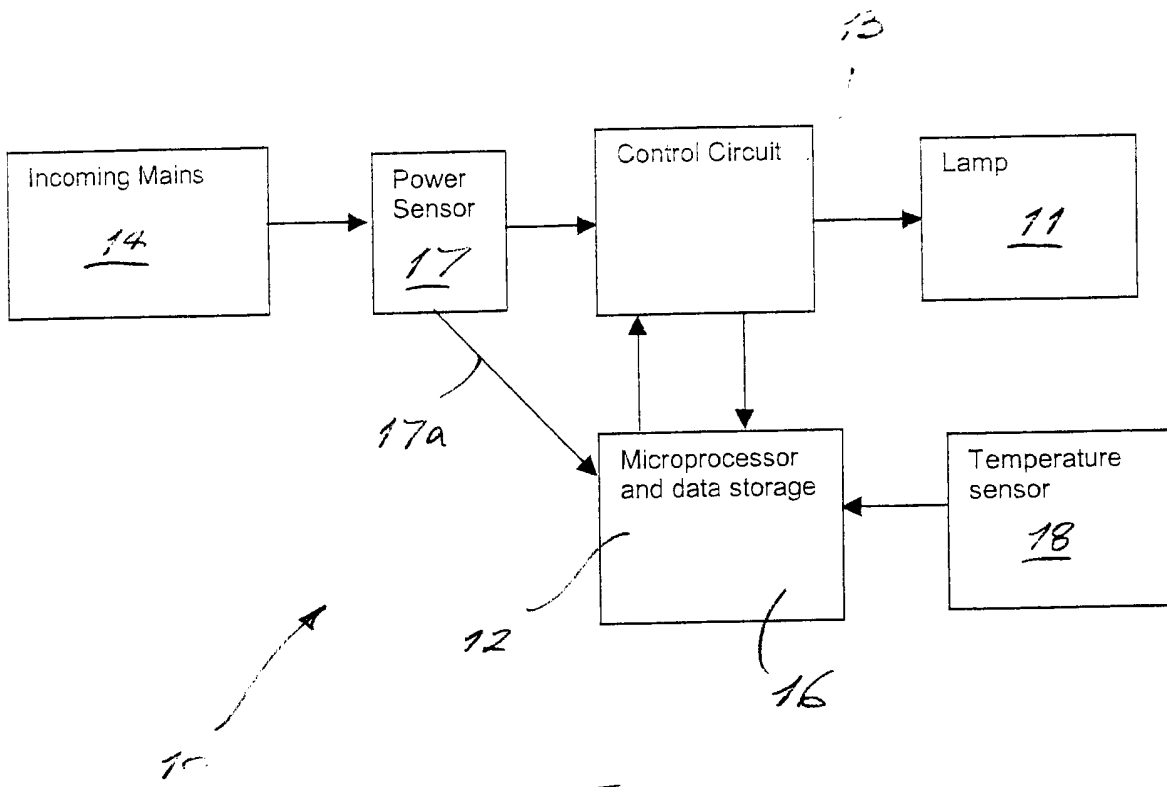


FIGURE 1

AN ELECTRONIC CONTROL GEAR AND METHOD OF ITS USE

This invention relates to an electronic control gear and method of its use.

5 In the field of street or area lighting, it is known to employ gas discharge lamps such as but not limited to high pressure sodium lamps. Such devices are desirable because of their high lumen efficiency values.

10 A gas discharge lamp requires a control gear including a ballast and an igniter circuit.

15 Electromagnetic ballasts are well known, but suffer from numerous disadvantages including significant losses, no way of tracking likely end of life of lamps and igniters connected to such ballasts, flickering or cycling between on and off states at or near end of life, and lumen outputs that are related to the input voltage to the ballast.

In view of the these disadvantages, so-called microprocessor control gears have been developed.

20 These solve the majority of the problems identified above, and additionally may offer desirable control options such as the ability to adjust the light output of a discharge lamp continuously over a range of lumen values.

25 However, the microprocessor control gears typically include an electronic ballast whose operating life is sensitive to ambient temperatures. Thus if an electronic ballast forming part of a microprocessor control gear operates in ambient conditions exceeding a recommended maximum temperature value, the electronic ballast may fail prematurely.

30 This may lead to undesirable disputes between an operator of a street lighting network and a supplier of the control gears, since it is impossible for the supplier

of such control gears to establish, from a remote location, the ambient temperatures which a failed control gear has encountered.

5 A further problem associated with the use of microprocessor control gears is that the utility companies which supply electric power to area and street lighting networks often only record imprecise data about power consumption levels, and in many cases record no data at all. This makes it difficult for operators of street lighting networks successfully to argue, on the basis of data provided by the utility companies, that they are entitled to reductions in the costs of the power supplied,
10 or that they are not operating their networks outside the terms of supply agreements.

According to a first aspect of the invention there is provided an electronic control gear, for one or more lamps, comprising a memory device and a microprocessor
15 configured to acquire data relating to one or more of the following parameters of operation of one or more said lamps:

- (i) the electrical power consumption of the or each lamp, during a period of operation;
- (ii) the duration of operation of one or more lamps during a period as
20 defined herein;
- (iii) the duration of operation of one or more lamps at each of a plurality of power consumption levels or bands; or
- (iv) the operating temperature of one or more components of a circuit in which a said lamp is connected.

25 the microprocessor additionally being configured to store acquired data in the memory device.

Apparatus configured in accordance with the invention as broadly stated hereinabove advantageously permits:

- 30 a) a supplier of electronic control gears to establish, unequivocally, whether eg. a warranty claim from an operator of area or street lighting apparatuses is justified or is the result of incorrect use of electronic ballasts (for example including extended use at excessive ambient temperatures); or

b) an operator of area or street lighting to obtain data which justify a power cost reduction, or which show that networks are being operated within the terms of power supply agreements.

5 In a preferred embodiment of the invention, the microprocessor is or includes an electronic ballast that controls the supply of electrical power to one or more said lamps.

10 Preferably the electronic control gear according to the invention includes a temperature sensor operatively connected to the microprocessor, the control gear being configured to record, during operation of one or more of the lamps, data from the temperature sensor related to the ambient temperature surrounding the microprocessor.

15 This feature conveniently permits the recording of ambient temperature data using an electronic "package" that is compact.

20 Similarly, the electronic control gear may optionally include an electrical power sensor operatively connected to the microprocessor, the control gear being configured to record, during operation of one or more of the lamps, data from the electrical power sensor related to the electrical power consumption of one or more said lamps.

25 This feature also conveniently allows the recording of power consumption data of the kinds defined hereinabove.

30 The electrical power sensor may optionally be configured to provide to the microprocessor data on the duration of operation of one or more said lamps at each of a plurality of power consumption levels or bands. Such data are advantageously helpful if the electronic ballast is of a type that is capable of controlling operation of the lamps at various variable power levels.

Conveniently the microprocessor includes a clock that generates periodic clock pulse signals, the microprocessor allocating selected said clock pulse signals to define a counter that measures the duration of operation of one or more lamps according to a parameter as defined hereinabove.

5

Thus the apparatus includes a readily configured arrangement for recording time-related power consumption and ambient temperature data.

Preferably the memory device includes a non-volatile memory. Even more preferably, the microprocessor during operation of the electronic control gear causes the clock pulse signals to initiate the storage of data in the non-volatile memory at predetermined intervals.

10

Alternatively, the electronic power sensor is capable of generating a power loss signal to the microprocessor which causes the storing of data in the non-volatile memory on receipt of a said power loss signal.

15

In either case, the control gear according to the invention is capable of assuring storage of relevant data even in the event of total power loss to the lighting network under consideration.

20

The invention also relates to an electronic control gear as defined hereinabove when connected to control one or more gas discharge lamps.

According to a further aspect of the invention there is provided a method of controlling one or more lamps and simultaneously recording data relating to one or more of:

25

(i) the electrical power consumption of one or more said lamps, during a period of operation;

30

(ii) the duration of operation of one or more said lamps;

(iii) the duration of operation of one or more said lamps at each of a plurality of power consumption levels or bands; and/or

(iv) the operating temperature of one or more components of a circuit in which a said lamp is connected.

the method including the steps of causing a microprocessor to effect storage of the data in a memory device.

5

Further, operational aspects of the method of the invention are defined in Claims 12 to 17 hereof.

10 There now follows a description of a preferred embodiment of the invention, by way of non-limiting example, with reference being made to the accompanying drawing which is a schematic representation of an electronic control gear according to the invention.

15 In view of the nature of the invention defined herein, the following is a description of both the arrangement (hardware) of an electronic control gear, and its method of use or operation.

Referring to Figure 1, an electronic control gear 10 is connected to control the operation of one or more lamps 11 each configured as a gas discharge lamp.

20

In the arrangement of Figure 1, a microprocessor 12 is operatively connected, so as to permit two way data and command communication, to a control circuit 13 containing an electrical power control device.

25 Mains power represented schematically by reference numeral 14 is supplied via the control circuit 13 to the lamp 11, in a *per se* known manner such that in dependence on command signals generated by the microprocessor 12 the voltage and current applied to the lamp 11 are maintained as far as possible at predetermined levels.

30

The control gear 10 additionally includes a memory device 16 that in the embodiment shown is configured as part of the same package as the microprocessor 12. This however need not necessarily be so, it being sufficient

merely for the memory device 16 to be operatively connectable to the microprocessor 12 for the purpose of transfer and storage of data.

The microprocessor 12 is a programmable device that in accordance with the invention is configured to acquire data relating to one or more of the following parameters of operation of the or each lamp 11 in an area or street lighting network:

- (i) the electrical power consumption of the or each lamp, during eg. a period of use;
- 10 (ii) the duration of operation of one or more lamps during a period as defined herein;
- (iii) the duration of operation of one or more lamps at each of a plurality of power consumption levels or bands; or
- (iv) the operating temperature of one or more components of a circuit in
15 which a said lamp is connected.

To this end, the control gear 10 includes a power sensor 17 of *per se* known design that is connected to measure the power supplied to the control circuit 13. As signified by arrow 17a, power sensor 17 conveys data relating to parameters
20 (i)-(iii) above to the microprocessor 12.

The control gear 10 additionally includes a temperature sensor 18 of *per se* known design that is connected to supply to the microprocessor data on the ambient temperature in which the electronic ballast forming part of the control gear
25 operates.

The temperature sensor 18 may be for example a thermister, and integrated circuit temperature sensor or another *per se* known design. The output of the temperature sensor may be an analogue or digital signal. The microprocessor preferably
30 implements an algorithm that translates the output of the temperature sensor to units of temperature measurement or quantities related to such units.

The microprocessor 12 operates to store data acquired from the power sensor, control circuit and/or temperature sensor in the memory device 16.

5 In this regard, it is not essential that both the power sensor 17 and the temperature sensor 18 are present in an embodiment according to the invention. One or other, or both, of these components may be present in order to provide the advantages of the invention.

10 The microprocessor and power sensor are arranged in certain preferred embodiments of the invention to acquire and store data on the duration of operation of one or more of the lamps 11 at each of a plurality of power consumption levels or bands. This feature is of most utility in the case of a control gear that is capable of providing electrical power within such bands to the lamps 11.

15 As is conventional, the microprocessor includes a clock that generates periodic clock pulse signals. The microprocessor 12 allocates selected said clock pulse signals to define a counter that measures the duration of operation of one or more lamps according to a parameter as defined herein.

20 The memory device 16 typically includes a non-volatile memory such as an EEPROM (electronically erasable programmable read only memory), a flash memory or a FRAM (ferro-electric random access memory).

25 In one preferred embodiment of the invention the microprocessor is programmed or otherwise configured to cause the clock pulse signals to initiate the storage of data in the non-volatile memory at predetermined intervals (for example every 5 minutes).

30 Alternatively, the electronic power sensor 17 is capable of generating a power loss signal that is indicative of the loss of mains power to one or more lamps 11. The control gear 10 is capable of transmitting the power loss signal via the connection 17a to the microprocessor which, depending on the type of non-volatile memory

employed, may effect storage of data on the power consumption and/or ambient temperature parameters of the control gear 10 in the non-volatile memory on receipt of the power loss signal.

5 In either case, the electronic control gear 10 is capable of storing in an inviolable manner recent data relating to the recorded parameters as defined herein, even in the event of a total loss of power to the control gear 10.

10 During recording of data in the event of power loss, the microprocessor may be arranged to provide power to the control gear 10 for a short period (typically a fraction of a second) after generation of the power loss signal. The power loss signal may be treated in the microprocessor 12 as a high priority interrupt, thereby permitting the recording of the latest usage data in the non-volatile memory before power in the electronic control gear decays entirely.

15 A further refinement possible in the electronic control gear of the invention is to provide within the microprocessor a software counter that increments periodically for example once an hour or once every 24 hours in order to record the total usage of the control gear 10.

20 Overall the apparatus of the invention is advantageously cheap and simple to embody.

25 Data from the memory device 16 may be downloaded eg. using the wiring of the lighting network. To this end, the microprocessor 12 may allocate identifier or flag bits to each string of data, so as uniquely to identify the lamp 11 and/or electronic control gear 10 with which it is associated.

30 As noted, it is not necessary that both the power sensor 17 and the temperature sensor 18 are present in embodiments of the invention as defined herein. In the absence of one or other of these components, therefore, operation of the electronic control gear 10 is of course modified in ways that would be within the knowledge of the worker of ordinary skill in the relevant art.

CLAIMS

1. An electronic control gear, for one or more lamps, comprising a memory device and a microprocessor configured to acquire data relating to one or more of the following parameters of operation of one or more said lamps:
- 5
- (i) the electrical power consumption of the or each lamp, during a period of operation;
 - (ii) the duration of operation of one or more lamps during a period as defined herein;
 - 10 (iii) the duration of operation of one or more lamps at each of a plurality of power consumption levels or bands; or
 - (iv) the operating temperature of one or more components of a circuit in which a said lamp is connected;
- the microprocessor additionally being configured to store acquired data in
- 15 the memory device.
2. An electronic control gear according to Claim 1 wherein the microprocessor is or includes an electronic ballast that controls the supply of electrical power to one or more said lamps.
- 20
3. An electronic control gear according to Claim 1 or Claim 2 including a temperature sensor operatively connected to the microprocessor, the control gear being configured to record, during operation of one or more of the lamps, data from the temperature sensor related to the ambient temperature surrounding the
- 25 microprocessor.
4. An electronic control gear according to any preceding claim including an electrical power sensor operatively connected to the microprocessor, the control gear being configured to record, during operation of one or more of the lamps,
- 30 data from the electrical power sensor related to the electrical power consumption of one or more said lamps.

5. An electronic control gear according to Claim 4 wherein the electrical power sensor provides to the microprocessor data on the duration of operation of one or more said lamps at each of a plurality of power consumption levels or bands.

5

6. An electronic control gear according to any preceding claim wherein the microprocessor includes a clock that generates periodic clock pulse signals, the microprocessor allocating selected said clock pulse signals to define a counter that measures the duration of operation of one or more lamps according to a parameter
10 as defined in any preceding claim.

7. An electronic control gear according to any preceding claim wherein the memory device includes a non-volatile memory.

15 8. An electronic control gear according to Claim 7 when dependent from Claim 6, wherein microprocessor causes the clock pulse signals to initiate the storage of data in the non-volatile memory at predetermined intervals.

9. An electronic control gear according to Claim 7 when dependent from
20 Claim 4, wherein the electrical power sensor is capable of generating a power loss signal that is indicative of the loss of mains power to a said lamp and transmitting the power loss signal to the microprocessor which causes the storing of data in the non-volatile memory on receipt of a said power loss signal.

25 10. An electronic control gear according to any preceding claim when connected to control one or more gas discharge lamps.

11. A method of controlling one or more lamps comprising the steps of
30 supplying electrical power to one or more said lamps and simultaneously recording data relating to one or more of:

(i) the electrical power consumption of one or more said lamps, during a period of operation;

(ii) the duration of operation of one or more said lamps;

(iii) the duration of operation of one or more said lamps at each of a plurality of power consumption levels or bands; and/or

(iv) the operating temperature of one or more components of a circuit in which a said lamp is connected,

5 the method including the steps of causing a microprocessor to effect storage of the data in a memory device.

12. A method according to Claim 11 including the step of operating a temperature sensor operatively connected to the microprocessor, so as to permit
10 recording, during operation of one or more of the lamps, of data from the temperature sensor related to the ambient temperature surrounding the microprocessor.

13. A method according to Claim 11 or Claim 12 including the step of
15 operating an electrical power sensor that is operatively connected to the microprocessor, so as to permit recording, during operation of one or more of the lamps, of data from the electrical power sensor related to the electrical power consumption of one or more said lamps.

20 14. A method according to Claim 13 wherein the electrical power sensor provides to the microprocessor data on the duration power consumed by one or more said lamps at each of a plurality of power consumption levels or bands.

15. 15. A method according to any of Claims 11 to 14 wherein the
25 microprocessor includes a clock that generates periodic clock pulse signals, the method including the step of causing the microprocessor to allocate selected said clock pulse signals to define a counter that measures the duration of operation of one or more lamps according to a parameter as defined in any of claims 1 to 10.

30 16. A method according to any of Claims 11 to 15 wherein the memory device includes a non-volatile memory; and wherein the method includes the step of operating the microprocessor to cause the clock pulse signals to initiate the storage of data in the non-volatile memory at predetermined intervals.

17. A method according to Claim 13 or Claim 14 or Claim 15 when dependent from Claim 13, wherein the memory device includes a non-volatile memory; wherein the electrical power sensor is capable of generating a power loss signal
5 that is indicative of the loss of mains power to a said lamp; and wherein the method includes the step of transmitting the power loss signal to the microprocessor so as to cause the storing of data in the non-volatile memory on receipt of a said power loss signal.

10 18. An electronic control gear generally as herein described, with reference to and/or as illustrated in the accompanying drawing figure.

19. A method generally as herein described.



Application No: GB0518790.1

Examiner: Simon Coldrick

Claims searched: 1-19

Date of search: 22 November 2005

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1,2,4,5,7,10,11,13,14	GB 2403357 A (LIGHTHOUSE DATA MAN LTD) See the paragraph bridging pages 5 and 6.
X	1,4,5,7,10,11,13,14	GB 2372160 A (SELV LTD) See figure 2 and paragraph 3 on page 2.
A	-	EP 1414278 A1 (HEWLETT PACKARD) See paragraph [0006] and figure 4.
A	-	US 6333602 B1 (EXFO) See column 1, lines 31-43 and column 4, lines 5-50.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

G3N

Worldwide search of patent documents classified in the following areas of the IPC⁰⁷

H05B

The following online and other databases have been used in the preparation of this search report

ONLINE: WPI, EPODOC