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(56) Documents Cited:
EP 1821177 A1 US 20040207607 A
Cobalt Aerospace, products and news, [online],
available from: <http://web.archive.org/web/20160403073901/http://www.cobaltaerospace.com/> [Accessed 14/11/2016].

(58) Field of Search:
INT CL H01H
Other: WPI, EPODOC

(54) Title of the Invention: LED lighting system for aircraft
Abstract Title: Retrofit LED lighting system and multi mode control switch

(57) An aircraft lighting system may replace fluorescent tubes with LED modules. A variety of lighting modes that vary colour and/or brightness may be selected using a switch 1 which may be any type of switch or touch screen panel. Basic light intensity levels may be selected between off, dim, medium and bright. A further range of options may be implemented by moving the switch between two positions within a set period of time. Thus mood lighting may be implemented and it may be possible to have various sections of the interior of the cabin at different levels of illumination and color spectrum. The LED units incorporate LEDs of red, green blue and white to create a palette of shades. The device seeks to provide retrofit options without introducing additional controls or controllers.

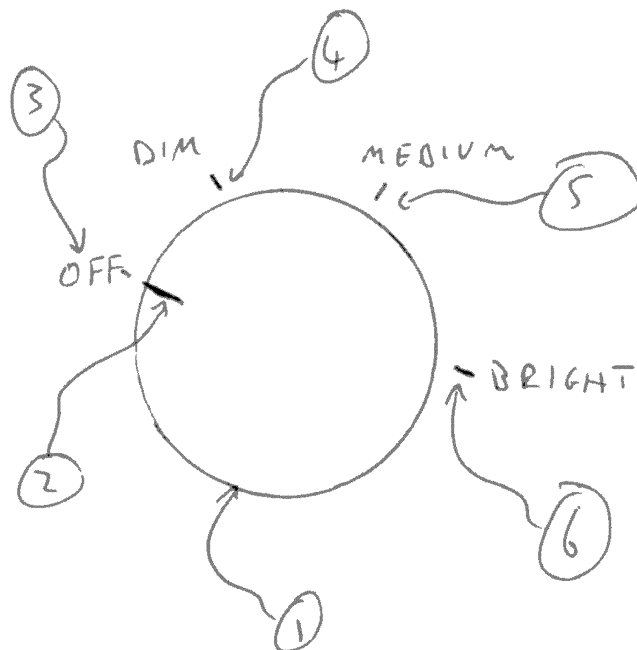


FIGURE 1

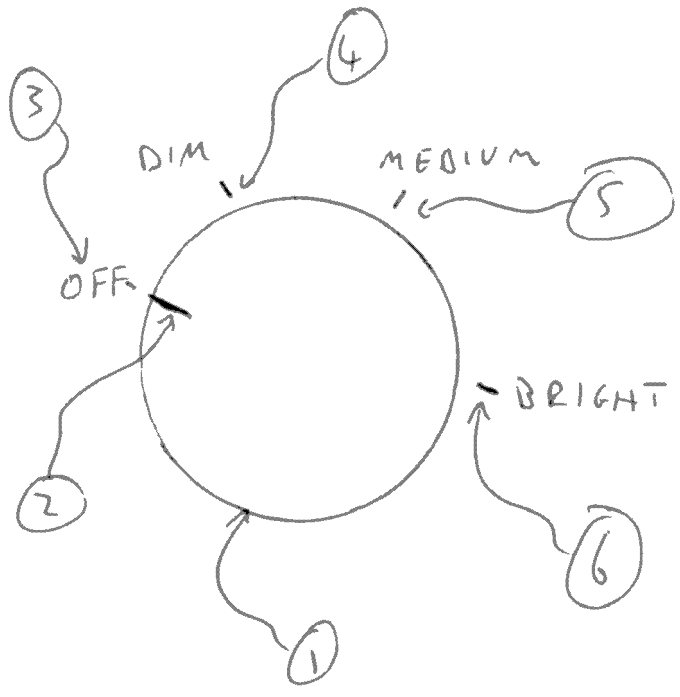


FIGURE 1

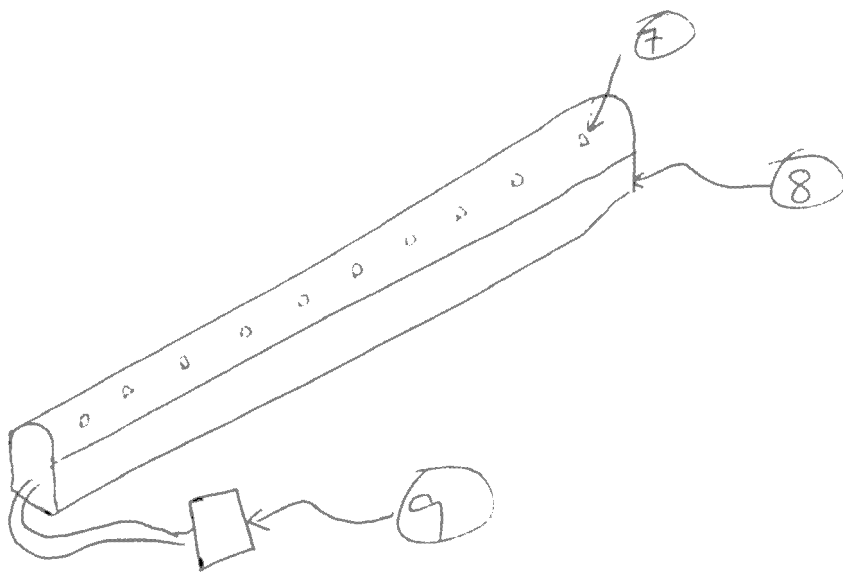


FIGURE 2

Title

LED Lighting for Aircraft.

Background

LED lighting as a drop-in replacement for existing fluorescent based lighting systems on aircraft have become common place, as have replacement lighting systems offering a lot more features than the original equipment ('full mood systems'), albeit requiring too many changes to be considered 'drop in'.

A branch of drop-in lighting has emerged which provides some of the features of more advanced systems without the need for aircraft changes but there are limitations to these systems in the number of operating modes they may provide.

The original fluorescent based lighting system of a typical aircraft will have 2, 3 or 4 modes of operation corresponding to varying levels of brightness. In a 3 mode system these may be referred to as 'Bright, Medium and Dim' for example and these modes are usually controlled by simple switches or push buttons, or from buttons on a touch screen display. It is also common for the existing lighting system control to be split into groups being lights placed nominally over the windows ('sidewall lights') and lights placed nominally in the ceiling ('ceiling' or 'aisle' lights) and for there to be separate switches controlling the light level for these two lighting groups. Additionally, the cabin lighting system may be further split into zones from front to back, commonly business class, premium class and economy class.

Drop in lighting systems that look to replace the existing usually fluorescent based cabin lighting system without requiring additional wiring or controllers can either provide white light in all modes as per the original system typically found, at brightness levels that correspond to the original system for each mode or can introduce a colour to 1 or more of the existing modes in order to bring some of the benefits of full mood lighting systems without requiring extensive changes or additional controllers.

A common arrangement is for a drop in system to provide white light in the bright and dim modes and a blue light in the medium setting for the lighting units placed in the ceiling positions to create a blue sky effect.

The compromise is the loss of the ability to provide a medium brightness white light on the ceiling of the cabin.

The problem therefore exists to provide lighting colours without the loss of existing functionality of the original system.

Statement of invention

To overcome the problem, the present invention tracks sequences of mode changes to trigger additional modes to the existing directly commanded modes.

A typical system with settings for bright, medium and dim may provide a new colour mode when the setting is moved from medium to bright and back to medium within a predetermined time frame.

In this way, and with the use of longer sequences, many new operating modes may be accessed without the need for an additional controller and without the loss of existing operating modes for the system.

Advantages

The present invention provides a means to replace fluorescent lighting systems with an LED system providing not only the original functionality but also many additional control modes without the need for extensive changes to an aircraft or an additional controller.

Introduction to drawings

The invention will now be described and illustrated for reference in the text, by way of a drawing.

Figure 1 shows a typical lighting control switch (1) found on an aircraft to control the cabin lights. There may be more than one switch (1) if there are multiple zones or the switch may be a push button or a button on a touch screen.

The switch (1) can be moved to different positions shown as (3), (4), (5), and (6) and its position is shown with a marker (2).

Figure 2 shows a typical lighting unit that forms part of a system designed to directly replace the lighting units found on an aircraft.

Detailed description

A lighting system designed as a drop-in replacement for the lighting system of an aircraft cabin may comprise of 1 or more lighting units with each lighting unit having 1 or more light sources providing 1 or more colours and 1 or more brightness levels.

In an embodiment of the invention, the light sources are LED's(7) arranged inside an elongate housing (8) similar in form to a fluorescent lighting tube. The lighting unit has a connector (9) that is appropriate to connect directly to the aircraft connector in place of the lighting unit that it is replacing. There are LED's for at least 2 colours controlled by a controller that can mix the light from the different coloured LED's to provide a range of white or coloured light outputs.

The controller is configured to respond to the settings from the lighting control switch (1) so that it provides no light in the off setting (3), dim white light in the dim setting (4), medium white light in the medium setting (5) and bright white light in the bright setting (6). These functions typically replicate the functionality of a standard aircraft lighting system.

The controller is also configured to provide an additional brightness level or colour of mixed light when the control switch (1) is witched from Dim (4) to medium (5) and back to dim (4) within a predetermined time from the first switch transition. This time may be 3 seconds.

When the control switch (1) is moved to a new mode, for example bright (6) the light unit will transition to the normal bright white light output.

In other embodiments of the invention, there may be many more sequences that the controller recognises and that trigger additional operating modes.

The control switch may be a button on a touch screen display.

In another embodiment of the invention, the existing lighting system of the aircraft is controlled by a touch screen display which has buttons to set modes Dim 2, Dim 1 and Bright which normally correspond to three brightness levels of white light. The invention is embodied in an LED lighting system containing Red, Green, Blue and White (RGBW) LED's that is designed to directly replace the fluorescent lighting ballast units of the aircraft system and connect directly to the existing aircraft lighting connector. The replacement lighting units that are to

be fitted in the ceiling locations of the aircraft are configured to provide bright white light in the bright setting, medium brightness blue light in the Dim 1 setting and a dim warm white in the Dim 2 setting.

The replacement lighting units that are to be fitted in the sidewall locations of the aircraft are configured to provide bright white light in the bright setting, medium brightness orange light in the Dim 1 setting and a dim pink in the Dim 2 setting.

The Bright setting of the aircraft then provides bright white light in both ceiling and sidewall locations, the Dim 1 setting provides a sun-set effect with a blue ceiling and orange sidewalls and the Dim 2 setting provides a relaxing soft light on both the ceiling and sidewalls.

Additionally, in response to the control sequence Bright, Dim 1, Dim 2, carried out within a pre-determined period of time, the Ceiling units provide a dim warm white light and the sidewall units provide a medium blue light.

In response to the control sequence Bright, Dim 2, Dim 1, carried out within a predetermined period of time, all light units provide a medium white light.

The invention provides a means to greatly expand the available control modes of an existing system without introducing additional controls or controllers.

It can be seen that many different sequences with more than 3 transitions may be used to provide a greater range of operating modes and that the period of time between control transitions may also be used to initiate different control modes.

The sequence Bright, Dim 1, Dim 2, executed within 3 seconds, for example, may have a different control response to the same sequence executed within 1 second.

Claims

- 1) A lighting system for an aircraft comprised of 1 or more units, each unit containing 1 or more light sources, that provides a predetermined light output in response to a predetermined sequence of control transitions between operating modes.
- 2) A lighting system of claim 1 where the lighting system uses LED's as the light sources.
- 3) A lighting system of any preceding claim where the lighting unit has 2 different colour sources.
- 4) A lighting system of claim 1 where the light sources are LED's and there are at least 1 or more each of red, green, blue and white LED's arranged to provide a palette of predetermined colours by varying the level to which each LED is driven.
- 5) A lighting system of any preceding claim which has 2 or more operating modes that are directly commanded and 1 or more operating modes that are commanded by a sequence of transitions between the two or more directly commanded operating modes.



Application No: GB1610565.2

Examiner: Gareth Jones

Claims searched: 1 - 5

Date of search: 17 November 2016

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 - 5	EP1821177 A1 (MATSUSHITA ELECTRIC IND CO LTD) See at least paragraphs (0023, 0041-0045) and claim 7.
X	1 - 5	Cobalt Aerospace, products and news, [online], available from: http://web.archive.org/web/20160403073901/http://www.cobaltaerospace.com/ [Accessed 14/11/2016]. Note products and news - Spectrum lighting
A	-	US2004/0207607 A (SPECKS et al) See whole document

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 :

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

H01H

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

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
H01H	0043/00	01/01/2006