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Office européen des brevets



(11)

**EP 1 115 272 A1**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**11.07.2001 Bulletin 2001/28**

(51) Int Cl.7: **H05B 37/02**, H05B 41/04,  
H05B 37/00, H05B 37/03,  
H05B 41/295, H02M 5/45

(21) Application number: **00100375.5**

(22) Date of filing: **07.01.2000**

(84) Designated Contracting States:  
**DE**  
Designated Extension States:  
**AL LT LV MK RO SI**

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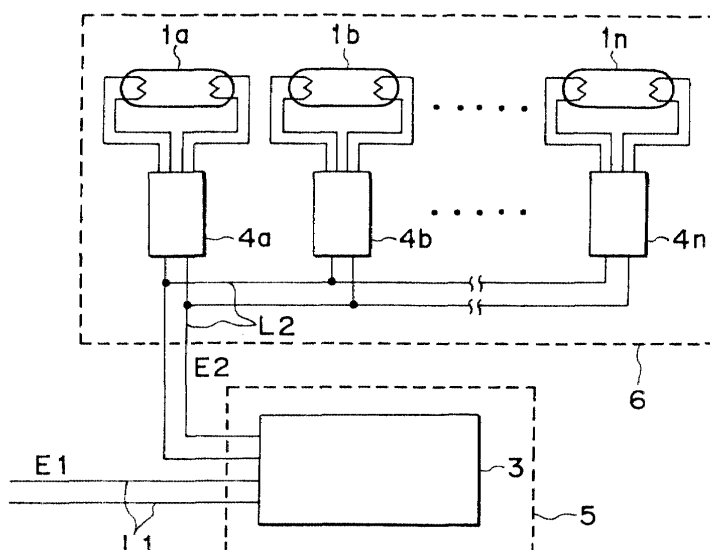
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(54) **Method and system for lighting discharge lamps**

(57) The method and system according to this invention is characterized in that commercial power supply at low frequency is frequency converted to large capacity high frequency current and respective discharge lamps are parallelly connected to this large capacity high frequency current via high frequency stabilizers associated with these respective discharge lamps. With such arrangement, various sites utilizing a plurality of discharge lamps such as offices, factories and the other operation centers may frequency convert the commer-

cial power supply at low frequency usually available for the purpose of lighting the discharge lamps to the large capacity high frequency current and then light these discharge lamps via the small-sized and lightweight high frequency stabilizers associated with the respective discharge lamps. Only the large capacity frequency converter which is rather apt to be accompanied with various problems such as a significant temperature fluctuation, noise and wear may be isolatably installed at a place appropriate for repair and/or maintenance of this converter.

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## Description

### BACKGROUND OF THE INVENTION

#### Field of the Invention

**[0001]** This invention relates to method and system for lighting a plurality of light sources of discharge type, i.e., discharge lamps.

#### Description of the Related Art

**[0002]** Discharge lamps typically in the form of metal-halide lamps, fluorescent lamps or the like are connected to commercial power supply usually available for such purpose and usually stabilizers (choke coils) are connected to the respective discharge lamps.

**[0003]** When a plurality of discharge lamps are used, it is obvious that the corresponding number of said stabilizers must be provided.

**[0004]** At sites to be illuminated, for example, offices, factories and the other operation centers, the commercial power supply (100V or 200V/50Hz or 60Hz) is generally used as a power source for the discharge lamps.

**[0005]** Referring to Fig. 2, respective florescent lamps 1a, 1b,... 1n are parallelly connected to commercial power supply E1 and stabilizers 10 are connected between the power supply E1 and the respective fluorescent lamps. The frequency of the current fed from the power supply E1 is as low as 50Hz or 60Hz and inductance of each stabilizer 10 correspondingly increases. Consequently, the stabilizers necessarily become bulky and heavy. Copper loss as well as iron loss during lighting are also remarkable and Joule heat generated by the stabilizers converts approximately 15 ~ 20% of the full power fed from the power supply to heat. Thus, a cost of equipment is relatively low, but it is impossible to achieve a high running efficiency and a cost for air conditioning the illuminated site. In addition, it is difficult for the prior art to frequency control a plurality of discharge lamps and thereby to dim these discharge lamps simultaneously.

**[0006]** Particularly in the case of facilities provided with dozens or a hundred or more of fluorescent lamps, a running cost of the air conditioning system considerably increases due to said generation of Joule heat in an environment affected by a raised temperature, for example, in summer. In addition to the problem of cost, the respective stabilizers 10 fed with the low frequency current generate sound corresponding to this low frequency. While such sound generated from a single stabilizer is rather negligible, the sound increases as the number of stabilizers increases until the volume of sound reaches undesirable noise.

### SUMMARY OF THE INVENTION

**[0007]** In view of the problem as has been described

above, it is a principal object of this invention to provide a method for lighting a plurality of discharge lamps comprising steps of frequency converting commercial power supply of low frequency to large capacity high frequency current and parallelly connecting the respective discharge lamps to said large capacity high frequency current via high frequency stabilizers associated with said respective discharge lamps.

**[0008]** According to this invention, various sites utilizing a plurality of discharge lamps such as offices, factories and the other operation centers may frequency convert the commercial power supply of low frequency usually available for the purpose of lighting the discharge lamps to the large capacity high frequency current and then light these discharge lamps via the high frequency stabilizers associated with the respective discharge lamps. The high frequency stabilizers serve to eliminate undesirable noise due to low frequency and at the same time to lower a level of current. The lowered level of current correspondingly lowers generation of Joule heat to  $1/10 \sim 1/20$  of the level which has been inevitable in the conventional stabilizers. Thus, the respective choke coils can have their number of turns correspondingly reduced and material of the iron cores also can be saved. With a consequence, not only a copper loss but also an iron can be remarkably alleviated. A durability of the high frequency stabilizers is thereby remarkably improved so that these stabilizers are substantially free from a demand for repair as well as maintenance. These small-sized stabilizers may be installed on elevated spots of said offices, factories, operation centers or the like to light a plurality of discharge lamps. On the other hand, the large capacity frequency converter is rather apt to be accompanied with various problems such as a significant temperature fluctuation, noise and wear. Accordingly, only this large capacity frequency converter may be isolatably installed at a place which facilitates the converter to be repaired and/or maintained.

**[0009]** This invention provides also the method according to Claim 1, wherein said discharge lamps are metal-halide lamps, fluorescent lamps, sodium vapor lamps, neon tube lamps or mercury vapor lamps.

**[0010]** This invention further provides the method according to Claim 1 or 2, wherein, after a step of frequency conversion, the current has a frequency of 25KHz or higher.

**[0011]** Furthermore, this invention provides the method according to any one of Claims 1 ~ 3, further comprising a step of controlling a frequency of said large capacity high frequency current during said step of frequency conversion to dim the discharge lamps.

**[0012]** According to this invention, the large capacity frequency converter may be frequency-controlled during the step of frequency conversion to dim the discharge lamps because the level of current is lowered and luminance of the discharge lamps are reduced as the frequency is increased.

**[0013]** This invention provides, according to another

aspect thereof, a system for lighting a plurality of discharge lamps comprising a large capacity frequency converter connected to commercial power supply of low frequency and a plurality of high frequency stabilizers via which the corresponding number of said discharge lamps are parallelly connected to secondary current side of said large capacity frequency converter.

**[0014]** According to this novel system the commercial power supply available at low frequency may be converted to high frequency current by said large capacity frequency converter installed at a place suitable for sound insulation, heat radiation, repair and maintenance and a plurality of discharge lamps installed at elevated spots may be lit with a relatively small power consumption via the stabilizers of high frequency type substantially free from generation of heat as well as of noise. Advantageously, these stabilizers also can be installed at elevated spots because they are small-sized, lightweight and practically free from repair and maintenance.

**[0015]** As one preferred embodiment, this invention provides the system according to Claim 5, wherein said large capacity frequency converter is isolated by soundproof wall from said high frequency stabilizers and said discharge lamps.

**[0016]** As another preferred embodiment, this invention provides the system according to Claim 5 or 6, wherein said large capacity frequency converter is thermally isolated from said high frequency stabilizers and said discharge lamps.

**[0017]** As still another preferred embodiment, this invention provides the system according to any one of Claims 5 ~ 7, wherein said discharge lamps are metal-halide lamps, fluorescent lamps, sodium vapor lamps, neon tube lamps or mercury vapor lamps.

**[0018]** As further another preferred embodiment, this invention provides the system according to any one of Claims 5 ~ 8, wherein, after frequency converted, said large capacity high frequency current has a frequency of 25KHz or higher.

**[0019]** As still further another preferred embodiment, this invention provides the system according to any one of Claims 5 ~ 9, wherein a frequency of said large capacity high frequency current is controlled by said large capacity frequency converter in a range of 25KHz or higher to dim the discharge lamps.

**[0020]** As an additional preferred embodiment, this invention provides the system according to any one of Claims 5 ~ 9, wherein each of said high frequency stabilizers comprises a choke coil having a relatively small number of turns and a capacitor adapted to cause series resonance of the current fed to said discharge lamps to light these discharge lamps.

**[0021]** As another additional preferred embodiment, this invention provides the system according to any one of Claims 5 ~ 11, wherein said choke coil making a part of said high frequency stabilizer includes an iron core made of lightweight material such as ferrite.

## BRIEF DESCRIPTION OF THE DRAWINGS

### [0022]

Fig. 1 is a schematic circuit diagram illustrating a system of this invention to light discharge lamps; and

Fig. 2 is a schematic circuit diagram illustrating a method of prior art to light the discharge lamps.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

**[0023]** Details of this invention will be more fully understood from the description of a preferred embodiment given hereunder in reference with the accompanying drawings.

**[0024]** Referring to Fig. 1, a reference numeral 3 designates a frequency converter of a sufficiently large capacity to support lighting, for example, of 30-100 or more 40W discharge lamps. A feeder line L1 is connected between said large capacity frequency converter 3 and commercial power supply usually available for the purpose of said lighting to feeds this converter 3 with electric power of 100V or 200V at low frequency of 50Hz or 60Hz, respectively, as primary current E1. On the other hand, a feeder line L2 is connected to discharge lamps 1a, 1b,...1n and feeds them with secondary current E2 via high frequency stabilizers 4a, 4b,...4n, respectively.

**[0025]** The large capacity frequency converter 3 may be isolated from the high frequency stabilizers and the discharge lamps by a partition 5 or the like provided with air conditioning and soundproof equipment to achieve desired effects of heat radiation, heat insulation and sound insulation for the converter 3.

**[0026]** Said large capacity frequency converter 3 converts said primary current of low frequency, for example, to high frequency current of 25KHz to be fed to the feeder line L2 as the secondary current. Each of said high frequency stabilizers comprises a choke coil and a capacitor adapted to induce series resonance of the current fed to the discharge lamp associated with this stabilizer during lighting of this discharge lamp. The choke coil can have its number of turns substantially decreased and a relatively lightweight material such as ferrite can be used to form an iron core because the current fed to the discharge lamp is of high frequency. Consequently, the respective high frequency stabilizers 4a ~ 4n are reduced in their sizes to 1/10 or less, on one hand, and in their weight to 1/5 or less, on the other hand, of those of the conventional stabilizers. In this manner, these stabilizers can be substantially miniaturized. In addition, a decrease in the number of turns enables a copper loss to be correspondingly alleviated and use of ferrite as material for the iron core enables an iron loss also to be correspondingly alleviated. As a result, generation of Joule heat also is alleviated to 1/10 ~ 1/20 of such heat possibly generated by the conven-

tional stabilizers. Furthermore, the high frequency is advantageous to avoid generation of noise.

**[0027]** While the system for lighting fluorescent lamps has been described hereinabove as a specific embodiment of this invention, it will be apparent to those skilled in the art that this invention is applicable also to the other luminous bodies of discharge type such as a mercury-arc lamp.

#### Effect of the Invention

**[0028]** As will be understood from the foregoing description, the method and system according to this invention for lighting discharge lamps is characterized in that the commercial power supply at low frequency is frequency converted to the large capacity high frequency current and the respective discharge lamps are parallelly connected to said large capacity high frequency current via the high frequency stabilizers associated with the respective discharge lamps. Specifically to describe, the various sites utilizing a plurality of discharge lamps such as offices, factories and the other operation centers may frequency convert the commercial power supply of low frequency usually available for the purpose of lighting the discharge lamps to the large capacity high frequency current and then light these discharge lamps via the high frequency stabilizers associated with the respective discharge lamps. The high frequency stabilizers serve to eliminate undesirable noise due to low frequency and at the same time to lower a level of current. The lowered level of current correspondingly lowers generation of Joule heat to 1/10 ~ 1/20 of the level which has been inevitable in the conventional stabilizers. Thus, the respective choke coils can have their number of turns correspondingly reduced and material of the iron cores also can be saved. With a consequence, not only a copper loss but also an iron can be remarkably alleviated. A durability of the high frequency stabilizers is thereby remarkably improved so that these stabilizers are substantially free from a demand for repair as well as maintenance. These small-sized stabilizers may be installed on elevated spots of said offices, factories, operation centers or the like to light a plurality of discharge lamps. On the other hand, the large capacity frequency converter is rather apt to be accompanied with various problems such as a significant temperature fluctuation, noise and wear. Accordingly, only this large capacity frequency converter may be isolatably installed at a place which facilitates the converter to be repaired and/or maintained.

**[0029]** This invention enables the large capacity high frequency current to be frequency-controlled during the frequency conversion to achieve a dimming effect.

**[0030]** Furthermore, this invention enables generation of Joule heat from the respective high frequency stabilizers to be substantially reduced and thereby to reduce a power consumption as well as a cost necessary to operate an air conditioner installed at the site to be

illuminated.

**[0031]** Finally, this invention effectively solves the problem of offensive noise peculiar to the low frequency generated from the conventional stabilizers by adopting the stabilizers of high frequency current type.

#### Claims

1. Method for lighting a plurality of discharge lamps comprising steps of:
  - frequency converting commercial power supply of low frequency to large capacity high frequency current; and
  - parallelly connecting the respective discharge lamps to said large capacity high frequency current via high frequency stabilizers associated with said respective discharge lamps.
2. Method according to Claim 1, wherein said discharge lamps are metal-halide lamps, fluorescent lamps, sodium vapor lamps, neon tube lamps or mercury vapor lamps.
3. Method according to Claim 1 or 2, wherein, after a step of frequency conversion, the current has a frequency of 25KHz or higher.
4. Method according to any one of Claims 1 ~ 3, further comprising a step of controlling a frequency of said large capacity high frequency current during said step of frequency conversion to dim the discharge lamps.
5. System for lighting a plurality of discharge lamps comprising:
  - a large capacity frequency converter connected to commercial power supply of low frequency; and
  - a plurality of high frequency stabilizers via which the corresponding number of said discharge lamps are parallelly connected to secondary current side of said large capacity frequency converter.
6. System according to Claim 5, wherein said large capacity frequency converter is isolated by sound-proof wall from said high frequency stabilizers and said discharge lamps.
7. System according to Claim 5 or 6, wherein said large capacity frequency converter is thermally isolated from said high frequency stabilizers and said discharge lamps.
8. System according to any one of Claims 5 ~ 7,

wherein said discharge lamps are metal-halide lamps, fluorescent lamps, sodium vapor lamps, neon tube lamps or mercury vapor lamps.

9. System according to any one of Claims 5 ~ 8, 5  
wherein, after frequency converted, said large capacity high frequency current has a frequency of 25KHz or higher.
10. System according to any one of Claims 5 ~ 9, 10  
wherein a frequency of said large capacity high frequency current is controlled by said large capacity frequency converter in a range of 25KHz or higher to dim the discharge lamps. 15
11. System according to any one of Claims 5 ~ 9, 15  
wherein each of said high frequency stabilizers comprises a choke coil having a relatively small number of turns and a capacitor adapted to cause series resonance of the current fed to said discharge lamps to light these discharge lamps. 20
12. System according to any one of Claims 5 ~ 11, 25  
wherein said choke coil making a part of said high frequency stabilizer includes an iron core made of lightweight material such as ferrite. 30

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Fig. 1

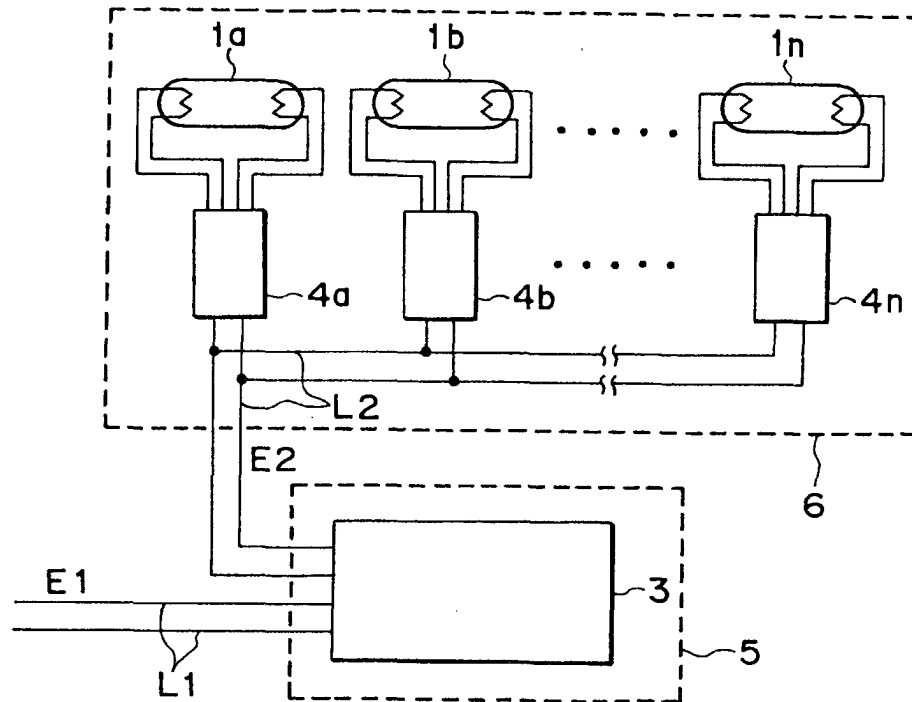
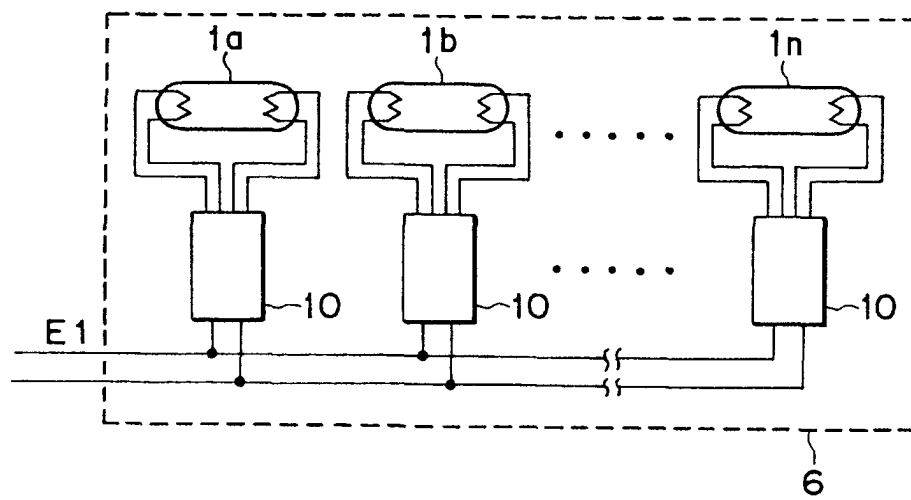


Fig. 2





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# EUROPEAN SEARCH REPORT

Application Number  
EP 00 10 0375

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 4 751 398 A (ERTZ III ALEXANDER L) 14 June 1988 (1988-06-14)	1,5	H05B37/02 H05B41/04
A	* column 1, line 7 - column 3, line 6 * * column 4, line 10 - column 12, line 44; claims 1-5; figures 1-3 *	2-4,6-12	H05B37/00 H05B37/03 H05B41/295 H02M5/45
X	EP 0 380 795 A (DENKOSHA KK) 8 August 1990 (1990-08-08)	1,5	
A	* page 1, line 8-13 * * page 7, line 11 - page 9, line 20; claims 1-9; figures 6,7 *	2-4,6-12	
X	EP 0 152 026 A (SUISSE HORLOGERIE) 21 August 1985 (1985-08-21)	1,5	
A	* page 1, line 1-29 * * page 6, line 4 - page 11, line 2; claims 1-17; figure 3 *	2-4,6-12	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H05B H02M
The present search report has been drawn up for all claims			
Place of search <b>MUNICH</b>		Date of completion of the search <b>30 May 2000</b>	Examiner <b>Pierron, P</b>
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03/82 (P4/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 10 0375

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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30-05-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4751398 A	14-06-1988	NONE	
EP 0380795 A	08-08-1990	JP 3020999 A	29-01-1991
		US 4999546 A	12-03-1991
		US 5068574 A	26-11-1991
EP 0152026 A	21-08-1985	FR 2559334 A	09-08-1985
		AU 578263 B	20-10-1988
		AU 3828785 A	08-08-1985
		CA 1227528 A	29-09-1987
		DE 3563584 D	04-08-1988
		JP 1761923 C	28-05-1993
		JP 4047959 B	05-08-1992
		JP 60189196 A	26-09-1985
		KR 9000669 B	02-02-1990
		SG 42291 G	26-07-1991
		US 4649322 A	10-03-1987

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82