

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Hisense USA Corporation
Petitioner

v.
Brightplus Ventures LLC
Patent Owner

Patent No. 8,330,710
Filing Date: October 11, 2011
Issue Date: December 11, 2012
Title: SYSTEMS AND METHODS FOR CONTROLLING A SOLID STATE
LIGHTING PANEL

Inter Partes Review No. IPR2023-01412

**Ex. 1020 – Declaration of Rafael Betancourt
in Response to Patent Owner’s Contingent Motion to Amend**

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I, Rafael J. Betancourt, declare as follows:

I. Introduction

1. I am an independent consultant. I am over eighteen years of age, and I would otherwise be competent to testify as to the matters set forth herein if I am called upon to do so.

2. I have prepared this Declaration for consideration by the Patent Trial and Appeal Board in the *Inter Partes* Reviews of U.S. Patent No. 8,330,710 (“the ’710 Patent”) with respect to the Contingent Motion to Amend (the “Motion”) Filed by Patent Owner in that *Inter Partes* Review proceeding.

3. I provide this Declaration at the request of and have been retained by Kilpatrick Townsend & Stockton, LLP, which represents Hisense USA Corporation (“Hisense”) in connection with the above-captioned *Inter Partes* Review. I have been informed and understand that Hisense contends that the proposed substitute claims 58–61 submitted by Patent Owner in the Motion are invalid.

4. I am being compensated at an hourly rate of \$750 per hour. My compensation is not dependent on the outcome of or any issue in relation to the above-captioned *Inter Partes* Review, and I have no interest in either party.

5. In forming my opinions, I relied on my knowledge, education, experience, and training in the field and on documents and information referenced in this Declaration.

6. My qualifications are summarized in Ex. 1005, which is my prior declaration in this proceeding and my *curriculum vitae*, which was submitted as Ex. 1006. My understanding of the legal issues, including with respect to obviousness, are also summarized in my prior declaration. My prior declaration also provides my opinion on the appropriate level of experience for a person to be a person of ordinary skill in the art with respect to the '710 Patent.

II. Materials Considered

7. In addition to the materials identified in my prior declaration, in forming my opinions, I have considered Patent Owner's Motion in addition to my own knowledge and experience based upon my education and work in the field, as described above and in my *curriculum vitae* (Ex. 1005).

III. Patent Owner's Proposed Substitute Claims

8. I am informed and understand that Patent Owner has proposed to substitute original claims 1, 17, 47, and 48 of the '710 Patent with the following substitute claims (the "Substitute Claims"):

58. (proposed substitute for Claim 1) A backlight lighting system for an LCD display, comprising:

a plurality of strings of solid state lighting devices arranged in a first direction and positioned at intervals in at least one second direction;

a current supply circuit configured to selectively supply ~~a plurality of an~~ on-state drive current to each of the plurality of strings responsive to a plurality of control signals, wherein the on-state drive current is individually determined for each string; and

a control system configured to receive a user input and to selectively provide control signals to the current supply circuit responsive to the user input to selectively drive the plurality of strings, the control system further including firing logic configured to determine a firing order of the plurality of strings, the control system further being operable to determine a luminous intensity of each of the strings in the plurality of strings; and

wherein the control system is configured to receive a synchronizing signal from a display controller configured to a display and wherein the firing order of the plurality of strings and the luminous intensity of each of the strings in the plurality of strings are synchronized with periodic operations of the display.

59. (proposed substitute for Claim 17) A method for controlling a plurality of strings of solid state lighting devices in a backlight system for an LCD display configured to extend in a first direction and to be arranged in substantially adjacent positions relative to one another in a second direction that is different from the first direction, the method comprising:

receiving an input from a user; and

supplying, based in part on the input from the user, a plurality of pulsed drive currents to the plurality of strings in a non-spatially-sequential firing order, wherein the firing order and luminous intensity of each of the strings are synchronized with periodic operations of the display.

60. (proposed substitute for Claim 47) ~~The backlight system of claim 58, wherein A method for controlling a plurality of strings of solid state lighting devices configured to extend in a first direction and arranged substantially adjacent to one another, the method comprising supplying a plurality of pulsed drive currents to a plurality of groups of the plurality of strings~~ each drive current supplied to the plurality of strings comprises an independently determined PWM signal.

61. (proposed substitute for Claim 48) The method of claim ~~47~~59, further comprising receiving a user input,

Wherein supplying the ~~plurality of pulsed~~ drive currents is based on the user input, wherein each drive current comprises an independently determined PWM signal.

IV. The Elements Newly Introduced in the Substitute Claims Were Each Well Known in the Art Prior to the '710 Patent

9. In my prior declaration I broke down the elements of claims 1, 2, 5, 11-13, 16-17, and 47-48 of the '710 Patent and demonstrated that each of the elements was known in the art before the May 8, 2007, priority date of the '710 Patent. In the analysis below I address the newly introduced elements of Substitute Claims 58–61 and demonstrate that each was also known in the art before the May 8, 2007, priority date of the '710 Patent.

A. The Use of Lighting Systems as Backlighting Systems for LCDs Was Well Known in the Art Prior to the '710 Patent

10. I understand that Patent Owner, in Substitute Claim 58, proposes amending claim 1 of the '710 Patent to recite that the “lighting system” of claim 1 instead recite a “backlight system for an LCD display.” I also understand that Patent Owner, in Substitute Claim 59, proposes amending claim 17 of the '710 Patent to recite that the claimed lighting method be applied “in a backlight system for an LCD display.” The use of lighting systems as backlights for LCDs, however, was well known prior to the May 8, 2007, priority date of the '710 Patent.

11. As a fundamental matter, I note that the '710 Patent itself acknowledges that use of lighting systems as backlights for LCDs was well known prior to the May 8, 2007, priority date of the '710 Patent. In the “Background” section of the '710 Patent, the patent states: “Solid state lighting panels are commonly used as

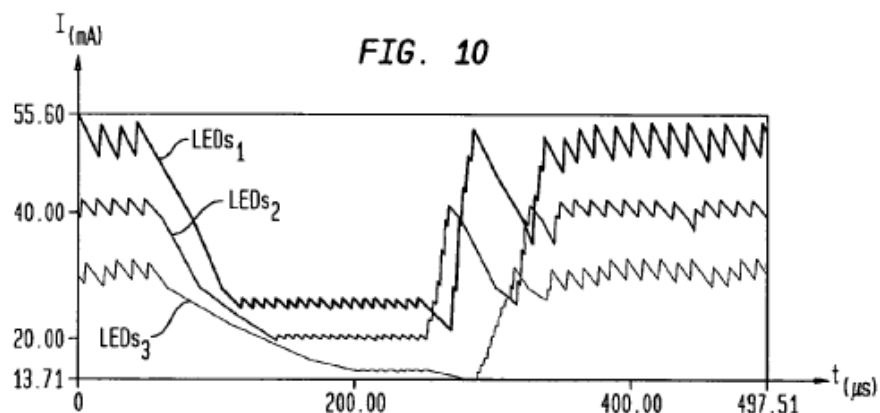
backlights for small LCD display screens, such as LCD display screens used in portable electronic devices. In addition, there has been increased interest in the use of solid state lighting arrays for backlights of larger displays, such as LCD television displays.” ’710 Patent, 1:32–37.

12. Additionally, the prior art references I discussed in my prior declaration teach the use of their lighting systems/methods, respectively, as backlights for LCDs. For example, Arai teaches that its “backlight unit 3” can be used in a “liquid crystal panel unit 2” to deliver display light to a “liquid crystal panel 1.” Arai, [0024], [0027]. Zhang teaches that its illumination method with respect to “backlight modules” may be “applied to liquid crystal displays (LCD).” Zhang, 1:6-8, 5:2-5. The invention of Kawabata “relates to a lighting unit for use as a backlight in a liquid crystal display device.” Kawabata, [0002]. Lee discloses an improved LED light source for use as a “backlight unit for a liquid crystal display (LCD).” Lee, [0003]. Kobori teaches that its invention relates to “techniques and equipment to perform image formation by applying a light flux from a light source to a ... liquid crystal panel.” Kobori, [0002]. And Shteynberg states that one of the many “functional purposes” of its LED display system is “backlighting.” Shteynberg, [0079]. A person of ordinary skill in the art would have understood that one instance or application of such “backlighting,” as described in Shteynberg, was with respect to an LCD.

B. The Use of Individually Determined Currents for a Plurality of Light Sources Was Well Known in the Art Prior to the '710 Patent

13. I understand that Patent Owner, in Substitute Claim 58, proposes amending claim 1 of the '710 Patent to recite that the “on-state drive current” supplied to each of the plurality of strings “is individually determined for each string.” The use of individually determined drive currents for a plurality of lighting sources, such as LEDs, however, was well known prior to the May 8, 2007, priority date of the '710 Patent.

14. Shteynberg discloses a “LED array driver circuit 100” that selectively supplies on-state drive currents to LED “strings” 110₁, 110₂, 110₃, through 110_N in Shteynberg’s lighting system. Shteynberg, [0043], [0044], [0047], [0048], [0051]. Shteynberg expressly teaches that each string of LEDs 110₁, 110₂, 110₃, through 110_N is “provided with a selected and independent current level.” Shteynberg, [0054]. The independent and varied nature of such current levels across Shteynberg’s LED strings is illustrated in Figure 10 of Shteynberg, for example:



Shteynberg, Fig. 10, [0037], [0104]. A person of ordinary skill in the art thus would have understood that the drive currents supplied to each string of LEDs in Shteynberg's lighting system were individually determined for each string.

15. Additionally, Kawabata discloses a "lighting unit 100" that "includes a lighting controller 30 that is made up of a plurality of control circuits 3 connected to the respective light-emitting elements 2." Kawabata, [0061]. Kawabata teaches that "lighting controller 30 controls the emission states of the light-emitting elements 2 independently by supplying drive signals (e.g., currents []) of substantially different types to the respective light-emitting elements 2." Kawabata, [0061]. A person of ordinary skill in the art thus would have understood that the drive currents supplied to light-emitting elements in Kawabata were individually determined for each light-emitting element.

C. The Use of Pulse Width Modulation (PWM) Signals to Control Current Drive to Light Sources Was Well Known in the Art Prior to the '710 Patent

16. I understand that Patent Owner, in Substitute Claim 60, proposes amending claim 47 of the '710 Patent to recite that the "each drive current supplied to the plurality of strings comprises an independently determined PWM signal." I also understand that Patent Owner, in Substitute Claim 61, proposes amending claim 48 of the '710 Patent to recite that "each drive current comprises an independently determined PWM signal." The use of PWM signals in supplying drive currents to a

plurality of lighting sources, such as LEDs, however, was well known prior to the May 8, 2007, priority date of the '710 Patent.

17. As a fundamental matter, I note that the '710 Patent itself acknowledges that the use of PWM signals in supplying drive currents to a plurality of lighting sources was well known prior to the May 8, 2007, priority date of the '710 Patent. In the "Background" section of the '710 Patent, the patent states: "One common method for controlling the current driven through the solid state lamps to achieve desired intensity and color mixing is a Pulse Width Modulation (PWM) scheme. PWM schemes pulse the solid state lamps alternately to a full current 'ON' state followed by a zero current 'OFF' state." '710 Patent, 2:11-15. And, when later describing an embodiment of the purported invention of the '710 Patent, the patent states that "[o]ne common method for controlling the current driven through the strings is a Pulse Width Modulation (PWM) scheme." '710 Patent, 10:44-46.

18. Additionally, the prior art references I discussed in my prior declaration teach the use of PWM signals in supplying drive currents to a plurality of lighting sources. For example, Shteynberg discloses that it is well known in the prior art that "pulse-width modulated ('PWM') signals" may be used "[f]or driving an array of LEDs" in a lighting system. Shteynberg, [0003]. Shteynberg states: "Multistring LED Drivers with PWM regulation are known." Shteynberg, [0004]. Shteynberg illustrates such a system in its Figure 1, wherein a "LED light source 15" is

controlled by a “PWM 20 driving scheme.” Shteynberg, [0004]. In particular, “[t]he color control system is implemented in a DSP controller 25 [], which supplies the PWM turn-on and turn off signals for the power supply.” Shteynberg, [0004]. Shteynberg also discloses that it is well known to control LED strings in an LED array “by a [] current regulator with a processor ... using pulse-width modulated signals.” Shteynberg, [0008]. A person of ordinary skill in the art thus would have understood that the drive currents supplied to each string of LEDs in Shteynberg may comprise PWM signals.

19. Additionally, Kobori discloses a lighting system wherein a “lamp driver 3” generates different “drive signal waveforms 3a to 3d for each of the LEDs 4-7.” Kobori, [0027], [0029], Figs. 1, 3. Kobori discloses that “the drive current amount is indicated by an amplitude value AMP and the drive/stop interval is indicated by the drive cycle PWM.” Kobori, [0027], [0029]. A person of ordinary skill in the art thus would have understood that the drive signals supplied to each LED in Kobori may comprise PWM signals.

D. Controlling the Luminous Intensities of a Plurality of Light Sources Was Well Known in the Art Prior to the ’710 Patent

20. I understand that Patent Owner, in Substitute Claim 58, proposes amending claim 1 of the ’710 Patent to recite that the “control system” is further operable to “determine a luminous intensity of each of the strings in the plurality of strings.” I also understand that Patent Owner, in Substitute Claim 59, proposes

amending claim 17 of the '710 Patent to recite a “luminous intensity” of each of the plurality of strings. The use and control of a luminous intensity of a plurality of light sources, such as LEDs, however, was well known prior to the May 8, 2007, priority date of the '710 Patent.

21. As a fundamental matter, I note that the '710 Patent itself acknowledges that the use and control of a luminous intensity of a plurality of light sources, such as LEDs, was well known prior to the May 8, 2007, priority date of the '710 Patent, including as related to the amount of current driven through each light source, respectively. In the “Background” section of the '710 Patent, the patent states: “Solid state lamps, such as LED’s, are current-controlled devices in the sense that the intensity of the light emitted from an LED is related to the amount of current driven through the LED.” '710 Patent, 2:8-11. Indeed, a person of ordinary skill in the art would have understood, as of the May 8, 2007, priority date of the '710 Patent, that LEDs are commonly referred to as “current-controlled devices” in the art because the intensity of light emitted from an LED is directly proportional to the current flowing through the LED (rather than the voltage applied across it).

22. Additionally, the prior art references I discussed in my prior declaration teach controlling the luminous intensity of a group solid state lighting devices, such as LEDs. For example, Shteynberg, while discussing prior art, discloses that it is well known to control LED strings in an LED array “by a [] current regulator with a

processor, to alter the brightness and/or color of the generated light using pulse-width modulated signals.” Shteynberg, [0008]. A person of skill in the art would understand that the “brightness ... of generated light” referenced in Shteynberg is another term for the “luminous intensity” recited in the Substitute Claims.

23. Shteynberg also discloses that its own invention “provide[s] a multistring LED driver which controls current independently for each series of LEDs of the array, for corresponding effective color and brightness control.” Shteynberg, [0011]. And, once again, a person of skill in the art would understand that the “brightness” referenced in Shteynberg is another term for the “luminous intensity” recited in the Substitute Claims. In particular, Shteynberg discloses that its “controller 125” sets a “duty cycle” for the time-division modulation control of the LED array driver circuit 100. Shteynberg, [0080]; Shteynberg, [0019] (“[T]he controller may be further adapted ... to adjust an output brightness of the plurality of series of light-emitting diodes by modifying each corresponding period of time of current switching to each of the series of light-emitting diode.”). A person of skill in the art would have understood that such control of the “duty cycle” for the current supplied to each LED string in Shteynberg has corresponding control of the “brightness” (or “luminous intensity”) of each LED string in Shteynberg. Indeed, similar to Shteynberg, the ’710 Patent discloses that, in its purported invention, the

“brightness” of light emitted by each string is controlled by the “duty cycle of current supplied to each string.” ’710 Patent, 9:33-36.

24. Additionally, Kawabata discloses that, in its “lighting unit 100” wherein “lighting controller 30 controls the emission states of the light-emitting elements 2 independently by supplying drive signals (e.g., currents or voltages) of substantially different types to the respective light-emitting elements 2,” “the emission intensities of the light-emitting elements are also controllable by getting the magnitudes of the currents or voltages, supplied or applied to the light-emitting elements, (i.e., the maximum signal intensities of their drive signals) adjusted by the lighting controller.” Kawabata, [0061], [0097]. A person of ordinary skill in the art thus would have understood that Kawabata’s lighting controller 30 control the luminous intensity of the light-emitting elements 2 in Kawabata’s lighting unit.

E. The Synchronization of a Firing Order and Luminous Intensities of a Plurality of Light Sources With Respect to a Display Operation Was Well Known in the Art Prior to the ’710 Patent

25. I understand that Patent Owner, in Substitute Claim 58, proposes amending claim 1 of the ’710 Patent to recite that “the firing order of the plurality of strings and the luminous intensity of each of the strings in the plurality of strings are synchronized with periodic operations of the display.” I also understand that Patent Owner, in Substitute Claim 59, proposes amending claim 17 of the ’710 Patent to recite that “the firing order and luminous intensity of each of the strings

are synchronized with periodic operations of the display.” The synchronization of a firing order and luminous intensities of a plurality of light sources with respect to a display operation, however, was well known prior to the May 8, 2007, priority date of the ’710 Patent.

26. Kawabata discloses a “lighting unit 100,” wherein a “lighting controller 30 that is made up of a plurality of control circuits 3” controls emission states of “light-emitting elements 2 independently by supplying drive signals (e.g., currents []) of substantially different types to the respective light-emitting elements 2.” Kawabata, [0061]. When the lighting unit 100 is used in connection with a “liquid crystal panel 300,” Kawabata discloses that its “light-emitting regions 4” (which correspond to light-emitting elements 2) may be arranged in a “vertical scanning direction” of the liquid crystal panel 300, such that “as the pixels of the liquid crystal panel 300 are sequentially rewritten in the vertical scanning direction [], light can be emitted from one of the light-emitting regions 4 of the lighting unit 100 after another.” Kawabata, [0060], [0066].

27. Kawabata specifically teaches “the lighting controller 30 is so constructed as to sequentially turn ON and OFF the respective light-emitting elements 2 synchronously with the input of the vertical sync signal to the liquid crystal panel 300.” Kawabata, [0069]. To this end, Kawabata discloses “[a] drive signal (i.e., ... a current signal) to be supplied to each of the light-emitting elements

is a periodic signal, of which one period is as long as one vertical scanning period of the liquid crystal panel 300.” Kawabata, [0069]. A person of ordinary skill in the art would thus have understood that this means the firing rate of light-emitting elements 2 in this embodiment of Kawabata is synchronized with (e.g., the same as) the refresh rate of the liquid crystal panel 300 in this embodiment of Kawabata. Specifically, a person of ordinary skill in the art would have understood that “vertical scanning period of the liquid crystal panel 300” described in Kawabata is the inverse of a “vertical scanning frequency,” which is also referred to as “refresh rate” in the art.

28. Additionally, Kobori discloses a lighting system wherein a “lamp driver 3” generates different “drive signal waveforms 3a to 3d for each of the LEDs 4-7.” Kobori, [0027], [0029], Figs. 1, 3. In particular, “the lamp driver 3 generates the drive signal waveforms 3a to 3d for each of the LEDs 4-7 so as to turn ON and OFF the LEDs 4 to 7.” Kobori, [0029]. Kobori discloses “the luminiferous level of the LED which is ON is determined by the drive power.” Kobori, [0029]. In an embodiment wherein Kobori’s lighting system is applied to a “display system having an image display panel,” Kobori discloses that the display panel receives light generated by the LEDs 4-7 in accordance with a “video display signal.” Kobori, [0040]–[0041]. In such an embodiment, Kobori discloses that “the luminiferous level of the LED is corrected/controlled” “in synchronization with the image refresh cycle of the input video signal”—“thereby realizing luminiferous level control

linking with the video signal.” Kobori, [0043]. A person of ordinary skill in the art would have understood that this means the luminous intensity of the LEDs in this embodiment of Kobori is controlled in synchronization with the refresh rate of the display panel in this embodiment of Kobori.

V. The Substitute Claims Are Not Patentable Over the Prior Art

A. The Substitute Claims Are Obvious Under § 103 Over the Combination of Shteynberg, Arai, Kawabata, and Kobori

29. In my prior declaration I demonstrated that a person of ordinary skill in the art would have recognized that each element of claims 1-2, 5, 12, and 16-17 of the '710 Patent, as well each overall claim, was obvious in view of the combination of Shteynberg, Arai, and Kawabata in view of the knowledge of a person of ordinary skill in the art. In my opinion, each of Substitute Claims 58-61 is obvious in view of the same combination in further view of Kobori. In particular, as I discussed above and further below, a person of ordinary skill in the art would have recognized that each new element introduced into Substitute Claims 58-61 by the Patent Owner was disclosed in Shteynberg, Kawabata, and/or Kobori, and a person of ordinary skill in the art would have been motivated to modify the Shteynberg lighting system (or Shteynberg-Arai system) in view of Kawabata and/or Kobori to arrive at the amended purported inventions claimed in Substitute Claims 58-61.

1. Substitute Claim 58

30. I understand that, in Substitute Claim 58, Patent Owner first proposes amending claim 1 of the '710 Patent to recite that the “lighting system” of claim 1 instead recite a “backlight system for an LCD display.” A person of ordinary skill in the art would have recognized that this newly added element was obvious in view of, if not disclosed in, Shteynberg.

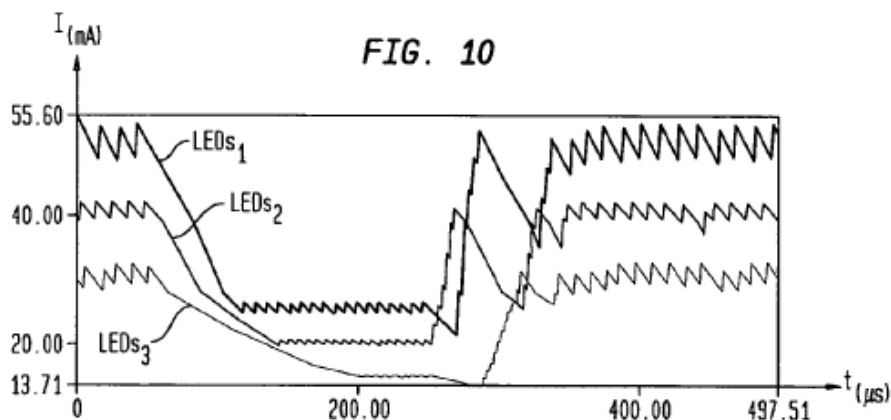
31. As I discussed above, Shteynberg discloses a “lighting system” and expressly states that one of the many “functional purposes” of its lighting system is “backlighting.” Shteynberg, [0021], [0079]. A person of ordinary skill in the art would have understood that one instance or application of such “backlighting,” as described in Shteynberg, was with respect to an LCD. Indeed, the '710 Patent acknowledges that solid state lighting panels, like that described in Shteynberg, “are commonly used as backlights for [] LCD display screens.” '710 Patent, 1:32–37. And Arai, Kawabata, and Kobori teach the use of lighting units as backlights for LCDs, as I discussed above. Arai, [0024], [0027]; Kawabata, [0002]; Kobori, [0002].

32. Thus, in my opinion, a person of ordinary skill in the art would have understood that Shteynberg discloses, or, at minimum, renders obvious, a “backlight system for an LCD display.”

33. I understand that, in Substitute Claim 58, Patent Owner next proposes amending claim 1 of the '710 Patent to recite that the “on-state drive current”

supplied to each of the plurality of strings “is individually determined for each string.” A person of ordinary skill in the art would have recognized that this newly added element was obvious in view of, if not disclosed in, Shteynberg.

34. As I discussed above, Shteynberg is generally directed to “a multistring LED driver which controls current independently for each series of LEDs of [an] array.” Shteynberg, [0011]. In particular, Shteynberg discloses a “LED array driver circuit 100” that selectively supplies each string of LEDs 110₁, 110₂, 110₃, through 110_N in Shteynberg’s lighting system “with a selected and independent current level.” Shteynberg, [0054]. Shteynberg illustrates the independent and varied nature of such current levels across Shteynberg’s LED strings (and over time) in Figure 10 of Shteynberg, for example:



Shteynberg, Fig. 10, [0037], [0104]. A person of ordinary skill in the art thus would have understood that the drive currents supplied to each string of LEDs in Shteynberg’s lighting system were “individually determined for each string.”

35. Additionally, as I discussed above, Kawabata teaches that its “lighting controller 30” controls the emissions states of the “light-emitting elements 2” in Kawabata’s “lighting unit 100” “independently by supplying drive signals (e.g., currents []) of substantially different types to the respective light-emitting elements 2.” Kawabata, [0061]. And Kawabata discloses that, as a direct result of such a technique, “the lighting unit as a whole can emit light having a uniform luminance without causing the unwanted variation in luminance.” Kawabata, [0025]. In my opinion, a person of ordinary skill in the art would have been motivated to apply Kawabata’s technique to Shteynberg’s lighting system to achieve improved uniform luminance in Shteynberg’s lighting system. And it was well within the technical ability of a person of ordinary skill in the art at the time to incorporate such a technique, as Shteynberg itself describes and contemplates.

36. Thus, in my opinion, a person of ordinary skill in the art would have understood that Shteynberg, whether alone or in combination with Kawabata, discloses, or, at minimum, renders obvious, “wherein the on-state drive current is individually determined for each string.”

37. I understand that, in Substitute Claim 58, Patent Owner next proposes amending claim 1 of the ’710 Patent to recite that the “control system” is further operable to “determine a luminous intensity of each of the strings in the plurality of

strings.” A person of ordinary skill in the art would have recognized that this newly added element was obvious in view of, if not disclosed in, Shteynberg.

38. As discussed I above, a person of ordinary skill in the art would have generally understood that controlling the current supplied to an LED will necessarily also control the luminous intensity of the LED. Indeed, in the “Background” section of the ’710 Patent, the patent states: “Solid state lamps, such as LED’s, are current-controlled devices in the sense that the intensity of the light emitted from an LED is related to the amount of current driven through the LED.” ’710 Patent, 2:8-11.

39. Relatedly, Shteynberg discloses that it is well known to control LED strings in an LED array “by a [] current regulator with a processor, to alter the brightness and/or color of the generated light using pulse-width modulated signals.” Shteynberg, [0008]. A person of skill in the art would understand that the “brightness ... of generated light” referenced in Shteynberg is another term for the “luminous intensity” recited in the Substitute Claim 58.

40. And Shteynberg also discloses that its own invention “provide[s] a multistring LED driver which controls current independently for each series of LEDs of the array, for ... brightness control.” Shteynberg, [0011]. In particular, Shteynberg discloses that its “controller 125” sets a “duty cycle” for the time-division modulation control of the LED array driver circuit 100. Shteynberg, [0080]. A person of skill in the art would have understood that such control of the “duty cycle”

for the current supplied to each LED string in Shteynberg has corresponding control of the “brightness” (or “luminous intensity”) of each LED string in Shteynberg. Indeed, I note that, similar to Shteynberg, the ’710 Patent discloses that, in its purported invention, the “brightness” of light emitted by each string is controlled by “duty cycle of current supplied to each string.” ’710 Patent, 9:33-36.

41. Thus, in my opinion, a person of ordinary skill in the art would have understood that Shteynberg discloses, or, at minimum, renders obvious, a “control system” operable to “determine a luminous intensity of each of the strings in the plurality of strings.”

42. Finally, I understand that, in Substitute Claim 58, Patent Owner next proposes amending claim 1 of the ’710 Patent to recite that “the control system is configured to receive a synchronizing signal from a display controller configured to a display and wherein the firing order of the plurality of strings and the luminous intensity of each of the strings in the plurality of strings are synchronized with periodic operations of the display.” A person of ordinary skill in the art would have recognized that this newly added element was obvious in view of Shteynberg and Kawabata and Kobori.

43. As I discussed above, Kawabata discloses an LCD embodiment of its invention, wherein the “drive signal” (*i.e.*, “current signal”) supplied to Kawabata’s light-emitting elements 2 is “a periodic signal, of which one period is as long as one

vertical scanning period of the liquid crystal panel 300.” Kawabata, [0069]. Therewith, Kawabata discloses that its controller 30 “turn[s] ON and OFF the respective light-emitting elements 2 synchronously with the input of [a] vertical sync signal to the liquid crystal panel 300.” Kawabata, [0069]. And as such, “each light-emitting element 2 should start to emit light synchronously with the input of a video signal to a predetermined display area of the liquid crystal panel 300.” Kawabata, [0070]. As I discussed above, a person of ordinary skill in the art would thus have understood that the firing rate of light-emitting elements 2 is synchronized with the refresh rate of the liquid crystal panel 300. And in order to achieve this synchronization, a person of ordinary skill in the art would have understood that Kawabata’s controller 30 necessarily receives some type of signal that is synchronized with the “vertical sync signal.”

44. Additionally, as I discussed above, Kobori discloses a lighting system wherein a display panel receives light generated by the LEDs driven by a “luminiferous control circuit 1” in accordance with a “video display signal.” Kobori, [0040]–[0041]. In particular, Kobori discloses that an “image processor 13” receives a “input video signal” and thereby controls both “display panel 14” as well as “the luminiferous level received by the luminiferous control circuit 1 in a linking relation with the brightness and color components of the input video signal.” Kobori, [0042], Fig. 4. As a result, Kobori discloses that “the luminiferous level of the LED is

corrected/controlled” “in synchronization with the image refresh cycle of the input video signal.” Kobori, [0043]. To achieve this “synchronization,” a person of ordinary skill in the art would have understood that the luminiferous control circuit 1 receives a synchronization signal from the image processor 13. For example, in one implementation, the synchronization signal may be included in the “input video signal” received by the image processor 13 and relayed to the luminiferous level controller 1.

45. In my opinion, a person of ordinary skill in the art would have been motivated to modify the Shteynberg lighting system to synchronize the firing rate and luminiferous level of the LED strings in Shteynberg’s lighting system with the periodic refresh rate or cycle of the liquid crystal panel in Shteynberg’s lighting system, as described in Kawabata and Kobori, collectively, when Shteynberg’s lighting system is used for its “backlighting” purpose. Shteynberg, [0079].

46. As I discussed above, each of Shteynberg, Kawabata, and Kobori are directed to use of lighting sources as backlights to a liquid crystal display panel. Shteynberg, [0079]; Kawabata, [0002]; Kobori, [0002]. And to that end, Kawabata teaches that its disclosed synchronization results in “a lighting unit causing substantially no luminance variation.” Kawabata, [0074]. And Kobori similarly teaches that its disclosed synchronization similarly eliminates any “uncomfortable feeling” in viewing the display. Kobori, [0043]. Notably, a person of ordinary skill

in the art would have understood that this “uncomfortable feeling” sought to be avoided in Kobori (and Kawabata) is the same “unwanted effects due to the interference of non-synchronized processes” that the ’710 Patent sought to solve via its described synchronization of the “firing” rate of a backlight panel with the “refresh rate” of an LCD. ’710 Patent, 15:44-50.

47. In my opinion, a person of ordinary skill in the art would have been motivated to modify the display system in Shteynberg to introduce the synchronization described and taught in each of Kawabata and Kobori to alleviate any “uncomfortable feeling” caused by the various drive currents delivered to LED “strings” 110₁, 110₂, 110₃, through 110_N in Shteynberg’s lighting system in any “backlighting” implementation of Shteynberg’s lighting system. In my opinion, it was well within the technical ability of a person of ordinary skill in the art at the time to incorporate the synchronization techniques described and taught in each of Kawabata and Kobori, including in view of those references’ disclosures. And, relatedly, a person of ordinary skill in the art would have had a reasonable expectation of success in implementing such synchronization techniques in Shteynberg’s lighting system, including in view of Kawabata’s and Kobori’s teachings.

48. Thus, in my opinion, a person of ordinary skill in the art would have understood that Shteynberg in combination with Kawabata and Kobori discloses, or,

at minimum, renders obvious, “the control system is configured to receive a synchronizing signal from a display controller configured to a display and wherein the firing order of the plurality of strings and the luminous intensity of each of the strings in the plurality of strings are synchronized with periodic operations of the display.”

2. Substitute Claim 59

49. I understand that, in Substitute Claim 59, Patent Owner first proposes amending claim 17 of the '710 Patent to recite that the “method for controlling a plurality of strings of solid state lighting devices” of claim 17 be implemented “in a backlight system for an LCD display.” A person of ordinary skill in the art would have recognized that this newly added element was obvious in view of, if not disclosed in, Shteynberg for the reasons I discuss above with respect to Patent Owner’s similar amendment to Substitute Claim 58.

50. I understand that, in Substitute Claim 59, Patent Owner first proposes amending claim 17 of the '710 Patent to recite that the “method for controlling a plurality of strings of solid state lighting devices” of claim 17 further requires “wherein the firing order and luminous intensity of each of the strings are synchronized with periodic operations of the display.” A person of ordinary skill in the art would have recognized that this newly added element was obvious in view of

Shteynberg and Kawabata and Kobori for the reasons I discuss above with respect to Patent Owner's similar amendment to Substitute Claim 58.

3. Substitute Claim 60

51. I understand that, in Substitute Claim 60, Patent Owner proposes amending claim 47 of the '710 Patent to recite that "each drive current supplied to the plurality of strings" in the "backlight system" of Substitute Claim 58 "comprises an independently determined PWM signal." A person of ordinary skill in the art would have recognized that this newly added element was obvious in view of, if not disclosed in, Shteynberg.

52. As I discussed above, Shteynberg discloses a "LED array driver circuit 100" that selectively supplies each string of LEDs 110₁, 110₂, 110₃, through 110_N in Shteynberg's lighting system "with a selected and independent current level." Shteynberg, [0054], [0011]. And Shteynberg further discloses that it is well known that "pulse-width modulated ('PWM') signals" may be used "[f]or driving an array of LEDs" in a lighting system such as Shteynberg's lighting system. Shteynberg, [0003], [0004]. Shteynberg specifically discloses that it is well known to control LED strings in an LED array "by a [] current regulator with a processor ... using pulse-width modulated signals." Shteynberg, [0008]. Thus, in my opinion, person of ordinary skill in the art thus would have understood that the independent drive currents supplied to each string of LEDs in Shteynberg's lighting system may

comprise PWM signals. Indeed, and as I noted above, the '710 Patent acknowledges that the use of “a Pulse Width Modulation (PWM) scheme” was a “common method for controlling the current driven through the solid state lamps” well before the purported invention of the '710 Patent. '710 Patent, 2:11-15, 10:44-46.

53. Thus, in my opinion, a person of ordinary skill in the art would have understood that Shteynberg discloses, or, at minimum, renders obvious, “each drive current supplied to the plurality of strings comprises an independently determined PWM signal.”

4. Substitute Claim 61

54. I understand that, in Substitute Claim 61, Patent Owner proposes amending claim 48 of the '710 Patent to recite that the “method for controlling a plurality of strings of solid state lighting devices” of Substitute Claim 59 further comprise “wherein each drive current comprises an independently determined PWM signal.” A person of ordinary skill in the art would have recognized that this newly added element was obvious in view of, if not disclosed in, Shteynberg for the reasons I discuss above with respect to Patent Owner’s similar amendment to Substitute Claim 60.

I hereby declare that statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. Should further information become available to me as this matter proceeds, I may revise my opinions accordingly as necessary. I declare under penalty of perjury that the foregoing Declaration is true and correct.

October 17, 2024

Date



Rafael J. Betancourt