UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.
Petitioner

v.

LYNK LABS, INC.
Patent Owner

Patent No. 10,687,400

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,687,400

TABLE OF CONTENTS

LIST OF EXHIBITS

Ex. 1001	U.S. Patent No. 10,687,400
Ex. 1002	Declaration of R. Jacob Baker, Ph.D., P.E.
Ex. 1003	Curriculum Vitae of R. Jacob Baker, Ph.D., P.E.
Ex. 1004	Prosecution History of U.S. Patent No. 10,687,400
Ex. 1005	U.S. Patent Application Publication No. 2003/0137258 ("*Piepgras*")
Ex. 1006	U.S. Patent Application Publication No. 2003/0085870 ("*Hinckley*")
Ex. 1007	U.S. Patent Application Publication No. 2002/0158590 ("*Saito*")
Ex. 1008	U.S. Patent No. 4,656,398 ("*Michael*")
Ex. 1009	U.S. Patent Application Publication No. 2003/0144034 ("*Hack*")
Ex. 1010	U.S. Patent No. 7,180,265 ("*Naskali*")
Ex. 1011	U.S. Patent Application Publication No. 2003/0015968 ("*Allen*")
Ex. 1012	U.S. Patent Application Publication No. 2002/0021573 ("*Zhang*")
Ex. 1013	U.S. Reissued Patent No. RE42,161 ("*Hochstein-Re*")
Ex. 1014	Australian Patent Application Publication No. AU 2003/100206 ("*Birrell*")
Ex. 1015	U.S. Patent Application Publication No. 2004/0206970 ("*Martin*")
Ex. 1016	International Application Publication No. WO 01/01385 ("*Reymond*")
Ex. 1017	U.S. Patent No. 5,663,719 ("*Deese*")
Ex. 1018	U.S. Patent No. 5,982,103 ("*Mosebrook*")
Ex. 1019	U.S. Patent No. 6,856,103 ("*Hudson*")
Ex. 1020	U.S. Patent No. 6,510,995 ("*Muthu*")

Ex. 1021	U.S. Patent Application Publication No. 2002/0191029 (“*Gillespie*”)
Ex. 1022	U.S. Patent No. 6,636,005 (“*Wacyk*”)
Ex. 1023	U.S. Patent Application Publication No. 2002/0086702 (“*Lai*”)
Ex. 1024	U.S. Patent Application Publication No. 2004/0108997 (“*Lee*”)
Ex. 1025	RESERVED
Ex. 1026	U.S. Patent No. 5,086,294 (“*Kasegi*”)
Ex. 1027	U.S. Patent No. 6,061,259 (“*DeMichele*”)
Ex. 1028	U.S. Patent No. 5,519,263 (“*Santana*”)
Ex. 1029	U.S. Patent No. 4,563,592 (“*Yuhasz*”)
Ex. 1030	Watson, J., Mastering Electronics, Third Ed., McGraw-Hill, Inc. (1990) (“*Watson*”)
Ex. 1031	U.S. Patent No. 5,463,280 (“*Johnson*”)
Ex. 1032	U.S. Patent No. 6,411,045 (“*Nerone*”)
Ex. 1033	U.S. Patent No. 7,202,613 (“*Morgan*”)
Ex. 1034	Sedra *et al.*, Microelectronic Circuits, Fourth Ed., Oxford University Press (1998) (“*Sedra*”)
Ex. 1035	U.S. Patent No. 5,621,225 (“*Shieh*”)
Ex. 1036	U.S. Patent Application Publication No. 2003/0035075 (“*Butler*”)
Ex. 1037	RESERVED
Ex. 1038	U.S. Patent Application Publication No. 2002/0176259 (“*Ducharme*”)
Ex. 1039	U.S. Patent Application Publication No. 2002/0175870 (“*Gleener*”)
Ex. 1040	U.S. Patent Application Publication No. 2002/0060530 (“*Sembhi*”)

Ex. 1041	U.S. Patent Application Publication No. 2003/0020629 ("*Swartz*")
Ex. 1042	U.S. Patent No. 6,300,725 ("*Zinkler*")
Ex. 1043	U.S. Patent No. 7,019,662 ("*Shackle*")
Ex. 1044	U.S. Patent No. 5,267,134 ("*Banayan*")
Ex. 1045	U.S. Patent No. 6,300,748 ("*Miller*")
Ex. 1046	U.S. Patent No. 6,879,497 ("*Hua*")
Ex. 1047	Excerpts from Chamber's Dictionary of Science and Technology, Chambers Harrap Publishers Ltd. (1999)
Ex. 1048	Excerpts from Dictionary of Scientific and Technical Terms, Sixth Ed., McGraw-Hill, Inc. (2003)
Ex. 1049	U.S. Patent No. 6,412,971 ("*Wojnarowski*")
Ex. 1050	U.S. Patent No. 10,750,583 (Application No. 16/449,273)
Ex. 1051	U.S. Patent No. 10,575,376 (Application No. 16/443,759)
Ex. 1052	U.S. Patent No. 10,492,252
Ex. 1053	U.S. Patent No. 10,492,251
Ex. 1054	U.S. Patent No. 10,091,842
Ex. 1055	U.S. Patent No. 9,615,420
Ex. 1056	U.S. Patent No. 9,198,237
Ex. 1057	International Application Publication No. WO 2011/082168 A1 (Application No. PCT/US2010/062235)
Ex. 1058	U.S. Patent No. 8,179,055
Ex. 1059	U.S. Patent No. 8,148,905
Ex. 1060	U.S. Patent No. 7,489,086

Ex. 1061	International Application Publication No. WO 2010/138211 A1 (Application No. PCT/US2010/001597)
Ex. 1062	International Application Publication No. WO 2010/126601 A1 (Application No. PCT/US2010/001269)
Ex. 1063	U.S. Provisional Application No. 61/333,963
Ex. 1064	U.S. Provisional Application No. 61/284,927
Ex. 1065	U.S. Provisional Application No. 61/335,069
Ex. 1066	U.S. Provisional Application No. 60/997,771
Ex. 1067	U.S. Provisional Application No. 60/547,653
Ex. 1068	U.S. Provisional Application No. 60/559,867
Ex. 1069	U.S. Provisional Application No. 61/217,215
Ex. 1070	U.S. Provisional Application No. 61/215,144
Ex. 1071	U.S. Patent Application Publication No. 2005/0001225 ("*Yoshimura*")
Ex. 1072	U.S. Patent No. 6,717,353 ("*Mueller*")
Ex. 1073	U.S. Patent Application Publication No. 2003/0185005 ("*Sommers*")
Ex. 1074	U.S. Patent Application Publication No. 2003/0102810 ("*Cross*")
Ex. 1075	U.S. Patent Application Publication No. 2003/0043611 ("*Bockle*")
Ex. 1076	Case docket in *Samsung Elecs. Co., Ltd.*, *v. Lynk Labs, Inc.* No. 1:21-cv-2665 (N.D. Ill.) (accessed Nov. 5, 2021)
Exs. 1077-1078	RESERVED

Ex. 1079	Estimated Patent Case Schedule for Northern District of Illinois (available at https://www.ilnd.uscourts.gov/_assets/_documents/_forms/_judges/Pacold/Estimated%20Patent%20Schedule.pdf)
Ex. 1080	Lynk Labs, Inc.'s Preliminary Infringement Contentions in *Samsung Elecs. Co., Ltd. v. Lynk Labs, Inc.*, No. 1:21-cv-2665 (N.D. Ill.) (served July 21, 2021)
Ex. 1081	Lynk Labs, Inc.'s Exemplary Infringement Charts for U.S. Patent No. 10,506,400 (App. K-1) accompanying Lynk Labs, Inc.'s Preliminary Infringement Contentions in *Samsung Elecs. Co., Ltd. v. Lynk Labs, Inc.*, No. 1:21-cv-2665 (N.D. Ill.) (served July 21, 2021)
Ex. 1082	Lynk Labs, Inc.'s Answer and Counterclaims (Dkt. #51) in *Samsung Elecs. Co., Ltd.*, *v. Lynk Labs, Inc.*, No. 1:21-cv-2665 (N.D. Ill. Aug. 3, 2021)
Ex. 1083	Lynk Labs, Inc.'s Amended Preliminary Infringement Contentions in *Samsung Elecs. Co., Ltd. v. Lynk Labs, Inc.*, No. 1:21-cv-2665 (N.D. Ill.) (served Aug. 31, 2021)
Ex. 1084	Lynk Labs, Inc.'s Exemplary Infringement Charts for U.S. Patent No. 10,506,400 (App. K-1) accompanying Lynk Labs, Inc.'s Amended Preliminary Infringement Contentions in *Samsung Elecs. Co., Ltd. v. Lynk Labs, Inc.*, No. 1:21-cv-2665 (N.D. Ill.) (served Aug. 31, 2021)
Ex. 1085	Notification of Docket Entry (Dkt. #50) in *Samsung Elecs. Co., Ltd.*, *v. Lynk Labs, Inc.*, No. 1:21-cv-2665 (N.D. Ill. July 27, 2021)
Ex. 1086	Order (Dkt. #57) in *Samsung Elecs. Co., Ltd.*, *v. Lynk Labs, Inc.*, No. 1:21-cv-2665 (N.D. Ill. Aug. 19, 2021)
Ex. 1087	Supplemental Report of Parties' Planning Meeting (Dkt. #72) in *Samsung Elecs. Co., Ltd.*, *v. Lynk Labs, Inc.*, No. 1:21-cv-2665 (N.D. Ill. Oct. 14, 2021)
Ex. 1088	Notification of Docket Entry (Dkt. #73) in *Samsung Elecs. Co., Ltd.*, *v. Lynk Labs, Inc.*, No. 1:21-cv-2665 (N.D. Ill. Oct. 18, 2021)

Ex. 1089	Williams, T., The Circuit Designer's Companion, First Ed., Butterworth-Heinemann Ltd. (1991) ("*Williams*")
Ex. 1090	U.S. Patent Application Publication No. 2005/0128751 ("*Roberge*")
Ex. 1091	U.S. Patent Application Publication No. 2002/0195968 ("*Sanford*")
Ex. 1092	U.S. Patent Application Publication No. 2003/0122502 ("*Clauberg*")
Ex. 1093	U.S. Patent No. 6,078,148 ("*Hochstein-148*")
Ex. 1094	U.S. Patent No. 6,814,642 ("*Siwinski*")
Ex. 1095	U.S. Patent Application Publication No. 2003/076306 ("*Zadesky*")
Ex. 1096	U.S. Patent Application Publication No. 2003/0231168 ("*Bell*")
Ex. 1097	U.S. Patent No. 6,879,319 ("*Cok*")
Ex. 1098	U.S. Patent No. 4,816,698 ("*Hook*")
Ex. 1099	U.S. Reissue Patent No. RE33285 ("*Kunen*")
Ex. 1100	GB Patent Application Publication No. 2,202,414 ("*Logan*")
Ex. 1101	U.S. Patent No. 7,226,442 ("*Sheppard*")
Ex. 1102	International Application Publication No. WO 2002/023956 ("*Panagotacos*")
Ex. 1103	U.S. Patent No. 6,850,169 ("*Manavi*")
Ex. 1104	U.S. Patent No. 5,739,639 ("*Johnson-639*")

I. INTRODUCTION

Samsung Electronics Co., Ltd. ("Petitioner" or "Samsung") requests *inter partes* review of claims 7-20 ("challenged claims") of U.S. Patent No. 10,687,400 ("the '400 patent") (Ex. 1001) assigned to Lynk Labs, Inc. ("PO"). For the reasons below, the challenged claims should be found unpatentable and canceled.

II. MANDATORY NOTICES

<u>Real Parties-in-Interest</u>: Petitioner identifies the following as the real parties-in-interest: Samsung Electronics Co., Ltd., Samsung Electronics America, Inc.

<u>Related Matters</u>: The '400 patent is at issue in the following matters:

- *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, No. 1-21-cv-02665 (N.D. Ill.) (seeking declaratory judgment of non-infringement as to the '400 patent and also U.S Patent Nos. 10,492,252, 10,499,466, 10,506,674, 10,966,298, 10,492,251, 10,750,583, 10,517,149, 10,154,551, 10,652,979, and 11,019,697) ("Illinois Litigation").

- Petitioner is concurrently filing another IPR petition challenging claims 1-6 and 21-26 of the ’400 patent.[1]

The ’400 patent claims priority to, *inter alia*, two provisional applications (U.S. Provisional Application Nos. 60/547,653 filed February 25, 2004 and 60/559,867 filed April 6, 2004. The following patents claim the same benefit of priority to the ’653 and ’867 applications and have corresponding IPR proceedings:

- U.S. Patent No. 8,531,118 at issue in *Acuity Brands Lighting, Inc., v. Lynk Labs, Inc.*, IPR2016-01133 (terminated);
- U.S. Patent No. 10,506,674 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01299 (pending);
- U.S Patent No. 11,019,697 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01300 (pending);
- U.S Patent No. 10,492,252 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01345 (pending);
- U.S Patent No. 10,499,466 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01346 (pending);

[1] Petitioner concurrently submits a separate paper (consistent with the Trial Practice Guide Update, July 2019), explaining why the filing of multiple petitions should not be a basis for discretionary denial under 35 U.S.C. § 314.

- U.S Patent No. 10,966,298 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01347 (pending);
- U.S Patent No. 10,652,979 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01576 (pending);
- U.S Patent No. 10,154,551 at issue in *Home Depot USA, Inc. v. Lynk Labs, Inc.*, IPR2021-01367 (pending) and *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2021-01575 (pending);
- U.S. Patent No. 10,492,251 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2022-00051 (pending), *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2022-00052 (pending), and *The Home Depot USA, Inc. et al. v. Lynk Labs, Inc.*, IPR2021-01369 (pending);
- U.S Patent No. 10,517,149 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2022-00098 (pending), and *The Home Depot USA, Inc. et al. v. Lynk Labs, Inc.*, IPR2022-00023 (pending);
- U.S. Patent No. 10,750,583 at issue in *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2022-00100 (pending) and *Samsung Electronics Co., Ltd. v. Lynk Labs, Inc.*, IPR2022-00101 (pending).

Counsel and Service Information: Lead counsel: Naveen Modi (Reg. No. 46,224), and Backup counsel are (1) Joseph E. Palys (Reg. No. 46,508), (2) Arvind Jairam (Reg. No. 62,759), (3) Mark Consilvio (Reg. No. 72,065), (4) Howard Herr (*pro hac vice* admission to be requested). Service information is Paul Hastings LLP, 2050 M St., Washington, D.C., 20036, Tel.: 202.551.1700, Fax: 202.551.1705, email: PH-Samsung-LynkLabs-IPR@paulhastings.com. Petitioner consents to electronic service.

III. PAYMENT OF FEES

The PTO is authorized to charge any fees due during this proceeding to Deposit Account No. 50-2613.

IV. GROUNDS FOR STANDING

Petitioner certifies that the '400 patent is available for review and Petitioner is not barred or estopped from requesting review on the grounds identified herein.

V. PRECISE RELIEF REQUESTED AND GROUNDS

Claims 7-20 should be canceled as unpatentable based on the following grounds:

Ground 1: Claims 7, 9, and 11 are unpatentable under pre-AIA 35 U.S.C. § 103(a) as being obvious over *Nerone* (Ex. 1032) and *Martin* (Ex. 1015);

Ground 2: Claim 8 is unpatentable under § 103(a) as being obvious over *Nerone*, *Martin*, and *Morgan* (Ex. 1033);

Ground 3: Claim 10 is unpatentable under § 103(a) as being obvious over *Nerone*, *Martin*, and *Zinkler* (Ex. 1042);

Ground 4: Claim 12 is unpatentable under § 103(a) as being obvious over *Nerone*, *Martin*, and *Michael* (Ex. 1008);

Ground 5: Claim 13 is unpatentable under § 103(a) as being obvious over *Nerone*, *Martin*, *Michael*, and *Gleener* (Ex. 1039);

Ground 6: Claims 7, 9-11, and 17 are unpatentable under § 103(a) as being obvious over *Zhang* (Ex. 1012) and *Martin*;

Ground 7: Claim 8 is unpatentable under § 103(a) as being obvious over *Zhang*, *Martin*, and *Morgan*;

Ground 8: Claim 14 is unpatentable under § 103(a) as being obvious over *Zhang*;

Ground 9: Claim 15 is unpatentable under § 103(a) as being obvious over *Zhang* and *Mosebrook* (Ex. 1018);

Ground 10: Claim 16 is unpatentable under § 103(a) as being obvious over *Zhang*, *Michael*, and *Gleener*;

Ground 11: Claim 18 is unpatentable under § 103(a) as being obvious over *Zhang* and *Morgan*;

Ground 12: Claim 19 is unpatentable under § 103(a) as being obvious over *Zhang* and *Hudson* (Ex. 1019); and

Ground 13: Claim 20 is unpatentable under § 103(a) as being obvious over *Zhang* and *Muthu* (Ex. 1020).

The ’400 patent issued June 16, 2020 from Application No. 16/693,081 filed November 22, 2019, and claims priority via a chain of applications to eight provisional applications. Petitioner does not concede that the priority claim to the foregoing provisional, or any other application in the priority chain, is proper, but for purposes of this proceeding only, assumes the critical date for the ’400 patent is February 25, 2004, the earliest date of the provisional applications.

Nerone issued on June 25, 2002. *Zinkler* issued on October 9, 2001. *Zhang* was published on February 21, 2002. *Michael* issued on April 7, 1987. *Gleener* was published on November 28, 2002. *Mosebrook* issued on November 9, 1999. *Muthu* issued on January 28, 2003. Therefore, these references qualify as prior art under pre-AIA 35 U.S.C. § 102(b).

Hudson issued from a patent application filed September 17, 2003. *Martin* is a publication of a patent application filed April 16, 2003. *Morgan* issued from a patent application filed February 6, 2003. These references therefore qualify as prior art at least under pre-AIA 35 U.S.C. § 102(e).

Although *Martin* was cited in an Information Disclosure Statement (IDS) during prosecution (Ex. 1004, 5), that should not be the basis for discretionary denial, as explained below in §X.B. The other references listed above in the grounds were not considered during prosecution. (*See generally* Ex. 1004.)

VI. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art as of the claimed priority date of the ’400 patent (“POSITA”) would have had at least a bachelor’s degree in electrical engineering, computer engineering, computer science, physics, or the equivalent, and two or more years of experience with LED devices and/or related circuit design, or a related field. (Ex. 1002, ¶¶20-21.)[2] More education can supplement practical experience and vice versa. (*Id.*)

VII. OVERVIEW OF THE ’400 PATENT

While the ’400 patent purports to identify an invention directed to an LED device/system having various features (*e.g.*, Ex. 1001, 4:25-10:67, 13:34-67), the claims are broadly directed to a lighting system/device having a combination of known components and features (*id.*, 27:19-29:4). The ’400 patent was allowed on first action during prosecution (Ex. 1004, 130-136), and the Examiner’s statement of reasons for allowance merely repeated most of the limitations of claim 1 (*compare* Ex. 1004, 135, *with* Ex. 1001, 27:19-35). Yet the features listed by the Examiner, like all of the other generically claimed features, were already known in the prior art. *See In re Gorman*, 933 F.2d 982, 986 (Fed. Cir. 1991) (“The criterion ... is not

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[2] Petitioner submits the declaration of R. Jacob Baker, Ph.D., P.E. (Ex. 1002), an expert in the field of the ’400 patent. (Ex. 1002, ¶¶1-19; Ex. 1003.)

the number of references, but what they would have meant to a person of ordinary skill in the field of the invention."). (*Infra* §IX; Ex. 1002, ¶¶55-57, 59-103; *see also id.*, ¶¶22-54 (citing, *inter alia*, Exs. 1005, 1007, 1012, 1014, 1030, 1033-1034, 1049, 1089-1099); *see generally* Ex. 1004; Exs. 1050-1070.)

VIII. CLAIM CONSTRUCTION

The Board only construes the claims when necessary to resolve the underlying controversy. *Toyota Motor Corp. v. Cellport Systems, Inc.*, IPR2015-00633, Paper No. 11 at 16 (Aug. 14, 2015) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)). For purposes of this proceeding, Petitioner believes that no special constructions are necessary to assess whether the challenged claims are unpatentable over the asserted prior art.[3] (Ex. 1002, ¶58.)

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[3] Petitioner reserves all rights to raise claim construction and other arguments, including challenges under 35 U.S.C. §§ 101 or 112, in district court as relevant to those proceedings. *See*, *e.g.*, *Target Corp. v. Proxicom Wireless, LLC*, IPR2020-00904, Paper 11 at 11–13 (November 10, 2020). A comparison of the claims to any accused products in litigation may raise controversies that are not presented here given the similarities between the references and the patent.

IX. DETAILED EXPLANATION OF GROUNDS[4]

A. Ground 1: Claims 7, 9, and 11 Are Obvious Over *Nerone* and *Martin*

1. Claim 7

a) A lighting system comprising:

To the extent the preamble is limiting, *Nerone* discloses the limitations therein. (Ex. 1002, ¶¶59-62, 104-107.) For instance, *Nerone* discloses a power supply circuit 400 ("lighting system") including an array of light emitting diodes (LEDs), *e.g.*, used in a traffic signal (traffic light). (*Id.*, ¶105.) The lighting system is shown in Figure 4 of *Nerone*:

[4] §IX references exhibits other than the asserted prior art for each ground. Such exhibits in the respective grounds reflect the state of the art known to a POSITA at the time of the alleged invention consistent with the testimony of Dr. Baker.

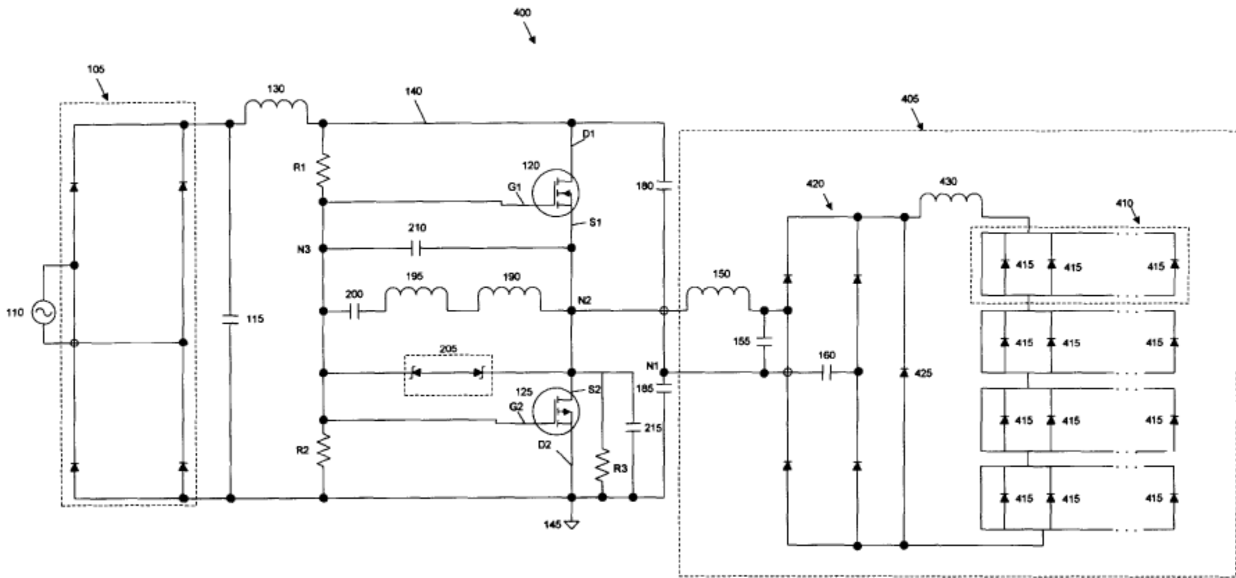

FIG. 4

(Ex. 1032, FIG. 4; *see also id.*, 2:57-59, 5:52-54 ("The power supply circuit 400 is identical to the power supply circuit 100 of FIG. 1, with the exception of the resonant load circuit 405."); Ex. 1002, ¶105.)

Nerone explains that "FIG. 4 depicts [a] power supply circuit 400 for an LED traffic signal," and Figure 4 shows that power supply circuit 400 comprises LEDs 415 that provide the traffic signal's lighting. (Ex. 1032, 5:51-60; *see also id.*, FIG. 4 (above), 1:6-9, 6:9-11; Ex. 1002, ¶106.) A POSITA would have understood that circuit 400 of Figure 4, which includes an LED array used as a traffic light, is a "lighting system" as claimed. (Ex. 1002, ¶107; §IX.A.1(b)-§IX.A.1(g).)

b) an LED circuit array comprising an LED circuit comprising a plurality of LEDs connected in series;

Nerone discloses this limitation. (Ex. 1002, ¶¶108-110.) For instance, *Nerone*'s circuit 400 ("lighting system") comprises an LED circuit array comprising a plurality of LEDs connected in series:

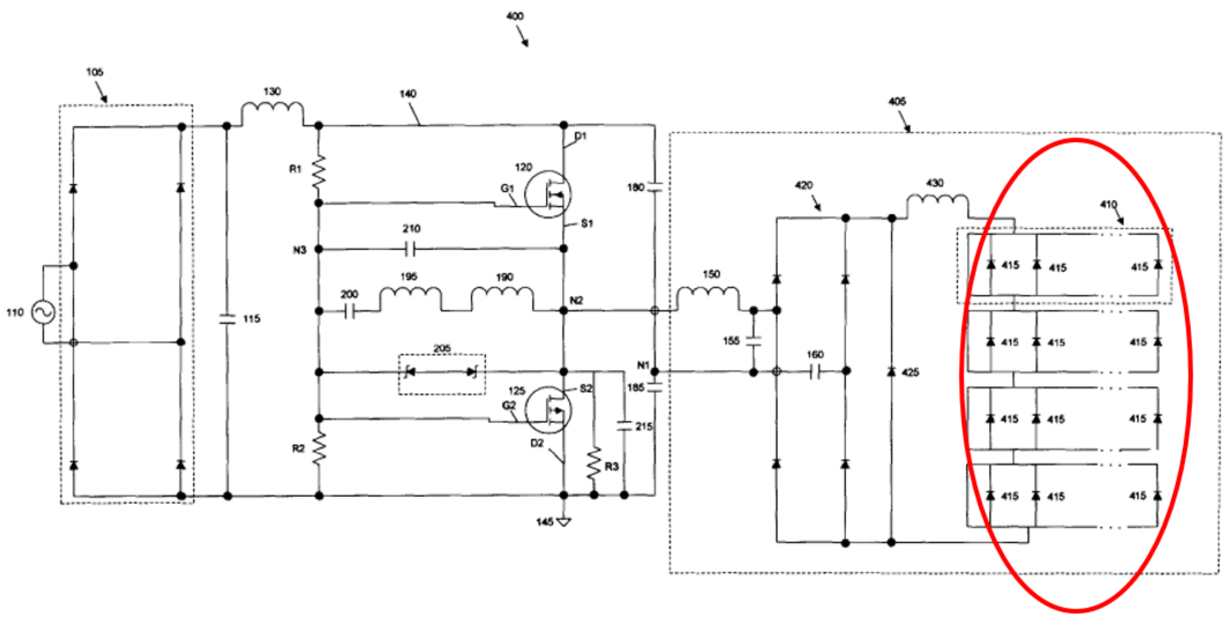

FIG. 4

(Ex. 1032, FIG. 4 (annotated); Ex. 1002, ¶108.)

Nerone discloses that its LED circuit array (red above) comprises an LED circuit (*i.e.*, groups 410) comprising a plurality of LEDs connected in series. (Ex. 1002, ¶109.) For example, *Nerone* discloses that its resonant load circuit 405 shown above in Figure 4 "includes at least one group 410 of LEDs 415 connected in parallel and polarized in the same direction," and "**[t]he groups 410 of the LEDs 415 are**

connected in series." (Ex. 1032, 5:57-60.)[5] The arrangement of LEDs annotated in red above in Figure 4 of *Nerone* is an *LED circuit array*, *e.g.*, because *Nerone* explains that "[t]he present invention provides a more cost efficient electrical circuit for supplying power to an LED array." (Ex. 1032, 2:15-16; Ex. 1002, ¶110.) Similarly, *Nerone* describes in its Abstract a "circuit arrangement for supplying power to an LED array" (Ex. 1032, Abstract), and discloses at its "Brief Summary of the Invention" section a "power supply circuit for an LED array" (*id.*, 2:17-28). (*See also id.*, 6:11-14 ("array of LEDs"); Ex. 1075, ¶[0005]; Ex. 1002, ¶110.)

c) a capacitor;

Nerone discloses this limitation. (Ex. 1002, ¶111.) For instance, as shown below in Figure 4, *Nerone* discloses that circuit 400 ("lighting system") includes capacitors 115, 155, 160, 185, 200, 210, and 215 (red below), any of which is "a capacitor" as claimed in limitation 7(c). (*Id.*)

[5] Emphasis added unless otherwise indicated.

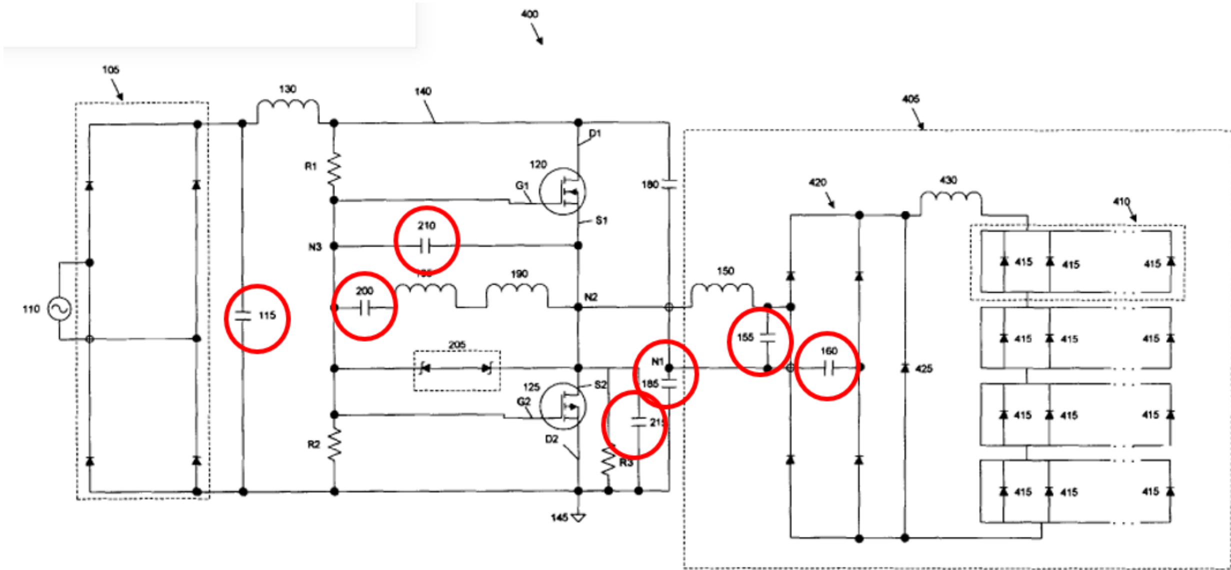

FIG. 4

(Ex. 1032, FIG. 4 (annotated); *see also id.*, Abstract, 2:67-3:4, , 3:15-16, 3:31-33, 4:15-25, 4:27-64, 5:5-9, 5:54-57, 6:1-2, 3:17-30; Ex. 1002, ¶111.)

d) a bridge rectifier configured to receive an input AC voltage from a mains power source;

Nerone in view of the state of the art discloses or suggests this limitation. (Ex. 1002, ¶¶112-115.) For instance, as shown below in Figure 4, *Nerone* discloses that circuit 400 ("lighting system") comprises a bridge rectifier 105 (red below) configured to receive an input AC voltage. (*Id.*, ¶112.)

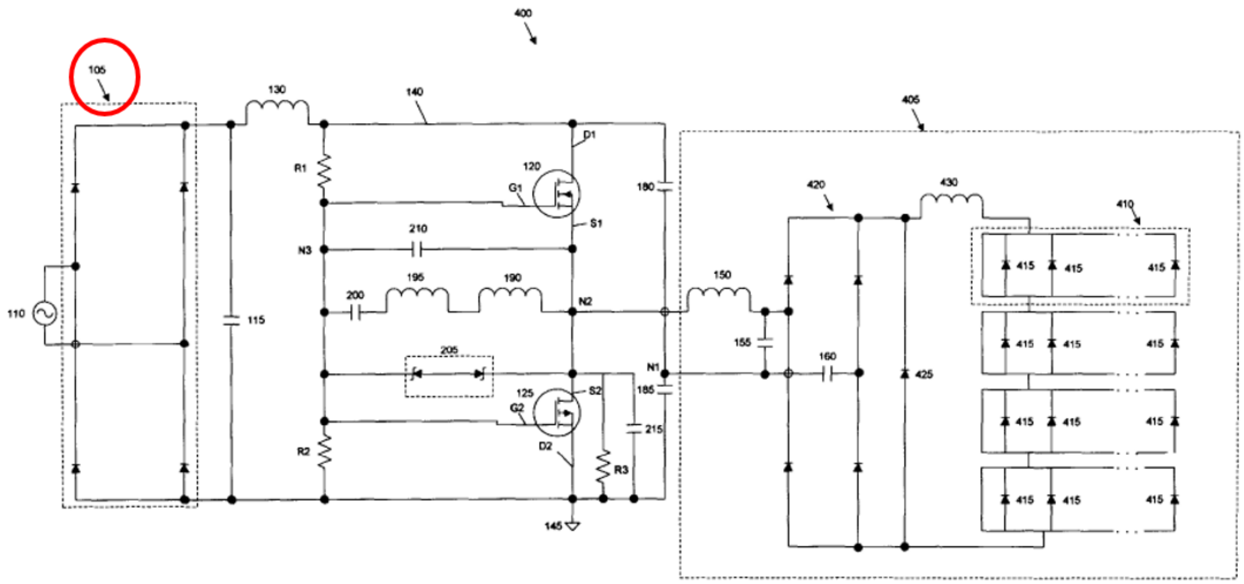

FIG. 4

(Ex. 1032, FIG. 4 (annotated); Ex. 1002, ¶112.)

Nerone describes a "full-way bridge rectifier 105 coupled to an AC source 110" with reference to Figure 1. (Ex. 1032, 2:65-67.) As discussed for limitation 7(a), *Nerone* explains that that its circuit 400 ("lighting system") of Figure 4 "is identical to the power supply circuit 100 of FIG. 1, with the exception of the resonant load circuit 405" (Ex. 1032, 5:52-54), so Figure 4, too, shows bridge rectifier 105, which is configured to receive an input AC voltage from AC source 110. (Ex. 1032, 2:65-67 (disclosing an "AC current" is provided by AC source 110 to bridge rectifier 105); Ex. 1002, ¶113.)

Thus, *Nerone* discloses bridge rectifier 105 configured to receive an input AC voltage from AC source 110. (Ex. 1002, ¶114.) *Nerone* further discloses in its background section that "[i]n the environment of traffic signals, incandescent lamps typically operate with a 120 volt 60 Hz AC power supply" (Ex. 1032, 1:51-56), and a POSITA would have known that an AC voltage of 120 V (*i.e.*, 120 VAC) was commonly available from a *mains* power source. (Ex. 1013, 1:25-29; Ex. 1027, 1:8-12, 1:18-27; Ex. 1045, 1:20; Ex. 1002, ¶114.)[6]

In light of such disclosures in *Nerone* and the state of the art, a POSITA would have been motivated and found obvious to configure *Nerone*'s bridge rectifier 105 to receive its input AC voltage from a *mains* power source. (Ex. 1002, ¶115.) For example, such a configuration would have been a predictable way to provide AC power using a convenient, readily available technology. (*Id.*) Given that usage of a mains power source was well known and commonplace, a POSITA would have had a reasonable expectation of success implementing the above configuration. (*Id.*) Indeed, this would have been a simple combination of known components and technologies, according to known methods, to produce the predictable result of obtaining power from a mains power source. (*Id.*) *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

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[6] PO asserted that a 120V source is a "mains" power source. (Ex. 1081, 6-7; Ex. 1080.)

e) a driver connected to the bridge rectifier and configured to provide a rectified output AC voltage to the LED circuit array;

Nerone discloses this limitation. (Ex. 1002, ¶¶116-118.) For instance, *Nerone* discloses a driver (red below) connected to bridge rectifier 105 ("the bridge rectifier") and configured to provide a rectified output AC voltage to the LED circuit array. (*Id.*, ¶116.)

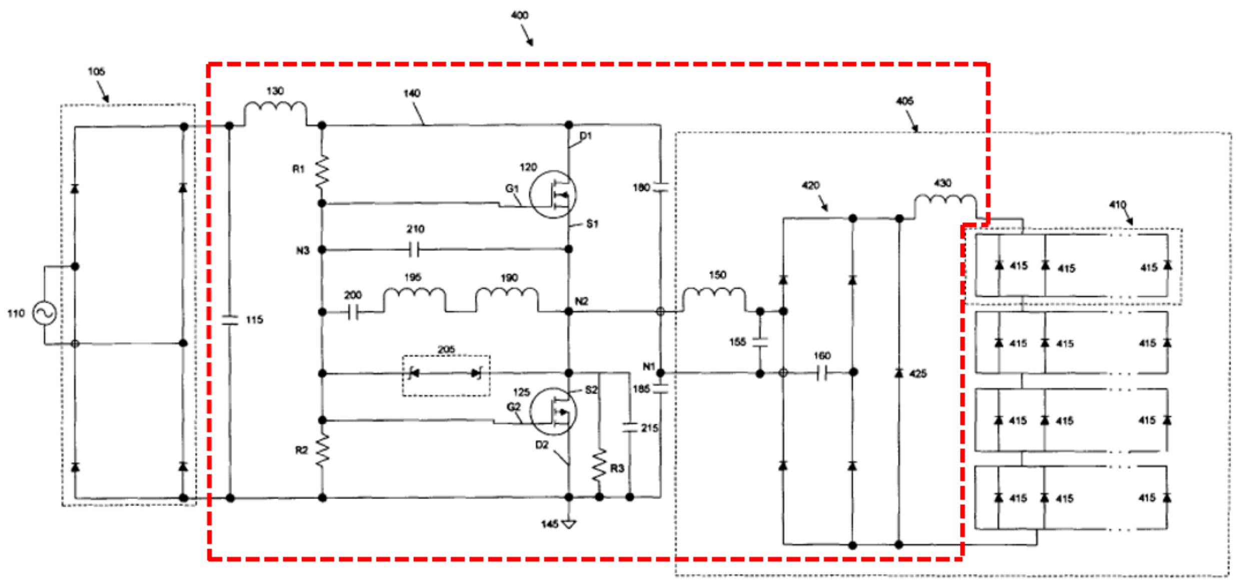


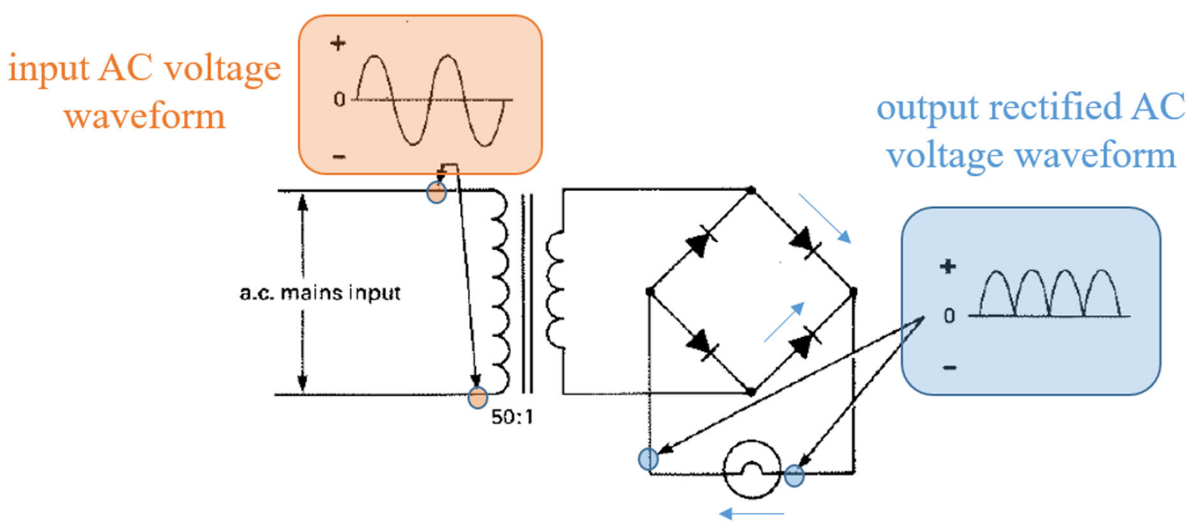
FIG. 4

(Ex. 1032, FIG. 4 (annotated); Ex. 1002, ¶116.)

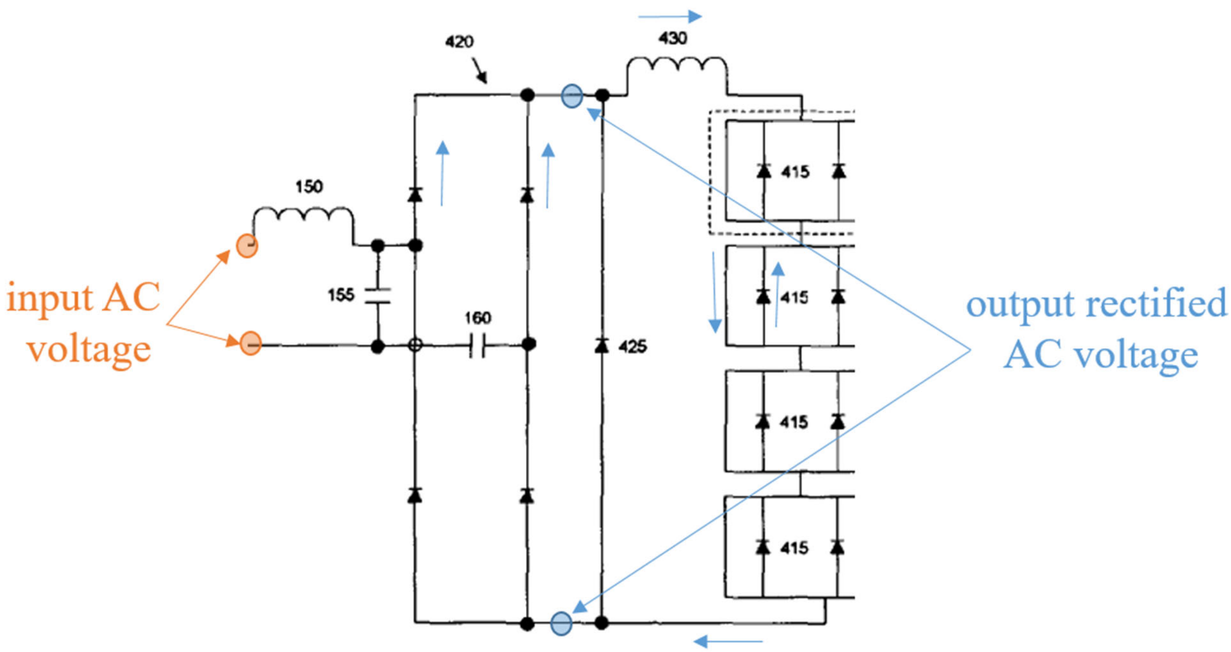
The circuitry annotated in red above is a *driver*, *e.g.*, because it drives current and power to the LED circuit array. (Ex. 1002, ¶117.) The voltage provided by the driver to the LED circuit array is a rectified output AC voltage because it is a rectified AC voltage (rectified by "a second full-wave bridge rectifier 420") that is provided at the output of the driver. (Ex. 1032, 5:63; *see also id*., 5:65-67; Ex. 1002, ¶117.)

The function of the bridge rectifier is illustrated by Dr. Baker's annotated figure below. (Ex. 1002, ¶117 (annotated figure from Ex. 1030).) As the caption indicates, the bridge rectified allows both halves of the input AC voltage waveform to pass through the lamp in the same current direction (indicated by the blue arrow), thus producing a rectified AC voltage waveform output. (Ex. 1002, ¶117.)

fig 3.20 *the diode 'bridge rectifier' configuration, used to provide full-wave rectification of an a.c. supply (although both halves of the a.c. input waveform pass through the lamp, the current flow through the lamp is not smooth—and this would upset the operation of many circuits)*



(Ex. 1030, 38 (FIGS. 3.20 (annotated); Ex. 1002, ¶117.) The second bridge rectifier 420 of *Nerone* operates in much the same manner, as illustrated by the annotated Figure 4 below. (Ex. 1002, ¶118.)



(Ex. 1032, FIG. 4 (annotated); Ex. 1002, ¶118.) *Nerone*'s disclosures are thus consistent with a POSITA's knowledge regarding the use of a bridge rectifier and related circuitry to provide a rectified AC output voltage to drive LED circuits. (Ex. 1002, ¶118; Ex. 1032, 3:8-11, 5:51-54, 5:65-67; *see also* Ex. 1007, FIGS. 7-8 and corresponding description in specification.)

f) wherein a forward voltage of the LEDs of the LED circuit array matches the rectified input AC voltage output of the driver; and

To the extent *Nerone* does not expressly disclose that the forward voltage of the LEDs of the LED circuit array (discussed for limitation 7(b)) matches the rectified input AC voltage output of the driver (discussed for limitation 7(e)), it would have been obvious in view of *Martin* and the state of the art to configure *Nerone*'s circuit 400 ("lighting system") system to provide such features to ensure proper operation of the LED circuitry (which receives as its input the driver's output voltage) in circuit 400.[7] (Ex. 1002, ¶¶63-65, 119-131.)

When designing and implementing *Nerone*'s circuit 400, a POSITA would have understood and taken into account the following considerations: (a) the total voltage drop of the circuit would dictate the current drawn by the LED circuitry, which would have been known to be inversely proportional to the voltage; (b) fewer LEDs in the design would lead to a larger current compared to a circuit with a greater number of LEDs; (c) excessive current would have been harmful to *Nerone*'s LEDs that could lead to failure; (d) too small a current may be insufficient to power the LEDs in a manner that enabled the lighting device operate as intended. (Ex. 1002, ¶120.) Accordingly, typical of LED circuit design at the time, a POSITA would have taken into consideration the number of LEDs and the total voltage drop of the LED circuit when designing and implementing *Nerone*'s circuit 400. (*Id.*) For these

[7] Petitioner assumes that "the rectified input AC voltage output of the driver" in limitation 7(f) refers to the "rectified output AC voltage" provided by the "driver" of limitation 7(e). Petitioner reserves the right to challenge this claim under 35 U.S.C. § 112 in other proceedings.

reasons, matching the input voltage to the forward voltage of the LEDs had become a matter of routine optimization. (Ex. 1074, ¶[0030]; Ex. 1002, ¶121.)

Additionally, *Martin* explains that "[e]xcessive forward voltage can damage the LEDs irreversibly" and that "[s]eries interconnection reduces the voltage drop across each LED to a level that does not exceed the maximum forward voltage of each LED." (Ex. 1015, ¶[0021].) *Martin* "relates to monolithic arrays of semiconductor light emitting devices powered by alternating current sources," and thus is similar to *Nerone* and the '400 patent. (*Id.*, ¶[0002]; *see also id.*, Title ("Alternating Current Light Emitting Device"), FIG. 5 (shown below in this section, and disclosing a circuit including LEDs); Ex. 1001, Title, Abstract).) Therefore, a POSITA contemplating implementing *Nerone*'s circuit 400 (the "lighting system" that discussed for limitation 7(a) in §IX.A.1(a)), which includes LEDs that provide lighting, would have had reason to consider the teachings of *Martin*, which similarly describes LED-based lighting. (Ex. 1002, ¶122.)

Martin discloses that "**[t]he number of LEDs in the monolithic array may be selected to achieve a particular voltage drop across each device** … such that the maximum voltage across each individual LED during the peak in the alternating current cycle is low enough so as to not damage the LEDs." (Ex. 1015, ¶[0022].) *Martin* explains that "[t]he voltage across each of the individual LEDs in the array is the line voltage divided by the number of LEDs in series," and "[t]he number of

LEDs is chosen such that the maximum voltage across each individual LED during the peak in the alternating current cycle is low enough so as to not damage the LEDs." (Ex. 1015, ¶[0022]; Ex. 1002, ¶123.) This analysis applies equally to LEDs powered directly from an alternating current (where the LEDs are powered on only during half of each cycle of the alternating current), as well as those powered by rectified AC current (where the LEDs are powered on continuously). (Ex. 1015, ¶¶[0023]-[0024], FIG. 5 (below, illustrating a bridge rectifier to rectify the AC voltage from the AC power source); Ex. 1002, ¶124.)

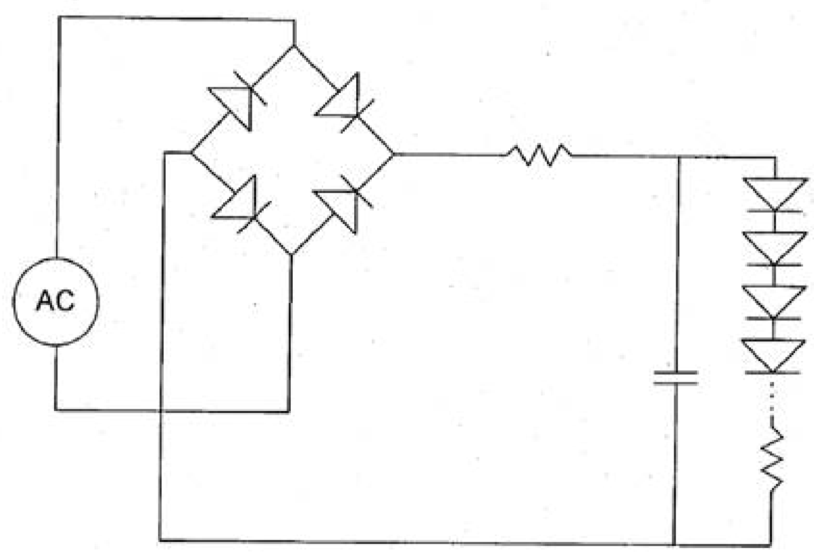
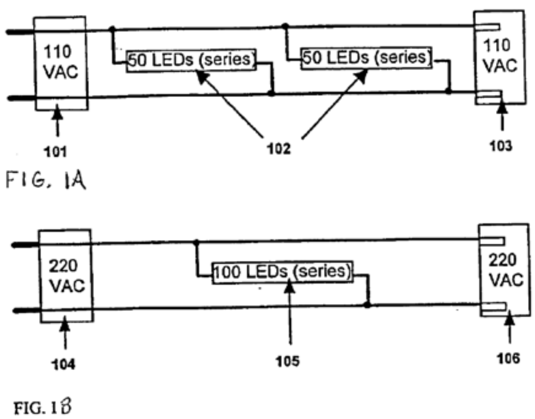
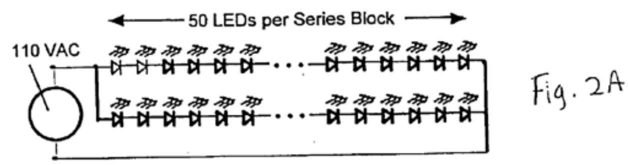


Fig. 5

Thus, in light of *Martin*'s teachings, a POSITA configuring *Nerone*'s circuit 400 would have recognized that the forward voltage of the series-connected LEDs should approximately match the rectified AC voltage output of the above-described LED driver circuit. (Ex. 1002, ¶124.)

Beyond the teachings of *Martin* and *Cross* discussed above, *Allen* similarly describes an LED configuration consistent with the state of the art. (*Id.*, ¶125.) In particular, *Allen* describes an exemplary string employing 100 LEDs in connection with Figures 1A and 1B that illustrate this matching technique as was known in the art. (Ex. 1011, ¶[0031], FIGS. 1A, 1B, 2A; Ex. 1002, ¶125.)





(Ex. 1011, FIGS. 1A-1B, 2A; *see also id.*, FIG. 2B, ¶[0035] ("FIGS. 2A and 2B [of *Allen*] show two schematic diagram implementations of the top diagram of FIG. 1, where the simplest example of AC drive is shown that uses two series blocks of 50 LEDs, connected in parallel and powered by 110 VAC.").)

Allen demonstrates that voltage matching like that recited in limitation 7(f) was known to be required in order to determine appropriate power to provide to LEDs. (Ex. 1002, ¶126.) For example, *Allen* discloses that "[i]n order to directly drive a network of diodes without current-limiting circuitry, the voltage of each series block of diodes must be **matched** to the input source voltage," and "[t]his

voltage matching requirement for direct AC drive places fundamental restrictions on the number of diodes on each diode series block, depending on the types of diodes used." (Ex. 1011, ¶[0056]; *see also id.*, Abstract ("In order to directly drive a network of diodes without current-limiting circuitry, the voltage of each series block of diodes must be matched to the input source voltage.").) *Allen* further explains that "[f]or the voltage to be '**matched**,' in each series block, the peak input voltage, V_{peak}, must be less than or equal to the sum of the maximum diode voltages for each series block.").) (Ex. 1011, ¶[0056]; *see also id.*, ¶¶[0032]-[0033], [0060] ("For AC or any other regularly varying input voltage, there is an additional requirement to direct drive voltage matching").) Were it otherwise not addressed, the design may be unstable, potentially leading to large current inputs and "the device will fail immediately or almost immediately." (Ex. 1011, ¶[0068].)

As additional evidence, *Bockle* discloses "a circuit arrangement for supplying voltage and controlling the operating behavior of light-emitting diodes for illumination purposes." (Ex. 1075, ¶[0003].) *Bockle* illustrates that this technique was not limited to simple circuits or specific voltages, disclosing that "with suitable adjustment of [a] load circuit, the supply direct voltage delivered by [a] direct-voltage source can be chosen from a wide range" and "[w]ith a correspondingly high supply voltage, very many light-emitting diodes can accordingly be connected in series." (Ex. 1075, ¶[0012].) Further, *Bockle* teaches a known arrangement configured to "match[] the supply voltage … to the requirements of the LED arrays, which also makes possible the integration of the circuit arrangement on a single chip if three or more LED colors are used, with the result that very compact and high-performance illumination means can be formed." (Ex. 1075, ¶[0043].) *Bockle* and *Allen* thus exemplify the state of the art and illustrate that matching a forward voltage of the LEDs to "the rectified input AC voltage output of the driver" was a matter of routine optimization within the knowledge and skill of a POSITA. (Ex. 1002, ¶127.)

Therefore, a POSITA would have been motivated in view of *Martin* and the state of the art (*e.g.*, as demonstrated by *Bockle* and *Allen*, discussed above) to choose an appropriate number of LEDs connected in series such that a total forward voltage drop matches the rectified output AC voltage of the driver. (*Id.*, ¶128.) For example, a POSITA would have been motivated to implement such a modification because of the known risks and potential failure associated with such arrangements, *e.g.*, as discussed above regarding *Martin*'s disclosures. (*Id.*) Thus, to avoid such problems and provide a stable circuit design, a POSITA would have chosen the number of series-connected LED chips consistent with the teachings of *Nerone* and *Martin* (and the state of the art) to ensure the forward voltage of the LEDs of the LED circuit array matches the rectified input AC voltage output of the above-described LED driver. (*Id.*)

A POSITA would have recognized that such a configuration of the *Nerone* system (*i.e.*, implementing voltage matching as in limitation 7(f)) would have been useful for operating the LEDs of the combined system correctly (*e.g.*, without overdriving them, which may damage the LEDs, and without under-driving them, which may lead to less LED output brightness than desired). (Ex. 1102, 6:6-9 ("Since driving the LEDs 14 with too much current shortens their lifetime, a safe level of current ... which provides sufficiently bright illumination but that also ensures adequate lifetime of the LEDs, must be determined and consistently provided to the array of LEDs 14 when activated."); Ex. 1002, ¶129.) A POSITA would have been skilled at circuit design/implementation and would have found such a configuration predictable and a basic application of fundamental circuit principles regarding voltage. (Ex. 1002, ¶129.) A POSITA would further have known that the application of such voltage matching principles in the context of an LED circuit was known. (Ex. 1014, 20:26-31 (*Birrell* disclosing "nine LEDs"), 22:9-30 (disclosing that for nine LEDs, "the voltage drop VAB will be 1.5 volts for diodes 67 plus 3.5 volts each for [nine] LEDs 59" so that "[t]otal voltage drop VAB will be 33 volts," and explaining that two capacitors have a voltage drop of 7.5 volts each so that "a 48 Volt AC power supply ... will satisfactorily illuminate the [LEDs] of Figure 8"); Ex. 1002, ¶129.)

Given the knowledge of a POSITA and the disclosures/suggestions of *Nerone* and *Martin*, a POSITA would have had the skills and rationale to consider and implement the above modification and would have done so with a reasonable expectation of success. (Ex. 1002, ¶130.) Such a modification would have involved the use of known technologies and techniques (as demonstrated above) to produce the predictable result of providing LED driver output that matches a forward voltage of LEDs of the LED circuit array to minimize failure and provide stable operations of *Nerone*'s lighting system. (*Id.*) *KSR*, 550 U.S. at 416. The background section of the '400 patent mentions *Allen*'s disclosure, confirming that such voltage matching as discussed above regarding *Allen* (demonstrating the state of the art) was known, feasible, and predictable for ensuring proper operation of LEDs in a lighting system. (Ex. 1001, 2:24-35; Ex. 1002, ¶130.) *Martin*'s system, like *Nerone*'s system, includes a bridge rectifier for rectifying an AC voltage source, as shown below in Figure 5 of *Martin*, and thus configuring the *Nerone-Martin* system in the above manner would have been consistent with the principles of operation of *Nerone*'s system. (Ex. 1002, ¶131.)

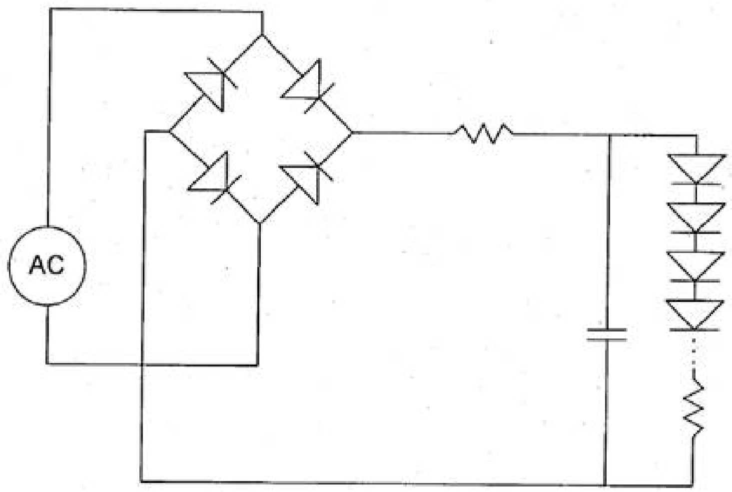


Fig. 5

(Ex. 1015, FIG. 5.)

g) wherein the LED circuit array, the capacitor, the bridge rectifier, and the driver are all mounted on a single substrate.

Nerone (as modified above) discloses this limitation. (Ex. 1002, ¶¶132-134.) For instance, *Nerone* discloses that "**[a]ll of the circuit components may be placed on the same circuit board as the light emitting elements** (170, 175), thereby taking up less space in a traffic signal housing and making retrofitting a traditional incandescent lamp traffic signal easier." (Ex. 1032, Abstract.) The foregoing disclosure is applicable not just to *Nerone*'s circuit 300 of Figure 3, which includes LEDs 170 and 175, but also to circuit 400 of Figure 4. (Ex. 1002, ¶132.) For example, the foregoing disclosure is provided in *Nerone*'s Abstract section, which would have been understood to be generally applicable to *Nerone*'s various examples. (*Id.*) Additionally, *Nerone* discloses at its "Brief Summary of the

Invention" section that "[s]till another advantage is realized since integrated circuits will fit on the same circuit board as the LED array," and this disclosure is described without reference to a specific figure of *Nerone*, so a POSITA would have understood that it applies to all of *Nerone*'s figures, including Figure 4. (Ex. 1002, ¶132.)

Thus, the LED circuit array, the various capacitors discussed above for limitation 7(c) (any of which is "the capacitor"), bridge rectifier 105 ("the bridge rectifier"), and the driver discussed above for limitation 7(e) are all mounted on a single circuit board ("single substrate"). (§IX.A.1(c), §IX.A.1(e); Ex. 1002, ¶133.) *Nerone*'s disclosures are consistent with a POSITA's knowledge regarding the use of a substrate to mount LED circuits and associated components in a lighting system, such as *Johnson-639*, *Martin*, and *Bockle.* (*See*, *e.g.*, Ex. 1104, FIG. 1, 3:58-4:31; Ex. 1015, ¶¶[0020], [0023]-[0025]; Ex. 1075, ¶¶[0039]-[0042], FIG. 9; Ex. 1002, ¶134.)

2. Claim 9

a) The lighting system of claim 7, wherein the LEDs are coated or doped with at least one of a phosphor, nano-crystals, or a light changing or enhancing substance.

Nerone-Martin discloses or suggests this limitation. (Ex. 1002, ¶¶135-137.) Although *Nerone* does not explicitly disclose that LEDs 415 are coated or doped with at least one of a phosphor, nano-crystals, or a light changing or enhancing substance, this was well known in the art. (*See*, *e.g.*, Ex. 1015, ¶[0027]; Ex. 1014, 12:4-13; Ex. 1049, 2:37-45, 3:36-45, 4:34-37, 5:54-58, 8:34-39, FIG. 6; Ex. 1071, ¶¶[0003]-[0030], [0267]-[0271]; Ex. 1072, 1:6-36, 3:13-33; Ex. 1073, ¶¶[0027]-[0028]; Ex. 1002, ¶135.) *Martin* exemplifies the conventional use of light changing substances, describing "a wavelength converting material [] provided over the LEDs" (Ex. 1015, ¶[0005]) and that "any suitable phosphors" may be "deposited over each [LED]." (Ex. 1015, ¶[0027]; Ex. 1002, ¶136.)

In light of *Martin* and state-of-the-art knowledge, it would have been obvious to coat the LEDs of *Nerone*'s system with a phosphor or wavelength converting material. (Ex. 1002, ¶137.) As discussed regarding limitation 7(f), *Martin* is from the same field as the '400 patent and thus would have been considered by a POSITA. (§IX.A.1(f); Ex. 1002, ¶137.) Further, a POSITA would have found phosphors and light changing substances useful for forming an LED lighting system (such as a traffic light) emitting light of a desired color (*e.g.*, red, green, or white). As shown by *Martin*, the use of a phosphor for altering light color was well known, and thus a POSITA would have found the above configuration feasible and straightforward to implement with a reasonable expectation of success. (Ex. 1038, ¶[0042]; Ex. 1002, ¶137.) Indeed, such a configuration would have been a combination of known components and technologies, according to known methods, to produce predictable results. (Ex. 1002, ¶137.) *KSR*, 550 U.S. at 416.

3. Claim 11

a) The lighting system of claim 7, wherein the capacitor is configured to smooth the rectified output AC voltage.

Nerone (as modified above) discloses this limitation. (Ex. 1002, ¶¶138-144.) In particular, *Nerone*'s capacitor 160 is "configured to smooth the rectified output AC voltage," as claimed. *Nerone* explains that the matching capacitor 160 "affects how the resonant inductor 150 and resonant capacitor 155 network perceives the impedance of the LEDs." (Ex. 1032, 3:25-28.) Thus, "[t]he matching capacitor 160 may limit the current through the LEDs." (Ex. 1032, 3:28-29.) Because current and voltage are directly related (Ohm's Law), restricting the peaks and valleys of the current likewise limits the peaks and valleys of the voltage waveform. Hence, the matching capacitor 160 "smooth[s]" the voltage waveform. (Ex. 1002, ¶138; *see also id.*, ¶¶139-140.)

Nevertheless, to the extent *Nerone* does not explicitly disclose the features of claim 11, it would have been obvious in view of *Martin* to modify the *Nerone-Martin* system (discussed for claim 7) to implement such features. (*Id.*, ¶141.) Adding a capacitor to smooth a rectified voltage output was a common arrangement and "the basis of almost all power supply systems used in electronic circuits." (Ex. 1030, 38-39; Ex. 1043, 6:60-7:3; Ex. 1002, ¶141.) For example, *Martin* discloses a capacitor connected in parallel with the LEDs that smooths the voltage provided to the LEDs.

(Ex. 1015, ¶[0024]; Ex. 1002, ¶142.)

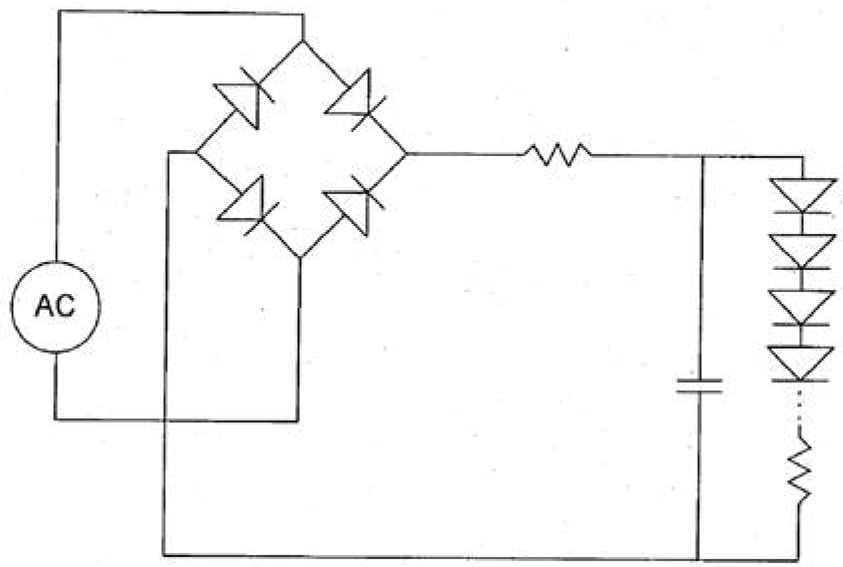


Fig. 5

(Ex. 1015, FIG. 5.)

In light of *Martin* and state-of-the-art knowledge, a POSITA would have been motivated, and found it obvious, to include a capacitor to smooth the rectified output voltage as conventionally employed. (Ex. 1002, ¶143.) A POSITA would have been motivated to make such a modification, *e.g.*, to provide an efficient waveform and constant current of a desired amount as taught by *Martin* and others. (*See*, *e.g.*, Ex. 1030, 39; Ex. 1015, ¶[0024]; Ex. 1007, ¶¶[0095], [0102], [0104]; Ex. 1015, ¶[0024]; Ex. 1030, 39; Ex. 1002, ¶143.)

Further, as evidenced by state-of-the-art knowledge, a POSITA would have had a reasonable expectation of success in implementing such a modification to *Nerone*'s lighting system. (*See*, *e.g.*, Ex. 1030, 38-39, Ex. 1007, ¶¶[0094]-[0104];

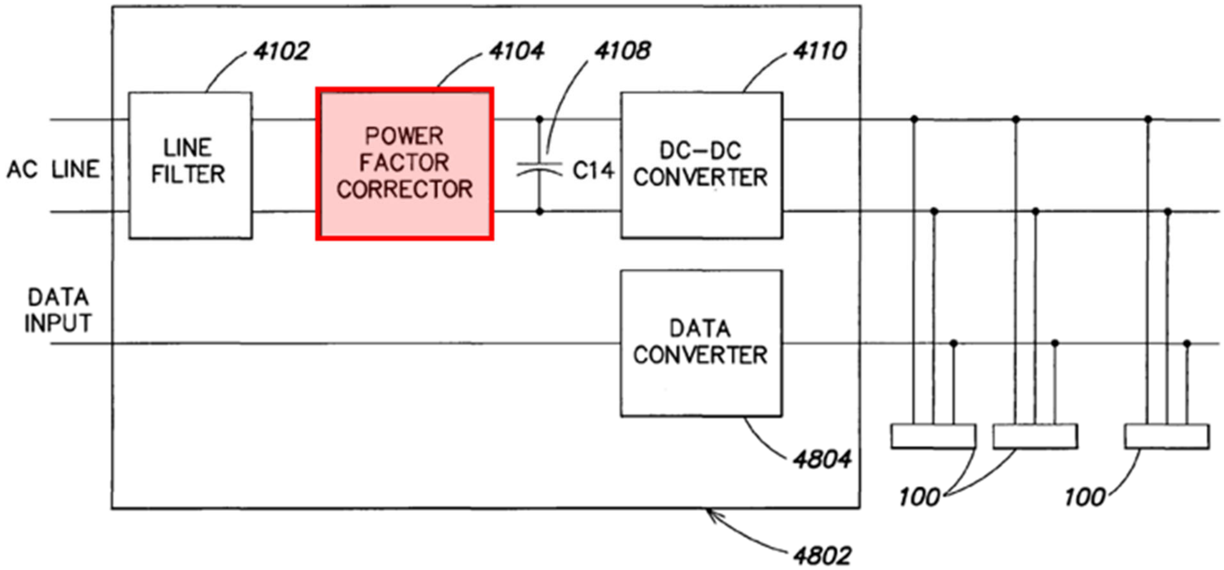
Ex. 1015, ¶[0024]; Ex. 1075, ¶[0017].) Thus, adding a capacitor onto a single substrate with the LEDs and other circuitry was well within ordinary skill. (Ex. 1015, ¶[0024]; Ex. 1075, ¶[0017]; Ex. 1002, ¶144.)

B. Ground 2: Claim 8 Is Obvious Over *Nerone*, *Martin*, and *Morgan*

1. Claim 8

a) The lighting system of claim 7, further comprising power factor correction circuitry.

Although *Nerone-Martin* does not explicitly disclose power factor correction circuitry, it would have been obvious in view of *Morgan* to configure the *Nerone-Martin* system to implement this feature. (Ex. 1002, ¶¶66-70, 145-153.) For example, power factor and power factor correction were well understood by a POSITA. (*Id.*, ¶147.) A poor power factor would reduce efficiency of a circuit, and certain power supply/driver circuitry could lower a system's power factor. (*See*, *e.g.*, Ex. 1013, 5:1-12; Ex. 1002, ¶148.) Further, switching power supplies, in particular, can have undesirably low power factors. (Ex. 1002, ¶148; Ex. 1033, 76:40-49.) *Morgan* not only recognized the problem, but also describes power factor correction as a solution. (Ex. 1033, 76:49-54.) Figure 48 of *Morgan*, *e.g.*, illustrates a "block diagram of a typical LED illumination power and data supply system for a lighting unit." (Ex. 1033, 13:16-17, FIG. 48 (annotated).)



(*Id.*, FIG. 48 (annotated); Ex. 1002, ¶148.) Thus, the problem of low power factor was known, as was the solution, *e.g.*, which was known to be a publicly and commercially available product. (Ex. 1002, ¶¶149-150, 153; *see also* Ex. 1093, 1:6-26, 1:53-55; Ex. 1013, 1:54-2:67, 3:14-45, 5:53-59 ("a power factor correction...integrated circuit (I.C.) controller 40, which is a **commercial device available from many sources**"); Ex. 1031, 7:5-10.)

Additionally, *Morgan* "relates to the field of lighting" (Ex. 1033, 1:38) and describes "LED based lighting devices" (*id.*, 2:64-3:1). Accordingly, *Morgan* is in the same field as *Nerone* and the '400 patent and addresses similar problems associated with integrating LEDs and driving circuitry, and thus would have been considered by a POSITA when contemplating the design and implementation of the *Nerone-Martin* system. (Ex. 1002, ¶151; Ex. 1001, 1:45-48.)

In light of *Morgan* and a POSITA's knowledge of power factor correction, a POSITA would have been motivated to modify the combined *Nerone* lighting system to include power factor correction circuitry like that claimed, *e.g.*, for obtaining a high power factor and thereby increasing the efficiency of the lighting system. (Ex. 1002, ¶152.) A POSITA would have been motivated to use various known design concepts and components in implementing the above-discussed modified *Nerone* lighting system, and in light of the state-of-the-art knowledge and *Morgan*, would have recognized the predictable benefit of providing a power factor correction circuit to improve the power factor of the driver in the *Nerone* system. (*Id.*, ¶153; Ex. 1013, 2:22-26, 2:52-53, 5:53-59; Ex. 1016, 3:17-18, 5:22-25, 11:3-4, 13:7-11, 15:12-18.) Such a modification would have provided similar desirable benefits known to be provided by such circuits, as suggested by *Morgan*. (Ex. 1002, ¶153.)

A POSITA would have had the skills and rationale to consider the various ways to configure the driver in the combined system to provide power factor correction functionalities, and thus would have been able to design and implement the above modification with a reasonable expectation of success, especially given the disclosures of *Nerone*, *Martin,* and *Morgan*, and the state of the art. Such a modification would have involved the use of known technologies and techniques (*e.g.*, the use of known power factor correction circuit designs) to produce the predictable result of providing a driver in the combined *Nerone* lighting system with such power factor correction circuitry that provided desirable high power factor benefits, like that suggested by *Morgan*.[8] (Ex. 1002, ¶153.) *KSR*, 550 U.S. at 416.

C. Ground 3: Claim 10 Is Obvious Over *Nerone*, *Martin*, and *Zinkler*

1. Claim 10

a) The lighting system of claim 7, wherein the rectified output AC voltage provided to the LED circuit array is relatively close to the input AC voltage input received from the mains power source.

Nerone-Martin in view of *Zinkler* discloses or suggests this limitation.[9] (Ex. 1002, ¶¶71-74, 154-163.) While *Nerone* and *Martin* do not expressly disclose that

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[8] The only place the '400 patent specification discusses power factor correction is in its mention of "[p]ower factor correction means 232," and it does so without identification of any criticality associated with the component. (Ex. 1001, 19:37-39.)

[9] The '400 patent does not provide guidance regarding the scope of "relatively close" in this limitation. (*See generally* Ex. 1001; Ex. 1002, ¶155.) Nor do PO's infringement contentions in district court. (Ex. 1081, 8-9; Ex. 1084, 8-9; *see also* Exs. 1080, 1083.) For purposes of this proceeding, Petitioner analyzes the prior art under the words of the claim. Petitioner reserves the right to challenge this claim under 35 U.S.C. § 112 in other proceedings.

the rectified output AC voltage provided to the LED circuit array is relatively close to the input AC voltage input received from the mains power source, a POSITA would have been motivated and found it obvious in view of *Zinkler* to implement such features in the *Nerone-Martin* system. (*Id.*, ¶155.)

As discussed for limitation 7(a) (§IX.A.1(a)), *Nerone* explains that its circuit 400 of Figure 4 "is identical to the power supply circuit 100 of FIG. 1, with the exception of the resonant load circuit 405." (Ex. 1032, 5:52-54.) Therefore, circuit 400 of *Nerone*'s Figure 4, like circuit 100 of *Nerone*'s Figure 1, discloses "[a] DC-to-AC converter, which includes first and second switches 120 and 125," as shown below in Figures 1 and 4.

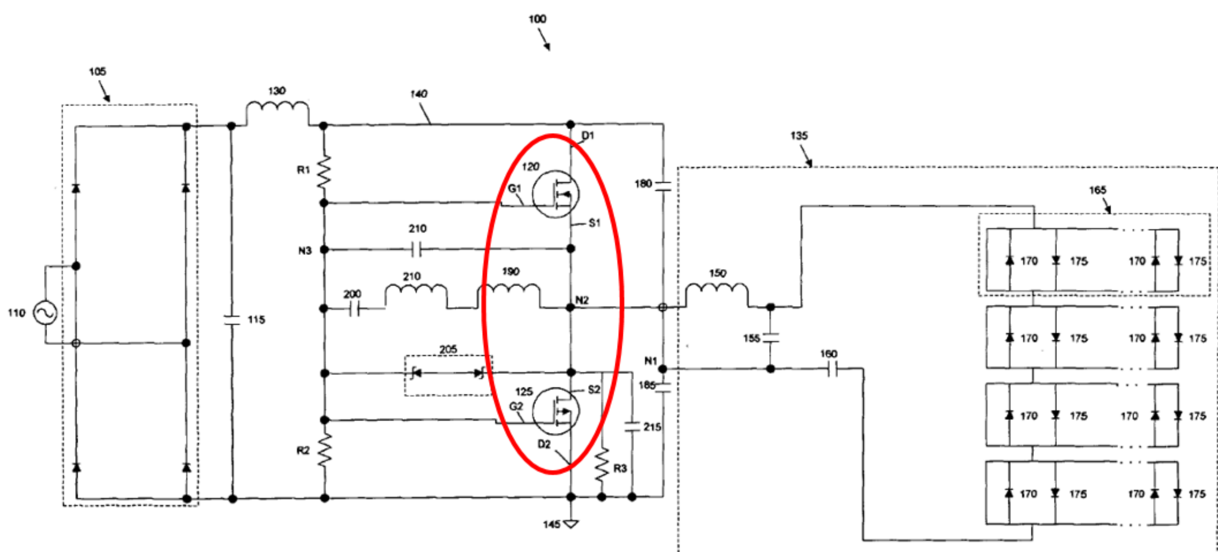


FIG. 1

(Ex. 1032, FIG. 1 (annotated); Ex. 1002, ¶156.)

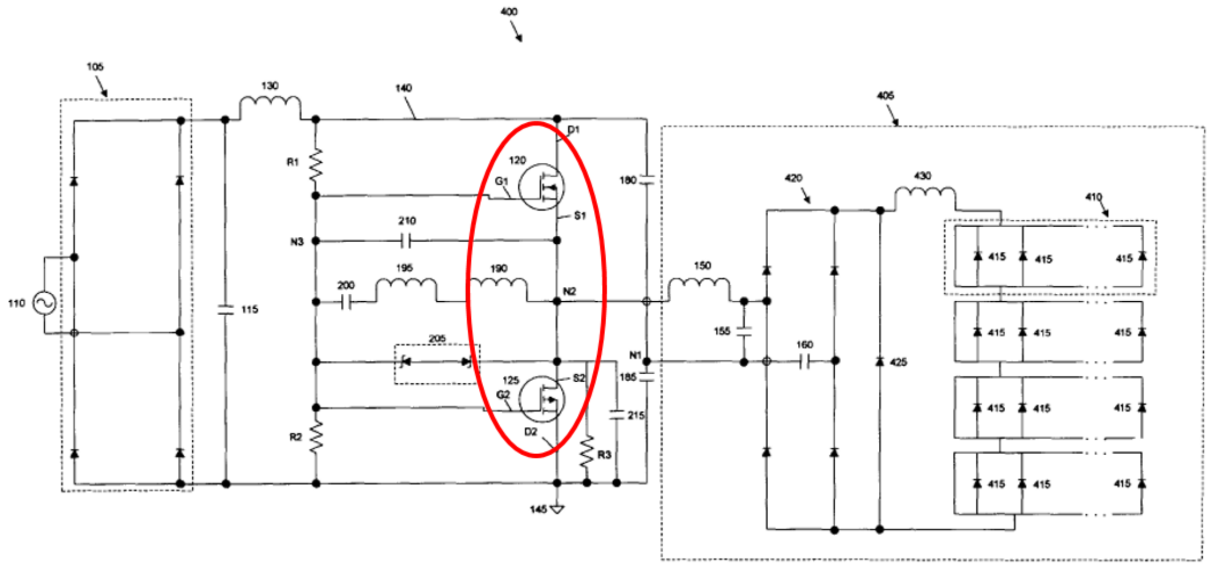


FIG. 4

(Ex. 1032, FIG. 4 (annotated); Ex. 1002, ¶156.)

Zinkler "relates to power supplies for illumination systems" (Ex. 1042, 1:11-12), including in the context of a 120V/60Hz AC voltage source (*id.*, 4:17-20) (like *Nerone*, *see* Ex. 1032, 1:51-55), and thus a POSITA contemplating implementing *Nerone*'s lighting system would have had reason to consider the teachings of *Zinkler*. (Ex. 1002, ¶157.) Figure 4 of *Zinkler* (below) shows an AC voltage source 42 that provides a voltage that is provided to a processing chain that includes a rectifier 46 and inverter 48, wherein "[t]he rectifier 46 in combination with the variable frequency inverter 48 constitutes a frequency conversion means 50 for converting the low frequency voltage produced by the AC voltage source 42 to a high frequency voltage." (Ex. 1042, 9:12-15.)

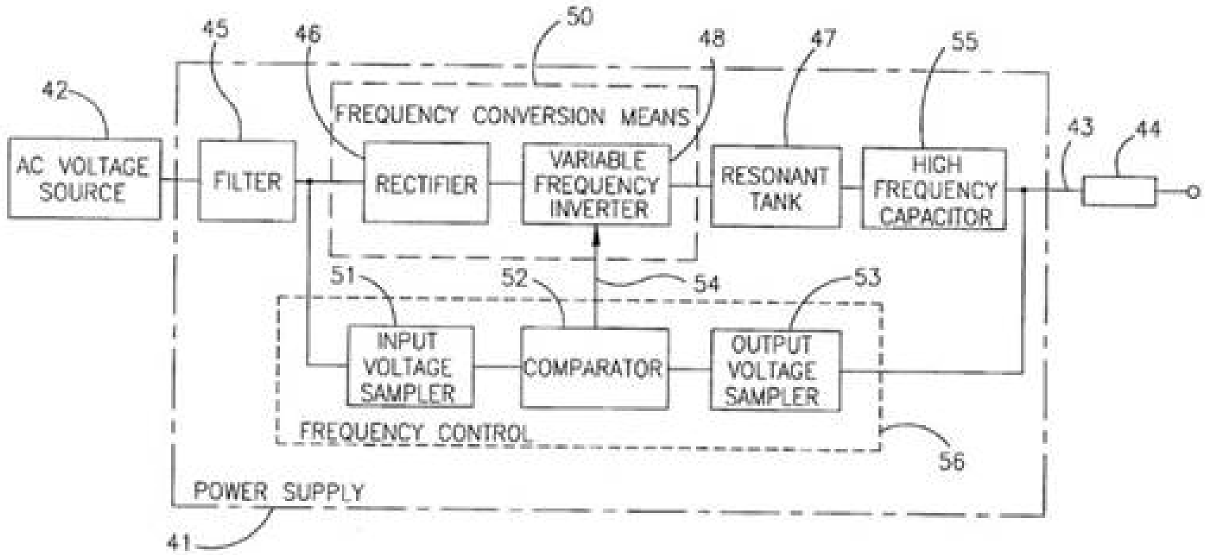


FIG.4

(Ex. 1042, FIG. 4.)

Zinkler discloses that a "step up transformer adjusts the voltage V_{out} on the conductors 43 to the required value" wherein "[t]he step up transformer can be used to ensure that the voltage V_{out} across the conductors 43 is **equal to the voltage of the AC source 42 or to any other desired value**." (*Id.*, 9:33-41; Ex. 1002, ¶158.)

In light of *Zinkler* and the state of the art, a POSITA would have been motivated to, and found it obvious to, configure the driver of the above *Nerone-Martin* system to implement a transformer to adjust the voltage provided by *Nerone*'s DC-AC converter circuitry such that the output of the driver is relatively close to the input AC voltage received from the mains power source discussed above. (Ex. 1002, ¶159.) A POSITA would have taken into account the voltage drop across circuitry following the DC-AC converter (e.g., rectifier 420 and other circuitry in power supply circuit 400) to supply appropriate voltage for powering a particular number of LEDs in the LED circuitry of *Nerone*'s modified lighting system. (Ex. 1014, 22:5-30; Ex. 1075, ¶¶[0012], [0043]; Ex. 1002, ¶159.) *Nerone*'s second rectifier 420 is a full-wave bridge rectifier (Ex. 1032, 5:61-64), and a POSITA would have understood that the voltage drop across such a rectifier (which would receive the output from the above modified DC-AC converter circuitry in light of *Zinkler*) would have been negligible as compared to the input AC voltage received from the mains source, and compared to the voltage level received from the DC-AC converter. (Ex. 1030, 37-39 (FIGS. 3.20-3.21 and associated description), 81-83; Ex. 1002, ¶¶43, 161.) Consequently, the driver in the *Nerone-Martin-Zinkler* system would provide a rectified output AC voltage to the LED circuit array that is relatively close to the input AC voltage input received from the mains power source as explained above for claim 7. (*Id.*; §IX.A.1.)

Thus, a POSITA would have found it predictable, feasible, and appropriate in some circumstances, *e.g.*, dependent on the number of LEDs and voltage requirement of each LED to implement the above modification with a reasonable expectation of success. (Ex. 1002, ¶¶161-162.) Indeed, it was known to provide at the output of a DC-AC converter the same or relatively close voltage supplied by a mains power source (e.g., 110VAC). (Ex. 1044, FIGS. 3A, 3B (showing "OUTPUT ~ **110 V**"), 4:44-50 ("110 [volt] source"), 5:20-22 ("The alternating current produced by the inverter circuit 37 is provided at an output 40...”); Ex. 1046, 1:15-16; Ex. 1002, ¶¶161-163.)

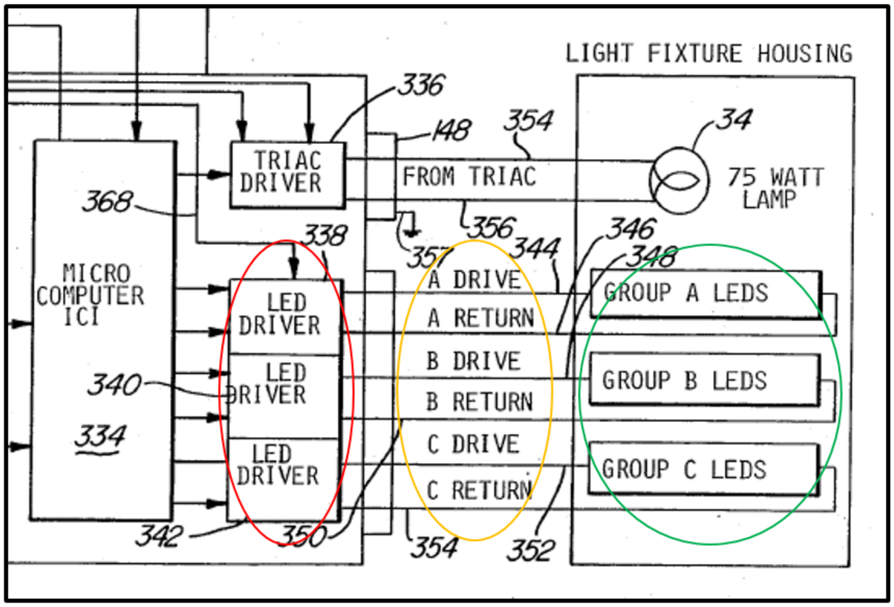
D. Ground 4: Claim 12 Is Obvious Over *Nerone*, *Martin*, and *Michael*

1. Claim 12

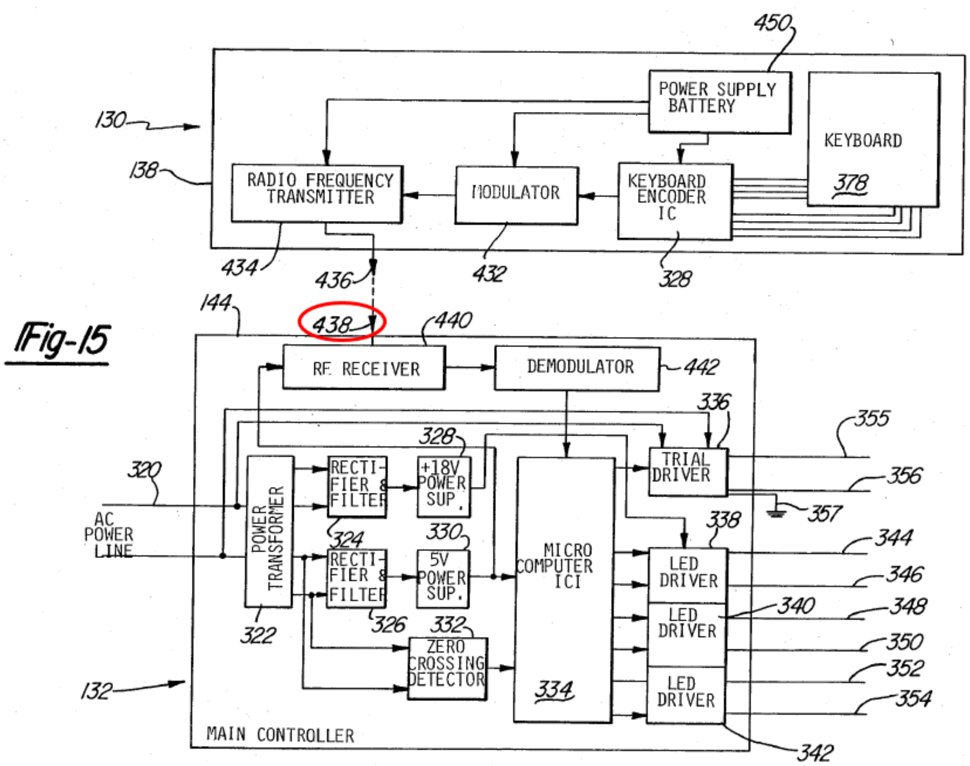
a) The lighting system of claim 7, further comprising a data communication circuit comprising an antenna, wherein the data communication circuit is integrated with the substrate.

While *Nerone-Martin* does not explicitly disclose a data communication circuit comprising an antenna, wherein the data communication circuit is integrated with the substrate, it would have been obvious in view of *Michael* and the state of the art to implement this feature. (Ex. 1002, ¶¶75-79, 164-173.) *Michael* “relates to lighting assemblies” and discloses (like *Nerone*) LED-based lighting. (Ex. 1008, 1:5-7; *id.*, Title, 7:20-8:47; Ex. 1032, Title, Abstract, 1:5-9, FIG. 4, 5:51-6:6; Ex. 1002, ¶165.) Accordingly, a POSITA contemplating implementing the *Nerone-Martin* LED lighting system would have had reason to consider the teachings of *Michael*. (Ex. 1002, ¶165.)

Michael discloses a lighting assembly including LED drivers (red below) coupled to LEDs (green below) via drive/return lines (orange below), and further discloses an antenna 438 (red below in FIG. 15) receiving data wirelessly for remotely control of LEDs. (Ex. 1008, 8:23-24, 8:29-34, 8:54-66, 8:67-9:2, FIG. 15; Ex. 1002, ¶166.)



(Ex. 1008, FIG. 12 (excerpted/annotated); *see also id.*, 7:20-21, 7:35-40; Ex. 1002, ¶166.)



(Ex. 1008, FIG. 15 (annotated); Ex. 1002, ¶166.)

Michael's encoder IC 328 provides an encoded signal that is modulated and transmitted to antenna 438, and "[t]he signal received on antenna 438 is inputted to a radio frequency receiver 440 ... [which] outputs to a demodulator 442 which outputs to microcomputer 334." (Ex. 1008, 10:48-58; Ex. 1002, ¶167.) *Michael* discloses AC power lines 320 and a circuit ground 357 (Ex. 1008, FIG. 15, 7:41-43, 8:11), describes various aspects of circuitry (*id.*, 4:58-9:37), including describing that a "forward current flows ... from a drive terminal through the circuit board to the appropriate LED load" (*id.*, 9:53-55), and further discloses that the LED drivers shown in Figure 15 are coupled to LEDs as shown in Figure 12. (Ex. 1002, ¶168; *see also* Ex. 1008, FIG. 12, 7:35-40.) Thus, *Michael*'s controller 132, in conjunction with antenna 438, discloses a data communication circuit comprising an antenna. (Ex. 1002, ¶168.)

It was well known to integrate various types of circuits, including a data communication circuit, with a substrate. (Ex. 1022, FIGS. 7-8; *see also id.*, FIGS. 2-5, 4:7-16, 4:48-50; Ex. 1002, ¶169.) In light of *Michael* and the state of the art, a POSITA would have been motivated to configure the *Nerone-Michael* system to comprise a data communication circuit that comprises an antenna and that is integrated with the substrate. (Ex. 1002, ¶170.) For example, such a configuration would have been useful for enabling remote wireless control of the lighting system. (*Id.*) Indeed, wireless control of lighting was well known (Ex. 1005, Abstract, FIG.

6, ¶¶[0032], [0083], [0110], [0123], [0177]; Ex. 1008, FIG. 15, 10:48-58; Ex. 1022, FIG. 4A), including in the context of traffic light systems, like that disclosed in *Nerone*. (Ex. 1103, 1:11-62, 3:45-63; Ex. 1002, ¶171.)

Integrating the data communication circuit with the substrate would have been predictable, *e.g.*, because integrating various components was a well-known design goal and was beneficial for compactness, reliability, and/or aesthetic considerations. (Ex. 1018, 5:5-9, 11:6-8, FIG. 2; Ex. 1002, ¶172.)[10] A POSITA would have been capable of implementing such a configuration with a reasonable expectation of success, as it would have been a combination of known components, according to known methods, to produce predictable results. (Ex. 1002, ¶173.) *KSR*, 550 U.S. at 416.

E. Ground 5: Claim 13 Is Obvious Over *Nerone*, *Martin*, *Michael*, and *Gleener*

1. Claim 13

a) The lighting system of claim 12, wherein the capacitor is a first capacitor, wherein the data communication circuit further comprises an inductor and a second capacitor.

Nerone-Martin-Michael in view of *Gleener* discloses or suggests this

[10] Exhibit 1018 is cited in this ground to demonstrate the state of the art. (Ex. 1002, ¶172.)

limitation. (Ex. 1002, ¶¶80-83, 174-181.) As discussed for limitation 7(c) (§IX.A.1(c)), rectifier 34 includes a capacitor, and that capacitor is a "first capacitor" as claimed. (Ex. 1002, ¶175.) To the extent *Nerone-Martin-Michael* does not explicitly disclose that the data communication circuit discussed for claim 12 (§IX.D.1) comprises an inductor and a second capacitor, it would have been obvious in view of *Gleener* to configure the *Nerone-Martin-Michael* system to implement such features. (Ex. 1002, ¶175.)

As discussed for claim 12, it would have been obvious to implement an antenna for enabling wireless remote control of *Nerone*'s lighting system. (§IX.D.1; Ex. 1002, ¶176.) A POSITA contemplating implementing the *Nerone-Martin-Michael* system, including its antenna (which would have been desirable and predictable to implement for the reasons discussed above for claim 12), would have found *Gleener* to be a relevant reference to consider, because *Gleener* describes implementing an antenna-based system, including maximizing transfer of energy to the antenna. (Ex. 1039, Title, Abstract ("tunable dual band antenna system"), ¶[0001] ("matching networks for antennas"); Ex. 1002, ¶176.)

Gleener discloses a data communication circuit comprising an inductor and a capacitor. (Ex. 1002, ¶177.) For example, Figure 3 of *Gleener* (below) is a "circuit diagram for a dual band antenna system 100 [that] has a transceiver 102 electrically connected to a matching network 104" and further includes an antenna 106, and thus shows a data communication circuit because such a circuit including a transceiver and an antenna is for communication (*e.g.*, transmission/reception) of data. (Ex. 1039, ¶[0020]; Ex. 1002, ¶177.)

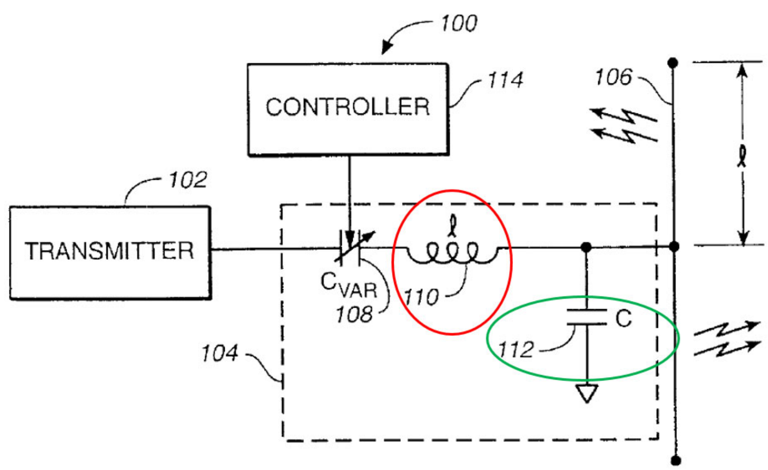


FIG._3

(Ex. 1039, FIG. 3 (annotated); Ex. 1002, ¶177.)

Gleener discloses that its data communication circuit includes a matching network 104 comprising an inductor 110 (red above) and a capacitor 112 (green above). (Ex. 1039, FIG. 3, ¶[0014]; Ex. 1002, ¶178.) *Gleener* discloses that "matching network 104 provides impedance matching between the antenna 106 and the transceiver 102 for two prescribed frequency bandwidths." (Ex. 1039, ¶[0020]; *see also id.*, ¶[0011]; Ex. 1002, ¶178.) A POSITA would have been knowledgeable about impedance matching. (Ex. 1002, ¶179.) For example, *Gleener* explains that such impedance matching was known at the time of *Gleener* and improves antenna performance. (Ex. 1039, ¶[0002]; *see also id.*, ¶¶[0004], FIG. 1; Ex. 1002, ¶179.)

In light of *Gleener*, a POSITA would have been motivated to configure the *Nerone-Martin-Michael* data communication circuit to comprise an inductor and a second capacitor. (Ex. 1002, ¶180.) Including an impedance matching system comprising an inductor and a second capacitor to match the impedance between a transmitter/receiver and the *Nerone-Martin-Michael* antenna would have promoted efficiency and antenna performance. (Ex. 1039, ¶[0002]; Ex. 1002, ¶180.)

A POSITA would have been able to implement the above configuration with a reasonable expectation of success, particularly because such inductor-capacitor (LC) impedance matching concepts were well known and because such a configuration would have been a combination of known components and technologies, according to known methods, to produce predictable results. (Ex. 1002, ¶181.) *KSR*, 550 U.S. at 416.

F. Ground 6: Claims 7, 9-11, and 17 Are Obvious Over *Zhang* and *Martin*

1. Claim 7

a) Limitation 7(a)[11]

To the extent the preamble of claim 7 is limiting, *Zhang* discloses the limitations therein. (Ex. 1002, ¶¶84-90, 182-183.) For example, *Zhang* discloses "**Lighting Devices** Using LEDS," (Ex. 1012, Title (emphasis added).) In particular, *Zhang* describes "5 **lighting devices**," including "chip-on-board LED exit signs"). (*Id*., ¶¶[0018], [0022], [0032]-[0039] (emphasis added).) *Zhang* teaches that a chip-on-board LED lighting system used for various lighting contexts, such as an illuminated exit sign. (*Id*., ¶[0018]; *see also id*., ¶¶[0002] ("LED exit signs"), [0005]-[0006] ("LED Exit Signs"), [0079] ("Chip-on-board LED Exit Signs").) A circuit diagram of Figure 2.1 (below) illustrates the electronic circuit board configuration for the exit sign. At least this embodiment of *Zhang*'s lighting devices constitutes a "lighting system" as claimed. (*See also* §IX.F.1(b)-§IX.F.1(g).)

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[11] For claims 7-11 in Grounds 6 (*Zhang-Martin* ground) and 7 (*Zhang-Martin-Morgan* ground), Petitioner does not repeat the claim language, which is presented above at Grounds 1-3 (§§IX.A.1-3).

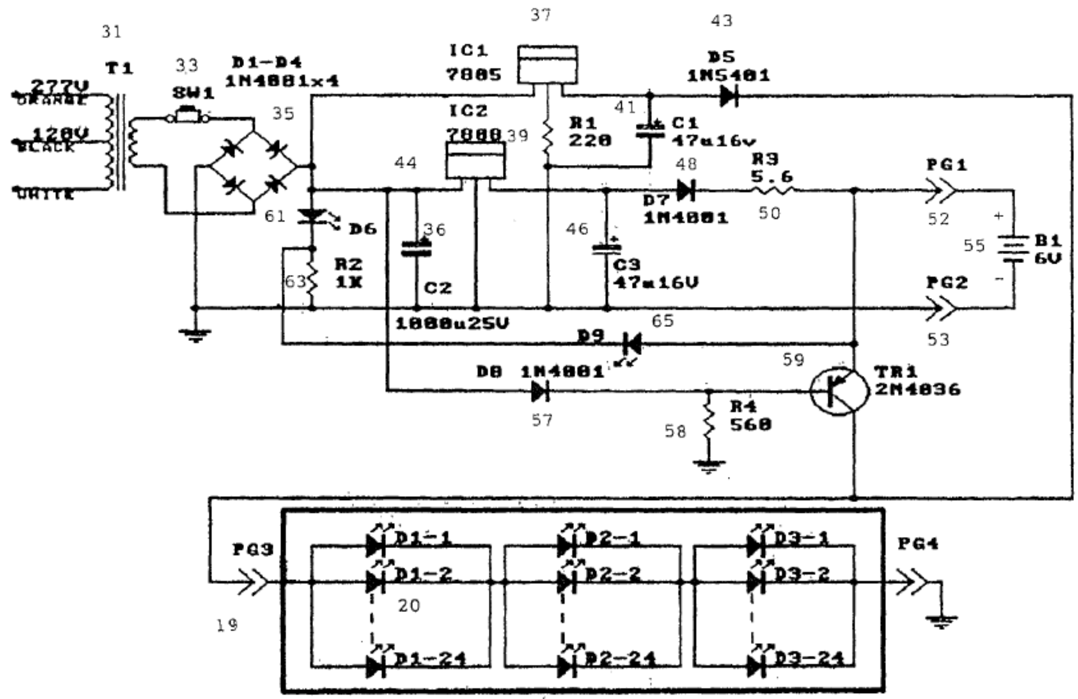

FIG. 4 <EXIT> SIGN
CIRCUIT DIAGRAM

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1012, FIG. 2.1; Ex. 1002, ¶183.)

b) Limitation 7(b)

Zhang discloses this limitation. (Ex. 1002, ¶184.) As discussed for the preamble of claim 7, *Zhang* discloses a lighting system including LEDs. (§IX.F.1(a); Ex. 1012, FIG. 2.1; Ex. 1002, ¶184.) *Zhang* further discloses that its LED lighting device comprises LEDs arranged in parallel-connected rows, wherein each row ("LED circuit") comprises n LEDs ("a plurality of LEDs") connected in series. (Ex. 1012, ¶[0037] ("There are **n LEDs in serial on one row** and m rows in parallel on the board...."); *see also id.*, ¶[0088] ("The COBLEDES [chip-on-board LED exit sign] 19 has **n LEDs [in] one row** and **m [r]ows in parallel**."), FIG. 2.1;

Ex. 1002, ¶184.) Each row of LEDs is an *LED circuit*, because current flows through an LED to produce light output and a circuit is required for current to flow. (Ex. 1002, ¶184.) With *Zhang*'s array of parallel-connected rows, *Zhang* discloses an *LED circuit array* as claimed. (*Id.*)

c) Limitation 7(c)

Zhang discloses this limitation. (Ex. 1002, ¶185.) For instance, as shown below in Figure 2.1, *Zhang* discloses that its lighting system includes capacitors C1, C2, C3 (any of which is "a capacitor") (blue below).

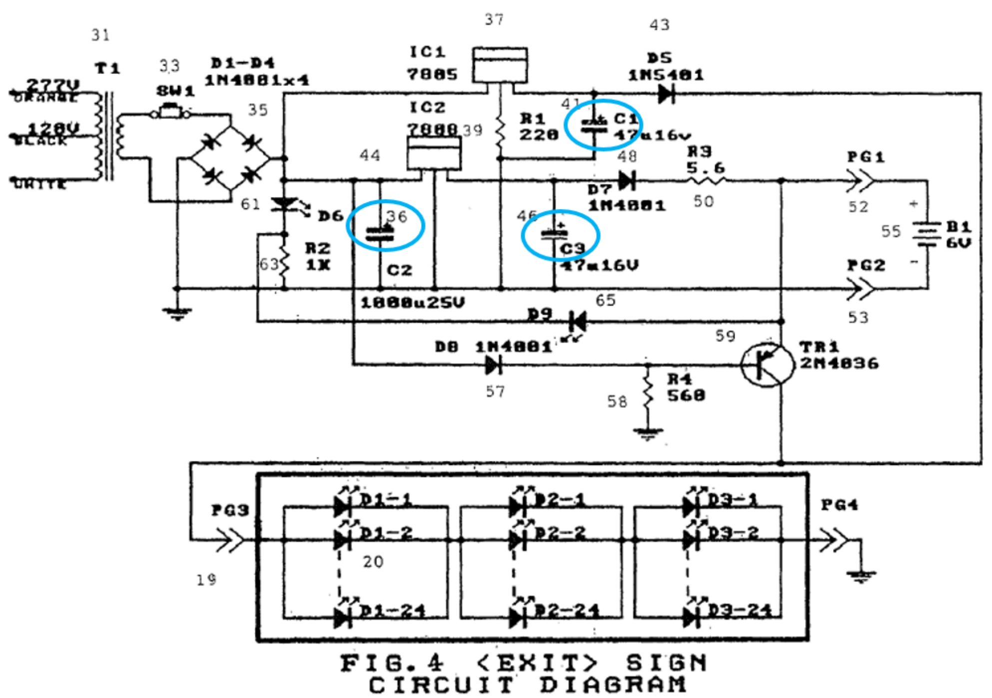

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1012, FIG. 2.1 (annotated); Ex. 1002, ¶185.)

d) Limitation 7(d)

Zhang discloses this limitation. (Ex. 1002, ¶¶186-188.) For instance, as shown below in Figure 2.1, *Zhang* discloses a "bridge rectifier 35" (red below) configured to receive an input AC voltage from a mains power source. (Ex. 1012, ¶[0083]; Ex. 1002, ¶186.)

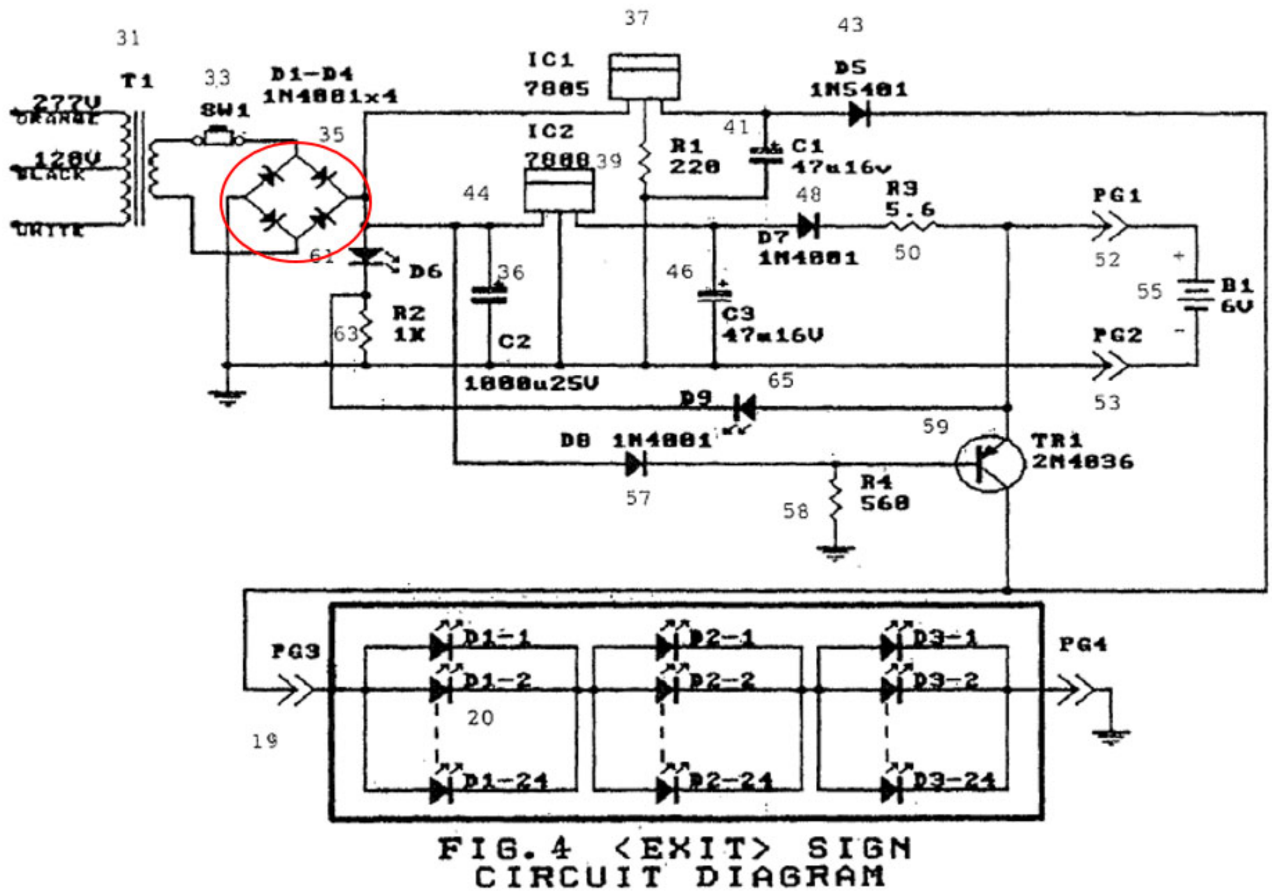

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1012, FIG. 2.1 (annotated); *see also id.*, ¶¶[0084]-[0087] ("rectifier 35"); Ex. 1002, ¶186.)

Zhang discloses that "**120 VAC or 220 VAC power from [a] commercial line is reduced to 9 VAC by [a] transformer 31** and sent to [a] test switch 33." (Ex. 1012, ¶[0083]; *see also id.*, ¶[0036]; Ex. 1002, ¶187.) As shown above in Figure

2.1, bridge rectifier 35 is coupled to switch 33. (Ex. 1012, FIG. 2.1; *see also id.*, ¶[0083]; Ex. 1002, ¶187.) The 120 or 220 VAC input AC voltage received by bridge rectifier 35 via *Zhang*'s commercial line is received via transformer 31 from a *mains* power source. (Ex. 1013, 1:25-29 ("a.c. mains (120 v.a.c., 60 Hz)"); Ex. 1027, 1:8-12, 1:18-23; Ex. 1002, ¶187.)

Additionally, a POSITA would have also understood the 9 VAC voltage at the output of transformer 31 (Ex. 1012, ¶[0083], FIG. 2.1) to be an input AC voltage from a mains power source, and bridge rectifier 35 is configured to receive that voltage. (Ex. 1002, ¶188.) Thus, *Zhang* also discloses limitation 7(d) in this additional way. (*Id.*)

e) Limitation 7(e)

Zhang discloses this limitation. (Ex. 1002, ¶189.) For instance, as shown below in Figure 2.1, *Zhang* discloses a regulator 37 ("driver") (red below) connected to bridge rectifier 35 ("the bridge rectifier") and configured to provide a rectified output AC voltage to the LED circuit array. (Ex. 1012, ¶[0084] ("regulator 37").) The voltage provided by regulator 37 to the LEDs is a *rectified AC* voltage because of the rectification performed by rectifier 35, and it is an *output* voltage because it is the output of regulator 37 ("driver"). (Ex. 1002, ¶189.)

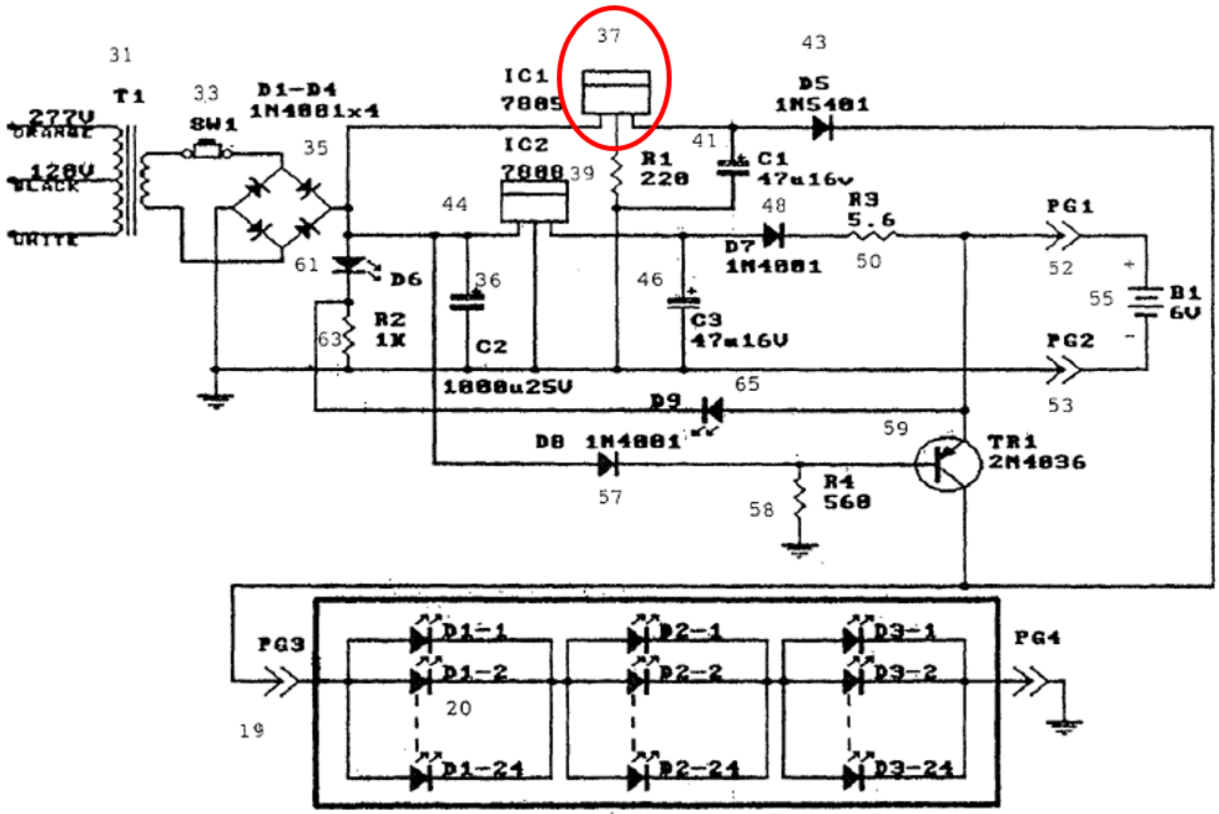

FIG. 4 <EXIT> SIGN
CIRCUIT DIAGRAM

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1012, FIG. 2.1 (annotated); Ex. 1002, ¶189.)

f) Limitation 7(f)

Zhang in view of *Martin* discloses or suggests this limitation.[12] (Ex. 1002, ¶¶190-193.) As discussed for limitation 7(e) in Ground 6 (§IX.F.1(e)), *Zhang* discloses a driver that provides a voltage output ("the rectified input AC voltage

[12] Petitioner makes the same assumption discussed for this limitation in Ground 1. (§IX.A.1(f).)

output") to the LED circuit array. While *Zhang* does not expressly disclose that the forward voltage of the LEDs of the LED circuit array matches the rectified input AC voltage output of regulator 37 ("the driver"), it would have been obvious in view of *Martin* to configure *Zhang*'s system to provide such features to ensure proper operation of the LED circuitry. (Ex. 1002, ¶190.)

As discussed above for limitation 7(f) in Ground 1, *Martin* (like *Zhang* and the '400 patent) relates to LED lighting. (§IX.A.1(f); *see also* §IX.F.1(a) (discussing *Zhang*'s LED lighting system).) Therefore, a POSITA contemplating implementing *Zhang*'s lighting system would have had reason to consider the teachings of *Martin*. (Ex. 1002, ¶191.) A POSITA contemplating implementing *Zhang*'s system would have had the same knowledge regarding the state of the art and recognition of design issues as discussed for limitation 7(f) in Ground 1, including recognition that the forward voltage of the series-connected LEDs should approximately match the DC voltage output of the LED driver circuit, as known in the art. (§IX.A.1(f); Ex. 1002, ¶191.) A POSITA would have considered and recognized the pertinence of *Martin*'s teachings, discussed above for limitation 7(f) in Ground 1 as demonstrating the state of the art, including *Martin*'s disclosure regarding providing an appropriate amount of voltage for powering LEDs safely, and such a skilled person would have also known (*e.g.*, as demonstrated by *Allen*, discussed above for limitation 7(f)) that voltage matching like that recited in limitation 7(f) is used, and indeed required, to determine appropriate power to provide to LEDs. (§IX.A.1(f); Ex. 1011, ¶¶[0032]-[0033], [0056], [0060], [0068], Abstract; Ex. 1002, ¶192.)

In view of *Martin* and the state of the art (*e.g.*, as demonstrated by *Allen* and discussed above for limitation 7(f) in Ground 1), a POSITA would have found it obvious to choose an appropriate number of LEDs connected in series such that a total forward voltage drop matches the rectified output AC voltage of the driver. (§IX.A.1(f); Ex. 1002, ¶193.) A POSITA would have had the same motivation, skill, rationale, and expectation of success regarding the *Zhang-Martin* combination for limitation 7(f) in Ground 7, as for limitation 7(f) discussed in Ground 1 regarding the *Nerone-Martin* combination. (§IX.A.1(f); Ex. 1002, ¶193.)

g) Limitation 7(g)

Zhang discloses this limitation. (Ex. 1002, ¶¶194-196.) *Zhang* discloses that "[t]he circuit board [for *Zhang*'s lighting system] is shown in FIG. 2.1," which is annotated below. (Ex. 1012, ¶[0038]; *id.*, ¶¶[0032]-[0039], [0080]-[0088]; Ex. 1002, ¶194.)

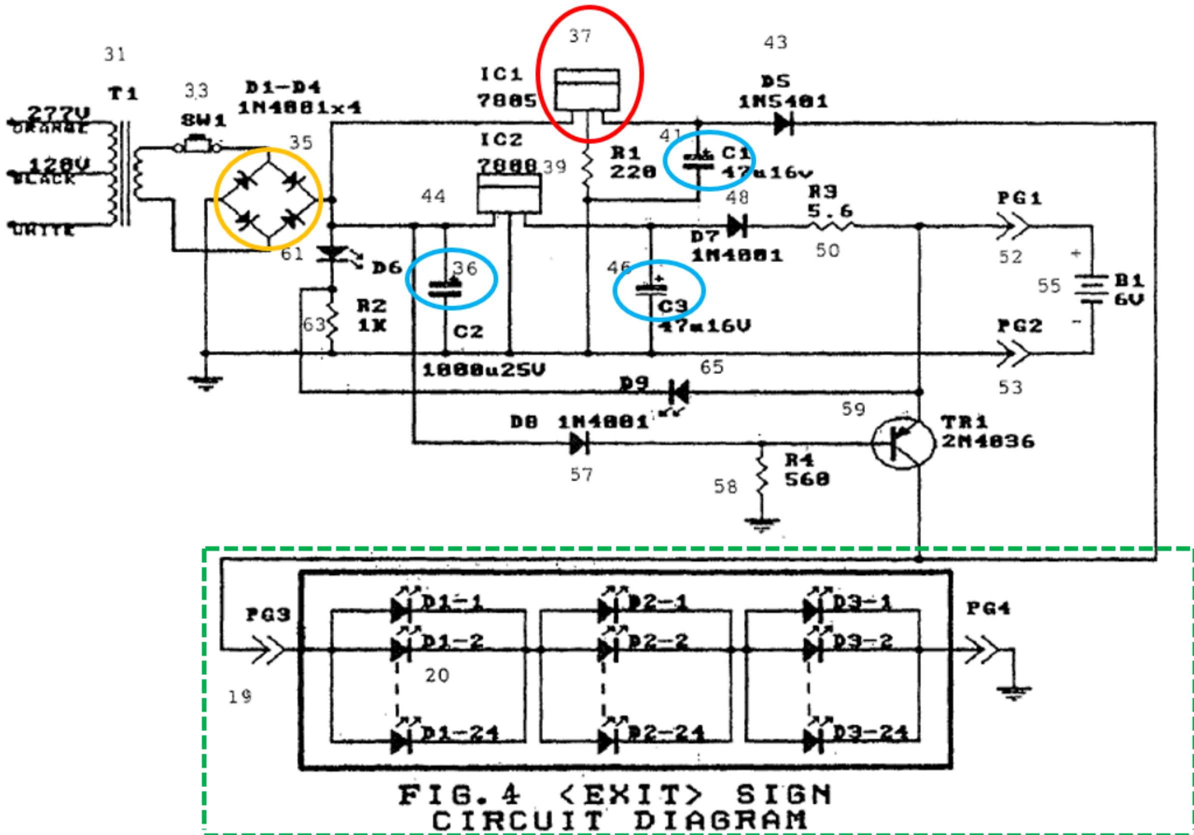

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1012, FIG. 2.1 (annotated); Ex. 1002, ¶194.)

As shown above, *Zhang* discloses that its LED circuit array (green above), capacitors C1-C3 (any of which is "the capacitor" as claimed) (blue above), bridge rectifier 35 (orange above), and driver (red above) that drives power and current to LEDs are all mounted on a single circuit board ("substrate"). (Ex. 1002, ¶195.) A POSITA would have understood that these components in *Zhang*'s system are *mounted* as claimed. (Ex. 1035, 1:60-2:5; Ex. 1002, ¶196.) *Zhang*'s disclosures are consistent with state-of-the-art knowledge (discussed above for limitation 7(g) in §IX.A.1(g)) of a POSITA regarding the use of a substrate to mount LED circuits and associated components in a lighting system. (Ex. 1104, FIG. 1, 3:58-4:31; *see also* Ex. 1015, ¶¶[0020], [0023]-[0025]; Ex. 1075, ¶¶[0039]-[0042], FIG. 9; Ex. 1002, ¶196.)

2. Claims 9 and 17[13]

As discussed above in §IX.F, *Zhang-Martin* discloses or suggests all the features of claim 7. Likewise, as discussed below in §IX.H, *Zhang* discloses or suggests all the features of claim 14. Although *Zhang* does not explicitly disclose that LEDs the features of claims 9 and 17, the application of phosphors and light changing substances to LEDs was a well-known technique in the art, as explained in Ground 1. (§IX.A.2; Ex. 1015, ¶[0027]; Ex. 1014, 12:4-13; Ex. 1049, 2:37-45, 3:36-45, 4:34-37, 5:54-58, 8:34-39, FIG. 6; Ex. 1002, ¶¶197-200.)

A POSITA would have been motivated in view of *Martin* to include this feature with the *Zhang-Martin* lighting system (claim 7) / *Zhang* LED lighting device (claim 14). (Ex. 1002, ¶198.) As explained in §IX.A.2, *Martin* discloses LEDs coated with a wavelength converting layer (*i.e.*, "a light changing substance," as claimed), such as a phosphor, to enable conversion of the color of light emitted

[13] Claim 17 recites: "The LED lighting device of claim 14, wherein the LEDs are coated or doped with at least one of a phosphor, nano-crystals, or a lighting changing or enhancing substance."

by the LEDs. (Ex. 1015, ¶¶[0005], [0027]; Ex. 1014, 12:4-13; Ex. 1002, ¶198.) In light of *Martin* and the state of the art, a POSITA would have been motivated, and found it obvious, to coat the LEDs of *Zhang-Martin*'s system (claim 7) / modified *Zhang*'s device (claim 14) with a phosphor or other light changing material. (Ex. 1002, ¶199.) A POSITA would have had the same appreciation, knowledge, skills, rationale, motivation, and reasonable expectation of success regarding the above modification for claims 9 and 17 in this section, as discussed above in Ground 1 regarding modifying *Nerone*'s system in view of *Martin*. (§IX.A.2; Ex. 1002, ¶200.)

3. Claim 10

Zhang-Martin discloses or suggests this limitation. (Ex. 1002, ¶201.) For instance, as explained for limitation 7(d) in §IX.G.1(d), *Zhang* discloses that rectifier 35 receives a 9 VAC input AC voltage from the mains power source via transformer 33 ("the input AC voltage input received from the mains power source"). And as explained for limitation 7(e), *Zhang* discloses that regulator 37 provides the rectified output AC voltage to the LED circuit array. (§IX.G.1(e).) Regulator 37 provides a 5V output. (Ex. 1012, ¶[0084] ("regulator 37 of 5 VDC"). The '400 patent provides no guidance regarding what "relatively close" encompasses. (*See* §IX.C.1 n.9.) Without conceding definiteness, *Zhang-Martin* discloses or suggests claim 10.

4. Claim 11

Zhang (as modified above) discloses or suggests this limitation. (Ex. 1002,

¶¶202-203.) For instance, as shown below in Figure 2.1, *Zhang* discloses that capacitor C1 (“the capacitor”) (blue below) is configured to smooth the rectified output AC voltage provided by regulator 37 (red below). (*Id.*)

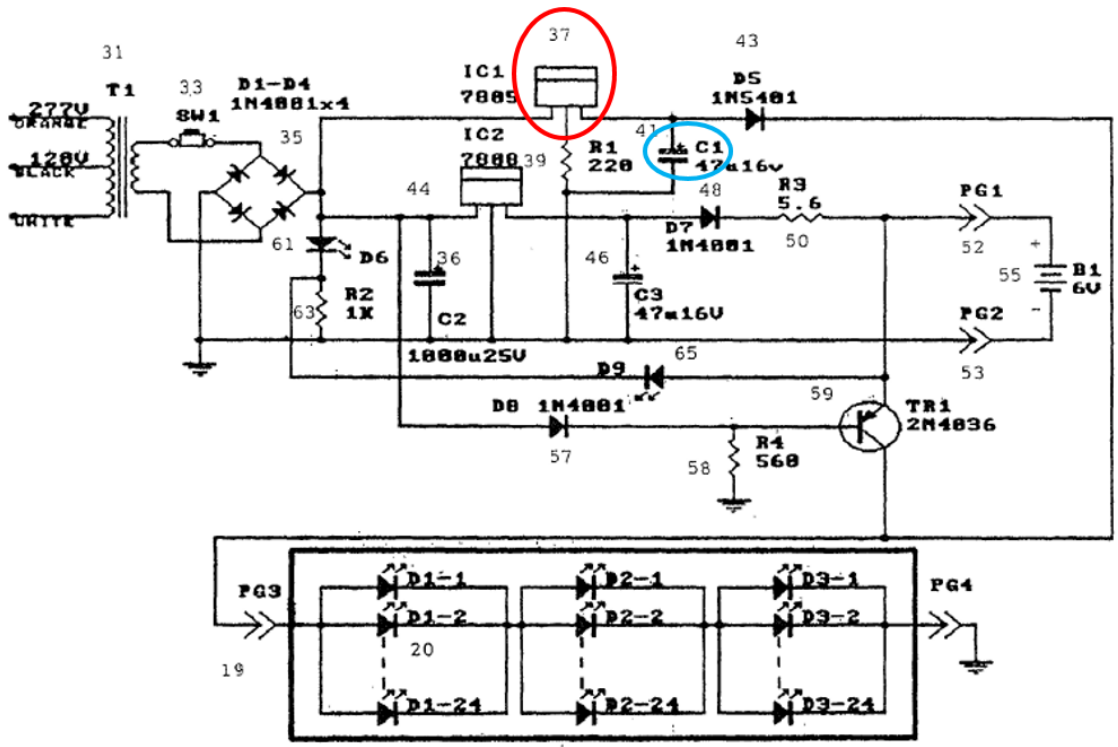

FIG. 4 <EXIT> SIGN
CIRCUIT DIAGRAM

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1012, FIG. 2.1 (annotated); Ex. 1002, ¶202.)

Capacitor C1 (having reference numeral 41 in *Zhang*) is configured to smooth the voltage at the output of regulator 37 (“the rectified output AC voltage”). (Ex. 1002, ¶203.) For example, *Zhang* describes “filtering by capacitor 41” (Ex. 1012, ¶[0084]) and a capacitor arranged as shown above in Figure 2.1 was well known to perform smoothing of a voltage. (Ex. 1007, FIG. 7, ¶[0095]; Ex. 1002, ¶203.)

G. Ground 7: Claim 8 Is Obvious Over *Zhang*, *Martin*, and *Morgan*

1. Claim 8

While *Zhang-Martin* does not explicitly disclose power factor correction circuitry, it would have been obvious in view of *Morgan* to configure the *Zhang-Martin* system to implement this feature. (Ex. 1002, ¶¶204-207.) As discussed above in §IX.B (claim 8), *Morgan* is in the same field as the '400 patent and addresses similar problems associated with integrating LEDs and driving circuitry, and thus would have been considered by a POSITA when contemplating the design and implementation of the *Zhang-Martin* lighting system. (Ex. 1001, 1:45-48.)

As discussed in §IX.B, power factor was "well understood in the electrical engineering community." (Ex. 1013, 2:22-26.) *Morgan* recognizes the desire for a high power factor and provides a solution in the form of power factor correction circuitry. (§IX.B.1; Ex. 1033, 76:40-54; Ex. 1031, 7:5-10; Ex. 1002, ¶206.) In light of *Morgan* and the state of the art, a POSITA would have been motivated to modify the *Zhang-Martin* lighting system to include power factor correction circuitry like that claimed, *e.g.*, for obtaining a high power factor. (Ex. 1002, ¶207.) A POSITA would have had the same appreciation, knowledge, skills, rationale, motivation, and reasonable expectation of success regarding the above modification of the *Zhang-Martin* system in view of *Morgan* for claim 8, as discussed for claim 8 regarding modifying the *Nerone-Martin* system. (§IX.B.1; Ex 1002, ¶207.)

H. Ground 8: Claim 14 Is Obvious Over *Zhang*

1. Claim 14

a) An LED lighting device comprising:

Zhang discloses this limitation. (Ex. 1002, ¶¶208-209.) For example, *Zhang* discloses "**Lighting Devices** Using LEDS," (Ex. 1012, Title (emphasis added).) In particular, *Zhang* describes "5 **lighting devices**," including "chip-on-board LED exit signs"). (*Id*., ¶¶[0018], [0022], [0032]-[0039] (emphasis added).) *Zhang* teaches that a chip-on-board LED lighting system used for various lighting contexts, e.g., an illuminated exit sign. (*Id*., ¶[0018]; *id.*, ¶¶[0002] ("LED exit signs"), [0005]-[0006] ("LED Exit Signs"), [0079] ("Chip-on-board LED Exit Signs").) Figure 2.1 (below) illustrates the electronic circuit board configuration for the exit sign.

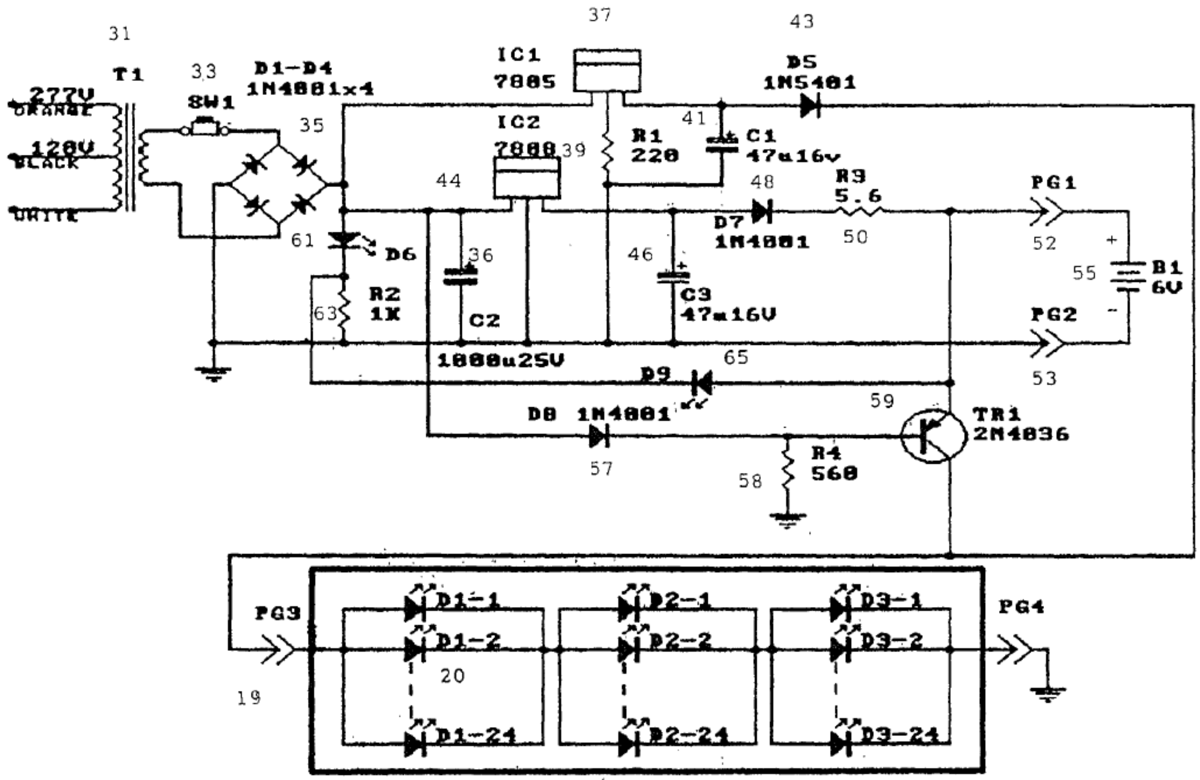

FIG. 4 <EXIT> SIGN
CIRCUIT DIAGRAM

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1012, FIG. 2.1; *see also* §§IX.H.1(b)-(e); Ex. 1002, ¶209.)

b) a plurality of LED circuits connected in parallel, wherein each LED circuit comprises at least two LEDs;

Zhang discloses this limitation. (Ex. 1002, ¶210.) As discussed for the preamble of claim 14, *Zhang* discloses an LED lighting device including LEDs. (§IX.H.1(a); Ex. 1012, FIG. 2.1; Ex. 1002, ¶210.) *Zhang* further discloses that its LED lighting device comprises LEDs arranged in parallel-connected rows ("a plurality of LED circuits connected in parallel"), wherein each row of LEDs ("each LED circuit") comprises at least two LEDs. (Ex. 1002, ¶210.) For example, *Zhang* discloses that "[t]he COBLEDES [chip-on-board LED exit sign] 19 has **n LEDs [in] one row** and **m [r]ows in parallel**." (Ex. 1012, ¶[0088]; *see also id.*, ¶¶[0037] ("There are n LEDs in serial on one row and m rows in parallel on the board...."), [0088], FIG. 2.1; Ex. 1002, ¶210.) Each row of LEDs is an *LED circuit*, as explained for limitation 7(b) in Ground 6. (§IX.F.1(b); Ex. 1002, ¶210.)

c) wherein the LED circuits are mounted on a reflective substrate;

Zhang discloses this limitation. (Ex. 1002, ¶¶211-212.) *Zhang* discloses its lighting device (*e.g.*, LED exit sign) includes a circuit board. (Ex. 1012, ¶¶[0079] ("Chip-on-board LED Exit Signs"), [0083] ("The circuit board design is shown in FIG. 2.1."), FIG. 2.1 ("Electronic Circuit Board for LED Exit Sign"); Ex. 1002, ¶211.) The circuit board is a substrate upon which *Zhang*'s LEDs and other components of *Zhang*'s lighting device (shown in Figure 2.1, below) are mounted. (Ex. 1002, ¶211.) For example, a POSITA would have had this understanding because Figure 2.1 of *Zhang* is captioned "Electronic Circuit Board for LED Exit Sign" and shows the LEDs and the other components of the lighting device. (Ex. 1012, FIG. 2.1; *see also* Ex. 1035, 1:60-2:5; Ex. 1002, ¶211.)

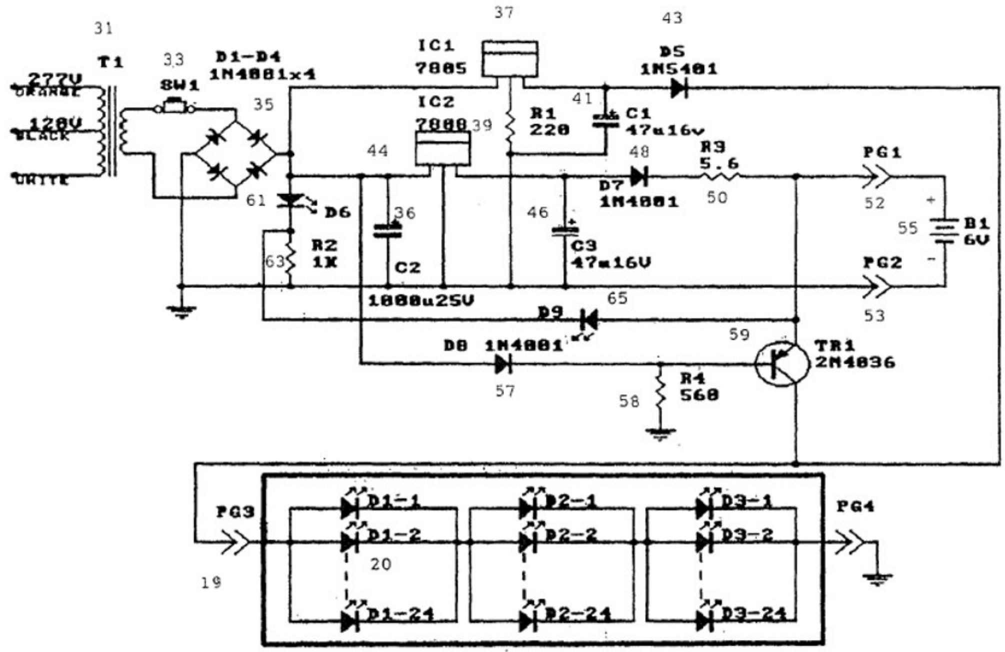

FIG. 4 <EXIT> SIGN CIRCUIT DIAGRAM

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1012, FIG. 2.1 (annotated); Ex. 1002, ¶211.)

Zhang discloses that its circuit board (“substrate”) is a *reflective* circuit board. (Ex. 1012, ¶[0081] (“coat a layer of high **reflection material** on the top of the board”); *see also id.*, ¶¶[0018], [0034]; Ex. 1002, ¶212.) *Zhang*’s LED circuits are *mounted* on *Zhang*’s circuit board. (Ex. 1035, 1:60-2:5; Ex. 1012, FIG. 2.1; Ex. 1002, ¶212.)

d) an LED driver configured to receive one of at least two different input voltage levels from an AC mains power source; and

Zhang discloses this limitation. (Ex. 1002, ¶¶213-214.) For instance, as shown below in annotated Figure 2.1, *Zhang* discloses an LED driver (red below) coupled to LEDs 20. (Ex. 1012, FIG. 2.1; Ex. 1002, ¶213.) The circuitry annotated in red below is a *driver*, *e.g.*, because it drives voltage and current to LEDs 20. (Ex. 1002, ¶213.)

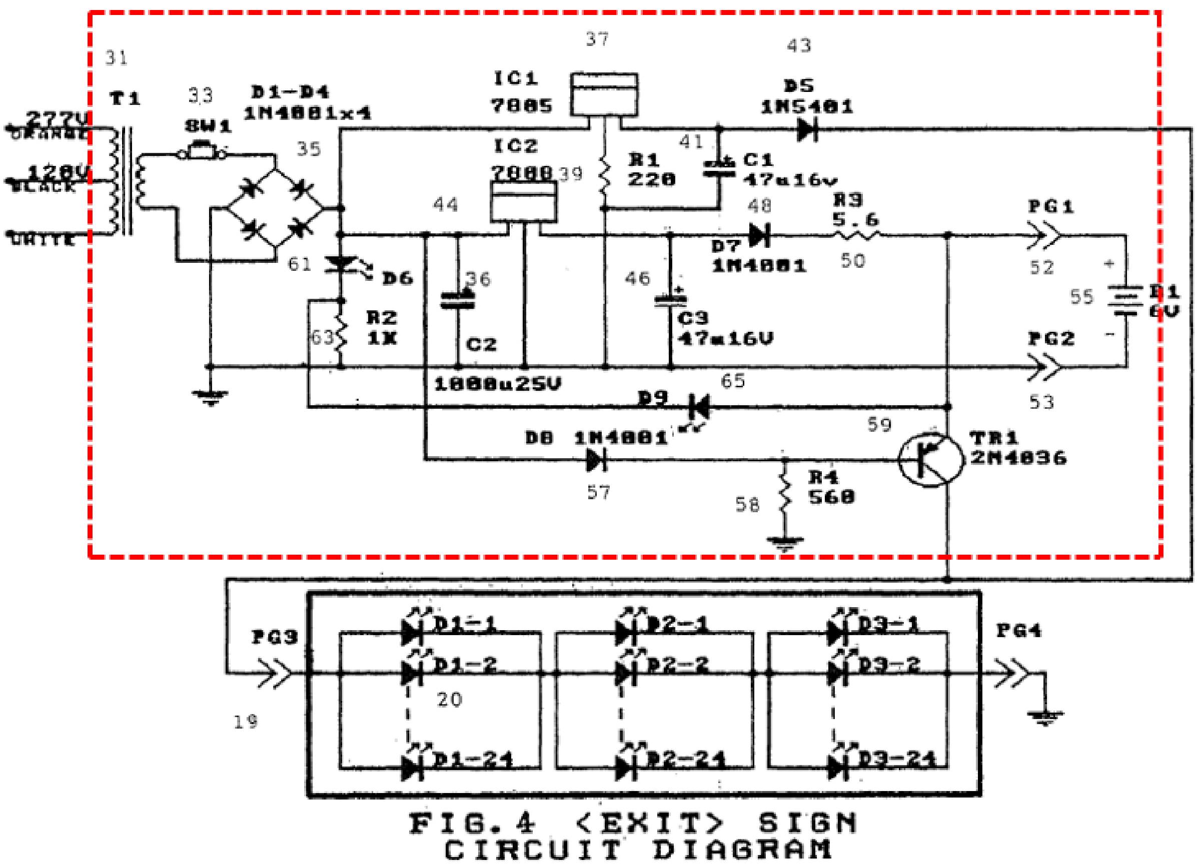

Fig. 2.1, Electronic Circuit Board for LED Exit Sign

(Ex. 1012, FIG. 2.1 (annotated); Ex. 1002, ¶213.)

Zhang discloses that "**120 VAC or 220 VAC power from the commercial line** is reduced to 9 VAC by the transformer 31 and sent to the test switch 33." (Ex. 1012, ¶[0083]; *see also id.*, ¶[0036]; Ex. 1002, ¶214.) Thus, *Zhang* discloses that its LED driver is configured to receive one of at least two different input voltage levels from an AC mains power source. (Ex. 1002, ¶214.) As explained for limitation 7(d) (§IX.F.1(d)), the AC voltage received via *Zhang*'s commercial line is received from a *mains* power source. (Ex. 1013, 1:25-29; Ex. 1027, 1:8-12, 1:18-27; Ex. 1045, 1:20; Ex. 1002, ¶214.)

e) wherein the LED circuits and the LED driver are integrated in a single package.

Zhang discloses or suggests this limitation. (Ex. 1002, ¶¶215-217.) As discussed for limitation 14(b), *Zhang* discloses LED circuits, and a POSITA would have understood that *Zhang*'s LED circuits and the LED driver are integrated in a single package, *e.g.*, because the LED circuits and LED driver are shown on the circuit board of *Zhang*'s Figure 2.1, which is the circuit board for the lighting device that is implemented as an LED exit sign or backlight. (Ex. 1012, FIG. 2.1, ¶¶[0082]-[0090]; Ex. 1002, ¶215.)

To the extent *Zhang* does not explicitly disclose that the above-discussed LED circuits and LED driver are integrated in a single package, it would have been obvious to configure the above-discussed LED circuits and driver in *Zhang*'s lighting device as a package. (Ex. 1002, ¶216.) A POSITA would have been motivated to consider using or forming such an integrated component for the LED driver and circuits because of the desire for and benefits of using integrated components that were predictable to build and package. Indeed, a POSITA would have been aware of the advantages in such designs, especially for lighting devices (including ones relating to exit signs) like *Zhang*'s device. (Ex. 1015, ¶¶[0004]-[0006], [0024], [0028]-[0029]; Ex. 1104, FIG. 1, 2:27-37 (disclosing an illuminated "exit sign," like *Zhang*'s LED exit sign), 3:58-4:31; *see also* Ex. 1022, FIG. 7; Ex. 1002, ¶216.)

The above configuration of *Zhang*'s device would have been feasible and straightforward to implement, as integrating various components in a single package was well within a POSITA's capabilities. (Ex. 1002, ¶217.) Indeed, such a configuration would have been a mere combination/integration of known components according to known methods to produce the predictable and expected results of a single package that includes the components. (*Id.*) *KSR*, 550 U.S. at 416. For similar reasons, a POSITA would have had a reasonable expectation of success implementing such a configuration. (Ex. 1002, ¶217.)

I. Ground 9: Claim 15 Is Obvious Over *Zhang* and *Mosebrook*

1. Claim 15

a) The LED lighting device of claim 14, further comprising a 3-way switch.

While *Zhang* does not explicitly disclose a 3-way switch, it would have been obvious in view of *Mosebrook* and state of the art to implement this feature in *Zhang*'s device. (Ex. 1002, ¶¶91-92, 218-221.) *Zhang* discloses the use of a switch in LED lighting devices that control signals connected to LEDs. (Ex. 1012, ¶[0119], FIG. 5.3.) *Mosebrook* describes lighting control systems, and thus would have been a relevant resource for a POSITA to consider when contemplating implementing *Zhang*'s lighting device. (Ex. 1018, 1:15-20, 1:40-41 ("lighting control system"); Ex. 1002, ¶219.)

Mosebrook explains that it was known that "a user can install a so called **three-way electrical switch**, *i.e.*, an additional light control switch to an existing hardwired single control system," and a POSITA would have known that such a three-way switch was a conventional device that was widely used in various lighting systems, *e.g.*, to enable a user to control a lighting system from two places (*e.g.*, control a hallway light using switches at both ends of a hallway), or control the selection of functionality in lighting systems. (Ex. 1018, 2:30-35; Ex. 1028, 2:1-15, 3:66-4:5, FIGS. 1, 4; Ex. 1029, 5:30-34, FIG. 1; Ex. 1040, ¶[0018]; Ex. 1002, ¶220.)

In light of *Mosebrook* and the state of the art, it would have been predictable and obvious to modify *Zhang*'s system to implement a 3-way switch. (Ex. 1002, ¶221.) Such an implementation would have been beneficial, *e.g.*, for providing increased flexibility to a user for controlling *Zhang*'s lighting device. (*Id.*) A POSITA would have been motivated to consider various designs to enable the lighting system to be controlled (*e.g.*, implement a three-way switch at the modified lighting system that would operate with another three-way switch at a location different from the modified lighting system, to provide similar functionality, such as allowing a user to turn on/off lighting features in the system from different locations). (*Id.*) Such an implementation would have been a mere combination of known components and technologies, according to known methods, to produce predictable results. (*Id.*) *KSR*, 550 U.S. at 416. A POSITA would have been skilled at circuit design and would have found a three-way switch to be simple to implement in various electrical systems, including *Zhang*'s lighting device. (Ex. 1002, ¶221.) Therefore, a POSITA would have had a reasonable expectation of success regarding such an implementation in the combined *Zhang-Mosebrook* device. (*Id.*)

J. Ground 10: Claim 16 Is Obvious Over *Zhang*, *Michael*, and *Gleener*

1. Claim 16

a) The LED lighting device of claim 14, further comprising a data communication circuit comprising an antenna, an inductor and a capacitor, wherein the data communication circuit is integrated in the single package.

To the extent *Zhang* does not explicitly disclose the features of claim 16, it would have been obvious in view of *Michael*, *Gleener*, and the state of the art to implement such features in *Zhang*'s device. (Ex. 1002, ¶¶222-228.) As discussed for claim 12 (§IX.D.1), *Michael* "relates to lighting assemblies" and discloses (like *Zhang*) LED-based lighting. (Ex. 1008, 1:5-7; *see also id.*, Title, 7:20-8:47; Ex. 1012, Title, Abstract, FIG. 2.1, ¶¶[0080]-[0090]; Ex. 1002, ¶223.) Accordingly, a POSITA contemplating implementing *Zhang*'s LED lighting device would have had reason to consider the teachings of *Michael*. (Ex. 1002, ¶223.) As discussed for claim 12, *Michael* discloses a data communication circuit comprising an antenna. (§IX.D.1; Ex. 1008, 10:48-61, FIG. 15; *see also id.*, FIG. 12, 7:20-21, 7:35-43, 9:53-55; Ex. 1002, ¶223.)

In light of *Michael* and the state of the art, a POSITA would have been motivated to configure *Zhang*'s lighting device to include a data communication circuit comprising an antenna. (Ex. 1002, ¶224.) For example, a POSITA would have found such a configuration useful for enabling remote wireless control of the lighting device, *e.g.*, to turn on/off or otherwise control lighting (*e.g.*, brightness of lighting). (*Id.*) Indeed, wireless control of lighting was well known, as discussed above for claim 12. (§IX.D.1; Ex. 1005, Abstract, FIG. 6, ¶¶[0032], [0083], [0110], [0123], [0177]; Ex. 1008, FIG. 15, 10:48-58; Ex. 1022, FIG. 4A; Ex. 1002, ¶224.)

For similar reasons, a POSITA contemplating implementing the *Zhang-Michael* system, including its antenna, would have found *Gleener* to be a relevant reference to consider, because *Gleener* describes implementing an antenna-based system, including maximizing transfer of energy to the antenna, as explained for claim 13 (§IX.E.1). (Ex. 1039, Title, Abstract, ¶[0001]; Ex. 1002, ¶225.) Thus, a POSITA would have found it relevant to consider the teachings of *Gleener* for implementing efficient wireless control of the *Zhang-Michael* lighting device. (Ex. 1002, ¶225.) As explained for claim 13, *Gleener* discloses a data communication circuit comprising an inductor and a capacitor for impedance matching and describes benefits associated with such impedance matching. (§IX.E.1; Ex. 1039, ¶¶[0002], [0004], [0014], [0020], FIGS. 1, 3; Ex. 1002, ¶225.)

In light of *Gleener*, a POSITA would have been motivated to configure the data communication circuit of the *Zhang-Michael* device to comprise an inductor and a capacitor, in addition to the antenna discussed above. (Ex. 1002, ¶226.) Such a configuration would have advantageously promoted efficiency and high antenna performance, as described in *Gleener* and discussed above. (Ex. 1039, ¶[0002]; §IX.F.1; Ex. 1002, ¶226.)

A POSITA would further have been motivated in view of the state of the art to integrate the data communication circuit of the *Zhang-Michael-Gleener* system in the single package discussed for limitation 14(e). (Ex. 1002, ¶227.) For example, it was well known to integrate various components of a lighting system in a single package (*e.g.*, a single circuit board or light fixture). (Ex. 1022, FIGS. 7-8; *see also id.*, FIGS. 2-5, 4:7-16, 4:48-50; Ex. 1002, ¶227.) Integrating the data communication circuit of the *Zhang-Michael-Gleener* device in the single package would have promoted efficiency, compactness, and system stability, and would have been a predictable implementation. (Ex. 1002, ¶228.) Integrating various components was a fundamental aspect of electronic system design and indeed underlies the well-known concept integrated circuits (ICs) in general. (*Id.*) A POSITA would have been capable of implementing the above configuration and would have had a reasonable expectation of success implementing it, for similar reasons as discussed above regarding claim 13 (in Ground 5) and in this section. (§IX.E.1; Ex. 1002, ¶228.)

K. Ground 11: Claim 18 Is Obvious Over *Zhang* and *Morgan*

1. Claim 18

a) The lighting device of claim 14, wherein the driver comprises power factor correction circuitry.

Although *Zhang* does not explicitly disclose that the driver discussed for limitation 14(d) (§IX.H.1(d)) includes power factor correction circuitry, it would have been obvious in view of *Morgan* to configure *Zhang*'s device to implement this feature. (Ex. 1002, ¶¶229-231.) As explained for claim 8 (§§IX.B.1, IX.G.1), *Morgan* is from the field of lighting (including LEDs for lighting) and addresses the problem of a poor power factor. (Ex. 1033, 1:38-39, 76:40-54.) Accordingly, *Morgan* is in the same field as *Zhang* and the '400 patent and addresses similar problems associated with LEDs and driving circuitry, and thus would have been considered by a POSITA when contemplating the design and implementation of *Zhang*'s lighting device. (Ex. 1002, ¶230; Ex. 1001, 1:59-62.) As also explained for claim 8, *Morgan* discloses a driver that includes power factor correction circuitry. (§§IX.B.1, IX.G.1; Ex. 1033, 76:40-54, FIG. 48; Ex. 1002, ¶230.)

In light of the knowledge of a POSITA at the time and the disclosures/suggestions of *Morgan*, it would have been obvious to modify *Zhang*'s lighting device to include power factor correction circuitry like that claimed. (Ex. 1002, ¶231.) A POSITA would have had the same motivation, knowledge, skills, appreciation of benefits, and reasonable expectation of success, with respect to this modification of *Zhang*'s lighting device in view of *Morgan*, for similar reasons as discussed with respect to the modification of the *Nerone-Martin-Morgan* combination. (*Id.*) *KSR*, 550 U.S. at 416.

L. Ground 12: Claim 19 Is Obvious Over *Zhang* and *Hudson*

1. Claim 19

a) The lighting device of claim 14, wherein the driver comprises soft start circuitry.

While *Zhang* combination does not explicitly disclose soft start circuitry, it would have been obvious in view of *Hudson* to configure *Zhang*'s driver to comprise soft start circuitry.[14] (Ex. 1002, ¶¶93-96, 232-237.) *Hudson* (like *Zhang*) discloses circuitry for an LED lighting system, and thus a POSITA would have had reason to consider the teachings of *Hudson* when contemplating implementing *Zhang*'s LED lighting device. (Ex. 1019, Abstract ("LED array circuits"), 8:25-27; Ex. 1002,

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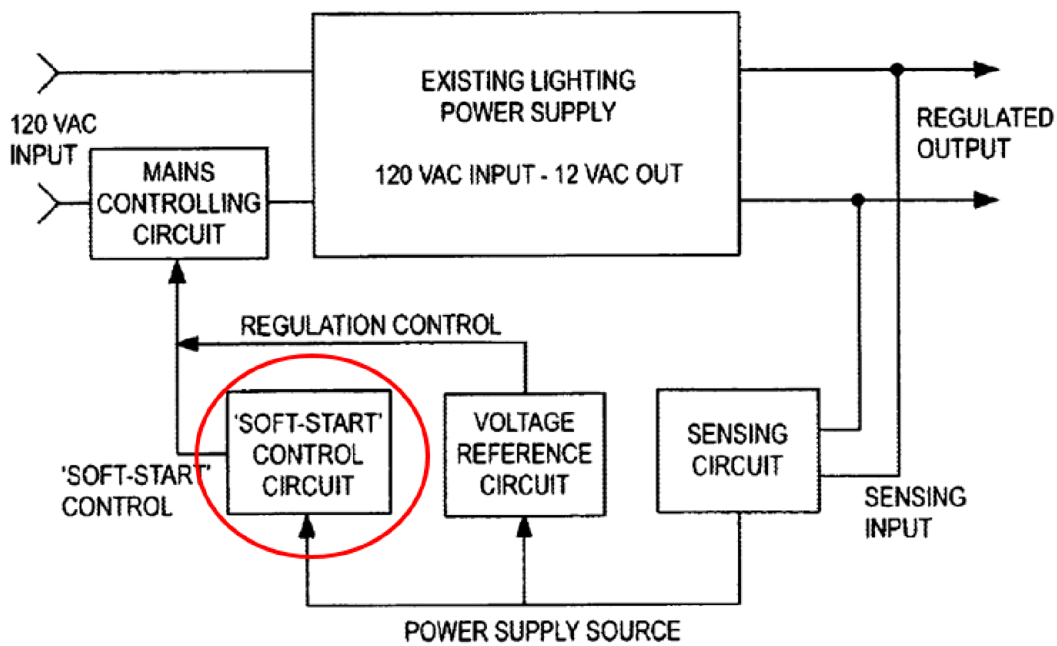
[14] The specification of the '400 patent only mentions "soft start" once, without explaining what it is. (Ex. 1001, 7:34-38; Ex. 1002, ¶233.) For purposes of this proceeding, Petitioner applies prior art to this claim based on the language of the claim.

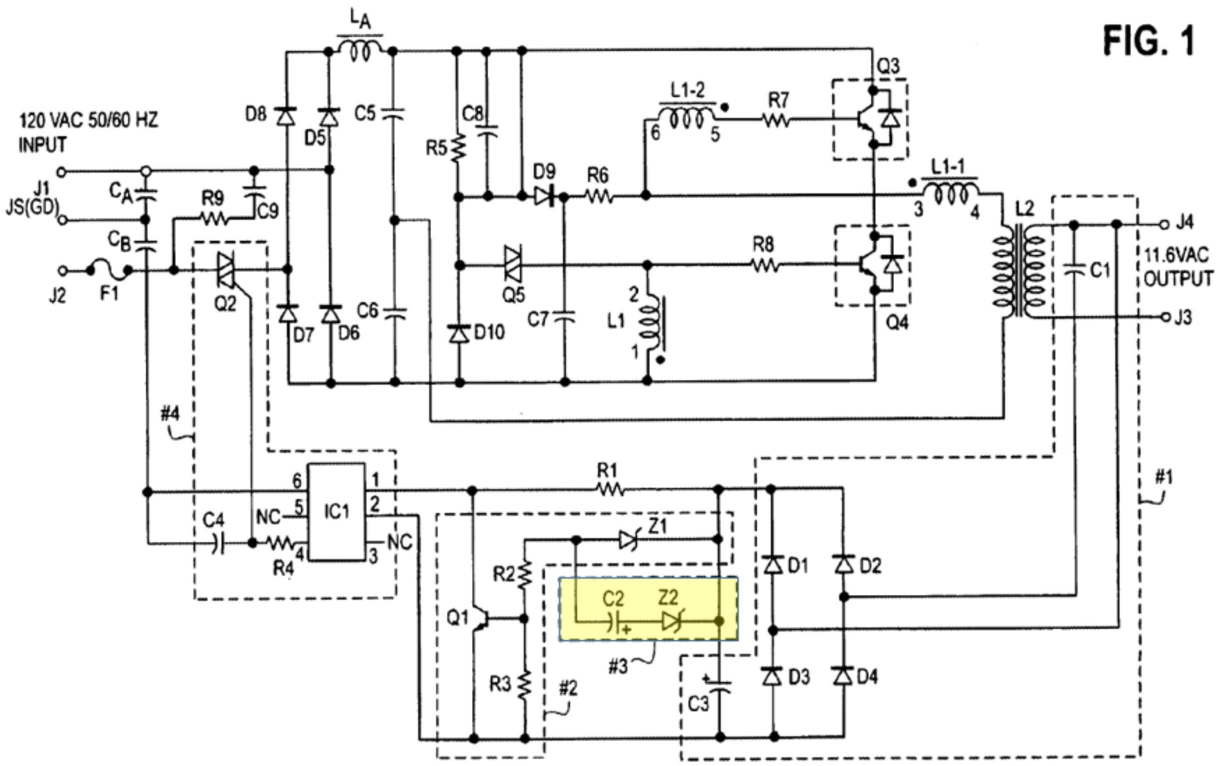
¶233.) *Hudson* discloses an LED driver that comprises soft start circuitry. (Ex. 1002, ¶234.) For example, *Hudson* discloses that a "**soft start** voltage equalizing **circuit** limits lamp starting current to allow a slow warm-up of tungsten filaments and LED arrays to reduce filament thermal shock." (Ex. 1019, 4:29-31.) *Hudson* discloses a voltage regulator (depicted in block diagram format in Figure 2 below) that includes a soft start control circuit (red below):

FIG. 2



(Ex. 1019, FIG. 2 (annotated); *see also id.*, 5:9-12; Ex. 1002, ¶234.)

Figure 1 (below) is a schematic diagram of *Hudson*'s voltage regulator that includes soft-start circuit #3 (yellow below), which "is comprised of zener diode Z2 and capacitor C2." (Ex. 1019, 6:36-37.)



(*Id.*, FIG. 1 (annotated); *see also id.*, 6:22-28 ("Referring to FIG. 1, the voltage regulator is comprised of four basic circuits.... Circuit No. 3 is the **soft-start circuit**."); Ex. 1001, ¶235.)

Hudson explains that an "[o]scillation frequency of the soft start circuit is determined by the values of zener diode Z2 and capacitor C2 of the soft start circuit and zener diode Z1 of [a] voltage reference circuit," and "[t]his oscillation process helps **limit the inrush currents experienced by the power supply** and **extends**

lamp life by permitting a slow warmup of tungsten filaments of the halogen lamps, thus reducing filament and LED array thermal shock." (Ex. 1019, 7:17-24; *see also id.*, 7:28-31, 9:54-57; Ex. 1002, ¶236.)

In light of *Hudson*'s disclosures, a POSITA would have been motivated to configure *Zhang*'s driver to comprise soft start circuitry. (Ex. 1002, ¶237.) A POSITA would have recognized that such a configuration would have promoted reliability/performance and would have been predictable and feasible given that *Hudson* describes soft start circuitry in detail. (*Id.*) A POSITA would been capable of implementing various types of circuitry, including soft start circuitry. (*Id.*) Such a skilled person would have found the above configuration to be straightforward and would have had a reasonable expectation of success implementing it, as this would have been a combination of known components and technologies, according to known methods, to produce predictable results. (*Id.*) *KSR*, 550 U.S. at 416.

M. Ground 13: Claim 20 Is Obvious Over *Zhang* and *Muthu*

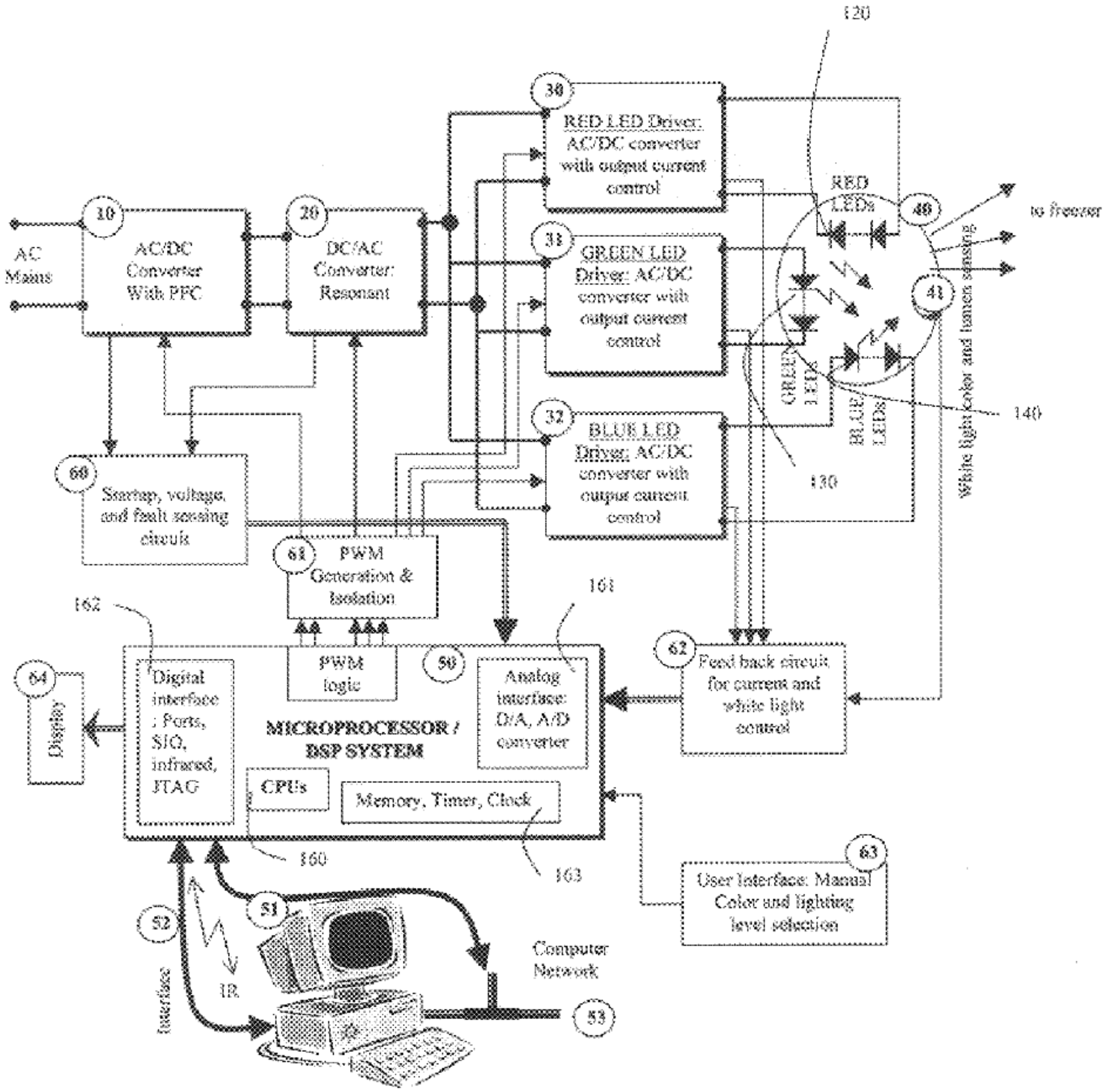
1. Claim 20

a) The lighting device of claim 14, wherein the driver comprises at least one field effect transistor.

While *Zhang* does not explicitly disclose a "field effect transistor" (regarding which the '400 patent does not describe any criticality, *see generally* Ex. 1001), it would have been obvious in view of *Muthu* to configure *Zhang*'s driver to comprise at least one field effect transistor. (Ex. 1002, ¶¶97-103, 238-243.) *Muthu* relates to

LED circuits for providing lighting for display systems, *e.g.*, displaying products in a retail environment. (Ex. 1020, Title ("RGB LED based light driver using microprocessor controlled AC distributed power system"), Abstract ("A device for controlling and adjusting a display light for a retail display system comprising a computer associated with plural light sources for adjusting the light sources to optimally display particular products."), FIGS. 1-3, 1:7-12; Ex. 1002, ¶239.) Additionally, *Muthu*, like *Zhang*, describes powering LEDs with AC power. (Ex. 1020, 2:62-3:2 ("The power is supplied by front-end AC/DC converter 10, high frequency DC/AC converter 20, and three load-end AC/DC converters 30, 31 and 32 for providing RGB LED drive currents. ...").) Therefore, a POSITA contemplating implementing *Zhang*'s LED lighting device would have found *Muthu* to be a relevant resource to consult. (Ex. 1002, ¶239.)

Figure 1 of *Muthu* (below) shows a "microprocessor controlled AC power supply system for [an] RGB LED based freezer driver." (Ex. 1020, 2:62-65.)



(Ex. 1020, FIG. 1; *see also id.*, 2:49-50; Ex. 1002, ¶240.)

Muthu discloses that "power is supplied by front-end AC/DC converter 10, high frequency DC/AC converter 20, and three load-end AC/DC converters 30, 31 and 32 for providing RGB LED drive currents" to "Red, Green and Blue LED light sources 120, 130 and 140 respectively," where "[e]ach Red, Green and Blue LED light source is made of a plurality of LEDs connected in a suitable series and/or parallel configuration." (Ex. 1020, 2:65-3:5; Ex. 1002, ¶241.)

Muthu describes the use of field effect transistors for driving its LEDs. (Ex. 1002, ¶242.) For example, *Muthu* describes that "[t]he outputs of [] isolation circuit [61] are fed into individual **MOSFET drivers** in AC/DC converter 10, DC/AC converter 20, and LED drivers 30, 31, and 32" shown in Figure 1. (Ex. 1020, 4:33-37.) A POSITA would have known that a MOSFET was a well-known semiconductor technology having widespread usage long before the alleged invention date of the '400 patent. (Ex. 1002, ¶242.)

In light of *Muthu*, a POSITA would have been motivated, and found it predictable and obvious, to configure *Zhang*'s driver to implement known field effect transistor design concepts. (Ex. 1002, ¶243.) For example, a POSITA would have recognized that *Muthu*'s disclosure of MOSFET drivers in an LED lighting system would have been a predictable usage of existing transistor technology. (*Id.*) Indeed, field effect transistors were well known to a POSITA for controlling circuits/signals. (Ex. 1017, FIG. 5 (FET 272), 10:54-11:13 (describing FET 272); Ex. 1030, 112-117; Ex. 1002, ¶243.) A POSITA would have found the usage of a field effect transistor to be beneficial, because it was a reliable technology for conditionally conducting current. (Ex. 1002, ¶243.) A POSITA would have had a reasonable expectation of success in implementing such a configuration, which would have involved the use of known technologies and techniques to produce the predictable results discussed above. (*Id.*) *KSR*, 550 U.S. at 416.

X. THE CIRCUMSTANCES WEIGH AGAINST DISCRETIONARY DENIAL

A. The *Fintiv* Factors Favor Institution

An evaluation of the factors under *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (Mar. 20, 2020) (precedential), favors institution notwithstanding the concurrent Illinois Litigation (§II).

First factor. Petitioner intends to seek a stay of the Illinois Litigation upon institution. The Board has explained it will not speculate as to the outcome of such unresolved issues before a district court, *Google LLC et al. v. Parus Holdings, Inc.*, IPR2020-00847, Paper 9 at 12-13, and this factor is neutral where no such stay motion has yet been filed, *Hulu LLC v. SITO Mobile R&D IP, LLC*, IPR2021-00298, Paper 11 at 10-11 (May 19, 2021). Accordingly, this factor does not weigh in favor of discretionary denial.

Second factor. Regarding the Illinois Litigation, the court has not set a trial date.[15] (Exs. 1076, 1086-1088.) There has not been significant resource investment by the court and the parties, particularly compared to the resource expenditures leading up to a trial. Moreover, any trial (if it occurs) would likely only occur at

[15] PO's motion to transfer the Illinois-Litigation to Texas was denied. (Ex. 1085.)

least 102 weeks after the service of the complaint (and indeed the complaint has been amended twice)—and thus after a final written decision in this IPR. (Ex. 1079, 1-2 (document available at Northern District of Illinois website, estimating "Case Ready for Trial" 102 weeks after complaint served); Ex. 1076, 8 (Dkt. #16 showing summons returned May 19, 2021).)

Third factor. The minimal investment by the court and parties in the Illinois Litigation weighs against discretional denial. Discovery is at an early stage. Expert discovery is not open, no depositions have occurred, and no substantive efforts toward claim construction have begun. In short, little has happened and the most resource intensive period in the district court case will occur after the institution decision in this proceeding. (*See* Exs. 1076, 1086.) This alone weighs against denial. *See*, *e.g.*, *Hulu*, IPR2021-00298, Paper 11 at 13.

Fourth factor. In the Illinois Litigation, PO has asserted only claims 7-11 of the '400 patent, while this Petition challenges claims 7-20, so the Illinois Litigation will not resolve all disputed validity issues. (§IX; Ex. 1083, 5; Ex. 1084, 2-9.) Furthermore, to mitigate any potential concerns, Petitioner stipulates that it will not pursue invalidity of the '400 patent in district court based on any instituted IPR grounds in this proceeding.

Fifth factor. That Petitioner is a party to the Illinois Litigation does not outweigh the other factors that strongly weigh against discretionary denial.

Sixth factor. Petitioner diligently filed this Petition with strong grounds (*supra* §IX) **within four months** of PO's assertion of the '400 patent (Ex. 1082, pp. 56-59, 67), **within three months** of PO's amended infringement contentions in the Illinois Litigation (Ex. 1083), and **more than eight months before** the statutory deadline for filing an IPR (Ex. 1082, 67). Such diligence weighs against exercising discretion. *See*, *e.g.*, *Hulu*, IPR2021-00298, Paper 11 at 13; *Facebook, Inc. v. USC IP P'ship, L.P.*, IPR2021-00033, Paper 13 at 13.

Further, the '400 patent issued on first office action without any substantive prior art analysis of the ultimately issued claims. (Ex. 1004, 134-136.) Institution is thus consistent with the significant public interest against "leaving bad patents enforceable." *Thryv, Inc. v. Click-To-Call Techs., LP*, 140 S. Ct. 1367, 1374 (2020). Moreover, this Petition is the ***sole*** challenge to claims 7-20 of the '400 patent before the Board—a "crucial fact" favoring institution. *Google LLC v. Uniloc 2017 LLC*, IPR2020-00115, Paper 10 at 6 (PTAB May 12, 2020).

Accordingly, based on a "holistic view of whether efficiency and integrity of the system are best served," the facts here weigh against exercising discretion denial. *Samsung Elecs. Co. Ltd. v. Dynamics Inc.*, IPR2020-00505, Paper 11 at 15 (Aug. 12, 2020). At a minimum, factors 2, 3, 4, and 6 (or combinations thereof) outweigh factors 1 (neutral) and 5, and thus favor institution.

B. The Board Should Not Exercise Discretion Under § 325(d) To Deny the Petition

Discretionary denial under § 325(d) is inappropriate in view of this Petition's reliance on *Martin*. While *Martin* was cited in an Information Disclosure Statement (IDS) during prosecution (Ex. 1004, 5), the Office erred in a manner material to the patentability of the challenged claims by not applying the teachings of *Nerone* and *Martin*. *Advanced Bionics, LLC v. Med-El Elekromediznische Geräete GMBH*, IPR2019-01469, Paper 6 at 8 (precedential) (Feb. 13, 2020). Specifically, *Martin* was not substantively discussed or applied during prosecution of the '400 patent (*see generally* Ex. 1004)—indeed the '400 patent issued as a first action allowance (*id.*, 130-136)—and the citation of *Martin* in an IDS should not serve as a basis for denial of institution here. *Becton, Dickinson and Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 16-18, 24-25 (PTAB Dec. 15, 2017). Moreover, the Examiner erred by dismissing *Martin* given its disclosures, which (as explained above) are material to the patentability of the challenged claims. (§§IX.A-IX.E.) Indeed, the Examiner never considered *Nerone* in view of *Martin* (the combination of references discussed for claim 7 above in §IX.A for Ground 1). Additionally, the Examiner did not have the benefit of expert testimony explaining the significance of *Nerone* in combination with *Martin* as explained above. Such oversight is critical and warrants consideration of *Martin* in the above-asserted grounds during trial here. *Advanced Bionics* at 8-9.

XI. CONCLUSION

Accordingly, Petitioner requests institution of IPR for the challenged claims based on the specified grounds.

Respectfully submitted,

Dated: November 12, 2021 By: /Joseph E. Palys/
Joseph E. Palys (Reg. No. 46,508)
Counsel for Petitioner

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 10,687,400 contains, as measured by the word-processing system used to prepare this paper, 13,990 words. This word count does not include the items excluded by 37 C.F.R. § 42.24 as not counting towards the word limit.

Respectfully submitted,

Dated: November 12, 2021

By: /Joseph E. Palys/
Joseph E. Palys (Reg. No. 46,508)
Counsel for Petitioner

CERTIFICATE OF SERVICE

I hereby certify that on November 12, 2021, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 10,687,400 and supporting exhibits to be served via express mail on the Patent Owner at the following correspondence address of record as listed on PAIR:

K&L Gates LLP-Chicago
P.O. Box 1135
Chicago IL 60690

By: /Joseph E. Palys/
Joseph E. Palys (Reg. No. 46,508)