

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMAZON.COM SERVICES LLC
Petitioner,

v.

SMART SPEAKER LLC
Patent Owner.

Patent No. 11,190,590

Inter Partes Review No. IPR2026-00148

**PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *et seq.***

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Claims Listing

Claim	Limitation #	Limitation
1	1[PR1]	An Alternating-Current (AC) powered appliance
	1[PR2]	associated with a food storage, handling, or preparation
	1[PR3]	for use with a wireless network, the appliance comprising:
	1[A]	an AC connector for connecting the appliance to an AC power source;
	1[B]	a current sensor coupled to the AC connector for measuring an AC current consumed by the appliance;
	1[C]	a first sensor having an output that responds to a physical phenomenon;
	1[D]	an antenna for communication over the wireless network;
	1[E]	a wireless transceiver coupled to the antenna for transmitting digital data to, and for receiving digital data from, the wireless network; and
	1[F]	a single enclosure housing the current sensor, the first sensor, the antenna, and the wireless transceiver,
	1[G]	wherein the first sensor is coupled to the wireless transceiver for transmitting digital data in response to the physical phenomenon to the wireless network,
	1[H]	wherein the appliance is controlled or activated in response to digital data received from the wireless network, and

Claim	Limitation #	Limitation
	1[I]	wherein the current sensor is further coupled to the wireless transceiver for transmitting digital data in response to the measured AC current to the wireless network.
2	2	The appliance according to claim 1, wherein the primary function of the appliance is heating food.
3	3	The appliance according to claim 2, wherein the appliance comprises a microwave oven, an electric mixer, a stove, an oven, or an induction cooker.
4	4	The appliance according to claim 1, wherein the primary function of the appliance is cooling food.
5	5	The appliance according to claim 4, wherein the appliance comprises a refrigerator, a freezer, or an iced-tea maker.
6	6	The appliance according to claim 1, wherein the appliance comprises a dishwasher, a food blender, a beverage maker, or a coffeemaker.
7	7	The appliance according to claim 1, further comprising in the single enclosure an electrically actuated switch connected to a switch electric power to at least part of the appliance, wherein the electrically actuated switch is coupled to the wireless transceiver for being activated in response to digital data received from the wireless network.
8	8	The appliance according to claim 7, wherein the electrically actuated switch is ‘normally open’ type, ‘normally closed’ type, or a changeover switch, wherein the electrically actuated switch is ‘make-before-break’ or ‘break-before-make’ type, or wherein the electrically actuated switch have two or more poles or two or more throws, and contacts of the electrically actuated switch are arranged as a

Claim	Limitation #	Limitation
		Single-Pole-Double-Throw (SPDT), Double-Pole-Double-Throw (DPDT), Double-Pole-Single-Throw (DPST), or Single-Pole-Changeover (SPCO).
9	9	The appliance according to claim 7, wherein the electrically actuated switch is a latching or a non-latching type relay.
10	10	The appliance according to claim 9, wherein the relay is a solenoid-based electromagnetic relay that is a reed relay, wherein the relay is solid-state or semiconductor based, or wherein the relay is a Solid State Relay (SSR).
11	11	The appliance according to claim 7, wherein the electrically actuated switch is based on an electrical circuit that comprises an open collector transistor, an open drain transistor, a thyristor, a TRIAC, or an opto-isolator.
12	12	The appliance according to claim 1, wherein the current sensor comprises an ampermeter, galvanometer, or a hot-wire ampermeter.
13	13	The appliance according to claim 1, wherein the current sensor comprises a current clamp, a current probe, a current transformer, or uses a 'Hall effect'.
14	14	The appliance according to claim 1, wherein the current sensor is a non-contact or a non-conductive current meter.
15	15	The appliance according to claim 1, further comprising in the single enclosure a wattmeter connected to the AC connector for measuring the magnitude of the active AC power or an electrical energy consumed by the appliance.
16	16	The appliance according to claim 15, wherein the

Claim	Limitation #	Limitation
		wattmeter comprises a single or multi-phase AC power or energy meter.
17	17	The appliance according to claim 15, wherein the wattmeter comprises a bolometer, or wherein the wattmeter accumulates or averages readings.
18	18	The appliance according to claim 15, wherein the wattmeter comprises the current sensor, or wherein the wattmeter is based on multiplying a measured voltage and the current measured by the current sensor.
19	19	The appliance according to claim 15, wherein the wattmeter or the current sensor are induction based.
20	20	The appliance according to claim 1, wherein the wireless network is a Wireless Personal Area Network (WPAN), the antenna is a WPAN antenna, and the wireless transceiver is a WPAN modem.
21	21	The appliance according to claim 20, wherein the WPAN is according to, based on, or compatible with, Bluetooth™ or Institute of Electrical and Electronics Engineers (IEEE) 802.15.1-2005 standards.
22	22	The appliance according to claim 20, wherein the WPAN is according to, based on, or compatible with, Zigbee™, IEEE 802.15.4-2003, or Z-Wave™ standards.
23	23	The appliance according to claim 1, wherein the wireless network is a Wireless Local Area Network (WLAN), the antenna is a WLAN antenna, and the wireless transceiver is a WLAN modem.
24	24	The appliance according to claim 23, wherein the WLAN is according to, based on, or compatible

Claim	Limitation #	Limitation
		with, IEEE 802.11-2012, IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, IEEE 802.11n, or IEEE 802.11ac.
25	25	The appliance according to claim 1, wherein the wireless network is a wireless broadband network.
26	26	The appliance according to claim 1, wherein the wireless network uses a licensed or unlicensed radio frequency band.
27	27	The appliance according to claim 26, wherein the unlicensed radio frequency band is an Industrial, Scientific and Medical (ISM) radio band.
28	28	The appliance according to claim 1, wherein the wireless network is a satellite network, the antenna is a satellite antenna, and the wireless transceiver is a satellite modem.
29	29	The appliance according to claim 1, wherein the wireless network is a WiMAX network, wherein the antenna is a WiMAX antenna and the wireless transceiver is a WiMAX modem, and wherein the WiMAX network is according to, or based on, or compatible with, IEEE 802.16-2009.
30	30	The appliance according to claim 1, wherein the wireless network is a cellular telephone network, the antenna is a cellular antenna, and the wireless transceiver is a cellular modem.
31	31	The appliance according to claim 30, wherein the cellular telephone network is a Third Generation (3G) network that uses Universal Mobile Telecommunications System (UMTS), Wideband Code Division Multiple Access (W-CDMA) UMTS, High Speed Packet Access (HSPA), UMTS Time-Division Duplexing (TDD), CDMA2000 1×RTT,

Claim	Limitation #	Limitation
		Evolution-Data Optimized (EV-DO), or Global System for Mobile communications (GSM), Enhanced Data rates for GSM Evolution (EDGE) EDGE-Evolution, or wherein the cellular telephone network is a Fourth Generation (4G) network that uses Evolved High Speed Packet Access (HSPA+), Mobile Worldwide Interoperability for Microwave Access (WiMAX), Long-Term Evolution (LTE), LTE-Advanced, Mobile Broadband Wireless Access (MBWA), or is based on IEEE 802.20-2008.
32	32	The appliance according to claim 1, further comprising an electrically actuated switch connected to switch electric power to at least part of the appliance, the switch is coupled to the first sensor for being activated in response to the physical phenomenon.
33	33	The appliance according to claim 1, wherein the first sensor is a piezoelectric sensor that includes a single crystal material or a piezoelectric ceramics and uses a transverse, longitudinal, or shear effect mode of the piezoelectric effect.
34	34	The appliance according to claim 1, further comprising multiple sensors arranged as a directional sensor array operative to estimate a number, magnitude, frequency, Direction-Of-Arrival (DOA), distance, or speed of the physical phenomenon impinging the sensor array.
35	35	The appliance according to claim 1, wherein the first sensor is a thermoelectric sensor that responds to a temperature or to a temperature gradient of an object using a conduction, convection, or radiation, and wherein the thermoelectric sensor consists of, or comprises, a Positive Temperature Coefficient (PTC) thermistor, a Negative Temperature

Claim	Limitation #	Limitation
		Coefficient (NTC) thermistor, a thermocouple, a quartz crystal, or a Resistance Temperature Detector (RTD).
36	36	The appliance according to claim 1, wherein the first sensor consists of, or comprises, a nanosensor, a crystal, or a semiconductor.
38	38	The appliance according to claim 1, wherein the first sensor consists of, or comprises, an atmospheric or an environmental sensor.
39	39	The appliance according to claim 1, wherein the first sensor consists of, or comprises, a bulk or surface acoustic sensor.
40	40	The appliance according to claim 1, wherein the first sensor consists of, or comprises, a radiation sensor that responds to radioactivity, nuclear radiation, alpha particles, beta particles, or gamma rays, and is based on a gas ionization.
41	41	The appliance according to claim 1, wherein the first sensor consists of, or comprises, a photoelectric sensor that responds to a visible or an invisible light, and wherein the invisible light is infrared, ultraviolet, X-rays, or gamma rays.
42	42	The appliance according to claim 41, wherein the photoelectric sensor is based on the photoelectric or photovoltaic effect, and consists of, or comprises, a semiconductor component that consists of, or comprises, a photodiode, a phototransistor, or a solar cell.
43	43	The appliance according to claim 41, wherein the photoelectric sensor is based on Charge-Coupled Appliance (CCD) or a Complementary Metal-Oxide Semiconductor (CMOS) element.

Claim	Limitation #	Limitation
44	44	The appliance according to claim 1, wherein the first sensor consists of, or comprises, a photosensitive image sensor array comprising multiple photoelectric sensors, for capturing an image and producing electronic image information representing the image, and the appliance further comprising one or more optical lens for focusing the received light and to guide the image, and wherein the image sensor is disposed approximately at an image focal point plane of the one or more optical lens for properly capturing the image.
45	45	The appliance according to claim 44, further comprising an image processor coupled to the image sensor for providing a digital data video signal according to a digital video format, the digital video signal carrying the digital data video based on the captured images, and wherein the digital video format is based on one out of: TIFF (Tagged Image File Format), RAW format, AVI, DV, MOV, WMV, MP4, DCF (Design Rule for Camera Format), ITU-T H.261, ITU-T H.263, ITU-T H.264, ITU-T CCIR 601, ASF, Exif (Exchangeable Image File Format), and DPOF (Digital Print Order Format) standards.
46	46	The appliance according to claim 1, wherein the first sensor consists of, or comprises, an electrochemical sensor that responds to an object chemical structure, properties, composition, or reactions.
47	47	The appliance according to claim 46, wherein the electrochemical sensor consists of, or comprises, a pH meter or a gas sensor responding to a presence of radon, hydrogen, oxygen, or Carbon-Monoxide (CO), or wherein the electrochemical sensor is based on an optical detection or on an ionization

Claim	Limitation #	Limitation
		and is a smoke, a flame, or a fire detector, or is responsive to a combustible, flammable, or toxic gas.
48	48	The appliance according to claim 1, wherein the first sensor consists of, or comprises, an electroacoustic sensor that responds to an audible or inaudible sound.
49	49	The appliance according to claim 48, wherein the electroacoustic sensor is an omnidirectional, unidirectional, or bidirectional microphone that is based on the sensing an incident sound-based motion of a diaphragm or a ribbon, and the microphone consists of, or comprises, a condenser, an electret, a dynamic, a ribbon, a carbon, or a piezoelectric microphone.
50	50	The appliance according to claim 1, further comprising in the single enclosure a light source that emits a visible or non-visible light for illumination or indication, the non-visible light is infrared, ultraviolet, X-rays, or gamma rays, the light source is coupled to the AC connector for being powered from the AC power, and wherein the light source is coupled to the wireless transceiver for illumination or indication in response to digital data received from the wireless network.
51	51	The appliance according to claim 50, wherein the light source is coupled to the current sensor for illumination or indication in response to the measured AC current.
52	52	The appliance according to claim 50, wherein the light source consists of, or comprises, a lamp, an incandescent lamp, a gas discharge lamp, a fluorescent lamp, a Solid-State Lighting (SSL), a Light Emitting Diode (LED), an Organic LED

Claim	Limitation #	Limitation
		(OLED), a polymer LED (PLED), or a laser diode.
53	53	The appliance according to claim 1, further comprising in the single enclosure an actuator for affecting the physical phenomenon, wherein the actuator is coupled to the wireless transceiver for being activated or controlled in response to digital data received from the wireless network.
54	54	The appliance according to claim 53, wherein the actuator consists of, or comprises, a motion actuator that causes a linear or rotary motion, and the appliance further comprising a conversion mechanism for respectfully converting to rotary or linear motion based on a screw, a wheel and axle, or a cam.
55	55	The appliance according to claim 53, wherein the actuator consists of, or comprises, a sounder for converting an electrical energy to omnidirectional, unidirectional, or bidirectional pattern emitted, audible or inaudible, sound waves.
56	56	The appliance according to claim 53, wherein the actuator consists of, or comprises, an electromagnetic coil or an electromagnet operative for generating a magnetic or electric field.
57	57	The appliance according to claim 53, wherein the actuator consists of, or comprises, an electrical signal generator.
58	58	The appliance according to claim 53, wherein the actuator consists of, or comprises, a chemical or an electrochemical actuator, and is operative for producing, changing, or affecting a matter structure, properties, composition, process, or reactions.
59	59	The appliance according to claim 53, wherein the

Claim	Limitation #	Limitation
		actuator consists of, or comprises, a thermoelectric actuator and is a heater or a cooler, operative for affecting the temperature of a solid, a liquid, or a gas object, and is coupled to the object by conduction, convection, force convention, thermal radiation, or by the transfer of energy by phase changes.
60	60	The appliance according to claim 1, further being addressable in the wireless network using distinct locally administered addresses or universally administered digital addresses stored in a volatile or non-volatile memory in the single enclosure, which uniquely identifying the appliance in the wireless network or in the Internet.
61	61	The appliance according to claim 60, wherein the digital address is a Media Access Control (MAC) layer address that is MAC-48, Extended Unique Identifier (EUI) EUI-48, or EUI-64 address type.
62	62	The appliance according to claim 60, wherein the digital address is a layer 3 address and is static or dynamic Internet Protocol (IP) address that is IPv4 or IPv6 type address.
63	63	The appliance according to claim 60, wherein the digital address is autonomously assigned, or wherein the digital address is assigned by another appliance using Dynamic Host Configuration Protocol (DHCP).

Petitioner Amazon.com Services LLC respectfully petitions for *inter partes* review of claims 1-36 and 38-63 of U.S. Patent No. 11,190,590 (EX1001) per 35 U.S.C. §§311-319 and 37 C.F.R. §42.100 *et seq.*

I. INTRODUCTION

In 2022, U.S. electric utilities had approximately 119 million smart meter installations, representing about 72% of all electric meters nationwide. (EX1042.) Smart meters are ubiquitous and form the foundation of energy monitoring in the United States. Ensuring that this critical industry remains vital and free from assertions of unpatentable claims is essential to the U.S. economy.

Smart Speaker has asserted one such patent. The claimed invention of the '590 patent encompasses routine smart meter functionalities—specifically, a device having a current sensor and the ability to transmit and receive data. The Director should institute review to protect our robust patent system and a critical segment of our nation's economy.

Review is particularly appropriate here, because the PTAB has determined that the independent claim recited mostly garden-variety limitations during prosecution. (EX1003, 184-252.) Following the decision, the Examiner allowed the case after the Applicant added a generic sensor (in addition to an already recited current sensor) to claim 1, incorrectly asserting that the PTAB had “allowed” such a claim. But the PTAB never did so. (*Infra* § II.C.) And as

explained herein, energy monitoring devices with integrated sensors were already prevalent. (*E.g.*, EX1004, EX1005, EX1006, EX1045.)

The challenged claims are unpatentable for the reasons set forth herein, as supported by Dr. Houh. (EX1002.)

II. THE '590 PATENT

A. Summary

The '590 patent is directed to an “Alternating-Current (AC) powered appliance.” (EX1001, Claim 1.) During prosecution, Patent Owner identified *FIG. 5e* as illustrating the claimed system. (EX1003, 190-193, 420, 593.)

FIG. 5e shows, and the Board found during prosecution, that the claimed *appliance* can comprise both “appliance 58a” and a “*single enclosure 50e*.”¹ (EX1003, 193, 420; EX1001, Claim 1.) The *enclosure* has “an *AC Connector* (such as *item 59f*, *59g*, or *59h*, in Figure 5e) for connecting the appliance [58a] to an AC power source.” (EX1003, 420; EX1001, Claim 1.)

¹ All emphasis and annotations are added unless otherwise stated.

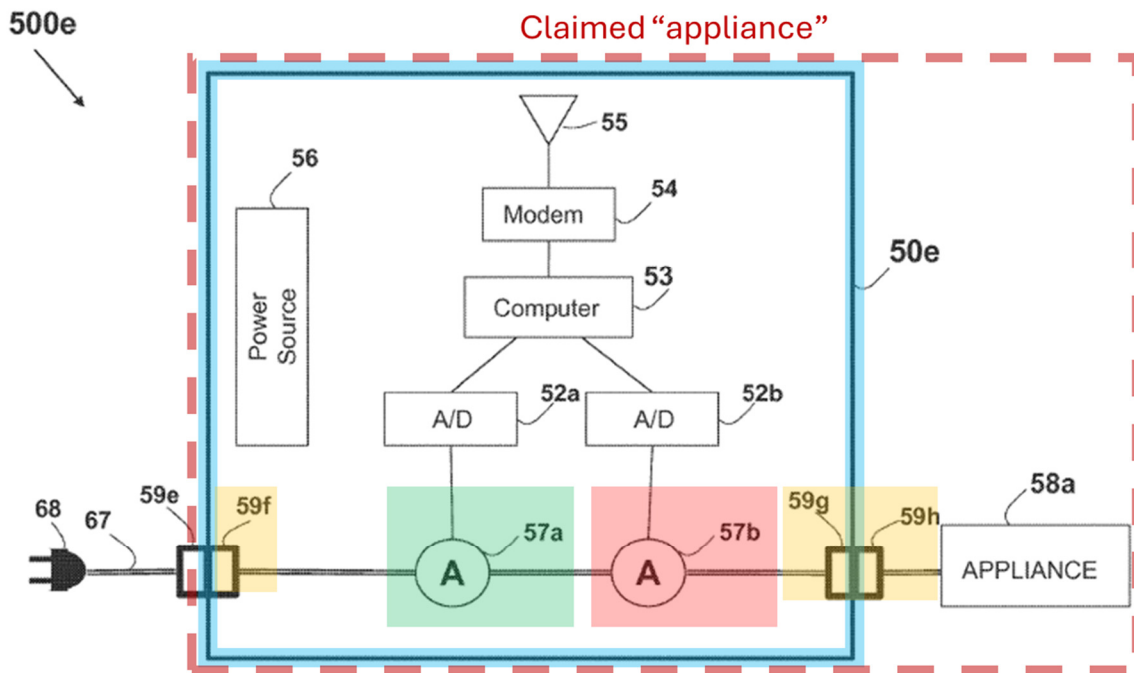


FIG. 5e

The *single enclosure 50e* houses several claimed elements according to the file history. The “*single enclosure* (such as *item 50e* in Figure 5e) hous[es] [a] *current sensor [57a]*, [an] antenna, and a wireless transceiver.” (EX1003, 420.) The “*current sensor* . . . [is] coupled to the *AC connector* for measuring an AC current consumed by the appliance.” (*Id.*) The antenna 55 and wireless transceiver 54 are for communication over a wireless network. (*Id.*) The *enclosure 50e* also houses a generic “*first sensor* [e.g., *57b*] having an output that responds to a physical phenomenon,” a claim element added to claim 1 to obtain allowance. (EX1001, Claim 1.) A physical phenomenon is broadly defined as encompassing “temperature, humidity, pressure, audio, vibration, light, motion, sound, proximity,

flow rate, electrical voltage, and electrical current.” (EX1001, 16:44-50.) Both the current sensor and the first sensor are coupled to the wireless transceiver for transmitting digital data. (EX1001, Claim 1.)

B. Effective Filing Date

The ’590 patent was filed on May 30, 2018, and issued on November 30, 2021. The ’590 patent claims earliest priority to a US provisional application that was filed on January 9, 2012, which Petitioner treats as the earliest effective filing date only for purposes of this proceeding. (EX1002, ¶18.)

C. Prosecution History

The application faced multiple Office Actions and an *ex parte* appeal before the Board.

During prosecution, the Applicant unsuccessfully argued that claim 1 implicitly requires “a single appliance in a single enclosure” in an attempt to overcome a reference disclosing an appliance with a separate plug enclosure. (EX1003, 422-424.)

The Board affirmed the Examiner’s anticipation rejection of claim 1, among others. In particular, the Board rejected the Applicant’s narrow interpretation that the appliance must be within the enclosure, pointing to FIG. 5e as “exemplifying the arrangement as claimed featuring *the appliance 58a of Figure 5e as separate from the single enclosure 50e.*” (EX1003, 193-194.) The Board reversed a §102

rejection of dependent claim 32, merely because the rejection relied on a different prior art embodiment than the embodiment used for claim 1 and was thus insufficient for anticipation. (EX1003, 197.)

Following the decision, the Applicant did not dispute the Board's determination that the enclosure can be "separate from" (*i.e.*, external to) the appliance. (EX1003, 166-179.) Nor did the Applicant amend the claim to explicitly require the claimed appliance within the enclosure. (*Id.*)

Instead, the Applicant incorporated dependent claim 32 into claim 1, *erroneously alleging* that "the content of the PTAB *allowed* claim 32 is incorporated into claim 1." (*Id.*, 178.) The Examiner nevertheless issued a Notice of Allowability, citing the PTAB decision in the "Reasons for Allowance." (EX1003, 34.)

But the Board never "allowed" claim 32. (EX1003, 197.) Rather, it held the Examiner erroneously relied on different embodiments for anticipation. (EX1003, 193-194; EX1002, ¶56.) Claim 32 merely recited a generic "first sensor having an output that responds to a physical phenomenon" and that is "coupled to the wireless transceiver for transmitting digital data . . ." (EX1003, 479; EX1002, ¶56.) The Examiner failed to consider obviousness, and this trivial addition should not have been a basis for allowance.

D. Level of Ordinary Skill in the Art

A POSITA in the field of the '590 patent would have a bachelor's degree in electrical engineering, computer engineering, or equivalent, and two years of experience working on remote device control and/or networked devices. An advanced graduate degree may make up for the work experience indicated above. (EX1002, ¶¶63.)

III. CLAIM CONSTRUCTION

Claim terms are presumed to carry their ordinary and customary meaning. The Board construes the terms only to the extent necessary to resolve the issue at hand: here, the invalidity of the claims under §103. The Board need not construe any of the claims because, as set forth in the Petition, the claims are invalid under §103 under any reasonable interpretation and thus no claim construction is necessary to resolve any issue before the Board. (EX1002, ¶¶65.)

IV. PRECISE REASONS FOR RELIEF REQUESTED

Pursuant to 37 C.F.R. §42.104(b), Petitioner requests cancellation of the challenged claims based on the following references. (EX1002, ¶¶66-79.) The Examiner never found, and Applicant never cited, any of these references during prosecution. *Id.*

Prior Art Reference	Abbreviation (Exhibit No.)	Prior Art Basis
U.S. Pat. Publication No. 2010/0238003	“Chan” (EX1004)	102(a)/(b)/(e)

Prior Art Reference	Abbreviation (Exhibit No.)	Prior Art Basis
U.S. Patent No. 8,461,861	“Botts” (EX1006)	102(e)
“Practical Electronics for Inventors” (2nd Edition, 2007)	“Scherz” (EX1007)	102(b)
“Handbook of Sensors and Actuators: Measuring Current, Voltage and Power” (Elsevier, 1999).	“Middelhoek” (EX1008)	102(b)
“Wireless Communications” (Cambridge University Press, 2005).	“Goldsmith” (EX1009)	102(b)
“Springer Handbook of Acoustics” (Springer Science+Business Media, LLC, 2007).	“Rossing” (EX1010)	102(b)
“Springer Handbook of Speech Processing” (Springer-Verlag Berlin Heidelberg, 2008).	“Benesty” (EX1011)	102(b)
“Handbook of Modern Sensors” (Springer Science+Business Media, LLC, 2010)	“Fraden” (EX1012)	102(a)
“Wireless Home Networking Simplified” (Cisco Press, 2007).	“Doherty” (EX1013)	102(b)
“Forced Air Cooling of CPUs with Heat Sinks: A Numerical Study” (IEEE Transactions on Components and Packaging Technologies, Vol. 31, No. 3, September 2008)	“Ozturk” (EX1014)	102(b)
Korean Patent Pub. No. 2010/0083686	“Seo” (EX1005)	102(a)/(b)

Prior Art Reference	Abbreviation (Exhibit No.)	Prior Art Basis
U.S. Pat. Publication No. 2010/0149163	“Betts-LaCroix” (EX1050)	102(b)

The statutory grounds for the challenge of each claim are set forth below.

All of the statutory citations are pre-AIA.

Ground	35 U.S.C. §	Claims	Prior Art Reference(s)
1	103	1-7, 13-16, 19-27, 29, 30, 32, 38, 41, 44-46, 53	Chan
2	103	50-52	Chan, Botts
3	103	8-11, 54, 57	Chan, Scherz
4	103	12, 17, 18	Chan, Middelhoek
5	103	28, 31	Chan, Goldsmith
6	103	33, 48, 49, 55, 56	Chan, Rossing
7	103	34	Chan, Benesty
8	103	35-36, 39, 40, 42, 43, 47	Chan, Fraden
9	103	60-63	Chan, Doherty
10	103	59	Chan, Ozturk
11	103	1, 23-24, 26-27, 38, 41, 53, 59	Seo, Chan
12	103	20-22	Seo, Chan, Goldsmith
13	103	35, 39	Seo, Chan, Fraden
14	103	58	Seo, Chan, Betts-LaCroix
15	103	60-63	Seo, Chan, Doherty

Below, Petitioner discusses why the challenged claims are unpatentable under the statutory grounds raised, including how and where the prior art satisfies

each element of each challenged claim, as required by 37 C.F.R. §42.104(b)(4).²

Petitioner’s showing establishes that there is a reasonable likelihood that it will prevail on each ground of unpatentability to each challenged claim.

A. Ground 1: Chan Renders Obvious Claims 1-7, 13-16, 19-27, 29, 30, 32, 38, 41, 44-46, 53

1. Summary of Chan

U.S. Pat. Publication No. 2010/0238003 (EX1004) was filed on August 30, 2009, and published September 23, 2010. (EX1004; EX1002, ¶¶80.) It is prior art under 35 U.S.C. §§102(a), (b), and (e). (EX1004.) Chan is analogous to the field of the ’590 patent. (EX1002, ¶¶89-90.) Both enhance performance of appliances via energy monitoring and wireless communication. (EX1004, [0041]; EX1001, 62:34-63:18, 82:2-54, 83:39-85:29; EX1002, ¶¶90.)

FIG. 1 of Chan illustrates a system 100 including household appliances such as refrigerators, washers and dryers, ranges, stoves, and microwaves. (EX1004, [0047]; EX1002, ¶¶81.) Each **appliance** includes an **appliance module 111**. (EX1004, [0046]-[0047]; EX1002, ¶¶81.) The **appliance module 111** “may be adapted to *measure, store and or control energy usage of connected appliances or devices*, bridge Zigbee wireless sensors and devices to the network, or *receive*

² Petitioner also shows how each claim preamble is satisfied but does not concede that any preamble is limiting.

and transmit information across network infrastructure.” (EX1004, [0047].)

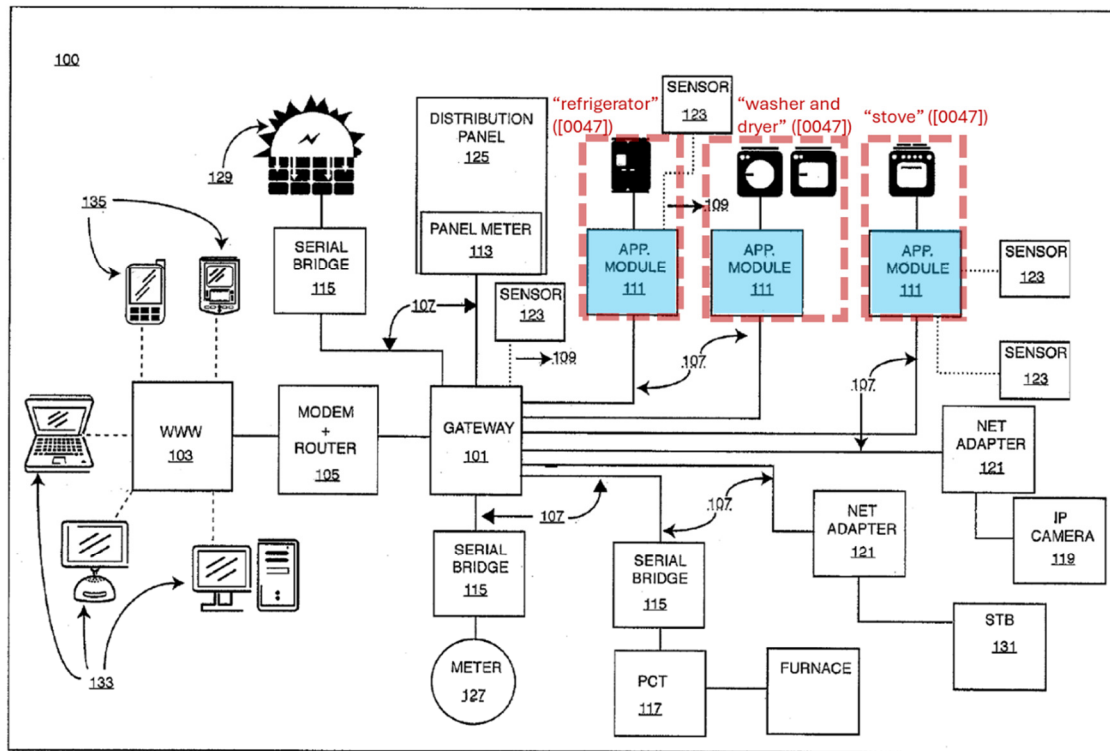
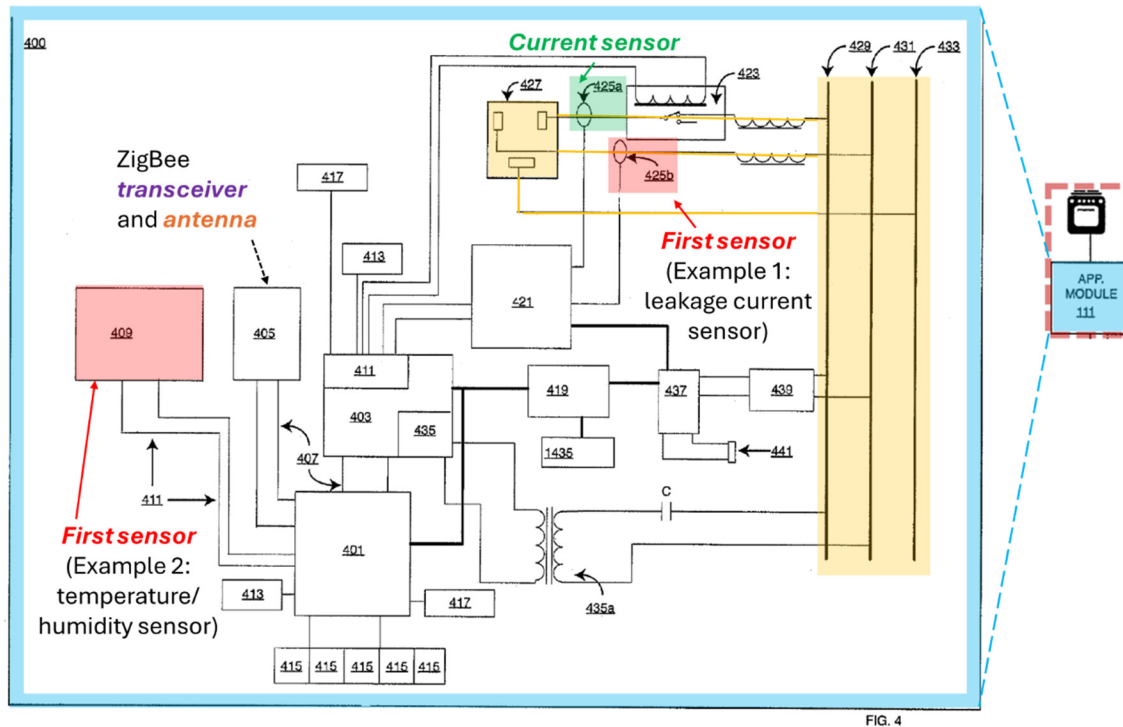


FIG. 1

In operation, the *appliance module* “sit[s] between a client device [e.g., stove, refrigerator, etc.] and a standard wall electrical outlet.” (EX1004, [0071]; EX1002, ¶82.) As shown in FIG. 4, an *appliance module 400* provides “a *standard AC socket 427*” for plugging in the appliance. (EX1004, [0070]; EX1002, ¶83.) “By plugging the client device into the *outlet* of *appliance module 400*, the client device is able to obtain electrical power.” (EX1004, [0071].)

(EX1001, FIG. 4³)

The **appliance module 400** has a **current sensor** for measuring AC current consumed by the connected appliance. (EX1002, ¶84.) Specifically, “**current transformer[] (CT) 425a** ... [is] connected to a **standard AC socket 427**” and the “**CT 425a measures current** on the live wire 429 [of AC wiring].” (EX1004, [0070].) Accordingly, “the **appliance module** is able to take measurements of energy usage.” (EX1004, [0071].)

The **appliance module** includes additional **sensors** (i.e., “**first sensors**”).

³ A portion of FIG. 1 is added on the right side, showing the relationship between the appliance module and an appliance.

(EX1002, ¶85.) First, *appliance module 400* includes a “*current transformer[] (CT) ...425b* that [is] connected to a standard AC socket 427.” (EX1004, [0070].)

Unlike *CT 425a*, “*CT 425b* measures current leakage on the neutral wire 431.”

(*Id.*) *Appliance module 400* separately includes “a *temperature and humidity sensor 409*,” and numerous additional sensors such as a “*light sensor*,” “*motion sensor*,” “*pressure sensor*,” etc. (EX1004, [0070], Claims 6-16; EX1002, ¶¶85-86.)

In operation, the *appliance module* wirelessly communicates with a control station (*i.e.*, “gateway”) and controls the appliance accordingly. (EX1004, [0008], [0053]; EX1002, ¶87.) For example, “a low-bandwidth signal may carry command or control information from gateway 300 [*i.e.*, gateway 101 in FIG. 1] to *appliance module 111* and turn the connected appliance on or off.” (EX1004, [0057].)

Chan’s network infrastructure is *wireless*. (EX1002, ¶88.) For example, “[t]he powerline data signal sent between *appliance module 400* and gateway 300 may be further transmitted by appliance module 400 as a *wireless* RF signal.” (EX1004, [0073].) Chan notes that “other *wireless* technologies, WiFi, ZigBee, Bluetooth, WPAN, RFID, UWB, infrared (IR), or other media” are also used. (EX1004, [0073], [0070].) In this manner, *appliances* are “couple[ed] to *appliance module 400* for *command or control* by gateway 300.” (EX1004, [0074]; EX1002, ¶88.)

2. Claim 1

a. 1[PR1]: “An Alternating-Current (AC) powered appliance”

Chan discloses appliances including “*refrigerator*,” “*stove*,” “*microwave*,” as shown in FIG. 1. (EX1004, [0070]-[0071]; EX1002, ¶91.)

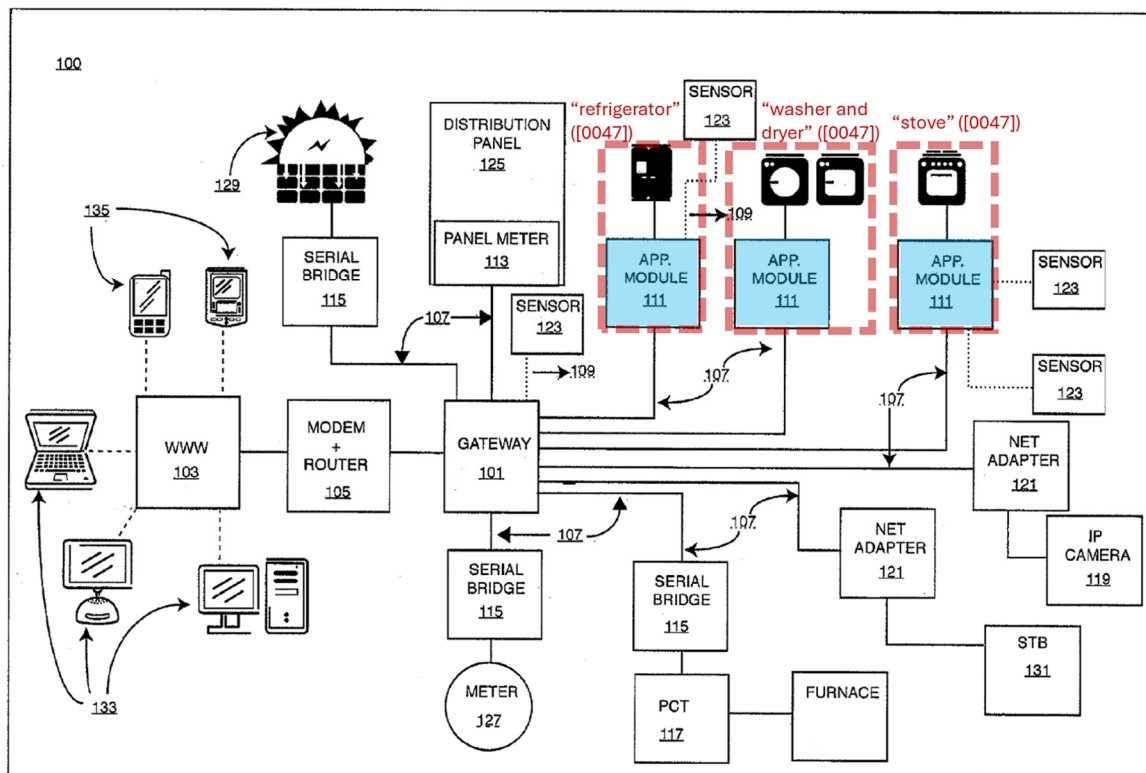
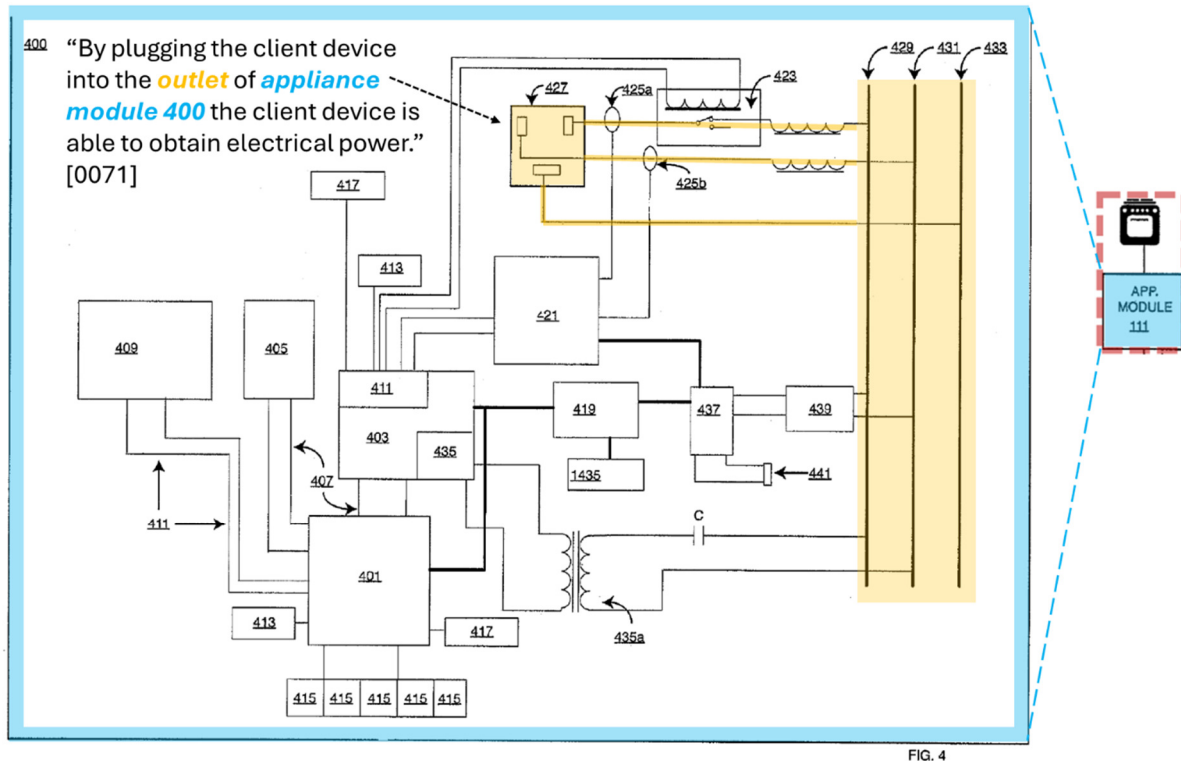


FIG. 1

Chan’s appliances are AC-powered. (EX1002, ¶92.) Each appliance includes an *appliance module*. (EX1002, ¶92.) The “*appliance module 400* may sit between a client device [*e.g.*, stove, refrigerator, etc.] and a *standard wall electrical outlet*.” (EX1004, [0071]; EX1002, ¶92.) As shown in FIG. 4, the *appliance module 400* includes “a *standard AC socket 427*” that “is plugged

directly onto the **AC wiring**.” (EX1004, [0070]-[0071]; EX1002, ¶¶92.) A POSITA would have understood (and found it obvious) that an appliance obtaining electrical power from a “standard wall electrical outlet” via “AC wiring” is AC-powered. (EX1004, [0070]; EX1002, ¶¶92.)



b. 1[PR2]: “associated with a food storage, handling, or preparation,”

Chan’s appliances (“**refrigerator**,” “**range**,” “**stove**,” “**microwave**”) are associated with food storage, handling, or preparation. (EX1004, [0047], [0009], [0071]; EX1002, ¶¶93.)

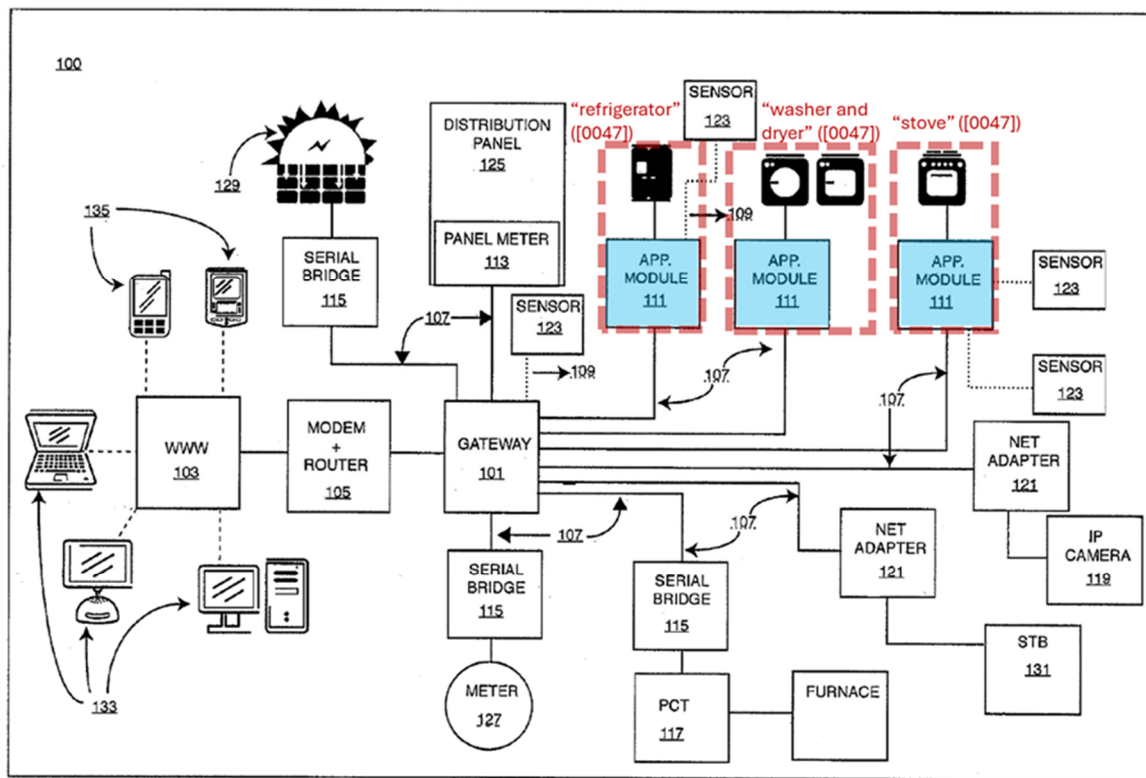


FIG. 1

c. 1[PR3]: “for use with a wireless network, the appliance comprising:”

Chan's *appliance* is for use with a *wireless network*. (EX1002, ¶¶94-101.)

The “*appliance module* []” functions to provide a network backbone across premises wiring and allows *wireless connectivity* to such network backbone.”

(EX1004, [0074].) Referring to FIG. 1, the wireless network is formed by *gateway 101* (also referred to as gateway 300) and the *appliance modules 111* (also referred to as *appliance modules 400*). (EX1004, [0008], [0009], [0045], [0046], [0053], [0057], [0073], [0074], [0111]; EX1002, ¶94.) The gateway is a “master control station” that “creates the networking infrastructure needed for connecting a variety

of appliances, devices, controls, and sensors to the World Wide Web.” (EX1004, [0008], [0053].) The *gateway* is “the central hosting device for ... [the] *wireless network*.” (EX1004, [0054], [0053].)

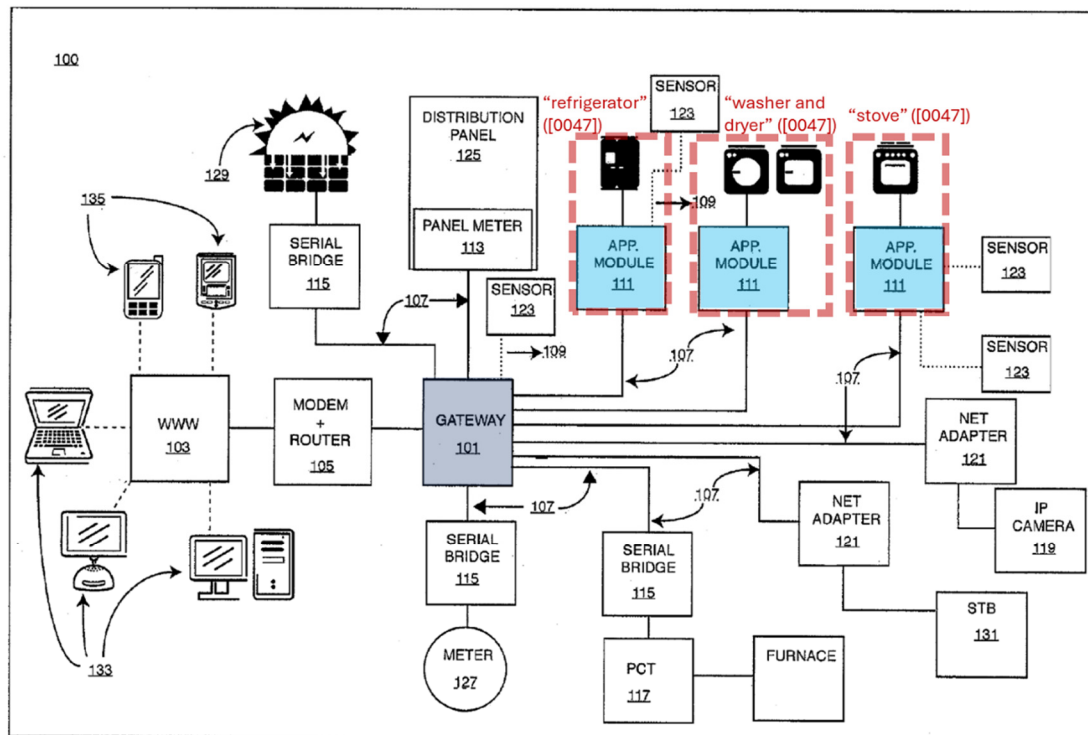


FIG. 1

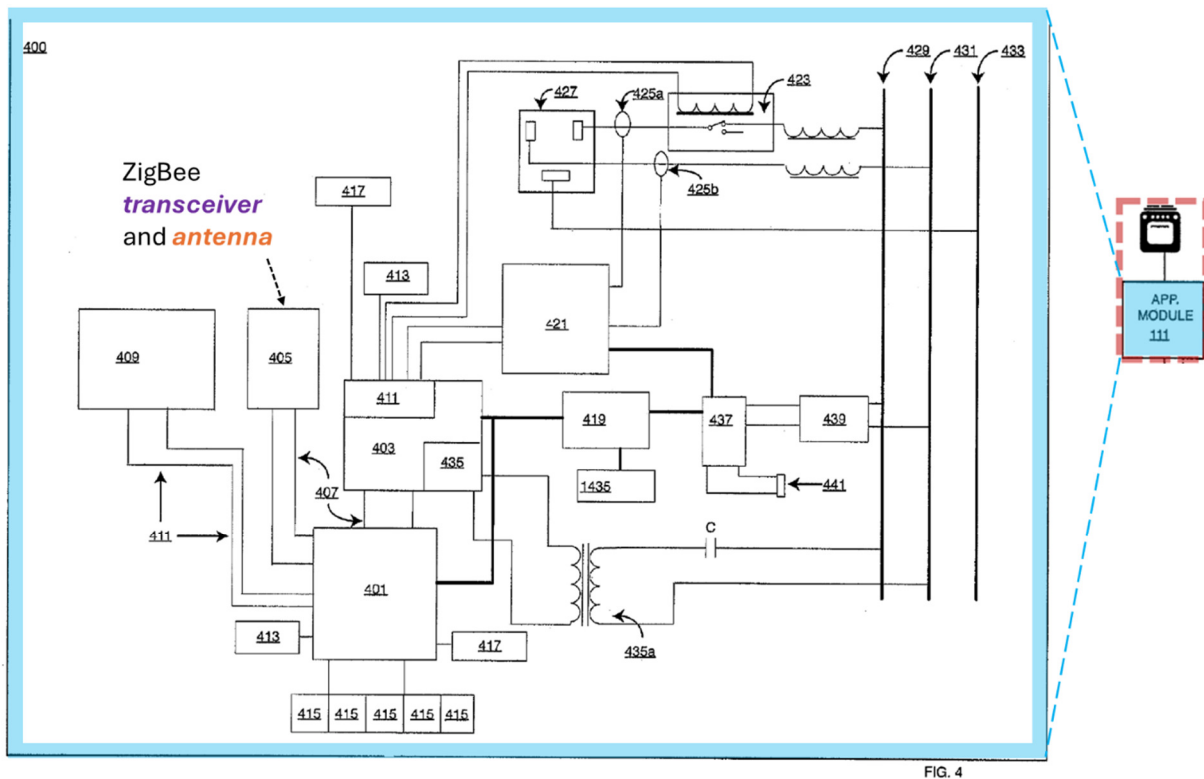
While FIG. 1 depicts *gateway 101* and the *appliance modules 111* as connected via solid lines, Chan consistently and repeatedly discloses that the connection between *gateway 101* and the *appliance modules 111* is also *wireless*, such that data can be *wirelessly* transmitted between *gateway 101* and *appliance modules 111*. (EX1004, [0008]-[0009], [0045]-[0046], [0053], [0057], [0073]-[0074], [0111]; EX1002, ¶97.) For example, the “powerline data signal sent between appliance module 400 and gateway 300 *may be further transmitted by*

appliance module 400 as a wireless RF signal. Additionally, other signal media may be used by appliance module 400 in communicating past the premises wiring system such as *other wireless technologies*, WiFi, ZigBee, Bluetooth, WPAN, RFID, UWB, infrared (IR), or other media.” (EX1004, [0073].) “Appliance module software may control the sending or receiving of data signals across the powerline network *or the wireless network*, or the integrated network infrastructure.” (EX1004, [0111].) Thus, a POSITA would have understood (and found it obvious) that Chan’s *network infrastructure* encompasses a *wireless infrastructure* because the connection between *gateway 101* and the *appliance modules 111* is wireless. (EX1002, ¶97.)

It also would have been obvious to a POSITA to implement such wireless connectivity between *gateway 101* and the *appliance modules 111*. (EX1002, ¶98.) Both components already include wireless communication hardware (*e.g.*, chipsets supporting ZigBee, Wi-Fi, etc.), so no hardware modification would be required. (EX1002, ¶98.) Using a wireless link would be an obvious design choice to reduce cabling, simplify installation, and allow flexible placement of *appliance modules*. (EX1004, [0070], [0073]; EX1002, ¶98.)

FIG. 4 shows the hardware components of the *appliance module* enabling wireless connectivity. (EX1004, [0070]; EX1002, ¶99.) As shown, the *appliance module 400* includes “a Zigbee *wireless* chipset 405.” (EX1004, [0070]; EX1002,

¶99.) The appliance module may also communicate with the gateway using “other *wireless* technologies, [including] WiFi, ZigBee, Bluetooth, WPAN, RFID, UWB, infrared (IR)” (EX1004, [0073]; EX1002, ¶99.) A POSITA would have understood (and found it obvious) that these are standard wireless networking protocols. (E.g., EX1001, 4:3-34, 152:18-32; EX1002, ¶99.)

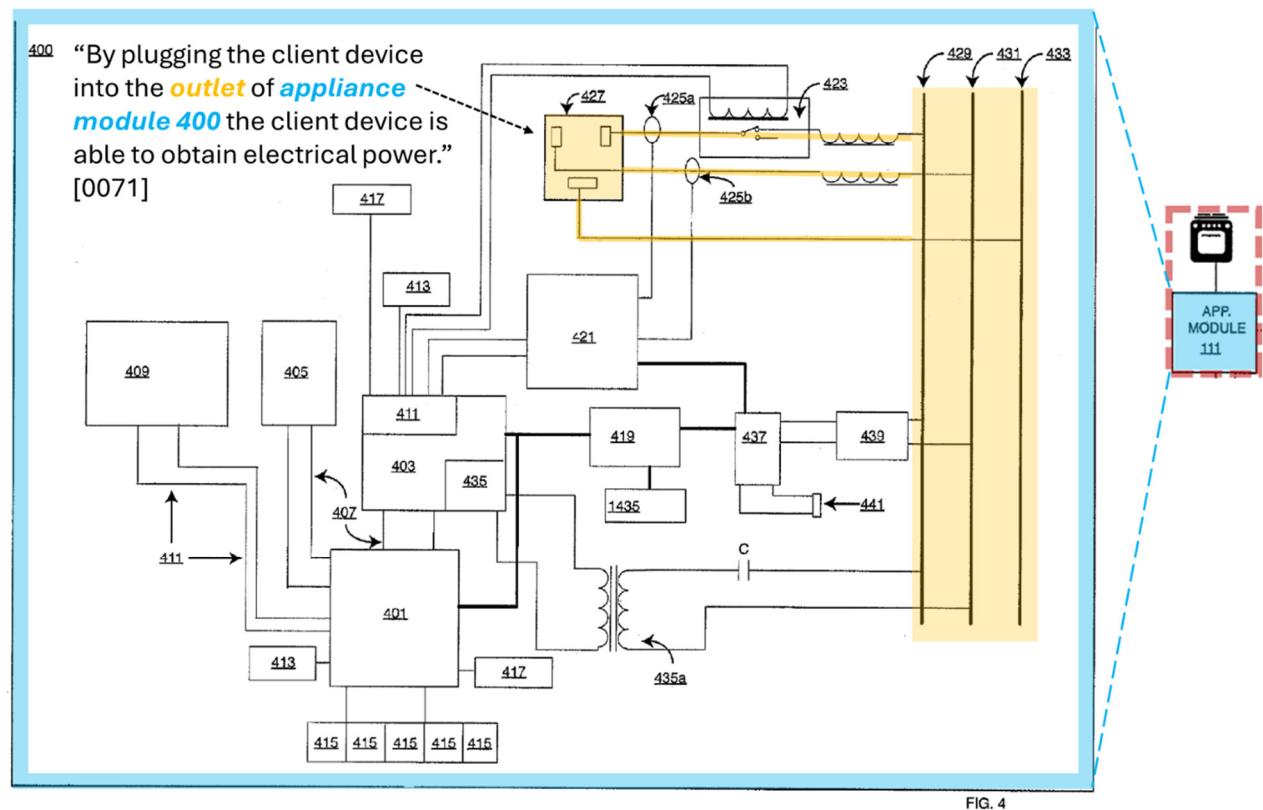


d. 1[A]: “an AC connector for connecting the appliance to an AC power source;”

First, Chan discloses an AC power source. (EX1004, [0070]; EX1002, ¶¶102-103.) The “*appliance module 400* may sit between a client device [e.g., stove, refrigerator, etc.] and a *standard wall electrical outlet*.” (EX1004, [0071]; EX1002, ¶103.) The *appliance module* includes “*AC wiring*” for connecting to

such standard wall electrical outlet. (EX1004, [0070]; EX1002, ¶103.) A POSITA would have understood (and found it obvious) that Chan’s “standard wall electrical outlet” is an AC power source. (EX1004, [0070], [0008], [0060]; EX1002, ¶103.)

FIG. 4 shows the *AC connector* of the *appliance module* for connecting the appliance to the AC power source. (EX1002, ¶104.) The appliance module provides “a *standard AC socket 427*” for plugging in the appliance. (EX1004, [0070]-[0071]; EX1002, ¶104.)



The *appliance module 400* also includes “*AC wiring*,” which are a part of the *AC connector*. (EX1002, ¶105.) “The *AC socket 427* is plugged directly onto the *AC wiring*. *AC wiring* has three wires which include, a live wire 429, a neutral

wire 431 and a ground wire 433.” (EX1004, [0070].) Simply put, the appliance is plugged into the *appliance module*’s “*AC socket 427*,” which is internally connected to the *appliance module*’s “*AC wiring*.” (EX1002, ¶105.) A POSITA would have understood (and found it obvious) that the “*AC wiring*” is in turn connected to the AC power source (*i.e.*, “standard wall electrical outlet”). (EX1004, [0070], [0071]; EX1002, ¶105.)

This aligns with the Board’s mapping of “*AC connector*” during prosecution. (EX1002, ¶106.) There, the Board agreed that the claimed *AC connector* is disclosed by the configuration shown below in the prior art, where a “*retrofit plug 600*” has an AC connector comprising “*slots 601 and 602* for connection to the appliance 130, and *pins 603 and 604* to supply mains AC power to the appliance”. (EX1003, 189-194; EX1017, FIG. 6d; EX1002, ¶106.) Chan’s AC configuration is analogous to that of the prior art, as well as to the ’590 patent itself (*e.g.*, FIG. 5e), both shown below. (EX1002, ¶107.)

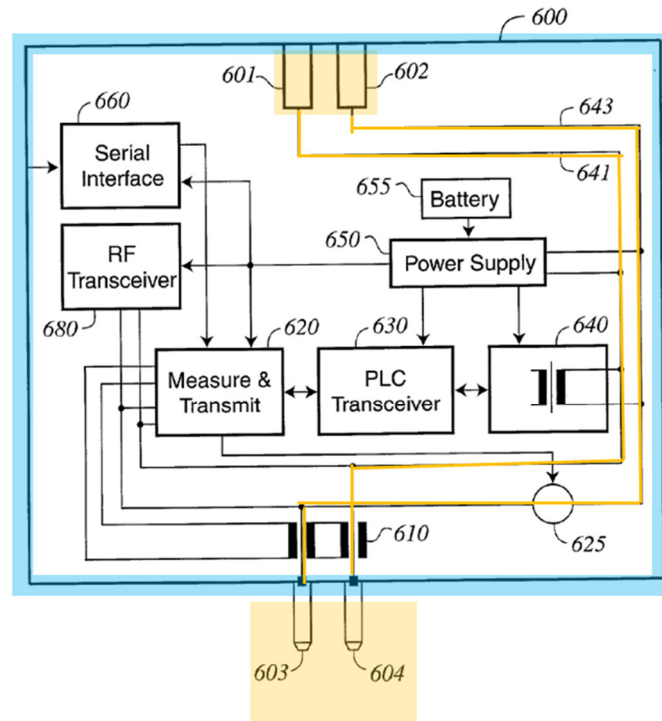


FIG. 6d

(EX1017 (prior art during prosecution), FIG. 6d; EX1002, ¶107.)

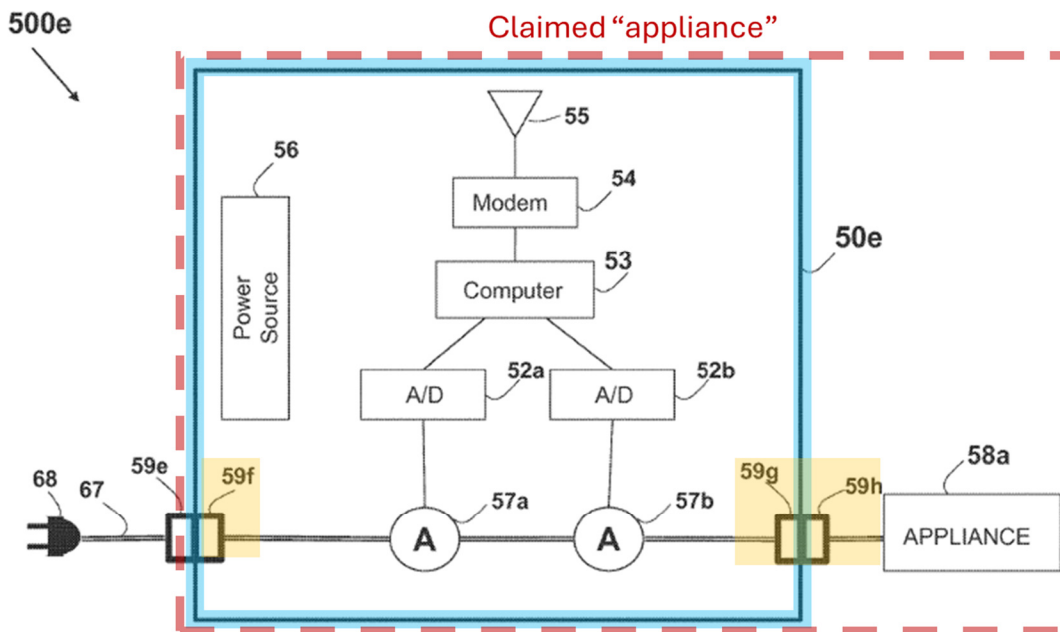


FIG. 5e

(EX1001, FIG. 5e; EX1002, ¶107.)

e. 1[B]: “a current sensor coupled to the AC connector for measuring an AC current consumed by the appliance;”

Chan discloses a *current sensor* coupled to the *AC connector* for measuring an AC current consumed by the *appliance*. (EX1002, ¶108.) As shown in FIG. 4, the *appliance module 400* includes a “*current transformer[] (CT) 425a*.”

(EX1004, [0070]; EX1002, ¶109.) “*CT 425a* measures current on *the live wire 429*.” (EX1004, [0070].) As discussed above, *the live wire 429* is part of the “*AC wiring*” of the *AC connector* between the appliance and the wall outlet and thus carries an AC current consumed by the appliance. (EX1004, [0070]; EX1002, ¶109; *supra* §IV.A.2.d.) Thus, *current transformer 425a* is a *current sensor* that

measures the AC current consumed by the appliance. (EX1002, ¶109.) This way, Chan’s “*appliance module* [] may be adapted to *measure, store and or control energy usage* of connected appliances or devices.” (EX1004, [0047].)

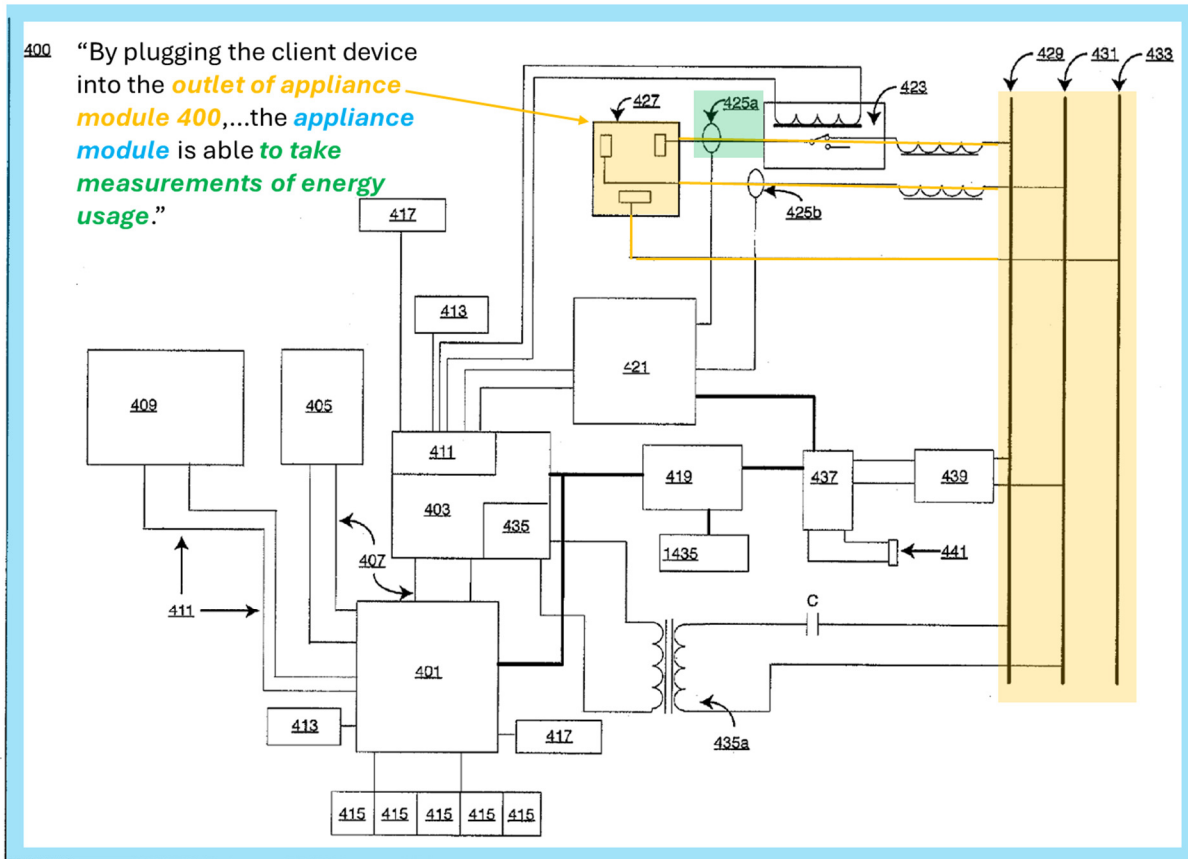


FIG. 4

Further, the *current sensor* is coupled to the *AC connector* because “*current transformer[] (CT) 425a* . . . [is] connected to a *standard AC socket 427* [that] . . . is plugged directly onto the *AC wiring*.” (EX1004, [0070]; EX1002, ¶110.)

f. 1[C]: “a first sensor having an output that responds to a physical phenomenon;”

FIG. 4 shows that *appliance module 400* includes a “*current transformer[] (CT) . . . 425b*”. (EX1004, [0070]; EX1002, ¶112.) “*CT 425b* measures current leakage on the *neutral wire 431*.” (EX1004, [0070].) The ’590 patent explains that electrical current is a physical phenomenon. (*See, e.g.*, EX1001, 16:44-50; EX1002, ¶¶111, 113.)

Chan discloses other *first sensors*. (EX1002, ¶114-116.) In FIG. 4, *appliance module 400* includes a “a *temperature and humidity sensor 409*.” (EX1004, [0070]; EX1002, ¶114.) Chan additionally discloses the *appliance module* comprises “a *thermal sensor*,” “a *humidity sensor*,” “a *security sensor*,” “a *motion sensor*,” “a *light sensor*,” “*motion sensors*,” “*pressure sensors*,” “*microphones*,” “*vibration sensors*,” “a *gyro* or *accelerometer*,” “*smoke sensors*,” “*biological sensors*,” or “one or more combinations of *sensor devices*.” (EX1004, Claims 3-16; EX1002, ¶116.) These all have outputs responsive to physical phenomena, consistent with the patent. (*See* EX1001, 16:44-50 (“An appropriate sensor may be adapted for a specific *physical phenomenon*, such as a sensor responsive to *temperature, humidity, pressure, audio, vibration, light, motion, sound, proximity, flow rate, electrical voltage*, and *electrical current*.”); EX1002, ¶116.)

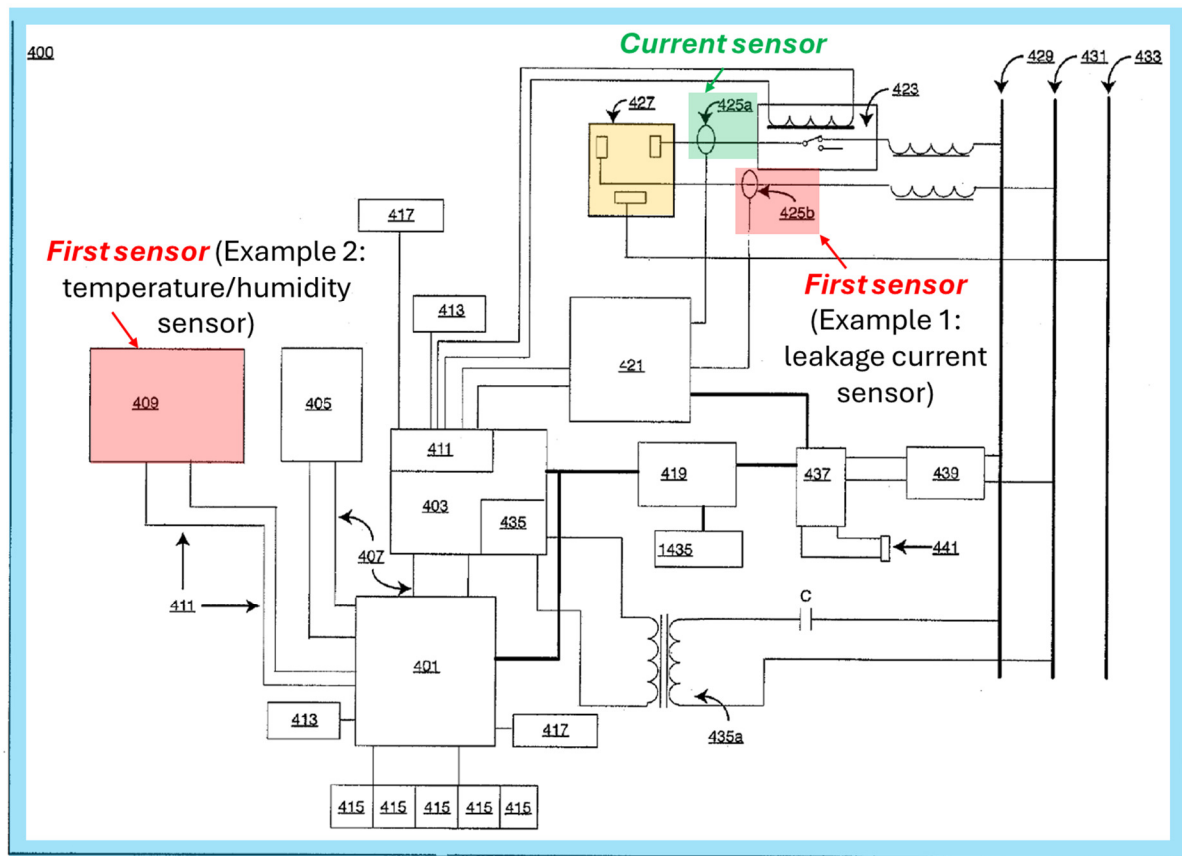


FIG. 4

g. 1[D]/1[E]: “an antenna for communication over the wireless network; a wireless transceiver coupled to the antenna for transmitting digital data to, and for receiving digital data from, the wireless network; and”

First, Chan discloses the *appliance module* includes an *antenna* coupled to a *wireless transceiver*. (EX1002, ¶117.) In FIG. 4 below, the *appliance module* 400 includes a “Zigbee wireless chipset 405.” (EX1004, [0070]; EX1002, ¶118.)

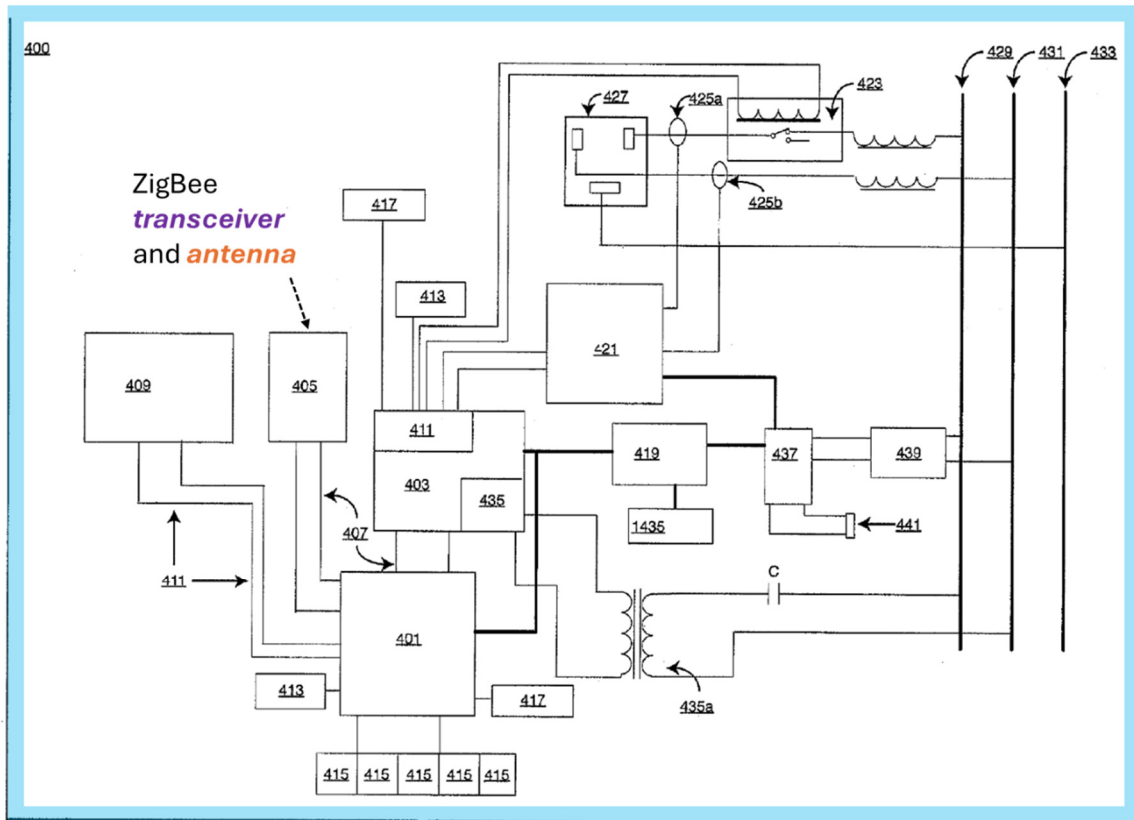


FIG. 4

A POSITA would have understood (and found it obvious) that the *Zigbee wireless chipset 405* to include an *antenna* coupled to a *wireless transceiver*.

(EX1016, 34; EX1002, ¶118.) Equipped with a “*Zigbee wireless chipset 405*,”

appliance module 400 is a ZigBee device. (EX1004, [0070]; EX1002, ¶118.) And

it was well-known to a POSITA that “[a] ZigBee network consists of ZigBee nodes

(devices)” and each ZigBee device “consists of a microcontroller, a *transceiver*,

and an *antenna*.” (EX1016, 34; EX1002, ¶118-119.)

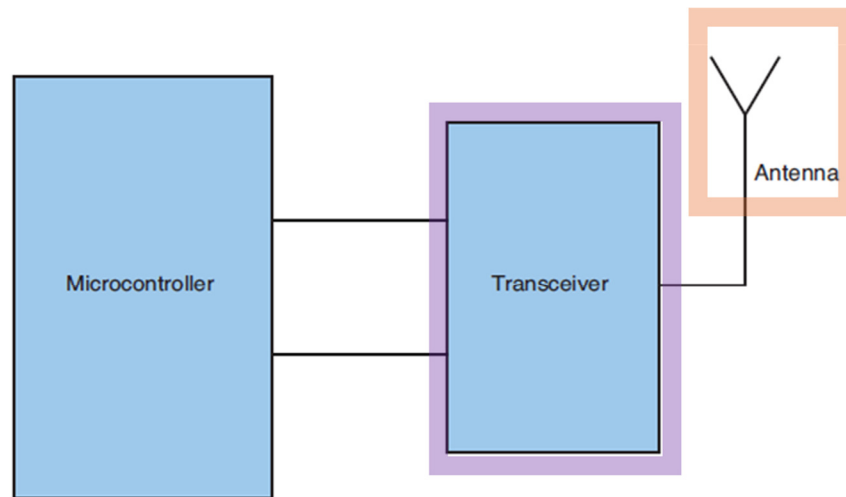


Figure 2.1 Architecture of ZigBee node

(EX1016, 34, FIG. 2.1.)

The *appliance module* also communicates using “other *wireless* technologies, [such as] WiFi, ZigBee, Bluetooth, WPAN, RFID, UWB, infrared (IR), or other media.” (EX1004, [0073].) It was well-known that “*wireless communication* requires a *transmitter* (*transmitter electronics* plus *antenna*) . . . [and] a *receiver* (*receiving electronics* plus *antenna*).” (EX1018, 369; *see also* EX1022, 3:17-20, 3:38-40; EX1023, [0013]-[0015]; EX1002, ¶120.) A “*transceiver* consists of a *transmitter* and a *receiver*.” (EX1018, 369.) Thus, the POSITA would have understood (and found it obvious) that, to implement these wireless communication technologies disclosed in Chan, the *appliance module* includes an *antenna* coupled to a *wireless transceiver*. (EX1018, 369; EX1002, ¶¶120-122.)

Chan teaches that the *antenna* is for *communication* over the wireless network and the *wireless transceiver* is for *transmitting* digital data to, and for *receiving* digital data from, the wireless network. (EX1002, ¶123.) As discussed above, referring to FIG. 1, the wireless network is formed by gateway 101 and the *appliance modules 111*. (EX1004, [0074]; EX1002, ¶123.)

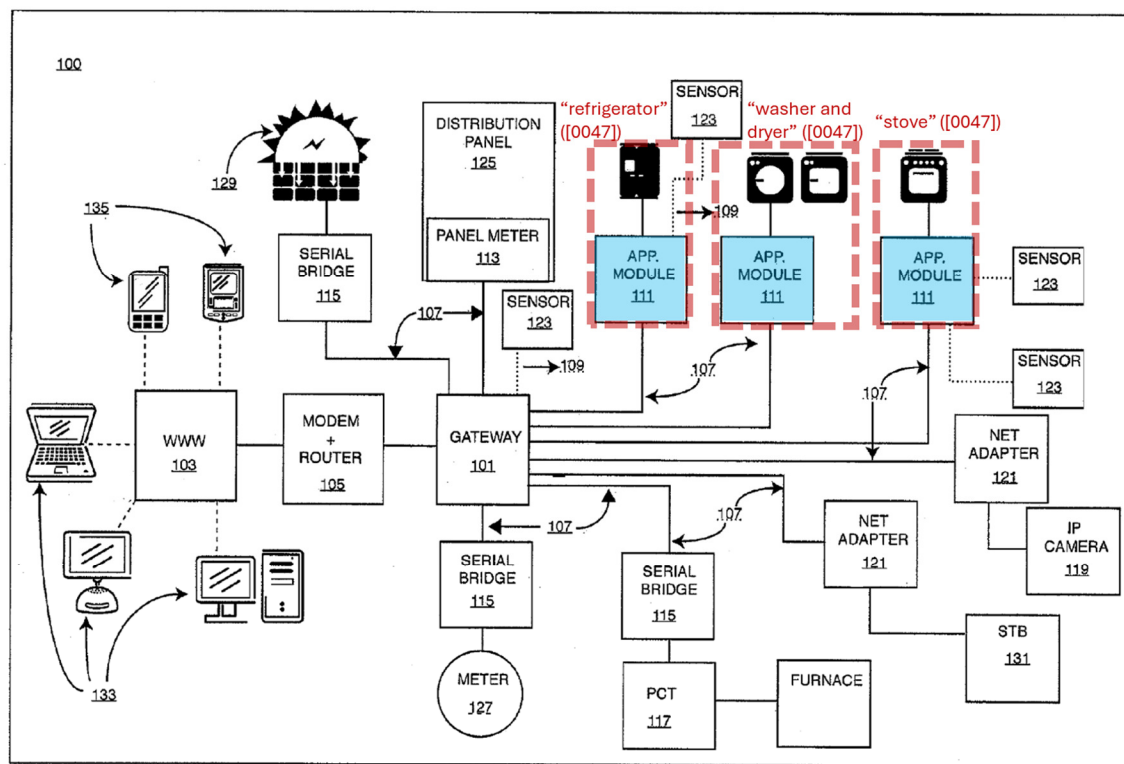


FIG. 1

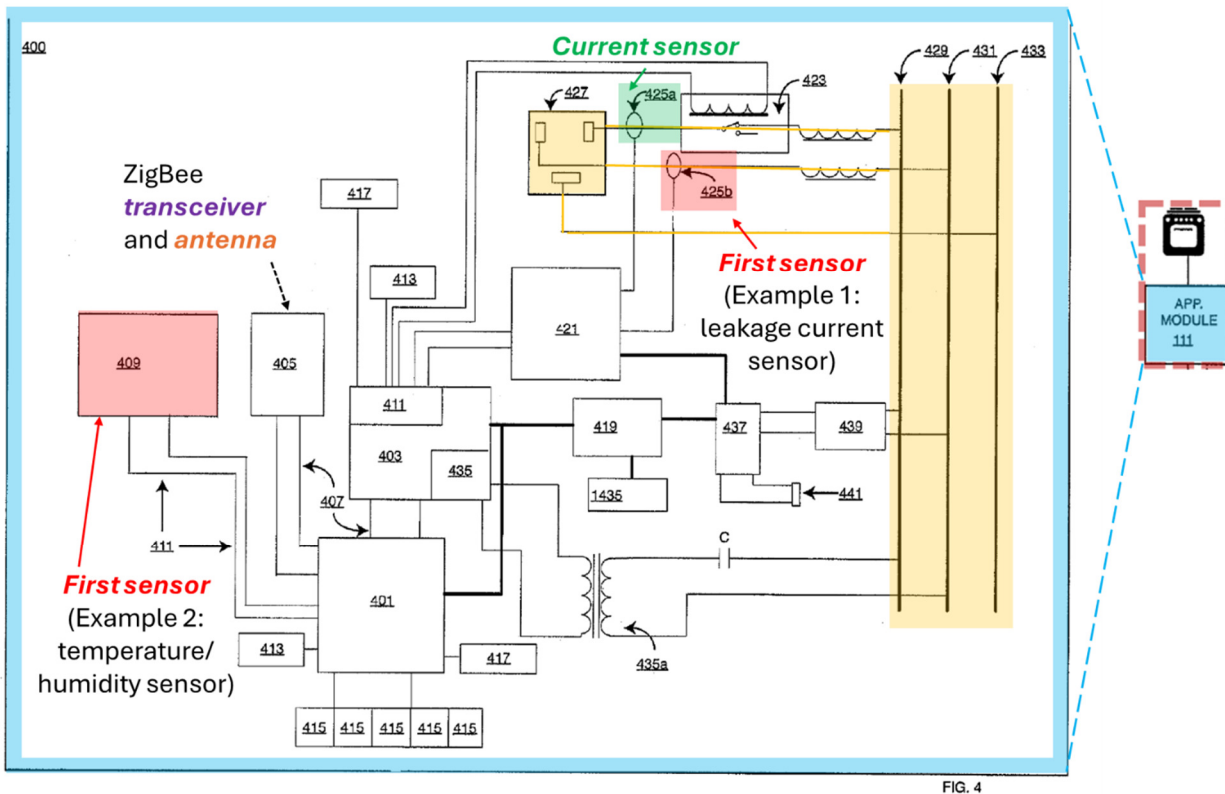
Chan’s *antenna* and *transceiver transmit* data to the gateway: “[d]ata measured by *appliance module 400* . . . includes power usage information” and “[*a*]ppliance module 400 sends such data to gateway 300 via network infrastructure.” (EX1004, [0075], [0073]; EX1002, ¶124.) Chan’s *antenna* and

transceiver also *receive* data from the gateway: “a low-bandwidth signal may carry command or control information *from* gateway 300 *to* *appliance module 111* and turn the connected appliance on or off.” (EX1004, [0057]; EX1002, ¶125-126.)

A POSITA would have understood (and found it obvious) that data received and transmitted by the *wireless transceiver* is *digital*. (EX1002, ¶127.) The *CPU 401* communicates with the *wireless transceiver* through *an RS-232 serial interface 407*, which is a digital communication link. (EX1004, [0070]; EX1002, ¶127.)

h. 1[F]: “a single enclosure housing the current sensor, the first sensor, the antenna, and the wireless transceiver,”

FIG. 4 expressly shows that *current transformer 425a* (“current sensor”), *current transformer 425b/temperature humidity sensor 409* (“first sensor”), and *Zigbee wireless chipset 405* (the “*antenna*” coupled to the “*wireless transceiver*”) are all housed within the single enclosure of the *appliance module*. (EX1004, FIG. 4; EX1002, ¶128-133.)



The *appliance module* is consistently described as a “*device*.” (EX1002, ¶129.) Specifically, “*appliance module 400* may be embodied as a *device* which may be plugged into an electrical outlet and ... simultaneously provide an outlet to a certain client device.” (EX1004, [0071].) A POSITA would have understood (and found it obvious) that appliance module, as a device, would have a device housing enclosing its parts. (EX1002, ¶129.) Indeed, “the *appliance module 111* may be a product manufactured by Jetlun Corporation . . . under the part number RD75613.” (EX1004, [0047].) As shown by the RD75613 User Manual, the *appliance module* is a single device enclosing its parts. (EX1043, FIG. 1; EX1002, ¶130.)



Figure 1: Front Panel of the Appliance Module

i. 1[G]: “wherein the first sensor is coupled to the wireless transceiver for transmitting digital data in response to the physical phenomenon to the wireless network,”

First, Chan discloses that the *first sensor* is *coupled* to the *wireless transceiver*. (EX1002, ¶134-135.) As shown in FIG. 4, the *current transformer 425b* is *coupled* to the “CPU 401” *through* the “power measure module 421” and “powerline chipset 403”, and that the “CPU 401” *communicates with* the “ZigBee wireless chipset 405 *through* a RS232 serial interface 407.” (EX1004, [0070]; EX1002, ¶135-136.) Thus, *CT 425b* is *coupled* (through these intermediary circuits) to the *ZigBee wireless chipset 405*, which includes the *wireless transceiver*. (EX1004, [0070]; EX1002, ¶136.) Such intermediary coupling of

circuitry between the *first sensor* and the *wireless transceiver* is consistent with the coupling in the '590 patent, which shows a computer (e.g., CPU) coupled in between *ampermeter 57b* and *modem 54*. (EX1001, FIG. 5e; EX1002, ¶136.)

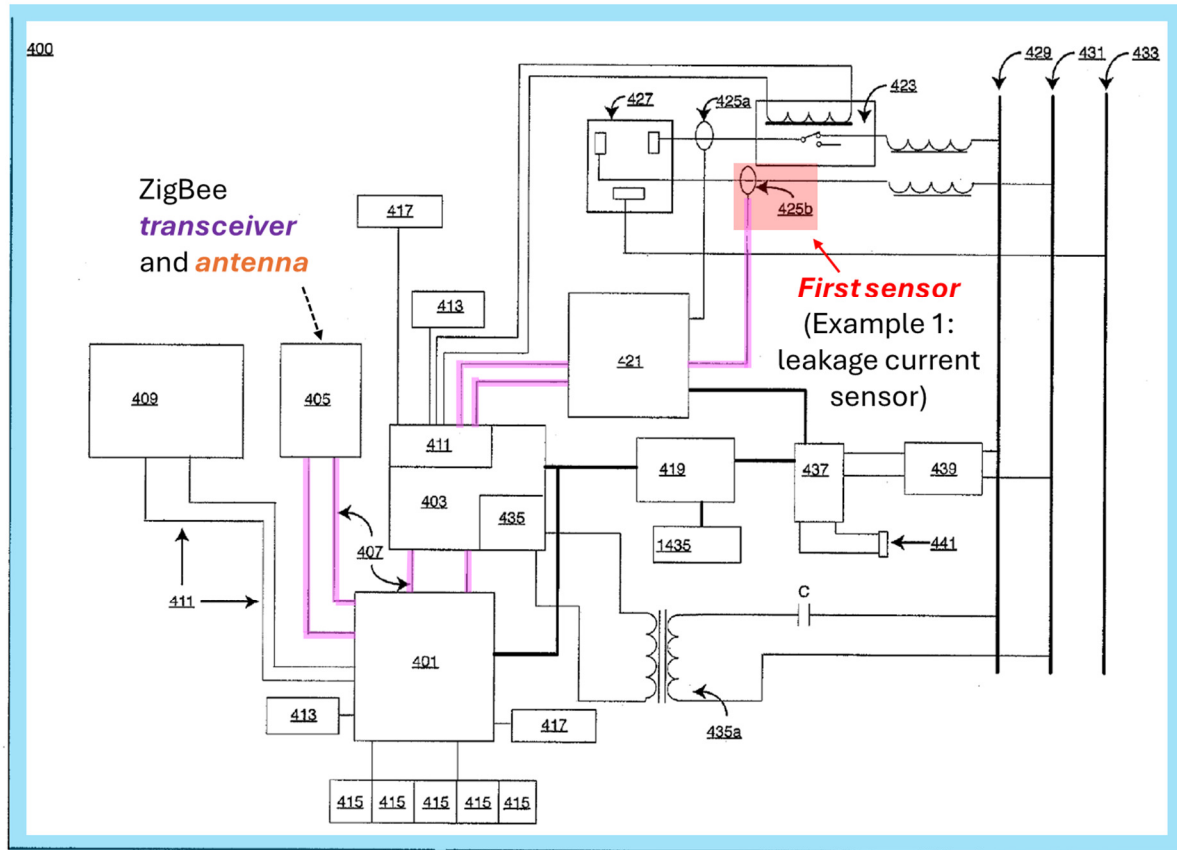


FIG. 4

FIG. 4 also shows the *temperature and humidity sensor 409* coupled to the *wireless transceiver through* the CPU 401 and the RS-232 serial interface 407. (EX1004, [0070], FIG. 4; EX1002, ¶137.)

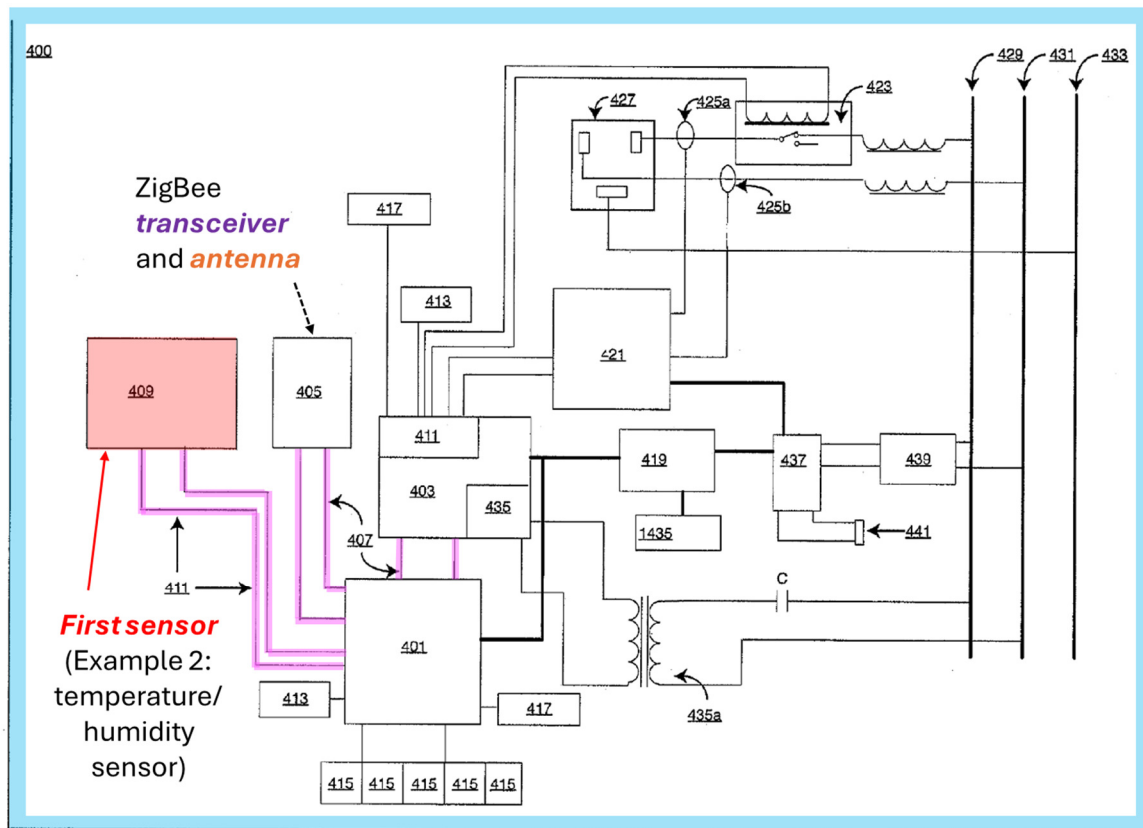


FIG. 4

Second, Chan discloses that the *wireless transceiver transmits digital data* over the wireless network *in response to* the physical phenomenon. (EX1002, ¶¶138-139.) An example *first sensor* is “*CT 425b* [that] measures current leakage on the neutral wire.” (EX1004, [0070]; EX1002, ¶140.) Chan’s *appliance module* transmits digital data in response to electrical current (“physical phenomenon”). (EX1002, ¶140.) “Data measured by *appliance module 400* . . . includes power usage information.” (EX1004, [0075]; [0047].) “*Appliance module 400 sends* such data to gateway 300 via network infrastructure.” (EX1004, [0075], [0073]; EX1002, ¶140.) A POSITA would have understood (and found it obvious) the

appliance module transmits the “power usage information” in response to the electrical current measured by *current transformer 425b*. (EX1002, ¶140; EX1020, 10.)

Chan has other *first sensors* (e.g., “*temperature and humidity sensor 409*,” “a *motion sensor*,” etc.). (EX1004, [0070], Claims 3-16.) Chan’s *appliance module* transmits digital data in response to the physical phenomena corresponding to these *first sensors*. (EX1002, ¶141.) Indeed, the “gateway 101 may be adapted to collect, aggregate, store, receive and or transmit information” and “may receive various data signals containing data from the network or client devices.” (EX1004, [0046], [0063].) And it was well-known that such environmental information can be transmitted for appliance monitoring and control. (E.g., EX1005, [0012]-[0017], [0049], [0051], [0081], [0083], [0099], [0106], [0015], [0120], [0126]; EX1045, 1:1-12, 4:4-16, 8:18-23, 11:19-12:2; EX1002, ¶141.)

To the extent that the claim requires the detection of physical phenomenon to trigger the data transmission (which is not conceded), it would have been obvious to a POSITA that Chan discloses or at least suggests this. (EX1002, ¶¶142-143.) For example, Chan states “*appliance module* [] may also be used for determining or locating client devices responsible for ‘vampire’ current and how much such leaks cost.” (EX1004, [0070], [0075].) Thus, it would have been obvious that, for example, upon detection of leakage current (e.g., over a threshold)

by *current transformer 425b*, digital data is transmitted to the gateway, thereby enabling real-time reporting and remediation of the leakage. (EX1002, ¶142, 145.)

The data transmission is over the wireless network (*i.e.*, between the appliance module and the gateway). (EX1002, ¶144.) It would have been obvious that the appliance module transmits the digital data using its “Zigbee wireless chipset 405” (comprising a wireless transceiver) or any of the other wireless protocols disclosed in Chan. (EX1004, [0070], [0073]; EX1002, ¶144-146.)

j. 1[H]: “wherein the appliance is controlled or activated in response to digital data received from the wireless network, and;”

First, Chan discloses that the *appliance module* receives digital data from a wireless network. (EX1002, ¶147-149.) The *appliance module* communicates with the wireless network to “*receive* and transmit *information.*” (EX1004, [0047]; *supra* § IV.A.2.g; EX1002, ¶148.)

Second, Chan discloses that the *appliance module* controls or activates the appliance. (EX1002, ¶150-152.) For example, “[c]ommand or control of client devices [*e.g.*, stoves, refrigerators, etc.] may be provided by *appliance module 400.*” (EX1004, [0076], [0057], [0065].) In particular, “*basic on or off switching of client devices* may be supported by *appliance module 400.*” (EX1004, [0076], [0057], [0065].)

Third, Chan discloses that the *appliance module* controls the appliance in response to digital data received from the wireless network formed between the gateway and the *appliance module*. (EX1002, ¶¶153-155.) Low- and/or high-bandwidth signals “may carry command or control information *from* gateway 300 *to appliance module 111* and turn the connected appliance *on or off*.” (EX1004, [0057]-[0058], [0076], [0009], [0047], [0109], [0113], FIG. 11, Claim 1; EX1002, ¶153.)

k. 1[I]: “wherein the current sensor is further coupled to the wireless transceiver for transmitting digital data in response to the measured AC current to the wireless network.”

First, as shown in FIG. 4, the *current transformer 425a* (i.e., the *current sensor*) is *coupled* to the *wireless transceiver*. (*Supra* § IV.A.2.i; EX1002, ¶¶156-158.)

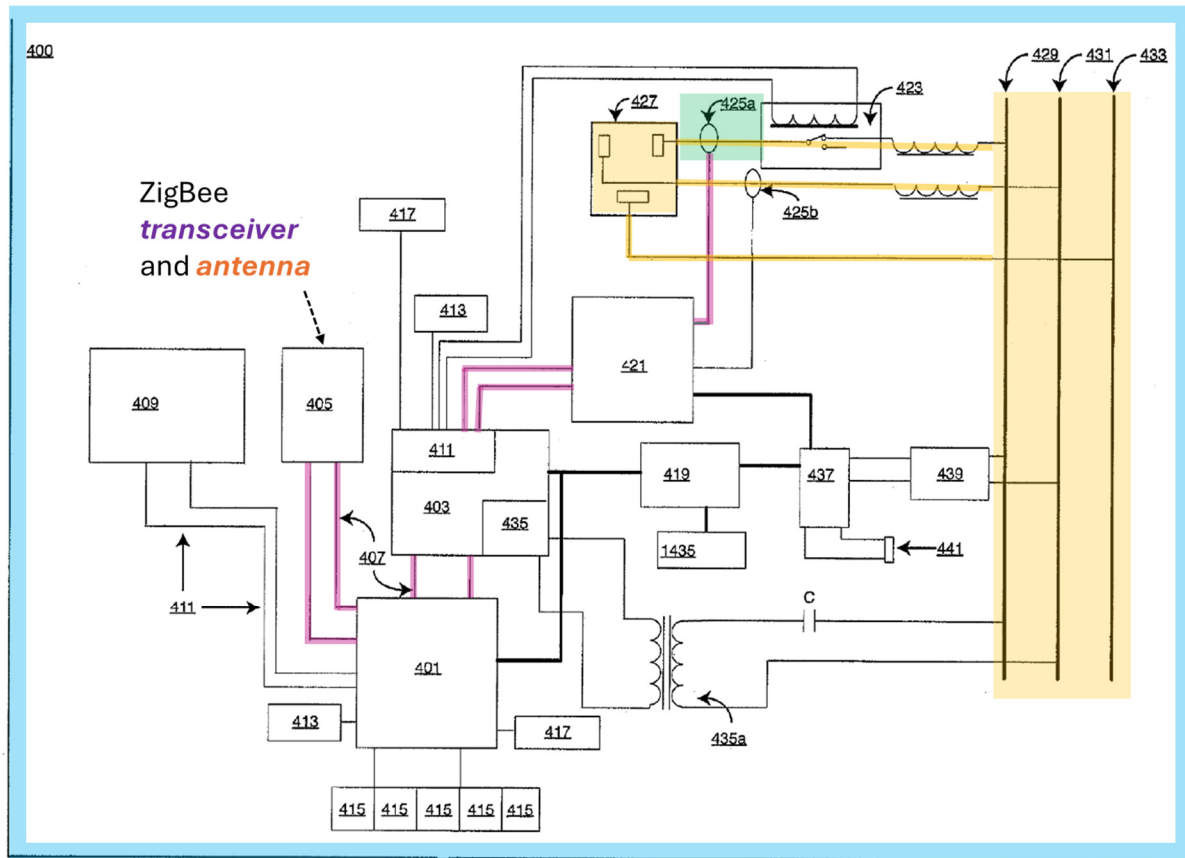


FIG. 4

Second, Chan discloses that the *wireless transceiver transmits digital data in response to* the measured AC current using the wireless network. (EX1002, ¶¶159-164.) “*CT 425a* measures current on the *live wire 429*.” (EX1004, [0070].) For the same reasons discussed for CT 425b, a POSITA would have understood (and found it obvious) the appliance module transmits the “power usage information” in response to the electrical current measured by *CT 425a* to the wireless network. (EX1002, ¶162; *Supra* § IV.A.2.f; EX1020, 10.) For example, “[d]ata measured by *appliance module 400* as a preferred embodiment includes power usage information...*Appliance module 400* sends such data to gateway 300

via *network infrastructure*.” (EX1004), [0075]; EX1002, ¶162.) As discussed, the *network infrastructure* is *wireless*. (Supra IV.A.2.c; EX1002, ¶162.) Indeed, “[d]ata provided by *appliance module 400* may be used [by remote computing devices connected to the gateway] for determining energy footprint, energy efficiency, sources of energy waste, levels of consumption, energy cost, or carbon footprint.” (EX1004, [0066], [0070], [0075], EX1020, 10-11; EX1002, ¶162.)

3. Claims 2/3/4/5

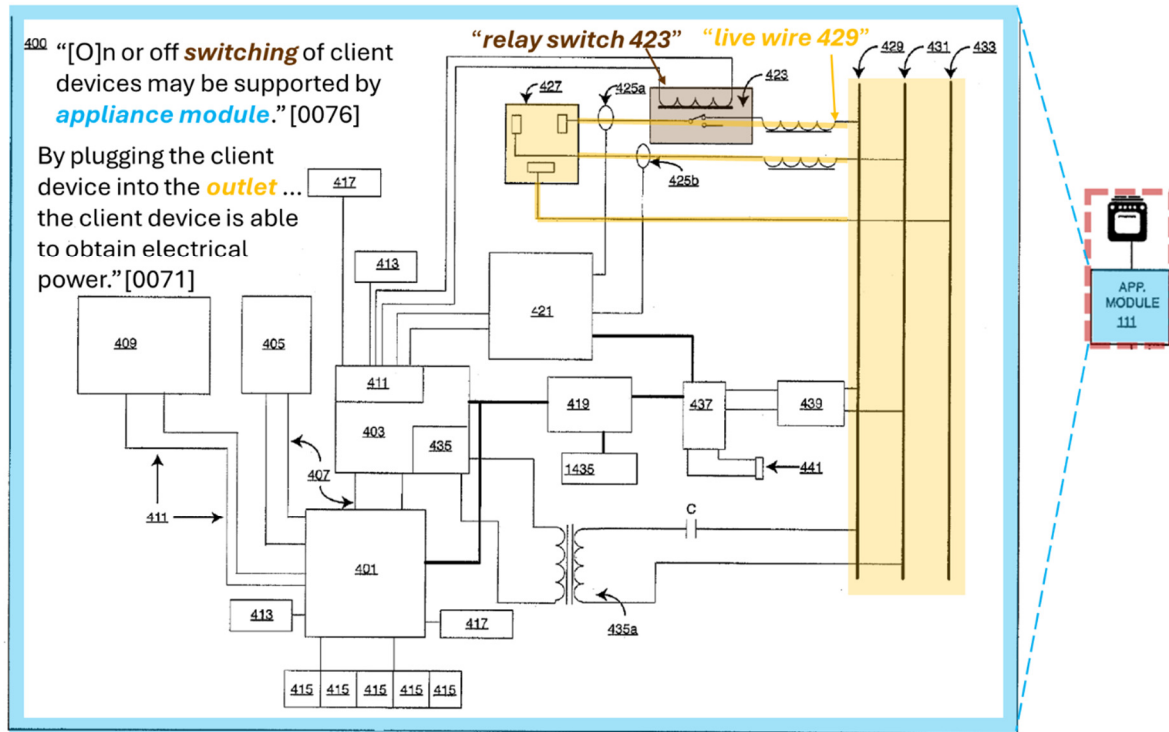
Chan discloses “*appliance module[s] 111* can connect to a variety of appliances and devices such as *refrigerator . . . range, stove, microwave*.” (EX1004, [0047], [0009], [0071].) *Ranges, stoves, and microwaves* primarily heat food. *Refrigerators* primarily cool food. (EX1002, ¶165-168.)

4. Claims 6

Chan’s “*appliance module[s] 111* can connect to a variety of appliances.” (EX1004, [0047], [0009], [0071].) In view of Chan’s example, it would have been obvious that it would be connected to other common appliances (a dishwasher, coffeemaker, etc.) to similarly monitor energy consumption. (EX1006, 4:20-25; EX1002, ¶¶169-170.)

5. Claim 7/32/53:

With respect to claim 7, Chan's *appliance module 400* (i.e., the *single enclosure*) houses "*relay switch 423*." (EX1004, [0070].) "Relays are electrically actuated switches." (EX1007, 307; EX1002, ¶¶171-172.)



Relay switch 423 is connected to a switch electric power to at least part of the appliance. (EX1002, ¶173.) As shown in FIG. 4, the *relay switch 423* is connected in between *AC socket 427* and *live wire 429*, such that *relay switch 423* supports "[b]asic on or off switching of client devices" plugged into *AC socket 427*. (EX1004, [0070], [0076], FIG. 4; EX1002, ¶173.)

Third, Chan discloses the *coupling* of *relay switch 423* to the *wireless transceiver* for being activated in response to digital data received from the

wireless network. (*See also* EX1004, [0070]; EX1002, ¶¶174-176.) “[A] low-bandwidth signal may carry command or control information *from* gateway 300 *to appliance module 111* and *turn the connected appliance on or off.*” (EX1004, [0057], [0065], [0076].) Such data signals are transmitted using “wireless signal technology.” (EX1004, [0057].)

The POSITA would also recognize that the data received by the *wireless transceiver* is digital. (EX1002, ¶177.) The *CPU 401* communicates with the *wireless transceiver* through *an RS-232 serial interface 407*. (EX1004, [0070].) Serial interfaces are digital communication links. (EX1019, 1; EX1002, ¶177; EX1001, 4:3-16.)

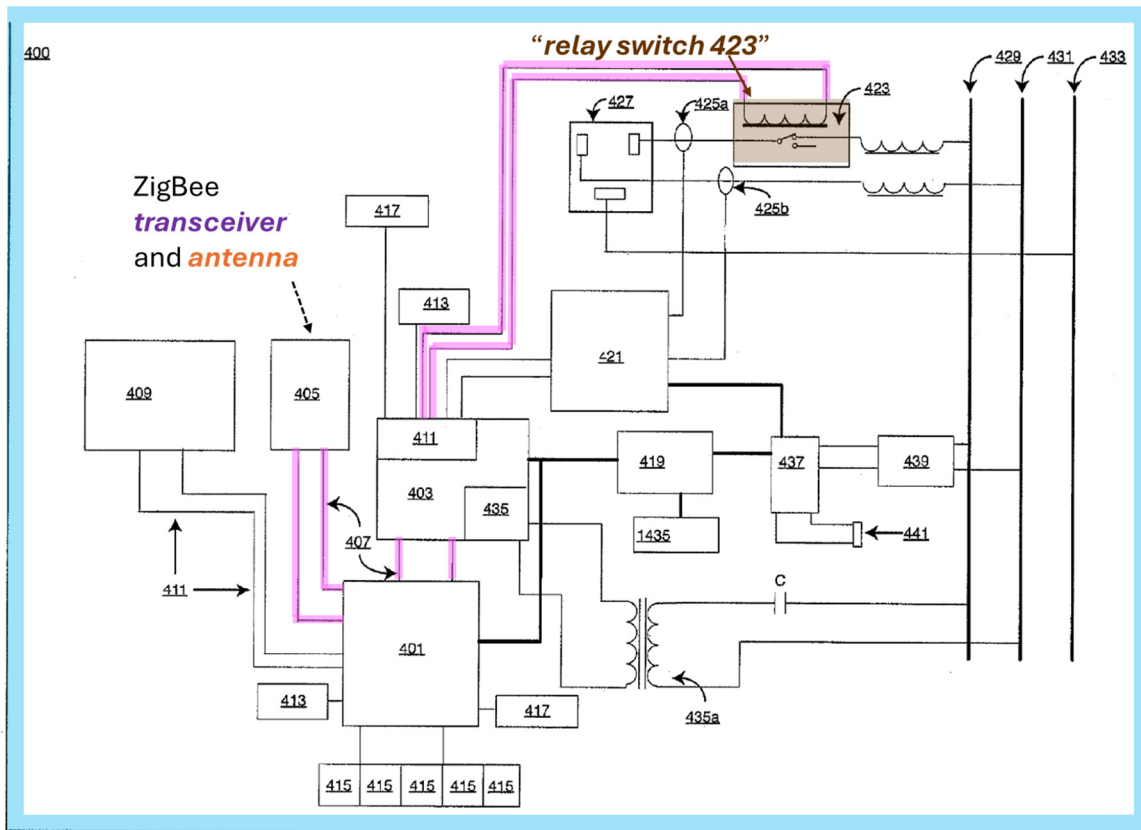
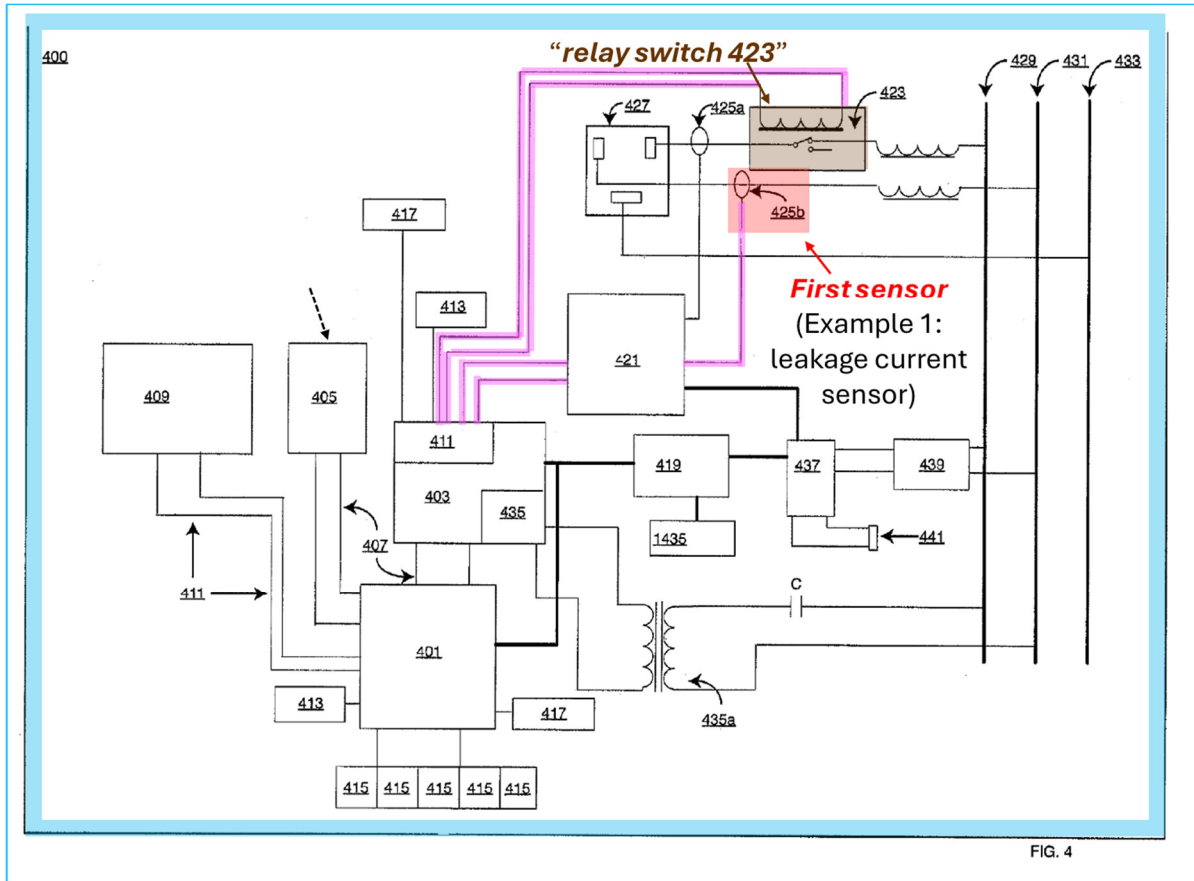


FIG. 4

With respect to claim 32, as discussed above, **relay switch 423** is an electrically actuated switch housed within the **appliance module 400** (i.e., the **single enclosure**) and connected to switch electric power to the appliance. (EX1002, ¶¶223-229.) Further, as shown in FIG. 4, **relay switch 423** is **coupled to CT 425b**. (EX1004, [0070], FIG. 4; EX1002, ¶224.) A POSITA would have understood (and found it obvious) that the **relay switch** is activated in response to the leakage current detected by **CT 425b**. (EX1002, ¶¶225-226.) The **appliance module** “may also be used for determining or locating client devices responsible for ‘vampire’ current.” (EX1004, [0070], [0075]; EX1002, ¶225.) Thus, it would

have been obvious that, when **CT 425b** detects leakage current, **relay switch 423** would disconnect power to the appliance to save power. (EX1002, ¶¶225-227.)



Regarding claim 53, Chan's **relay switch 423** is an actuator, consistent with the '590 patent. (EX1001, 90:14-20; 92:42-45; EX1002, ¶¶252-253.) It affects a physical phenomenon (*e.g.*, stopping current flow) and, as discussed above, is coupled to the wireless transceiver for being activated or controlled. (EX1004, [0057], [0070], FIG. 4; EX1002, ¶¶254-257.)

6. Claim 13/14/19:

With respect to claim 13, Chan’s current sensor (“*current transformer[] (CT) 425a*”) is a current transformer. (EX1004, [0070]; *supra*, §IV.A.2.e; EX1002, ¶178.)

With respect to claim 14, a POSITA would have understood (and found it obvious) that *current transformer 425a* is a *non-contact current meter*. (EX1004, [0070]; EX1002, ¶¶179-181.) It was well-known that *current transformers* are non-contact sensors because they operate by electromagnetic induction. (See, e.g., EX1020, 56–58 (“The changing flux around a coil that carries a changing current will also *induce* a voltage in another coil. This is the *principle of the transformer*.”); EX1008, 59; EX1002, ¶181.)

With respect to claim 19, a POSITA would have understood (and found it obvious) that *current transformer 425a* is *induction based*. (See EX1020, 56-58; EX1008, 59-60; EX1002, ¶190-191.)

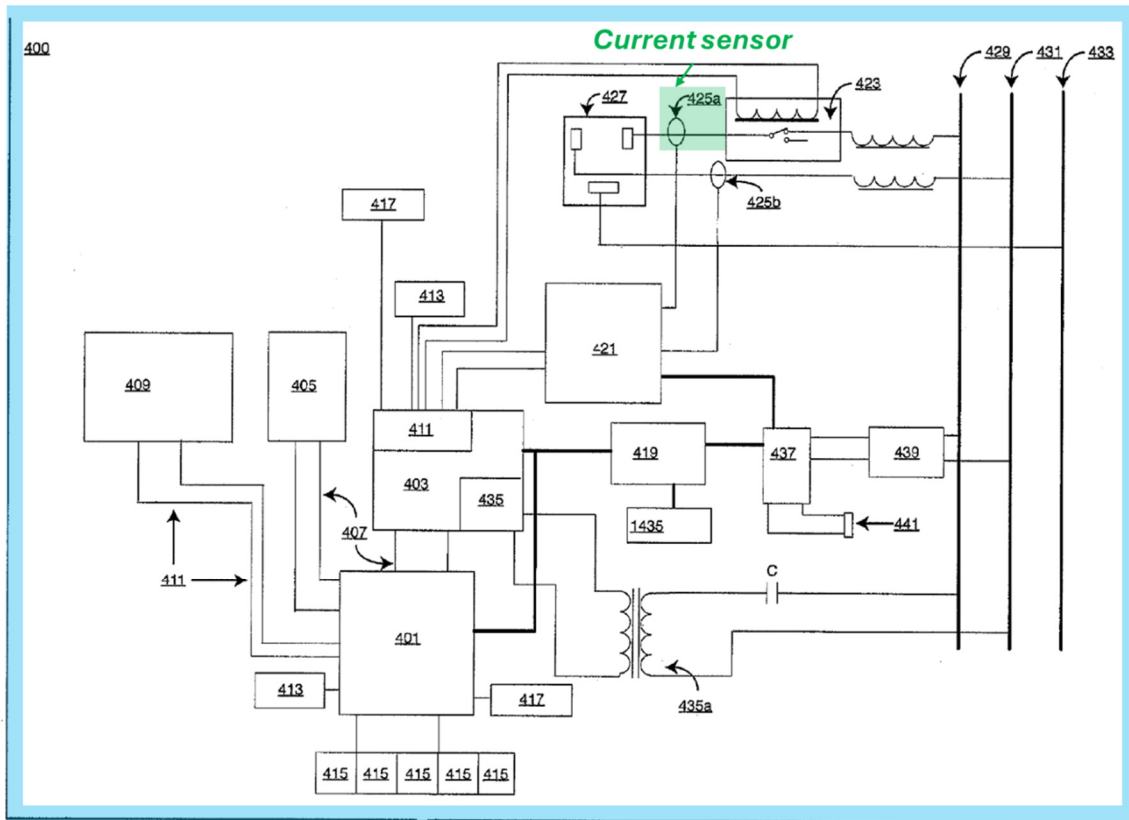


FIG. 4

7. Claim 15/16:

With respect to claim 15, Chan discloses a wattmeter connected to the **AC connector** for measuring the magnitude of the active AC power. (EX1002, ¶¶182-186.) As shown in FIG. 4, the **appliance module** includes a “**power measure module 421**.” (EX1004, [0070]; EX1002, ¶185.) A POSITA would have understood (and found it obvious) that a **power measure module** is a **wattmeter**. (E.g., EX1001, 69: 39-42 (“a wattmeter measur[es] the magnitude of the active power (or the supply rate of electrical energy).”); EX1004, [0070]; EX1002, ¶183.)

As shown in FIG. 4, the *power measure module 421* is enclosed in the *appliance module* and is “*connected to . . . two (2) current transformers (CT) 425a and 425b that are connected to a standard AC socket 427.*” (EX1004, [0070]; (EX1002, ¶186.)

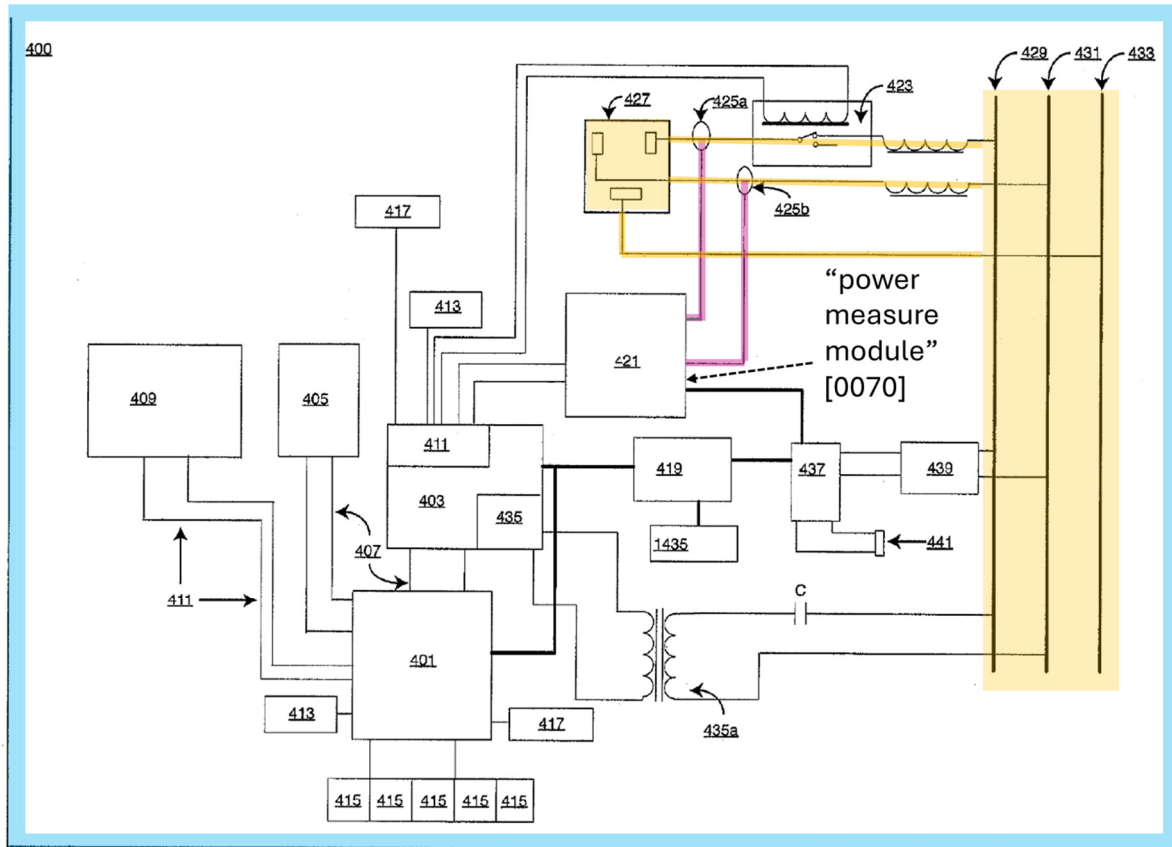


FIG. 4

With respect to claim 16, Chan discloses the wattmeter comprises *a single or multi-phase* AC power meter. (EX1002, ¶¶187-189) Because the appliance module connects to a standard wall outlet, a POSITA would have recognized that it would operate with the same phase as the connected AC source. (EX1002, ¶188.) “In the United States, homes receive a 60-Hz, 120-V *single-phase voltage*,

whereas industry typically receives a 60-Hz, 208-V/120-V *three-phase voltage*.” (EX1007, 901; EX1002, ¶188.)

8. Claims 20-22:

Chan discloses the recited WPAN (claim 20), Bluetooth (claim 21), and Zigbee (claim 22) functionalities. (EX1002, ¶¶192-197.) Chan’s *appliance module* communicates using “a wireless RF signal” or “other wireless technologies, WiFi, *ZigBee*... *WPAN*.” (EX1004, [0070], [0073], Claim 2; *Supra*, IV.A.2.g; *see also* EX1009, 601-602.) Chan’s *appliance module* includes “a *ZigBee* wireless chipset 405” having a ZigBee transceiver (*i.e.*, WPAN modem) and ZigBee antenna (*i.e.*, WPAN antenna). (EX1004, [0070], [0073], Claim 2; *Supra*, IV.A.2.g; EX1018, 369; EX1002, ¶¶192-195, 197.) Chan’s *appliance module* communicates using “*Bluetooth*.” (EX1004, [0070], [0073], Claim 2; *see also* EX1009, 601-602.) Further, Chan discloses “other chipsets ... for ... *Bluetooth*.” (EX1004, [0070], [0067]; EX1018, 369; EX1002, ¶196.)

9. Claims 23/24:

Chan discloses the recited WLAN functionalities. (EX1002, ¶¶198-204.) Chan’s *appliance module 400* communicates using “a wireless RF signal” or “other wireless technologies, [such as] *WiFi*.” (EX1004, [0070], [0073].) It was well-known that “[w]ireless local area networks (*WLANs*) are built around the family of IEEE 802.11 standards . . . The *802.11a/b/g* family of standards are

collectively referred to as **Wi-Fi**, for wireless fidelity.” (EX1009, 558-559; EX1021, 7:48-51; EX1001, 8:25-32; EX1002, ¶¶199, 202-203.) A POSITA would have understood (and found it obvious) that to enable **Wi-Fi (WLAN) communication**, the appliance module would include a **WLAN transceiver (modem)** and a **WLAN antenna**. (EX1018, 369; EX1002, ¶¶200-201.)

10. Claims 25/29:

Chan discloses the wireless network is a **wireless broadband network** such as a **WiMAX network** and the recited WiMAX functionalities. (EX1002, ¶¶205-206, 215-218.) Chan’s **appliance module 400** communicates with the gateway, which has “communication ports being configured for at least one format selected from . . . **WiMax**.” (EX1004, Claim 2.) It would have been obvious to implement the **appliance module** to provide WiMax connectivity. (EX1002, ¶¶205-206, 216.) It was well-known that “**WiMAX** is an emerging **broadband wireless technology** based on the **IEEE 802.16** standard . . . for **broadband wireless access** systems.” (EX1009, 17.) It would have been obvious to a POSITA at the time of the invention to use a recent IEEE 802.16 standard, such as **IEEE 802.16-2009**, for implementing Chan’s WiMax network. (EX1002, ¶217.)

A POSITA would have understood (and found it obvious) that communication via WiMAX networks would utilize a WiMAX antenna and a WiMAX modem (*e.g.*, a WiMAX transceiver). (EX1002, ¶218; EX1018, 369.)

11. Claims 26/27:

Chan discloses its *appliance module 400* may communicate using “*a wireless RF* signal.” (EX1004, [0070], [0073]; EX1002, ¶¶207-214.) Further, Chan’s *appliance module 400* communicates using “wireless technologies, *WiFi*, ...[or] *Bluetooth*.” (EX1004, [0070], [0073]; EX1002, ¶208.) It was well-known that “[m]any extremely successful wireless systems operate in *unlicensed bands*, including *wireless LANs*, *Bluetooth*, and cordless phones.” (EX1009, 21.) A POSITA would have understood (and find it obvious) that WiFi (802.11b and 802.11g) and Bluetooth use *unlicensed ISM* frequency bands. (EX1009, 23, Table 1.2; EX1002, ¶¶209-214.) It was well-known that “[m]any extremely successfully wireless systems operate in *unlicensed bands*, including *wireless LANs*, *Bluetooth*, and cordless phones.” (EX1009, 17.) Further, WiFi (802.11b and 802.11g) and Bluetooth use *unlicensed ISM* frequency bands. (EX1009, 23, Table 1.2.)

12. Claims 30:

Regarding claim 30, Chan discloses the wireless network is a cellular telephone network and the recited cellular components. (EX1002, ¶¶219-223.) Chan’s *appliance module 400* communicates with the gateway, which has “communication ports being configured for at least one format selected from ... *Cellular*.” (EX1004, Claim 2.) It would have been obvious to implement the

appliance module to provide cellular connectivity. (EX1002, ¶220.) A POSITA would have understood (and found it obvious) that communication via cellular networks would utilize a cellular antenna and a cellular modem (*e.g.*, a cellular transceiver). (EX1002, ¶¶221-223; EX1018, 369.)

13. Claims 38/41/44/45/46:

Regarding claim 38, Chan’s *temperature and humidity sensor* is an atmospheric and an environmental sensor. (EX1004, [0070], [0109]; EX1012, 445-446; EX1002, ¶¶230-232.)

Regarding claim 41, Chan’s “*temperature/fog/brightness/infrared sensor 1107*” or “*light sensor*” includes a photoelectric sensor responding to a visible or an invisible light such as infrared. (EX1004, [0070], [0109], Claims 7, 16; EX1012, 461-465; EX1002, ¶¶233-235.)

Regarding claim 44, a POSITA would have understood (and found it obvious) that the claim describes a camera. (EX1002, ¶¶236-241; EX1012, 478, 480, 497-498; EX1001, 17:55-18:25.) Chan discloses an “*IP camera*” connected to the *appliance module*. EX1004, [0076].) It would have been obvious to house the camera in the appliance module for monitoring purposes and to enable compact and efficient design. (EX1002, ¶238.) Chan’s claims 5-6 also recite a “*security sensor*” and a “*motion sensor*,” which a POSITA would have understood (and

found it obvious) to include cameras to perform those functions. (EX1004, Claims 5-6; EX1002, ¶238.)

Regarding claim 45, it would have been obvious to a POSITA that Chan's various *cameras* are video cameras, which were common at the time of the invention. (EX1012, 247-248; EX1002, ¶¶242-247.) In 2012, the recited digital video formats were well-known. (EX1026, [0048]; EX1002, ¶¶242-247.)

Regarding claim 46, Chan discloses "*smoke sensors*," which are electrochemical sensors responding to chemical properties, consistent with the description of the '590 patent. (EX1001, 36:15-23, Claim 47; EX1012, 569, 572; 575-576; EX1002, ¶¶248-252.)

B. Ground 2: Chan in View of Botts Renders Claims 50-52 Obvious

1. Summary of Botts

U.S. Pat. No. 8,461,861 ("Botts," EX1006) was filed on November 11, 2008, and issued June 11, 2013. (EX1006.) It is prior art under 35 U.S.C. §102(e). (EX1006.) Botts describes "a household appliance having an internal energy usage monitor that detects or monitors the energy usage for an appliance." (EX1006, 1:6-9, 1:65-2:8; EX1002, ¶¶258-262.)

2. Claims 50-52:

Regarding claim 50, Botts's appliance includes "an *indicator* for simply and easily conveying the energy usage of the appliance," including "a green light (*e.g.*,

a green LED)” when operating efficiently and “a red light (*e.g., a red LED*)” when usage is high. (EX1006, 10:56–67; EX1002, ¶¶267-273.)

Both Chan and Botts are analogous to the field of the ’590 patent. Both relate to measuring and communicating energy usage for appliances. (EX1004, [0045], [0047], [0071]; EX1006, 1:6-9, 1:65-2:14; EX1002, ¶259.) A POSITA would have been motivated to combine Chan’s *appliance module* with Botts’ conventional LED(s)/light(s) to indicate energy usage, thereby improving usability of the device with a reasonable expectation of success. (EX1002, ¶¶263-266.) It also would have been obvious that light indicator(s) would be coupled (directly or indirectly) to Chan’s *AC connector* to receive power. (EX1002, ¶¶270.) The light indicator(s) would also be coupled to Chan’s *wireless transceiver*, such that it emits light based on digital data received from the wireless network, such as control settings or efficiency thresholds transmitted by the gateway. (EX1002, ¶¶271-273.)

Regarding claim 51, Chan-Botts discloses the light source is coupled to the *current sensor* for illumination or indication in response to the measured AC current. (EX1002, ¶¶274-275.) A POSITA would have recognized that coupling the light source to Chan’s *current sensor* would allow the indicator to respond quickly to real-time current measurements with a reasonable expectation of success. (EX1002, ¶¶274-275.) In this manner, the light source would emit light

based on measured AC current and/or digital data received from the wireless network, such as control settings or efficiency thresholds transmitted by the gateway. (EX1002, ¶¶274-275.)

Regarding claim 52, Chan-Botts discloses the indicator is an LED. (EX1006, 10:56–67; EX1002, ¶276.)

C. Ground 3: Chan in View of Scherz Renders Claims 8-11, 54, 57 Obvious

1. Summary of Scherz

Scherz was published by at least January 9, 2007, and is prior art under 35 U.S.C. §102(b). (EX1030.) Scherz is a textbook titled “Practical Electronics for Inventors” (EX1007, Title). Scherz describes relay switches. (EX1007, 307-309; EX1002, ¶278.) A POSITA would have looked to Scherz for knowledge about relay switches when implementing Chan. (EX1002, ¶¶277-281.)

2. Motivation to combine Chan and Scherz

Chan and Scherz are analogous art to the '590 patent. Both relate to electrical switching devices. (EX1004, [0070]; EX1007, 307-310.) A POSITA would have been motivated to combine Chan and Scherz to apply Scherz's teachings to implement Chan's relay switch 423, with a reasonable expectation of success. (EX1002, ¶¶280-281.)

3. Claims 8-11/54/57

Chan's *appliance module* includes *a relay switch 423*. (EX1004, [0070]; EX1002, ¶282; *supra*, IV.A.5.) A POSITA would have known basic design choices for relay switches include: “mechanical relays, reed relays, and solid-state relays.” (EX1007, 307; EX1002, ¶283.) It would thus have been obvious to try them when implementing Chan's relay switch 423. (EX1007, 307; EX1002, ¶283, 287.)

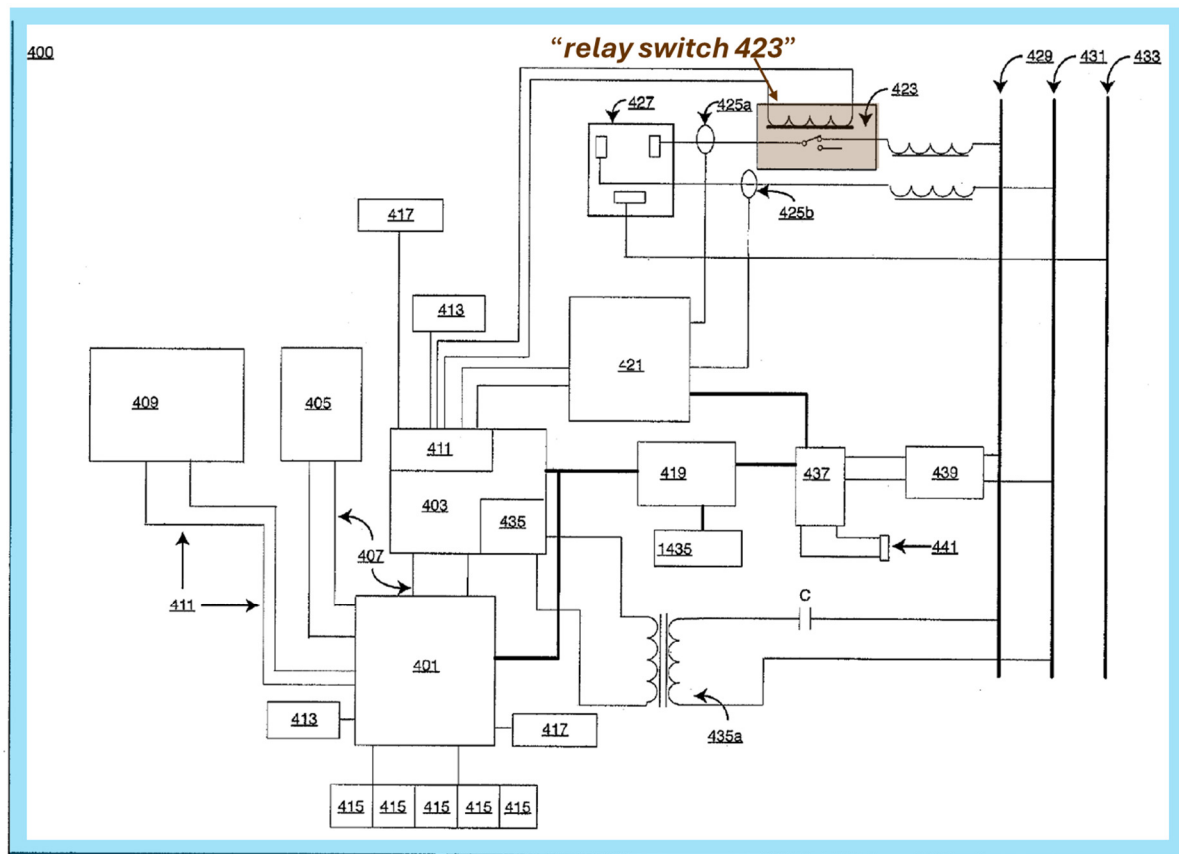


FIG. 4

Regarding claim 8, Chan-Scherz discloses the electrically actuated switch *has two or more poles or two or more throws*, and contacts of the electrically actuated switch are arranged as a *Single-Pole-Double-Throw (SPDT)* or *Double-*

Pole-Double-Throw (DPDT). (EX1002, ¶¶282-283.) For example, mechanical relays were available “in many of the standard manual switch arrangements (*e.g.*, SPST, ***SPDT***, ***DPDT***, etc.)” (EX1007, 308.)

Regarding claim 9, Chan-Scherz discloses the electrically actuated switch is a ***latching or a non-latching*** relay. (EX1002, ¶¶284-285.) Mechanical relays “come with a ***latching feature*** that gives them a kind of memory.” ((EX1007, 308.)

Regarding claim 10, Chan-Scherz discloses the relay is a ***solenoid-based*** electromagnetic relay that is a ***reed relay***. (EX1002, ¶¶286-287.) “[***R***]***eed relays*** consist of a pair of reeds ... that collapse whenever a current is sent through an ***encapsulating wire coil [e.g., solenoid]***.” (EX1007, 307).

Regarding claim 11, Chan-Scherz discloses the electrically actuated switch is based on an electrical circuit that comprises a ***thyristor*** or a ***TRIAC***. (EX1002, ¶¶288-289.) Solid-state relays “include ... ***thyristors*** (SCRs, ***triacs***, diacs, etc.)” (EX1007, 309.)

Regarding claim 54, Chan-Scherz discloses a ***motion actuator*** causing a ***linear motion*** and a conversion mechanism for converting linear motion to rotary motion based on a ***cam***. (EX1002, ¶¶290-295.) The ’590 patent explains that a relay switch (*e.g.*, Chan’s relay switch 423) is a ***motion actuator*** with a ***cam***. (*See* EX1001, 113:14-34.) As shown in Scherz, the relay switch converts linear motion

(*e.g.*, of the spring) to rotary motion (*e.g.*, of the moving contact arm) based on the cam. (EX1002, ¶295.)

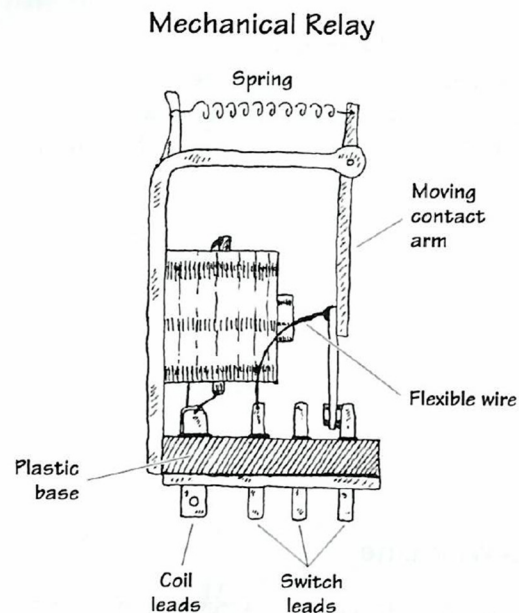


FIGURE 3.42

Regarding claim 57, Chan-Scherz discloses the actuator comprises an *electrical signal generator*. (EX1002, ¶¶296-299.) For example, the relay switch 423 can produce a “sudden, very large voltage” (*i.e.*, “electrical signal”) responsive to interrupted current flow. (EX1007, 310; EX1002, ¶298-299.)

D. Ground 4: Chan in View of Middelhoek Renders Obvious Claims 12, 17-18

1. Summary of Middelhoek

Middelhoek was published by at least June 30, 1999, and is prior art under 35 U.S.C. §102(b). (EX1031.) Middelhoek is a textbook about fundamental electronic components and devices for sensing current and power. (EX1008.) A

POSITA would have looked to Middelhoek for knowledge about current and power sensors when implementing Chan. (EX1002, ¶¶300-304.)

2. Motivation to combine Chan and Middelhoek

Chan and Middelhoek are analogous art to the '590 patent. Both relate to measuring current, voltage, and power. (EX1004, [0070]; EX1008, Title, 1, 29, 123-126, 141-159.) A POSITA would have been motivated to combine Chan and Middelhoek to apply Middelhoek's teachings to implement Chan's CT 425a and/or power measure module 421. (EX1002, ¶¶300-304.) Combining them would have obvious to try among a finite number of sensor and wattmeter configurations, yielding predictable results and with a reasonable expectation of success. (EX1002, ¶304.)

3. Claim 12:

Middelhoek discloses that “[g]alvanometers made accurate analogue current measures possible.” (EX1008, 1.) It would have been obvious to a POSITA to select a galvanometer to implement Chan's current sensor to achieve accurate AC current measurements. (EX1002, ¶¶305-309.)

4. Claims 17/18:

Chan discloses a wattmeter. (EX1004, [0070]-[0071]; *Supra*, IV.A.7; EX1002, ¶310.)

Regarding claim 17, Chan-Middelhoek teaches the wattmeter *averages*

readings. (EX1002, ¶¶310-312.) “[E]lectro dynamometers [are] another type of *averaging wattmeter*,” which “is a *most commonly used wattmeter*.” (EX1008, 154, 148.) It would have been obvious to a POSITA to select an electro dynamometer when implementing Chan’s wattmeter. (EX1002, ¶312.)

Regarding claim 18, Chan-Middelhoek discloses the wattmeter (“*power measure module*”) is based on multiplying a measured voltage and the current measured by the current sensor. (EX1002, ¶¶313-315.) It was common knowledge that a wattmeter is based on multiplying a measured voltage and measured current. (EX1002, ¶314.) “Standard methods for measuring power” include “measuring current and voltage separately, and multiplying the values.” (EX1008, 126, 123.)

E. Ground 5: Chan in View of Goldsmith Renders Obvious Claims 28, 31

1. Summary of Goldsmith

Goldsmith was published by at least January 20, 2006, and is prior art under 35 U.S.C. §102(b). (EX1009.) Goldsmith is a textbook on wireless communication systems and protocols available in 2005. (EX1009, xvii, 1-24, 595-603; EX1002, ¶¶316-324.) Chan and Goldsmith are analogous art to the ’590 patent and both relate to wireless communication techniques. (EX1004, [0070], [0073], Claim 2; EX1009, xvii, 1-24, 595-603; EX1002, ¶324.) A POSITA would have been motivated to combine Goldsmith and Chan. (EX1002, ¶¶325-328.) It

would have been obvious to apply Goldsmith's teachings to Chan because there were a finite number of wireless networking technologies available at the time, many already expressly disclosed in Chan as alternatives. (EX1002, ¶327.) A POSITA would have had a reasonable expectation of success integrating these standardized systems, motivated by known benefits such as improved compatibility, scalability, and performance. (EX1002, ¶328.)

2. Claim 28:

Regarding claim 28, Chan-Goldsmith discloses the wireless network is a satellite network, the antenna is a satellite antenna, and the wireless transceiver is a satellite modem. (EX1002, ¶¶329-333.) Chan's *appliance module 400* communicates using "*other wireless technologies, ... or other media.*" (EX1004, [0070], [0073].) Goldsmith discloses that the wireless systems available in 2005 include *satellite networks*. (EX1009, 18-19.) A POSITA would have found it obvious to use "satellite networks," a form of popular wireless communication system available in 2005 when implementing Chan. (EX1002, ¶332.) A POSITA would have understood (and found it obvious) that communication via satellite networks would utilize a satellite antenna and a satellite modem (*e.g.*, a satellite transceiver). (EX1002, ¶333; EX1018, 369.)

3. Claim 31:

Chan discloses the wireless network is a cellular network. (*Supra*, IV.A.12.) Chan-Goldsmith discloses the cellular telephone network is a 3G network that uses W-CDMA or EDGE. (EX1002, ¶¶334-341.) “[T]he *third generation (3G) cellular systems* are based on a *wideband CDMA standard*.” (EX1009, 10, 600.) “A more fundamental enhancement, *Enhanced Data Services for GSM Evolution (EDGE)*, further increases data rates using a high-level modulation format combined with FEC coding.” (EX1009, 12-13.) A POSITA would have found it obvious to use 3G networks such as W-CDMA or EDGE when implementing Chan’s cellular communication. (EX1002, ¶341.)

F. Ground 6: Chan in View of Rossing Renders Obvious Claims 33, 48, 49, 55, 56

1. Summary of Rossing

Rossing was published by at least July 23, 2007, and is prior art under 35 U.S.C. §102(b). (EX1032.) Rossing is a textbook related to microphones and speakers. (EX1010 757-765, 903.) Chan and Rossing are analogous art to the ’590 patent and relate to electroacoustic components. (EX1004, Claim 10; EX1010, 757-758, 763, 765, 903; EX1002, ¶¶342-350.) A POSITA would have been motivated to consider Rossing when implementing Chan’s audio parts. (EX1002, ¶¶351-353.)

Applying Rossing’s teachings to Chan would have been obvious to try given the finite number of predictable electroacoustic solutions to achieve expected and

reliable results. (EX1002, ¶353.) The known benefits (*e.g.*, improved sensitivity, directionality) would have prompted their application with a reasonable expectation of success. (EX1002, ¶353.)

2. Claims 33/48/49:

Chan's *microphones* are *first sensors*. (*Supra*, IV.A.2.f; EX1002, ¶354.)

Regarding claim 33, Chan's microphone is a *piezoelectric* sensor that includes a piezoelectric *ceramic*. (EX1002, ¶¶354-358.) For example, "the crystal microphone" is "based on the *piezoelectric* effect ... [where] the *diaphragm* constricts a thin crystal made of Rochelle salt, *ceramic*, or similar material, directly producing a voltage." (EX1010, 757-758.) Further, a POSITA would have understood (and found it obvious) that piezoelectric sensors operate in at least one of these modes: *transverse, longitudinal and shear*. (*See, e.g.*, EX1001, 71:59–67; EX1002, ¶358.)

Regarding claim 48, Chan's microphone is an electroacoustic sensor that responds to an audible sound. (EX1002, ¶¶359-361.) "[A] *microphone* is . . . generally used to convert acoustic signals to proportional *electrical signals*." (EX1010, 757-758; EX1002, ¶360; *see also* EX1002, 17:47–54.)

Regarding claim 49, Rossing discloses that "common to virtually all microphones ever made is a *diaphragm* ... *the sound waves impinging on a diaphragm* cause movement of the diaphragm, and it is this movement that is

sensed and converted to an electrical audio signal.” (EX1010, 757-758; EX1002, ¶¶362-370.) For example, “the crystal microphone” is “based on the *piezoelectric effect*” (EX1010, 757-758.) “[A] microphone is an audio device inextricably tied to *spatial considerations*” and “most microphones exhibit some *directional bias*.” (EX1010, 757.) That is, microphones are *omnidirectional, unidirectional, or bidirectional*. (EX1010, 759; EX1002, ¶370; *see also* EX1020, 118-119.)

3. Claims 55/56:

Chan’s “*appliance module* compris[es] one or more *audio devices*.” (EX1004, Claim 11.) An *audio device* (*e.g., speaker/sounder*) is *an actuator*. (EX1002, ¶¶371-372; *see also* EX1001, 105:48-106:18.) A POSITA would understand that, like Chan’s other actuators, the *sounder* would be *coupled to the wireless transceiver* to operate (*e.g., to output an alarm in response to received data*). (EX1004, [0057], [0076]; EX1002, ¶372.)

Regarding claim 55, in a speaker, “the *electrical energy* is converted to mechanical energy, specifically the movement of a diaphragm . . . which *then radiates acoustical energy*.” (EX1010, 763; *see also* EX1020, 122-123; EX1002, ¶¶371-375.) “Sound radiates from a loudspeaker in all directions . . . and . . . almost unavoidably *omni-directional* at low frequencies.” (EX1010, 765.)

Regarding claim 56, Chan-Rossing discloses the actuator has an electromagnetic coil or an electromagnet operative for generating a magnetic field.

(EX1002, ¶¶376-378.) “Many of the same transduction methods that have been used in microphones have at least been tried for loudspeakers including *magnetic*.”

(EX1010, 763.) A magnetic speaker comprises an electromagnetic coil or an electromagnet operative for generating a magnetic field. (*See, e.g.*, EX1020, 122-123; EX1012, 3; EX1002, ¶¶377-378.)

G. Ground 7: Chan in View of Benesty Renders Obvious Claim 34

1. Summary of Benesty

Benesty was published by December 11, 2007, and is prior art under 35 U.S.C. §§102(b). (EX1033.) Benesty is a textbook related to speech processing techniques, including microphone arrays. (EX1011.) Chan and Benesty are analogous art to the ’590 patent as both relate to microphones. (EX1004, Claim 10; EX1011, 1021; EX1002, ¶¶379-384.) A POSITA would have been motivated to apply Benesty’s microphone arrays when implementing Chan to allow audio capture with higher clarity and spatial accuracy. (EX1002, ¶¶385-387.)

2. Claim 34:

Chan’s appliance module includes *multiple microphones*. (EX1004, Claim 10; EX1002, ¶389.)

Chan-Benesty discloses multiple microphones arranged as a directional sensor array operative to estimate the Direction-Of-Arrival (DOA) of the physical phenomenon impinging the sensor array. (EX1002, ¶¶388-394.) “[A] microphone

array beamformer ... [can] lead to an *estimate of the direction of an active speech source*.” (EX1011, 1044; EX1002, ¶392.) A POSITA would have understood (and found it obvious) that arranging multiple microphones in Chan’s module as taught by Benesty would create a *directional sensor array* operative to estimate the *direction of arrival* of a sound. (EX1002, ¶394.)

H. Ground 8: Chan in View of Fraden Renders Obvious Claims 35, 36, 39, 40, 42, 43, 47

1. Summary of Fraden

Fraden was published by May 10, 2011, and is prior art under 35 U.S.C. §102(a). (EX1012.) Fraden is a sensor textbook. (EX1012, Chapters 6, 10- 11, 13--17.) Chan and Fraden are analogous to the ’590 patent and both relate to use of sensors. (EX1004, [0070], [0109], Claims 3-16; EX1012, Chapters 6, 10-11, 13-14-17; EX1002, ¶¶395-396.) A POSITA would have been motivated to consider Fraden when implementing Chan’s sensors. (EX1002, ¶¶397-401.)

2. Claims 35-36/39/40

As discussed, Chan’s *first sensors* include “*temperature and humidity sensor 409*,” “*temperature/fog/brightness/infrared sensor 1107*,” “*humidity sensor*,” “*pressure sensor*,” “*microphones*,” “*smoke sensor*.” ([0070], [0109], Claims 3-16.)

Regarding claim 35, Chan’s *temperature sensor* is a *thermoelectric* sensor responding to a temperature of an object using *conduction, convection, or*

radiation and includes a thermistor, a thermocouple, or a RTD as taught by Fraden. (EX1004, [0070], [0109]; EX1002, ¶¶402-404.) “*Taking a temperature*” requires “transmission of . . . the *object*’s thermal energy to the sensor,” which “convert[s] that energy into an *electrical signal* . . . This applies to any method of sensing: *conductive, convective, and radiative*.” (EX1012, 519.) Fraden discloses that *thermistors, resistance temperature detectors (RTDs), and thermocouple* are common temperature sensors. (EX1012, 526; EX1020, 34.)

Regarding claim 36, Chan’s *first sensors* includes a crystal or a semiconductor. (EX1002, ¶¶405-409.) Fraden discloses that microphones include a “piezoelectric *crystal*.” (EX1012, 435-436; EX1010, 758; *supra*, IV.F.2.) “A reference *temperature detector* in this example is a *semiconductor sensor*[.]” (EX1012, 553, 608; EX1002, ¶408.)

Regarding claim 39, Fraden discloses that “*temperature sensor[s]* can be fabricated with the *surface acoustic waves* (SAW) and plate waves (PW) techniques” and “oscillating *hygrometer[s]*” “*may be employed by using the SAW sensors*[.]” (EX1012, 564-565, 458, 442; EX1002, ¶412.) It would have been obvious to a POSITA to implement Chan’s *temperature and humidity sensor* with surface acoustic sensors. (EX1002, ¶¶410-415.)

Regarding claim 40, Chan-Fraden’s *first sensor* is a *radiation* sensor based on a gas ionization that responds to radioactivity, nuclear radiation, alpha particles,

beta particles, or gamma rays. (EX1002, ¶¶416-419.) Radiation sensors that operate in the recited manner were well-known. (EX1012, 503-505.) It would thus have been obvious to incorporate it into Chan and/or try it when implementing Chan's various sensors to enhance Chan's functionalities. (EX1002, ¶419.)

3. Claims 42/43

Regarding claim 42, Chan's "*temperature/fog/brightness/infrared sensor 1107*" or "*light sensor*" includes a photoelectric sensor based on the photoelectric effect, and include a semiconductor component that comprises a photodiode, a phototransistor, or a solar cell. (EX1002, ¶¶420-421.) Photoelectric sensors include photodiodes ("a *photoelectric device*" and "*semiconducting* optical sensor[]"), phototransistor (which can "do the same" as a photodiode), and solar batteries. (EX1012, 465, 471-472.)

Regarding claim 43, Chan's photoelectric sensor is based on CCD or a CMOS element. (EX1002, ¶¶422-425.) Fraden discloses CCD and CMOS image sensors as types of photoelectric sensors. (EX1012, 478-480.) It would have been obvious to try them when implementing Chan's light sensor. (EX1002, ¶425.)

4. Claim 47

Chan's smoke sensor is based on an optical detection or on an ionization. (EX1002, ¶¶426-430.) Fraden discloses that "*[i]onization and optical detectors*" are widely employed in smoke sensors. (EX1012, 424-428.) It would thus have

been obvious to try them when implementing smoke sensors in Chan. (EX1002, ¶430.)

I. Ground 9: Chan in View of Doherty Renders Obvious Claims 60-63

1. Summary of Doherty

Doherty was published by January 16, 2007, and is prior art under 35 U.S.C. §102(b). (EX1035.) Doherty is a textbook titled “Wireless Home Networking Simplified.” (EX1013, Introduction, Chapter 6; EX1002, ¶¶431-432.) A POSITA would have looked to Doherty for implementing Chan’s wireless devices. (EX1002, ¶¶433-435.)

2. Claims 60-63

Regarding claim 60, Chan-Doherty discloses the appliance is addressable in the wireless network using distinct *locally* administered addresses or *universally* administered *digital addresses* stored in a volatile or non-volatile memory in the single enclosure, which *uniquely identify the appliance* in the wireless network. (EX1002, ¶436-440.) Chan’s appliance module communicates using “wireless technologies, [including] WiFi.” (EX1004, [0073].) Doherty discloses that each networked device in a wireless network “has a *unique identifier called a MAC address*.” (EX1013, 99, 166.) Further, “[t]he second least significant bit of the most significant byte MAC address is known as the *universal or locally administered address (U/L) bit*.” (EX1027, 24.)

Further, “each device (computer, laptop, and so on) *in a home network* needs to have an *IP address*, which is how the device is known on the network . . . the *router assigns each device an address* from this pool when it boots.”

(EX1013, 108, 210, 175.) “Internet protocol (IP) addresses are the *unique numbers used to identify individual connections* to the Internet.” (EX1025, 127.)

A POSITA would have understood (and found it obvious) that the IP address may be an assigned IP address for the device (*e.g.*, by the router), the router’s IP address, a combination of the two, or a globally unique IP address. (EX1002, ¶439.) A POSITA would also have understood (and found it obvious) that IP addresses are stored in a local memory of the appliance module. (EX1013, 211, Figure 10-44, 265; EX1002, ¶440.)

Regarding claim 61, a POSITA would have known (and found it obvious that) “[m]ost MAC addresses use one of the IEEE standardized protocols; *MAC-48, EUI-48®*, and *EUI-64®*.” (EX1048, 2:50-59; EX1002, ¶¶441-442.)

Regarding claim 62, it was well known that “Internet Protocol (IP) is a *Layer 3 protocol . . .*” (EX1027, 11; EX1002, ¶¶443-447.) “In the case of today’s Internet, these addresses are *Internet protocol version 4 (IPv4)* addresses.” (EX1025, 127.) Doherty discloses that IP addresses can be dynamic or static. (EX1013, 277.)

Regarding claim 63, Chan-Doherty discloses the digital address is assigned by another *appliance* using *DHCP*. (EX1002, ¶¶448-449.) “Most home networks use IP addresses . . . and *the router assigns* each device an address . . . This is called dynamic IP addressing, or *Dynamic Host Configuration Protocol (DHCP)*.” (EX1013, 210; EX1025, 135; EX1002, ¶449.)

J. Ground 10: Chan in View of Ozturk Renders Obvious Claim 59

1. Summary of Ozturk

Ozturk was published by at least October 2008 and is prior art under 35 U.S.C. §102(b). (EX1036.) Ozturk is an IEEE article about forced air cooling of CPUs using heat sinks and fans. (EX1014; EX1002, ¶450.) A POSITA would have looked to Ozturk when implementing Chan’s CPU. (EX1002, ¶¶451-454.)

2. Claim 59:

Chan-Ozturk discloses the actuator comprises a thermoelectric cooler and is coupled to the object by convection. (EX1002, ¶¶455-458.) Chan’s appliance module comprises a “CPU 401.” (EX1004, [0070], FIG. 4.) Ozturk discloses that CPUs have coolers that operate by convection. (EX1014, 650.) A POSITA would have been motivated to include a fan and heatsink in Chan’s appliance module to remove heat dissipated by the CPU 401. (EX1002, ¶456.) A POSITA would have further understood that the fan and heatsink would be coupled to the wireless transceiver for controlled in response to digital data received from the wireless

network, since the CPU operates based on such data and the cooling assembly responds to the resulting increase in processor activity and heat generation.

(EX1002, ¶458.)

K. Ground 11: Seo in View of Chan Renders Obvious Claims 1, 23-24, 26-27, 38, 41, 53, 59

1. Summary of Seo

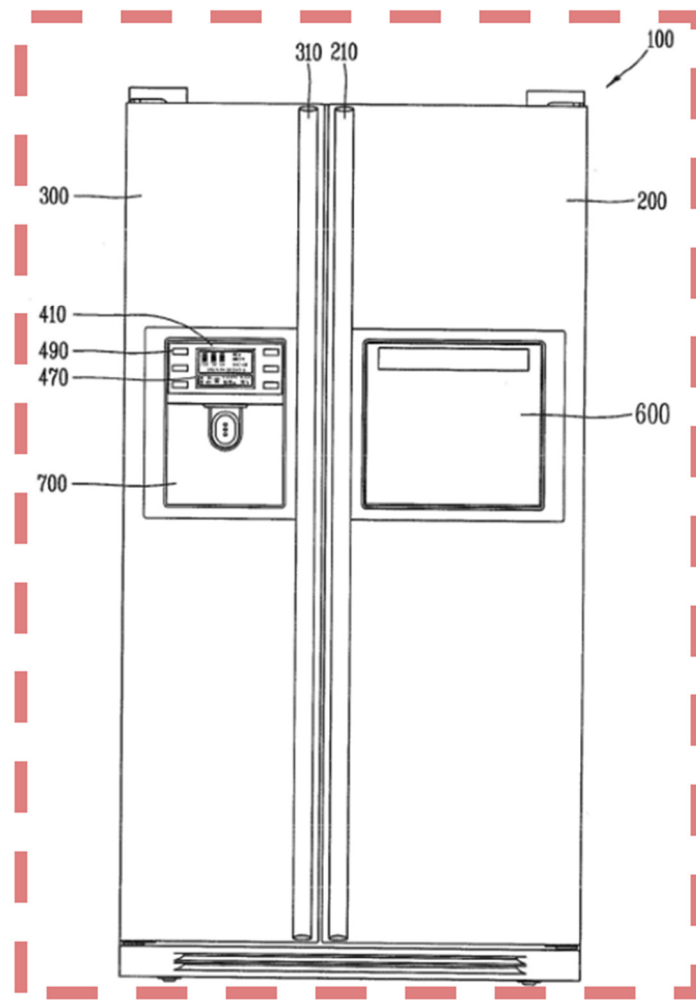
Seo was filed on August 28, 2009, and published July 22, 2010. (EX1005.)

It is prior art under 35 U.S.C. §§102(a) and (b). (EX1005.)

Seo discloses a *refrigerator* comprising a control unit 410, as shown in FIG.

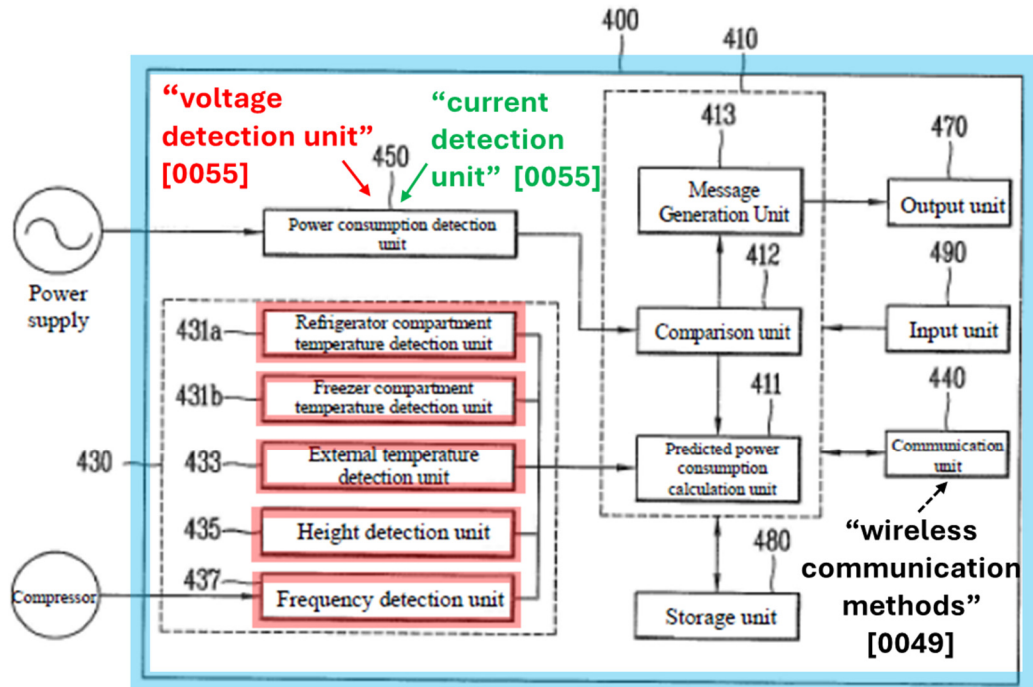
1. (EX1005, [0012], [0019]; EX1002, ¶459.)

FIG. 1



Control unit 410 is enclosed in a *control device 400* of the *refrigerator*, shown in FIG. 4. The *control device 400* encloses “a power consumption detection unit 450, connected to the *input power source*.” (EX1005, [0054]; EX1002, ¶460.) The “power consumption detection unit 450 can . . . detect the current . . . applied to the refrigerator main body 100 through a *current detection unit*.” (EX1005, [0055]; EX1002, ¶460.)

FIG. 4



Seo discloses numerous additional sensors, including “*internal temperature detection units* (431),” “an *external temperature detection unit 433*,” “a *gas sensor* (not shown),” a “*a voltage detection unit*,” etc. (EX1005, [0055], [0057]-[0061]; EX1002, ¶461.) The information is used for “calculating predicted power consumption and usage fees” and “generating one or more messages corresponding to the internal and external states.” (EX1005, [0086]; EX1002, ¶461.)

Seo’s refrigerator transmits and receives information wirelessly. (EX1002, ¶462.) For example, it “can transmit and output the data detected, calculated, or generated by the . . . state detection unit 430 to external devices . . . through the communication unit.” (EX1005, [0041], [0051].) Seo’s communication unit 440

is connected to the external device by wired or *wireless* communication methods.” (EX1005, [0049], [0051]; EX1002, ¶¶462-463.) Seo further describes that the communication unit “*transmits* to the external device the data detected, calculated, or generated by the control unit 410 or the state detection unit 430,” and “*receives* various information or *control commands* from the external device.” (EX1005, [0051], [0049]-[0051], [0126]; EX1002, ¶¶463-467.)

2. Motivation to combine Seo and Chan

It would have been obvious for a POSITA to combine the appliance control functionality disclosed in Chan with Seo’s refrigerator. (EX1002, ¶¶467-471.) Both Seo and Chan are analogous to the field of the ’590 patent. (EX1002, ¶467.) Each enhances performance of appliances via energy monitoring and wireless communication. (EX1004, [0041]; EX1005, [0001], [0016]; EX1002, ¶467.)

A POSITA would have been motivated to combine Seo and Chan. (EX1002, ¶468.) Seo itself discloses claim 1 because its refrigerator is already *controlled (e.g., displaying messages, switching energy sources)* based on received data. (*Infra* § IV.B.3.) Further, the Seo-Chan combination provides *more ways to control or activate Seo’s refrigerator*, for example, allowing the refrigerator to receive command data as taught by Seo and/or Chan and “turn the connected appliance on or off” as taught by Chan. ((EX1005, [0051]); EX1004, [0057]; EX1002, ¶468.) By adopting Chan’s teaching, Seo’s refrigerator—already

configured for wireless communication—would process command data to operate the refrigerator beyond displaying messages and switching energy sources.

(EX1002, ¶468.)

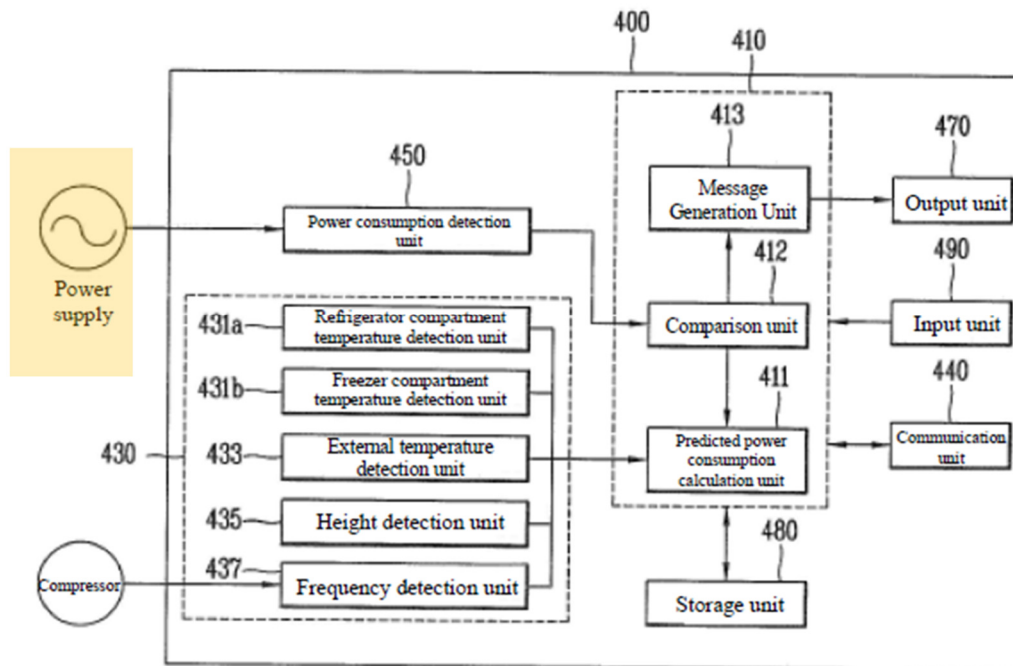
This combination would expand Seo’s remote-control functionalities (*e.g.*, by enabling on/off switch of the appliance as taught by Chan). (*See* EX1004, [0066]; EX1002, ¶469.) It would have been obvious to combine Seo and Chan because the known benefits of Chan would prompt its application in the same field based on design incentives and other market forces. *Id.* Moreover, the combination would have required no more than the routine integration of known elements. Seo already includes the necessary hardware/software to control the refrigerator, while Chan teaches additional ways to control the refrigerator. (EX1005, [0049]-[0051]; EX1004, [0057], [0076], [0110]-[0112].)

3. Claim 1

a. 1[PR1]: “An Alternating-Current (AC) powered appliance”

Both Seo and Chan disclose an AC powered appliance. (*Supra* §IV.A.2.a; EX1002, ¶¶472-475) For example, it would have been obvious to a POSITA that Seo’s refrigerator—a household appliance—is AC-powered. (*See e.g.*, EX1004, [0070], [0071]; EX1002, ¶¶472.) Indeed, FIG. 4 of Seo depicts the refrigerator’s “*input power source*” or “*power supply*” as a sinusoidal waveform, a symbol for an AC power source. (EX1005, Claim 2, [0012], [0054], FIG. 4; EX1002, ¶473.)

FIG. 4

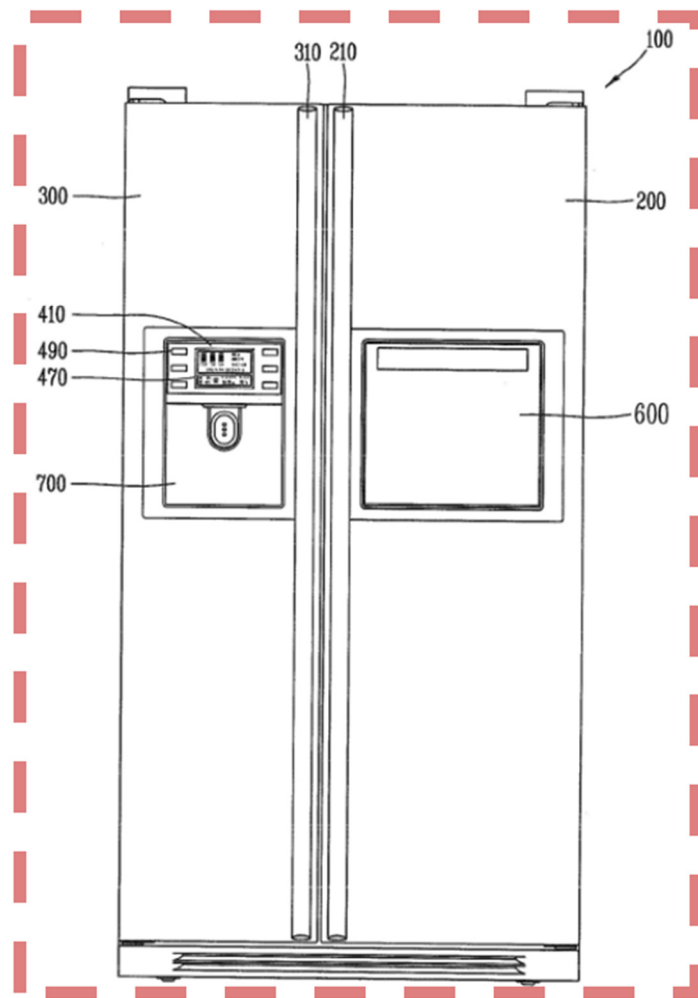


b. 1[PR2]: “associated with a food storage, handling, or preparation,”

Both Seo and Chan disclose element 1[PR2]. (*Supra* §IV.A.2.b.)

For example, Seo’s “*refrigerator* is an appliance used to keep stored items such as food and beverages fresh over an extended period of time.” (EX1005, [0002], [0003], [0022], [0092]; EX1002, ¶¶476-478.)

FIG. 1



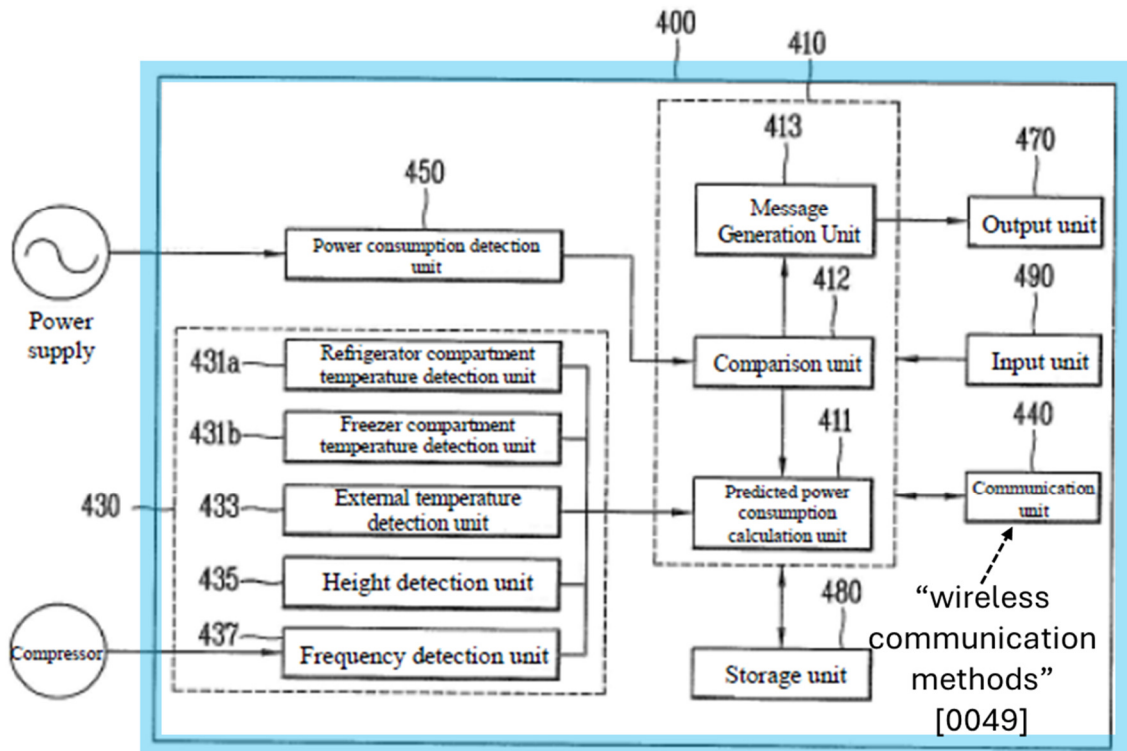
c. 1[PR3]: “for use with a wireless network, the appliance comprising:”

Both Seo and Chan disclose element 1[PR3]. (*Supra* §IV.A.2.c.)

For example, in FIG. 4 below, Seo’s *refrigerator* has a *control device 400*, which comprises a “*communication unit 440*.” (EX1005, [0049], [0051], [0081], [0083], FIG. 4; EX1002, ¶479.) “The communication unit 440 is connected to the external device by . . . *wireless communication methods*.” (EX1005, [0049],

[0051], [0081], [0083], [0104], [0105], [0124].) Thus, a wireless network is formed by the “external devices” and the *refrigerator*. (EX1002, ¶¶479-480.)

FIG. 4

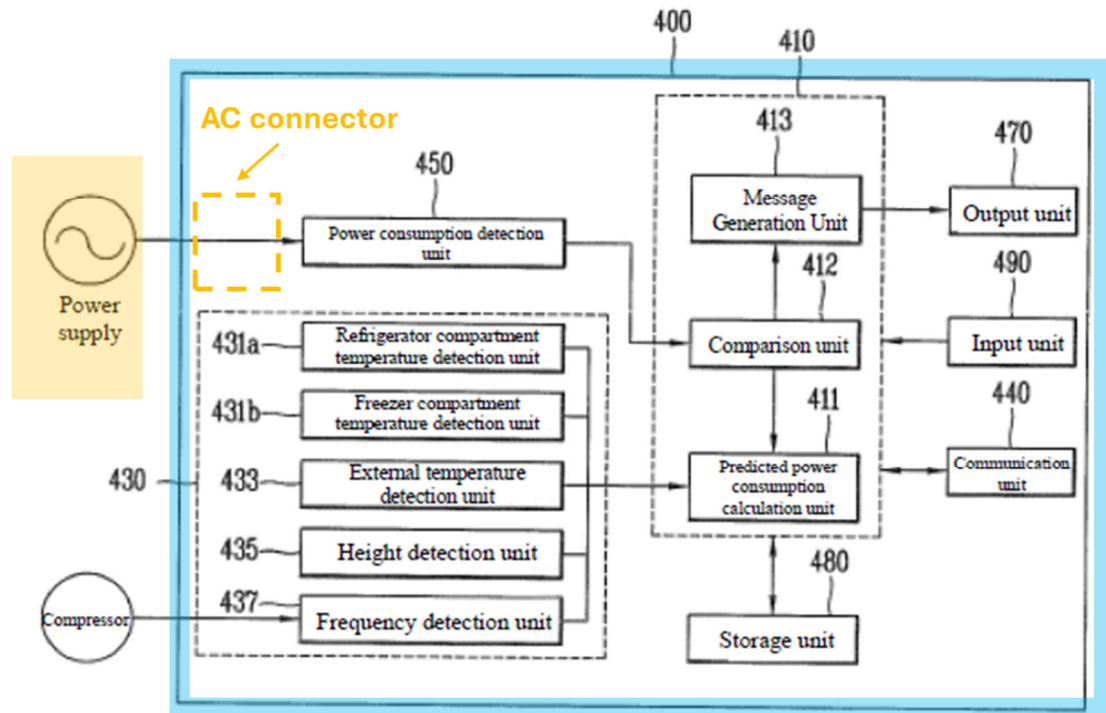


d. 1[A]: “an AC connector for connecting the appliance to an AC power source;”

Both Seo and Chan disclose claim 1[A]. (*Supra* §IV.A.2.d.)

For example, it was well-known that a *refrigerator* such as Seo's has *an AC connector* for connecting to and drawing power from an *AC input power source* (e.g., the standard electrical wall outlet as disclosed in Chan). (EX1004, [0012], [0054]; EX1002, ¶¶481-483.)

FIG. 4

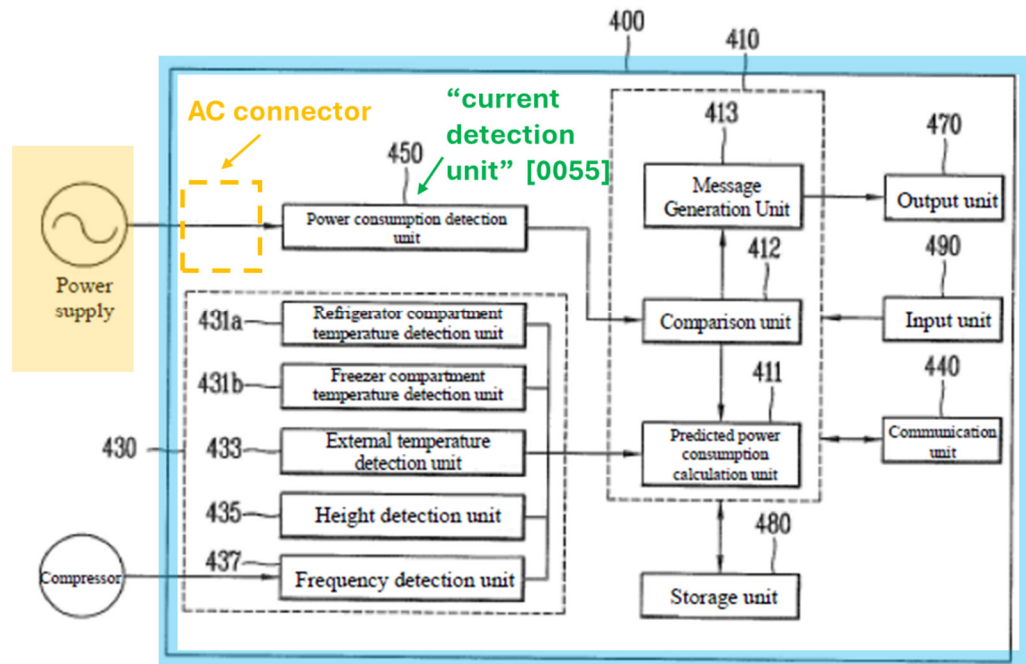


e. 1[B]: “a current sensor coupled to the AC connector for measuring an AC current consumed by the appliance;”

Both Seo and Chan disclose claim 1[B]. (*Supra* §IV.A.2.e.)

For example, Seo’s “power consumption detection unit 450 can . . . detect the current . . . applied to the refrigerator main body 100 through a **current detection unit**.” (EX1005, [0047], [0055], [0128]; EX1002, ¶¶484-485.) The **current detection unit** is coupled to an **AC connector** because “power consumption detection unit 450 [comprising the **current detection unit**] [is] connected to an input power source [*i.e.*, via the **AC connector** of the refrigerator].” (EX1005, [0012], [0054], [0055]; EX1002, ¶484.)

FIG. 4

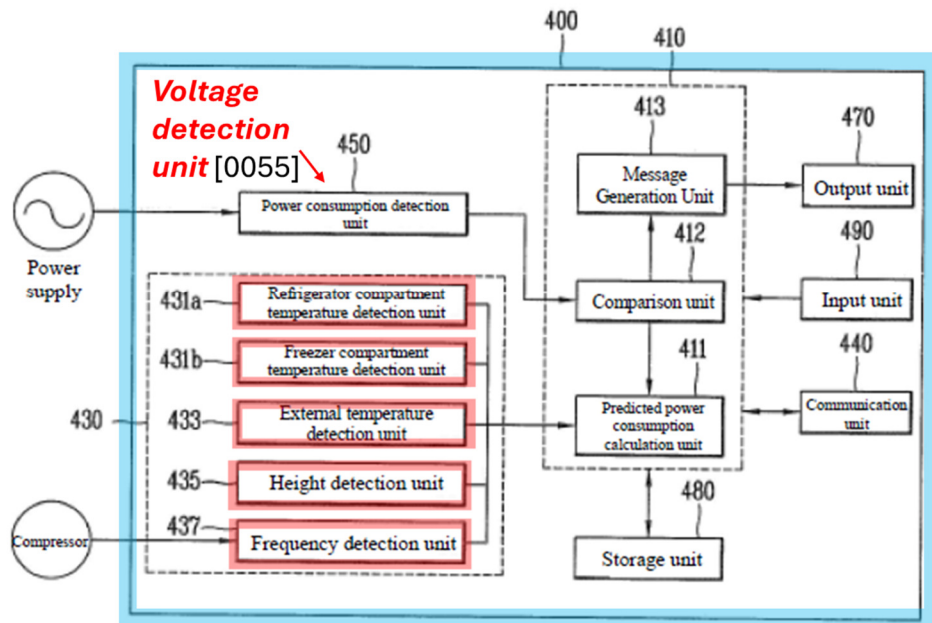


f. 1[C]: “a first sensor having an output that responds to a physical phenomenon;”

Both Seo and Chan disclose claim 1[C]. (*Supra* §IV.A.2.f.)

For example, Seo discloses numerous such *first sensors* in the control device 400, including “*internal temperature detection units (431)*,” “*an external temperature detection unit 433*,” “*a gas sensor* (not shown),” “*a voltage detection unit*,” and “*a sensor* (not shown) that *detects the opening and closing of the door*.” (EX1005, [0057]-[0061], [0012], [0020]-[0022], [0027]-[0031], [0047], [0055], [0071]; EX1002, ¶¶486-487.) All such sensors have outputs responsive to physical phenomena. (See, e.g., EX1001, 16:44-50; 22:25-34; EX1002, ¶486.)

FIG. 4



g. 1[D]/1[E]: “an antenna for communication over the wireless network; a wireless transceiver coupled to the antenna for transmitting digital data to, and for receiving digital data from, the wireless network; and”

Both Seo and Chan disclose claim 1[D]/1[E]. (*Supra* §IV.A.2.g.)

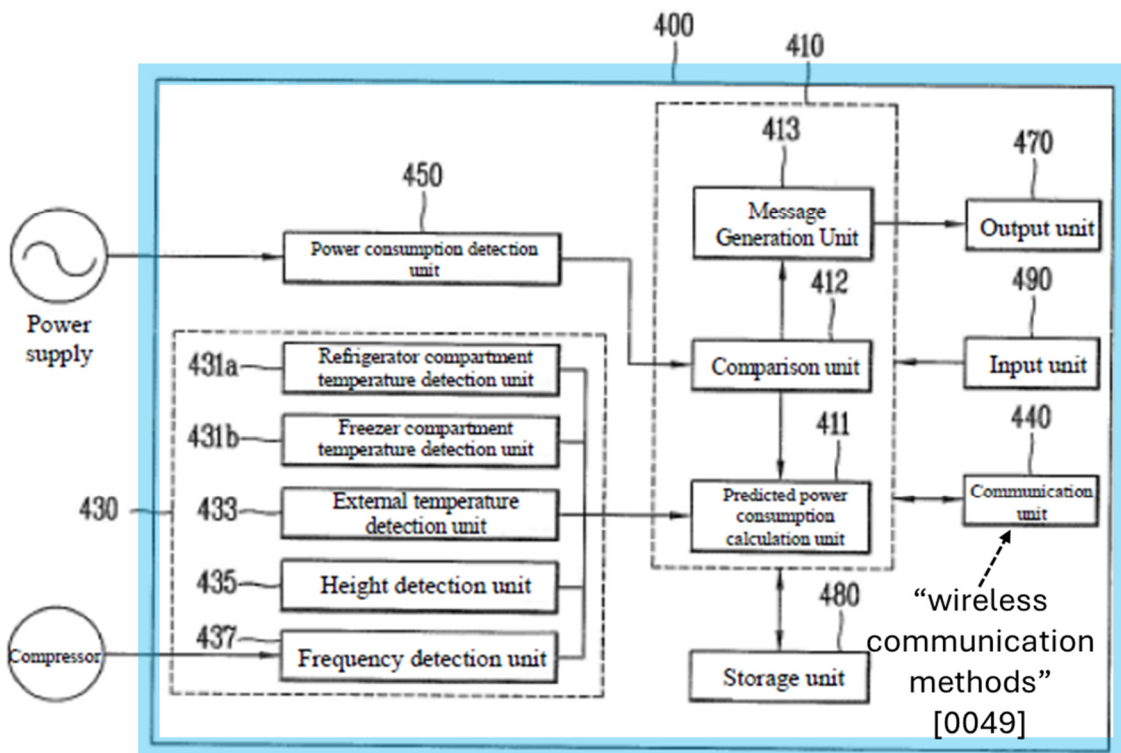
For example, Seo teaches an *antenna* coupled to a *wireless transceiver* for communication over the wireless network. (EX1002, ¶¶488-490.) As shown in FIG. 4, the control device 400 includes a “communication unit 440 [that] is connected to the external device by ... *wireless* communication methods.”

(EX1005, [0049], [0051], [0081], [0083], [0104], [0106].) A POSITA would have understood (and found it obvious) the communication unit 440 includes an *antenna* coupled to a *wireless transceiver* for enabling wireless communication.

(EX1018, 369; EX1002, ¶488.) It was well-known that “wireless communication

requires a *transmitter* (*transmitter electronics* plus *antenna*) . . . [and] a *receiver* (*receiving electronics* plus *antenna*).” EX1018, 369; EX1022, 3:17-20, 3:38-40; EX1023, [0013]-[0015]; EX1002, ¶488.) A “*transceiver* consists of a *transmitter* and a *receiver*.” *Id.*

FIG. 4



Seo further teaches the wireless transceiver is for *transmitting* digital data to, and for *receiving* digital data from, the wireless network. (EX1002, ¶489.) Seo’s communication unit 440 (including the *wireless transceiver*) is “connected to an external power device and *exchanges* information therewith.” (EX1005, [0049], [0081]; EX1002, ¶489.) Seo’s communication unit both “*transmits* to the

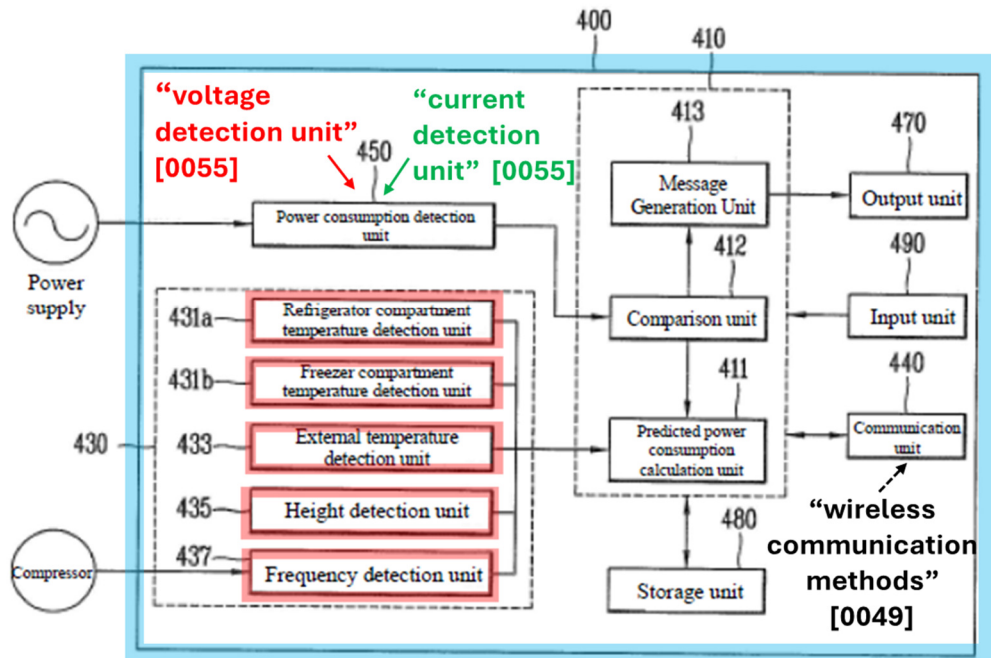
external device [*e.g.*, “mobile phones,” “remote controllers,” “external power device,” etc.] the data detected, calculated, or generated by the control unit 410 or the state detection unit 430” and “*receives* various information or control commands.” (EX1005, [0049], [0051], [0081], [0083]; EX1002, ¶489.)

h. 1[F]: “a single enclosure housing the current sensor, the first sensor, the antenna, and the wireless transceiver,”

Both Seo and Chan disclose claim 1[F]. (*Supra* §IV.A.2.h; EX1002, ¶¶491-493.)

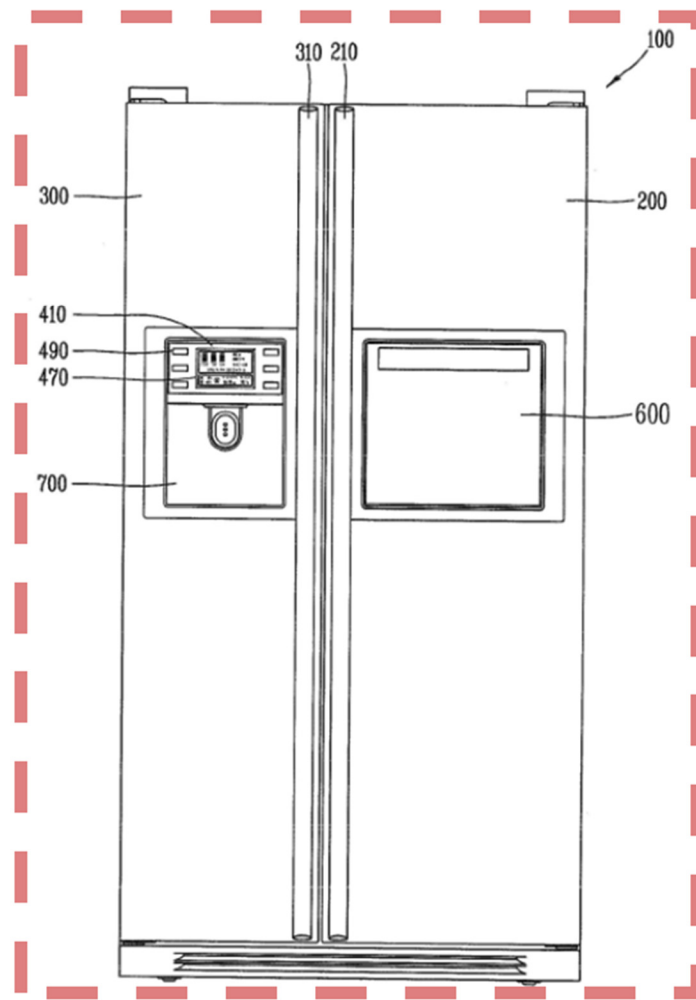
For example, FIG. 4 of Seo expressly shows that the *control device 400* encloses the power consumption detection unit 450 (including “*current detection unit*”), the various *first sensors*, and the communication unit 440 (including *the wireless transceiver* and *antenna*). (EX1005, [0054]-[0057], FIG. 4; EX1002, ¶491.) Seo describes the *control device 400* as a “device.” (EX1005, [0016], [0054], [0081]; EX1002, ¶491.) A POSITA would have understood (and found it obvious) that the *control device 400*, as a device, would have a device housing enclosing its parts. (EX1002, ¶491.)

FIG. 4



Additionally, the *refrigerator* itself is also a single enclosure. (EX1002, ¶492.) As shown in FIG. 1, the *refrigerator* has an outer shell ("main body 100") enclosing its parts including the claimed elements. (EX1005, [0019], [0047], [0055], FIG. 1; EX1002, ¶492.)

FIG. 1



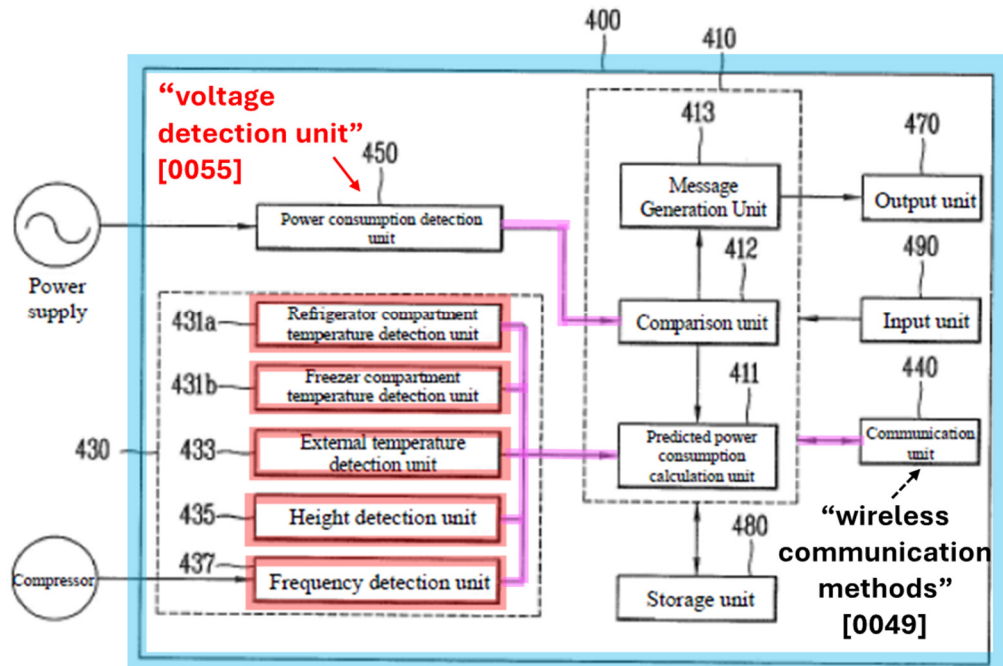
i. 1[G]: “wherein the first sensor is coupled to the wireless transceiver for transmitting digital data in response to the physical phenomenon to the wireless network,”

Both Seo and Chan disclose claim 1[G]. (*Supra* §IV.A.2.i.)

For example, Seo discloses that the *first sensor* is *coupled* to the *wireless transceiver*. (EX1002, ¶¶494-501.) Seo includes *sensors* responsive to physical phenomenon. (EX1005, [0012], [0055]-[0061], [0071]; *see also supra*, IV.B.3.f; EX1002, ¶495.) In FIG. 4 below, the control device 400 includes a communication

unit 440 (including a *wireless transceiver*) *coupled to* various *physical phenomenon sensors*. (EX1005, FIG. 4; EX1002, ¶495.)

FIG. 4



Seo discloses that the *wireless transceiver* *transmits digital data in response to* the measured physical phenomenon. (EX1002, ¶496.) The *first sensors* are part of the "*state* detection unit 430" and they monitor physical phenomenon (*e.g.*, the fridge's "internal and external states"), such as temperature (*e.g.*, by the "internal temperature detection units (431)" or "external temperature detection unit 430"), greenhouse gases (*e.g.*, by the "gas sensor"), etc.). (EX1005, [0021]-[0031], [0054]-[0062]; (EX1002, ¶496.)

Seo's communication unit 440 transmits *digital data* in response to the internal and external states ("physical phenomenon"). (EX1002, ¶497.) "The

communication unit 440 *transmits* to the external device *the data detected, calculated, or generated* by the . . . *state* detection unit 430.” (EX1005, [0051], [0083].) For example, “the communication unit 440 *transmits* the consumed power amount of the refrigerator, such as the calculated predicted power consumption or the detected supplied power consumption . . . the estimated greenhouse gas emissions. . . *internal and external state values* of the refrigerator.” (EX1005, [0051], [0083].)

Seo also teaches that such data is transmitted via the *wireless* network. (EX1002, ¶498.) For example, Seo’s “communication unit 440 is connected to the external device by wired or *wireless communication methods* such as serial communication, the Internet, power line communication, or wireless LAN.” (EX1005, [0051].)

To the extent that the claim requires the detection of physical phenomenon to trigger the data transmission (which is not conceded), it would have been obvious to a POSITA that Seo discloses or at least suggests this. (EX1002, ¶499.) For example, Seo states “control unit 410 further includes a comparison unit 412 that *compares* the [detected] internal and external states with the preset reference states, and a message generation unit 413 that generates one or more messages corresponding to the internal and external states based on the comparison results.” (EX1005, [0035].) Further, communication unit 440 “transmits to the external

device the data detected, calculated, or generated by the control unit 410.”

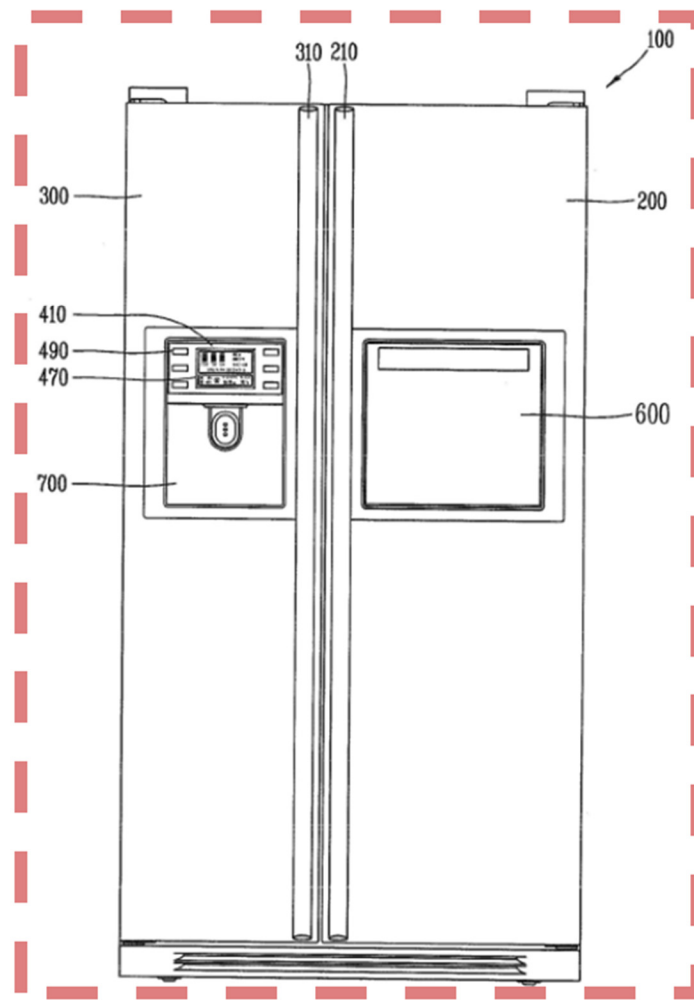
(EX1005, [0051].) Thus, it would have been obvious that, for example, upon detection of a state value exceeding a threshold (*e.g.*, when the temperature, door-open time, or gas concentration deviates from a set condition) the control unit 410 would transmit information for real-time reporting and remediation. (EX1002, ¶¶499-501.)

j. 1[H]: “wherein the appliance is controlled or activated in response to digital data received from the wireless network, and;”

Both Seo and Chan disclose claim 1[H]. (*Supra* §IV.A.2.j.; EX1002, ¶¶502-509.)

For example, Seo discloses that the *refrigerator* is controlled. Seo’s *refrigerator* includes an “output unit 470 [that] includes a screen display unit that outputs the power consumption and the corresponding usage fees.” (EX1005, [0040], [0043], [0073], [0074]; EX1002, ¶503.) The ‘590 patent explains that a display is an actuator. (EX1002, ¶503.) “An actuator may be a display for presentation of visual data or information, commonly on a screen.” (EX1001, 25:33-37.)

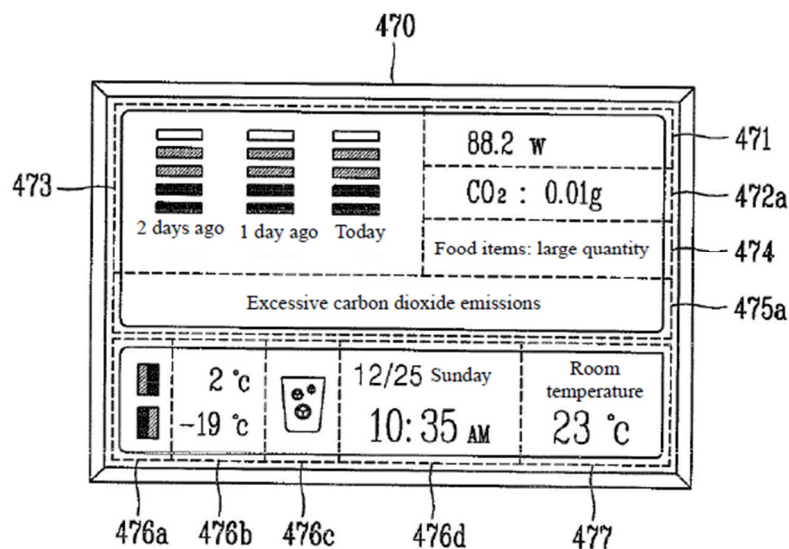
FIG. 1



The control/activation of the display is *in response to digital data received* from the wireless network. (EX1002, ¶504.) For example, “the control device can *receive*, through the communication unit 440, *information* such as the type of energy source and the *greenhouse gas index* corresponding to the energy source from the external power device.” (EX1005, [0049], [0104]; EX1002, ¶504-505.) The “the control unit 410 calculates the *estimated greenhouse gas emissions* . . . by multiplying the *carbon dioxide index* of the energy source by the predicted

power consumption or the supplied power consumption” and “the output unit 470 *displays* the calculated predicted power consumption and *the corresponding greenhouse gas emissions* and usage fees.” (EX1005, [0024], [0040], [0065], [0102].) As shown in FIG. 7, “when the currently supplied energy source is expected to produce a high amount of greenhouse gases . . . *messages* such as ‘Carbon dioxide emissions are high’ or ‘Please switch to a different energy source’ are generated.” (EX1005, [0067].)

FIG. 7



Seo’s refrigerator is also controlled to switch types of energy source in response to received data. (EX1002, ¶506.) “[T]he control device may replace the energy source with one having a relatively lower greenhouse gas index when the *estimated greenhouse gas emissions* exceed, or are expected to exceed, a certain amount while the refrigerator is operating using a fossil fuel as the energy source.”

(EX1005, [0044].) Thus, the control device 400 receives energy source information wirelessly, uses that data to calculate expected greenhouse-gas emissions, and automatically switches to a different type of energy source accordingly. (EX1002, ¶506.)

Further, “the communication unit 440 is connected between the output unit 470 and an external device” and “receives various information or *control commands*.” (EX1005, [0051].) A POSITA would have understood (and found it obvious) that these received “control commands” would be used by the control unit 410 to control the refrigerator. (EX1002, ¶507.)

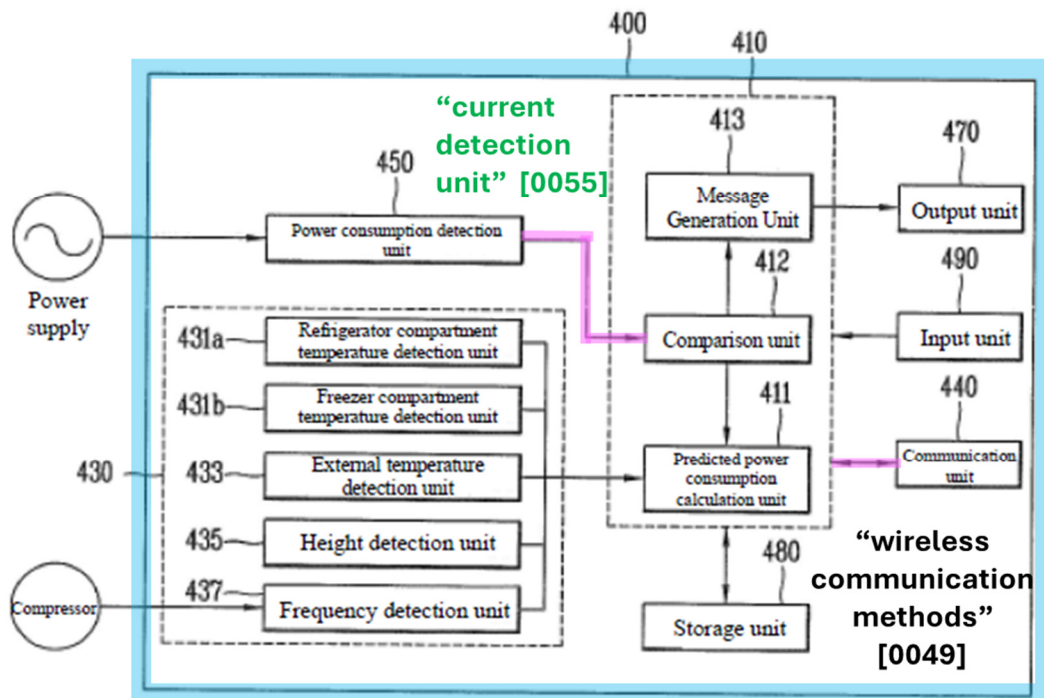
The Seo-Chan combination also discloses this. Chan discloses that the appliance is turned on or off in response to digital data received from the wireless network. (*Supra* § IV.A.2.j.) In the combined system, the refrigerator would receive “commands,” as taught by Seo and/or Chan, and operate accordingly (*e.g.*, “turning the connected appliance on or off” as taught by Chan). (EX1005, [0051]; EX1004, [0057]; EX1002, ¶508.) A POSITA would have been motivated to combine Chan’s additional control features (*e.g.*, turning the appliance on and off and other control features) with Seo to achieve known benefits of expanding controllable features of Seo. (EX1002, ¶508.)

k. 1[I]: “wherein the current sensor is further coupled to the wireless transceiver for transmitting digital data in response to the measured AC current to the wireless network.”

Both Seo and Chan disclose claim 1[I]. (*Supra* §IV.A.2.k; EX1002, ¶¶510-514.)

For example, as shown in FIG. 4 below, the *control device 400* includes a communication unit 440 (including a *wireless transceiver*) *coupled to* the power consumption unit 450 (including the *current detection unit*). (EX1005, FIG. 4; EX1002, ¶511.)

FIG. 4



Second, the *wireless transceiver* *transmits digital data in response to* the measured AC current. (EX1002, ¶512.) For example, “the *communication unit 440* [comprising the *wireless transceiver*] *transmits* the consumed power amount, including the *predicted power consumption calculated* in the refrigerator or the

supplied power consumption detected.” (EX1005, [0083].) As discussed previously, the “power consumption detection unit 450 can detect power consumption in various ways; for example, ... through a *current detection unit*.” (EX1005, [0055]; EX1020, 9-10.)

Such data is transmitted via the *wireless* network. (EX1002, ¶513.) For example, Seo’s communication unit 440 sends such data using “*wireless* communication methods.” (EX1005, [0051].)

4. Claims 23/24/26/27:

Both Seo and Chan disclose claims 23/24/26/27. (Supra §IV.A.9, §IV.A.11.)

For example, regarding claims 23 and 24, Seo discloses the recited WLAN functionalities. (EX1009, 558-559; EX1021, 7:48-51; EX1001, 8:25-32; EX1002, ¶¶515-523.) Seo’s “communication unit 440 is connected to the external device by wired or wireless communication methods such as . . . wireless LAN.” (EX1005, [0051].) A POSITA would have understood (and found it obvious) that to enable *WLAN communication*, the appliance module would include a *WLAN transceiver (modem)* and a *WLAN antenna*. (EX1018, 369; EX1002, ¶517-518.)

Regarding claims 26 and 27, Seo discloses the wireless network uses an *unlicensed, ISM radio frequency band*. (EX1002, ¶¶524-532.) It was well-known that “[m]any extremely successfully wireless systems operate in *unlicensed*

bands, including *wireless LANs*.” (EX1009, 17.) Further, WLAN (802.11b and 802.11g) uses *unlicensed ISM* frequency bands. (EX1009, 23, Table 1.2.)

5. Claims 38/41:

Both Seo and Chan disclose claims 38/41. (*Supra* §IV.A.13.)

For example, regarding claim 38, Seo’s *gas sensor* is an atmospheric and an environmental sensor. (EX1005, [0031]; EX1002, ¶¶533-535.)

Regarding claim 41, Seo discloses a photoelectric sensor that responds to infrared light. Seo’s *height detection units 435* include “a pair of *infrared* sensors.” (EX1005, [0029]; EX1002, ¶¶536-538.)

6. Claims 53/59:

Both Seo and Chan disclose claims 53. (*Supra* §IV.A.5.)

For example, regarding claim 53, Seo-Chan discloses an *actuator in the single enclosure* for affecting the physical phenomenon, wherein the actuator is coupled to the wireless transceiver for being controlled in response to received digital data. (EX1002, ¶¶539-542.) Seo’s “*refrigerator* is operated by the driving of a *compressor* equipped *inside the refrigerator* [e.g., the *single enclosure*].” (EX1005, [0003].) The compressor “allow[s] the food inside the refrigerator to be stored at the desired temperature [e.g., affecting the physical phenomenon (temperature)].” (EX1005, [0003]; *see also* EX1001, 41:23-32, 97:18-26.)

As discussed previously, Seo-Chan’s communication unit 440 (including a

wireless transceiver) wirelessly receives digital data for controlling the refrigerator. (*Supra*, IV.K.3.j.) It would have been obvious to a POSITA that such wireless control functionality includes *temperature control* since Seo’s state detection unit 430 already measures internal temperatures and is coupled to the compressor to detect drive parameters. (EX1005, [0040], [0064], FIG. 4; EX1002, ¶¶541.) To enable such functionality, a POSITA would have understood (and found it obvious) the compressor to be *coupled to the wireless transceiver* for being controlled in response to digital data received from the wireless network. (EX1002, ¶541.)

Regarding claim 59, Seo’s *compressor* is a *thermoelectric cooling actuator* that is coupled to an object by *convection* or by the transfer of energy by phase changes. (EX1002, ¶¶543-545.) “The cold air [is]. . . supplied to the inside of the refrigerator by repeatedly performing the *compression-condensation-expansion-evaporation* cycle, and the refrigerant supplied . . . is evenly distributed inside the refrigerator by *convection*.” (EX1005, [0003].) As described by the ’590 patent, a compressor is a thermoelectric cooling actuator. (EX1001, 41:23-32, 97:18-26.)

L. Ground 12: Seo in View of Chan and Goldsmith Renders Obvious Claims 20-22

1. Motivation to combine

Seo, Chan, and Goldsmith are analogous art to the ’590 patent and all relate to wireless communication techniques. (EX1004, [0070], [0073]; EX1005, [0051];

EX1009, 1-24; EX1002, ¶546.) A POSITA would have been motivated to combine Seo, Chan, and Goldsmith. (EX1002, ¶¶546-549.)

2. Claims 20-22:

Seo-Chan-Goldsmith discloses the recited WPAN functionalities. (EX1002, ¶¶550-553.) Seo’s “communication unit 440 is connected to the external power device by . . . **wireless communication**, and may be connected in particular through . . . the Internet, . . . wireless LAN, or *the like*.” (EX1005, [0051], [0083], Claim 2; *Supra*, IV.K.3.g.) The wireless systems available in 2005 include **WPAN**. (EX1009, 19, 601-602.) A POSITA would have found it obvious to use WPAN, a popular wireless communication system available in 2005, when implementing Seo. (EX1002, ¶552.) A POSITA would have understood (and found it obvious) that communication via WPAN would utilize a WPAN antenna and a WPAN modem (*e.g.*, a WPAN transceiver). (EX1002, ¶553; EX1018, 369; EX1009, 19.)

Seo-Chan-Goldsmith discloses the recited Bluetooth (claim 21) and Zigbee (claim 22) functionalities. (EX1002, ¶¶554-559.) “**Zigbee, Bluetooth, and UWB**, [] have emerged to support a wide range of short distance wireless network applications. These specifications are designed to be **compliant with the IEEE 802.15 standards**, a family of IEEE standards for short distance wireless networking called **Wireless Personal Area Networks (WPANs)**.” (EX1009, 601-

602.) A POSITA would have found it obvious to use *Zigbee or Bluetooth* when implementing WPAN connectivity. (EX1002, ¶¶556, 559.)

M. Ground 13: Seo in View of Chan and Fraden Renders Obvious Claims 35, 39

1. Motivation to Combine Seo, Chan, and Fraden

Seo, Chan, and Fraden are analogous to the '590 patent and all relate to sensors. (EX1005, [0057]-[0061], [0027]-[0031]; EX1004, [0070], [0109], Claims 3-16; EX1012, Chapters 6, 10-11, 13-4-17.) A POSITA would have been motivated to look to Fraden to implement Seo's sensors. (EX1002, ¶¶560-562.)

2. Claims 35/39:

Seo discloses numerous *first sensors* in the control device 400, including “*internal temperature detection units*,” and “*an external temperature detection unit 433*,” (EX1005, [0027]-[0031]; EX1002, ¶¶563-568.)

Regarding claim 35, Seo-Fraden's *temperature detection units* are *thermoelectric* sensors responding to a temperature using *conduction, convection, or radiation* and includes a thermistor, a thermocouple, or a RTD as taught by Fraden. (EX1004, [0070], [0109]; EX1002, ¶¶563-565; *supra* IV.H.2.)

Regarding claim 39, Fraden discloses that “*temperature sensor* can be fabricated with the *surface acoustic waves* (SAW) and plate waves (PW) techniques.” (EX1012, 564-565, 458, 442; EX1002, ¶¶566-568.) It would have

been obvious to a POSITA to implement Seo's *temperature detection units* with surface acoustic sensors. (EX1002, ¶568.)

N. Ground 14: Seo in View of Chan and Betts-LaCroix Renders Obvious Claim 58

1. Summary of Betts-LaCroix

Betts-LaCroix was published in 2010 and is prior art under 35 U.S.C. §§102(b). (EX1050.) Betts-LaCroix is a patent describing improvements to OLED technology. (EX1050, Abstract, [0003].) A POSITA would have looked to Betts-LaCroix for implementing Seo's screen display unit. (EX1002, ¶¶569-573.)

2. Claim 58:

Seo-Chan-Betts-LaCroix discloses the actuator comprises an *electrochemical* actuator operative for changing or affecting matter structure or properties. (EX1002, ¶574-578.) The '590 patent explains that an OLED is an electrochemical actuator. (EX1001, 25:33-37; 111:42-61; 95:45-52, 39:10-26; EX1002, 577; EX1015, 174.) Seo's refrigerator has a "*screen display unit*." (EX1005, [0041], [0074].) Betts-LaCroix discloses that "OLED displays do not require a backlight to function and *thus consume far less power than LCDs* ." (EX1050, [0002]; EX1015, 174.) A POSITA would have found it obvious to use an OLED screen in Seo's refrigerator to reduce power usage. (EX1002, ¶578.)

O. Ground 15: Seo in View of Chan and Doherty Renders Obvious Claims 60-63

1. Motivation to Combine Seo, Chan, and Doherty

Seo, Chan, and Doherty are all analogous art to the '590 patent. All relate to wireless devices and wireless networking. (EX1001, 8:25-32, 45:49-67, 47:34-51, 152:18-38; EX1005, [0049], [0051], [0081]; EX1013, Introduction, Chapter 6.) A POSITA would have looked to Doherty for implementing Seo's communication unit. (EX1002, ¶¶579-581.)

2. Claims 60-63:

Regarding claim 60, Seo-Chan-Doherty discloses the recited addressing features. (EX1002, ¶¶582-586.) Seo's "communication unit 440 is connected to the external power device by . . . wireless communication." (EX1005, [0051].) A POSITA would have understood (and found it obvious) that the communication unit "has a *unique identifier called a MAC address*" which is *universally administered*. (EX1013, 99, 166; EX1027, 24; *supra* § IV.I.2; EX1002, ¶584.)

A POSITA would have understood (and found it obvious) that the communication unit "needs to have an *IP address*, . . . the *router assigns each device an address* from this pool when it boots." (EX1013, 108, 210, 175; *see also* EX1025, 127; *supra* § IV.I.2; EX1013, 211, Figure 10-44, 265; EX1002, ¶585.) A POSITA would have understood (and found it obvious) that the IP address may be an assigned IP address for the device (*e.g.*, by the router), the router's IP

address, a combination of the two, or a globally unique IP address. (EX1002, ¶585.)

Seo-Chan-Doherty further discloses claims 61-63. (*Supra* § IV.I.2; EX1002, ¶¶587-595.)

V. NOTICES AND STATEMENTS

Pursuant to 37 C.F.R. §42.8(b)(1), Amazon.com Services LLC and Amazon.com, Inc. are the real parties-in-interest for Petitioner.

Pursuant to 37 C.F.R. §42.8(b)(2), Petitioner identifies the following related matter.

- *Smart Speaker LLC v. Amazon.com Services LLC*, No. 2-25-cv-00707 (E.D. Tex.)

Pursuant to 37 C.F.R. §42.8(b)(3), Petitioner identifies the following counsel (and a power of attorney accompanies this Petition).

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Pursuant to 37 C.F.R. § 42.8(b)(4), service information for lead and back-up counsel is provided above. Petitioner consents to electronic service by email to Amazon_SmartSpeaker_IPRs@mofo.com.

Pursuant to 37 C.F.R. § 42.104(a), Petitioner certifies that the '590 patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified in this Petition.

The USPTO is authorized to charge any required fees, including the fee as set forth in 37 C.F.R. § 42.15(a) and any excess claim fees, to Deposit Account No. **03-1952** referencing Docket No. **41951-00008.26**.

Dated: November 22, 2025

Respectfully submitted,

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Certification of Word Count (37 C.F.R. § 42.24)

I hereby certify that this Petition for *Inter Partes* Review has 13,971 words (as counted by the “Word Count” feature of the Microsoft Word™ word-processing system), exclusive of “a table of contents, a table of authorities, mandatory notices under § 42.8, a certificate of service or word count, or appendix of exhibits or claim listing.”

Dated: November 22, 2025

By /s/ Alex S. Yap

Alex S. Yap

Certificate of Service (37 C.F.R. § 42.6(e)(4) and 42.205(a))

I hereby certify that the attached Petition for *Inter Partes* Review and supporting materials was served as of the below date by Priority Mail Express®, on the Patent Owner at the correspondence address indicated for U.S. Patent No. 11,190,590.

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Dated: November 22, 2025

/s/ Alex S. Yap
Alex S. Yap