IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent of Takayuki Matsuzuka	§	REQUEST FOR *EX PARTE* REEXAMINATION
U.S. Patent 7,397,318	§	
	§	Attorney Docket No.: ARI318
Filed: November 28, 2006	§	
	§	Customer No.: 165774
Issued: July 8, 2008	§	
	§	
Title: VOLTAGE-CONTROLLED OSCILLATOR	§	
	§	
	§	
	§	

REQUEST FOR *EX PARTE* REEXAMINATION
UNDER 35 U.S.C. §§ 301-307

Mail Stop *Ex Parte* Reexam
Hon. Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Pursuant to the provisions of 35 U.S.C. §§ 301-307, Unified Patents, LLC ("Requester") hereby requests an *ex parte* reexamination of claims 1 and 2 ("Challenged Claims") of United States Patent 7,397,318 ("the '318 patent," EX1001) that issued on July 8, 2008, to Takayuki Matsuzuka, resulting from U.S. Patent Application 11/563,757 filed on November 28, 2006. The '318 patent claims priority to Japanese Patent Application 2005-347456, filed December 1, 2005. The '318 patent is presently assigned to Arigna Technology Limited ("Arigna" or "Patent

Owner"). The assignment to Arigna is recorded in the U.S. Patent and Trademark Office (USPTO) at reel/frame 052042/0651.

Requester hereby asserts that claims 1 and 2 of the '318 patent are invalid over prior art references that were not previously considered in any rejections before the Patent Office, that are non-cumulative of, and better than, the prior art that was before the examiner during the original prosecution of the '318 patent, and that raise substantial new questions of patentability. Requester therefore requests that an order for reexamination be issued, and that the Office reject and cancel the Challenged Claims.

The '318 Patent is the subject of 2 prior or pending district court litigations and 1 prior or pending post-grant proceeding. These cases are still pending. No final judgment has been entered in any of the cases.

District Court Litigations
Arigna Technology Limited v. Volkswagen AG et al., 2:21-cv-00054-JRG (E.D. Tex.)
Conti Temic Microelectronic GmbH and ADC Automotive Distance Control Systems GmbH v. Arigna Technology Limited, 1:21-cv-00826 (E.D. Va.)
Post-Grant Proceedings
Volkswagen Group of America, Inc., v. Arigna Technology Limited, IPR2021-01263

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I. EX PARTE REEXAMINATION FILING REQUIREMENTS

Pursuant to 37 C.F.R. § l.510(b)(l), statements pointing out at least one substantial new question of patentability based on material, non-cumulative reference patents and printed publications for the Challenged Claims of the '318 Patent are provided in Section II.I of this Request.

Pursuant to 37 C.F.R. § l.510(b)(2), reexamination of the Challenged Claims of the '318 Patent is requested, and a detailed explanation of the pertinence and manner of applying the cited references to the Challenged Claims is provided in Section III of this Request.

Pursuant to 37 C.F.R. § 1.510(b)(3), copies of every patent or printed publication relied upon or referred to in the statement pointing out each substantial new question of patentability or in the detailed explanation of the pertinence and manner of applying the cited references are provided as Exhibits 1002-1014 of this Request.

Pursuant to 37 C.F.R. §1.510(b)(4), a copy of the '318 Patent is provided as Exhibit 1001 of this Request, along with a copy of any disclaimer, certificate of correction, and reexamination certificate issued corresponding to the patent.

Pursuant to 37 C.F.R. § 1.510(b)(5), the attached Certificate of Service indicates that a copy of this Request, in its entirety, has been served on Patent Owner at the following address of record for Patent Owner, in accordance with 37 C.F.R. § l.33(c):

LEYDIG VOIT & MAYER, LTD
1900 Duke Street
SUITE 420
Alexandria VA 22314

Also submitted herewith is the fee set forth in 37 C.F.R. § l.20(c)(1).

Pursuant to 37 C.F.R. § 1.510(b)(6), Requester hereby certifies that the statutory estoppel provisions of 35 U.S.C. § 315(e)(l) and 35 U.S.C. § 325(e)(l) do not prohibit Requester from filing this *ex parte* patent reexamination request. Requester has not previously challenged the ’318 patent and has not been involved in any proceeding involving the ’318 patent.

II. STATEMENT POINTING OUT SUBSTANTIAL NEW QUESTIONS OF PATENTABILITY

A. Summary of Substantial New Questions of Patentability

This Request presents substantial new questions of patentability for claims 1 and 2 of the ’318 patent. This Request relies on references that have not been previously considered by the Office in any rejection, and which render obvious claims 1 and 2 of the ’318 patent.

As discussed in Section II.E below, no material rejections were made during prosecution of the ’318 patent; the examiner issued a first action Notice of Allowance. EX1008, p. 14. In the Notice of Allowance, the examiner indicated that the following features of claims 1 and 2 rendered the ’318 patent’s application allowable:

> [1g] “[the temperature compensation bias generation circuit having:] a first resistor having a first end connected to the collector or drain of the transistor and having a second end that is **grounded**”[1] (Claim 1);

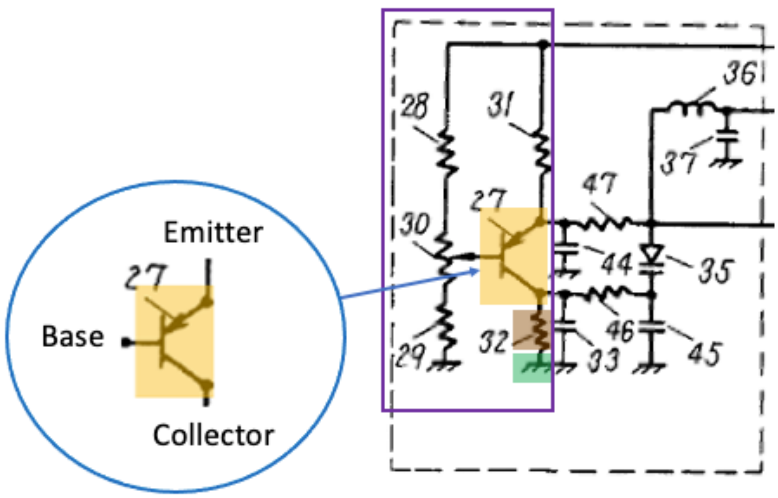
> [2f] “the temperature compensation bias generation circuit having: a **diode** having a cathode connected to the temperature compensation bias application circuit” (Claim 2). *Id.*

These limitations identified by the examiner, however, were not new and are shown by the Grounds presented herein.

For example, JP105 and Kubo, as well as JP105, Kubo, and Kokubo, disclose or at least render obvious limitation [1g]. In each combination, JP105 discloses components 27 through 32 form a circuit that is a *temperature compensation bias generation circuit* that has a resistor 32 (*a first resistor*) having a first end connected to the collector of transistor 27 (*having a first end connected to the collector or drain*

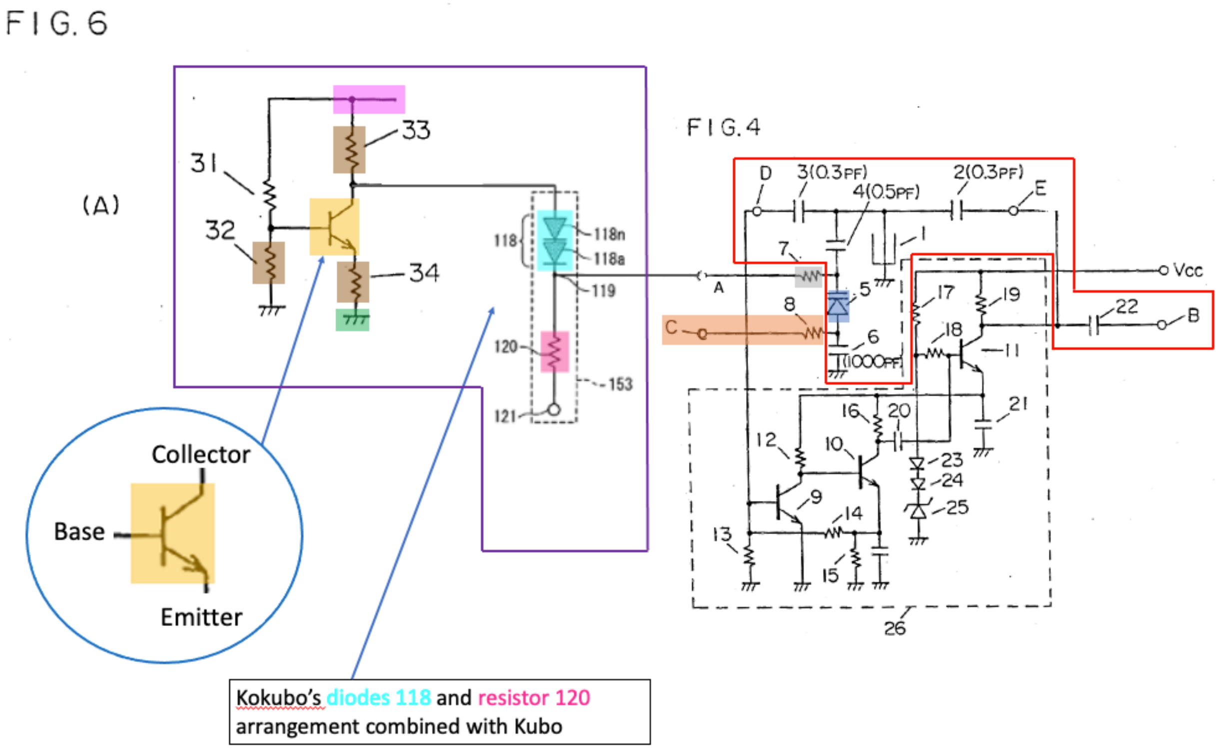
[1] Bolding emphasis added unless otherwise noted.

of the transistor) and a second end that is grounded (a*nd having a second end that is grounded*) as shown in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8. *See* Section III.B.4.g (limitation 1g).



EX1006, Fig. 8 (partial view, annotated)

Further, the combination of Kubo, Kokubo, and Shapiro disclose or at least render obvious limitation [2f]. In this combination, Kubo's circuit for generating temperature compensation voltage, which forms a *temperature compensation bias generation circuit*, includes Kokubo's diode(s) 118, which provide *a diode having a cathode connected to* Kubo's resistor 7, which is a *temperature compensation bias application circuit*). EX1003, 3:5-7, 3:18-21, 4:14-25 and 4:42-46, Figs. 4, 6(A); EX1004, 7:15-18, 7:32-46, 7:66-8:51, 10:13-48, Fig. 14. *See* Section III.A.4.f (limitation 2f).



EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (item 153 of Fig. 14)

combined (annotated)

Kokubo, Shapiro, and JP105 were not considered during prosecution of the ’318 patent. Kubo is listed on the ’318 patent’s face and its Japanese equivalent is discussed in the patent’s background. EX1001, cover, 1:54-56. However, Kubo (and its Japanese equivalent) was not used to reject claims of the ’318 patent during prosecution or otherwise analyzed. To the extent Kubo’s disclosure was before the Examiner, the Examiner overlooked its relevance and as presented herein, Kubo is presented in a new light and a different way because it is combined with Kokubo as well as Shapiro and JP105 in the grounds; as noted, Kokubo, Shapiro, and JP105 were not considered by the examiner during prosecution. As set forth in MPEP §

2216, a "substantial new question of patentability may be based on art previously considered by the Office if the reference is presented in a new light or a different way that escaped review during earlier examination."

Therefore, the combinations of (1) JP105 and Kubo, and (2) JP105, Kubo, and Kokubo raise substantial new questions of patentability with respect to claim 1 of the '318 patent. The combination of Kubo, Kokubo, and Shapiro raise substantial new questions of patentability with respect to claim 2 of the '318 patent.

As shown below and confirmed in the Declaration of Dr. Jake Baker (EX1002), the technology claimed in the '318 patent was not new. The Grounds presented in this Request render obvious the Challenged Claims, which should be canceled for unpatentability.

B. Technical Background

1. Transistors

Transistors are semiconductor devices that control current flow. EX1009, p. 799.[2] Two main types of transistors exist: (1) bipolar junction transistors ("BJTs") and (2) field-effect transistors ("FETs"). *Id.*; EX1010, p. 646.[3] BJTs and FETs differ in how charge carriers (i.e., electrons and holes) form electrical current flow when

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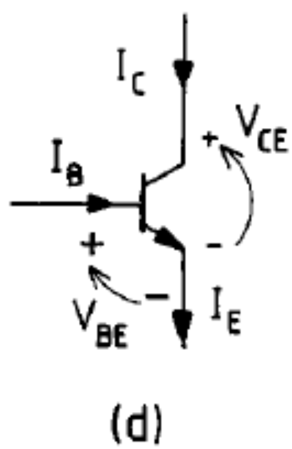
[2] EX1009's page numbers at the top of each document page are cited to.

[3] EX1010's labeled PDF page numbers are cited to.

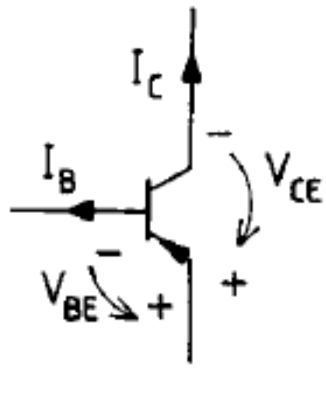
the transistor is active. EX1009, pp. 72, 280. All carriers (electrons **and** holes) flow within an active BJT; in contrast, the majority carrier (electrons **or**[4] holes) flows within an active FET. *Id.*; EX1002, ¶45.

BJTs have collector, base, and emitter terminals. EX1010, p. 646. Applying an appropriate voltage at the base causes current flow between collector and emitter. *Id.*, p. 648. BJTs come in two forms—NPN and PNP—which differ in their current flow direction and voltage polarity. *Id.*, p. 646. Figure 24.25(d) shows an NPN transistor and Figure 24.25(e) shows a PNP transistor. For NPN transistors, current flows out of the emitter, and for PNP transistors, current flows into the emitter. *Id.*; EX1002, ¶46.



EX1010, Fig. 24.25(d) (NPN transistor)

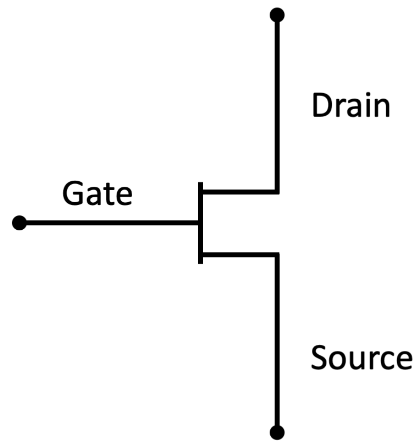
[4] Bolding and/or underlining emphasis added unless otherwise noted.



EX1010, Fig. 24.25(e) (PNP transistor)

The main current flow in a BJT is between collector and emitter, with a much smaller amount flowing between base and emitter. EX1010, p. 646. Emitter current (I_E) relates to collector current (I_C) and base current (I_B) as follows: $I_E = I_C + I_B$. EX1010, p. 646. *Id.* A voltage drop exists between collector and emitter (V_{CE}) and base and emitter (V_{BE}), with each having different polarities for NPN and PNP transistors as shown in Figure 24.25(d) and (e) above. *Id.* The V_{BE} voltage controls current flow between collector and emitter. *Id.*, pp. 646-648; EX1002, ¶47.

FETs have gate, drain, and source terminals. EX1009, p. 280; EX1010, p. 669. Applying an appropriate voltage at the gate causes current flow between drain and source. EX1010, pp. 670, 681. An n-channel FET is shown below. *Id.*, 669-670; Kokubo, 7:25-31, Fig. 10; EX1002, ¶48.



EX1012, pp. 16-18.[5]

A POSITA would have understood that use of BJTs and/or FETs is specific to the particular design or application. But a POSITA would have understood that circuitry and associated techniques of applying voltages to terminals of a BJT (e.g., at the collector, base, and/or emitter) would be applicable to applying voltages to the positionally equivalent terminals of a FET (e.g., at the drain, gate, and/or source), where possible modifications or changes to configuration may be required but would be routine and well within the capabilities of a POSTIA. EX1010, pp. 646-648, 669-670, 672, 681; EX1004, 7:25-31, Fig. 10; EX1012, pp. 16-18, 42-45. This is because BJTs and FETs are operated in similar ways, where a base or gate voltage controls current flow by the transistor, and are well-known electrical components. *Id.*; EX1002, ¶49.

[5] EX1012's page numbers at the top of each document page are cited to.

EX1012 explains that to make an npn BJT transistor active and cause current to flow from collector to emitter, a voltage should be established at the transistor's base that is equal to or greater than the base to emitter voltage (V_{BE}) such as 0.7 volts. EX1012, pp. 42-45; EX1010, pp. 646-648. Here, for example, if the base voltage is less than 0.5 volts, no current will flow from collector to emitter. *Id.*; EX1002, ¶50.

EX1010 and EX1012 also explain that for FET-type transistors, the gate voltage is what makes the transistor "switch from 'off' to 'on'," and causes current to flow from drain to source (for an n-channel FET). EX1010, p. 672, EX1012, p. 20. The gate voltage must meet or exceed some threshold voltage at the gate to turn on the transistor and provide this current flow or be below the threshold voltage to turn off the transistor and restrict this current flow. *Id.*; EX1002, ¶51.

2. Resistors

Resistors introduce resistance into current flow. EX1010, p. 7. Greater amounts of resistance indicate greater current flow opposition. *Id.* Resistance can be defined in terms of the voltage drop across a resistor and current flow through the resistor: R = V / I (where R = resistance, V = voltage drop across the resistor and I = current flowing through the resistor). *Id.*, 8. The voltage drop is defined as follows: V = I*R where "*" indicates multiplication. *Id.*; EX1002, ¶52.

3. Capacitors

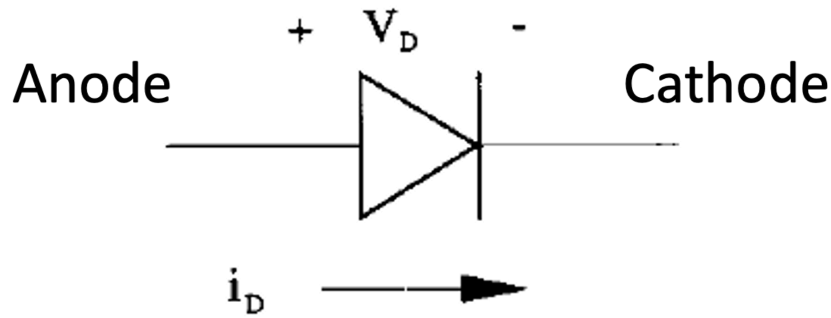
When a voltage difference occurs between two points, an electric field representing the difference exists. EX1010, p. 17. Capacitors are devices that store the electric field's energy. *Id.* Capacitors can be used to block DC current flow resulting from applied DC voltage and therefore be used to isolate parts of circuitry. *Id.*, pp. 19, 31; EX1002, ¶53.

4. Inductors

Inductors store magnetic energy and introduce inductance into a circuit. EX1010, pp. 25, 33. When connected in series or in parallel with a capacitor, a resonant circuit is formed. *Id.*, p. 31. Resonant circuits produce a resonant frequency, which is the frequency at which a system responds with maximum amplitude when driven by an external sinusoidal force having constant amplitude. *Id.*, pp. 31, 33; EX1002, ¶54.

5. Diodes

Diodes are devices that present a low impedance to current flowing in one direction through the diode and high impedance to current flowing in the opposite direction. EX1010, pp. 139. Diodes have an anode at a positive voltage terminal and a cathode a negative voltage terminal. EX1009, pp. 27, 98, 194; EX1002, ¶55.



EX1010, Fig. 5.1 (annotated)

Setting a voltage V_D between the anode and cathode controls current flow between anode and cathode. *Id.*; EX1010, pp. 139-140. Diodes can be "forward biased" or "reverse biased" depending on V_D. EX1009, pp. 296-297 (definitions of forward bias, forward current), 661 (definition of reverse bias). When VD is equal or greater than a forward biasing voltage, the diode is forward biased and current flows from anode to cathode; in contrast, when VD is less than the forward biasing voltage, the diode is reverse biased and little or no current flows; EX1002, ¶56.

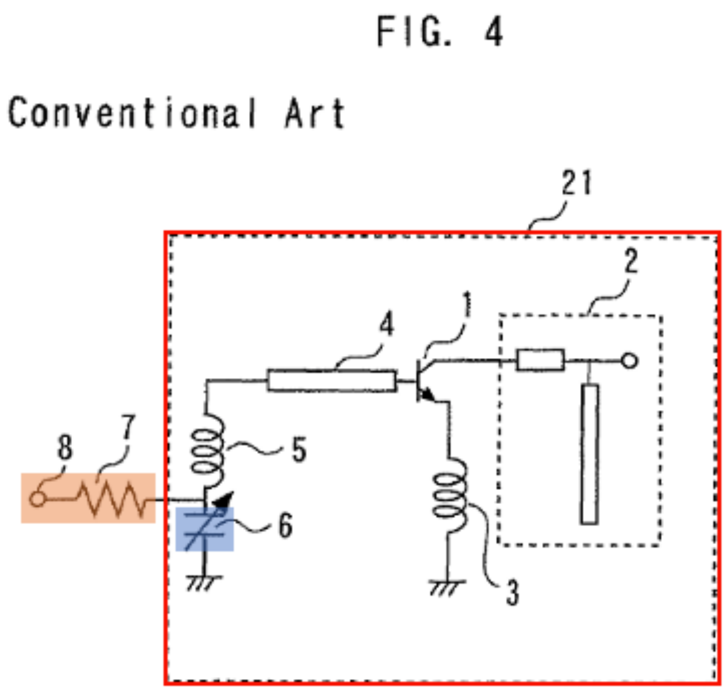
6. Voltage-Controlled Oscillators

A voltage-controlled oscillator (VCO) is a circuit that produces an AC voltage output having a frequency proportional to its input voltage. EX1010, p. 1818. Thus, VCO input voltage sets the output voltage oscillation frequency. *Id.* Changes in temperature can create variations in the oscillation frequency produced by a VCO. EX1001, 1:5-12, 3:26-30; EX1003, 2:11-49; EX1002, ¶57.

C. U.S. Patent 7,397,318

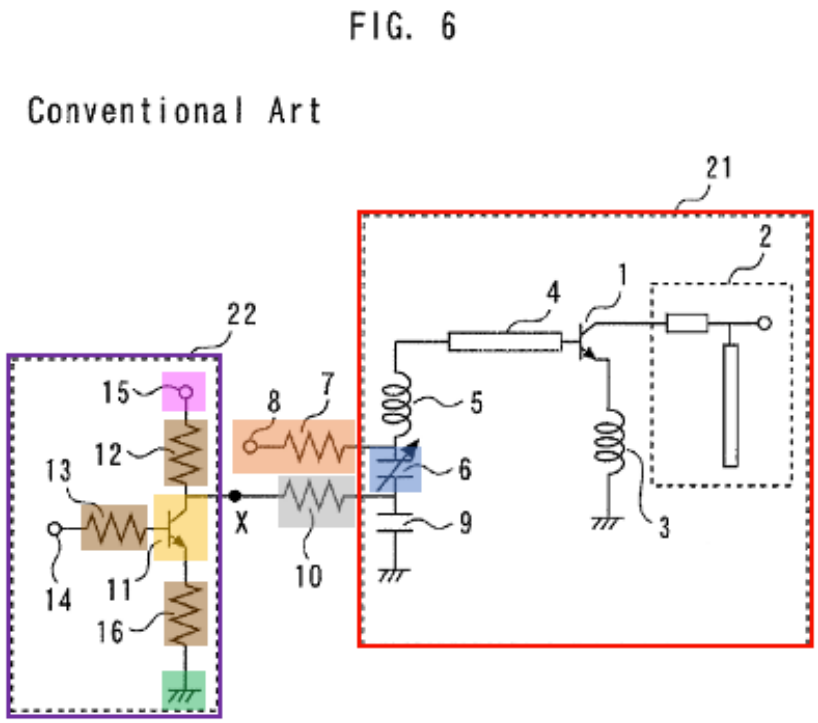
Claims 1 and 2 of the '318 patent are each directed to voltage-controlled oscillators that compensate oscillation frequency variations caused by temperature. EX1001, 1:6-12, claims 1, 2. But the patent admits that much of what it claims is "**conventional**" and well-known. *Id.*, 1:14-16, 1:54-56, Figs. 4, 6.

Figure 4 of the '318 patent shows a "**conventional** voltage-controlled oscillator" having a "voltage-controlled oscillation section 21 which controls the oscillation frequency by a voltage applied to a variable-capacitance element 6, and a frequency control bias circuit 7 which applies a frequency control bias to one end of the variable-capacitance element 6." EX1001, 1:11-22, Fig. 4. In addition to the written description, Figure 4 is itself labeled as "Conventional Art." *Id.*, Fig. 4.



EX1001, Fig. 4 (annotated)

Figure 6 of the '318 patent shows another "**conventional** voltage-controlled oscillator" having the same Figure 4 oscillator components and further including temperature compensation bias circuit 10, temperature compensation bias generation circuit 22, and direct current blocking capacitor 9. EX1001, 1:54-65, Fig. 6. In addition to the written description, Figure 6 is itself labeled as "Conventional Art." *Id.*, Fig. 6.



EX1001, Fig. 6 (annotated)

The ’318 patent explains temperature compensation bias generation circuit 22 includes bipolar transistor 11 “having its collector connected to the temperature compensation bias circuit 10” at point X, and resistors 12, 13, and 16 connected to the collector, base, and emitter of bipolar transistor 11, respectively. EX1001, 2:1-15. Resistor 12 also has one end connected to a collector bias application terminal 15 and resistor 16 has one end connected to ground. *Id.*, 2:12-15.

In operation, temperature compensation bias circuit 10 and temperature compensation bias generation circuit 22 “enable[] the oscillator to output [] a signal at a fixed frequency even when the temperature rises.” EX1001, 2:18-22. “With the increase in temperature, the collector current of the bipolar transistor 11 increases to increase the voltage drop across the resistor 12 and reduce the voltage at point X." *Id.*, 2:23-26. Then, "voltage across the variable-capacitance element 6 is thereby increased to increase the oscillation frequency, thus correcting the reduction in oscillation frequency due to an increase in temperature" and "[a]s a result, there is no need to apply the frequency control bias" at terminal 8 connected to frequency control bias circuit 7 "in a complicated way according to temperature." *Id.*, 2:26-31.

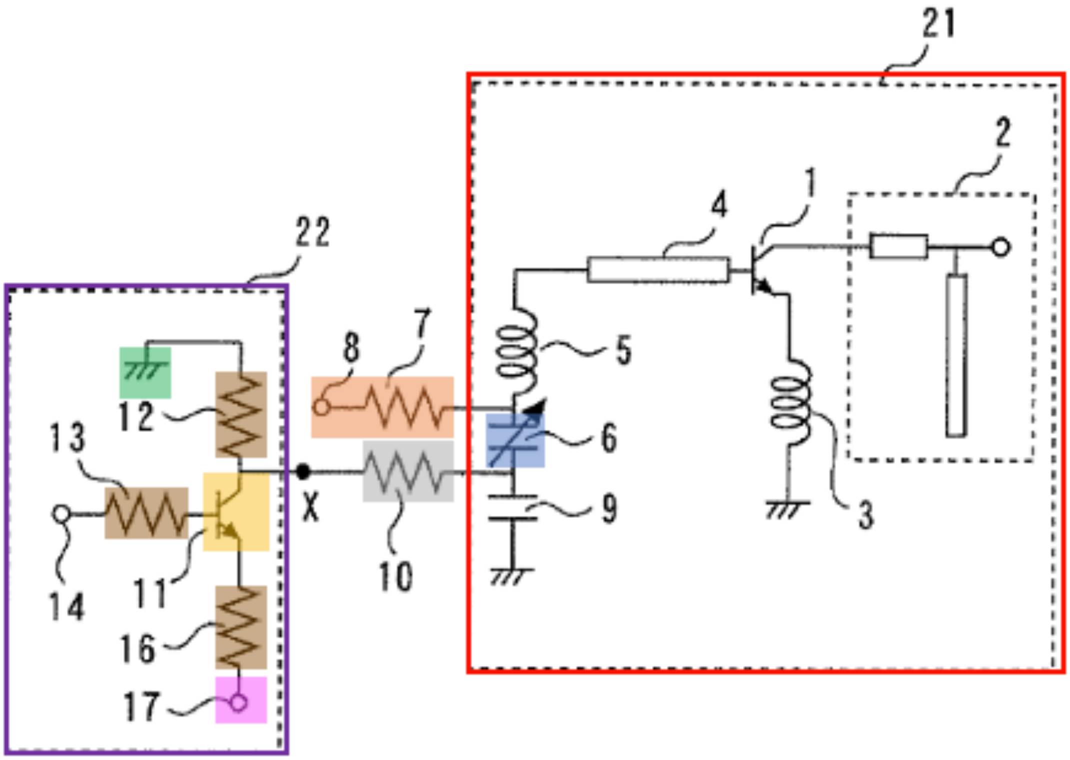
But the '318 patent explains the conventional oscillator shown in Figure 6 has drawbacks, including a limited temperature range for operation compared to the temperature range associated with "ideal voltage characteristic." EX1001, 2:40-45, Figs. 7, 8. Further, sufficient temperature compensation may fail using the Figure 6 oscillator and noise may result that can be difficult to account for that, if not sufficiently addressed, cause performance degradation. EX1001, 2:45-3:2.

Accordingly, the '318 patent discloses and claims two embodiments of voltage oscillators that purport to address this issue, which are discussed below.

1. Summary of Alleged Invention – Claim 1

The '318 patent's first embodiment is shown in Figure 1 below and relates structurally to claim 1.

FIG. 1

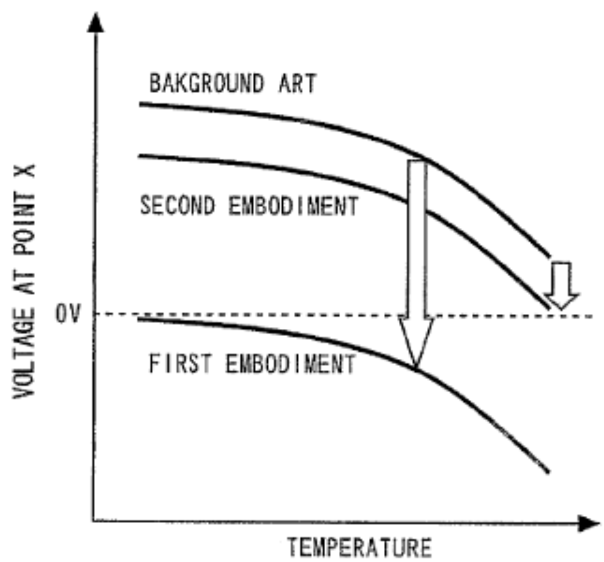


EX1001, Fig. 1 (annotated)

During operation of the Figure 1 oscillator, "[w]hen the temperature rises…the collector current of the bipolar transistor 11 increases to increase the voltage drop across the resistor 12" and "[t]he voltage at point X is thereby reduced…." EX1001, 4:54-58. Thus, "[t]he voltage across the variable-capacitance element 6 is thereby increased to shift the oscillation frequency to a value on the high-frequency side" and "variation in oscillation frequency with temperature can be easily corrected without externally applying a compensation voltage according to temperature." *Id.*, 4:59-64.

Moreover, the patent explains that the "collector of the bipolar transistor 11 is grounded and a negative voltage is applied to the emitter bias application terminal 17. Therefore, the voltage at point X shown in FIG. 1 is also negative." *Id.*, 4:65-5:1. Thus, the "voltage at point X changes according to the collector current of the bipolar transistor 11 with respect to different temperatures and has a voltage characteristic such as shown in FIG. 2 since the voltage drop across the resistor 12 is reduced at a low temperature at which the collector current is reduced." *Id.*, 5:1-6.

FIG. 2



EX1001, Fig. 2

The '318 patent explains that "[s]ince the voltage at point X is negative, the range of voltage applicable across the variable capacitance element can be shifted to a higher-frequency region in comparison with the conventional art shown in FIG.

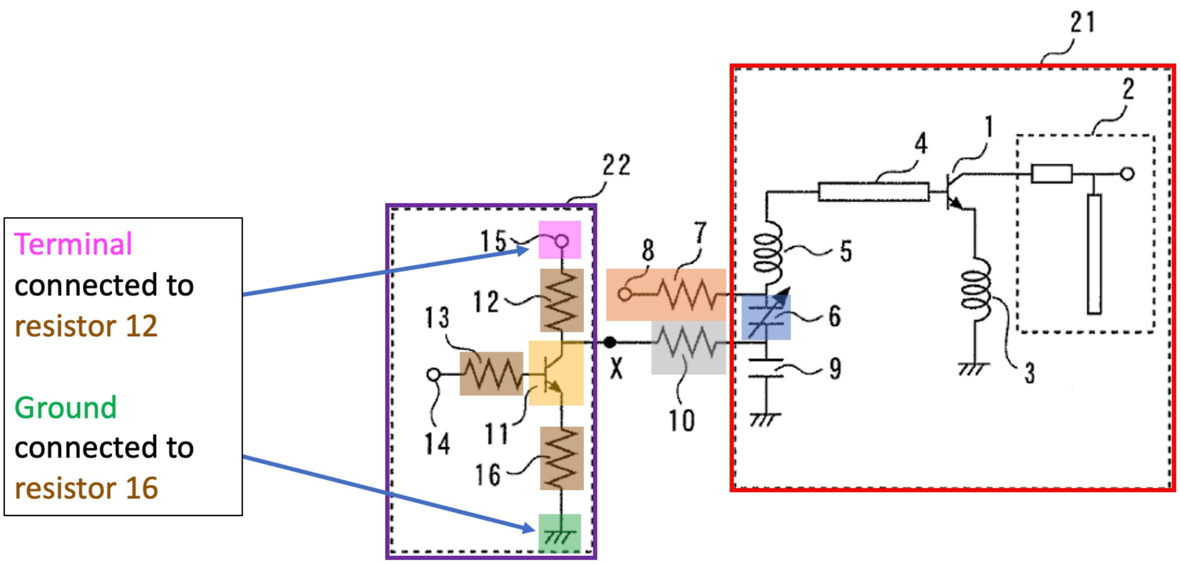
6." *Id.*, 5:6-10. In other words, because the point X voltage is decreased, the voltage across the variable capacitance element 6 is increased, resulting in smaller capacitance provided by element 6 and oscillation frequency increasing. *Id.*

Claim 1 of the '318 patent does not require a negative voltage at an emitter bias application terminal. EX1001, claim 1. Indeed, claim 1 is silent about the specific voltage present at an emitter bias application terminal, and only recites structure—namely, "an emitter or source bias application terminal connected to the other end of the third resistor." *Id.*; EX1002, ¶70.

When comparing the oscillator of the '318 patent's conventional Figure 6 to that of Figure 1, the oscillators are exactly the same—identical—except for only a single difference: the connection at the ends of resistor 12 and resistor 16 are switched. EX1001, Figs. 1, 6. Specifically, the Figure 1 oscillator has one end of resistor 12 connected to Ground (rather than a terminal 15 in conventional Figure 6) and one end of resistor 16 connected to a terminal 17 (rather than Ground in conventional Figure 6). Figures 1 and 6 are reproduced together below to show a comparison.

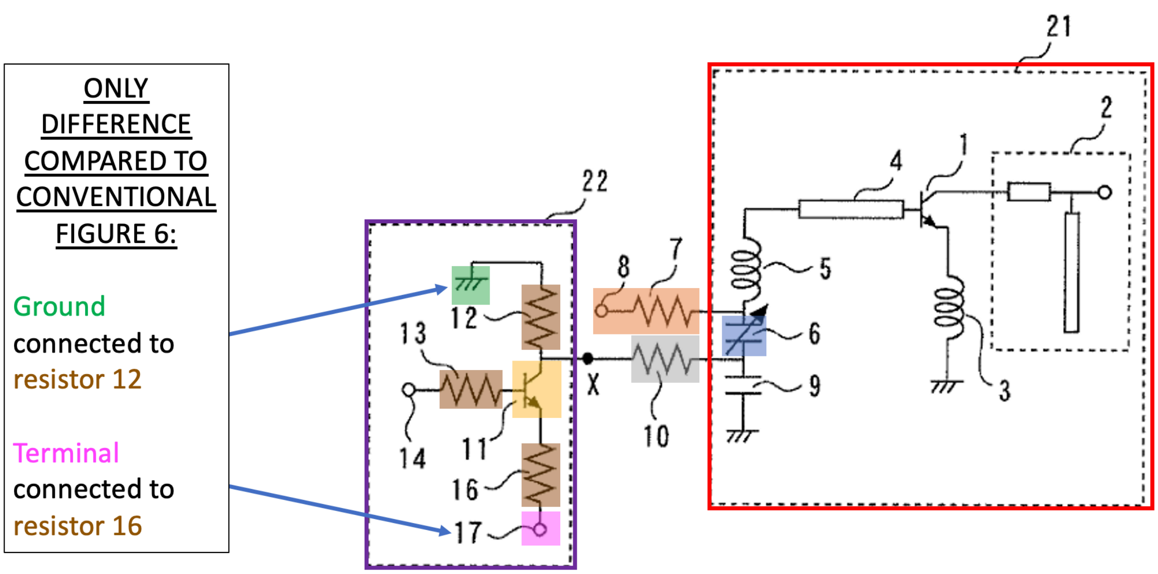
FIG. 6

Conventional Art



EX1001, Fig. 6 (annotated)

FIG. 1



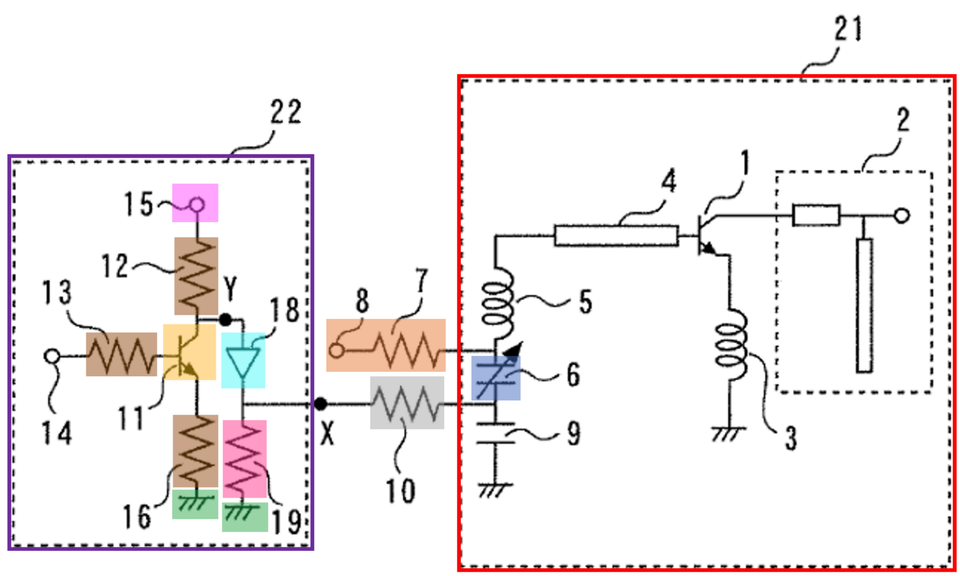
EX1001, Fig. 1 (annotated)

Thus, the ’318 patent acknowledges that the majority its first embodiment, which is recited in claim 1, is conventional and considered background art, and the only alleged invention of the first embodiment is simply switching the locations of ground and an input terminal. EX1001, 1:13-2:2, 4:65-5:10, Figs 1, 6. But such an arrangement was well-known before the ’318 patent’s earliest claimed priority date. The Request’s grounds confirm that the first embodiment, which corresponds to claim 1, was in the prior art and that the alleged invention of switching Ground and an input terminal in the conventional circuit of Figure 6 was obvious. EX1002, ¶72.

2. Summary of Alleged Invention – Claim 2

The ’318 patent’s second embodiment is shown in Figure 3, reproduced and annotated below, and relates to claim 2.

FIG. 3



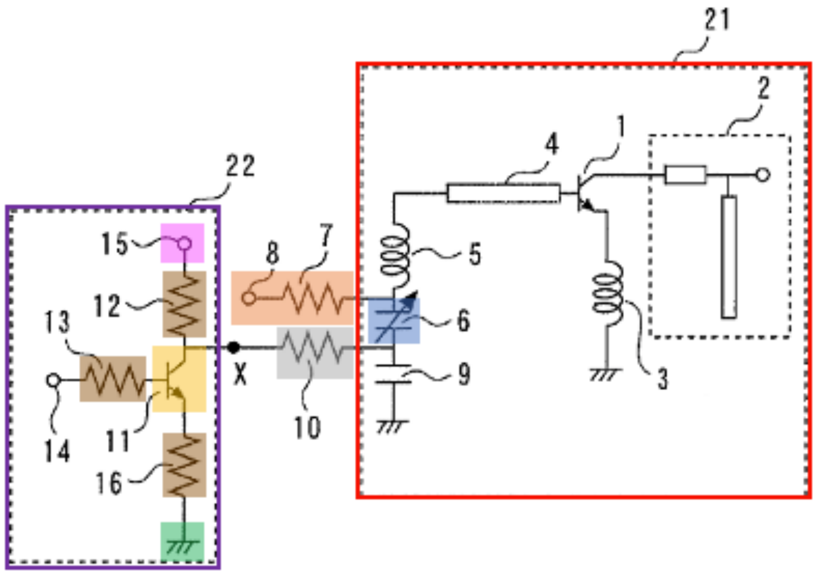
EX1001, Fig. 3 (annotated)

Embodiment 2 operates similarly to embodiment 1 such that the voltage at point X is reduced and a voltage across variable-capacitance element 6 is increased. EX1001, 6:12-22. The patent further explains that a diode 18 and resistor 19 are included in the second embodiment's circuitry, where diode 18 "reduces the voltage at point Y (in Figure 3) by a value corresponding to its on voltage." EX1001, 5:60-64, Fig. 3 (parenthetical added). Diode 18 thereby "reduces the voltage by a value corresponding to its on voltage, so that the voltage at point X (in Figure 3) can be reduced…and the range of Voltage applicable across the variable-capacitance element can be shifted to a region on the higher-Voltage side in comparison with the conventional art shown in FIG. 6." *Id.*, 6:23-29 (parenthetical added).

But as shown below, when comparing the oscillator of conventional Figure 6 to that of Figure 3, the oscillators are again exactly the same—identical—except for the inclusion of diode 18 and resistor 19. EX1001, 5:60-64, 6:8-11. Figures 3 and 6 are reproduced together below to show a comparison.

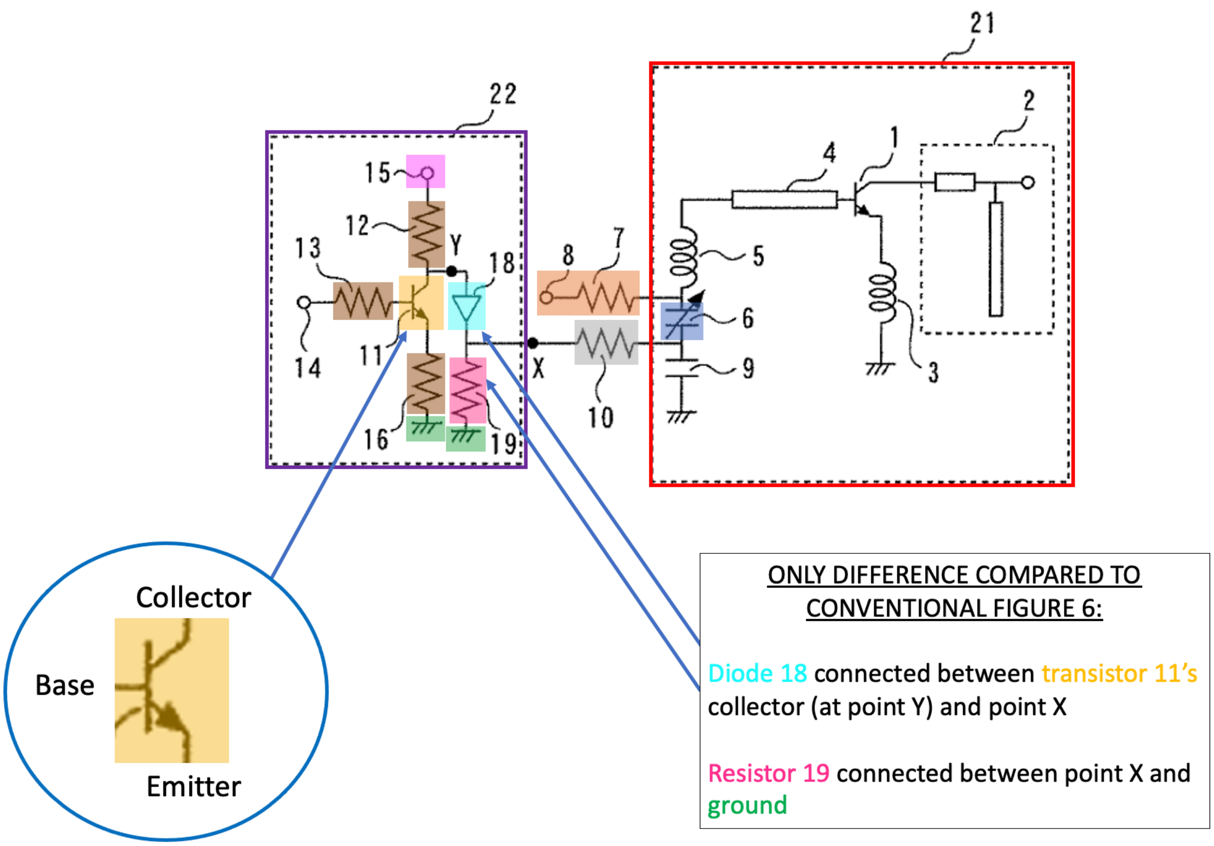
FIG. 6

Conventional Art



EX1001, Fig. 6 (annotated)

FIG. 3



EX1001, Fig. 3 (annotated)

Specifically, the Figure 3 oscillator is exactly the same as the conventional Figure 6 oscillator, but includes a diode 18 connected between the collector bipolar transistor 11 (at point Y) and point X, and a resistor 19 connected between point X and Ground. Thus, the '318 patent acknowledges that the majority its second embodiment is conventional and considered background art, and the only alleged invention of the second embodiment is the addition of a diode and resistor to provide a voltage drop. EX1001, 1:13. But such an arrangement was known before the '318 patent's earliest claimed priority date. The Request's grounds confirm that this second embodiment, which corresponds to claim 2, was in the prior art and that the alleged invention of adding a diode and resistor to a conventional circuit as claimed was obvious. EX1002, ¶76.

D. Priority Date of the '318 Patent

The '318 patent was filed in the United States on November 28, 2006, before enactment of the America Invents Act ("AIA"), and claims priority to Japanese Patent Application 2005-347456, filed December 1, 2005. Pre-AIA statutory framework applies. All of the prior art cited in the proposed grounds of rejection predates December 1, 2005 (*see* Section II.G below).

E. Prosecution History

As noted above, in a first action notice of allowance, the examiner indicated the following limitations rendered claims 1 and 2 allowable:

> "[the temperature compensation bias generation circuit having:] a first resistor having a first end connected to the collector or drain of the transistor and having a second end that is **grounded**" (Claim 1);
>
> "the temperature compensation bias generation circuit having: a **diode** having a cathode connected to the temperature compensation bias application circuit" (Claim 2). EX1008, p. 14.

As described in Sections II.I and III below, however, these limitations were disclosed by prior art not considered by the examiner.

F. Claim Construction

The ’318 patent is not expired. Thus, this Request analyzes claims 1 and 2 according to their broadest reasonable interpretation in light of the specification. MPEP 2258 § I.G. For the purposes of this Request, Requester submits that all terms should be given their broadest reasonable interpretation, and that a specific construction is not necessary for any claim term. No express construction is necessary for this proceeding to show the unpatentability of the claims. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (construing terms “only to the extent necessary to resolve the controversy”); MPEP § 2111.01. EX1002, ¶¶77-78.

As noted above, the ’318 patent is involved in two pending district court cases ses. At the time of this Request’s filing, no district court has issued a claim construction order in any of the district court cases.

Because the Challenged Claims do not recite the term “means,” the claim terms are not presumed to be “means-plus-function” terms. Further, a POSITA would have understood that the terms in the Challenged Claims have sufficient structure or recite a function with sufficient structure for performing that function. EX1002, ¶79. Accordingly, the terms of the Challenged Claims should not be treated as means-plus-function terms. To the extent the following terms are treated as means-plus-function terms, the following analysis is provided. EX1002, ¶79.

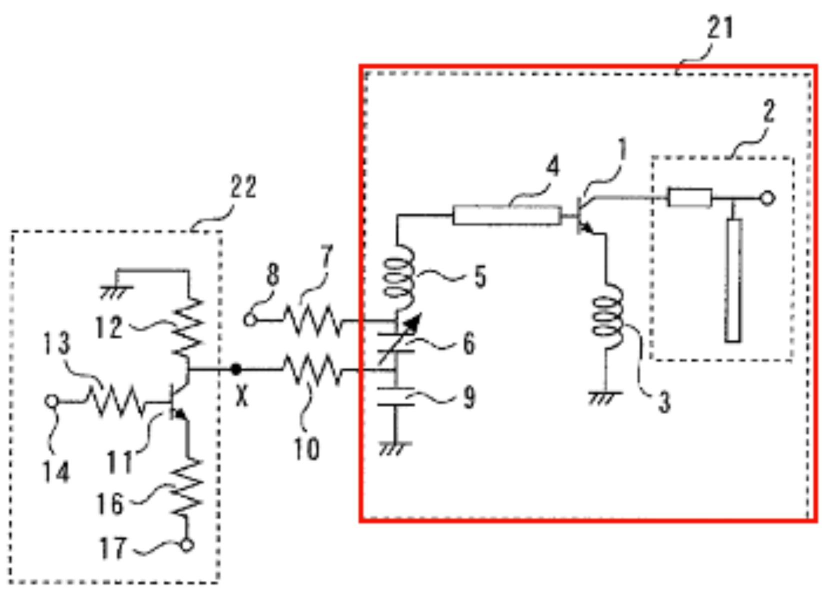
1. *a voltage-controlled oscillation section which controls oscillation frequency through a voltage applied to a variable-capacitance element* (claims 1 and 2)

The term *voltage-controlled oscillation section* is not presumed to be a means-plus-function term because it does not employ the word "means." *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1348 (Fed. Cir. 2015). A POSITA would have recognized *voltage-controlled oscillation section* has a sufficiently definite and known meaning as the section of the claimed oscillator providing *voltage-controlled oscillation* and controlling oscillation frequency. EX1001, claims 1, 2; 1:16-19, 3:65-4:1 ("…voltage-controlled oscillation section 21…controls the oscillation frequency by a voltage applied to a variable capacitance element 6…"), Figs. 1, 3, 4, 6. This is because, for instance, the '318 patent states "[t]he voltage controlled oscillator has a voltage controlled oscillation section 21 which controls the oscillation frequency by a voltage applied to a variable-capacitance element 6." *Id.*, 3:64-4:1. This is also because voltage-controlled oscillators are a known class of structures implemented by various known elements. *Id.*; EX1009, p. 847 (defining "voltage-controlled oscillator"). The term *section* is not used as a nonce phrase; instead, it refers to a certain part (a section) of the recited oscillator as discussed above. *Id.*; EX1002, ¶80.

To the extent §112(6) does apply, the recited function is *controls oscillation frequency through a voltage applied to a variable-capacitance element*. EX1001, Claims 1, 2; EX1002, ¶81.

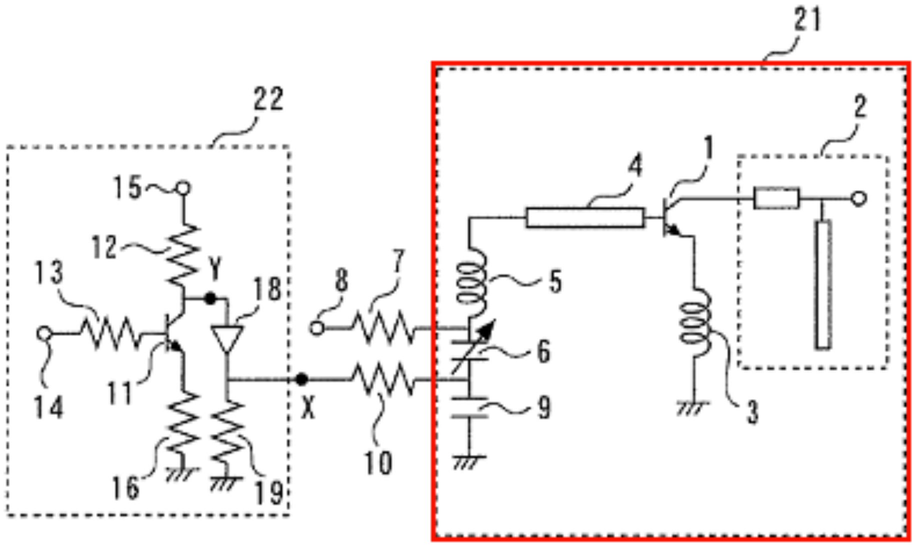
The structure includes the circuit shown by voltage-controlled oscillation section 21 in Figures 1, 3, and 6 and equivalents thereof. EX1001, 1:54-2:15, 3:65-4:24, 5:29-59, Figs. 1, 3, 6; EX1002, ¶82.

FIG. 1



EX1001, Fig. 1 (annotated)

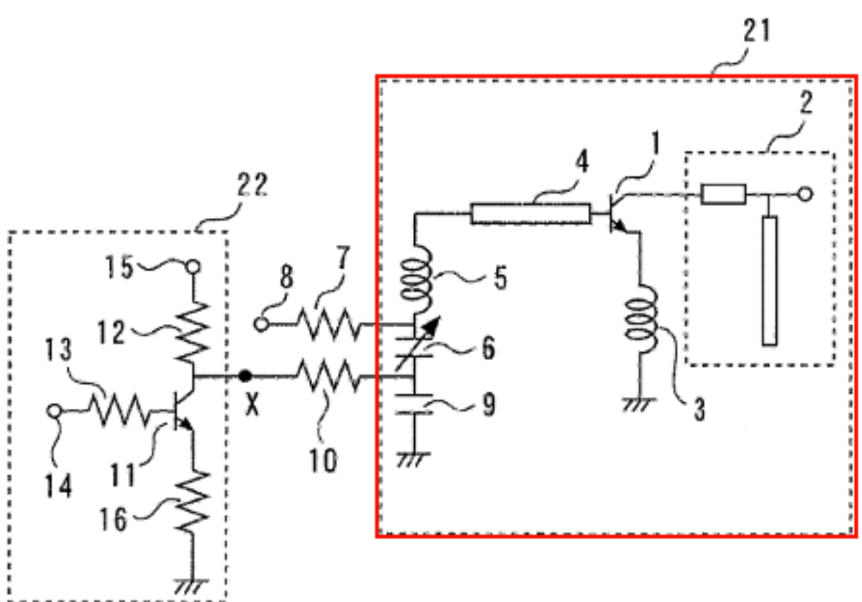
FIG. 3



EX1001, Fig. 3 (annotated)

FIG. 6

Conventional Art

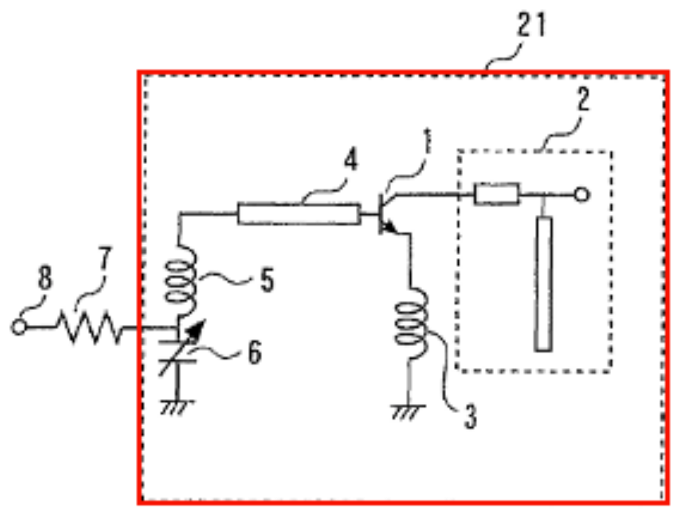


EX1001, Fig. 6 (annotated)

The structure also includes the circuit shown by voltage-controlled oscillation section 21 in figure 4 and equivalents thereof. EX1001, 1:14-37, Fig. 4; EX1002, ¶83.

FIG. 4

Conventional Art



EX1001, Fig. 4 (annotated)

2. *variable capacitance element* (claims 1 and 2)

Variable capacitance element is not presumed to be a means-plus-function term because it does not employ the word "means" and no recited functionality is specified regarding the term. *Williamson*, 792 F.3d at 1348; *York Products, Inc. v. Central Tractor Farm & Family Center*, 99 F.3d 1568, 1574 (Fed. Cir. 1996) (finding a "means" claim limitation without recited function was not subject to

§112(6)). To the extent §112(6) does apply, its function is receiving applied frequency control bias at a first end and receiving applied temperature compensation bias at a second end. EX1001, Claims 1, 2. The structure includes a diode, pn diode, and Schottky diode, and equivalents thereof. *Id.*, 2:40-41, 4:22-24; 35 U.S.C. §112(6); EX1002, ¶84.

3. *circuit* claim limitations

The terms ***frequency control bias circuit***, ***temperature compensation bias circuit***, and ***temperature compensation bias generation circuit*** are not presumed to be means-plus-function terms because they do not employ the word "means." *Williamson*, 792 F.3d at 1348. A POSITA would have recognized these *circuit* limitations have sufficiently definite and known meanings, at least because they recite the term *circuit* with an appropriate identifier (e.g., *frequency control bias*, *temperature compensation bias*, *temperature compensation bias generation*) that "identifies some structural meaning to one of ordinary skill in the art." *See Apex Inc. v. Raritan Computer, Inc.*, 325 F.3d. 1364, 1374 (Fed. Cir. 2003); EX1002, ¶¶85-90.

The recited *circuits* further include contextual language of the "desired output of the 'circuit'" (e.g., *appl[ying][] a frequency control bias to a first end of the variable-capacitance element*; *appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element*; *generat[ing][] the temperature* *compensation bias and suppl[ying][] the temperature compensation bias generated to the temperature compensation bias circuit*), conveying structural meaning to a POSITA. *Linear Technology Corp. v. Impala Linear Corp.*, 379 F.3d 1311, 1320 (Fed. Cir. 2004); *Massachusetts Institute of Technology and Electronics for Imaging, Inc. v. Abacus Software*, 462 F.3d 1344, 1356 (Fed. Cir. 2006); *MTD Products Inc. v. Iancu*, 933 F.3d 1336, 1342 (Fed. Cir. 2019); EX1001, claims 1, 2. Moreover, for *temperature compensation bias generation circuit*, claims 1 and 2 recite the structure forming this circuit. EX1001, claims 1, 2; EX1002, ¶¶91-93.

To the extent §112(6) does apply, function and structure are identified below:

- *frequency control bias circuit*

Function: *appl[ying][] a frequency control bias to a first end of the variable-capacitance element*. EX1001, claims 1, 2, 1:19-37, 4:1-3, 4:25-28, 5:42-43; EX1002, ¶94.

Structure: a resistor feed-type bias circuit and equivalents thereof. EX1001, 1:19-37, 4:1-3, 4:25-28, 5:42-47, Figs. 1, 3, 6 (items 7 and 8); EX1002, ¶94.

- *temperature compensation bias circuit*

Function: *appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element*. EX1001, claims 1, 2, 4:3-5; EX1002, ¶95

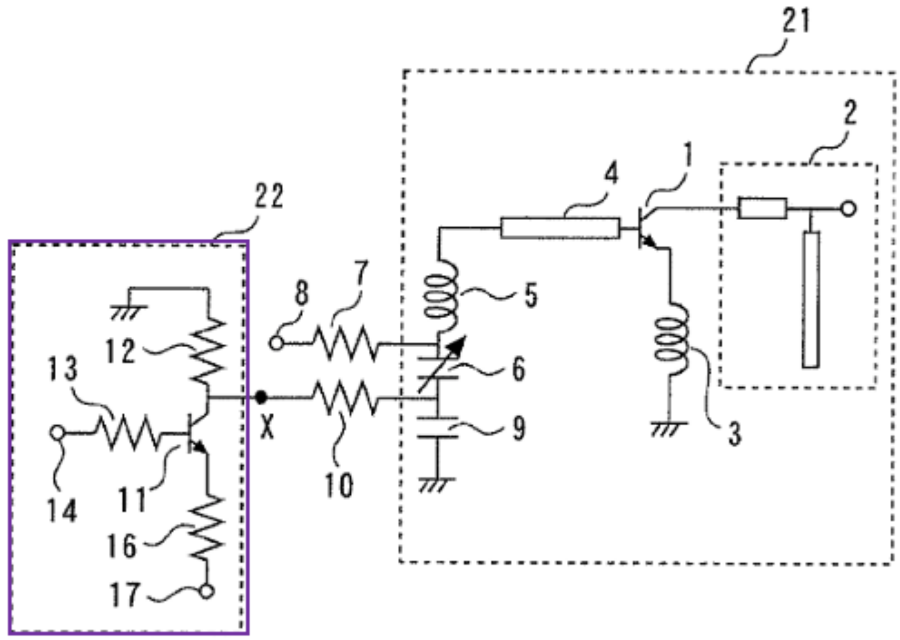
Structure: a resistor connected to a second end of the variable-capacitance element and equivalents thereof. EX1001, 4:3-8, Figs. 1, 3, 6 (item 10); EX1002, ¶95.

- *temperature compensation bias generation circuit* (claim 1)

Function: *generat[ing][] the temperature compensation bias and suppl[ying][] the temperature compensation bias generated to the temperature compensation bias circuit*. EX1001, claim 1, 1:61-64, 2:1-4, 4:29-33, 5:57-59, 6:12-22; EX1002, ¶96.

Structure: the circuit shown by temperature compensation bias generation circuit 22 in Figure 1 and equivalents thereof. EX1001, claim 1, 4:6-8, 4:34-53, Fig. 1; EX1002, ¶96.

FIG. 1



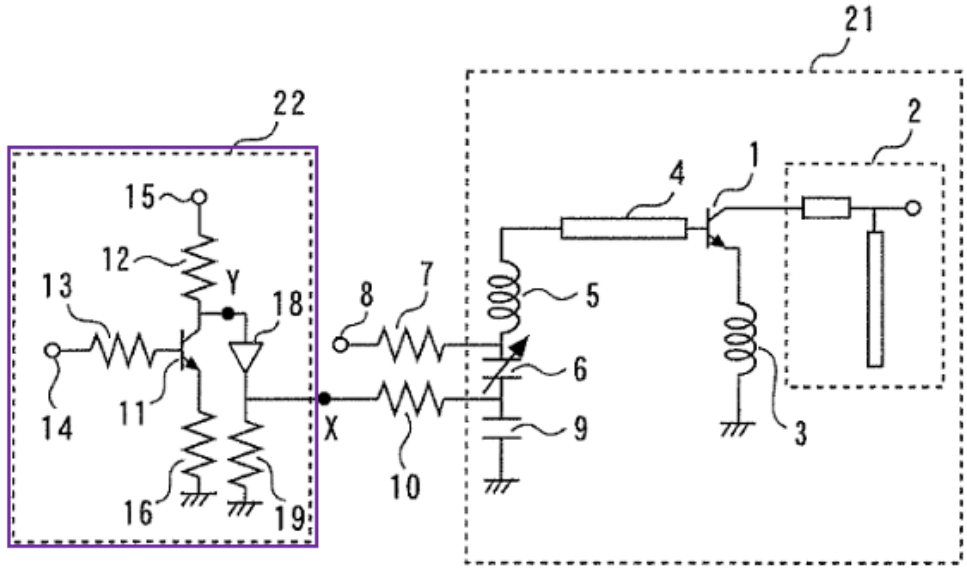
EX1001, Fig. 1 (annotated)

- *temperature compensation bias generation circuit* (claim 2)

Function: *generat[ing][] the temperature compensation bias and suppl[ying][] the temperature compensation bias generated to the temperature compensation bias circuit*. EX1001, claim 2, 1:61-64, 2:1-4, 4:29-33, 5:57-59, 6:12-22; EX1002, ¶97.

Structure: the circuit shown by temperature compensation bias generation circuit 22 in figure 3 and equivalents thereof. EX1001, claim 2, 4:5-8, 5:55-6:11, Fig. 3; EX1002, ¶97.

FIG. 3



EX1001, Fig. 3 (annotated)

G. Citation of Prior Art Patents and Printed Publications

In accordance with 37 C.F.R. § 1.510(b)(3), reexamination of claims 1 and 2 (the "Challenged Claims") of the '318 patent is requested in view of the following references. Each reference is prior art to the '318 patent under 35 U.S.C. §§ 102(b), 102(a), and/or 102(e).[6]

1. U.S. Patent 4,751,475 (published June 14, 1988) ("Kubo" (EX1003)).

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[6] The '682 patent was filed in the United States on November 28, 2006, before enactment of the America Invents Act ("AIA"), and claims priority to a Japanese application filed December 1, 2005. Pre-AIA statutory framework applies.

2. U.S. Patent 7,230,493 (filed February 3, 2005) ("Kokubo" (EX1004)).

3. U.S. Patent 6,452,454 (published September 17, 2002) ("Shapiro" (EX1005)).

4. Japan Unexamined Patent Application S57-131105 (published August 13, 1982) ("JP105"). A certified English translation of JP105 is submitted as Exhibit 1006 and cited to. A Japanese-language copy is submitted as Exhibit 1007.[7]

A detailed explanation of the pertinence and manner of applying these prior art patents and printed publications to every claim for which reexamination is requested is set forth in Section III below.

H. Level of Skill in the Art

A "person of ordinary skill in the art," ("POSITA") as of the earliest claimed priority date of the '318 patent would have had at least a bachelor's degree in Electrical Engineering or a related field, and at least two years of academic or industry experience in transistor-level circuit design. More education can supplement practical experience and vice-versa. EX1002, ¶¶26-27.

I. Identification of Substantial New Questions of Patentability

In this Request, multiple substantial new questions (SNQs) of patentability

[7] Exhibit 1011 is a declaration by Exhibit 1006's translator certifying the translation is accurate.

are raised as set forth below.[8]

1. Kubo, Kokubo, and Shapiro Raise Substantial New Questions of Patentability

Kubo, Kokubo, and Shapiro raise substantial new questions of patentability because this combination discloses or at least renders obvious each limitation of claim 2, including the allegedly allowable limitation of claim 2 (limitation [2f]). As discussed, Kokubo and Shapiro were not considered during prosecution of the ’318 patent and Kubo was not considered in any rejection during prosecution of the ’318 patent. While Kubo is listed on the ’318 patent’s face and its Japanese equivalent is discussed in the patent’s background (*see* EX1001, cover, 1:54-56), to the extent Kubo’s disclosure was before the Examiner, the Examiner overlooked its relevance and as presented herein, Kubo is presented in a new light and a different way because it is combined with Kokubo and Shapiro in the Ground 1. As set forth in MPEP § 2216, a “substantial new question of patentability may be based on art previously considered by the Office if the reference is presented in a new light or a different way that escaped review during earlier examination.” A reasonable examiner would have found Kubo, Kokubo, and Shapiro relevant to the Challenged Claims for the

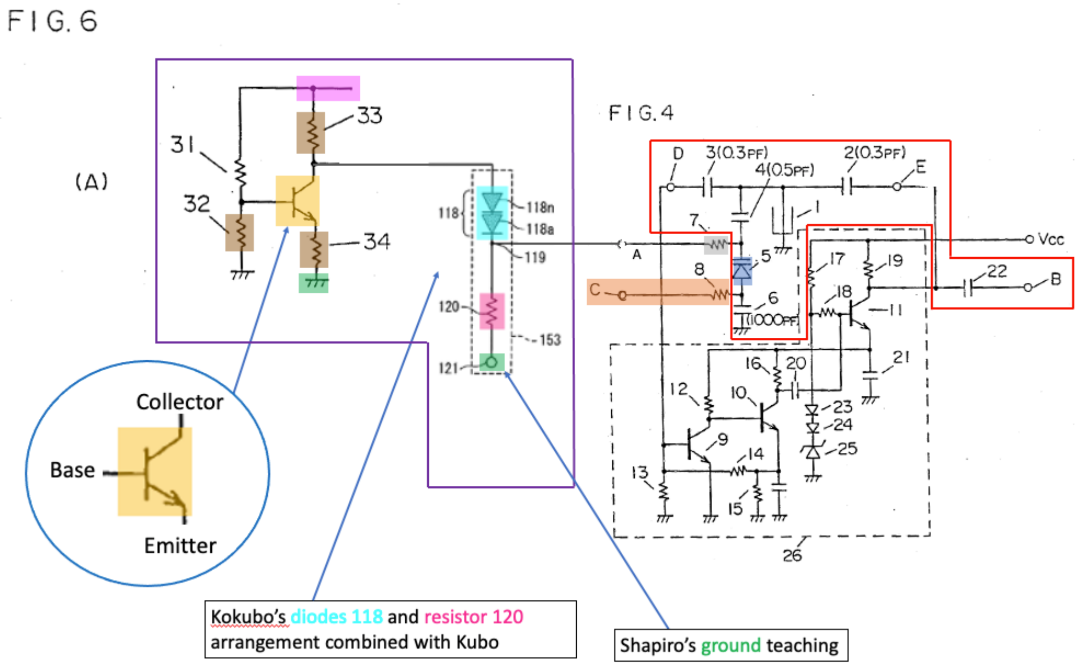
[8] Unless otherwise specified, all **bold** and ***bold italics*** emphasis below has been added. Text in *italics* is used to signify claim language, and reference names are also *italicized*.

following reasons. EX1002, ¶99.

a) Claim 2 is unpatentable under 35 U.S.C. § 103(a) over Kubo, Kokubo, and Shapiro.

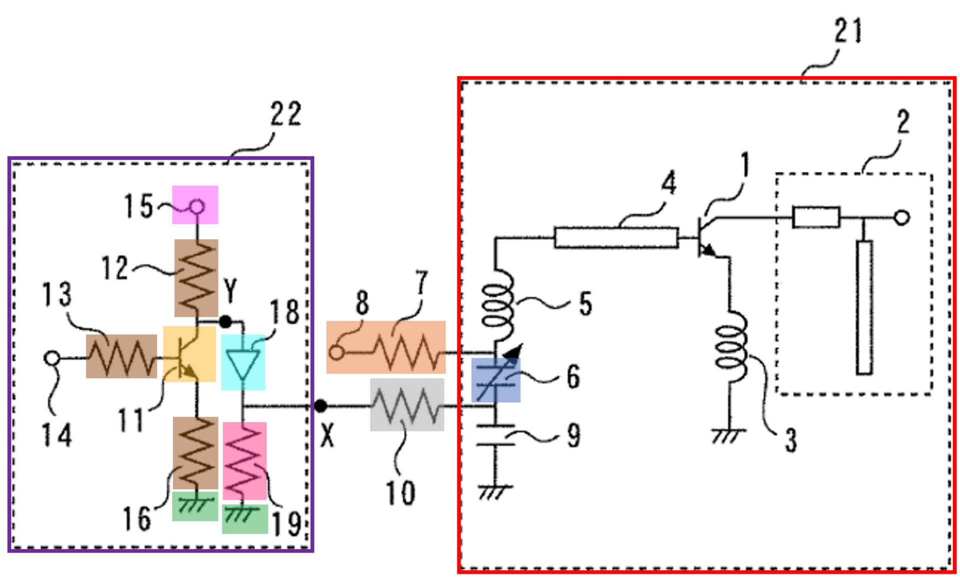
As shown in the detailed analysis of claim 2 (Section III.A), claim 2 is unpatentable under 35 U.S.C. § 103(a) over Kubo, Kokubo, and Shapiro. *See* Section III.A. The circuit arrangement[9] that results from combining Kubo, Kokubo, and Shapiro renders claim 2 unpatentable because it discloses or at least renders obvious each limitation of claim 2. *Id.* A comparison of the combination's circuit arrangement and Figure 3 of the '318 patent, which relates to claim 2, is shown below.

[9] Kokubo's terminal is also used in the combination to render claim 2 unpatentable, as discussed with respect to limitation [2k] below. *See* Section III.A.4.k.



EX1003 (Kubo) (Figs. 4 and 6(A)), EX1004 (Kokubo) (Fig. 14), and EX1005 (Shapiro) combined (annotated)

FIG. 3

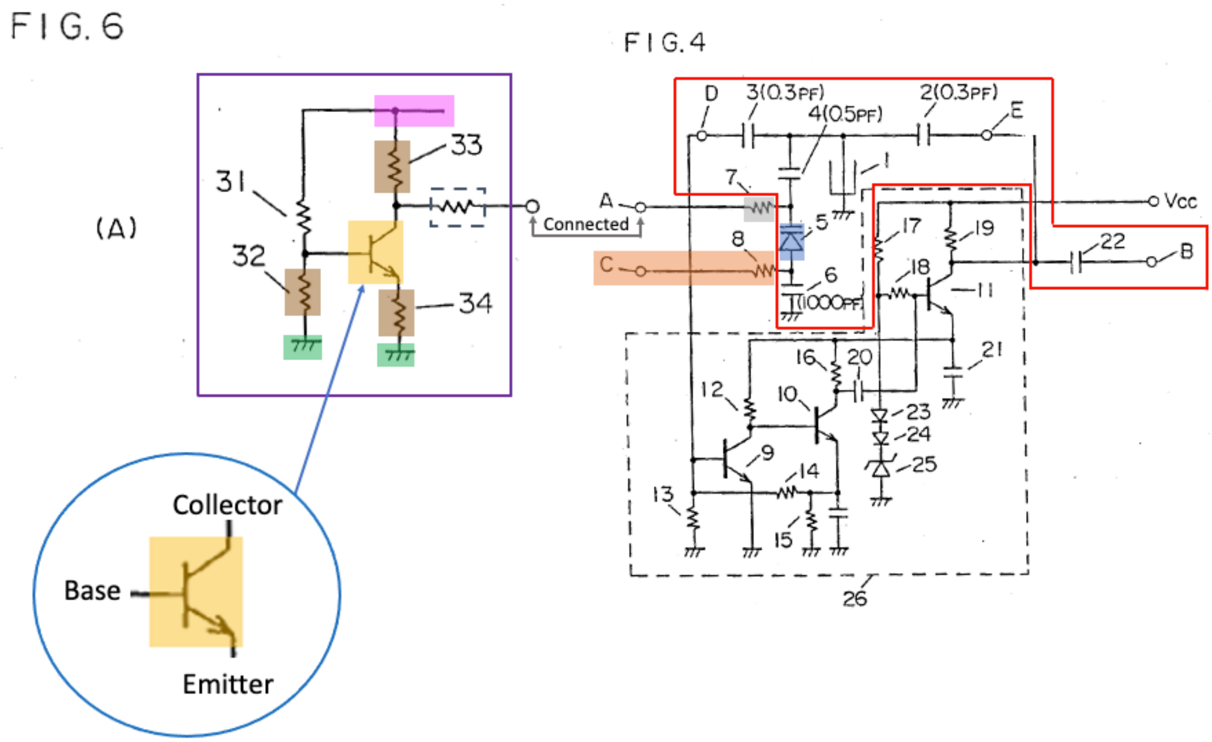


EX1001, Fig. 3 (annotated)

Claim 2 recites "*[the temperature compensation bias generation circuit having:] a diode having a cathode connected to the temperature compensation bias application circuit*" (limitation [2f] below). As discussed above in Section II.E, the Examiner stated this limitation of claim 2 rendered the claim allowable.

However, the combination of Kubo, Kokubo, and Shapiro disclose or at least render obvious limitation [2f]. In the combination, Kubo and Kokubo disclose or at least render obvious "*[the temperature compensation bias generation circuit having:] a diode having a cathode connected to the temperature compensation bias application circuit*." EX1002, ¶101.

First, Kubo discloses that its oscillation apparatus and circuit for generating temperature compensation voltage collectively form the claimed *voltage-controlled oscillator*, and further discloses or at least renders obvious a *temperature compensation bias generation circuit* in the form of the circuit for generating temperature compensation voltage. EX1003, 4:14-25, 4:42-46, Figs. 4, 6(A); EX1002, ¶102.

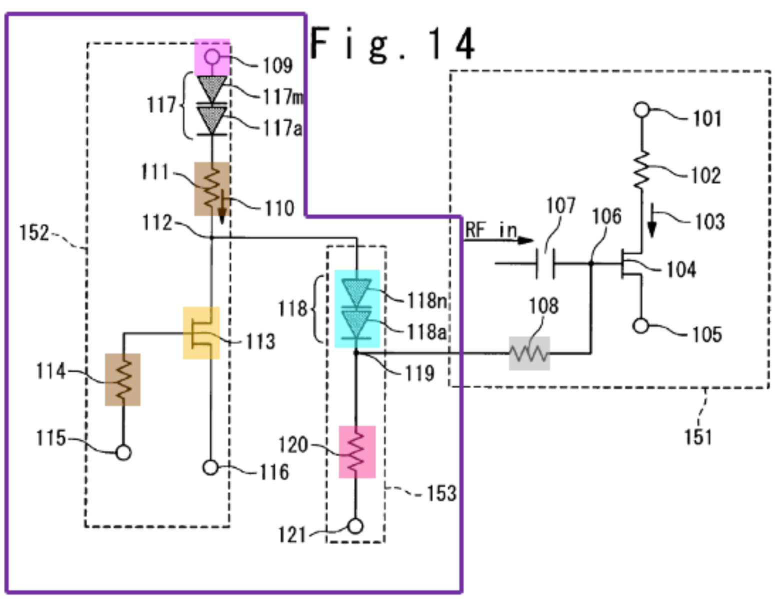


EX1003, Figs. 4, 6(A) (annotated)

Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) generates the compensating voltage that accounts for temperature changes (*generates the temperature compensation bias*) and supplies this generated voltage (*supplies the temperature compensation bias generated*) to resistor 7, which is a *temperature compensation bias circuit*, via terminal A of the Figure 4 oscillation apparatus. EX1003, 4:17-26, 4:42-46; Section III.A.4.d-e; EX1002, ¶103.

To the extent *temperature compensation bias generation circuit* is interpreted under §112(6), Kubo discloses or at least renders obvious its function for the reasons discussed in Section III.A.4.e, and Kubo, Kokubo, and Shapiro disclose or at least render obvious the identified corresponding structure for *temperature compensation bias generation circuit* for the reasons discussed in Sections III.A.4.f-III.A.4.m. *See also* Section II.f; EX1002, ¶104.

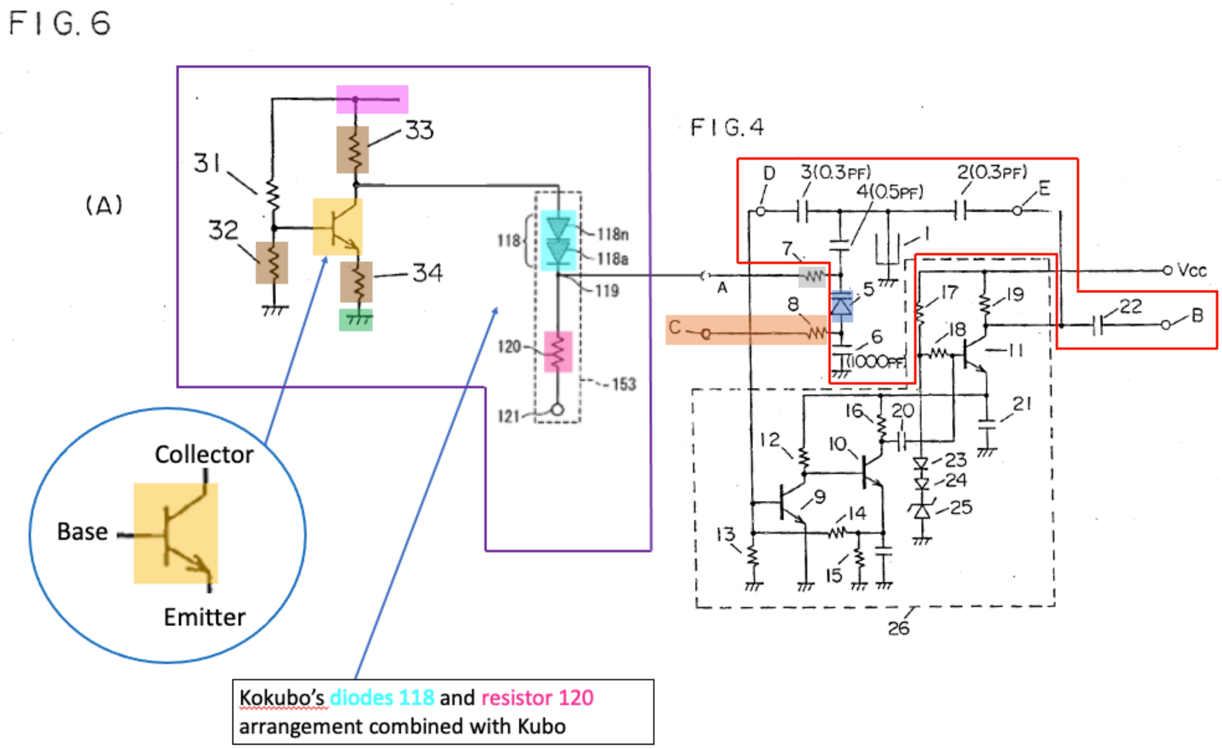
Second, Kokubo describes a bias circuit having temperature compensation circuit 153 that includes diodes 118 connected between node 112 and a node where voltage 119 is formed, and a resistor 120 connected in series with diodes 118 to node 121. EX1004, 6:60-62, 7:15-21, 10:22-48, Fig. 14; EX1002, ¶105.



EX1004, Fig 14 (annotated)

Diodes 118 introduce a "voltage drop from the set voltage at the node 12" to form a voltage at node 119, where the voltage drop increases with the decrease of temperature. *Id.*, 7:66-8:12, 10:22-48. When temperature increases or decreases, diodes 118 and resistor 120 configure the voltage at node 119, which in turn configures the voltage at node 106 (since voltage at these nodes are the same), compensating voltage changes caused by temperature changes. *Id.*, 7:66-8:19, 8:49-51, 10:9-48, Fig. 14; EX1002, ¶106.

Thus, a POSITA would have combined Kubo and Kokubo such that Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) includes Kokubo's temperature compensation circuit 153 having diodes 118 and resistor 120 arranged just as they are in Kokubo's bias circuit, attaching diodes 118 between Kubo's transistor and resistor 7 and resistor 120 between diodes 118 to node 121. EX1003, 3:5-7, 3:18-21, 4:14-25 and 4:42-46, Figs. 4, 6(A); EX1004, 7:15-18, 7:32-46, 7:66-8:51, 10:13-48, Fig. 14; *See* III.A.4.e; EX1002, ¶107. A combined figure showing the combination is below.



EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (item 153 of Fig. 14) combined (annotated)

A POSITA would have been motivated to combine Kubo and Kokubo in this manner with a reasonable expectation of success for the reasons discussed in Section III.A.4.f.; EX1002, ¶108.

Kokubo states that diodes 118 are formed by "n (n is a positive integer) diodes 118 (118a to 118n)." EX1004, 7:15-17, 10:22-48, Fig. 14 (parentheticals in original). Thus, a POSITA would have understood that one diode 118 would have been present in the bias circuit when n is equal to one, a positive integer. *Id.*; EX1009, p. 379 (defining "integer" as "[t]he set of numbers including zero, and all positive and negative whole numbers."); EX1002, ¶109. In such a case, the combined Kubo-

Kokubo system would have resulted in Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) including Kokubo's single diode 118 (*a diode*) *having a cathode connected to* resistor 7 (*the temperature compensation bias application circuit*). *Id.*

To the extent it is argued that the Kubo-Kokubo combined system requires multiple diodes 118, the Kubo-Kokubo combined system still discloses or at least renders obvious limitation [2f]. This view of the combination still results in Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) including Kokubo's diodes 118a-n with diode 118a having its cathode connected to resistor 7 which is part of Kubo's oscillation apparatus (*a diode having a cathode connected to the temperature compensation bias application circuit*). EX1003, 3:5-7, 3:18-21, 4:14-25 and 4:42-46, Figs. 4, 6(A); EX1004, 7:15-18, 7:32-46, 7:66-8:51, 10:13-48, Fig. 14; EX1002, ¶110.

The combination of Kubo, Kokubo, and Shapiro also disclose or at least render obvious limitation [2m] (*a fourth resistor having a first end connected to the temperature compensation bias application circuit and having a second end that is grounded*) as discussed in Section III.A.4.m.

The combination of Kubo, Kokubo, and Shapiro therefore raise substantial new questions of patentability because (1) the combination of Kubo and Kokubo disclose or at least render obvious each limitation of claim 2, including limitation

[2f], the limitation that rendered claim 2 allowable during prosecution, and (2) the combination of Kubo and Kokubo was not considered during prosecution of the '318 patent. EX1002, ¶111.

2. JP105 and Kubo Raise Substantial New Questions of Patentability

JP105 and Kubo raise substantial new questions of patentability because this combination discloses or at least renders obvious each limitation of claim 1, including the allegedly allowable limitation of claim 1 (limitation [1g]). As discussed, JP105 was not considered during prosecution of the '318 patent and Kubo was not considered in any rejection during prosecution of the '318 patent. While Kubo is listed on the '318 patent's face and its Japanese equivalent is discussed in the patent's background (*see* EX1001, cover, 1:54-56), to the extent Kubo's disclosure was before the Examiner, the Examiner overlooked its relevance and as presented herein, Kubo is presented in a new light and a different way because it is combined with JP105 in the Ground 2. As set forth in MPEP § 2216, a "substantial new question of patentability may be based on art previously considered by the Office if the reference is presented in a new light or a different way that escaped review during earlier examination." A reasonable examiner would have found JP105 and Kubo relevant to the Challenged Claims for the following reasons. EX1002, ¶112.

a) **Claim 1 is unpatentable under 35 U.S.C. § 103(a) over JP105 and Kubo.**

As shown in the detailed analysis of claim 1 (Section III.B), claim 1 is unpatentable under 35 U.S.C. § 103(a) over JP105 and Kubo. *See* Section III.B.

Claim 1 recites "*[the temperature compensation bias generation circuit having:] a first resistor having a first end connected to the collector or drain of the transistor and having a second end that is grounded*" (limitation [1g] below). As discussed above in Section II.E, the Examiner stated this limitation of claim 1 rendered the claim allowable.

However, the combination of JP105 and Kubo disclose or at least render obvious limitation [1g]. In the combination, JP105 discloses or at least renders obvious "*[the temperature compensation bias generation circuit having:] a first resistor having a first end connected to the collector or drain of the transistor and having a second end that is grounded*." EX1002, ¶114.

JP105 discloses or at least renders obvious a *temperature compensation bias generation circuit* in the form of its circuit formed by components 27 through 32, outlined in purple in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶115.

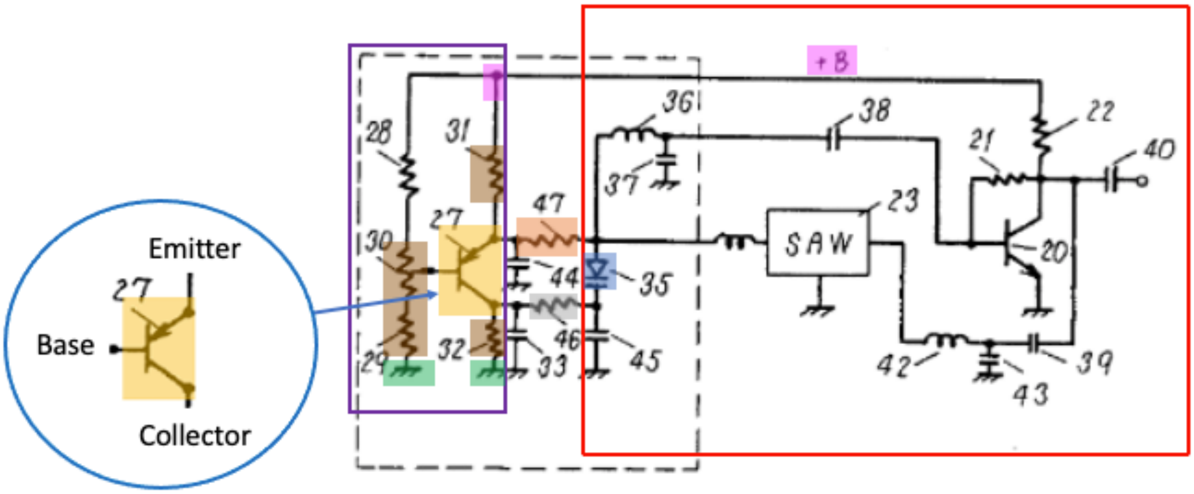


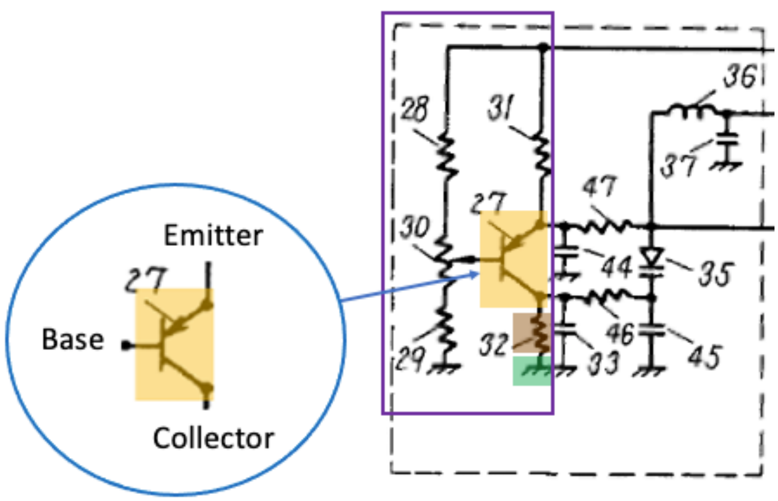
FIG. 8

EX1006, Fig. 8 (annotated)

JP105's circuit formed by components 27 through 32 (*temperature compensation bias generation circuit*) generates the capacitance control voltage (*generates the temperature compensation bias*) at the collector of transistor 27 and supplies this generated voltage (*supplies the temperature compensation bias generated*) to the arranged bias transfer resistor 46, which is a *temperature compensation bias circuit*. EX1006, 3:29-5:15, 5:22-6:2, Figs. 7, 8; Section III.B.4.d-e; EX1002, ¶116.

To the extent *temperature compensation bias generation circuit* is interpreted as a means-plus-function recitation, JP105 discloses or at least renders obvious its function for the reasons discussed above in Section III.B.4.e, and JP105 and Kubo disclose or at least render obvious the identified corresponding structure for *temperature compensation bias generation circuit* for the reasons discussed in Sections III.B.4.f-III.B.4.k, II.f.

Second, in the combination, JP105 discloses the circuit formed by components 27 through 32 (*the temperature compensation bias generation circuit*) has a resistor 32 (*a first resistor*) having a first end connected to the collector of transistor 27 (*having a first end connected to the collector or drain of the transistor*) and a second end that is grounded (a*nd having a second end that is grounded*) as shown in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶118.



EX1006, Fig. 8 (partial view, annotated)

The combination of JP105 and Kubo therefore raise substantial new questions of patentability because (1) the combination of JP105 and Kubo disclose or at least render obvious each limitation of claim 1, including limitation [1g], the limitation that rendered claim 1 allowable during prosecution, and (2) the combination of JP105 and Kubo was not considered during prosecution of the '318 patent. EX1002, ¶119.

3. JP105, Kubo, and Kokubo Raise Substantial New Questions of Patentability

JP105, Kubo, and Kokubo raise substantial new questions of patentability because this combination discloses or at least renders obvious each limitation of claim 1, including the allegedly allowable limitation of claim 1 (limitation [1g]). As discussed, JP105 and Kokubo were not considered during prosecution of the '318 patent and Kubo was not considered in any rejection during prosecution of the '318 patent. While Kubo is listed on the '318 patent's face and its Japanese equivalent is discussed in the patent's background (*see* EX1001, cover, 1:54-56), to the extent Kubo's disclosure was before the Examiner, the Examiner overlooked its relevance and as presented herein, Kubo is presented in a new light and a different way because it is combined with JP105 and Kokubo in the Ground 3. As set forth in MPEP § 2216, a "substantial new question of patentability may be based on art previously considered by the Office if the reference is presented in a new light or a different way that escaped review during earlier examination." A reasonable examiner would have found JP105, Kubo, and Kokubo relevant to the Challenged Claims for the following reasons. EX1002, ¶120.

a) Claim 1 is unpatentable under 35 U.S.C. § 103(a) over JP105, Kubo, and Kokubo.

As shown in the detailed analysis of claim 1 (Section III.B), claim 1 is unpatentable under 35 U.S.C. § 103(a) over JP105, Kubo, and Kokubo. *See* Section III.B.

Claim 1 recites "*[the temperature compensation bias generation circuit having:] a first resistor having a first end connected to the collector or drain of the transistor and having a second end that is grounded*" (limitation [1g] below). As discussed above in Section II.E, the Examiner stated this limitation of claim 1 rendered the claim allowable.

However, the combination of JP105, Kubo, and Kokubo disclose or at least render obvious limitation [1g]. In the combination, JP105 discloses or at least renders obvious "*[the temperature compensation bias generation circuit having:] a first resistor having a first end connected to the collector or drain of the transistor and having a second end that is grounded*" for the same reasons discussed above in Section II.I.2 with respect to the combination of JP105 and Kubo. EX1002, ¶122.

The combination of JP105, Kubo, and Kokubo therefore raise substantial new questions of patentability because (1) the combination of JP105, Kubo, and Kokubo disclose or at least render obvious each limitation of claim 1, including limitation [1g], the limitation that rendered claim 1 allowable during prosecution, and (2) the combination of JP105, Kubo, and Kokubo was not considered during prosecution of the ’318 patent. EX1002, ¶123.

III. DETAILED EXPLANATION OF THE PERTINENCE AND MANNER OF APPLYING THE PRIOR ART REFERENCES TO EVERY CLAIM FOR WHICH REEXAMINATION IS REQUESTED

The proposed rejections detailed below shows that claims 1 and 2 of the ’318 patent are unpatentable. The proposed rejections of claims 1 and 2 are first set forth in narrative form. As shown below and confirmed in the Declaration of Dr. Jake Baker (EX1002), the technology claimed in the ’318 patent was not new. The Grounds presented in this Request render obvious the Challenged Claims, which should be canceled for unpatentability. The proposed rejections are listed below.

Proposed Rejection 1: Claim 2 is unpatentable under 35 U.S.C. § 103(a) over Kubo, Kokubo, and Shapiro.

Proposed Rejection 2: Claim 1 is unpatentable under 35 U.S.C. § 103(a) over JP105 and Kubo.

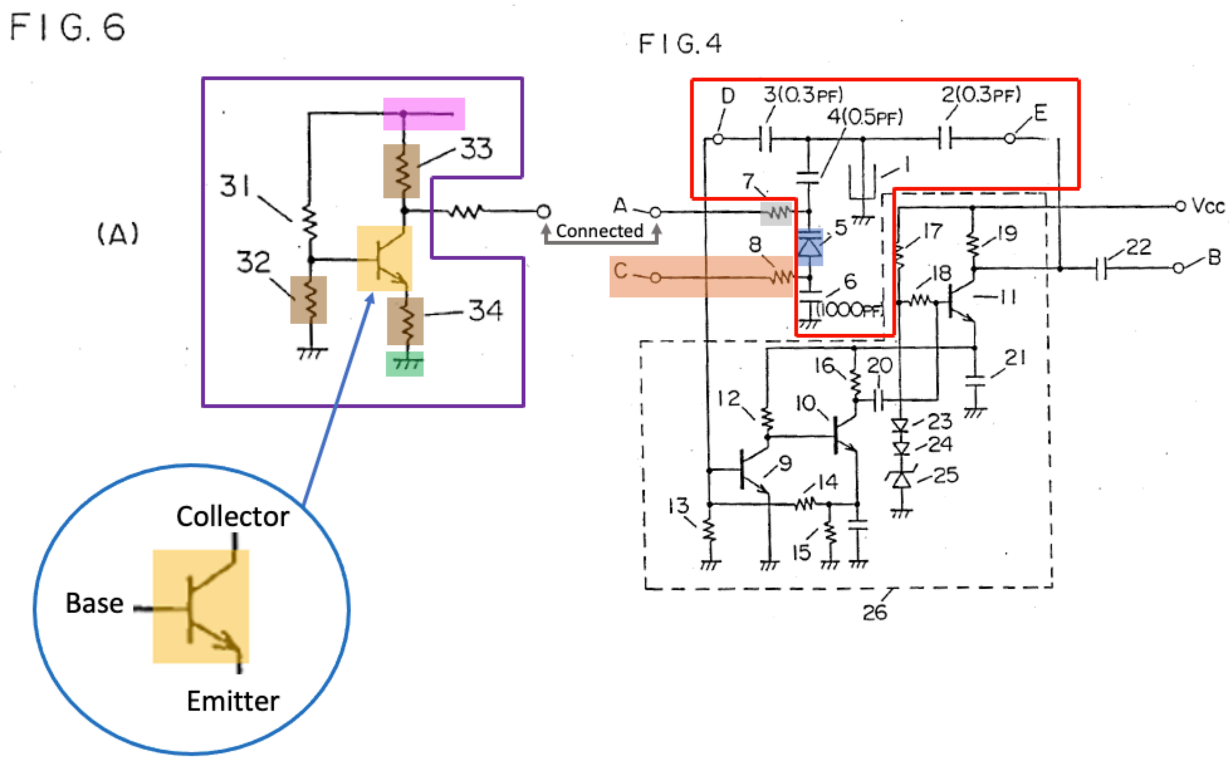
Proposed Rejection 3: Claim 1 is unpatentable under 35 U.S.C. § 103(a) over JP105, Kubo, and Kokubo.

A. Proposed Rejection 1: Claim 2 is unpatentable under 35 U.S.C. § 103(a) over Kubo, Kokubo, and Shapiro.

1. Overview of Kubo

Kubo describes a "local oscillation apparatus" that, like the '318 patent's claimed oscillators, compensates variations in oscillation frequency caused by temperature change. EX1003, 1:21-26 ("The present invention…has an object to provide a location oscillation apparatus wherein…the **influence of temperature drift can be reduced**"), 1:43-49 ("…**cause of the temperature drive of the oscillation frequency in the amplifier can be almost eliminated**, **temperature change can be suppressed** only by compensation of the temperature characteristics of the coaxial resonator, and a **stable oscillation frequency is obtainable**), 4:17-26 ("When the compensation voltage is applied to the terminal A in FIG. 4 and a voltage for adjusting oscillation frequency is applied to a terminal C, accompanying a temperature rise, a voltage applied across both terminals of the variable capacitance diode 5 is reduced, and a capacitances increases, and **thereby it acts to reduce oscillation frequency. Thus a frequency variation corresponding to a temperature of the resonator itself can be compensated**.")

Figures 4 and 6(A) of Kubo below show an exemplary local oscillation apparatus, where the Figure 6(A) circuit is a circuit for generating temperature compensation voltage coupled to terminal A of the Figure 4 circuit, which includes components that provide voltage-controlled oscillation. EX1003, 3:5-34, 3:54-64, 4:7-26, 4:42-46, Figs. 4, 6(A).



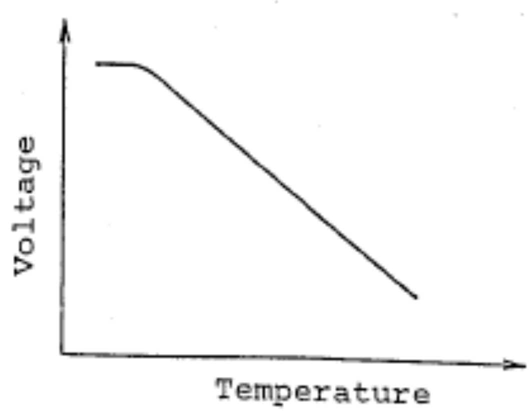
Kubo, Figs. 4, 6(A) (annotated)

Kubo explains that its circuit for generating temperature compensation voltage includes a transistor having its collector connected to resistor 7 of Figure 4 via an intermediate resistor, its collector also connected to resistor 33, and its base and emitted connected to resistors 32 and 34, respectively. EX1003, 4:7-26, 4:42-46, Figs. 4, 6(A). Resistor 33 also has one end connected to a terminal that receives a voltage; indeed, a voltage would be applied at this location in order to cause the circuit to function. *Id.* Resistor 34 has one end connected to ground as shown in Figure 6(A). EX1003, 4:7-26, Fig. 6(A).

Regarding the components providing voltage-controlled oscillation, a variable capacitance diode 5 has its cathode connected to one end of resistor 7 and its anode connected to one end of resistor 8. EX1003, 3:15-21, Fig. 4. Capacitors 2, 3, 4, and 6 and a resonator 1 are also included, where the resonator is connected to an amplifier 26 via capacitors 2 and 3. *Id.*, 3:49-52.

Kubo explains that the base to emitter voltage (VBE) of the transistor changes as temperature changes; as such, output voltage taken at the collector of the transistor changes as well as shown below in Figure (6B), where the collector voltage is lowered as temperature increases. EX1003, 4:7-13. This is just like the '318 patent, where a voltage at the collector of transistor 11—point X in Figures 1 and 3— is reduced. EX1001, 4:54-64, 6:12-22; Section II.C.

(B)



Kubo, Figure 6(B)

This collector voltage of the transistor, referred to as a "compensating voltage" by Kubo, is input to terminal A of the Figure 4 circuit and applied to the cathode of variable capacitance diode 5 via resistor 7. EX1003., 3:18-21, 4:17-21. A "voltage for adjusting oscillation frequency" is also input to terminal C of the Figure 4 circuit and applied to the anode of variable capacitance diode 5 via resistor 8. *Id.* When a temperature rise occurs, the "voltage applied across both terminals of the variable capacitance diode 5 is reduced, and a capacitance increases, and thereby it acts to reduce oscillation frequency," which means "a frequency variation corresponding to a temperature of the resonator itself can be compensated." *Id.*, 4:17-26.

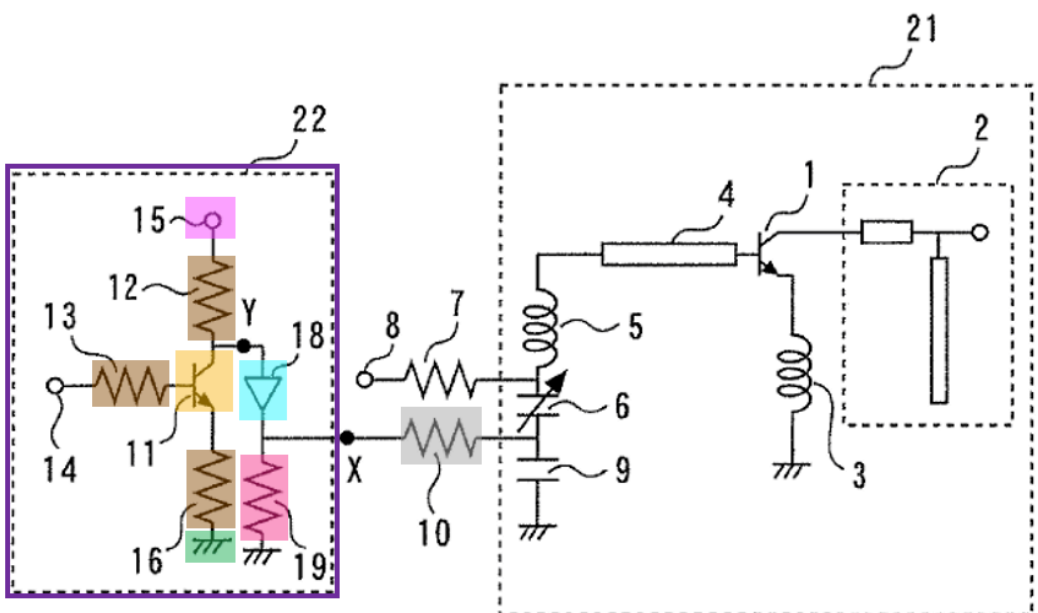
Kubo is analogous art to the '318 patent; it is from the same field of endeavor as the '318 patent (voltage-controlled oscillators) and reasonably pertinent to the particular problem the '318 patent was trying to solve (compensating variations in voltage-controlled oscillator oscillation frequency due to temperature). EX1001, 1:6-12; EX1003, 2:2-26, 2:37-39; EX1002, ¶137.

2. Overview of Kokubo

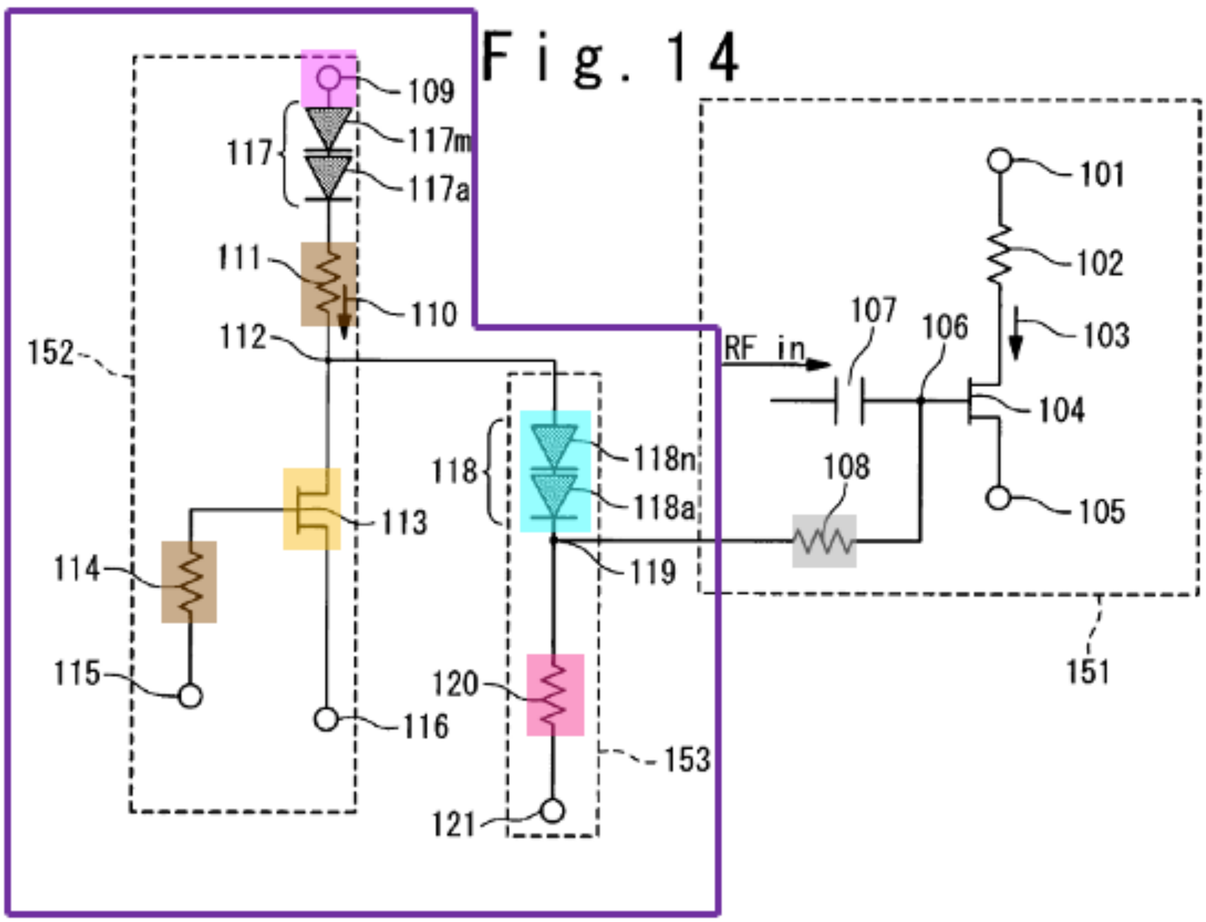
Kokubo describes a "bias circuit" that is constructed so "temperature compensation can be accomplished." EX1004, 1:9-11. The bias circuit includes a "threshold voltage change compensation circuit 152" that "supplies a voltage to the amplifier 151 through the temperature compensation circuit 153." *Id.*, 6:60-62, 7:19-21, 10:13-48, Figs. 10, 14. The bias circuit provides temperature compensation by adjusting the voltage applied to amplifier 151 to compensate voltage changes introduced by a change in temperature. *Id.*, 8:17-19, 8:49-51, 10:13-48, Figs. 10, 14.

Kokubo' Figure 14, showing the bias circuit, and the '318 patent's Figure 3, showing temperature compensation bias generation circuit 22, are reproduced below to illustrate how they have a very similar transistor arrangements that use a diode to provide a voltage drop from the voltage at a transistor drain or collector.

FIG. 3



EX1001, Fig. 3 (annotated)



Kokubo, Fig 14 (annotated)

In Kubo, voltage supplied by the bias circuit is input into a gate bias point 106 of transistor 104 forming amplifier 151. EX1004, 7:8-10, 10:13-48, Figs. 10, 14. The bias circuit has a threshold voltage change compensation circuit 152 that includes a transistor 113 with resistance 111 and 114 connected to its drain and gate, respectively, where a "voltage 109 is applied to the drain of the transistor 113 through the resistance 111" and a "voltage 115 is applied to the gate of the transistor 113 through the resistance 114." *Id.*, 7:21-27, 10:13-48, Figs. 10, 14.

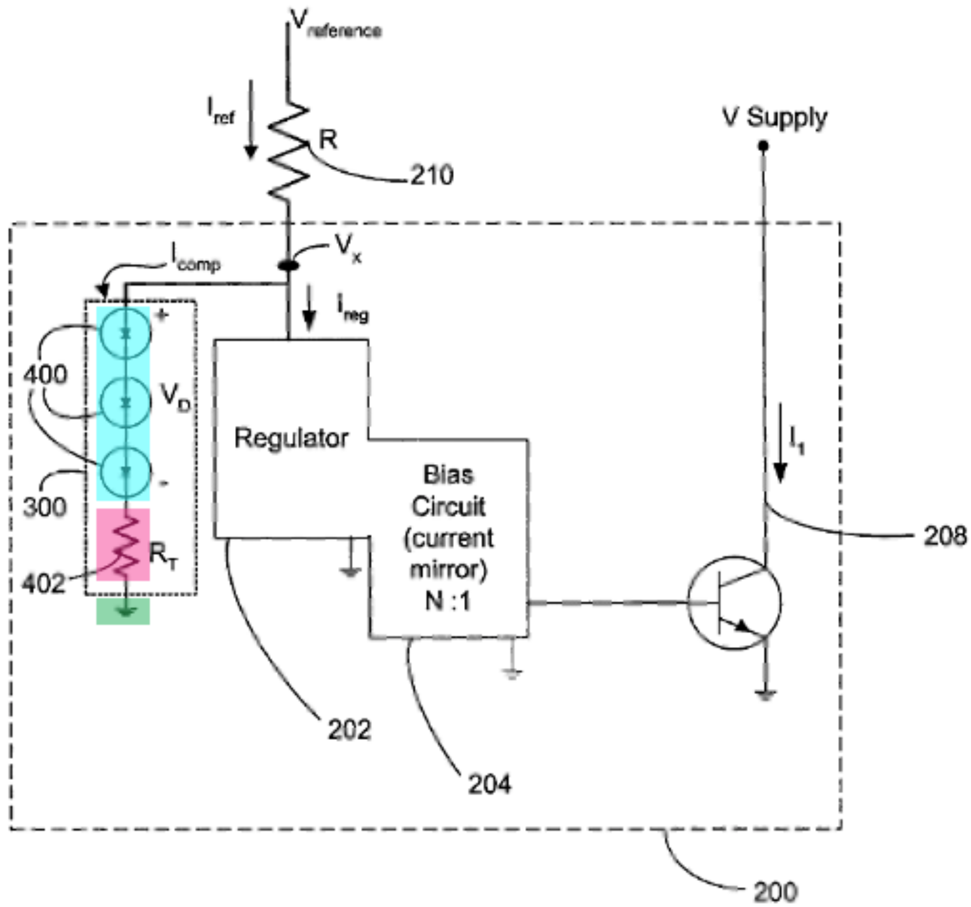
The bias circuit includes "n" number of diodes 118, where "n is a positive integer," and where diodes 118 are connected in series between node 112 (located at the drain of transistor 113) and a node where voltage 119 is formed. EX1004, 7:15-18, 7:32-39, 10:13-48, Figs. 10, 14. A resistor 120 is also connected in series with diodes 118. *Id.*, 7:15-17, 10:13-48, Figs. 10, 14. For diodes 118, their forward voltage "increases with the decrease of the temperature" and have a changeable forward voltage, where the change in the forward voltage (Vf) due to temperature is equal to the change of gate bias voltage at point 106 for transistor 104 "which is necessary to restrict the drain current with the decrease of the temperature." *Id.*, 7:66-8:8.

Thus, in operation, "a voltage drop from the set voltage at the node 112 becomes large at a low temperature" and as a result, "voltage 119 becomes low, which is the same voltage as the gate bias point 106 in the transistor 104." EX1004, 8:8-12. Thus, "it is possible to lower the voltage V106 of the gate bias point 106 with the decrease of the temperature." *Id.*, 8:12-14. In contrast, "when the temperature rises, the voltage drop from set voltage at the node 112 becomes small, so that the voltage V106 of the gate bias point 106 can be raised." *Id.*, 8:14-17. Thus, using this arrangement, "gain change of the transistor 104 due to the temperature change can be restrained" and "the bias circuit can achieve compensation functions for…the temperature change." *Id.*, 8:17-19, 8:49-51; *see also id.*, 10:13-19 ("Thus, the bias circuit has both functions of compensation for both of the threshold voltage change and the temperature change, resulting in improvement of the characteristic change and increase of a production yield of IC”). Diodes 118 and resistor 120 therefore configure output voltage at a bias node 106 when temperature increases or decreases. *Id.*, 1:9-11, 6:60-62, 7:19-21, 8:8-19, 8:49-51, 10:9-48, Figs. 10, 14.

Kokubo is analogous art to the ’318 patent; it is from the same field of endeavor as the ’318 patent (electrical circuits that are voltage controlled) and reasonably pertinent to the particular problem the ’318 patent was trying to solve (how to mitigate the influence of temperature changes on electrical circuit function). EX1001, 1:6-12; EX1004, 1:9-11, 7:49-65, 8:8-19, 10:13-48, Figs. 10, 14; EX1002, ¶143.

3. Overview of Shapiro

Shapiro discloses “a system for temperature compensation to improve bias circuit performance that can in turn improve amplifier performance.” EX1005, 1:6-8. Shapiro’s temperature compensation system “automatically adjusts the current flow into the reference node” of a current mirror circuit, which “compensates for the changes in current flow” in an amplifier that occur over a “range of temperatures.” *Id.*, 2:11-13. Figure 4 below shows an exemplary compensation circuit.



EX1005, Fig. 4

A "compensation module 300" is formed by diodes 400, which are connected in series with a resistor 402 to ground. EX1005, 6:23-27, Fig. 4. Diodes 400 have a thermal response that effectuate "a counter-balancing effect thus compensating for the otherwise undesirable reference current variation of systems in the prior art." *Id.*, 6:34-37. In particular, diodes 400 "generate non-linearity in compensation current over a temperature range" by providing "compensation current [that is][] minimal at low temperatures and increase[d] at high temperatures." *Id.*, 6:38-47. Resistor 402 is used to "control the compensation current flowing through the compensation module" and "insure a voltage adequate to achieve operation of the semiconductor devices in the compensation module." *Id.*, 6:67-7:3. Resistor 402 may also "be chosen to maintain an amount of current flow through the temperature compensation module 300." *Id.*, 7:3-5. As shown by Figure 4, diodes 400 cause a voltage drop V_D from voltage V_x, and a voltage drop is also caused by resistor 402 to ground. *Id.* As temperature changes occur, current drawn through the diodes 400 and resistor 402 to ground changes. *Id.*, 8:23-46, 5:46-67, Fig. 4.

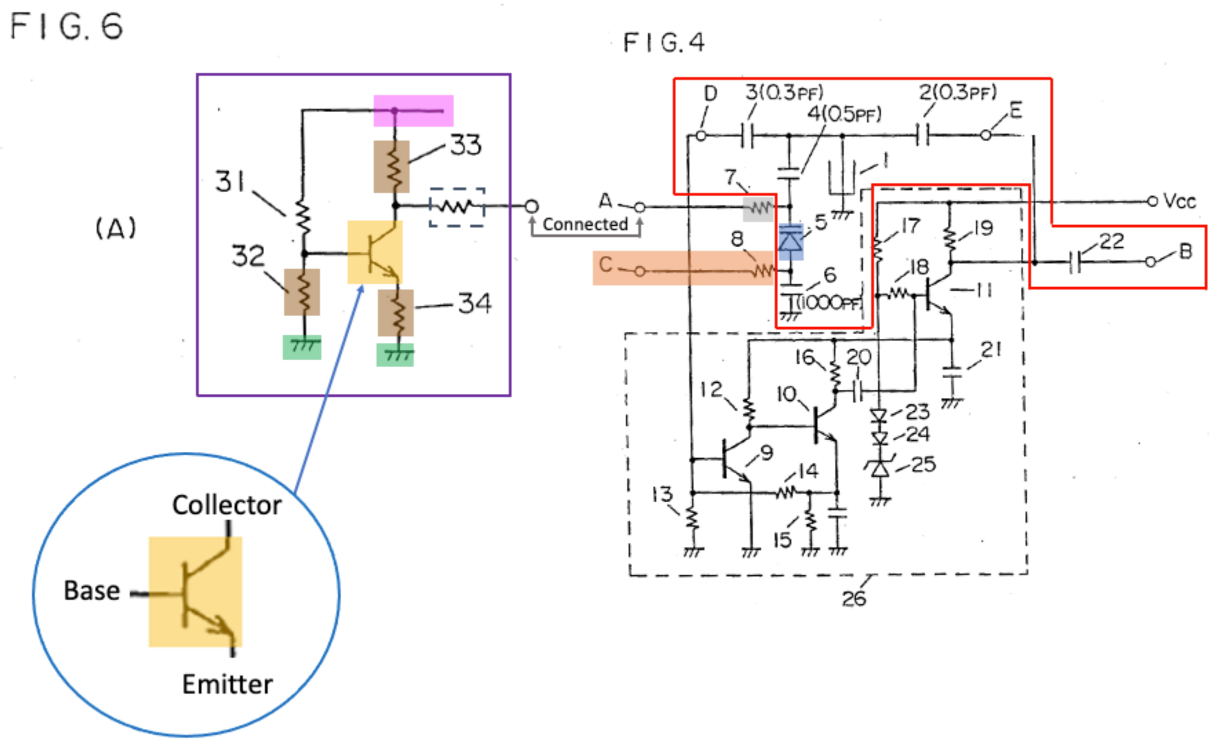
Specifically, in operation, as temperature changes occur, current drawn through the diodes 400 and resistor 402 of compensation module 300 to ground changes, where more current is drawn at high temperatures compared to lower temperatures. EX1005, 8:23-46, Fig. 4. This current draw subtracts from the reference current I_{ref} in Figure 4 and in turn changes the current I_{reg} that is input into regulator 202. *Id.* As such, the current I_{reg} that is maintained close to an ideal current even as temperature changes occur and temperature compensation is provided. *Id.*, 8:29-33, 8:40-46. Thus, the current I_1 of the amplifier, which mirrors I_{reg}, is kept close to ideal and unwanted variance of crrent in the amplifier is avoided. *Id.*; *see also id.*, 5:46-67.

Shapiro is analogous art to the ’318 patent; it is from the same field of endeavor as the ’318 patent (improving electrical circuit operation) and reasonably pertinent to the particular problem the ’318 patent was trying to solve (how to mitigate the influence of temperature changes on electrical circuit function). EX1001, 1:6-12, 3:6-11; EX1005, Abstract, 1:5-8, 2:11-13, 3:60-4:17; EX1002, ¶147.

4. Claim 2 is unpatentable under 35 U.S.C. § 103(a) over Kubo, Kokubo, and Shapiro

a. [2a-preamble] “A voltage-controlled oscillator comprising:”

Kubo discloses a circuit for generating temperature compensation voltage, shown in Figure 6(A), that is connected to an oscillation apparatus, shown in Figure 4, where the oscillation apparatus has a variable capacitance diode 5. EX1003, Abstract, 1:31-34, 1:61-66, 2:37-40, 3:5-21, 3:54-64, 4:7-38, 4:42-46, Figs. 4, 6(A). The circuit for generating temperature compensation voltage and oscillation apparatus collectively form the claimed *voltage-controlled oscillator*. *Id.*; EX1002, ¶148.

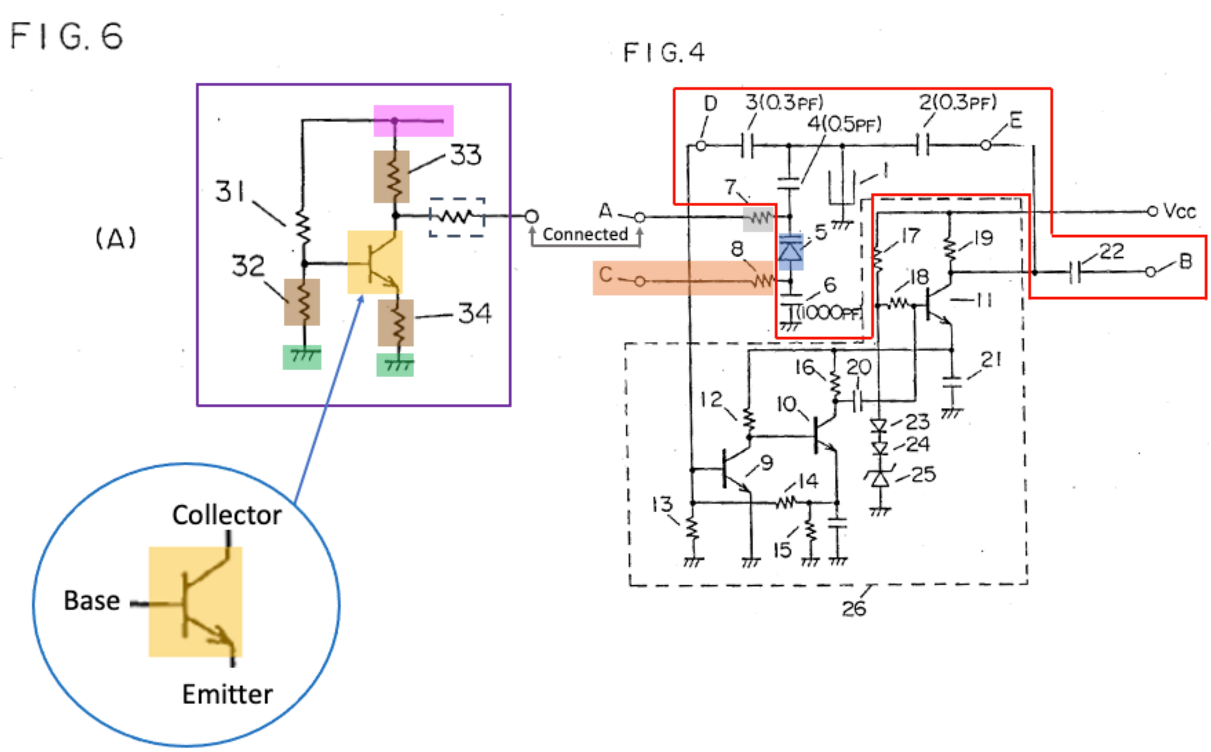


EX1003, Figs. 4, 6(A) (annotated)

The circuit for generating temperature compensation voltage applies a voltage at terminal A and a voltage is applied at terminal C, forming a voltage across variable capacitance diode 5. EX1003, Abstract, 1:31-34, 1:61-66, 2:37-40, 3:5-21, 3:54-64, 4:7-38, 4:42-46, Figs. 4, 6(A). When a temperature change occurs, the voltage across variable capacitance diode 5 changes, which changes capacitance of diode 5 and controls oscillation frequency output by the oscillation apparatus. *Id.* Thus, oscillation frequency is controlled by adjusting the voltage applied to variable capacitance diode 5 of the circuit for generating temperature compensation voltage and oscillation apparatus. *Id.* Thus, the circuit for generating temperature compensation voltage and oscillation apparatus form the claimed *voltage-controlled oscillator*. *Id.* Frequency variations corresponding to temperature can thereby be compensated. *Id.*; EX1002, ¶149.

b. [2b] "a voltage-controlled oscillation section which controls oscillation frequency through a voltage applied to a variable-capacitance element;"

Kubo discloses that its oscillation apparatus and circuit for generating temperature compensation voltage (*voltage-controlled oscillator*) includes coaxial resonator 1, capacitors 2 and 3, coupling capacitor 4, variable capacitance diode 5, DC stop capacitor 6, and coupling capacitor 22, which are outlined in red in Figure 4 below. EX1002, ¶150.



EX1003, Figs. 4, 6(A) (annotated)

The outlined red components collectively disclose, or at least render obvious, a *voltage-controlled oscillation section*. This is because they are a *section* of the circuitry formed by Kubo's oscillation apparatus and circuit for generating temperature compensation voltage (*voltage-controlled oscillator*) that collectively operate to provide a voltage-controlled oscillation frequency and control oscillation frequency by voltage applied across variable capacitance diode 5 (*voltage-controlled oscillation*). EX1003, 1:65-66, 3:8-18, 3:25-27, 3:49-64, 4:17-26. Kubo describes that "coaxial resonator 1 is connected to the amplifier 26 by the small capacitance capacitors 2 and 3" and that as capacitance of variable capacitance diode 5 changes, frequency of the resonator 1 changes. *Id.*, 3:8-64. Coupling capacitor 4 and DC stop capacitor 6 are connected to variable capacitance diode 5. *Id.* Coupling capacitor 22 is connected to capacitor 2 and coupled to the output terminal B where oscillating voltage is output. *Id.* 1:65-66, 3:8-64; EX1002, ¶151.

Components 1 through 6 and 22 (*voltage-controlled oscillation section*) further *control[] oscillation frequency through a voltage applied to a variable-capacitance element* for at least the following reasons. EX1002, ¶152.

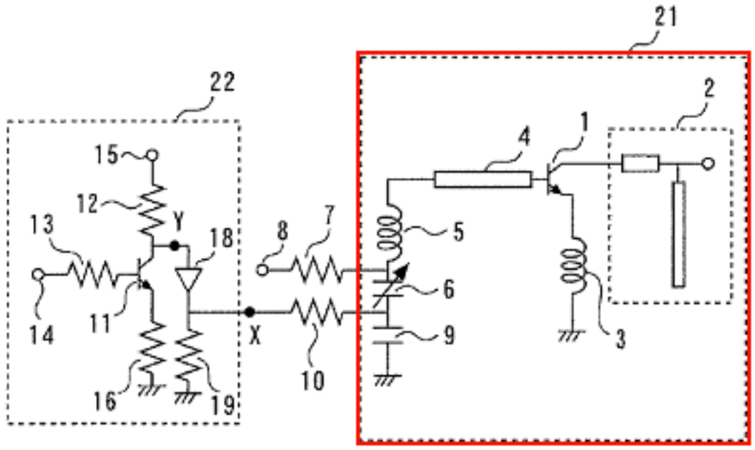
Kubo discloses or at least renders obvious a *variable-capacitance element* (if the term is interpreted as a means-plus-function limitation or not). Kubo describes variable capacitance diode 5, which corresponds to the identified means-plus-function structure of a "diode, pn diode, and Schottky diode, and equivalents thereof" discussed in Section II.F. EX1003, 3:16-17, Fig. 4; *see also* Section III.A.4.c-d; Section II.F. Kubo describes that variable capacitance diode 5 is a "variable capacitance diode for varying frequency" that receives applied frequency control bias voltage at a first end via terminal C and receives applied temperature compensation bias voltage at a second end via terminal A, which corresponds to the identified function discussed in Section II.F). *Id.* Indeed, Kubo explicitly calls diode 5 a *variable-capacitance* type of diode which explicitly aligns with the claim language. *Id.*; EX1002, ¶153.

The ’318 patent provides examples where the claimed *variable-capacitance element* is a diode just like Kubo’s variable capacitance diode 5. EX1003, 3:8-21, 3:49-56, 3:59-64, 4:17-26; EX1001, 2:40-41, 4:22-24. For example, the ’318 patent states that a variable-capacitance element can be “a diode” that is reverse-biased and provides an example where the variable-capacitance element is a “pn junction diode.” *Id*; EX1002, ¶154.

Components 1 through 6 and 22 (*voltage-controlled oscillation section*) further *control[] oscillation frequency through a voltage applied to* variable capacitance diode 5 (*variable-capacitance element*). This is because, as noted above for limitation [2b], they collectively operate to generate an oscillation frequency output at terminal B that is controlled (*controls oscillation frequency*) by voltage applied across (*through a voltage applied to*) variable capacitance diode 5 (*a variable-capacitance element*) at terminals A and C in Figure 4, where changing the applied voltage changes capacitance of variable capacitance diode 5 and in turn changes output oscillation frequency. EX1003, 3:8-18, 3:49-64, 4:17-26, Fig. 4; EX1002, ¶155.

To the extent limitation [2b] is interpreted as a means-plus-function limitation, Kubo discloses or at least renders it obvious. Kubo discloses or at least renders obvious the identified functionality of *control[ling] oscillation frequency through a voltage applied to a variable-capacitance element* for the reasons discussed above for this limitation. *See* Section II.F. Kubo further discloses, or at least renders obvious, an equivalent to the ’318 Patent’s identified structure of voltage-controlled oscillation section 21 in Figures 1, 3, 4, and 6 for the reasons discussed below. *Id;* EX1002, ¶156.

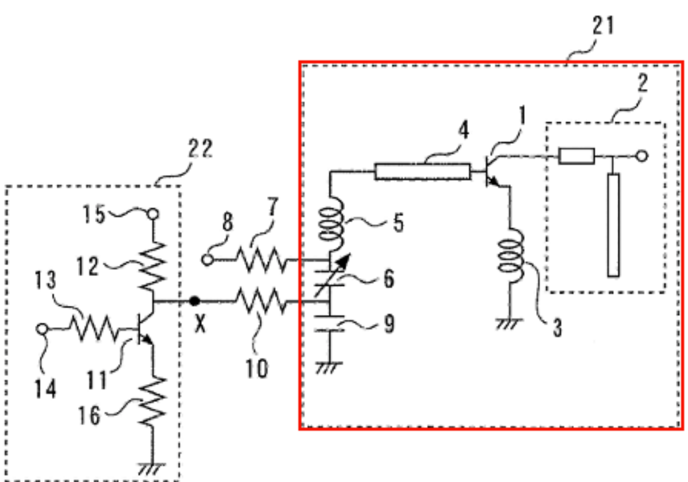
FIG. 3



EX1001, Fig. 3 (annotated)

FIG. 6

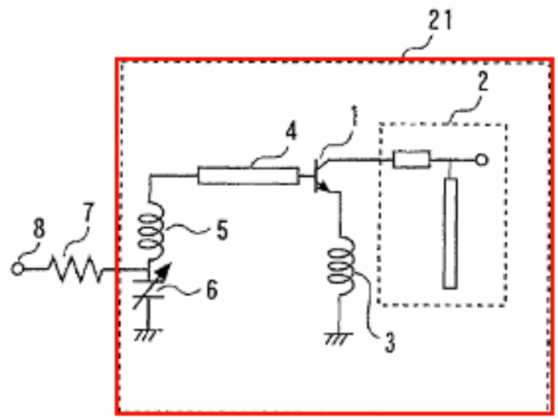
Conventional Art



EX1001, Fig. 6 (annotated)

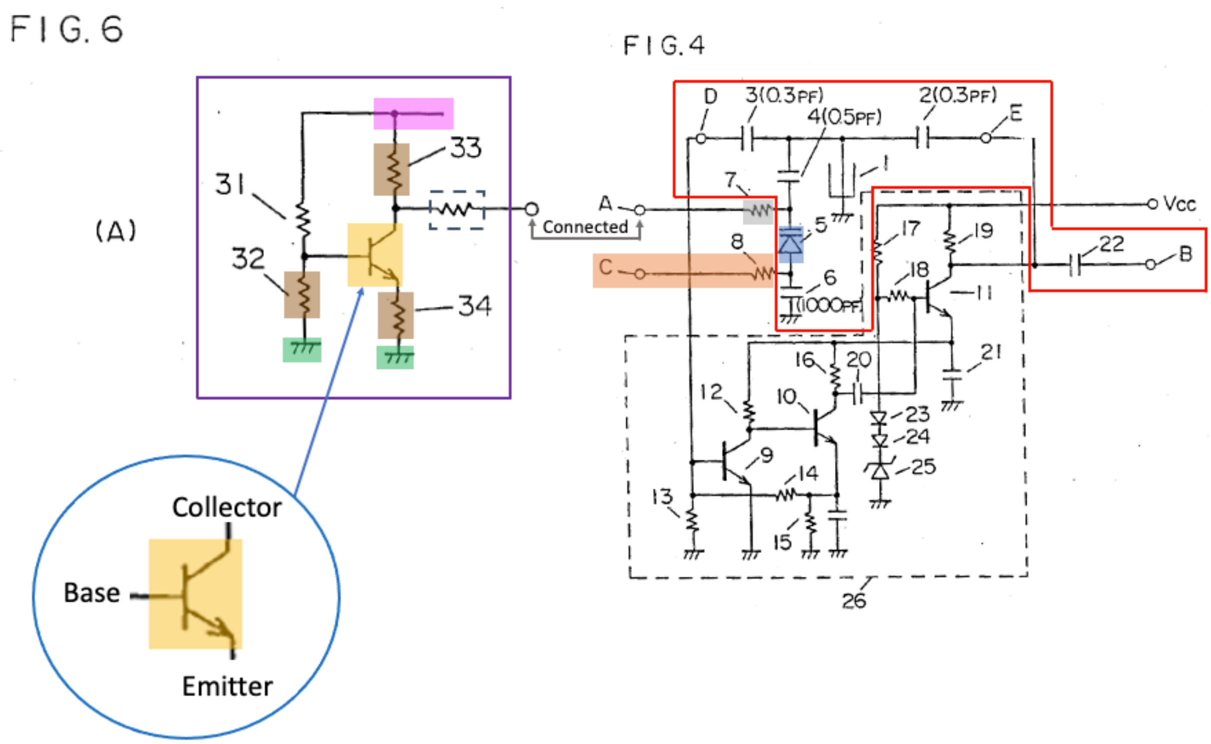
FIG. 4

Conventional Art



EX1001, Fig. 4 (annotated)

Kubo's components 1 through 6 and 22 (outlined in red in combined Figure 4/6(A) below) discussed above form an equivalent because they perform the function of *control[ling] oscillation frequency through a voltage applied to a variable-capacitance element* in substantially the same way (in Kubo and the '318 patent, by receiving a voltage applied to a variable-capacitance diode (for Kubo) or variable capacitance element 6 (for the '318 patent), capacitance of the diode/variable capacitance element changes, which in turn is used to control oscillation frequency and compensate frequency variations caused by temperature change) and produce substantially the same results (in both Kubo and the '318 patent, control of oscillation frequency and compensation of frequency variations caused by temperature change) as the identified structure. EX1003, 1:31-34, 1:61-66, 3:8-18, 3:49-64, 4:17-26, Fig. 4; EX1001, 1:23-37, 2:16-31, 3:65-4:24, 4:54-64, 5:29-51, 6:12-22, Figs. 1, 3, 4, 6; Section II.F; *Kemco Sales, Inc. v. Control Papers Co.*, 208 F.3d 1352, 1364 (Fed. Cir. 2000); M.P.E.P. 2183; EX1002, ¶157.



EX1003, Figs. 4, 6(A) (annotated)

A POSITA would have further recognized the interchangeability of components 1 through 6 and 22 for the identified structure of the ’318 patent’s voltage-controlled oscillation section 21. EX1001, 1:23-37, 3:65-4:24, 5:29-51, Figs. 1, 3, 4, 6); Section II.F; *Caterpillar Inc. v. Deere & Co.*, 224 F.3d 1374, 1380

(Fed. Cir. 2000); M.P.E.P. 2183. As shown by Kubo, using components 1 through 6 and 22 was a known alternative to voltage-controlled oscillation section 21 for providing voltage-controlled oscillation that compensates frequency variations caused by temperature. EX1003, 3:8-18, 3:49-58, 3:59-64, 4:17-26, Fig. 4. Interchanging such elements (e.g., interchanging Kubo's components 1 through 6 and 22 with '318 patent's identified structure of voltage-controlled oscillation section 21) and configuring the circuitry would have been routine and well-within the capabilities of a POSITA at least because (1) both elements receive voltages from external circuitry applied to both ends of a variable capacitance element (e.g., for Kubo, voltages applied to each end of variable capacitance diode 5 via terminals A and C; for the '318 patent, voltages applied to each end of variable capacitance element 6) that changes capacitance of a variable capacitance element and adjusts oscillation frequency, (2) both elements perform the same functionality (e.g., controlling oscillation frequency that compensate frequency variations caused by temperature), and (3) there is overlap in the specific components each use (e.g., Kubo's structure includes coaxial resonator 1, a variable capacitance diode 5, and a DC stop capacitor 6, which respectively correspond to the voltage-controlled oscillation section 21's inductor 5 forming an LC resonance circuit, variable-capacitance element 6, and direct current blocking capacitor). *Id.*; EX1003, 3:8-18, 3:49-58, 3:59-64, 4:17-26, Fig. 4. Also, for the same reasons, there are merely insubstantial differences between Kubo's components 1 through 6 and 22 and the '318 patent's voltage-controlled oscillation section 21. *IMS Technology, Inc. v. Haas Automation, Inc.*, 206 F.3d 1422, 1436 (Fed. Cir. 2000); *Minks v. Polaris Industries, Inc.*, 546 F.3d 1364, 1379 (Fed. Cir. 2008); *Odetics, Inc. v. Storage Technology Corp.*, 185 F.3d 1259, 1268 (Fed. Cir. 1999); M.P.E.P. 2183. Moreover, components 1 through 6 and 22 are not excluded by any explicit definition in the '318 patent's specification for an equivalent to voltage-controlled oscillation section 21. EX1001, 5:33-41, 6:44-48 (explaining "many modifications and variations of the present invention are possible"); *Paice LLC v. Toyota Motor Corp.*, 54 F.3d 1293, 1310-11 (Fed. Cir. 2007) (finding equivalence in the doctrine of equivalents context when the patent's specification did not disavowal the equivalent); M.P.E.P. 2183; EX1002, ¶158.

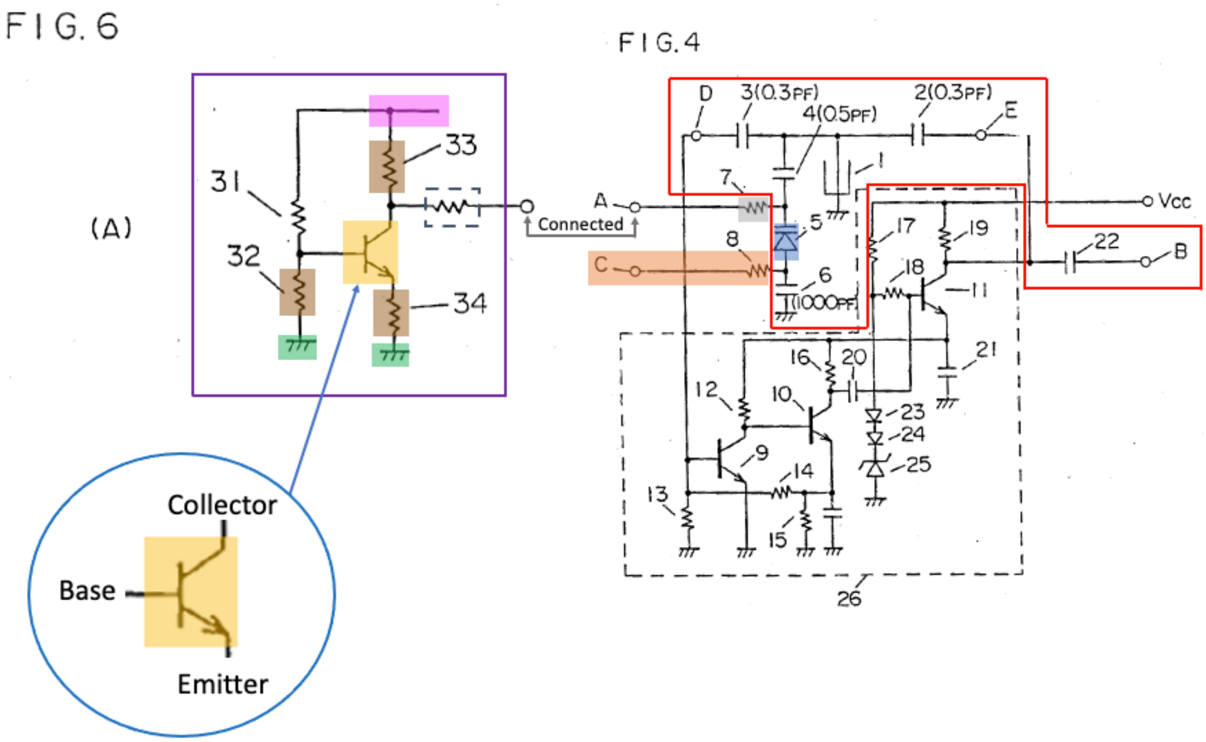
As shown in the above analysis, limitation [2b] is therefore known in the prior art to a POSITA. That limitation [2b], whether interpreted as a means-plus-function element or not, is generally known by a POSITA is further corroborated by the '318 patent's Applicant Admitted Prior Art (AAPA) statements. The '318 patent's AAPA explicitly identifies voltage-controlled oscillation section 21 shown in Figures 1, 3, 4 and 6 (the identified means-plus-function structure for *voltage controlled oscillation section*) as "conventional art" and part of a "conventional voltage-controlled oscillator" that performs the identified function of *control[ling]* *oscillation frequency through a voltage applied to a variable-capacitance element*. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6; Section II.F. A POSITA would have modified Kubo with a reasonable expectation of success such that it includes the AAPA structure ('318 patent's voltage-controlled oscillation section 21) rather than Kubo's components 1 through 6 and 22 because, as discussed above, the components are interchangeable. As modified, Kubo's system (and AAPA) would have performed the same function as when unmodified (e.g., control of oscillation frequency) and the results would have been predictable: control of oscillation frequency to compensate frequency variations caused by temperature using voltage applied to a variable-capacitance diode. *Id.*; *see* Section III.A.4.b, *supra*. This establishes the following motivations to combine: simple substitution of one known element (AAPA's voltage controlled oscillation section 21) for another (Kubo's components 1 through 6 and 22) to obtain predictable results (control of oscillation frequency to compensate frequency variations as discussed above); combining prior art elements (AAPA's voltage controlled oscillation section 21 with Kubo's circuit that includes components 1 through 6 and 22) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by Kubo at Fig. 4 and AAPA at Fig. 6) to yield predictable results (control of oscillation frequency to compensate frequency variations as discussed above using

AAPA's voltage controlled oscillation section 21 rather than Kubo's components 1 through 6 and 22). EX1002, ¶159.

Any alleged differences between limitation [2b] and the prior art cannot confer patentability because the '318 patent admits this limitation is conventional, and a POSITA would have used this conventional technology in Kubo with a reasonable expectation of success using known techniques as discussed above. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6; EX1002, ¶160; *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337-39 (Fed. Cir. 2020); *see Memorandum on Treatment of Statements of the Applicant in the Challenged Patent in Inter Partes Reviews under § 311* (August 18, 2020) ("AAPA Memo"), pp. 5, 6, 9.

c. [2c] "a frequency control bias circuit which applies a frequency control bias to a first end of the variable-capacitance element;"

Kubo discloses its oscillation apparatus and circuit for generating temperature compensation voltage (*voltage-controlled oscillator*) includes a *frequency control bias circuit* in the form of resistor 8 and circuitry that generates a voltage for adjusting oscillation frequency connected to terminal C of the oscillation apparatus. EX1003, 3:5-7, 3:18-21, 4:19-21, Fig. 4; EX1002, ¶161.



EX1003, Figs. 4, 6(A) (annotated)

Because a voltage for adjusting the oscillation frequency is generated and input to terminal C of Kubo, a POSITA would have understood that circuitry such as a voltage source or voltage source in combination with a resistor arrangement would have generated this voltage. EX1003, 3:18-21, 4:17-26, Fig. 4. This understanding is corroborated by EX1009, which defines a "voltage source" as "provid[][ing] voltage to a component, circuit, device, piece of equipment, or system" and EX1010, which discusses voltage sources and a representative circuit model for a voltage source including a resistor EX1009, p. 848; EX1010, pp. 51-54. Indeed, according to Thevenin's theorem, a DC voltage source is represented by a single voltage source and a series resistor. EX1009, p. 786. EX1012 also shows exemplary voltage source configurations, where a voltage source is coupled to a resistor arrangement to provide an output voltage, and where a voltage source and resistor arrangement can be replaced by a single voltage source and series resistance using Thevenin's theorum. EX1013,[10] pp. 7-8, 23, 45-46, Figs. 4-12(b), 4-13, 4-14, 4-15, 2-25 and 2-26 (showing voltage source and resistor arrangement applying voltage to a diode); EX1002, ¶162-163.

The circuitry that generates a voltage for adjusting oscillation frequency inputs "voltage for adjusting oscillation frequency" (*frequency control bias*) at terminal C that is applied via resistor 8 (*applies a frequency control bias*) to the anode (*a first end*) of variable capacitance diode 5 (*variable-capacitance element*). EX1003, 3:5-7, 3:18-21, 4:17-26, Fig. 4; Section III.A.4.b. This voltage is a *frequency control bias* because it is a voltage that adjusts the voltage formed across variable capacitance diode 5, biasing the capacitance of diode 5 which in turn controls output oscillation frequency. *Id.* And because resistor 8 is used to couple the circuit connected at terminal C to the oscillator, resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency (*frequency control bias circuit*) form a resistor feed-type bias circuit. *Id.*; EX1002, ¶164.

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[10] EX1013's page numbers at the top of each document page are cited to.

Kubo's disclosure of the claimed *frequency control bias circuit* being resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency corresponds to the '318 patent's description, which describes a *frequency control bias circuit* as a "resistance-feed-type bias circuit" that "applies a frequency control bias to one end of the variable-capacitance element 6." EX1001, 1:19-21, 1:33-35, 4:25-27, 5:42-43. The '318 patent does not otherwise explain the specific components that form the *frequency control bias circuit*, instead only noting that it is connected to terminal 8 in Figures 1, 3, and 6, that the circuit may be "a ¼ wavelength short stub type of bias circuit or the like," and that **"[t]he present invention, however, is independent of the kind of bias circuit**." *Id.*, 4:25-28, 5:42-47; EX1002, ¶165.

To the extent *frequency control bias circuit* is interpreted under §112(6), Kubo discloses or at least renders obvious the function of *appl[ying][] a frequency control bias to a first end of the variable-capacitance element* for the reasons discussed above, and the identified structure of a resistor feed-type bias circuit and equivalents thereof because it describes resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency is a resistor feed-type bias circuit as discussed above. Section II.F; EX1002, ¶166.

As shown in the above analysis, limitation [2c] is therefore known in the prior art to a POSITA. That limitation [2c], whether interpreted as a means-plus-function element or not, is generally known by a POSITA is further corroborated by the '318 patent's Applicant Admitted Prior Art (AAPA) statements. The '318 patent's AAPA explicitly identifies frequency control bias circuit 7 shown in Figures 1, 3, 4 and 6 (the identified means-plus-function structure for *frequency control bias circuit*) as "conventional art" and part of a "conventional voltage-controlled oscillator" that performs the identified function of *appl[ying][] a frequency control bias to a first end of the variable-capacitance* element. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6; Section II.F. A POSITA would have modified Kubo with a reasonable expectation of success such that it includes the AAPA structure ('318 patent's frequency control bias circuit 7) rather than Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency because the components are interchangeable: Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency is a known alternative to the '318 patent's frequency control bias circuit 7 because they perform the same functionality of *appl[ying][] a frequency control bias to a first end of the variable-capacitance element* as discussed above and are arranged in the same way within their respective systems. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6; EX1003, 3:5-7, 3:18-21, 4:19-21, Fig. 4; *supra*, Section III.A.4.c. Interchanging such elements (e.g., interchanging Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency with '318 patent's identified structure of frequency control bias circuit 7) and configuring the circuitry would have been routine and well-within the capabilities of a POSITA at least because (1) both elements apply a frequency control bias voltage to a first end of variable capacitance diode to adjust its capacitance (e.g., Kubo uses resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency to apply the voltage to a first end of variable capacitance diode 5, via terminal C, changing the diode's capacitance and adjusting oscillation frequency; the '318 patent uses frequency control bias circuit 7 to apply voltage to a first end of variable capacitance element, changing its capacitance and adjusting oscillation frequency), (2) both elements perform the same functionality (e.g., appl[ying][] a frequency control bias to a first end of the variable-capacitance element), and (3) there is overlap in the specific components each use (e.g., Kubo's structure includes resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency, which is a resistor feed-type circuit; the '318 patent uses frequency control bias circuit 7, which is shown as including a resistor in Figure 6 and described a being a resistor feed-type circuit). *Id.*; EX1002, 167. Also, for the same reasons, there are merely insubstantial differences between Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency and the '318 patent's frequency control bias circuit 7. Moreover, resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency are not excluded by any explicit definition in the '318 patent's specification for an equivalent to frequency control bias circuit 7. EX1001, 5:33-41, 6:44-48 (explaining "many modifications and variations of the present invention are possible"); EX1002, ¶167.

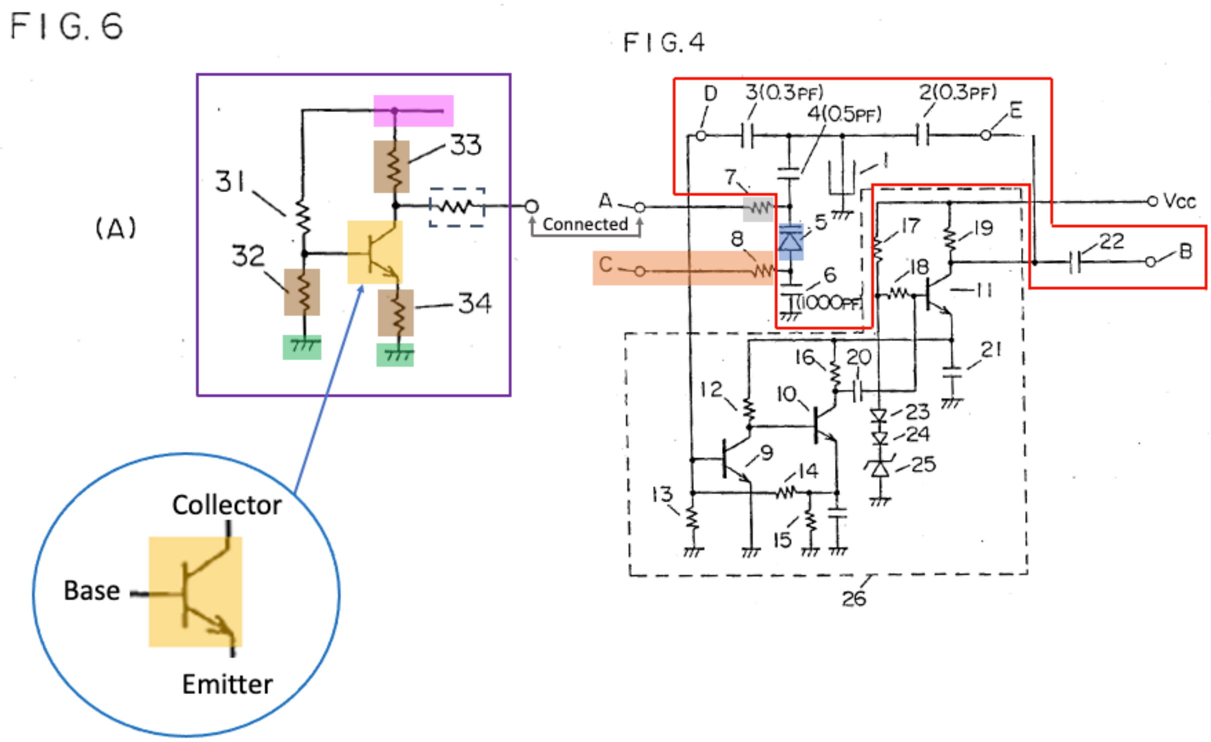
As modified, Kubo's system (and AAPA) would have performed the same function as when unmodified (e.g., applying a frequency control bias voltage to a first end of variable capacitance diode 5) and the results would have been predictable: applying a frequency control bias voltage to a first end of variable capacitance diode 5 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature. *Supra*, Section III.A.4.c.; EX1002, ¶168.

This establishes the following motivations to combine: simple substitution of one known element (AAPA's frequency control bias circuit 7) for another (Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency) to obtain predictable results (applying a frequency control bias voltage to a first end of variable capacitance diode 5 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature); combining prior art elements (AAPA's frequency control bias circuit 7 with Kubo's Figure 4 circuitry at terminal C, such that AAPA's frequency control bias circuit 7 is used to apply voltage to variable capacitance diode 5 via terminal C) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by Kubo at Fig. 4 and AAPA at Fig. 6) to yield predictable results (applying a frequency control bias voltage to a first end of variable capacitance diode 5 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature). EX1002, ¶169.

Any alleged differences between limitation [2c] and the prior art cannot confer patentability because the '318 patent admits this limitation is conventional, and a POSITA would have used this conventional technology in Kubo with a reasonable expectation of success using known techniques as discussed above. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6; EX1002, ¶170; *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337-39 (Fed. Cir. 2020); *see Memorandum on Treatment of Statements of the Applicant in the Challenged Patent in Inter Partes Reviews under § 311* (August 18, 2020) ("AAPA Memo"), pp. 5, 6, 9; EX1002, ¶170.

d. [2d] "a temperature compensation bias circuit which applies a temperature compensation bias to a second end of the variable-capacitance element; and"

Kubo discloses or at least renders obvious limitation [2d]. Kubo discloses its oscillation apparatus and circuit for generating temperature compensation voltage (*voltage-controlled oscillator*) includes a *temperature compensation bias circuit* in the form of resistor 7 connected to variable capacitance diode 5 and the circuit for generating temperature compensation voltage via terminal A. EX1003, 3:5-7, 3:18-21, Fig. 4; EX1002, ¶171.



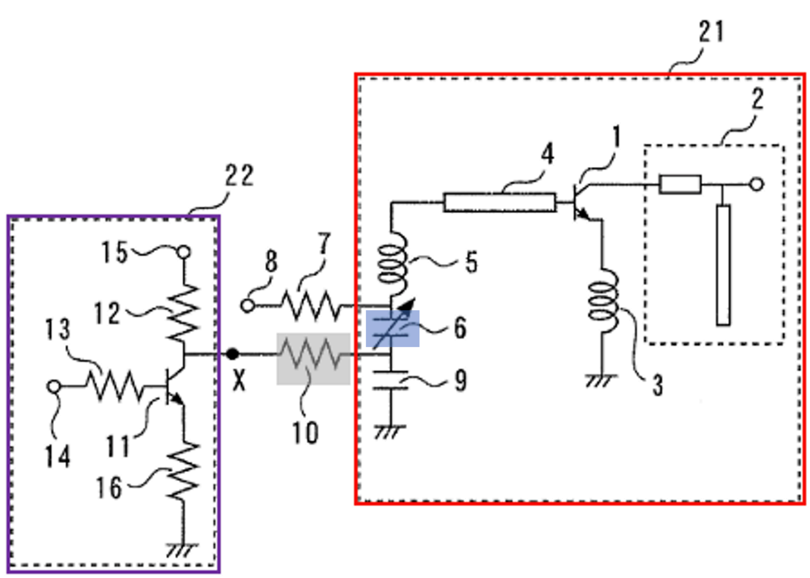
EX1003, Figs. 4, 6(A) (annotated)

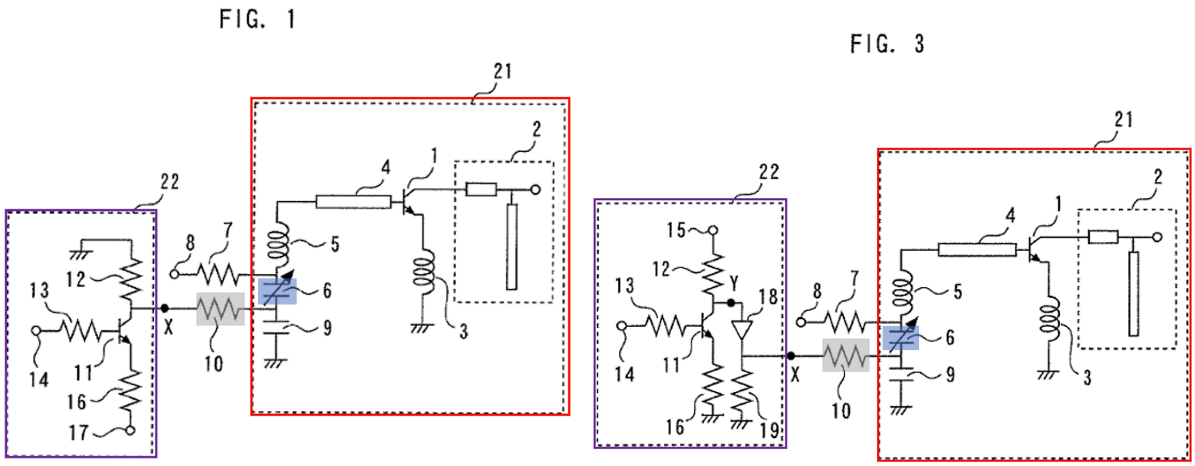
As resistor 7 is arranged (*temperature compensation bias circuit*), it applies a voltage received at terminal A (*applies a temperature compensation bias*) from the circuit for generating temperature compensation voltage to the cathode (*to a second end*) of variable capacitance diode 5 (*of the variable capacitance element*) to compensate temperature changes, where the voltage received at terminal A is a *temperature compensation bias* because it is a "temperature compensation voltage" that corresponds "to the temperature" and accounts for temperature changes, and biases the capacitance of diode 5 which in turn controls output oscillation frequency. EX1003, 4:7-26, 4:42-46, 3:5-7, 3:18-21, Fig. 4; Section III.A.4.b; EX1002, ¶172.

Kubo's disclosure of the claimed *temperature compensation bias circuit* being resistor 7 arranged as discussed above corresponds to the '318 patent's description, which describes a *temperature compensation bias circuit* as reference number 10, which is a resistor connecting temperature compensation bias generation circuit 22 at location X to one end of variable-capacitance element 6 as shown by Figures 1, 3, and 6. EX1001, 1:58-61, 4:3-26, Figs. 1, 3, 6; EX1002, ¶173.

FIG. 6

Conventional Art





EX1001, Figures 1, 3, and 6 (annotated)

To the extent *temperature compensation bias circuit* is interpreted under §112(6), Kubo discloses or at least renders obvious the function of *appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element* and the identified structure of a resistor connected to a second end of the variable-capacitance element and equivalents thereof for the reasons discussed above. Section II.F; EX1002, ¶174.

As shown in the above analysis, limitation [2d] is therefore known in the prior art to a POSITA. That limitation [2d], whether interpreted as a means-plus-function element or not, is generally known by a POSITA is further corroborated by the '318 patent's Applicant Admitted Prior Art (AAPA) statements. The '318 patent's AAPA explicitly identifies "temperature compensation bias circuit 10" shown in Figures 1, 3, 4 and 6 (the identified means-plus-function structure for *temperature compensation bias circuit*) as "conventional art" and part of a "conventional voltage-controlled oscillator" that performs the identified function of *appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element*. EX1001, 1:54-67, Fig. 6; Section II.F; EX1002, ¶175.

A POSITA would have modified Kubo with a reasonable expectation of success such that it includes the AAPA structure ('318 patent's temperature compensation bias circuit 10) rather than Kubo's arranged resistor 7 because the components are interchangeable: Kubo's arranged resistor 7 is a known alternative to the '318 patent's temperature compensation bias circuit 10 because they perform the same functionality of *appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element* as discussed above and are arranged in the same way in their respective systems. EX1001, 1:54-67, Fig. 6; EX1003, 4:7-26, 4:42-46, 3:5-7, 3:18-21, Fig. 4; *Supra*, Section III.A.4.d. Interchanging such elements (e.g., interchanging Kubo's arranged resistor 7 with '318 patent's identified structure of temperature compensation bias circuit 10) and configuring the circuitry would have been routine and well-within the capabilities of a POSITA at least because (1) both elements apply a temperature compensation bias to a second end of the variable-capacitance element (e.g., Kubo uses arranged resistor 7 to apply the voltage to a second end of variable capacitance diode 5, via terminal A, changing the diode's capacitance and adjusting oscillation frequency; the '318 patent uses temperature compensation bias circuit 10 to apply voltage to a second end of variable capacitance element, changing its capacitance and adjusting oscillation frequency), (2) both elements perform the same functionality (e.g., appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element), and (3) there is overlap in the specific components each use (e.g., Kubo's structure includes arranged resistor 7; the '318 patent uses temperature compensation bias circuit 10, which is shown as an arranged resistor in Figure 6). *Id.*; EX1002, 176. Also, for the same reasons, there are merely insubstantial differences between Kubo's arranged resistor 7 and the '318 patent's temperature compensation bias circuit 10. Moreover, Kubo's arranged resistor 7 is not excluded by any explicit definition in the '318 patent's specification for an equivalent to temperature compensation bias circuit 10. EX1001, 5:33-41, 6:44-48 (explaining "many modifications and variations of the present invention are possible"); EX1002, ¶176.

As modified, Kubo's system (and AAPA) would have performed the same function as when unmodified (e.g., appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element) and the results would have been predictable: appl[ying][] a temperature compensation bias voltage to a second end of the variable capacitance diode 5 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature. *Supra*, Section III.A.4.d.; EX1002, ¶177.

This establishes the following motivations to combine: simple substitution of one known element (AAPA's temperature compensation bias circuit 10) for another (Kubo's arranged resistor 7) to obtain predictable results (appl[ying][] a temperature compensation bias voltage to a second end of the variable capacitance diode 5 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature); combining prior art elements (AAPA's temperature compensation bias circuit 10 with Kubo's Figure 4 circuitry at terminal A, such that AAPA's temperature compensation bias circuit 10 is used to apply voltage to variable capacitance diode 5) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by Kubo at Fig. 4 and AAPA at Fig. 6) to yield predictable results (appl[ying][] a temperature compensation bias voltage to a second end of the variable capacitance diode 5 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature). EX1002, ¶178.

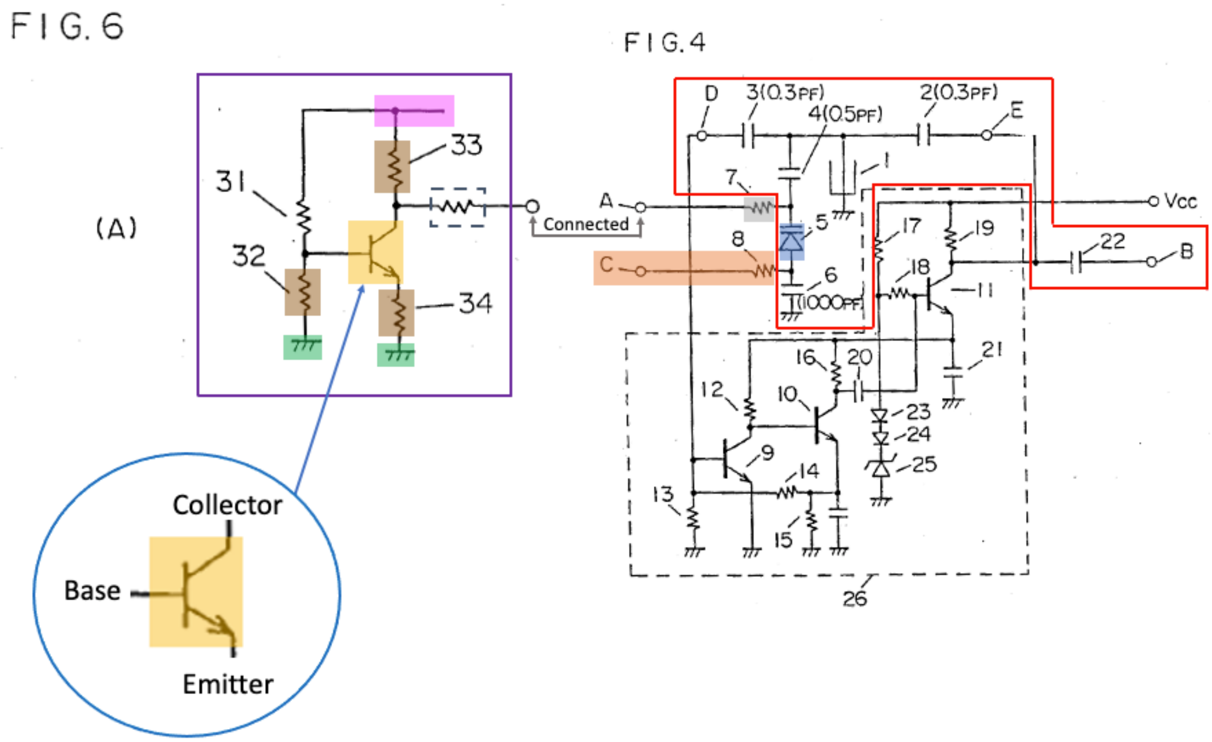
Any alleged differences between limitation [2d] and the prior art cannot confer patentability because the '318 patent admits this limitation is conventional, and a POSITA would have used this conventional technology in Kubo with a reasonable expectation of success using known techniques as discussed above. EX1001, 1:54-67, Figs. 1, 3, 4, 6; EX1002, ¶179; *Koninklijke Philips N.V. v. Google*

LLC, 948 F.3d 1330, 1337-39 (Fed. Cir. 2020); *see Memorandum on Treatment of Statements of the Applicant in the Challenged Patent in Inter Partes Reviews under § 311* (August 18, 2020) ("AAPA Memo"), pp. 5, 6, 9.

e. [2e] "a temperature compensation bias generation circuit which generates the temperature compensation bias and supplies the temperature compensation bias generated to the temperature compensation bias circuit,"

Kubo discloses or at least render obvious limitation [2e]. Limitations [2f]-[2m] recite the components that form the *temperature compensation bias generation circuit*. These components are addressed in the analysis for each of these limitations. EX1002, ¶180.

Kubo discloses that its oscillation apparatus and circuit for generating temperature compensation voltage collectively form the claimed *voltage-controlled oscillator* (*see* Section III.A.4.a), and further discloses or at least renders obvious a *temperature compensation bias generation circuit* in the form of the circuit for generating temperature compensation voltage. EX1003, 4:14-25, 4:42-46, Figs. 4, 6(A); EX1002, ¶181.



EX1003, Figs. 4, 6(A) (annotated)

Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) generates the compensating voltage that accounts for temperature changes (*generates the temperature compensation bias*) and supplies this generated voltage (*supplies the temperature compensation bias generated*) to resistor 7 (*temperature compensation bias circuit*) via terminal A of the Figure 4 oscillation apparatus. EX1003, 4:17-26, 4:42-46; Section III.A.4.d; EX1002, ¶182.

To the extent temperature compensation bias generation circuit is interpreted under §112(6), Kubo discloses or at least renders obvious the function of generat[ing][] the temperature compensation bias and suppl[ying][] the temperature compensation bias generated to the temperature compensation bias circuit for the reasons discussed above. See Section II.F; EX1002, ¶183.

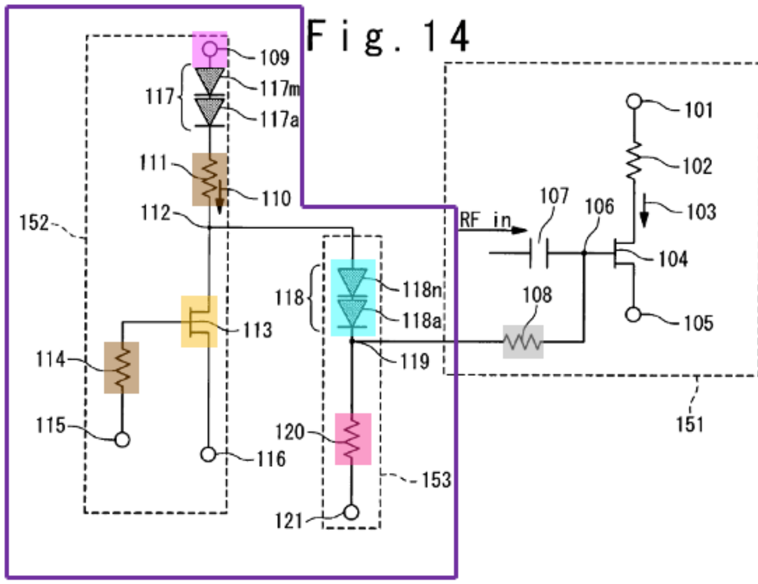
And as discussed in the analysis of limitations [2f]-[2m] below, Kubo, Kokubo, and Shapiro disclose or at least render obvious the identified corresponding structure for *temperature compensation bias generation circuit* of the '318 patent's temperature compensation bias generation circuit 22 in Figure 3, or at least an equivalent thereof, that performs the identified function. *See* Section III.A.4.f-m; Section II.F; EX1002, ¶184.

f. [2f] "the temperature compensation bias generation circuit having: a diode having a cathode connected to the temperature compensation bias application[11] circuit;"

Kokubo describes a bias circuit having temperature compensation circuit 153 that includes diodes 118 connected between node 112 and a node where voltage 119

[11] Limitation [2f] recites ***the*** *temperature compensation bias* ***application*** *circuit* but this exact term is not previously recited in claim 2. But a POSITA would have understood that ***the*** *temperature compensation bias* ***application*** *circuit* refers to the *temperature compensation bias circuit* of limitation [2d] because this circuit

is formed, and a resistor 120 connected in series with diodes 118 to node 121. EX1004, 6:60-62, 7:15-21, 10:22-48, Fig. 14; EX1002, ¶186.



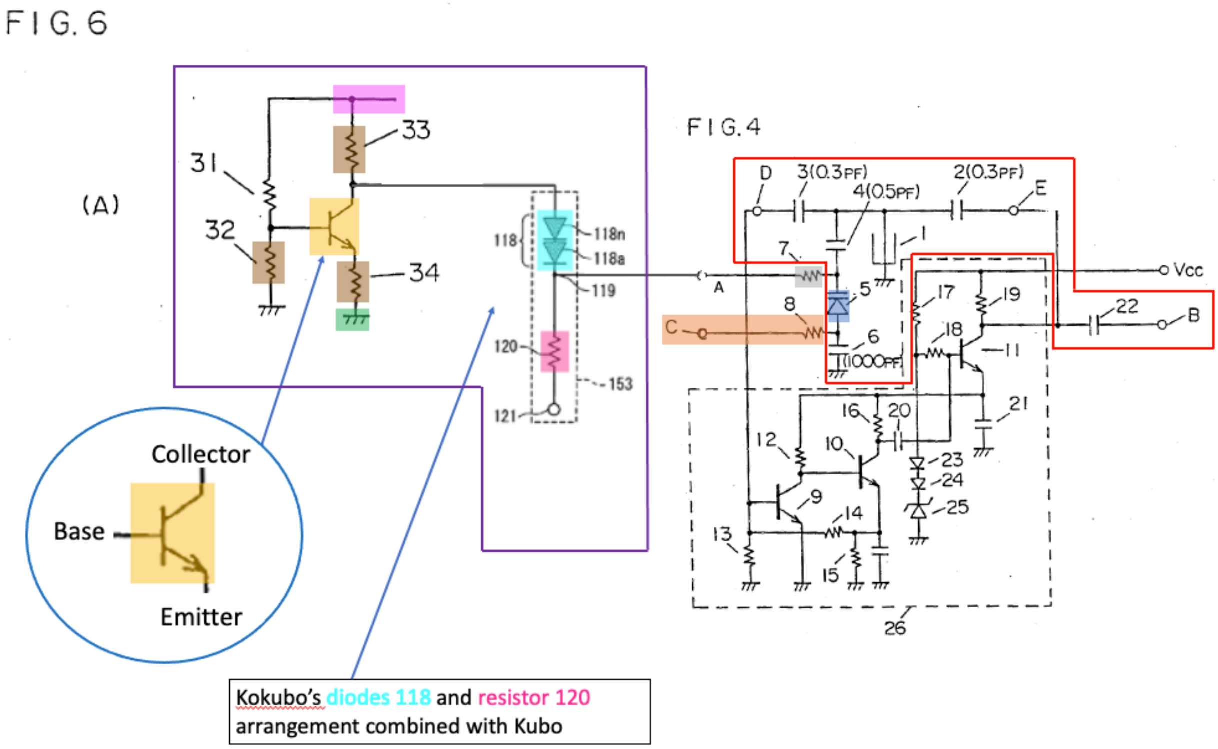
EX1004, Fig 14 (annotated)

Diodes 118 introduce a "voltage drop from the set voltage at the node 12" to form a voltage at node 119, where the voltage drop increases with the decrease of temperature. *Id.*, 7:66-8:12, 10:22-48. When temperature increases or decreases, diodes 118 and resistor 120 configure the voltage at node 119, which in turn configures the voltage at node 106 (since voltage at these nodes are the same),

applies a *temperature compensation bias*. EX1001, 5:55-6:11, Fig. 3; EX1002, ¶185.

compensating voltage changes caused by temperature changes. *Id.*, 7:66-8:19, 8:49-51, 10:9-48, Fig. 14; EX1002, ¶187.

A POSITA would have combined Kubo and Kokubo such that Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) includes Kokubo's temperature compensation circuit 153 having diodes 118 and resistor 120 arranged just as they are in Kokubo's bias circuit, attaching diodes 118 between Kubo's transistor and resistor 7 and resistor 120 between diodes 118 to node 121. EX1003, 3:5-7, 3:18-21, 4:14-25 and 4:42-46, Figs. 4, 6(A); EX1004, 7:15-18, 7:32-46, 7:66-8:51, 10:13-48, Fig. 14; *See* III.A.4.e EX1002, ¶188. A combined figure showing the combination is below.



EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (item 153 of Fig. 14) combined (annotated)

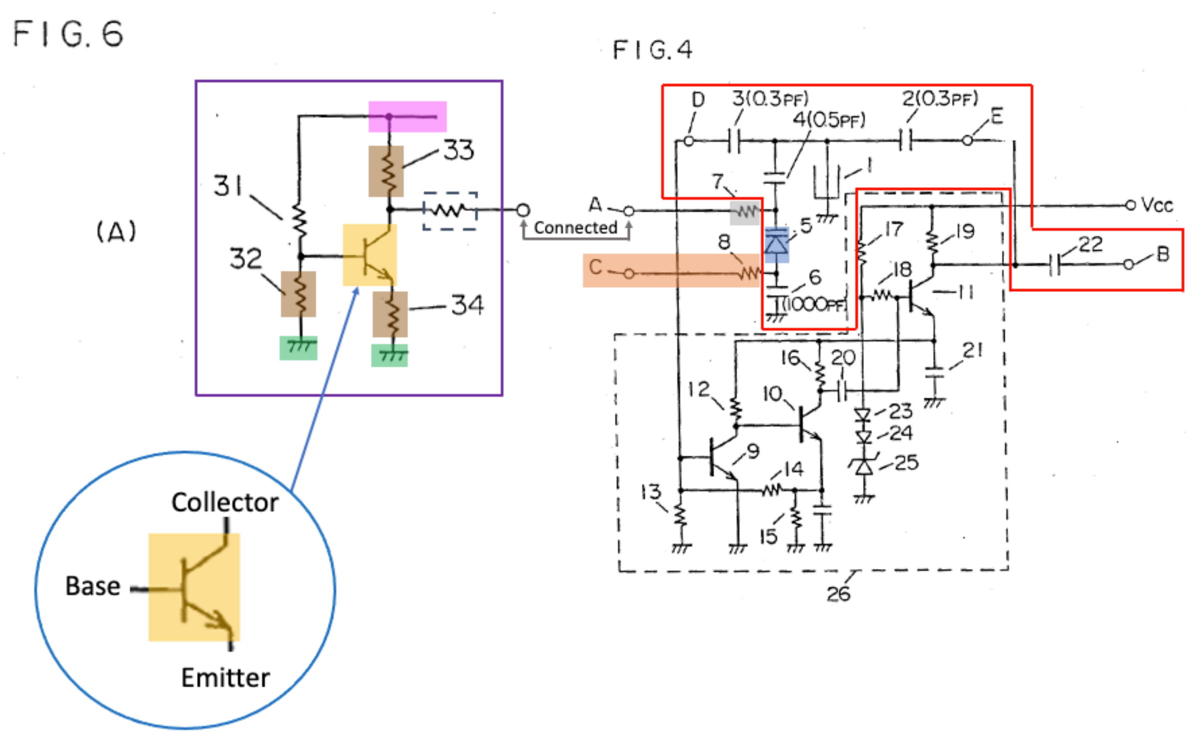
Additionally, Kokubo states that diodes 118 are formed by "n (n is a positive integer) diodes 118 (118a to 118n)." EX1004, 7:15-17, 10:22-48, Fig. 14 (parentheticals in original). Thus, a POSITA would have understood that one diode 118 would have been present in the bias circuit when n is equal to one, a positive integer. *Id.*; EX1009, p. 379 (defining "integer" as "[t]he set of numbers including zero, and all positive and negative whole numbers."). In such a case, the combined Kubo-Kokubo system would have resulted in Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) including Kokubo's single diode 118 (*a diode*) *having a cathode connected* *to* resistor 7 (*the temperature compensation bias application circuit*). *Id.*; EX1002, ¶¶189-190.

To the extent it is argued that the Kubo-Kokubo combined system requires multiple diodes 118, the Kubo-Kokubo combined system still discloses limitation [2f] or at least renders it obvious. This view of the combination still results in Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) including Kokubo's diodes 118a-n with diode 118a having its cathode connected to resistor 7 which is part of Kubo's oscillation apparatus (*a diode having a cathode connected to the temperature compensation bias application circuit*). EX1003, 3:5-7, 3:18-21, 4:14-25 and 4:42-46, Figs. 4, 6(A); EX1004, 7:15-18, 7:32-46, 7:66-8:51, 10:13-48, Fig. 14; EX1002, ¶191.

<u>Motivations to Combine Kubo and Kokubo with a Reasonable Expectation of Success</u>

A POSITA would have been motivated to combine Kubo and Kokubo with a reasonable expectation of success such that Kokubo's temperature compensation circuit 153 having diodes 118 and resistor 120 is used to connect the Kubo's transistor collector to terminal A. EX1002, ¶192.

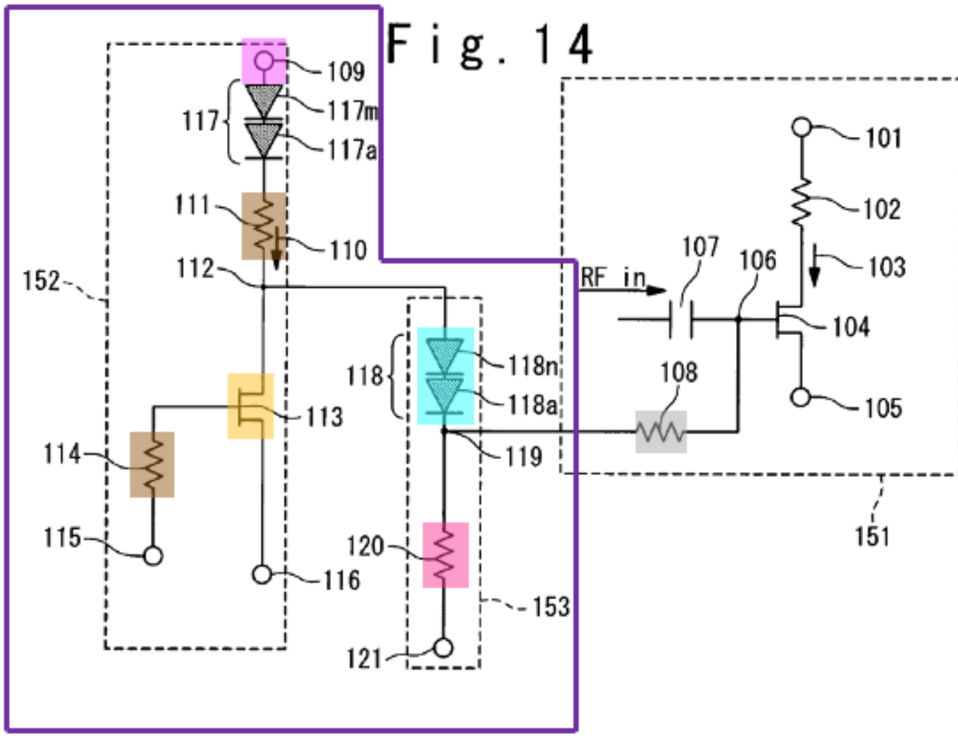
Kubo discloses a circuit for generating temperature compensation voltage having a transistor, where a voltage is formed at the transistor's collector that varies with temperature. EX1003, 4:7-25, Figs. 4, 6(A). This collector voltage is applied to the Kubo's terminal A via a resistor attached to the collector, shown within broken lines in the figure below. *Id.*; EX1002, ¶193.



EX1003, Figs. 4, 6(A) (annotated)

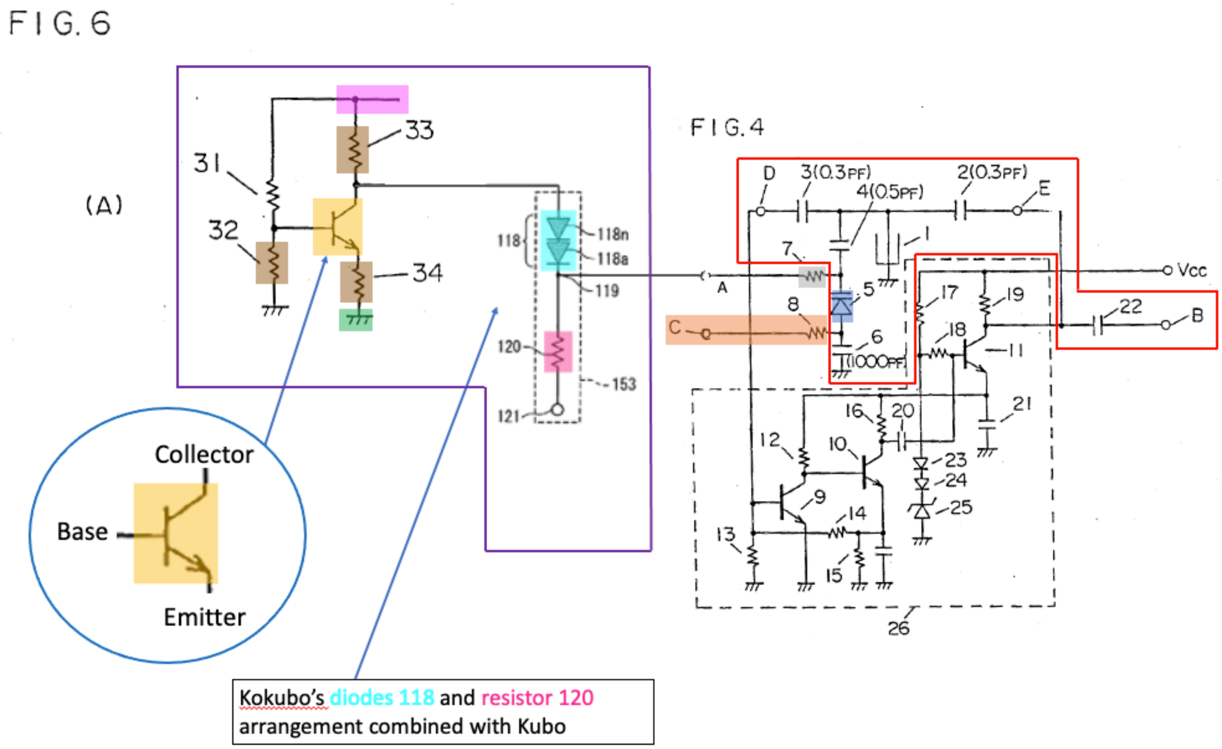
A voltage is thereafter formed across variable-capacitance diode 5, adjusting the capacitance of this diode, which provides compensation of oscillation frequency variations caused by temperature. *Id.*; EX1002, ¶194.

Kokubo teaches another technique for connecting a bias circuit that provides "temperature compensation" to other circuitry. EX1004, 1:9-11, 6:60-62, 10:9-48, Fig. 14. Kokubo discloses a transistor bias circuit having an almost identical arrangement to Kubo's circuit for generating temperature compensation voltage including a transistor, but where temperature compensation circuit 153 having diodes 118 and resistor 120 is connected to node 112 (the equivelent location to Kubo's transistor collector) rather than the resistor within broken lines as shown in Kubo's Figure 6(A) above. *Id.*, 7:15-18, 7:32-46, 7:66-8:51, 10:9-48, Fig. 14. Kokubo describes diodes 118 and resistor 120 allow for configuring the voltage present at node 119 (formed from the voltage at node 112) that will be delivered to gate bias node 106 of transistor 104, biasing the transistor. *Id.*, 8:8-19, 10:9-12, 10:22-48, Fig. 14. In particular, the voltage present at node 112 is delivered to node 119 via diodes 118 and an equivalent voltage is formed at 106, biasing transistor 104. *Id.* Whether temperature is increased or decreased, a voltage drop is introduced by diodes 118 such that the voltage at node 119 is reduced from that at node 112, configuring the voltage. *Id.* 8:8-19, 10:9-48, Fig. 14. Resistor 120 is also used to configure the voltage at node 119 by providing a voltage drop across it to the voltage at terminal 121 and current flow to node 119. *Id.*, 7:15-18, 10:9-48, Fig. 14. Without resistor 120 present to form current flow to terminal 121 via diodes 118, no voltage would be present at node 119. EX1002, ¶195.



EX1004, Fig 14 (annotated)

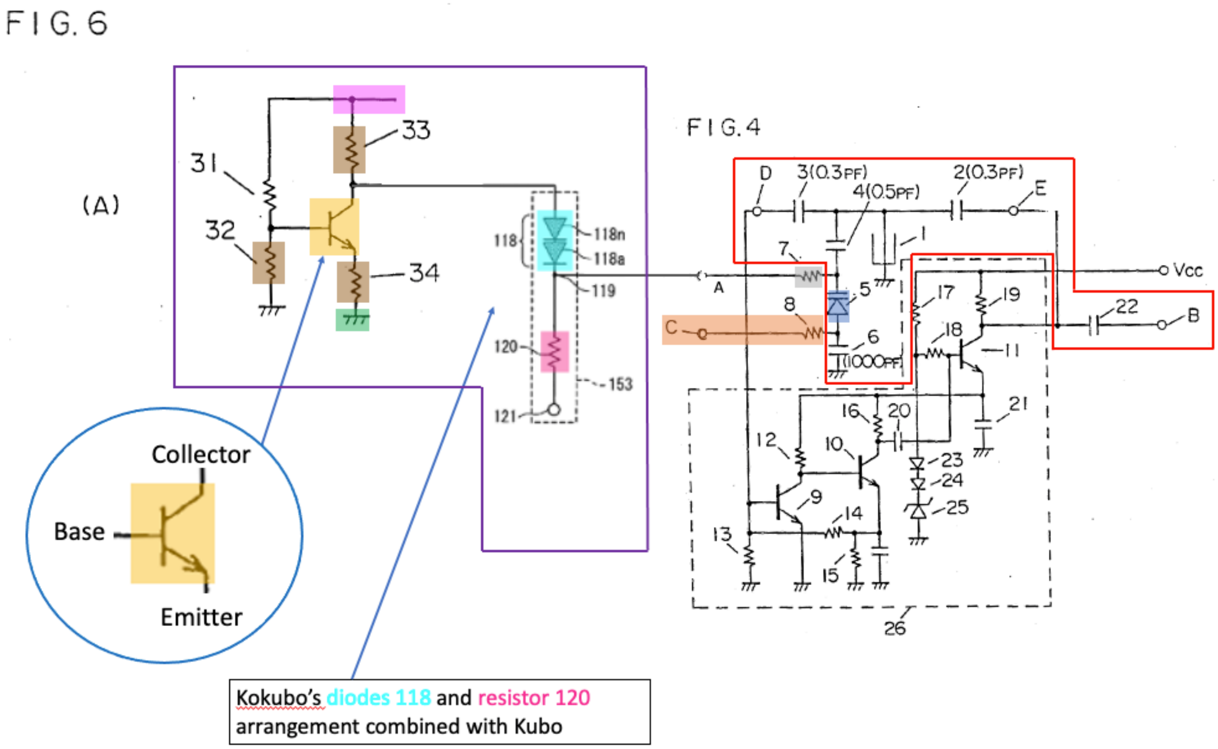
A POSITA would have therefore been motivated to use Kokubo's temperature compensation circuit 153 having diodes 118 and resistor 120 to deliver Kubo's transistor collector voltage to terminal A due to the resulting ability to control and configure voltage that would be applied to terminal A in the combination. EX1004, 7:66-8:51, 10:9-48, Fig. 14; EX1003, 4:7-26, Figs. 4, 6(A). The circuit of the combination is shown below. EX1002, ¶196.



EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined

(annotated)

Using Kokubo's temperature compensation circuit 153 having diodes 118 and resistor 120 to deliver Kubo's transistor collector to terminal A would have only required routine circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by Kubo in Figures 6(A) and 4 and Kokubo in Figure 14. EX1003, Figs. 4, 6(A); EX1004, Fig. 14. Such techniques were well within the capabilities of a POSITA. Moreover, there would have been a reasonable expectation of success because in combination, Kokubo's arrangement of diodes 118 and resistor 120 would have been situated in Kubo's system between Kubo's transistor collector and terminal A just like it already is in Kokubo's similar circuit. EX1003, Figs. 4, 6(A); EX1004, Fig. 14. In the combination, the resistor (annotated within broken lines in Kubo's Figure 4 shown previously) connected to the collector of Kubo's transistor would have been replaced with Kokubo's temperature compensation circuit 153 having diodes 118 and resistor 120, where diodes 118 are connected between a transistor collector (which is the positionally equivalent BJT location as Kokubo's FET transistor drain) and resistor 7 (which corresponds to Kokubo's resistor 108) at node 119, and resistor 120 is connected between the node 119 and a terminal where voltage 121 is present. EX1004, 7:66-8:19, 8:49-51, 10:9-48, Fig. 14. As noted above, this arrangement is exactly how diodes 118 and resistor 120 are already arranged in Kokubo. *Id.*; EX1002, ¶197

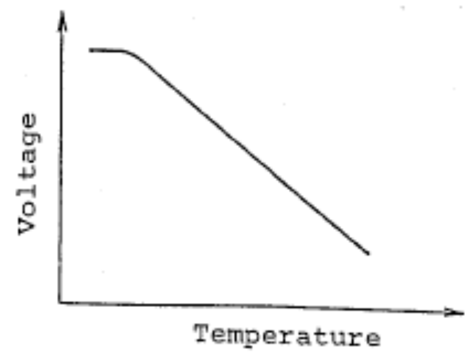


EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined

(annotated)

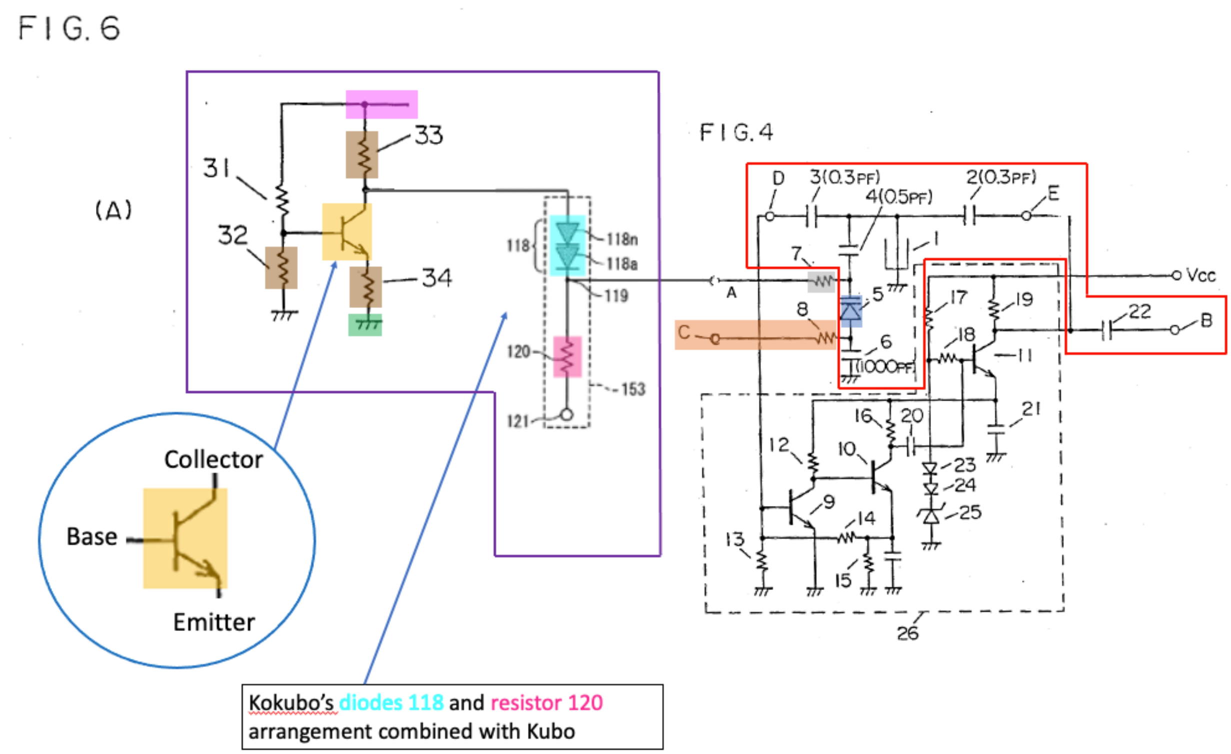
A POSITA would have further understood that the results of the combination would have been predictable; namely, that Kokubo's diodes 118 and resistor 120 would have been arranged in Kubo's system as discussed, and that a collector voltage at Kubo's transistor would have been delivered to terminal A. Indeed, prior to combining, Kubo's base to emitter voltage (V_{BE}) of its transistor decreases as temperature increases, causing output voltage taken at the collector of the transistor to decrease as shown below in Figure (6B). EX1003, 4:7-13. The transistor's collector voltage is output to terminal A of Kubo's figure 4 oscillator via the terminal resistor (within broken lines in previously shown Figures), and applied to variable-capacitance diode 5 to provide compensation of oscillation frequency variations caused by temperature. *Id.*, 4:7-25, Figs. 4, 6; EX1002, ¶198.

(B)



EX1003, Figure 6(B)

Using Kokubo's temperature compensation circuit 153 having diodes 118 and resistor 120 to connect Kubo's transistor collector to terminal A would have achieved the same functionality and, just as when uncombined, resulted in a voltage output to terminal A of Kubo's Figure 4 oscillator and applied to variable-capacitance diode 5 to provide compensation of oscillation frequency variations caused by temperature. *Id.*; EX1002, ¶199.



EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined (annotated)

This is because the transistor's collector voltage would have simply been output to terminal A via diodes 118, where the diodes 118 and resistor 120 would have allowed for the voltage delivered to terminal A to be configured as disclosed by Kokubo using the voltage value present at node 121, providing the benefit of additional control of voltage delivered to the variable capacitance diode 5 EX1004, 7:66-8:19, 8:49-51, 10:9-48, Fig. 14; EX1002, ¶200.

While Kubo's circuitry uses a bipolar junction transistor (BJT) and Kokubo's circuitry uses a MOSFET transistor 113, this difference is of no consequence to the combination because in the combination diodes 118 and resistor 120 would have operated in the same fashion regardless of the transistor type. In the combination, Kokubo's diodes 118 and resistor 120 are connected to the collector of Kubo's transistor, which is the equivalent BJT location compared to where they are connected in Kokubo (to the drain of Kokubo's transistor). Section III.A.4.f, *supra*; EX1004, Fig. 14; EX1002, ¶201.

The above analysis demonstrates that there are multiple motivations for combining Kubo and Kokubo:

- Combining prior art elements (Kubo's circuit for generating temperature compensation voltage having a transistor and Kokubo's temperature compensation circuit 153 having diodes 118 and resistor 120) according to known methods (known circuit design and implementation techniques where circuit sections and parts are coupled using common components such as terminals or leads, shown, for example, by Kubo's Figures 4 and 6(A) and Kokubo's Figure 14) to yield predictable results (delivering the collector voltage of Kubo's transistor to terminal A using Kokubo's diodes 118 connected between the transistor collector and resistor 7 at node 119 and resistor 120 connected between node 119 and a terminal where voltage 121 is present). EX1002, ¶202.
- Simple substitution of one known element (Kokubo's temperature compensation circuit 153 having diodes 118 and resistor 120) for another (the

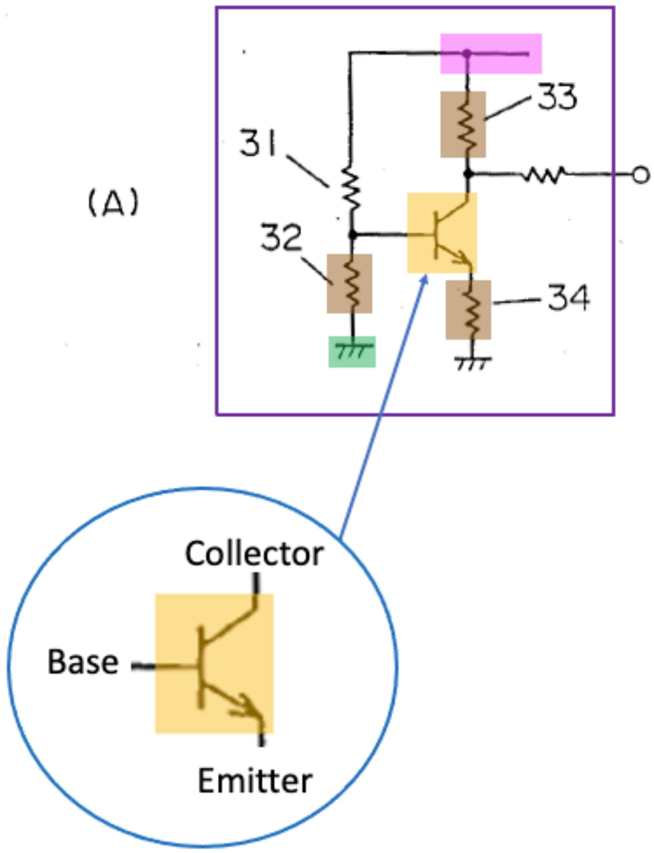
terminal resistor (shown within broken lines in Figures shown above) connected to the collector of Kubo's transistor) to obtain predictable results (delivering the collector voltage of Kubo's transistor to terminal A using Kokubo's diodes 118 connected between the transistor collector and resistor 7 at node 119 and resistor 120 connected between node 119 and a terminal where voltage 121 is present). EX1002, ¶202.

g. [2g] "[the temperature compensation bias generation circuit having:] a transistor having a collector or drain connected to the anode of the diode, a base or a gate, and an emitter or a source;"

Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) has a *transistor* having a *collector*, a *base*, and an *emitter*, as shown in annotated Figure 6(A) below. EX1003, 4:7-26, 4:42-46, Figs. 4, 6(A); EX1002, ¶203.

FIG. 6

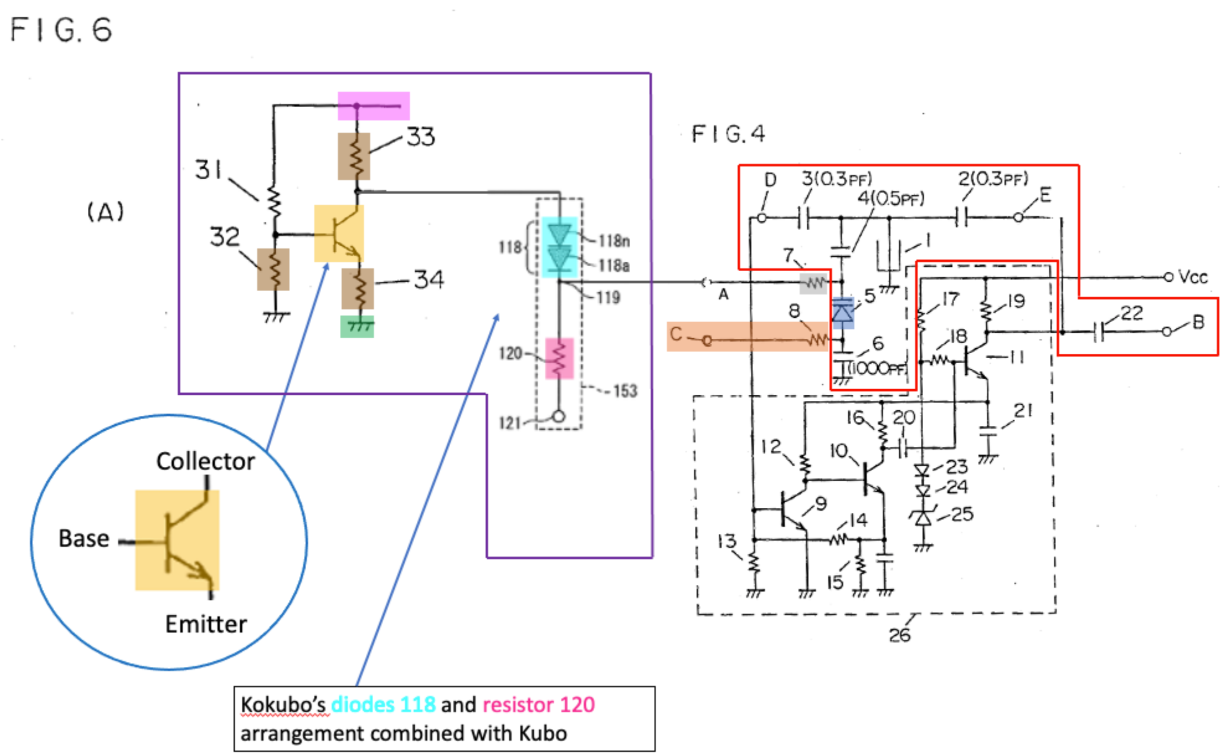
(A)



EX1003, Fig. 6(A) (annotated)

Kubo does not explicitly disclose that its *transistor* has a *collector or drain connected to the anode of the diode*. However, the combination of Kubo and Kokubo discloses or at least renders obvious this recitation. Combined, Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) would have included Kokubo's diodes 118 as discussed for limitation [2f] and a POSITA would have understood that a single diode 118 would have been present in the bias circuit. *See* Section III.A.4.f. Thus, in the combined

Kubo-Kokubo system, the *collector* of Kubo's *transistor* is connected to the anode of the single diode 118 (*connected to the anode of the diode*). EX1003, 3:5-7, 3:18-21, 4:7-26, Figs. 4, 6(A); EX1004, 7:15-18, 7:32-46, 7:66-8:8, 10:9-48, Fig. 14. A POSITA would have been motivated to combine Kubo and Kokubo in this manner with a reasonable expectation of success as discussed for limitation [2f]. EX1002, ¶204.



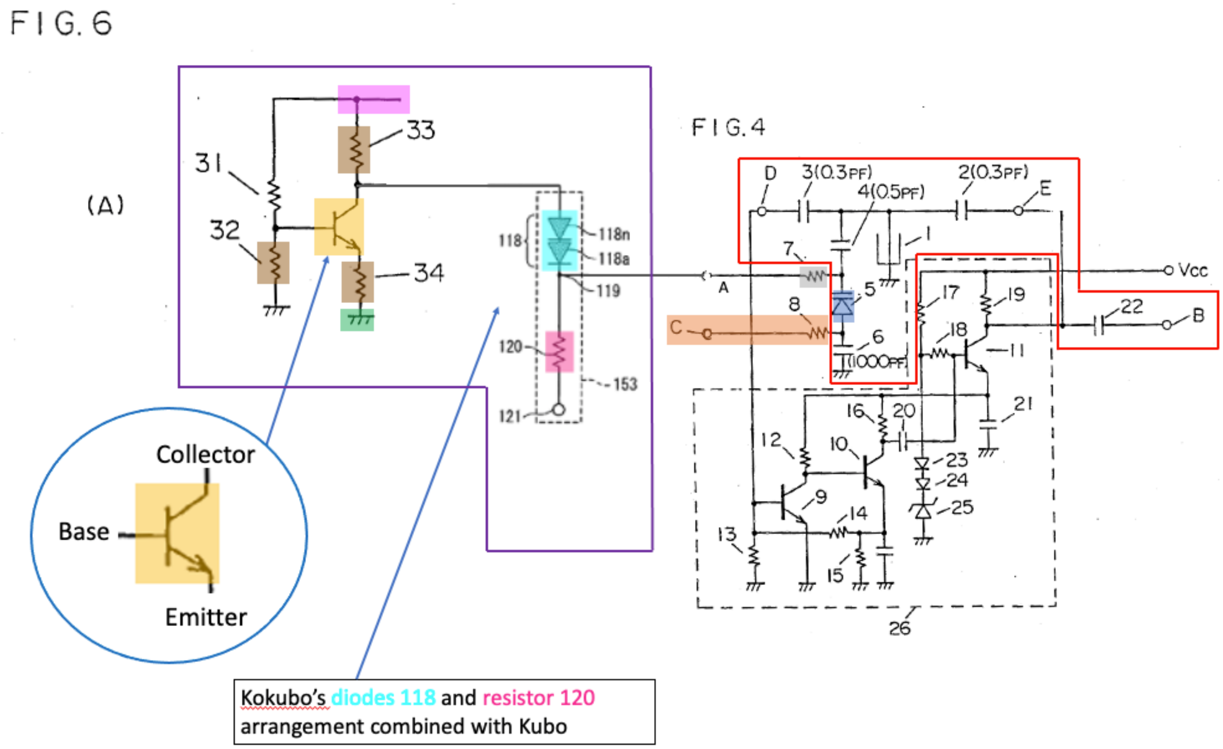
EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined

(annotated)

To the extent it is argued that the Kubo-Kokubo combined system requires multiple diodes 118 and therefore does not have a single *diode* having an *anode* directly connected to a transistor's *collector or drain* and a *cathode* directly connected *to the temperature compensation bias application circuit*, these limitations would still have been obvious. This view of the combination still results in Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) having Kokubo's diodes 118a-n including diode 118a (*a diode*), as discussed for limitation [2f]. Section III.A.4.f. Here, the *collector* of Kubo's *transistor* is connected to the anode of diode 118a (*connected to the anode of the diode*) via diode 118n. EX1003, 3:5-7, 3:18-21, 4:7-26, Figs. 4, 6(A); EX1004, 7:15-18, 7:32-46, 7:66-8:8, 10:9-48, Fig. 14; EX1002, ¶205.

In addition, to the extent Kokubo is found to only describe multiple diodes 118 (such as two diodes in series when n=2 number of diodes 118 are present), the single *diode* recited in limitations [2f] and [2g] is obvious in view of the Kubo-Kokubo combined system because the claimed single *diode* abuts the range of the multiple diodes 118 connected in series disclosed by the Kubo-Kokubo combined system, there is no meaningful distinction between using the claimed single *diode* or multiple diodes, and this difference in diode amount is minor (i.e. merely a single diode versus two of Kokubo's diodes 118 when n=2). *See In re Brandt*, 886 F.3d

1171, 1176-78 (Fed. Cir. 2018) (explaining obviousness exists when a claimed range and prior art range abut one another and there is no meaningful distinction between the two); *Iron Grip Barbell Co., Inc. v. USA Sports, Inc.*, 392 F.3d 1317, 1321-1323 (Fed. Cir. 2004) ("'[W]hen the difference between the claimed invention and the prior art is the range or value of a particular variable," then the patent should not issue if "the difference in range or value is minor") (citing *Haynes Int'l v. Jessop Steel Co.*, 8 F.3d 1573, 1577 n.3 (Fed.Cir.1993); EX1004, 7:15-18, 7:32-46, 7:66-8:8, 10:9-48, Fig. 14. Even when Kokubo is interpreted to only disclose multiple diodes in series (such as two), just like the *diode* of limitations [2f] and [2g], one of the multiple diodes 118 (e.g., diode 118n) has an *anode* directly connected to a transistor's *collector or drain* and another of the multiple diodes 118 (e.g., diode 118a) has a *cathode* directly connected to resistor 7 as arranged in Kubo's oscillation apparatus (*to the temperature compensation bias application circuit*) as shown in the combined figure below. *Id.*; *See* Section III.A.4.f; EX1002, ¶206.



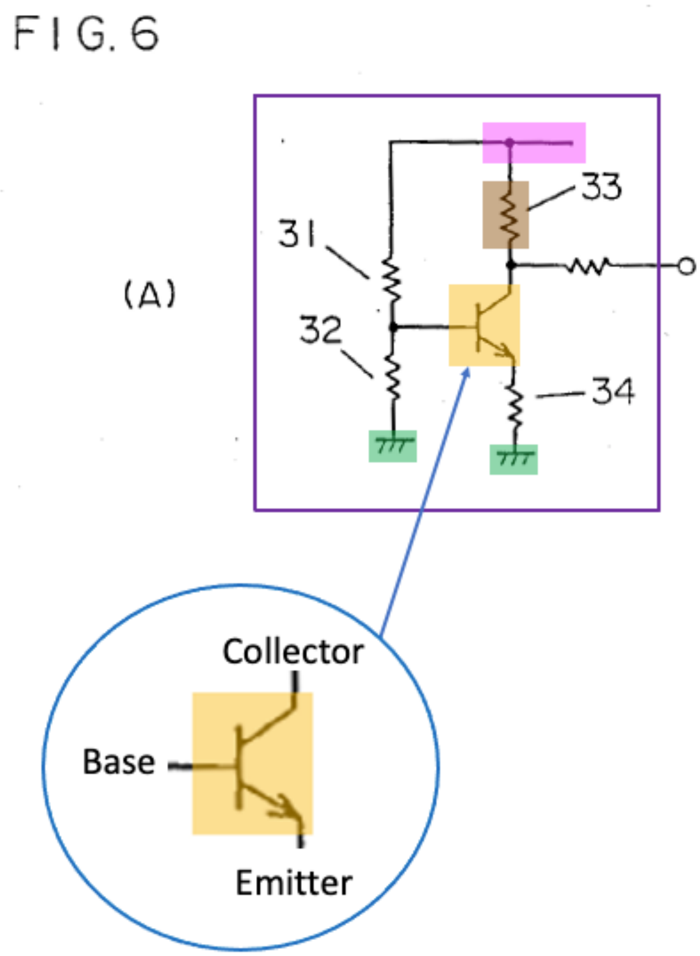
EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14)

combined (annotated)

Moreover, Kokubo does not teach away from using only a single diode—to the contrary, Kokubo teaches using a single diode 118 because it states "n (n is a positive integer) diodes 118 (118a to 118n)" are present, meaning that if n equals one, which is a positive integer, only one diode 118 would be included. EX1004, 7:15-16, 10:44-48, Fig. 14 (parentheticals in original). There is no meaningful distinction, criticality, or new or unexpected results from using only a single diode versus multiple diodes in series because in either case the diode(s) would simply provide a voltage drop between the nodes they are connected to and current flow from anode to cathode. *Id.*; EX1010, p. 139; EX1013, pp. 13-14, 23; *In re Woodruff*, 919 F.2d 1575, 1578 (explaining "when the difference between the claimed invention and the prior art is some range or other variable within the claims," there must be a showing that the range or variable is critical). And the '318 patent does not state that there is a meaningful distinction, criticality, or new or unexpected results from using only a single diode versus multiple diodes because the '318 patent simply states that "a diode" is used to "reduce[] the voltage by a value corresponding to its on voltage," which is well-known diode functionality as described by Kokubo. *Id.*; EX1001, 6:23-24, Fig. 3; EX1004, 7:66-8:19, 10:9-48 (describing diodes 118 as providing a "voltage drop"), Fig. 14; EX1002, ¶207.

h. [2h] "[the temperature compensation bias generation circuit having:] a first resistor having a first end connected to the collector or drain of the transistor;"

Kubo discloses that its circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) has a resistor 33 (*a first resistor*) having a first end connected to the collector of Kubo's transistor (*having a first end connected to the collector or drain of the transistor*) as shown in annotated Figure 6(A) of Kubo below. EX1003, 4:14-25, 4:42-46, Figs. 4, 6(A); EX1002, ¶208.

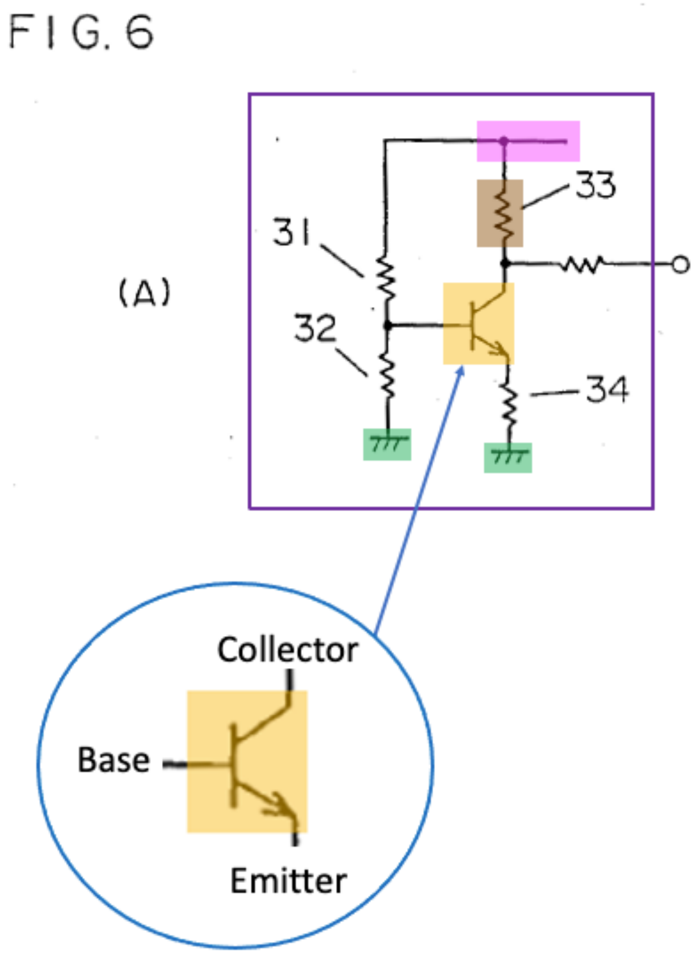


EX1003, Fig. 6(A) (annotated)

i. **[2i] "[the temperature compensation bias generation circuit having:] a collector or drain bias application terminal connected to a second end of the first resistor;"**

Kubo alone or combined with Kokubo discloses or at least renders obvious limitation [2i]. EX1002, ¶209.

Regarding Kubo alone, Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) includes voltage terminal (*a collector bias application terminal*) that applies a voltage to the collector of the *transistor*, as shown below in annotated Figure 6(A), and is connected to a second end (*connected to a second end*) of resistor 33 (*the first resistor*). EX1003, 4:7-26, 4:42-46, Figs. 4, 6(A); Section III.A.4.h; EX1002, ¶210.



EX1003, Fig. 6(A) (annotated)

A POSITA would have understood that a voltage is applied at the voltage terminal and thereby applied to the collector of Kubo's *transistor* (*a collector bias application terminal*) via resistor 33, making it an *application terminal* that *biases* the *collector* of Kubo's *transistor*. This is because Kubo states the collector has an "output voltage" formed at it. EX1003, 4:10-27. The collector is biased to that output voltage using a voltage applied at the voltage terminal (*a collector bias application terminal*). *Id.* Moreover, to form a voltage at the *transistor's* collector, a voltage would have had to have been applied to the voltage terminal. *Id.* Otherwise, the Figure 6(A) circuit would not have been operational because the *transistor* would not have had a base to emitter voltage or any current flow from collector to emitter. EX1003, 4:7-10. Moreover, Kokubo corroborates this POSITA understanding because it describes a bias circuit in Figures 10 and 14 having a transistor and voltage terminal connected to a second end of a resistor 111—arranged just like that of Kubo—and explicitly explains the voltage terminal provides a "voltage 109 [that] is applied to the drain of the transistor," where application of the voltage at the drain is positionally equivalent to application of voltage at the collector of Kubo's transistor. EX1004, 7:27-29, 7:57-62, 10:36-48, Figs. 10, 14; EX1002, ¶211.

Further, regarding this POSITA understanding, Kubo's Fig. 6(A) circuit is also shown by EX1010 at Figure 24.27, reproduced below. EX1002, ¶212.

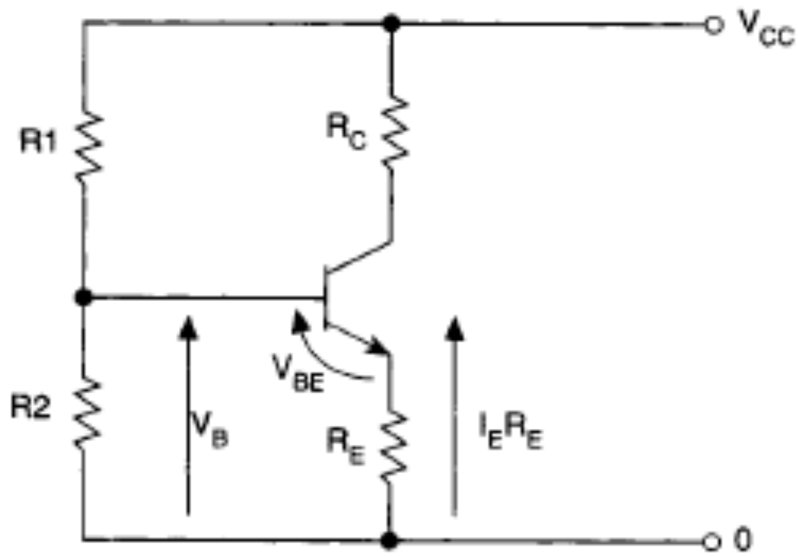


FIGURE 24.27 A transistor biasing circuit.

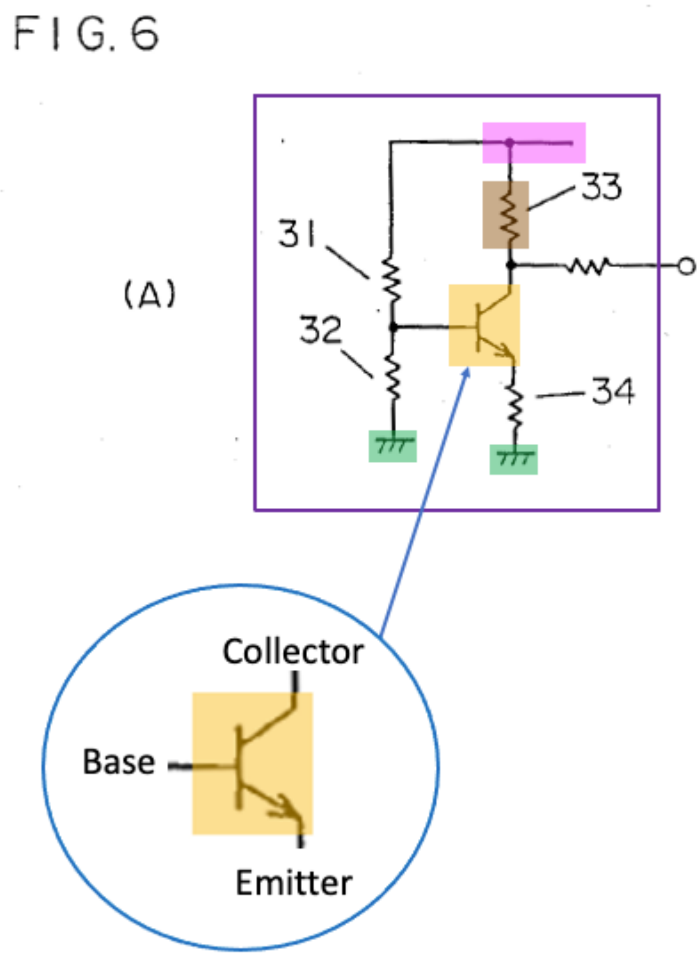
EX1010, Fig. 24.27

The voltage V_B is used to activate the transistor (when V_B is greater than V_{BE}) so that current flows from collector to emitter. EX1012, pp. 42-45; EX1010, pp. 646-648. Resistors R1, and R2 form a voltage divider, where V_B is defined as follows:

$$V_B \simeq \frac{V_{CC} R2}{R1 + R2}$$

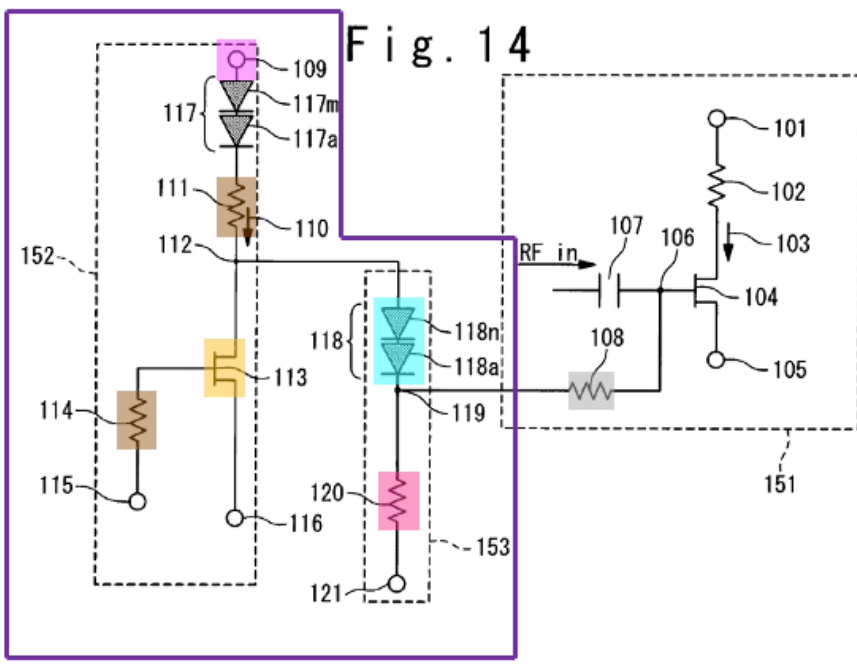
EX1010, p. 648; *see also* EX1013, p. 28; EX1002, ¶213.

In view of this equation, if V_{cc} were equal to zero, V_B would also be equal to zero. EX1012, pp. 42-45; EX1010, pp. 646-648; EX1013, p. 28. Thus, V_B would not be greater than the V_{BE} voltage necessary to activate the transistor and no current would flow between collector and emitter. *Id.* Because this circuit is the same as in Kubo, the same principle applies to Kubo. Namely, Kubo's Figure 6(A) circuit has a voltage applied to its terminal (equivalent to V_{cc} applied in EX1010, Fig. 24.27), which is applied to the transistor's collector. EX1003, 4:4-27. If it did not have a voltage, the voltage at this terminal would be equal to zero and the voltage at the base of the transistor (V_B) (across resistor 32 to ground) would be zero as well; V_B would not be greater than the V_{BE} voltage necessary to activate the transistor and no current would flow between collector and emitter, and the circuit would therefore not function. EX1012, pp. 42-45; EX1010, pp. 646-648; EX1013, p. 28. Moreover, the collector "output voltage" described by Kubo as forming would not be present if no voltage were applied at the terminal because as noted, the circuit would not be operational. EX1003, 4:10-13. Thus, a POSITA would have understood that a voltage is applied to the terminal in Kubo's Figure 6(A) circuit, and this voltage is applied to the transistor's collector via resistor 33. EX1003, 4:4-27; EX1012, pp. 42-45; EX1010, pp. 646-648; EX1013, p. 28; EX1002, ¶214.

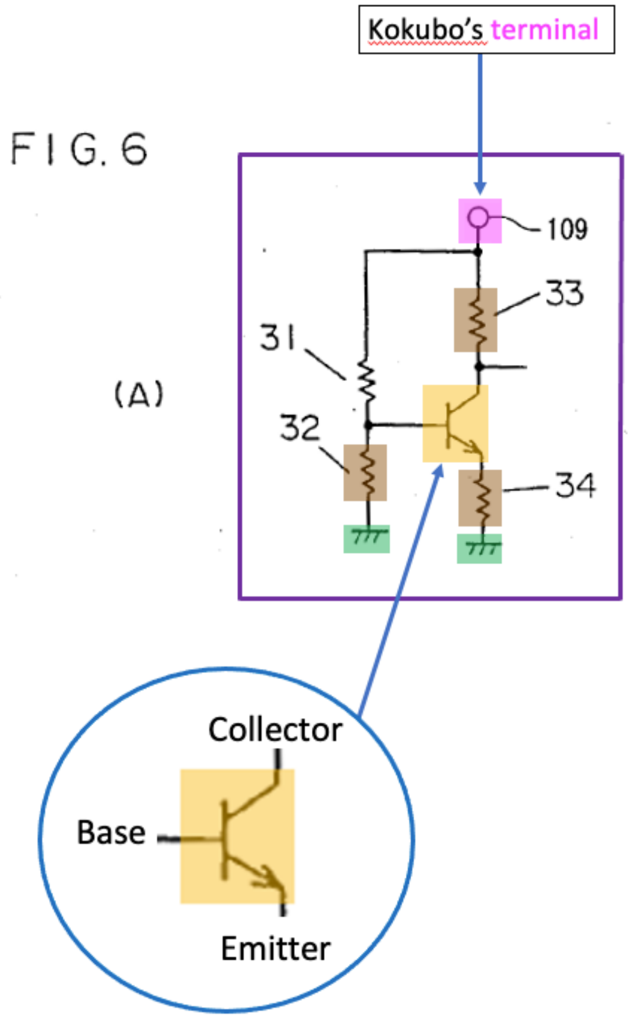


EX1003, Fig. 6(A) (annotated)

Back to the analysis for this limitation, the combination of Kubo and Kokubo further discloses or at least renders obvious limitation [2i]. A POSITA would have combined Kubo and Kokubo such that Kubo's voltage terminal is implemented using Kokubo's voltage terminal. As noted, Kokubo discloses its voltage terminal provides a "voltage 109 [that] is applied to the drain of the transistor 113," where the voltage terminal is connected to a second end of resistor 111. EX1004, 7:27-29, 7:57-62, Fig. 10, Fig. 14. Combined, Kokubo's voltage terminal would have been connected to a second end (*connected to a second end*) of Kubo's resistor 33 (*the first resistor*) and applied a voltage to the collector of Kubo's transistor, biasing the collector voltage to a certain value, making Kokubo's voltage terminal *a collector bias application terminal*. EX1003, 4:7-26, 4:42-46, Figs. 4, 6(A); EX1004, 7:27-29, 7:57-62, 10:36-48, Fig. 10, Fig. 14; Section III.A.4.h; EX1002, ¶215.



EX1004, Fig 14 (annotated)



EX1003, Fig. 6(A), and EX1004 (terminal from Fig. 14) combined (annotated)

Motivations to Combine Kubo and Kokubo with a Reasonable Expectation of Success

A POSITA would have been motivated to combine Kubo and Kokubo for the reasons discussed for limitation [2f]. A POSITA would have further been motivated to combine Kubo and Kokubo such that Kubo's voltage terminal is implemented using Kokubo's voltage terminal. Kubo teaches that its circuit for generating temperature compensation voltage as shown in FIG. 6(A) includes a voltage terminal connected to resistor 33 as shown in Figure 6(A) because (1) the terminal is shown in Figure 6A and (2) as discussed above, a voltage is formed at the collector of the circuit's transistor 113, meaning a voltage must be applied at the terminal for this collector voltage to form and the circuit itself to function. *Supra*, Section III.A.4.i. So motivated, a POSITA would have looked to Kokubo in particular for implementation details explaining how a voltage terminal applies a voltage to the collector of transistor 113. This is because, like Kubo, Kokubo is directed to a bias circuit that provides "temperature compensation" and includes an almost identical arrangement to Kubo, where a voltage terminal is connected to a second end of resistor 111 (like how Kubo's voltage terminal is connected to a second end of resistor 33) and applies a voltage to the same part of a transistor as Kubo (Kokubo's voltage terminal applies a voltage to a transistor drain and Kubo's voltage terminal applies a voltage to a transistor collector, where the transistor drain and collector are positionally equivalent locations but for BJT and FET-type transistors). EX1004, 1:9-11, 6:60-62, 7:27-62, 10:36-48, Figs. 10, 14; EX1003, 4:7-46, Figs. 4, 6(A). Combined or not, Kubo's bias circuit and Kokubo's terminal perform the same functions of outputting a voltage and applying a bias voltage, respectively, and combining the teachings would have simply provided the predictable result of using Kokubo's voltage terminal to apply voltage to the collector of Kubo's transistor. *Id.* The overlap in Kubo and Kokubo's goals of temperature compensation and circuit arrangement for applying voltage to a transistor's collector/drain at least provides a POSITA with a reasonable expectation of success in combining the teachings. *Id.* Moreover, only known circuit design and implementation techniques where circuit sections and parts are coupled using common components such as terminals or leads, shown, for example, by Kubo's Figures 4 and 6(A) and Kokubo's Figure 14, would have been needed to effectuate the combination. EX1003, Figs. 4, 6(A); EX1004, Fig. 14. Applying Kokubo's voltage terminal to Kubo's circuit for generating temperature compensation voltage as discussed in the analysis of limitation [2i] is therefore suggested by Kubo, and so motivated, a POSITA would have looked to Kokubo, in particular, because Kokubo's similar system provides an explicit implementation of a voltage terminal that applies voltage to a transistor as Kubo suggests. Moreover, a POSITA would have recognized that the result of the combination would have been predictable. EX1004, 1:9-11, 6:60-62, 7:27-29, 7:57-62, 10:36-48, Figs. 10, 14; EX1003, 4:7-13, Fig. 6(A). This is because the combination simply makes explicit that the voltage terminal of Kubo applies a voltage to the collector of its transistor as disclosed by Kokubo. *Id.*; EX1002, ¶216.

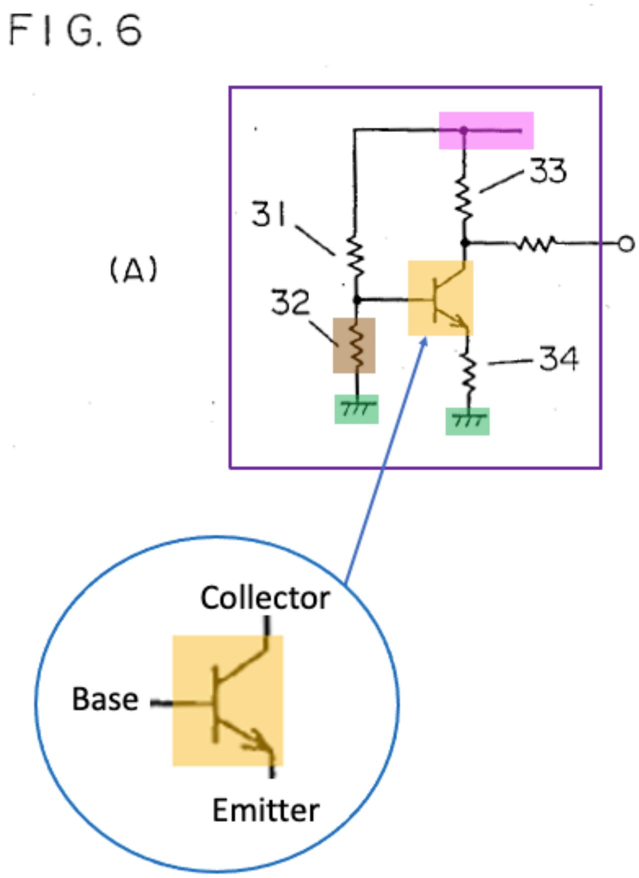
While Kubo's circuitry operates using a bipolar junction transistor (BJT) and Kokubo's circuitry operates using a MOSFET transistor 113, this difference is of no consequence to the combination because Kokubo's voltage terminal would have applied a voltage in the same fashion regardless of transistor type. In the combination, Kokubo's voltage terminal is connected to the collector of Kubo's transistor, which is the equivalent BJT location compared to where it is connected in Kokubo (i.e., to the drain of Kokubo's transistor). Section III.A.4.i, *supra*; EX1004, Fig. 14; EX1002, ¶217.

This discussion further demonstrates that the following motivation to combine applies:

- Combining prior art elements (Kubo's circuit for generating temperature compensation voltage having a voltage applied to a transistor collector and Kokubo's voltage terminal applying a voltage to a transistor drain (the equivalent location for a FET transistor compared to Kubo's BJT transistor)) according to known methods (known circuit design and implementation techniques where circuit sections and parts are coupled using common components such as terminals or leads, shown, for example, by Kubo's Figures 4 and 6(A) and Kokubo's Figure 14) to yield predictable results (Using Kokubo's voltage terminal in Kubo's circuit for generating temperature compensation voltage to apply a voltage to the collector of Kubo's transistor collector). EX1002, ¶218.

j. [2j] "[the temperature compensation bias generation circuit having:] a second resistor having a first end connected to the base or gate of the transistor;"

Kubo discloses or at least renders obvious limitation [2j]. Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) has a resistor 32 (*a second resistor*) having a first end connected to the base (*having a first end connected to the base*) of Kubo's transistor (*of the transistor*) as shown in annotated Figure 6(A). EX1003, 4:14-25, 4:42-46, Figs. 4, 6(A); EX1002, ¶219.

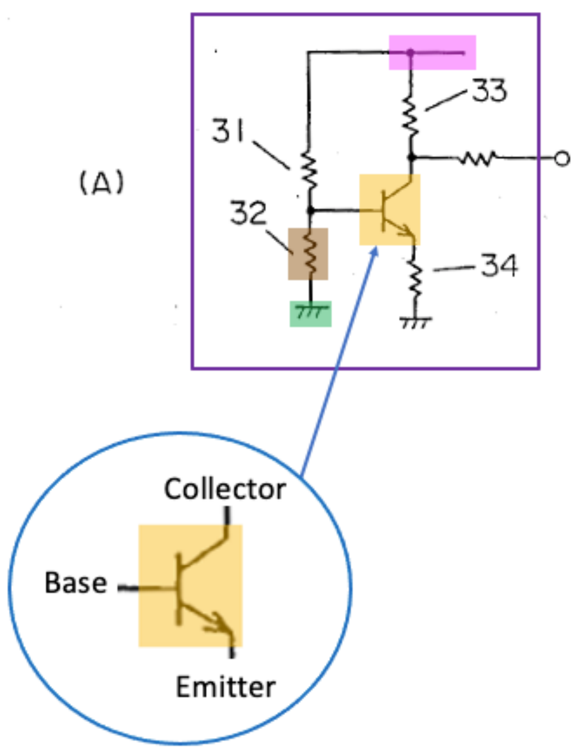


EX1003, Fig. 6(A) (annotated)

k. [2k] "[the temperature compensation bias generation circuit having:] a base or gate bias application terminal connected to a second end of the second resistor;

Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) has *a base bias application terminal* in the form of a ground terminal that is *connected to a second end of* resistor 32 (*second resistor*) as shown in annotated Figure 6(A) below. EX1003, 4:14-25, 4:42-46, Figs. 4, 6(A); Section III.A.4.j; EX1002, ¶220.

FIG. 6



EX1003, Fig. 6(A) (annotated)

A POSITA would have understood that the ground terminal connected to resistor 32 (the *second resistor*) is a *base bias application terminal* because this grounded terminal biases or adjusts the voltage at the transistor base such that it takes a certain value. EX1003, 4:14-17, Fig. 6(A); EX1010, pp. 648, 651 (describing biasing of a BJT transistor by forming a voltage V_B between the transistor's base and ground (also known as "common zero") over a resistor). The ground terminal creates a voltage drop across resistor 32, controlling the voltage that is applied to the base of the transistor. *Id.* By providing this control and application of voltage at the transistor base, the ground terminal (*base bias application terminal)* biases the base of transistor to a bias voltage having a value set by the voltage divider formed by resistors 31 and 32. *Id.*; EX1002, ¶221.

Regarding this understanding, EX1010's Fig. 24.27, reproduced below, is the same circuit as Kubo's Figure 6(A). *See* EX1003, Fig. 6(A); EX1002, ¶222.

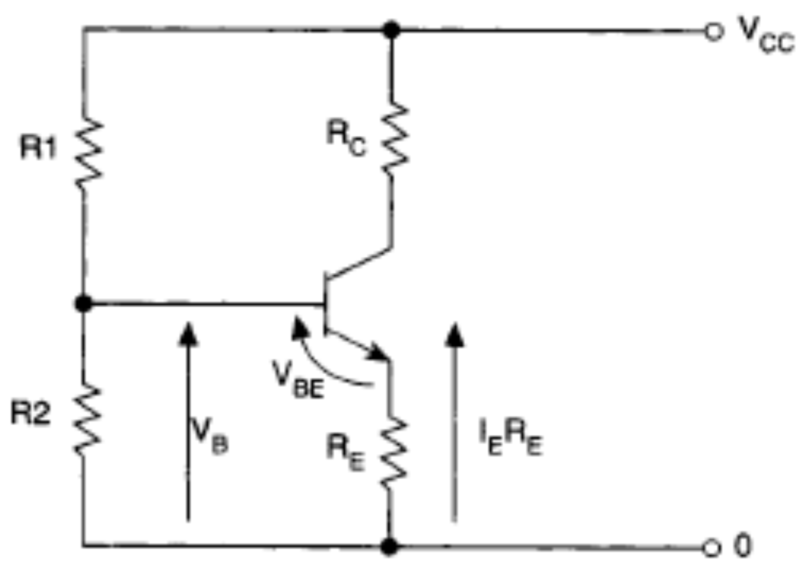


FIGURE 24.27 A transistor biasing circuit.

EX1010, Fig. 24.27

EX1010 explains that the voltage at the transistor base, V_B, is used to activate the transistor (when V_B is greater than V_{BE}) so that current flows from collector to emitter. EX1012, pp. 42-45; EX1010, pp. 646-648; EX1013, p. 28. The calculation of V_B can be determined from this equation in EX1010:

$$V_B \simeq \frac{V_{CC}R2}{R1 + R2}$$

EX1010, p. 648; EX1013, p. 28; EX1002, ¶223..

This equation can be manipulated as follows because the voltage over resistor R2 is $V_B - 0 = V_B$, where the zero is ground:

$$V_B*R1 + V_B*R2 = Vcc*R2$$

$$VB*R1/R2 + VB*R2/R2 = Vcc$$

$$VB*R1/R2 + V_B = Vcc$$

Because V=I*R, in view of Figure 24.27, $V_B = I2*R2$, where I2 is the current through R2. Thus the following manipulations occur:

$$I2*R2*R1/R2 + V_B = Vcc$$

$$I2*R1 + V_B = Vcc$$

And because the current to the base of the transistor is very small (EX1010, p. 648), the current I2 is about equal to the current I1 through R1. And the voltage V1 = I1*R1, where V1 is the voltage over R1. Thus, the following results (taking I1=I2):

$$I2*R1 + V_B = Vcc$$

$$I1*R1 + V_B = Vcc$$

$$V1 + V_B = Vcc$$

$$V_B = Vcc – V1$$

Thus, base voltage is simply Vcc minus the voltage V1 formed over R1. Thus, for Kubo's same circuit in Figure 6(A), the voltage at the base of Kubo's transistor equals the voltage at Kubo's voltage terminal minus the voltage over resistor 31. EX1002, ¶¶224-227.

But if ground is not present and instead some non-zero voltage X (VX) is present in ground's place (i.e., in Kubo's Figure 6(A), connected to resistor 32 instead of ground), the base voltage changes and must account for this difference. Now, the equation on p. 648 of EX1010 is adjusted to account for VX. *See also* EX1013, p. 28. The voltage over resistor R2 is now $V_B - VX$ rather than V_B alone:

$$V_B - VX = Vcc*R2 / (R1 + R2)$$

Because the current to the base of the transistor is very small (EX1010, p. 648), the current I2 through R2 is about equal to the current I1 through R1. And for current through R2, the voltage is ($V_B - VX$), so $V_B - VX = I1*R2$ (taking I1=I2). Thus:

$$I1*R2 = Vcc*R2 / (R1 + R2)$$

$$I1*R2*R1 + I1*R2*R2 = Vcc*R2$$

$$I1*R1 + I1*R2 = Vcc$$

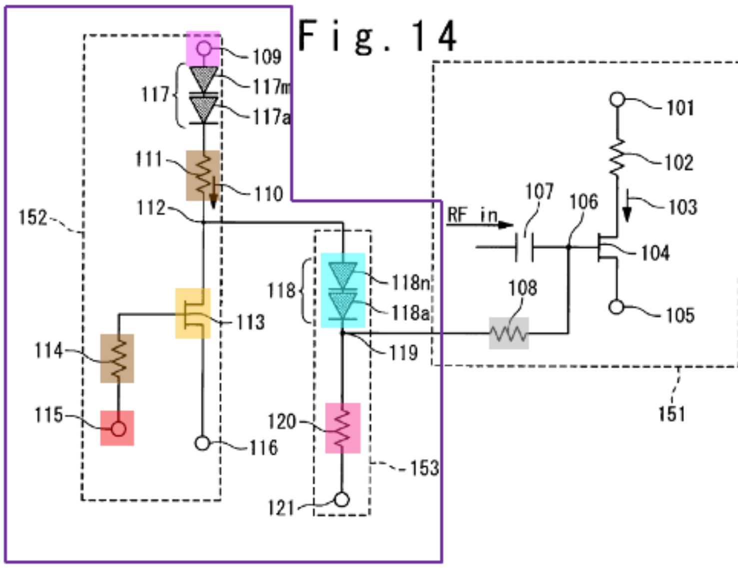
Now, $V1 = I1*R1$ and $I1*R2 = (V_B - VX)$. Thus:

$$V1 + V_B - VX = Vcc$$

$$V_B = Vcc - V1 + VX$$

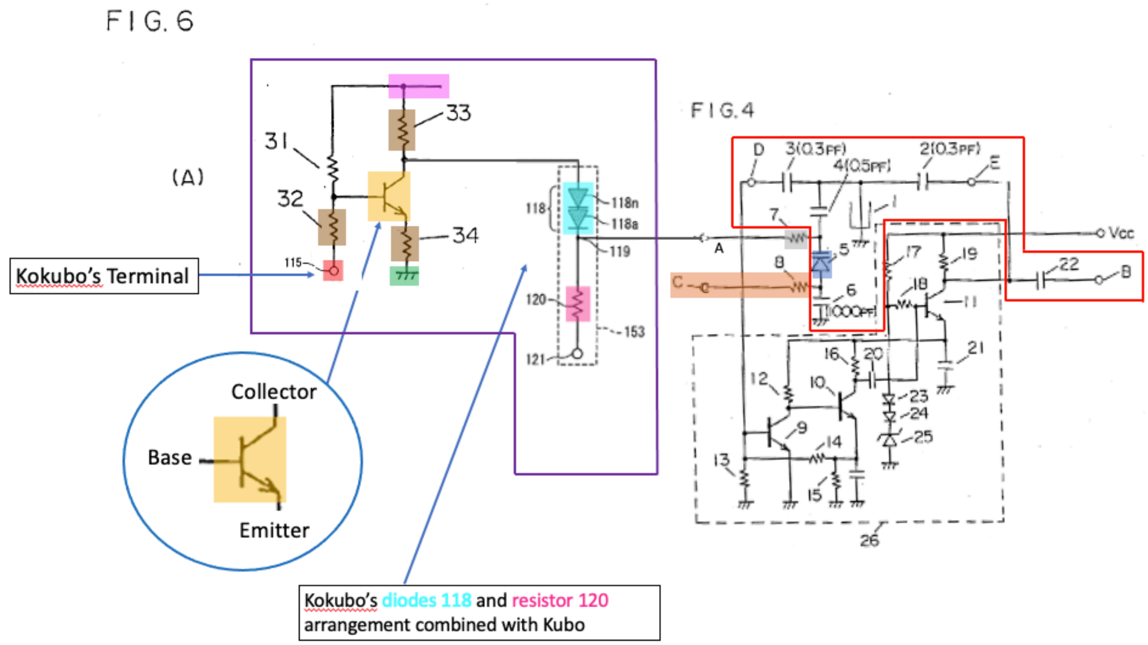
Thus, base voltage is Vcc minus the voltage V1 formed over R1 minus VX. Thus, for Kubo's same circuit in Figure 6(A) in such a case, the voltage at the base of Kubo's transistor equals the voltage at Kubo's voltage terminal minus the voltage over resistor 31 minus the voltage VX. The voltage at the base of Kubo's transistor voltage is therefore configured by the presence of ground (i.e., 0 volts) because it changes when ground is not used. A POSITA would have therefore understood that in Kubo, the ground terminal connected to resistor 32 (the *second resistor*) is a *base bias application terminal* because this grounded terminal biases or adjusts the voltage at the transistor base such that it takes a certain value. EX1002, ¶¶228-231.

Back to the analysis of the limitation, Kubo and Kokubo further disclose or at least render obvious limitation [2k]. Kokubo discloses that its bias circuit has a resistor 114 with a second end that is connected to a base or gate bias application terminal in the form of its terminal. EX1004, 7:26-30, 10:22-48, Fig. 14. The terminal is a base or gate bias application terminal because it applies voltage 115 to transistor 113's gate and biases transistor 113's gate to a voltage value. *Id.*; EX1002, ¶232.



EX1004, Fig 14 (annotated)

Thus, a POSITA would have combined Kubo and Kokubo such that Kokubo's terminal is used to provide a voltage to the base of the Kubo's transistor via resistor 32. EX1004, 7:26-30, 10:22-48, Fig. 14; EX1003, 4:4-27, Fig. 6(A); EX1002, ¶232. The resulting circuit is shown below.



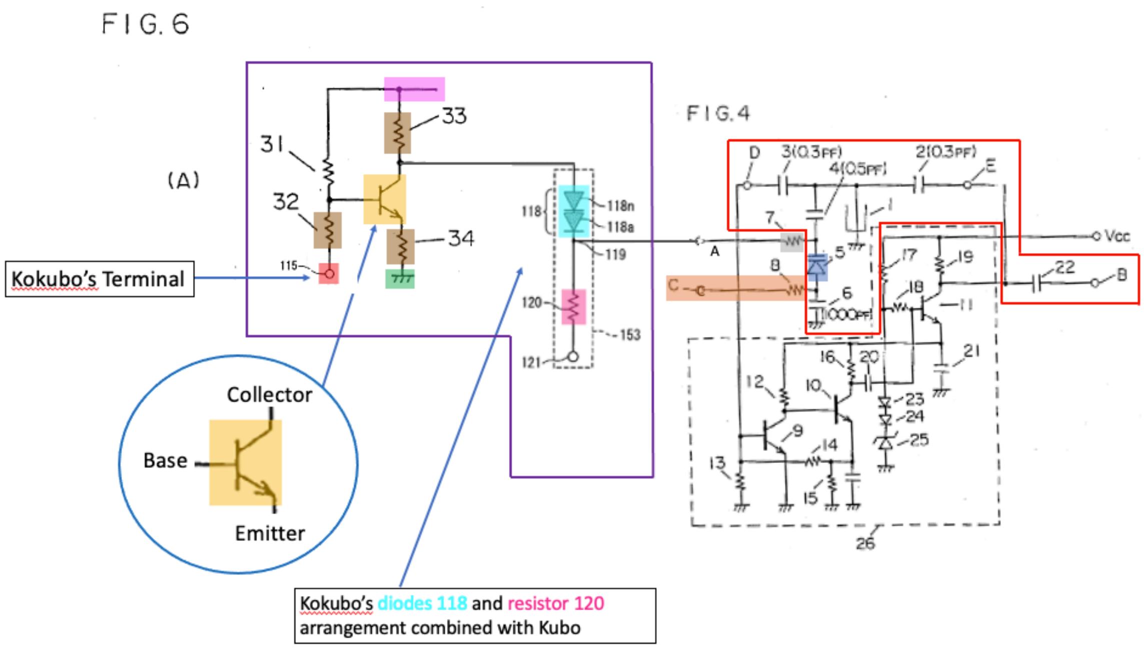
EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined

(annotated)

Combined, Kokubo's terminal discloses or at least renders obvious *a base or gate bias application terminal* because it applies a voltage to the base of Kubo's transistor via resistor 32, biasing the base to a voltage value; Kokubo's terminal is also *connected to a second end of* resistor 32 (*the second resistor*) that is different from the end of resistor 32 connected to the transistor's base. *Id.*; EX1002, ¶232.

<u>Motivations to Combine Kubo and Kokubo with a Reasonable Expectation of Success</u>

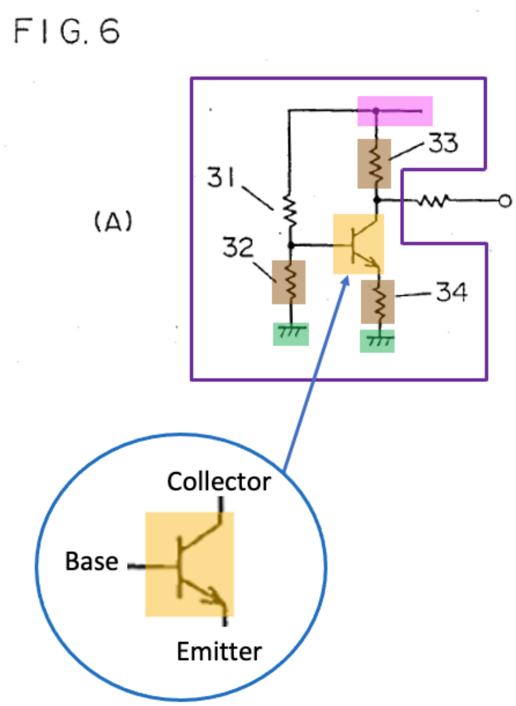
A POSITA would have been motivated to combine Kubo and Kokubo for the reasons discussed in the analysis of limitations [2f] and [2i]. A POSITA would have further been motivated to combine Kubo and Kokubo such that Kokubo's terminal is used to provide a voltage to the base of the Kubo's transistor via resistor 32. EX1004, 7:26-30, 10:22-48, Fig. 14; EX1003, 4:4-27, Fig. 6(A); EX1002, ¶233.



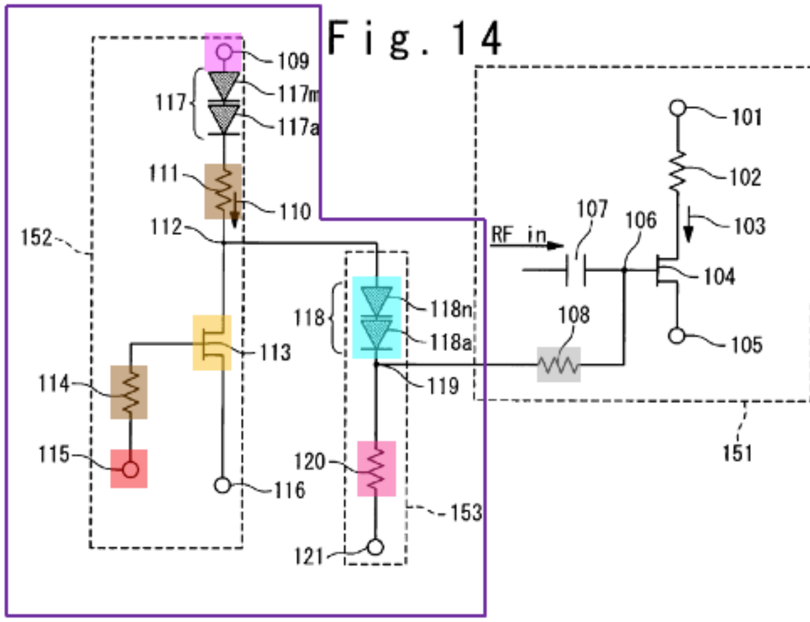
EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined (annotated)

Kubo teaches that its ground terminal biases or adjusts the voltage at its transistor base via a resistor such that it takes a certain value. *Supra*, Section III.A.4.k; EX1003, 4:14-17, Fig. 6(A). So motivated, a POSITA would have looked to Kokubo in particular for explicit disclosure explaining how the terminal biases voltage because Kokubo explicitly describes a terminal that applies a voltage 115 to the gate of transistor 113, which is the equivalent location for FET-type transistor in relation to Kubo's BJT transistor, via resistor 114. *Id.*; EX1004, 7:29-30, 10:22-

48, Figs. 10, 14. This is because, like Kubo, Kokubo is directed to a bias circuit that provides "temperature compensation" (EX1004, 1:9-11, 6:60-62, 10:22-48, Fig. 14) and Kokubo's terminal and resistor 114 are part of the bias circuit of Figure 14 having an almost identical arrangement to Kubo's circuit for generating temperature compensation voltage in Figure 6(A) having a ground terminal and resistor 32; both figures are reproduced below for comparison. *Id.*; EX1003, Fig. 6(A); EX1004, Fig. 10; EX1002, ¶234.



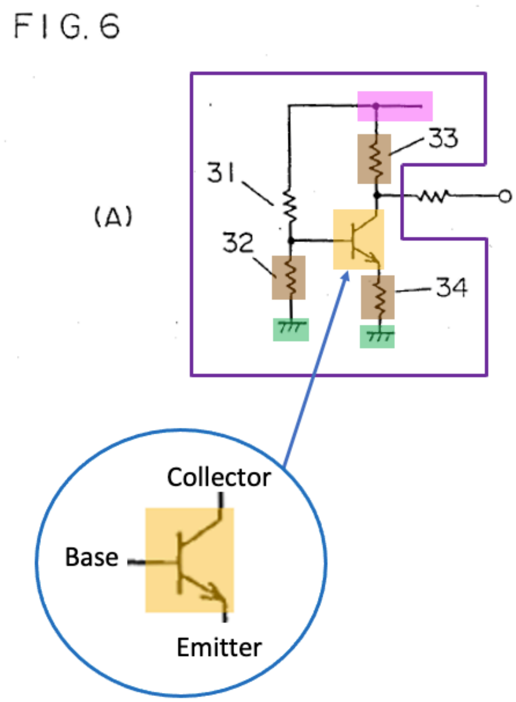
EX1003, Fig. 6(A) (annotated)



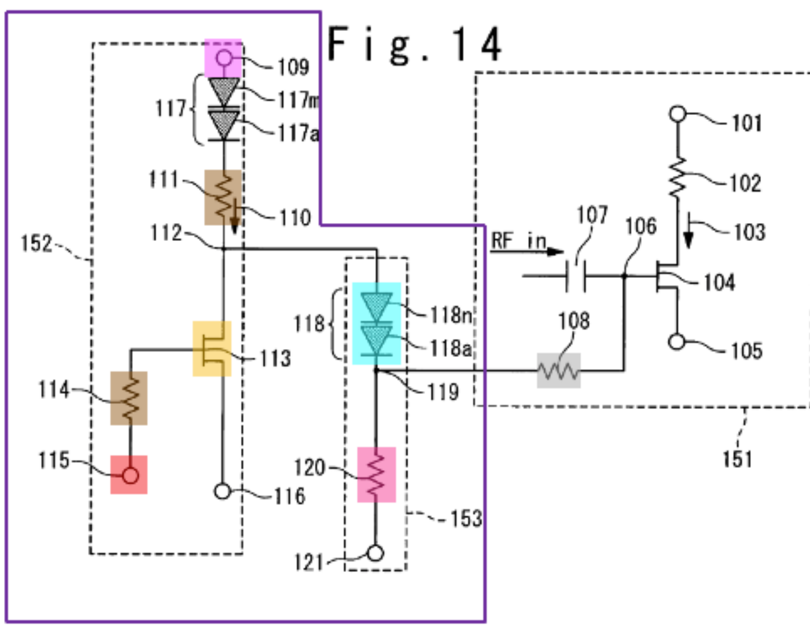
EX1004, Fig 14 (annotated)

Combined or not, Kubo and Kokubo's systems (e.g., Kubo's circuit using a ground terminal to bias a transistor base; Kokubo's circuit using a terminal to bias a transistor gate, the equivalent location to a base as discussed) perform the same function of configuring a voltage applied at equivalent transistor locations. *Id.* The overlap in Kubo and Kokubo's goals of temperature compensation and circuit arrangement for applying voltage to a transistor's base/gate at least provides a POSITA with a reasonable expectation of success in combining the teachings. *Id.*; EX1002, ¶235.

Moreover, only known circuit design and implementation techniques where circuit sections and parts are coupled using common components such as terminals or leads, shown, for example, by Kubo's Figures 4 and 6(A) and Kokubo's Figure 14, would have been needed to effectuate the combination. EX1003, Figs. 4, 6(A); EX1004, Fig. 14. Applying Kokubo's terminal to Kubo's circuit for generating temperature compensation voltage as discussed in the analysis of limitation [2k] is therefore suggested by Kubo, and so motivated, a POSITA would have looked to Kokubo, in particular, because Kokubo's similar system provides an explicit implementation of a terminal that applies voltage to a transistor as Kubo suggests. Moreover, a POSITA would have recognized that the result of the combination would have been predictable, providing the application of voltage to Kubo's transistor base. EX1003, 4:14-25, 4:42-46, Figs. 4, 6(A); EX1004, 7:29-30, 10:22-48, Figs. 10, 14; *see* Sections III.A.4.e, III.A.4.f, III.A.4.j. This is because the combination simply makes explicit the predictable result that the ground terminal of Kubo is used to apply and bias a voltage at the base of Kubo's transistor as taught by Kokubo's terminal that applies and biases a voltage at the equivalent location of its transistor. *Id.*; EX1002, ¶236.



EX1003, Fig. 6(A) (annotated)



EX1004, Fig 14 (annotated)

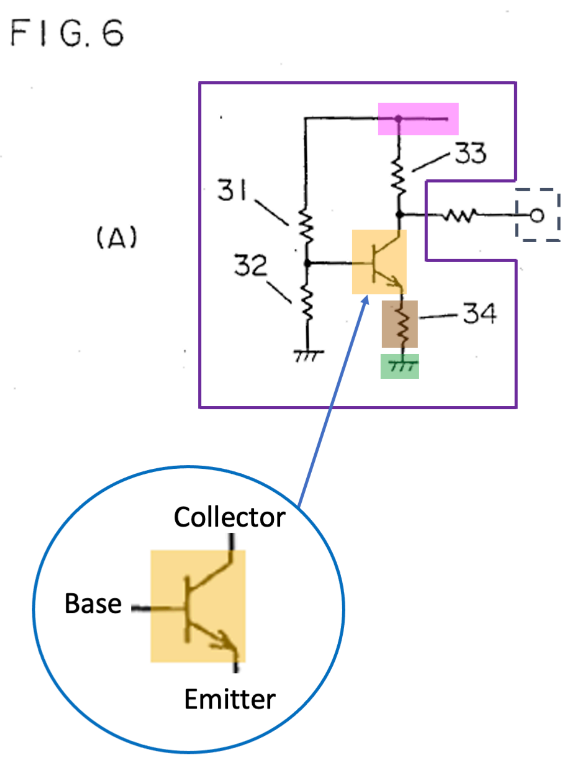
While Kubo's circuitry operates using a bipolar junction transistor (BJT) and Kokubo's circuitry operates using a MOSFET transistor 113, this difference is of no consequence to the combination because Kokubo's voltage terminal would have applied a voltage in the same fashion regardless of transistor type. In the combination, Kokubo's voltage terminal is connected to the base of Kubo's transistor, which is the equivalent BJT location compared to where it is connected in Kokubo (i.e., to the gate of Kokubo's transistor). Section III.A.4.k, *supra*; EX1004, Fig. 14; EX1002, ¶237.

This discussion further demonstrates that the following motivation to combine applies:

- Combining prior art elements (Kubo's circuit for generating temperature compensation voltage having a voltage applied and biased at a transistor base and Kokubo's terminal applying and biasing a voltage at a transistor gate (the equivalent location for a FET transistor compared to Kubo's BJT transistor)) according to known methods (known circuit design and implementation techniques where circuit sections and parts are coupled using common components such as terminals or leads, shown, for example, by Kubo's Figures 4 and 6(A) and Kokubo's Figure 14) to yield predictable results (Using Kokubo's terminal in Kubo's circuit for generating temperature compensation voltage to apply and bias a voltage at the base of Kubo's transistor collector). EX1002, ¶238.

l. [2l] "[the temperature compensation bias generation circuit having:] a third resistor having a first end connected to the emitter or source of the transistor and having a second end that is grounded; and"

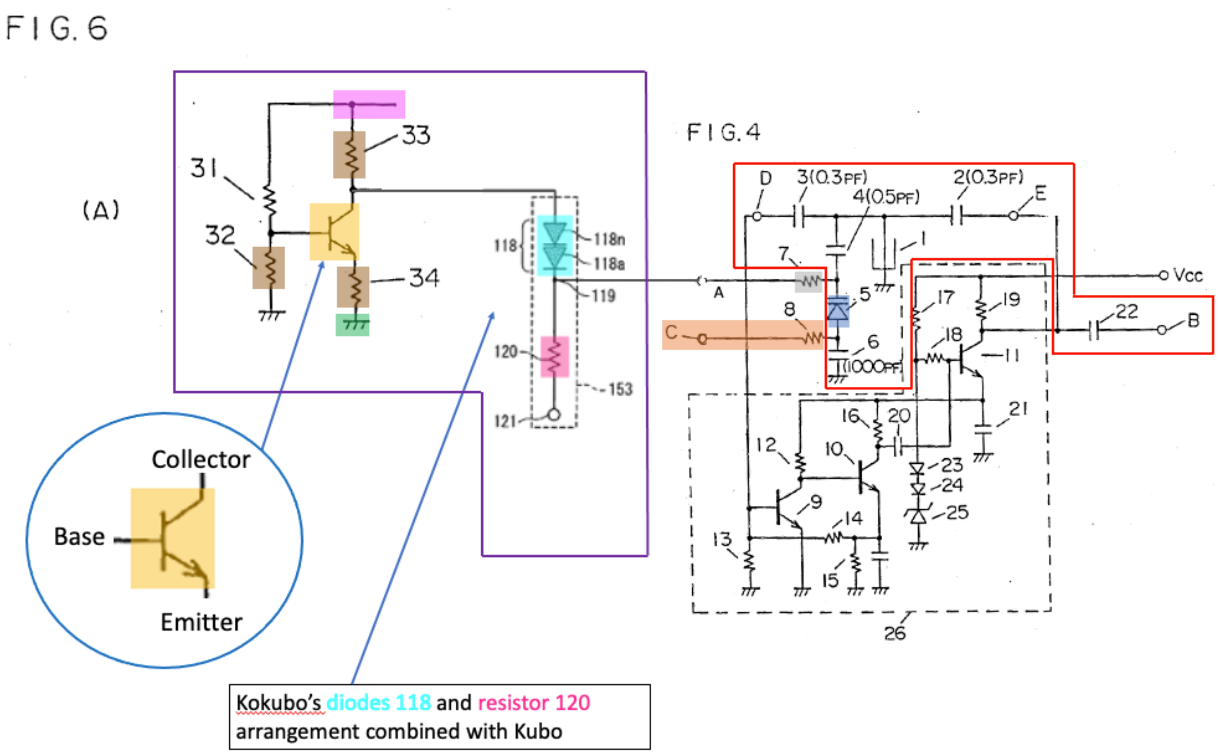
Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) has a resistor 34 (*a third resistor*) having a first end connected to the emitter (*having a first end connected to the emitter*) of Kubo's transistor (*of the transistor*) and having a second end that is grounded (*and having a second end that is grounded*) as shown in annotated Figure 6(A) below. EX1003, 4:14-25, 4:42-46, Figs. 4, 6(A); EX1002, ¶239.



EX1003, Fig. 6(A) (annotated)

m. [2m] "[the temperature compensation bias generation circuit having:] a fourth resistor having a first end connected to the temperature compensation bias application circuit and having a second end that is grounded."

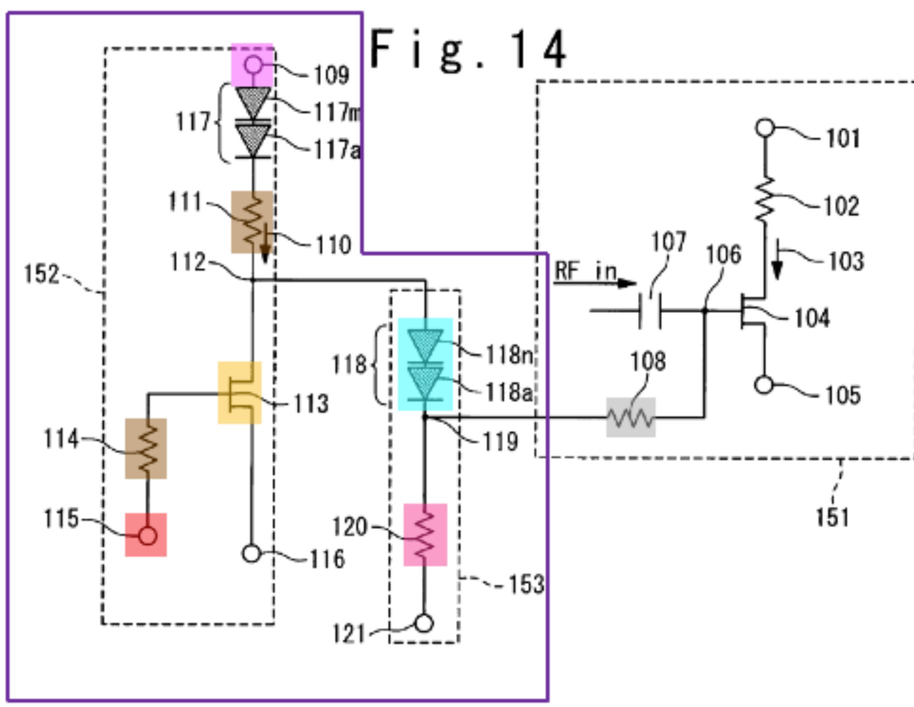
The Kubo-Kokubo combined system is shown below. *See* Section III.A.4.f, III.A.4.g.



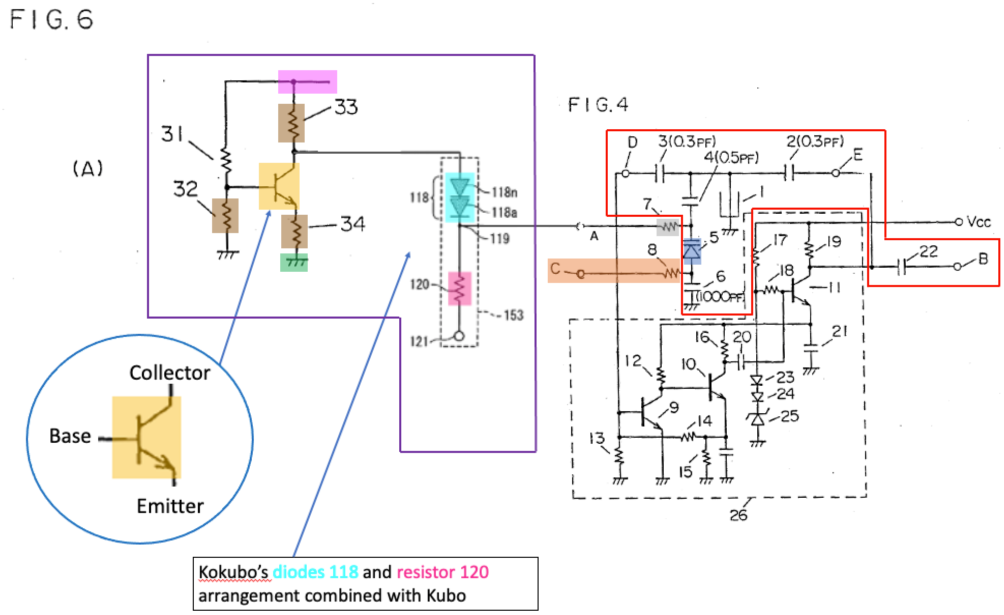
EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined (annotated)

In the Kubo-Kokubo combined system, Kubo's circuit for generating temperature compensation voltage (*temperature compensation bias generation circuit*) has a resistor 120 (*fourth resistor*) that has *a first end connected* to resistor 7 (*temperature compensation bias circuit)* and has *a second end* connected to a terminal inputting voltage 121. Kokubo, 7:17-18, Fig. 10; Section III.A.4.f, III.A.4.g; EX1002, ¶¶240-241.

A POSITA would have understood that Kokubo's voltage 121 is set to a lower value than the voltage at Kokubo' node 112/the collector of Kubo's transistor in the Kubo-Kokubo combined system. This is because current flows to the node where voltage 121 is present through diodes 118 and resistor 120, which each subtract a voltage drop from the voltage at node 112 of Kokubo/the collector of Kubo's transistor in the Kubo-Kokubo combined system to voltage 121. EX1002, ¶242.



EX1004, Fig 14 (annotated)



EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined

(annotated)

Indeed, this POSITA understanding is corroborated by EX1010, which explains that given a node a having a voltage a (v_a) and a node b having a voltage b (v_b), the voltage drop from node a to node b is v_{ab} and equal to v_a minus v_b, and current flows into the node b at the lower voltage. EX1010, pp. 60-63, Fig. 3.1; EX1002, ¶243. Figure 3.1, showing this, is reproduced below.

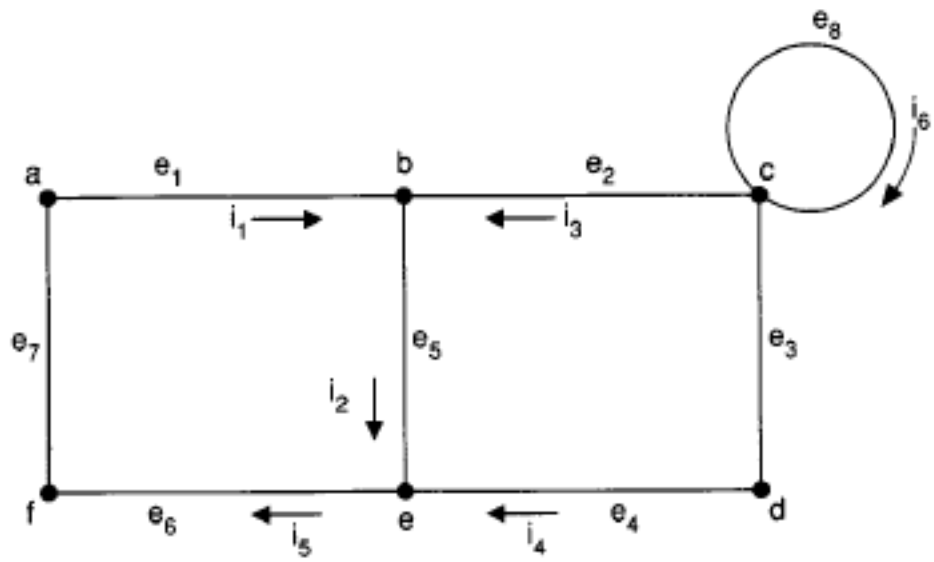


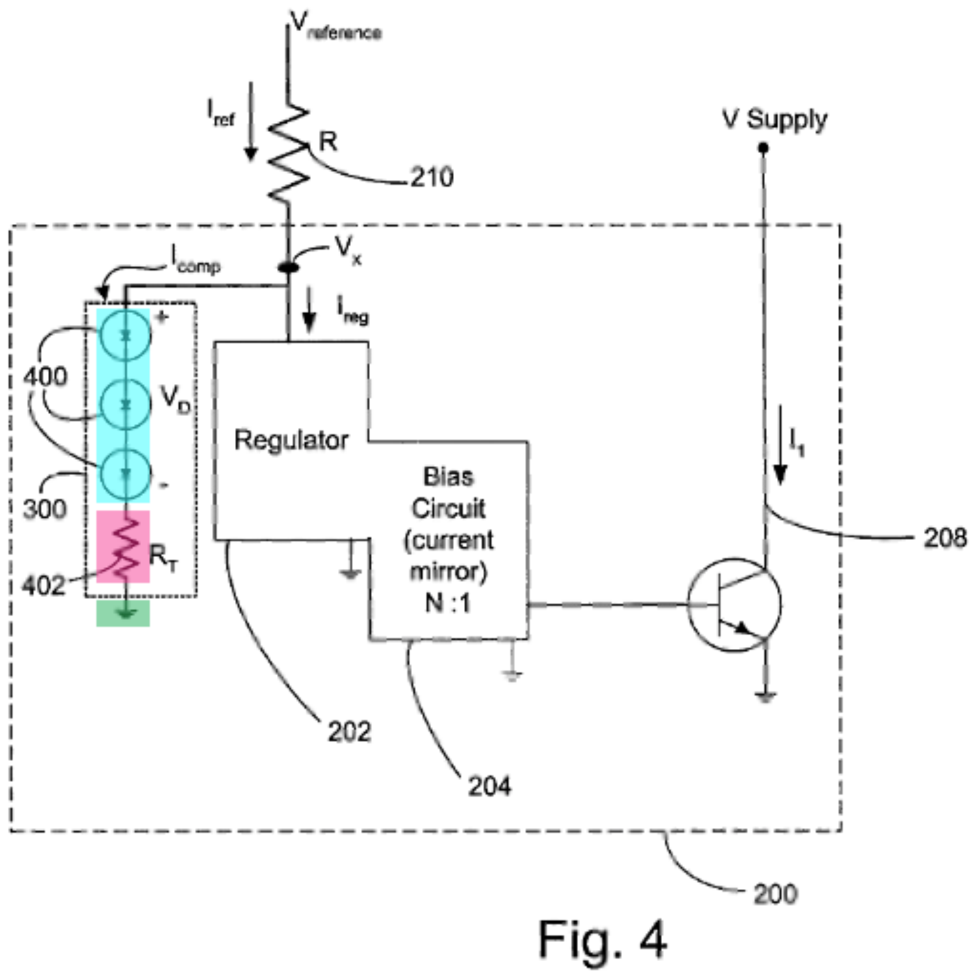
FIGURE 3.1 Graph representation of a linear circuit.

This understanding is also corroborated by EX1013, which shows that the voltage drop from a first node having a total voltage v in Fig. 3-3 to second node (i.e. node between voltages v1 and v2) is equal to v minus v1, and current flows into the second node at the lower voltage v1. EX1013, pp. 25-26, Fig. 3-3; EX1002, ¶244.

This is just how the Kubo-Kokubo combined system works. In the Kubo-Kokubo combined system, current flows from the node 112 (e.g., node a in EX1010) to the node where voltage 121 is present (e.g., node b in EX1010) through diodes 118 and resistor 120. Diodes 118 introduce a "voltage drop from the set voltage at the node 12" to form a voltage at node 119, where the voltage drop increases with the decrease of temperature. EX1004., 7:66-8:12, 10:22-48. Resistor 120 forms a voltage drop from node 119 to the node where voltage 121 is present because resistors are known to form voltage drops in this manner – it is a known resistor characteristic and voltage is equal to current multiplied by resistance (Ohm's law). EX1010, p. 8; EX1012, pp. 25-26; EX1004, 7:66-8:19, 8:49-51, 10:9-48, Fig. 14. Thus, diodes 118 and resistor 120 each subtract a voltage drop from the voltage at node 112 of Kokubo/the collector of Kubo's transistor in the Kubo-Kokubo combined system to voltage 121, making a voltage drop occur from node 112(e.g., node a in EX1010) to the node where voltage 121 is present (e.g., node b in EX1010). A POSITA would have therefore understood that Kokubo's voltage 121 is set to a lower value than the voltage at Kokubo' node 112/the collector of Kubo's transistor in the Kubo-Kokubo combined system. EX1002, ¶245.

Thus, while Kubo and Kokubo describe the *second end* of resistor 120 is connected to a terminal inputting voltage 121 that is a lower voltage value as discussed, Kubo and Kokubo do not explicitly describe that this terminal is *grounded* (i.e., that a *second end* of resistor 120 *is grounded*). The combination of Kubo, Kokubo, and Shapiro, however, disclose or at least render this obvious. EX1002, ¶246.

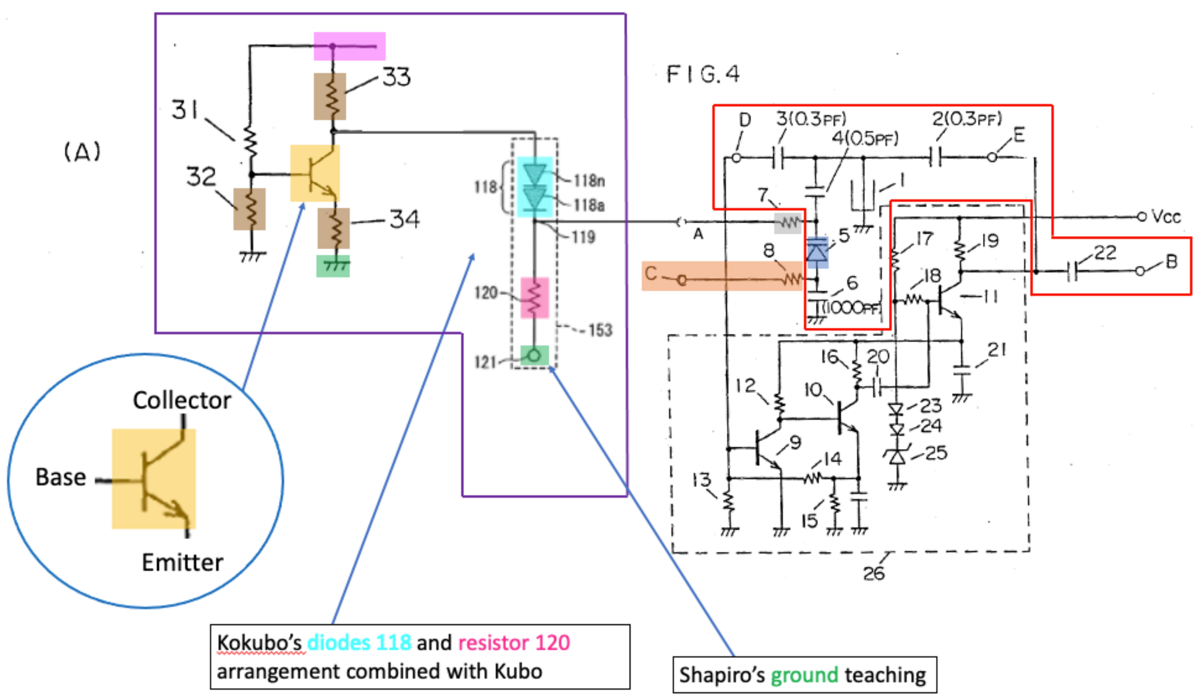
Like the Kubo-Kokubo combined system, Shapiro includes a "compensation module 300" formed by diodes 400 connected in series with a resistor 402 to ground. EX1005, 1:6-8, 2:11-13, 6:23-27, 6:67-7:5, Fig. 4. As shown by Figure 4, diodes 400 cause a voltage drop V_D from voltage V_x, and a voltage drop is also caused by resistor 402 to ground. *Id.* Resistor 402 may "be chosen to maintain an amount of current flow through the temperature compensation module 300." EX1005, 7:3-5. As temperature changes occur, current drawn through the diodes 400 and resistor 402 to ground changes, where more current is drawn at high temperatures compared to lower temperatures. *Id.*, 8:23-46, 5:46-67, Fig. 4; EX1002, ¶247.



EX1005, Fig. 4

Thus, a POSITA would have applied Shapiro's teachings of connecting resistor 402, which is in series with diodes 400, to ground to the combined system of Kubo and Kokubom, for the reasons discussed below in the motivation to combine section. As a result, resistor 120 of the Kubo and Kokubo system, which is in series with diodes 118, would have been connected to ground by making the voltage 121 ground. Resistor 120 (*fourth resistor*) therefore would have had a *second end that is grounded* as claimed. EX1002, ¶248.

FIG. 6

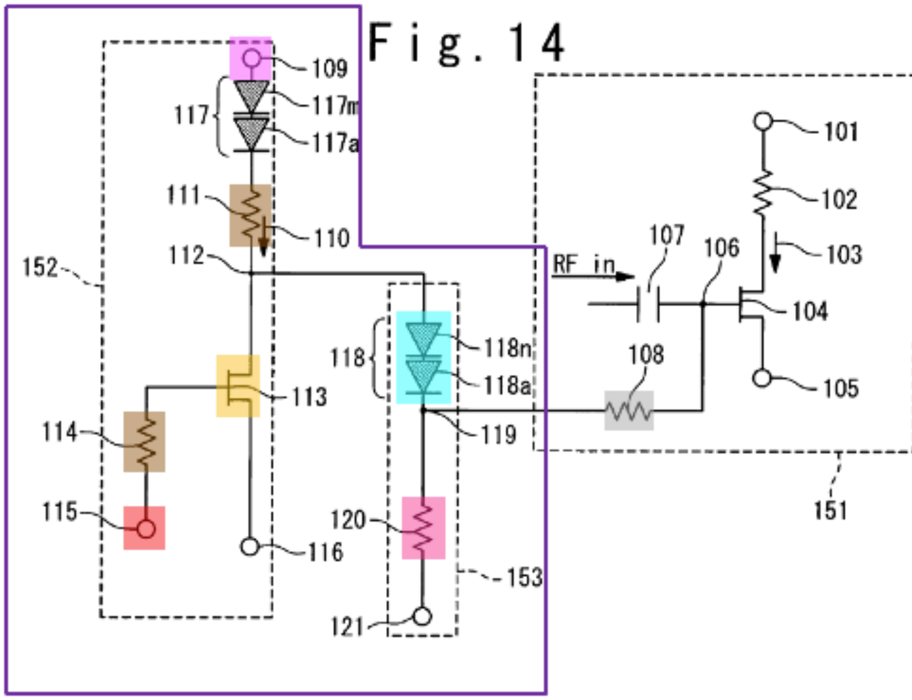


EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined

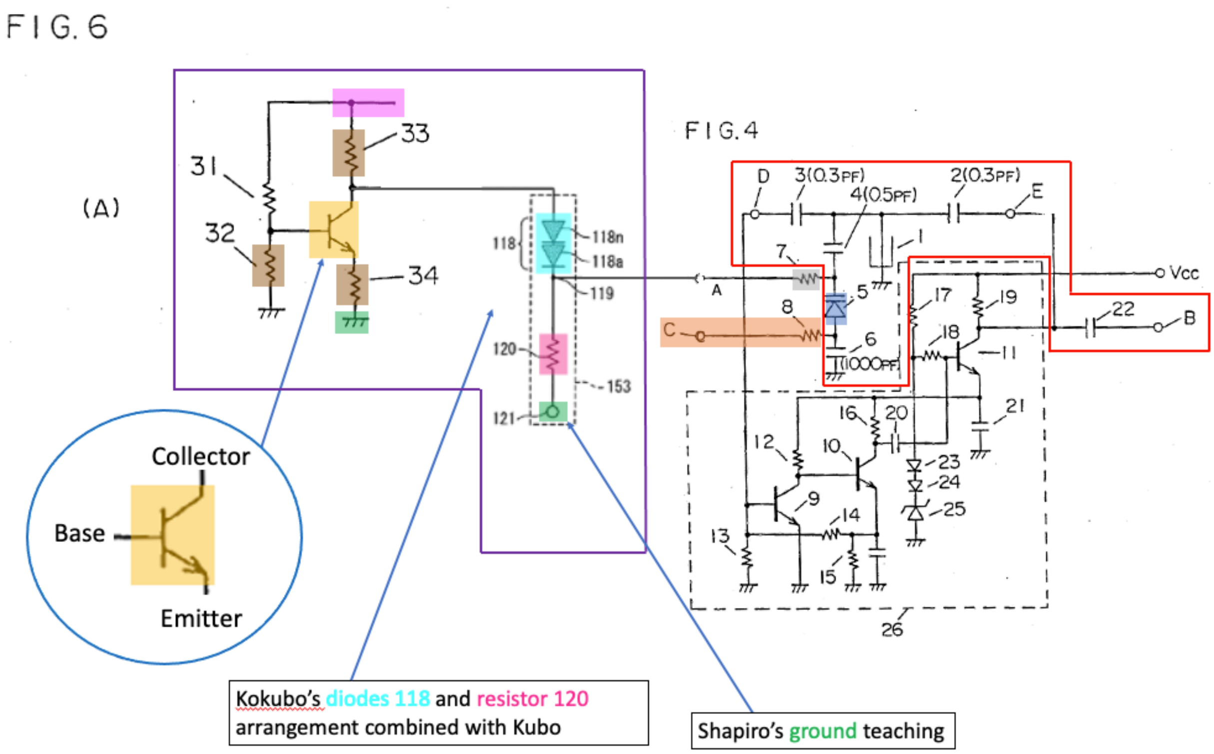
(annotated)

Motivations to Combine Kubo, Kokubo, and Shapiro with a Reasonable Expectation of Success

A POSITA would have been motivated to combine Kubo and Kokubo for the reasons discussed regarding limitations [2f], [2i], and [2k]. A POSITA would have been further motivated to combine Kubo and Kokubo's system ("Kubo-Kokubo") with Shapiro such that the Kubo-Kokubo terminal having voltage 121 is grounded, with the voltage 121 set to zero potential, for the following reasons. Section III.A.4.f, III.A.4.g; EX1005, 1:6-8, 2:11-13, 6:23-27, 6:67-7:5, Fig. 4. The Kubo-Kokubo system includes Kubo's circuit for generating temperature compensation voltage and includes Kokubo's diodes 118 in series with a resistor 120, where a voltage 121 is "applied to the cathode of diode 118 through the resistance 120" and a current flows through resistor 120. Section III.A.4.f-k; EX1004, 7:17-18, 10:22-48, Figs. 10, 14. As discussed above, a POSITA would have that voltage 121 is set to a lower voltage value than the voltage at node 112 in Kokubo/the collector of Kubo's transistor in the Kubo-Kokubo combined system, where current flows to the node where voltage 121 is present through diodes 118 and resistor 120. *See supra* Section III.A.4.m. Thus, the Kubo-Kokubo system at least suggests that a voltage 121 induces current flow through resistor 120 and is lower than the voltage at Kokubo's node 112/the collector of Kubo's transistor in the Kubo-Kokubo combined system. *Id.*; EX1002, ¶249.



EX1004, Fig 14 (annotated)



EX1003 (Kubo) (Figs. 4 and 6(A)) and EX1004 (Kokubo) (Fig. 14) combined

(annotated)

So motivated, a POSITA would have looked to Shapiro for details on how to set the value of this lower voltage 121 to provide such current flow and would have utilized Shapiro's teaching of setting the terminal having voltage 121 to ground (i.e., such that voltage 121 has a zero volt or zero potential value), which is a well-known technique for inducing current flow. EX1009, pp. 234 (defining "electrical ground" as having "electric potential of zero" and as "a conducting path to the earth"), 232 and 594-595 (describing "electric potential" as "expressed in volts"). This is because Shapiro, which is directed to "temperature compensation to improve bias circuit performance" like Kubo and Kokubo, shows that ground is connected to the series connected diodes 400 and resistor 402 and provides that current I_{comp} flows through diodes 400 and resistor 402 to ground, where diodes 400 form a voltage drop V_D and resistor 402 forms its own voltage drop. EX1005, 6:23-27, 6:34-47, 6:67-7:5, 8:26-46, Fig. 4; EX1003, 1:21-26, 1:43-49, 4:17-26; EX1004, 1:9-11. Kokubo does not preclude grounding the terminal having voltage 121 or otherwise indicate that voltage 121 must have some particular value, and using ground (i.e., zero volts) as taught by Shapiro was a well-known technique for inducing current flow. *Id.*; *See* EX1009, p. 234 (referring to "electrical ground" as "a conducting path to the earth"). Combined or not, Kubo-Kokubo and Shapiro's systems (e.g., Kubo-Kokubo circuit using a terminal having voltage 121 induce current flow through diodes 118 and resistor 120; Shapiro's circuit using a ground to induce current flow through diodes 400 and resistor 402) perform the same function of inducing current flow through diodes and a resistor. *Id.*; EX1002, ¶250.

A POSITA would have had a reasonable expectation of success in making this combination because it would have simply entailed grounding the terminal having voltage 121 and providing current flow to ground as taught by Shapiro—a predictable result; as taught by Shapiro; this is routine and well within the capabilities of a POSITA as it merely amounts to changing a voltage value applied to a terminal. *Id.* Only known circuit design and implementation techniques where circuit sections and parts are coupled using common components such as terminals or leads, shown, for example, by Kubo's Figures 4 and 6(A), Kokubo's Figure 14, and Shapiro's Figure 4 would have been needed to effectuate the combination. EX1003, Figs. 4, 6(A); EX1004, Fig. 14. The overlap in Kubo, Kokubo, and Shapiro's goals of temperature compensation and similar disclosure regarding providing current flow in circuit components also provide a reasonable expectation of success. *Id.* And for the same reasons, a POSITA would have recognized that the result of the combination—grounding the terminal of Kubo-Kokubo's circuit for generating temperature compensation voltage having voltage 121 such that current flows through resistor 120 to ground—would have been predictable. *Id.*; EX1002, ¶251.

Applying Shapiro's ground teachings to the Kubo-Kokubo circuit for generating temperature compensation voltage as discussed in the analysis of limitation [2m] is therefore suggested by Kubo-Kokubo, and so motivated, a POSITA would have looked to Shapiro, in particular, because Shapiro's similar system provides an explicit implementation of using a lower voltage (i.e., ground) to induce current flow. EX1002, ¶252.

This discussion further demonstrates that the following motivation to combine applies:

- Combining prior art elements (Kubo-Kokubo's circuit for generating temperature compensation voltage with a terminal having voltage 121 and Shapiro's ground teaching as discussed) according to known methods (known circuit design and implementation techniques where circuit sections and parts are coupled using common components such as terminals or leads, shown, for example, by Kubo's Figures 4 and 6(A), Kokubo's Figure 14, and Shapiro's Figure 4) to yield predictable results (Grounding the terminal of Kubo-Kokubo's circuit for generating temperature compensation voltage having voltage 121 such that current flows through resistor 120 to ground). EX1002, ¶253.

B. Proposed Rejections 2 and 3: Claim 1 is unpatentable under 35 U.S.C. § 103(a) over JP105 and Kubo (Proposed Rejection 2) and JP105, Kubo, and Kokubo (Proposed Rejection 3).

1. Overview of JP105

JP105 describes a phase shift oscillator that provides "temperature stabilization." EX1006, 2:24-29, 3:29-5:15, 5:22-6:2, Figs. 7, 8. JP105's system includes a "temperature compensation circuit" having a temperature variable voltage generating transistor 27 that is a PNP type transistor, an emitter resistor 31 connected to the emitter of transistor 27, a collector resistor 32 connected to the collector of transistor 27, and a bias resistor 28. *Id.*. Collector resistor 32 is also connected to ground. *Id.* A voltage +B is applied at the terminal connected to emitter resistor 31 as shown in Figure 8 below.

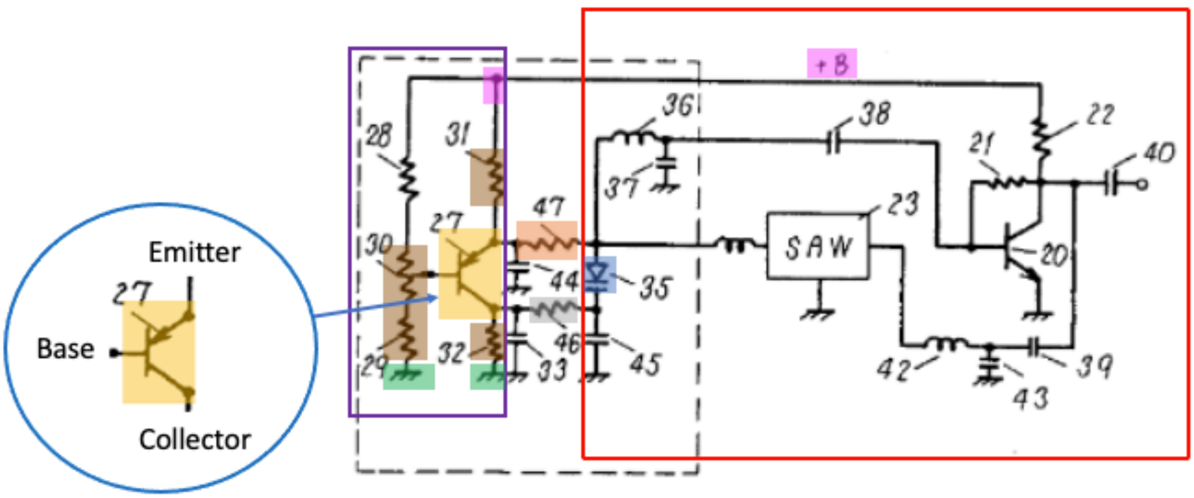


FIG. 8

EX1006, Fig. 8 (annotated)

In operation, the transistor 27 is biased by variable resistor 30 such that it is not active until a certain temperature T0 is reached. EX1006, 4:22-5:7, Fig. 7. When T0 is exceeded, the collector voltage of transistor 27 rises above ground as the temperature rises, which in turn increases the voltage across the varactor diode 35, reducing the diode's capacitance and thereby increasing the phase shift oscillator's output frequency. *Id.* The frequency output by the phase shift oscillator is thus compensated such that it becomes substantially constant a frequency f0 between temperature T0 and T1, as shown by curve D in Figure 7. *Id*. This contrasts to the situation where there is no compensation, which is shown by curve C, where frequency varies parabolically. *Id.*

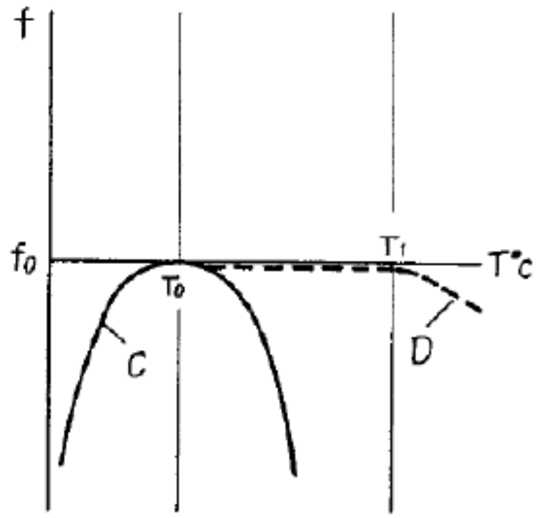


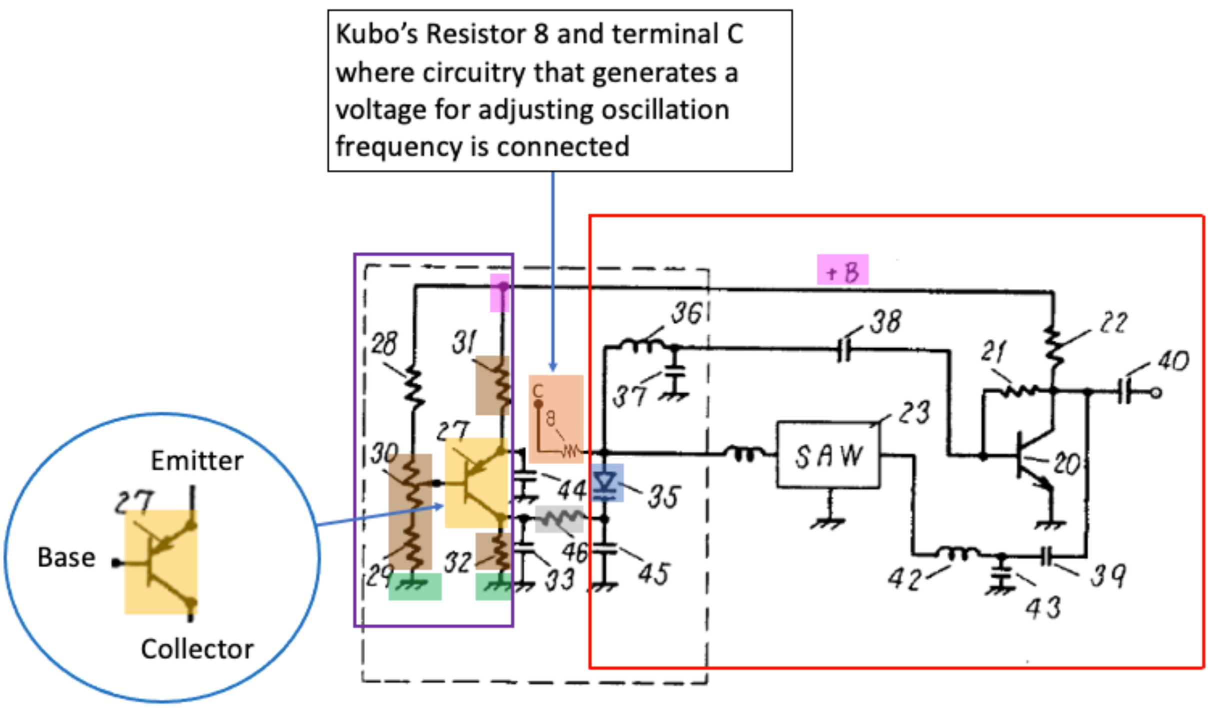
FIG. 7

EX1006, Fig. 7

JP105 is analogous art to the ’318 patent; it is from the same field of endeavor as the ’318 patent (improving oscillator functionality) and reasonably pertinent to the particular problem the ’318 patent was trying to solve (how to mitigate the influence of temperature changes on oscillator function). EX1001, 1:6-12, 3:6-11; EX1006, 2:24-29, 3:29-5:15, 5:22-6:2, Figs. 7, 8; EX1002, ¶257.

2. Motivation to Combine JP105 and Kubo with a Reasonable Expectation of Success (Ground 2)

A POSITA would have been motivated to combine JP105 and Kubo such that JP105's phase shift oscillator circuit uses Kubo's circuitry that generates a voltage for adjusting oscillation frequency and resistor 8 to apply the voltage to the anode of varactor diode 35. EX1006, 5:27-6:2; EX1003, 3:5-7, 3:18-21, 4:19-21, Fig. 4. The resulting circuit of the combination shown below. EX1002, ¶258.



EX1006 (Fig. 8) and EX1003 (item 8 and terminal C of Fig. 4) combined

(annotated)

A POSITA would have combined JP105 and Kubo in this manner for the following reasons. JP105 already discloses that its phase shift oscillator circuit includes a bias transfer resistor 47 that applies a "capacitance control voltage" to the anode of varactor diode 35. EX1006, 5:27-6:2, Fig. 8. By applying this voltage, capacitance of varactor diode 35 is controlled, which controls oscillation frequency by compensating variations caused by temperature changes and providing "temperature stabilization" for frequency over a range of temperatures. *Id.*, 4:3-9, 4:28-5:2, 5:27-6:2, Fig. 7; EX1002, ¶259.

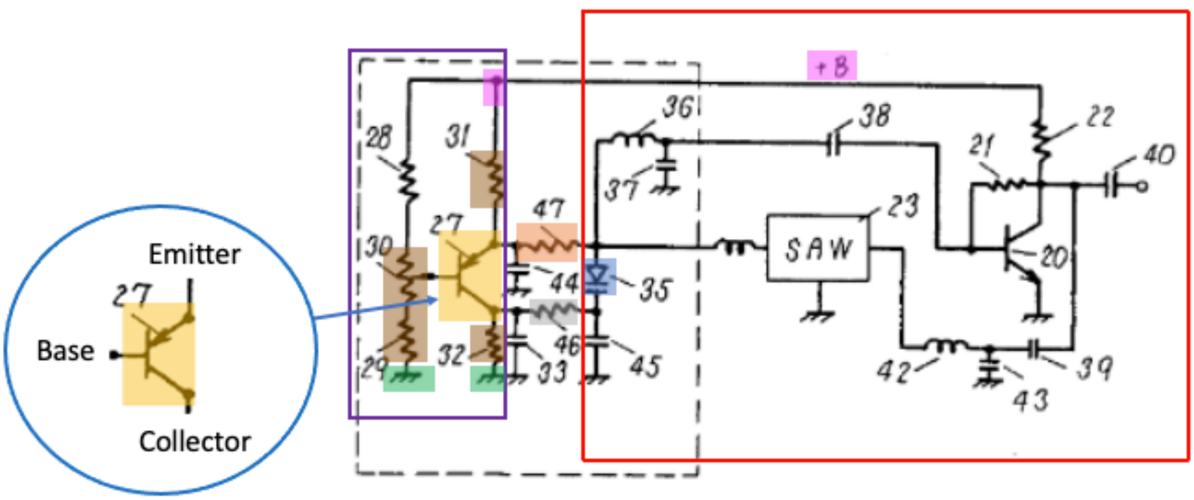
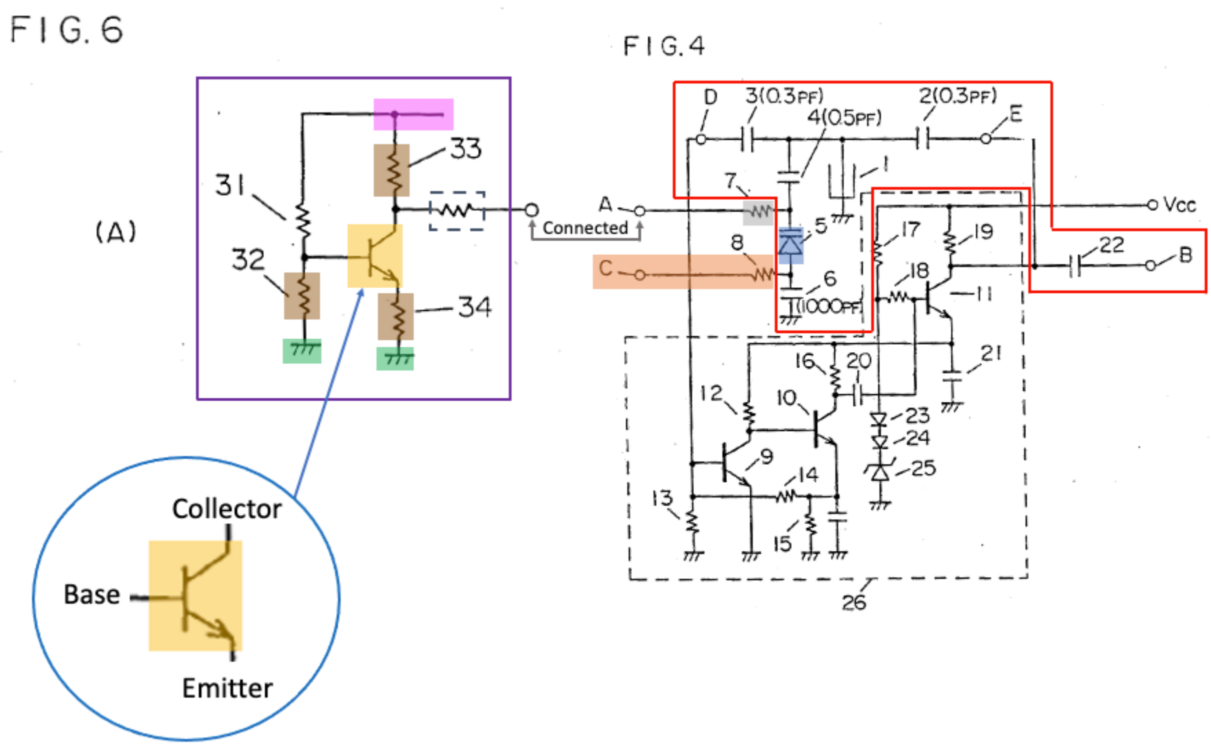


FIG. 8

EX1006, Fig. 8 (annotated)

Kubo operates similarly, where circuitry that generates a voltage for adjusting oscillation frequency and resistor 8 applies a "voltage for adjusting oscillation frequency" to the anode of variable capacitance diode 5. EX1003, 3:5-7, 3:18-21, 4:17-26, Fig. 4; Section III.A.4.c. By applying this voltage, the voltage formed across variable capacitance diode 5 is adjusted, which biases the capacitance of diode 5, controlling output oscillation frequency. *Id.* Using this circuitry and resistor of Kubo allows for configuring the amount of voltage applied to the anode. *Id.* EX1002, ¶260.



EX1003, Figs. 4, 6(A) (annotated)

Kubo therefore simply describes a similar way of applying a voltage to the anode of a variable capacitance diode as described by JP105, but allows for the flexibility of configuring of the voltage applied, and a POSITA would have therefore been motivated to use Kubo's circuitry that generates a voltage for adjusting oscillation frequency and resistor 8 to deliver a voltage to JP105's variable capacitance diode (i.e., varactor diode 35). Combining Kubo with JP105 in this manner would have been routine and well within the capabilities of a POSITA because it would have only required known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at Figure 8 and Kubo at Figure 4. This is also because in combination, Kubo's circuitry that generates a voltage for adjusting oscillation frequency and resistor 8 would have been situated in JP105's system just like it already is in Kubo, connected to the anode of a variable capacitance diodeand whether combined or not, Kubo's functionality of providing an input bias voltage to the variable capacitance diode's anode and JP105's functionality of applying a voltage to varactor 35's anode of would have been the same. *Id.*; EX1002, ¶261.

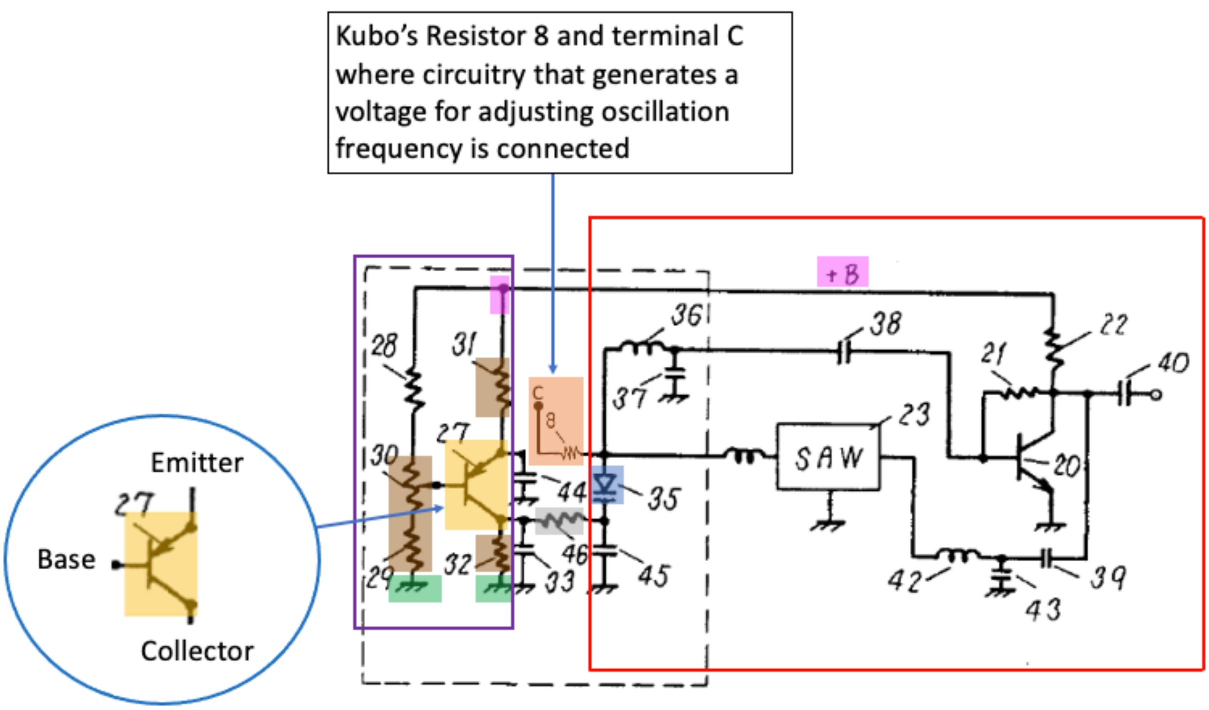


FIG. 8

EX1006 (Fig. 8) and EX1003 (item 8 and terminal C of Fig. 4) combined

(annotated)

A POSITA would have further understood that the results would have been predictable; namely, that a voltage would have been applied by Kubo's circuitry that generates a voltage for adjusting oscillation frequency and resistor 8 to the anode of JP105's varactor diode 35. Prior to combining, JP105's bias transfer resistor 47 applies a "capacitance control voltage" to the anode of varactor diode 35, which adjusts the capacitance of the diode and controls oscillation frequency by compensating frequency variations caused by temperature changes. EX1006, 5:3-9, 4:28-5:2, 5:27-6:2, Figs. 7, 8. Using Kubo's circuitry that generates a voltage for adjusting oscillation frequency and resistor 8 would have achieved the same functionality and, just as when uncombined, resulted in a voltage output to the anode of varactor diode 35 to adjust capacitance of the diode and control oscillation frequency by compensating frequency variations caused by temperature changes. *Id.;* EX1003, 3:5-7, 3:18-21, 4:17-26, Fig. 4; Section III.A.4.c. And due to this predictable nature of the combination as discussed, there would have been a reasonable expectation of success in making the combination in this manner as well. *Id.*; EX1002, ¶262.

The above analysis demonstrates that there are multiple motivations for combining JP105 and Kubo:

- Combining prior art elements (JP105's phase shift oscillator circuit with Kubo's resistor 8 and circuitry that generates a voltage for adjusting oscillation frequency) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at Fig. 8 and Kubo at Fig. 4) to yield predictable results (delivery of a voltage by Kubo's resistor 8 and circuitry that generates a voltage for adjusting oscillation frequency to an anode of JP105's varactor diode 35). EX1002, ¶263.
- Simple substitution of one known element (using Kubo's resistor 8 and circuitry that generates a voltage for adjusting oscillation frequency to apply a voltage to the anode of a variable capacitance diode) for another (using JP105's bias transfer resistor 47 to apply a voltage to the anode of a variable capacitance diode (varactor diode 35)) to obtain predictable results (using Kubo's resistor 8 and circuitry that generates a voltage for adjusting oscillation frequency to apply a voltage to the anode of a variable capacitance diode (varactor diode 35)). EX1002, ¶263.

3. Motivation to Combine JP105, Kubo, and Kokubo with a Reasonable Expectation of Success (Ground 3)

A POSITA would have been motivated to combine JP105 and Kubo for the reasons discussed above in Section III.B.2. A POSITA would have been further motivated to combine JP105 and Kubo with Kokubo for the reasons discussed below. EX1002, ¶264.

a) Combining Kokubo's resistor 114 alone with the JP105-Kubo system

A POSITA would have been motivated to combine the JP105-Kubo system with Kokubo such that JP105's circuitry uses Kokubo's resistor 114. EX1006, 3:29-4:2, 5:22-6:2, Fig. 8; EX1004, 7:21-30, 10:22-35, Fig. 14. The resulting circuit of the combination is shown below. EX1002, ¶265.

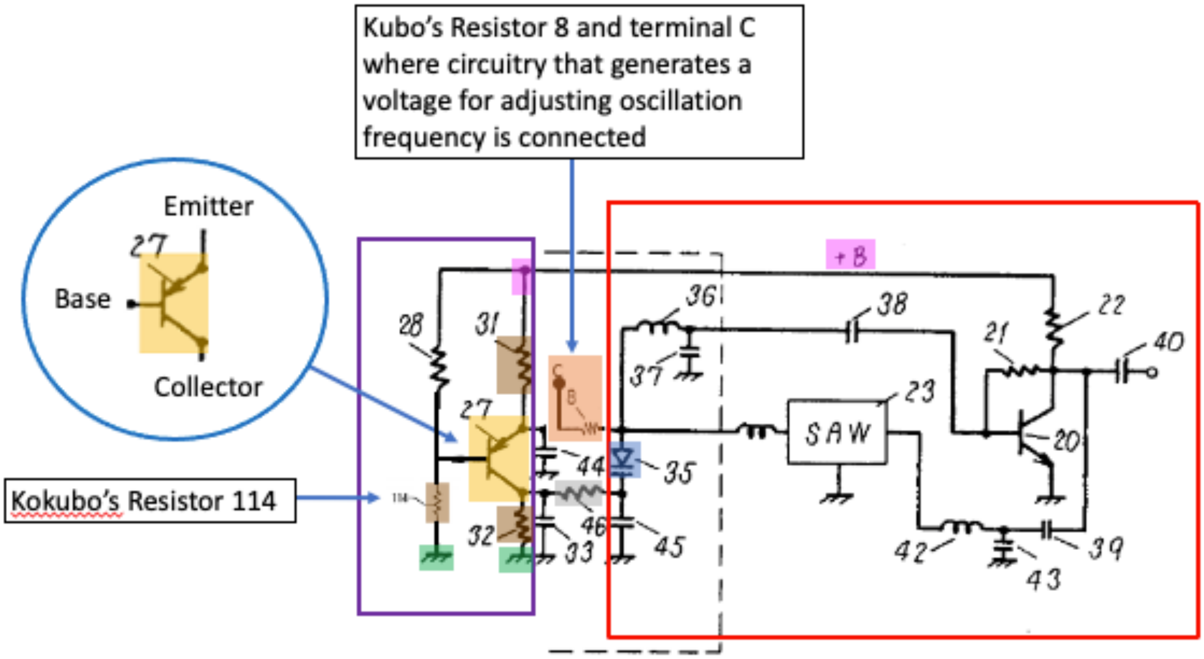
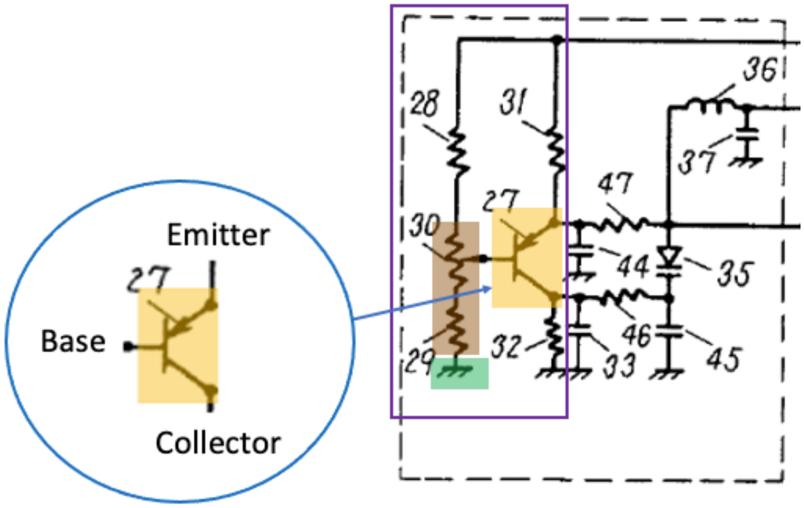


FIG. 8

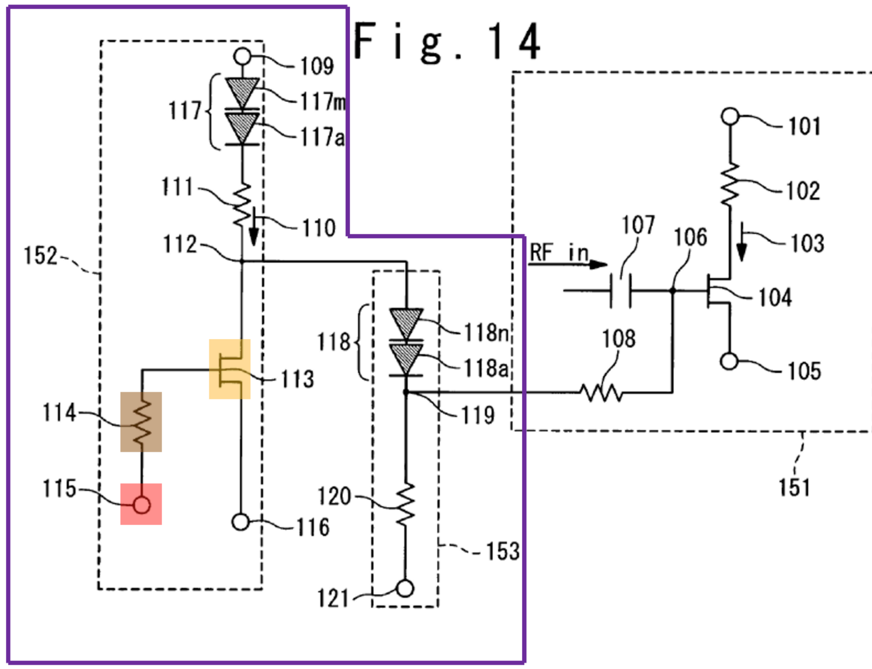
EX1006 (JP105) (Fig. 8), EX1004 (Kokubo) (resistor 114 from Fig. 14), EX1003 (Kubo) (Resistor 8 and terminal C from Fig. 4) combined (annotated)

A POSITA would have combined JP105, Kubo, and Kokubo in this manner for the following reasons. The JP105-Kubo system already describes resistors 29 and 30 connected to the base of transistor 27. EX1006, 3:29-4:2, 5:22-6:2, Fig. 8. As discussed for limitations [1h] and [1i], this resistor arrangement is used in the biasing or adjusting of the voltage applied to the base of transistor 27. *Id.*; *see* Sections III.B.4.h-i; EX1002, ¶266.



EX1006, Fig. 8 (partial view, annotated)

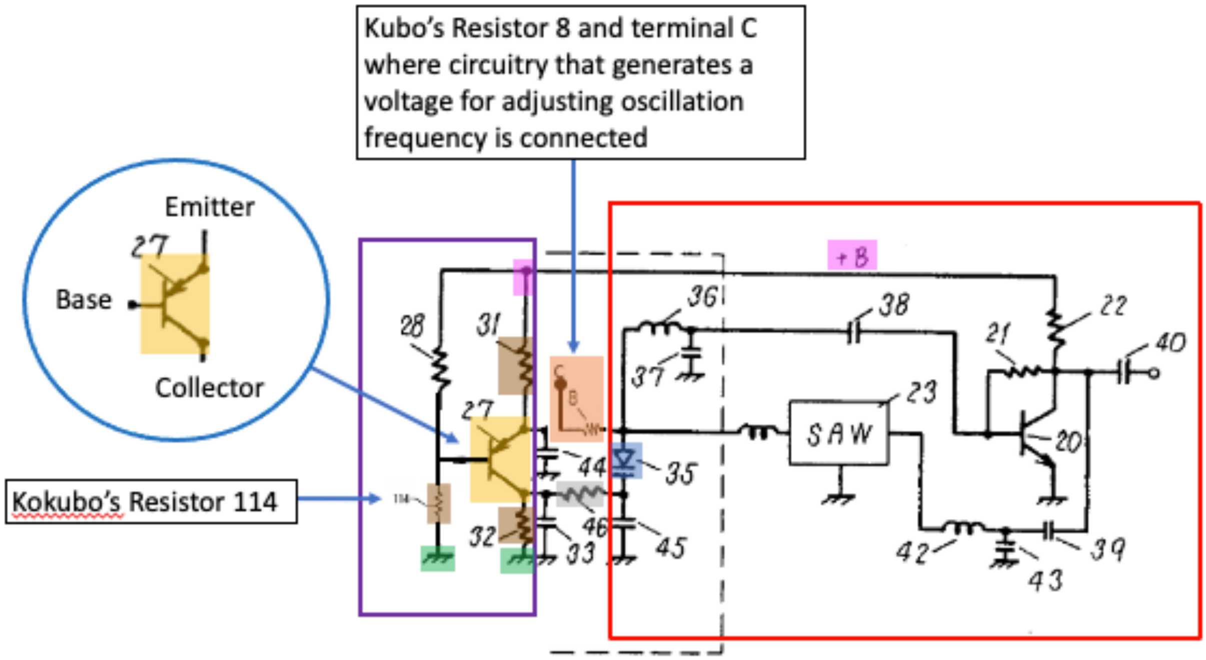
Kokubo operates similarly, where a single resistor 114 is connected to the gate of transistor 113, which is the same equivalent location the terminal and resistors are connected to in JP105, but for a FET-type transistor rather than a BJT-type transistor. *Id.*; EX1004, 7:21-30, 10:22-35, Fig. 14. As discussed for limitationa [1h] and [1i], this arrangement biases or adjusts the voltage applied to the gate of transistor 113 using resistor 114. *Id.*; Sections III.B.4.h-i; EX1002, ¶267.



EX1004, Fig 14 (annotated)

Kokubo therefore describes a simplified way of applying a bias voltage to the gate or base of a transistor using only one resistor 114 rather than multiple shown in JP105, and a POSITA would have therefore been motivated to use Kokubo's resistor 114. A POSITA would have understood that the resistance of JP105's variable resistor 30 and resistor 29 is equivalent to the single resistor of Kokubo having a corresponding resistance: in particular, a POSITA would have understood variable resistor 30 is formed by series resistances implementing a voltage divider and that the equivalent single resistor would be formed by adding resistor 29 to the series resistances of the divider from JP105 transistor base to ground. EX1002, ¶268. Thus, Kokubo's resistor 114 is simply the single resistor representing these added resistances. *Id.* Combining Kokubo with the JP105-Kubo system in this manner would have been well within the capabilities of a POSITA because it would have only required replacing two resisters with one as Kokubo illustrates at Fig. 14, using well-known circuit analysis principles where the equivalent resistance of series resistors is known to equal the sum of individual series resistances. EX1010, pp. 8-9; EX1009, p. 698 ("series resistors" are "[t]wo or more resistors connected in series," where the "total resistance is the sum of the values of each the individual resistors"); *See* Section III.B.4.h; EX1002, ¶268.

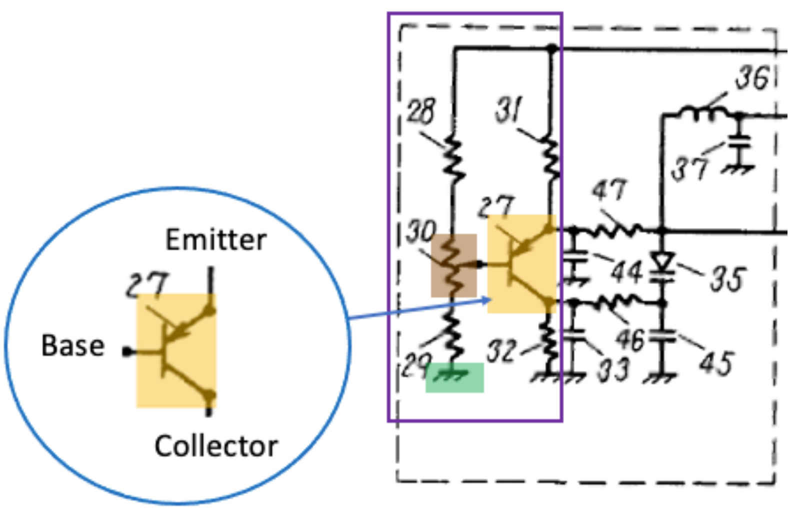
Combining Kokubo with the JP105-Kubo system in this manner would have been well within the capabilities of a POSITA because it would have only required known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at Fig. 8 and Kokubo at Fig. 14. EX1004, Fig. 14; EX1006, Fig. 8. This is also because in the combination, Kokubo's resistor 114 would have been situated in JP105's system just like it already is in Kokubo, connected to the base of a transistor 27. *Id.*; EX1002, ¶269.



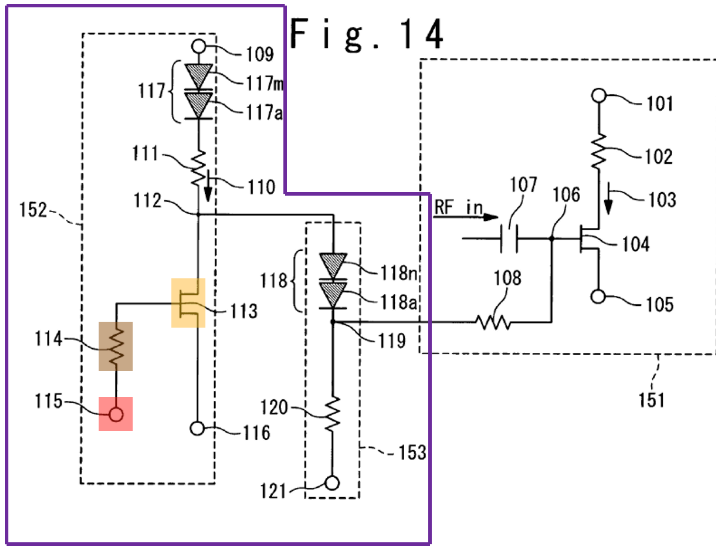
EX1006 (JP105) (Fig. 8), EX1004 (Kokubo) (Resistor 114 from Fig. 14), EX1003 (Kubo) (Resistor 8 and terminal C from Fig. 4) combined (annotated)

A POSITA would have further understood that the results of the combination would have been predictable—namely, using Kokubo's resistor 114 connected to the base of transistor 27 to apply and bias the voltage at the base rather than two separate resistors, leading to a reasonable expectation of success. EX1006, 3:29-4:2, 5:22-6:2, Fig. 8; EX1004, 7:21-30, 10:22-35, Fig. 14; *see also* Sections III.B.4.h-i Combined or not, JP105's resistors 29 and 30 and Kokubo's resistor 114 performed the same functionality of providing resistance and biasing of voltage. *Id.* And due to this predictable nature of the combination as discussed, there would have been a reasonable expectation of success in making the combination in this manner. *Id.*; EX1002, ¶270.

Moreover, like the JP105-Kubo system, Kokubo is directed to a bias circuit that provides "temperature compensation" (EX1004, 1:9-11, 6:60-62, 10:22-48, Fig. 14) and Kokubo's and resistor 114 are part of the bias circuit of Figure 14 having an almost identical arrangement to JP105's circuit in Figure 8 having resistors 29 and 30. *Id.*; EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1004, Fig. 10. The overlap in JP105 and Kokubo's goals of temperature compensation and similarity of circuit arrangement for applying voltage to a transistor's base/gate further provides a POSITA with a reasonable expectation of success in combining the teachings. *Id.*; EX1002, ¶271.



EX1006, Fig. 8 (partial view, annotated)



EX1004, Fig 14 (annotated)

While JP105's circuitry operates using a bipolar junction transistor (BJT) and Kokubo's circuitry operates using a MOSFET transistor 113, this difference is of no consequence for the reasons discussed for limitation [2k]. *See* Section III.A.4.k; EX1002, ¶272.

The above analysis demonstrates that there are multiple motivations for combining JP105, Kubo, and KoKubo:

- Combining prior art elements (JP105's phase shift oscillator circuit having a voltage applied and biased at the base of transistor 27 with Kokubo's resistor 114 used to apply a bias voltage at a transistor gate (the equivalent location for a FET transistor compared to JP105's BJT transistor)) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at Fig. 8 and Kokubo at Fig. 14) to yield predictable results (using Kokubo's resistor 114 connected to the base of transistor 27 to apply and bias the voltage at the base rather than two separate resistors). EX1002, ¶273.

- Simple substitution of one known element (using Kokubo's resistor 114 to apply and bias the voltage at a transistor gate, the equivalent location of a transistor base) for another (using JP105's resistors 29 and 30 to apply and bias the voltage at transistor 27's base) to obtain predictable results (using Kokubo's resistor 114 connected to the base of transistor 27 to apply and bias the voltage at the base rather than two separate resistors). EX1002, ¶273.

b) Combining Kokubo's terminal alone with the JP105-Kubo system

A POSITA would have been motivated to combine the JP105-Kubo system with Kokubo such that JP105's circuitry uses Kokubo's terminal alone. EX1006, 3:29-4:2, 5:22-6:2, Fig. 8; EX1004, 7:21-30, 10:22-35, Fig. 14. The resulting circuit of the combination is shown below. EX1002, ¶274.

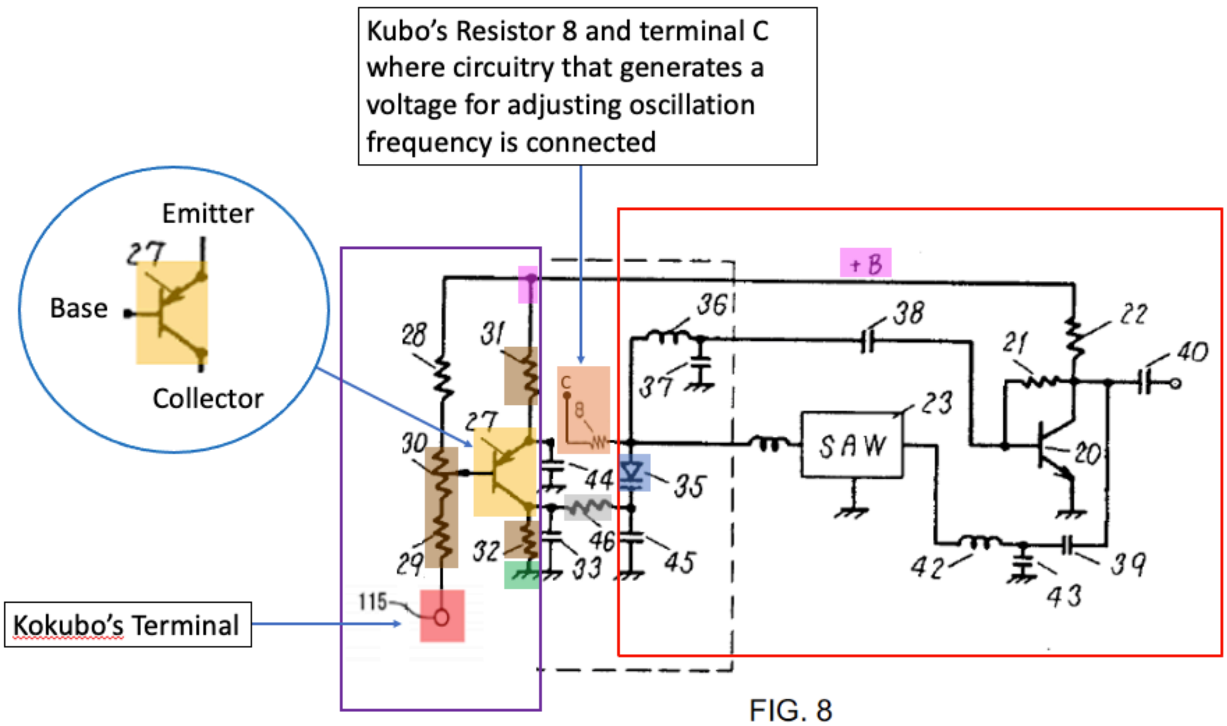
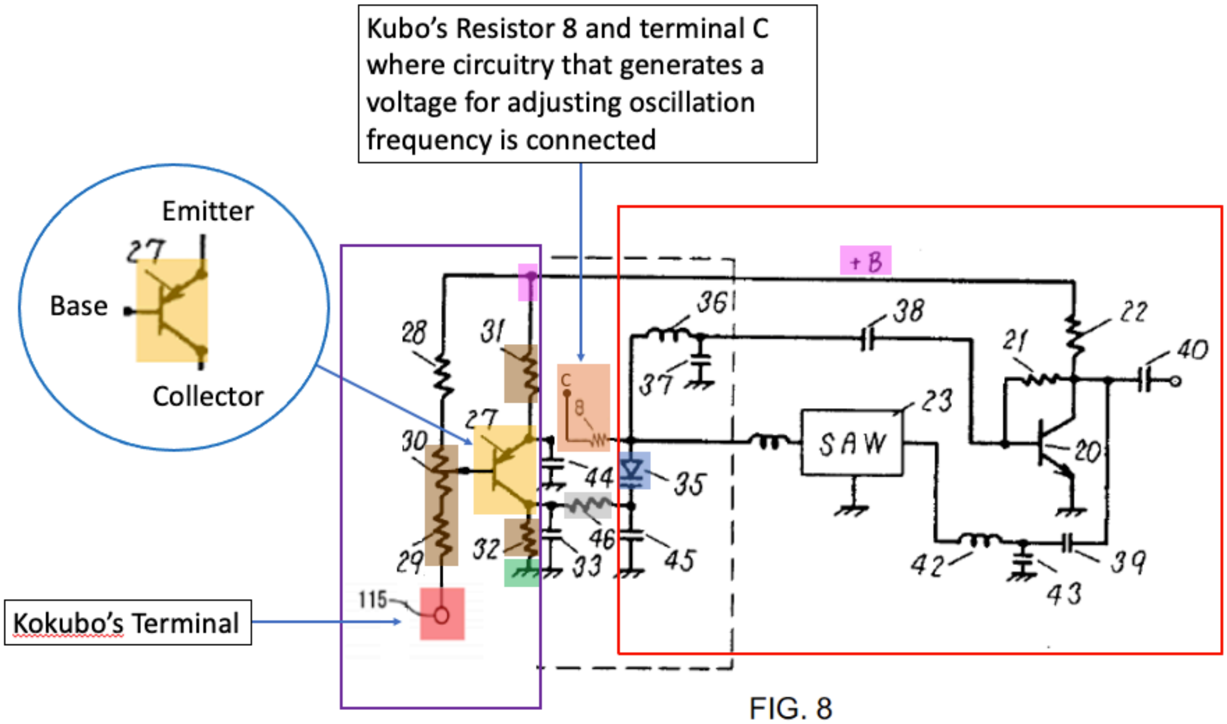


FIG. 8

EX1006 (JP105) (Fig. 8), EX1004 (Kokubo) (terminal from Fig. 14),

EX1003 (Kubo) (Resistor 8 and terminal C from Fig. 4) combined (annotated)

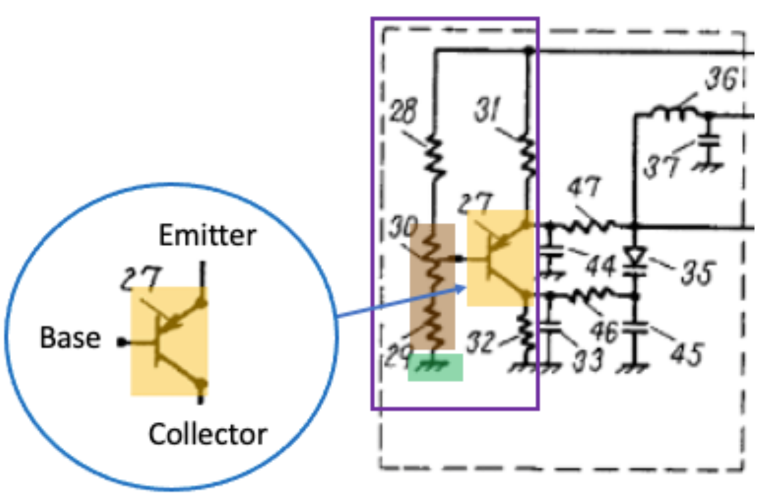
A POSITA would have combined JP105, Kubo, and Kokubo in this manner for the following reasons. The JP105-Kubo system already describes that its ground terminal biases or adjusts the voltage applied to the base of transistor 27 via resistors 29 and 30 such that the voltage takes a certain value. *See* Sections III.B.4.h-i. Kokubo operates similarly, explaining that its terminal applies a voltage 115 to the gate of transistor 113, which is the equivalent location for FET-type transistor in relation to JP105's BJT transistor, via resistor 114 to explicitely bias the transistor's gate. *Id.*; EX1004, 7:29-30, 10:22-48, Figs. 10, 14. Kokubo therefore makes explicite a way of applying a bias voltage to the gate or base of a transistor and a POSITA would have therefore been motivated to use Kokubo's terminal to apply a voltage in this manner. Combining Kokubo with the JP105-Kubo system in this manner would have been routine and well within the capabilities of a POSITA because it would have only required known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at Fig. 8 and Kokubo at Fig. 14. EX1004, Fig. 14; EX1006, Fig. 8. This is also because in the combination, Kokubo's terminal would have been situated in JP105's system just like it already is in Kokubo, connected to the base of a transistor 27 via a resistance. *Id.*; EX1002, ¶275.



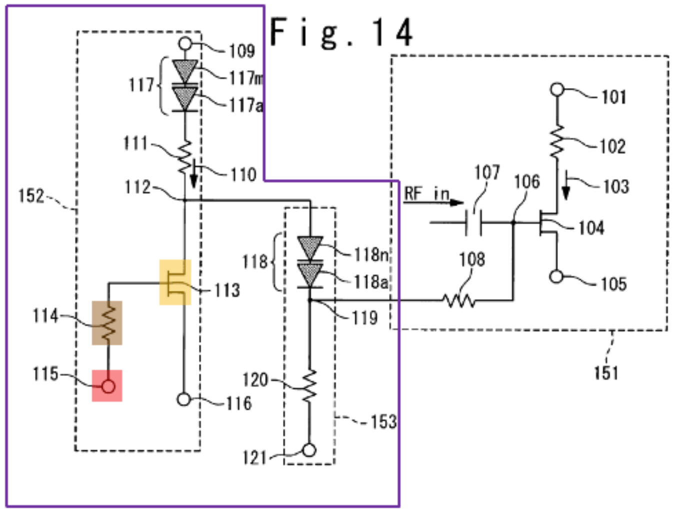
EX1006 (JP105) (Fig. 8), EX1004 (Kokubo) (Resistor 114 and terminal from Fig. 14), EX1003 (Kubo) (Resistor 8 and terminal C from Fig. 4) combined (annotated)

A POSITA would have further understood that the results of the combination would have been predictable—namely, using Kokubo's terminal connected to the base of transistor 27 via resistance to apply and bias voltage at the base rather than a ground terminal connected to the base via resistance. Further, prior to combining, JP105's arrangement of the grounded terminal and resistors 29 and 30 biases or adjusts the voltage applied to the base of transistor 27 as discussed above. Combined or not, the JP105-Kubo arrangement and Kokubo would have performed the same functionality of biasing the equivalent location (i.e., base or gate) of a transistor. EX1006, 3:29-4:2, 5:22-6:2, Fig. 8; *see also* Sections III.B.4.h-i. Using Kokubo's terminal instead of the ground terminal with resistors 29 and 30 as discussed would have achieved the same functionality and, just as when uncombined, resulted in biasing or adjusting the voltage applied to the base of transistor 27. EX1004, 7:21-30, 10:22-35, Fig. 14; Sections III.B.4.h-i. And due to this predictable nature of the combination as discussed, there would have been a reasonable expectation of success in making the combination in this manner. *Id.*; EX1002, ¶276.

Further, like JP105, Kokubo is directed to a bias circuit that provides "temperature compensation" and Kokubo's terminal and JP105's ground terminal are located in the same equivalent locations of their almost identical bias circuits.. EX1004, 1:9-11, 6:60-62, 10:22-48, Fig. 14; EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1004, Fig. 10; EX1002, ¶277.



EX1006, Fig. 8 (partial view, annotated)



EX1004, Fig 14 (annotated)

While JP105's circuitry operates using a bipolar junction transistor (BJT) and Kokubo's circuitry operates using a MOSFET transistor 113, this difference is of no consequence for the reasons discussed for limitation [2k]. *See* Section III.A.4.k; EX1002, ¶278.

The above analysis demonstrates that there are multiple motivations for combining JP105, Kubo, and KoKubo:

- Combining prior art elements (JP105's phase shift oscillator circuit having a voltage applied and biased at the base of transistor 27 with Kokubo's terminal applying and biasing a voltage at a transistor gate (the equivalent location for a FET transistor compared to JP105's BJT transistor)) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at Fig. 8 and Kokubo at Fig. 14) to yield predictable results (Kokubo's terminal connected to the base of transistor 27 via resistance to apply and bias voltage at the base). EX1002, ¶279.

- Simple substitution of one known element (using Kokubo's terminal to apply and bias the voltage at a transistor gate, the equivalent location of a transistor base) for another (using JP105's ground terminal to apply and bias the voltage at transistor 27's base) to obtain predictable results (using Kokubo's terminal to apply and bias voltage at the base). EX1002, ¶279.

c) Combining Kokubo's resistor 114 and terminal with the JP105-Kubo system

The reasoning in Sections III.B.3.a-b above demonstrate that a POSITA would have been motivated to combine the JP105-Kubo system with Kokubo such that JP105's circuitry uses Kokubo's resistor 114 and terminal connected to resistor 114 that provides voltage 115 with a reasonable expectation of success:

- Combining prior art elements (JP105's phase shift oscillator circuit having a voltage applied and biased at the base of transistor 27 with Kokubo's terminal and resistor 114 applying and biasing a voltage at a transistor gate (the equivalent location for a FET transistor compared to JP105's BJT transistor)) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at Fig. 8 and Kokubo at Fig. 14) to yield predictable results (using Kokubo's resistor 114 and terminal connected to the base of transistor 27 to apply and bias at voltage at the base). EX1002, ¶280.

- Simple substitution of one known element (using Kokubo's resistor 114 and terminal to apply and bias the voltage at a transistor gate, the equivalent location of a transistor base) for another (using JP105's ground terminal and resistors 29 and 30 to apply and bias the voltage at a transistor 27's base) to obtain predictable results (using Kokubo's resistor 114 and terminal to apply and bias the voltage at transistor 27's base). EX1002, ¶280.

4. Claim 1 is unpatentable under 35 U.S.C. § 103(a) over JP105 and Kubo (Proposed Rejection 2) and JP105, Kubo, and Kokubo (Proposed Rejection 3)

a. [1a-preamble] "A voltage-controlled oscillator comprising:"

To the extent the preamble is limiting, the JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose it or at least render it obvious in the same way. In both combinations, JP105 discloses or at least renders obvious a *voltage-controlled oscillator* in the form of its Figure 8 phase shift oscillator circuit, where a voltage applied to varactor diode 35 of the oscillator controls oscillation frequency by providing temperature compensation and maintaining oscillation frequency as temperature changes. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶281.

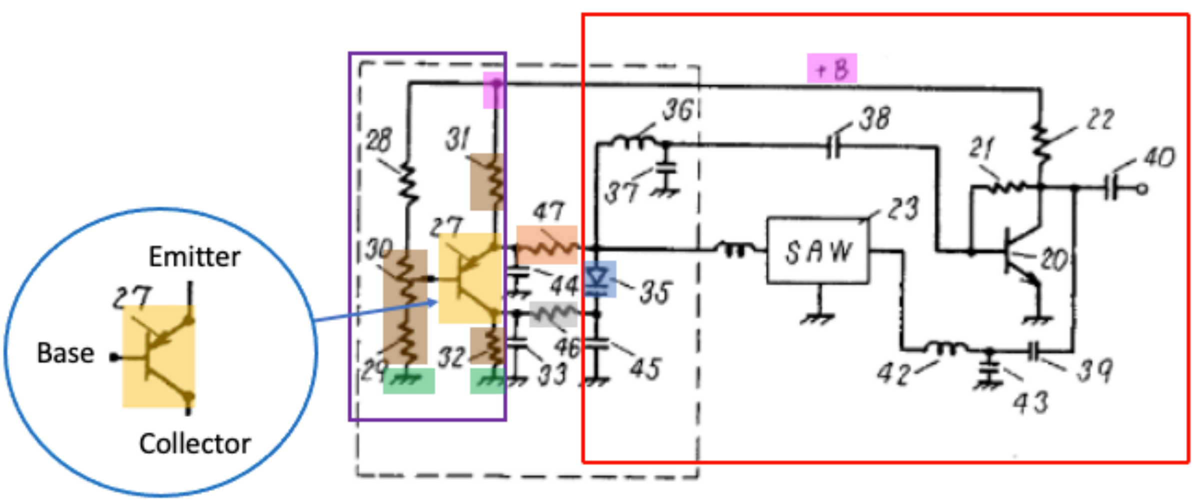
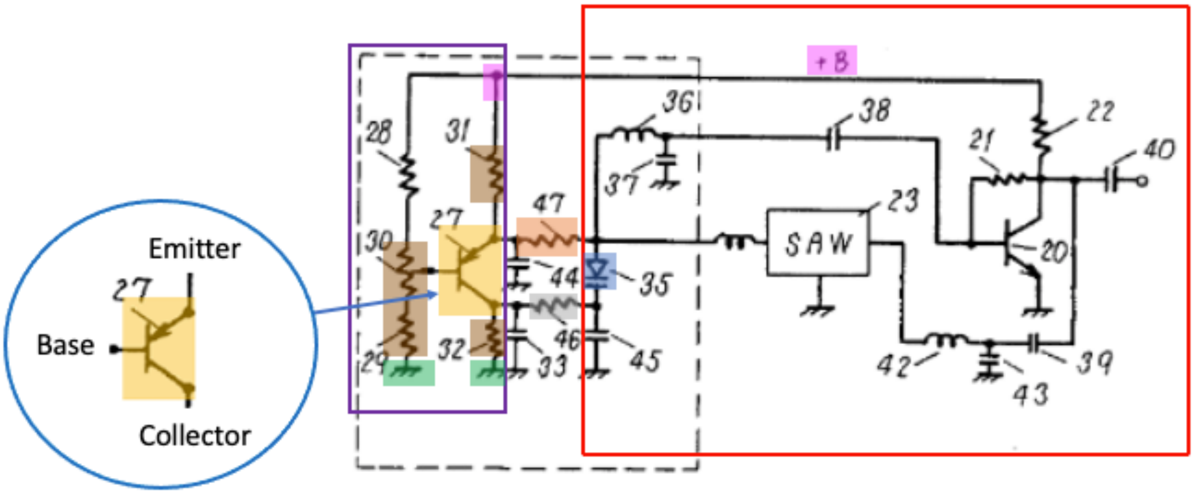


FIG. 8

EX1006, Fig. 8 (annotated)

b. [1b] "a voltage-controlled oscillation section which controls oscillation frequency through a voltage applied to a variable-capacitance element;"

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least render obvious limitation [1b] in the same way. In both combinations, JP105 discloses that its phase shift oscillator circuit (*voltage-controlled oscillator*) includes transistor 20, resistors 21 and 22, surface acoustic wave (SAW) 23, varactor diode 35, inductance 36 and 42, and capacitors 37, 38, 39, 40, 43, and 45, which are outlined in red in Figure 8 below; collectively, these components disclose, or at least render obvious, a *voltage-controlled oscillation section* because they are a *section* of the circuitry formed by JP105's phase shift oscillator circuit (*voltage-controlled oscillator*) that collectively operate to provide an oscillation frequency output via coupling capacitor 40 and control oscillation frequency by voltage applied across varactor diode 35 (*voltage-controlled oscillation*). EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶282.



EX1006, Fig. 8 (annotated)

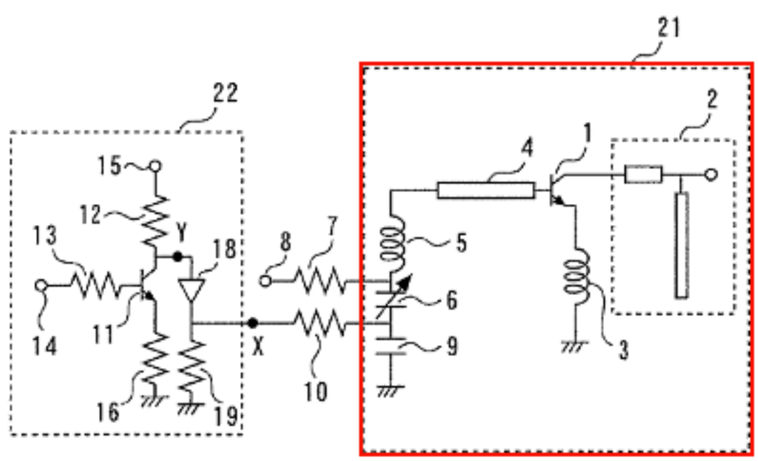
Components 20-23, 35-40, 42, 43, and 45 (*voltage-controlled oscillation section*) further *control[] oscillation frequency through a voltage applied to a variable-capacitance element*. JP105 discloses or at least renders obvious a *variable-capacitance element*—whether *variable-capacitance element* is interpreted as a means-plus-function limitation or not—because JP105 describes varactor diode 35 (corresponding to the identified means-plus-function structure of a "diode, pn diode, and Schottky diode, and equivalents" discussed in Section II.F), which is a known type of diode (as well as a pn diode) whose capacitance varies as voltage applied to it changes. EX1006, 4:3-4, 4:28-30, Fig. 8; EX1009, p. 831 (explaining a "varactor" is a "pn-junction diode" having a "capacitance [that] varies as a function of its applied voltage"). Varactor diode 35 further receives applied frequency control bias voltage at a first end and receives applied temperature compensation bias voltage at a second end (corresponding to the identified function discussed in Section II.F) as discussed for limitations [1c] and [1d]. *Id.*; *see* III.B.4.c-III.B.4.d; Section II.F; EX1002, ¶283.

A POSITA would have understood varactor diode 35 is a known type of diode whose capacitance varies as voltage applied across it changes. EX1006, 4:3-4, 4:28-30, Fig. 8. This is corroborated by EX1009, which explains a "varactor" is a "pn-junction diode" having a "capacitance [that] varies as a function of its applied voltage." EX1009, p. 831. EX1010 also corroborates this understanding, explaining a "varactor diode is an ordinary pn-diode that uses the voltage-dependent variable capacitance of the diode." EX1010, p. 598; EX1002, ¶284.

Back to the limitation analysis, components 20-23, 35-40, 42, 43, and 45 (*voltage-controlled oscillation section*) further *control[] oscillation frequency through a voltage applied to* varactor diode 35 (*variable-capacitance element*) because, as noted above for limitation [2b], they collectively operate to generate an oscillation frequency output that is controlled (*controls oscillation frequency*) by voltage applied across (*through a voltage applied to*) varactor diode 35 (*a variable-capacitance element*), where changing the voltage controls output oscillation frequency such that frequency changes due to temperature changes are compensated. EX1006, 4:3-4, 4:28-30, Fig. 8; EX1002, ¶285.

To the extent limitation [1b] is interpreted as a means-plus-function limitation, JP105 discloses or at least renders obvious the identified functionality of *control[ling] oscillation frequency through a voltage applied to a variable-capacitance element* for the reasons discussed above for this limitation. *See* Section II.F. JP105 further discloses, or at least renders obvious, an equivalent to the '318 Patent's identified structure of the circuit shown by voltage-controlled oscillation section 21 in Figures 1, 3, 4, and 6. *See* EX1001, Figs. 1, 3, 4, 6; Section II.F; EX1002, ¶286.

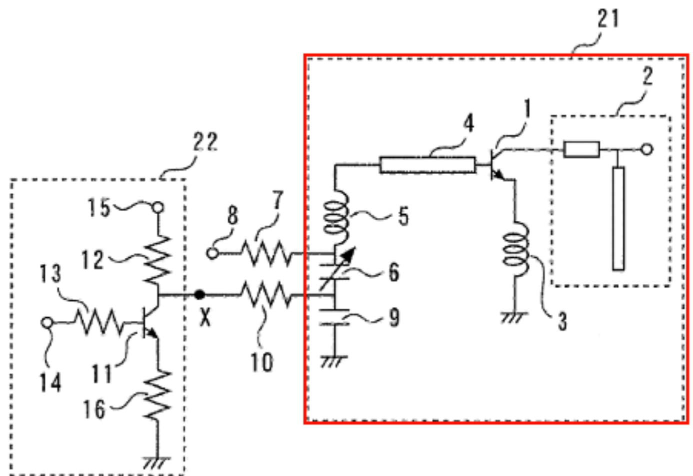
FIG. 3



EX1001, Fig. 3 (annotated)

FIG. 6

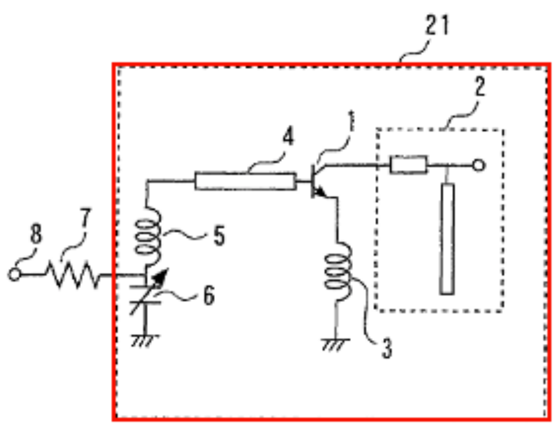
Conventional Art



EX1001, Fig. 6 (annotated)

FIG. 4

Conventional Art



EX1001, Fig. 4 (annotated)

JP105's components 20-23, 35-40, 42, 43, and 45 form an equivalent because they perform the function of *control[ling] oscillation frequency through a voltage applied to a variable-capacitance element* in substantially the same way (in JP105 and the '318 patent, by receiving a voltage applied to a varactor diode 35 (for JP105) or variable capacitance element 6 (for the '318 patent), capacitance of the diode/variable capacitance element changes, which in turn is used to control oscillation frequency and compensate frequency variations caused by temperature change) and produce substantially the same results (i.e., in both JP105 and the '318 patent, control of oscillation frequency and compensation of frequency variations caused by temperature change) as the identified structure. EX1006, 4:3-4, 4:28-30, Fig. 8; EX1001, 1:23-37, 2:16-31, 3:65-4:24, 4:54-64, 5:29-51, 6:12-22, Figs. 1, 3, 4, 6; Section II.F; EX1002, ¶287.

A POSITA would have further recognized the interchangeability of components 20-23, 35-40, 42, 43, and 45 for the identified structure of the '318 patent's voltage-controlled oscillation section 21. EX1001, 1:23-37, 3:65-4:24, 5:29-51, Figs. 1, 3, 4, 6); Section II.F; *Caterpillar Inc. v. Deere & Co.*, 224 F.3d 1374, 1380 (Fed. Cir. 2000); M.P.E.P. 2183. Indeed, as shown by JP105, using components 20-23, 35-40, 42, 43, and 45 was a known alternative to voltage-controlled oscillation section 21 for providing voltage-controlled oscillation that compensate frequency variations caused by temperature. EX1006, 4:3-4, 4:28-30,

Fig. 8. Interchanging such elements (e.g., interchanging JP105's components 20-23, 35-40, 42, 43, and 45 with '318 patent's identified structure of voltage-controlled oscillation section 21) and configuring circuitry would have been routine and well-within the capabilities of a POSITA at least because (1) both elements receive voltages from external circuitry applied to both ends of a variable capacitance element (e.g., for JP105, voltages applied to each end of varactor 35; for the '318 patent, voltages applied to each end of variable capacitance element 6) that changes capacitance of a variable capacitance element and adjusts oscillation frequency, (2) both elements perform similar functionality (e.g., controlling oscillation frequency that compensate frequency variations caused by temperature), and (3) there is overlap in the specific components each use (e.g., JP105's structure includes resistors 21 and 22, transistor 20, capacitors 37 and 40, inductor 36, which respectively correspond to the voltage-controlled oscillation section 21's inductor 5 forming an LC resonance circuit, variable-capacitance element 6, and direct current blocking capacitor). *Id.* For the same reasons, there are merely insubstantial differences between JP105's components 20-23, 35-40, 42, 43, and 45 and the '318 patent's voltage-controlled oscillation section 21, and an equivalence analysis does not focus "heavily or exclusively on physical structure" anyway. *IMS Technology, Inc. v. Haas Automation, Inc.*, 206 F.3d 1422, 1436 (Fed. Cir. 2000); *Minks v. Polaris Industries, Inc.*, 546 F.3d 1364, 1379 (Fed. Cir. 2008); *Odetics, Inc. v.*

Storage Technology Corp., 185 F.3d 1259, 1268 (Fed. Cir. 1999); M.P.E.P. 2183. Moreover, JP105's components 20-23, 35-40, 42, 43, and 45 (e.g., a resistor, transistor, capacitor, and inductor arrangement) are not excluded by any explicit definition in the '318 patent's specification for an equivalent to voltage-controlled oscillation section 21. EX1001, 5:33-41, 6:44-48 (explaining "many modifications and variations of the present invention are possible"); *Paice LLC v. Toyota Motor Corp.*, 54 F.3d 1293, 1310-11 (Fed. Cir. 2007) (finding equivalence in the doctrine of equivalents context when the patent's specification did not disavowal the equivalent); M.P.E.P. 2183; EX1002, ¶288.

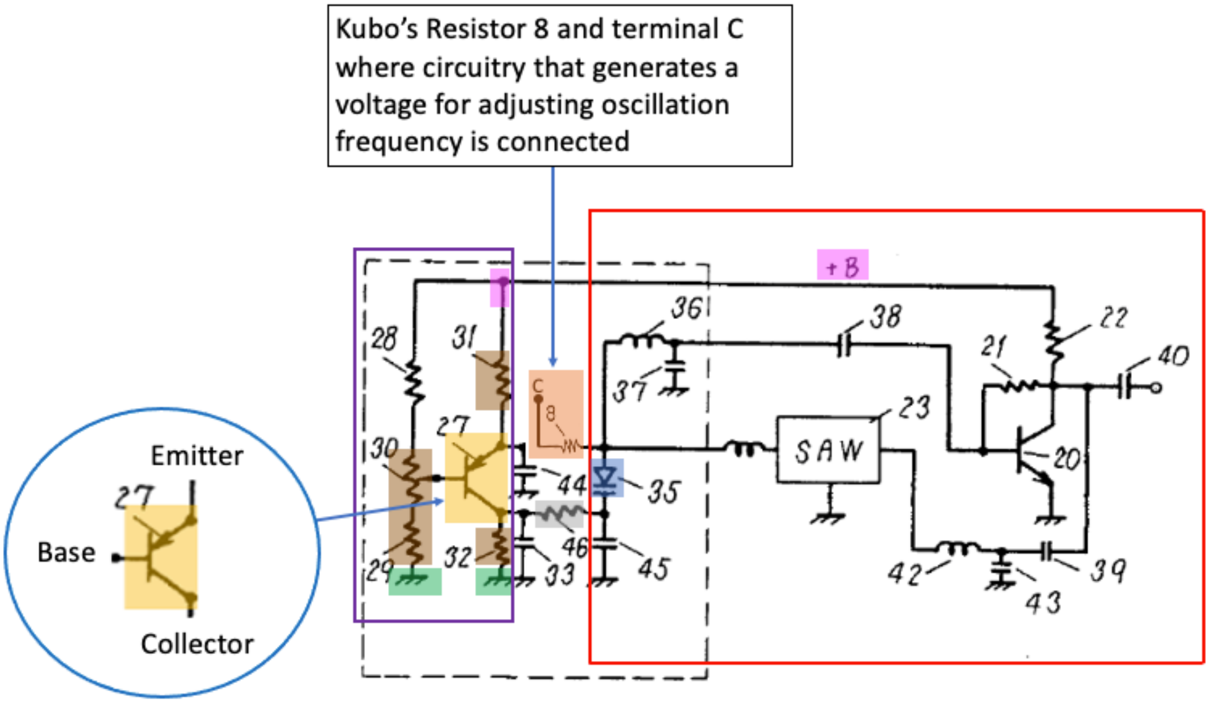
That limitation [1b], whether interpreted as a means-plus-function element or not, is generally known by a POSITA is further corroborated by the '318 patent's Applicant Admitted Prior Art (AAPA) statements. AAPA explicitly identifies voltage-controlled oscillation section 21 shown in Figures 1, 3, 4 and 6 (the identified means-plus-function structure for *voltage controlled oscillation section*, (*see* Section II.F)) as "conventional art" and part of a "conventional voltage-controlled oscillator" that performs the function of *control[ling] oscillation frequency through a voltage applied to a variable-capacitance element*. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6. A POSITA would have modified JP105 with a reasonable expectation of success such that it includes the AAPA structure ('318 patent's voltage-controlled oscillation section 21) rather than JP105's components

20-23, 35-40, 42, 43, and 45 because, as discussed above, the components are interchangeable. As modified, JP105's system (and AAPA) would have performed the same function as when unmodified (e.g., control of oscillation frequency) and the results would have been predictable: control of oscillation frequency to compensate frequency variations caused by temperature using voltage applied to a variable-capacitance diode. *Id.*; *see* Section III.B.4.b, *supra*. This demonstrates at least the following motivations to combine: simple substitution of one known element (AAPA's voltage controlled oscillation section 21) for another (JP105's components 20-23, 35-40, 42, 43, and 45) to obtain predictable results (control of oscillation frequency to compensate frequency variations as discussed above); combining prior art elements (AAPA's voltage controlled oscillation section 21 with JP105's circuit including components 20-23, 35-40, 42, 43, and 45) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at Fig. 8 and AAPA at Fig. 6) to yield predictable results (control of oscillation frequency to compensate frequency variations as discussed above). EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1001, 1:23-37, 2:16-31, 3:65-4:24, 4:54-64, 5:29-51, 6:12-22, Figs. 1, 3, 4, 6; Section II.F; EX1002, ¶289.

Any alleged differences between limitation [1b] and the prior art cannot confer patentability because the '318 patent admits this limitation is conventional, and a POSITA would have used this conventional technology in JP105 with a reasonable expectation of success using known techniques as discussed above. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6; *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337-39 (Fed. Cir. 2020); *see Memorandum on Treatment of Statements of the Applicant in the Challenged Patent in Inter Partes Reviews under § 311* (August 18, 2020) ("AAPA Memo"), pp. 5, 6, 9; EX1002, ¶290.

c. [1c] "a frequency control bias circuit which applies a frequency control bias to a first end of the variable-capacitance element;"

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least renders obvious limitation [1c] in the same way. In both combinations, JP105 is modified by Kubo such that such that JP105's phase shift oscillator circuit (*voltage-controlled oscillator*) uses Kubo's circuitry that generates a voltage for adjusting oscillation frequency and resistor 8 (*frequency control bias circuit*) to apply the voltage (*applies a frequency control bias*) to the anode of varactor diode 35 (*to a first end of the variable-capacitance element*). *See* Section III.B.3; EX1006, 5:27-6:2. Kubo's circuitry that generates a voltage for adjusting oscillation frequency and resistor 8 is a *frequency control bias circuit* that *applies a frequency control bias* for the reasons discussed for limitation [2c]. *See* Section III.A.4.c. A combined figure showing the result of the combination is included below; EX1002, ¶291.



EX1006 (Fig. 8) and EX1003 (item 8 and terminal C of Fig. 4) combined

(annotated)

A POSITA would have been motivated to combine JP105 and Kubo in this manner for the reasons discussed in Section III.B.2. EX1002, ¶292.

As shown in the above analysis, limitation [1c] is therefore known in the prior art to a POSITA. That limitation [1c], whether interpreted as a means-plus-function element or not, is generally known by a POSITA is further corroborated by the ’318 patent’s Applicant Admitted Prior Art (AAPA) statements. The ’318 patent’s AAPA explicitly identifies frequency control bias circuit 7 shown in Figures 1, 3, 4 and 6 (the identified means-plus-function structure for *frequency control bias circuit*) as "conventional art" and part of a "conventional voltage-controlled oscillator" that performs the identified function of *appl[ying][] a frequency control bias to a first end of the variable-capacitance* element. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6; Section II.F. This further supports that the combination of JP105 and Kubo would have been routing and well-known to a POSITA. Further, a POSITA would have modified JP105/JP105 and Kubo with a reasonable expectation of success such that it includes the AAPA structure ('318 patent's frequency control bias circuit 7) rather than JP105's bias transfer resistor 47 / Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency because the components are interchangeable: JP105's bias transfer resistor 47 and Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency are known alternatives to the '318 patent's frequency control bias circuit 7 because they perform the same functionality of *appl[ying][] a frequency control bias to a first end of the variable-capacitance element* as discussed above and are arranged in the same way within their respective systems. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6; EX1003, 3:5-7, 3:18-21, 4:19-21, Fig. 4; EX1006, 5:27-6:2, Fig. 8; *supra*, Section III.B.4.c; Section III.B.2. Interchanging such elements (e.g., interchanging JP105's bias transfer resistor 47 / Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency with '318 patent's identified structure of frequency control bias circuit 7) and configuring the circuitry would have been routine and well-within the capabilities of a POSITA at least because (1) these elements apply a frequency control bias voltage to a first end of variable capacitance diode to adjust its capacitance (e.g., JP105's bias transfer resistor 47 is used to apply a generated "capacitance control voltage" to a first end (anode) of varactor diode 35, changing the diode's capacitance and adjusting oscillation frequency; Kubo uses resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency to apply the voltage to a first end of variable capacitance diode 5, via terminal C, changing the diode's capacitance and adjusting oscillation frequency; the '318 patent uses frequency control bias circuit 7 to apply voltage to a first end of variable capacitance element, changing its capacitance and adjusting oscillation frequency), (2) both elements perform the same functionality (e.g., appl[ying][] a frequency control bias to a first end of the variable-capacitance element), and (3) there is overlap in the specific components each use (e.g., JP105's bias transfer resistor 47 as arranged is a resistor circuit used to apply a generated voltage; Kubo's structure includes resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency, which is a resistor feed-type circuit; the '318 patent uses frequency control bias circuit 7, which is shown as including a resistor in Figure 6 and described a being a resistor feed-type circuit). *Id.* Also, for the same reasons, there are merely insubstantial differences between JP105's bias transfer resistor 47, Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency, and the '318 patent's frequency control bias circuit 7. Moreover, JP105's bias transfer resistor 47 / Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency are not excluded by any explicit definition in the '318 patent's specification for an equivalent to frequency control bias circuit 7. EX1001, 5:33-41, 6:44-48 (explaining "many modifications and variations of the present invention are possible"); EX1002, ¶293.

As modified, JP105-Kubo's system (and AAPA) would have performed the same function as when unmodified (e.g., applying a frequency control bias voltage to a first end of variable capacitance element) and the results would have been predictable: applying a frequency control bias voltage to a first end of varactor diode 35 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature. *Supra*, Section III.B.4.c.; EX1002, ¶294.

This establishes the following motivations to combine: simple substitution of one known element (AAPA's frequency control bias circuit 7) for another (JP105's bias transfer resistor 47 / Kubo's resistor 8 and the circuitry that generates a voltage for adjusting oscillation frequency) to obtain predictable results (applying a frequency control bias voltage to a first end of varactor diode 35 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature); combining prior art elements (AAPA's frequency control bias circuit 7 with JP105's Figure 8 circuitry, such that AAPA's frequency control bias circuit 7 is used to apply voltage to varactor diode 35) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at FIG. 8, Kubo at Fig. 4 and AAPA at Fig. 6) to yield predictable results (applying a frequency control bias voltage to a first end of varactor diode 35 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature). EX1002, ¶295.

Any alleged differences between limitation [1c] and the prior art cannot confer patentability because the '318 patent admits this limitation is conventional, and a POSITA would have used this conventional technology in JP105/Kubo with a reasonable expectation of success using known techniques as discussed above. EX1001, 1:14-37, 1:54-67, Figs. 1, 3, 4, 6; *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337-39 (Fed. Cir. 2020); *see Memorandum on Treatment of Statements of the Applicant in the Challenged Patent in Inter Partes Reviews under § 311* (August 18, 2020) ("AAPA Memo"), pp. 5, 6, 9; EX1002, ¶296.

d. [1d] "a temperature compensation bias circuit which applies a temperature compensation bias to a second end of the variable-capacitance element; and"

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least renders obvious limitation [1d] in the same way. In both combinations, JP105 discloses its phase shift oscillator circuit (*voltage-controlled oscillator*) includes bias transfer resistor 46 connected to varactor diode 35 and the circuit formed by components 27 through 32, which discloses or at least renders obvious a *temperature compensation bias circuit*. EX1006, 5:27-6:2, Fig. 8; EX1002, ¶297.

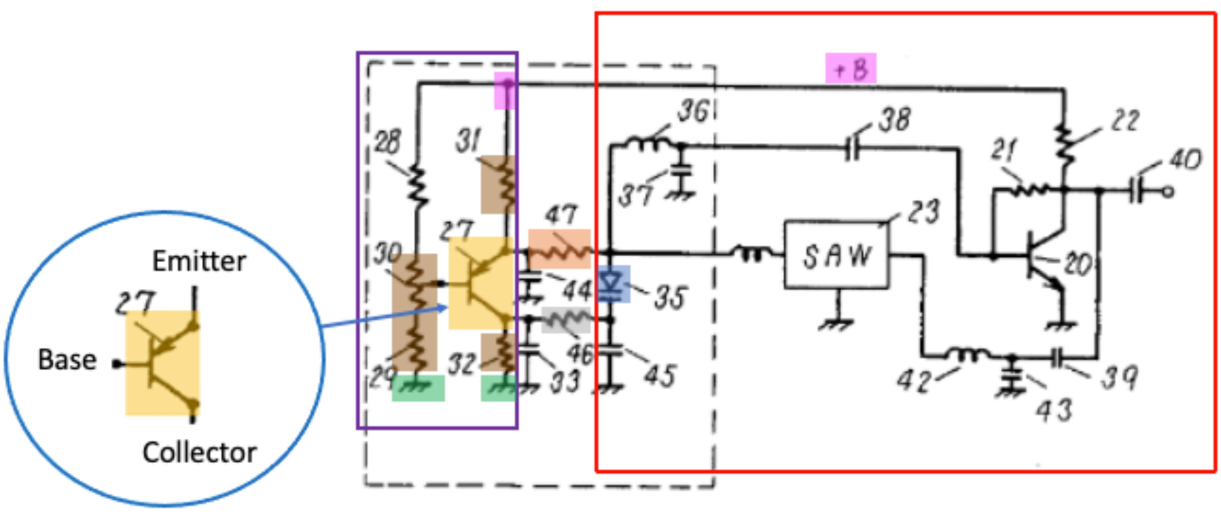


FIG. 8

EX1006, Fig. 8 (annotated)

As bias transfer resistor 46 is arranged (*temperature compensation bias circuit*), it applies a "capacitance control voltage" (*applies a temperature compensation bias*) received from the collector of transistor 27 to the cathode (*to a second end*) of varactor diode 35 (*of the variable capacitance element*). EX1006, 5:27-6:2. The voltage is a *temperature compensation bias* because it biases varactor diode 35 to provides "temperature sensitivity" for "temperature compensation," effectuating such temperature compensation over a "broad range from T_0 to T_1." *Id.*, 4:22-5:2, 5:27-6:2, Fig. 7; EX1002, ¶297.

JP105's disclosure of bias transfer resistor 46 as arranged also corresponds to how the '318 patent describes *temperature compensation bias circuit* for the same reasons discussed in limitation [2d]. Section III.A.4.d; EX1002, ¶298.

To the extent *temperature compensation bias circuit* is interpreted as a means-plus-function recitation, JP105 discloses or at least renders obvious the function of *appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element* and the identified structure of a resistor connected to a second end of the variable-capacitance element and equivalents thereof for the reasons discussed above. Section II.F; EX1002, ¶299.

As shown in the above analysis, limitation [1d] is therefore known in the prior art to a POSITA. That limitation [1d], whether interpreted as a means-plus-function element or not, is generally known by a POSITA is further corroborated by the '318 patent's Applicant Admitted Prior Art (AAPA) statements. The '318 patent's AAPA explicitly identifies "temperature compensation bias circuit 10" shown in Figures 1, 3, 4 and 6 (the identified means-plus-function structure for *temperature compensation bias circuit*) as "conventional art" and part of a "conventional voltage-controlled oscillator" that performs the identified function of *appl[ying][] a* *temperature compensation bias to a second end of the variable-capacitance element*. EX1001, 1:54-67, Fig. 6; Section II.F; EX1002, ¶300.

A POSITA would have modified JP105 with a reasonable expectation of success such that it includes the AAPA structure (’318 patent’s temperature compensation bias circuit 10) rather than JP105’s arranged bias transfer resistor 46 because the components are interchangeable: JP105’s arranged bias transfer resistor 46 is a known alternative to the ’318 patent’s temperature compensation bias circuit 10 because they perform the same functionality of *appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element* as discussed above and are arranged in the same way in their respective systems. EX1001, 1:54-67, Fig. 6; EX1006, 5:27-6:2, Fig. 8; *Supra*, Section III.B.4.d. Interchanging such elements (e.g., interchanging JP105’s arranged bias transfer resistor 46 with ’318 patent’s identified structure of temperature compensation bias circuit 10) and configuring the circuitry would have been routine and well-within the capabilities of a POSITA at least because (1) both elements apply a temperature compensation bias to a second end of the variable-capacitance element (e.g., JP105 uses arranged bias transfer resistor 46 to apply the voltage to a second end of varactor diode 35, changing the diode’s capacitance and adjusting oscillation frequency; the ’318 patent uses temperature compensation bias circuit 10 to apply voltage to a second end of variable capacitance element, changing its capacitance and adjusting oscillation frequency), (2) both elements perform the same functionality (e.g., appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element), and (3) there is overlap in the specific components each use (e.g., JP105's structure includes arranged bias transfer resistor 46; the '318 patent uses temperature compensation bias circuit 10, which is shown as an arranged resistor in Figure 6). *Id.* Also, for the same reasons, there are merely insubstantial differences between JP105's arranged bias transfer resistor 46 and the '318 patent's temperature compensation bias circuit 10. Moreover, JP105's arranged bias transfer resistor 46 is not excluded by any explicit definition in the '318 patent's specification for an equivalent to temperature compensation bias circuit 10. EX1001, 5:33-41, 6:44-48 (explaining "many modifications and variations of the present invention are possible"); EX1002, ¶301.

As modified, JP105's system (and AAPA) would have performed the same function as when unmodified (e.g., appl[ying][] a temperature compensation bias to a second end of the variable-capacitance element) and the results would have been predictable: appl[ying][] a temperature compensation bias voltage to a second end of the varactor diode 35 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature. *Supra*, Section III.B.4.d.; EX1002, ¶302.

This establishes the following motivations to combine: simple substitution of one known element (AAPA's temperature compensation bias circuit 10) for another (JP105's arranged bias transfer resistor 46) to obtain predictable results (appl[ying][] a temperature compensation bias voltage to a second end of the varactor diode 35 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature); combining prior art elements (AAPA's temperature compensation bias circuit 10 with JP105's Figure 8 circuitry, such that AAPA's temperature compensation bias circuit 10 is used to apply voltage to varactor diode 35) according to known methods (known circuit design and implementation techniques where circuitry is coupled using common components such as terminals or leads, discussed and shown, for example, by JP105 at Fig. 8 and AAPA at Fig. 6) to yield predictable results (appl[ying][] a temperature compensation bias voltage to a second end of the varactor diode 35 to adjust its capacitance, which controls oscillation frequency and compensates frequency variations caused by temperature). EX1002, ¶303.

Any alleged differences between limitation [1d] and the prior art cannot confer patentability because the '318 patent admits this limitation is conventional, and a POSITA would have used this conventional technology in JP105 with a reasonable expectation of success using known techniques as discussed above. EX1001, 1:54-67, Figs. 1, 3, 4, 6; EX1002, ¶304; *Koninklijke Philips N.V. v. Google*

LLC, 948 F.3d 1330, 1337-39 (Fed. Cir. 2020); *see Memorandum on Treatment of Statements of the Applicant in the Challenged Patent in Inter Partes Reviews under § 311* (August 18, 2020) ("AAPA Memo"), pp. 5, 6, 9; EX1002, ¶304.

e. [1e] "a temperature compensation bias generation circuit which generates the temperature compensation bias and supplies the temperature compensation bias generated to the temperature compensation bias circuit,"

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least renders obvious limitation [1e] in the same way. Limitations [1f]-[1k] recite the components that form the *temperature compensation bias generation circuit*. These components are addressed in the analysis for each of these limitations.

In both combinations, JP105 discloses or at least renders obvious a *temperature compensation bias generation circuit* in the form of its circuit formed by components 27 through 32, outlined in purple in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶306.

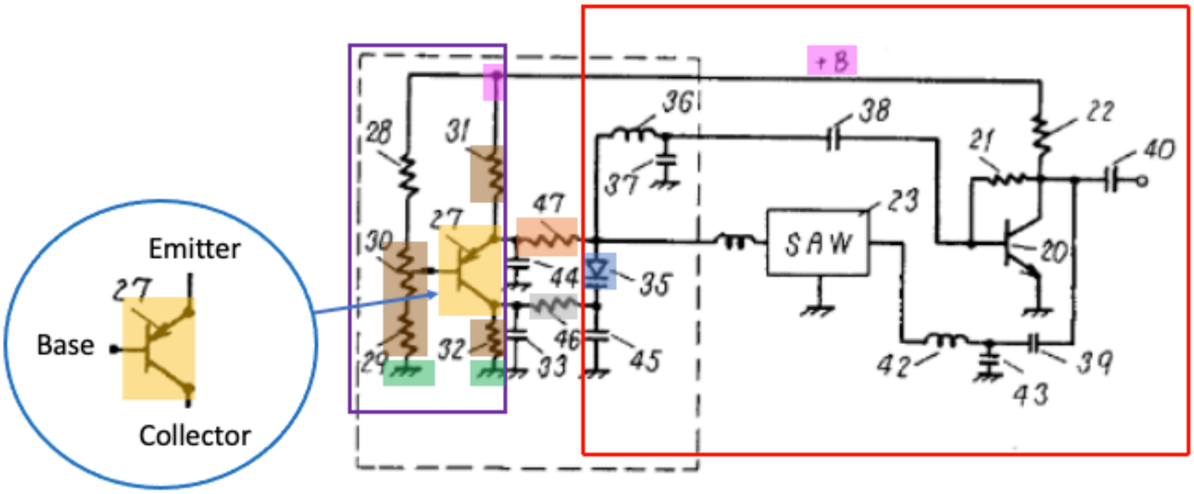


FIG. 8

EX1006, Fig. 8 (annotated)

JP105's circuit formed by components 27 through 32 (*temperature compensation bias generation circuit*) generates the capacitance control voltage (*generates the temperature compensation bias*) at the collector of transistor 27 and supplies this generated voltage (*supplies the temperature compensation bias generated*) to the arranged bias transfer resistor 46 (*temperature compensation bias circuit*). EX1006, 3:29-5:15, 5:22-6:2, Figs. 7, 8; Section III.B.4.d; EX1002, ¶307.

To the extent *temperature compensation bias generation circuit* is interpreted as a means-plus-function recitation, JP105 discloses or at least renders obvious the function of *generat[ing][] the temperature compensation bias and suppl[ying][] the temperature compensation bias generated to the temperature compensation bias* *circuit* for the reasons discussed above for limitation [1e]. *See* Section II.F; EX1002, ¶308.

And as discussed in the analysis of limitations [1f]-[1k] below, the JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least render obvious the identified corresponding structure for *temperature compensation bias generation circuit* of the '318 patent's temperature compensation bias generation circuit 22 in Figure 1, or at least an equivalent thereof, that performs the identified function. *See* Section III.B.4.f-III.B.4.k; Section II.F; EX1002, ¶309.

f. [1f] "the temperature compensation bias generation circuit having: a transistor having a collector or drain connected to the temperature compensation bias circuit, a base or a gate, and an emitter or a source;"

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least renders obvious limitation [1f] in the same way. In both combinations, JP105 discloses the circuit formed by components 27 through 32 (*the temperature compensation bias generation circuit*) has a PNP transistor 27 (*a transistor*) having a collector connected to resistor 46 (*having a collector or drain connected to the temperature compensation bias circuit*), and a base (*a base or a gate*) and emitter (*and an emitter or a source*) as shown in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶310.

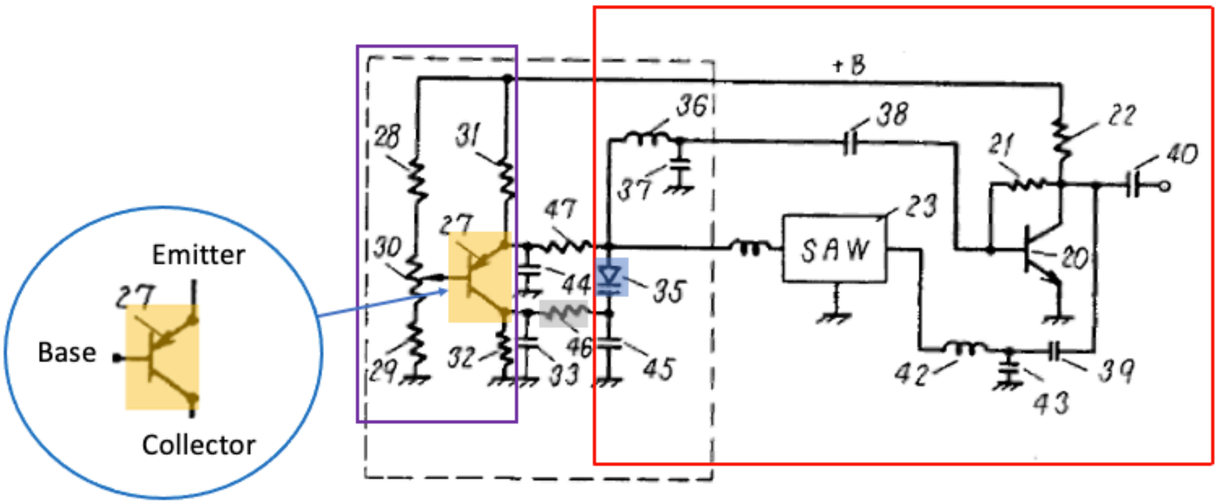
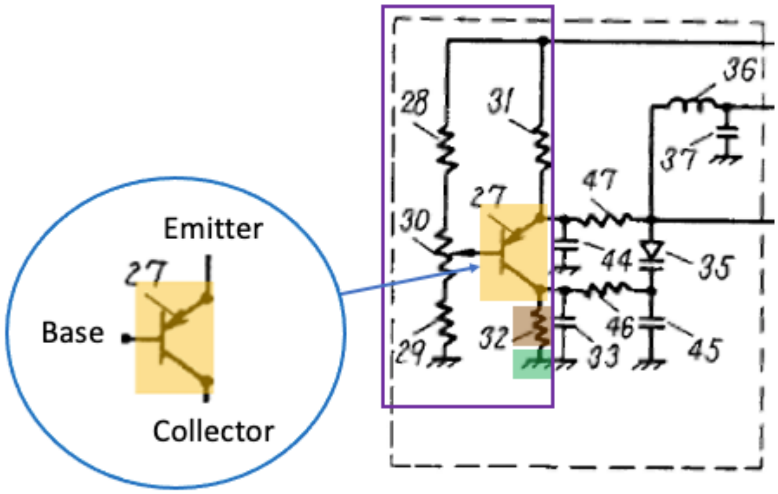


FIG. 8

EX1006, Fig. 8 (annotated)

g. [1g] "[the temperature compensation bias generation circuit having:] a first resistor having a first end connected to the collector or drain of the transistor and having a second end that is grounded;"

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least renders obvious limitation [1g] in the same way. In both combinations, JP105 discloses the circuit formed by components 27 through 32 (*the temperature compensation bias generation circuit*) has a resistor 32 (*a first resistor*) having a first end connected to the collector of transistor 27 (*having a first end connected to the collector or drain of the transistor*) and a second end that is grounded (a*nd having a second end that is grounded*) as shown in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶311.



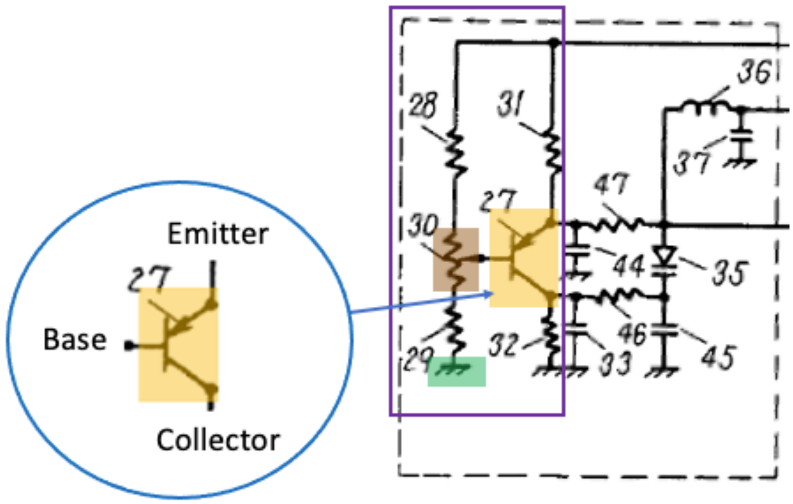
EX1006, Fig. 8 (partial view, annotated)

h. [1h] "[the temperature compensation bias generation circuit having:] a second resistor having a first end connected to the base or gate of the transistor;"

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least render obvious limitation [1h]. The analysis for each ground is discussed below; EX1002, ¶312.

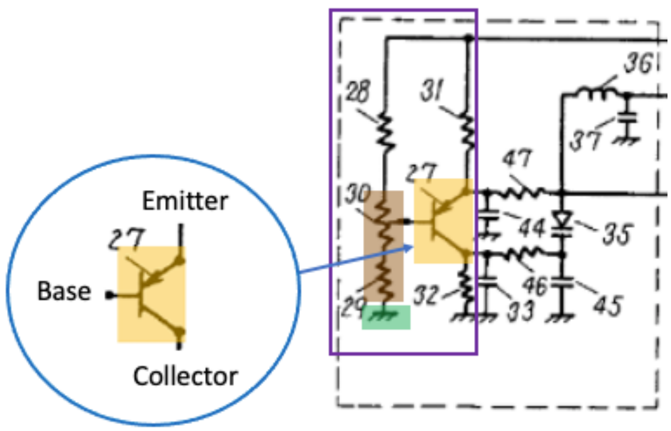
- **JP105-Kubo (Ground 2)**

In this combination, JP105 discloses the circuit formed by components 27 through 32 (*the temperature compensation bias generation circuit*) has a resistor 30 (*a second resistor*) having a first end connected to the base of transistor 27 (*having* *a first end connected to the base or gate of the transistor*) as shown in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶313.



EX1006, Fig. 8 (partial view, annotated)

Additionally, a POSITA would have further understood that a resistance formed by resistors 29 and 30 in Figure 8 produces an equivalent single resistor. EX1006, 3:29-4:2, 5:22-6:2, Fig. 8. This is because the resistor network formed by the "variable resistor" 30 and resistor 29 between ground and the base of transistor 27 is equivalent to a single resistor with a corresponding resistance between ground and the base of transistor 27. *Id.* A POSITA would have understood that the equivalence is determined using well-known circuit analysis principles where the equivalent resistance of series resistors is known to equal the sum of individual series resistances. EX1010, pp. 8-9; EX1009, p. 698 ("series resistors" are "[t]wo or more resistors connected in series," where the "total resistance is the sum of the values of each the individual resistors”). In such a case, the equivalent single resistor formed by resistors 29 and 30 (*a second resistor*) has a first end connected to the base of transistor 27 (*having a first end connected to the base or gate of the transistor*) as shown in Figure 8 below. *Id.*; EX1002, ¶314.



EX1006, Fig. 8 (partial view, annotated)

Regarding this POSITA understanding, resistor 30 is a “variable resistor” that biases transistor 27 by applying an a voltage to its base. EX1006, 3:29-4:2, 4:22-27, 5:22-6:2, Fig. 8. The arrangement of variable resistor 30 in JP105’s Figure 8—having three terminals connected to resistor 28, the base of transistor 27, and resistor 29, respectively—as well as resistor 30’s circuit symbol in Figure 8, show that resistor 30 is a potentiometer, which is a 3 terminal resistor arrangement that outputs a variable voltage to the base of transistor 27 as the resistance is varied. EX1006, 3:29-4:2, 4:22-27, 5:22-6:2, Fig. 8. Indeed, EX1009 explains that potentiometers are a "variable resistor incorporating a sliding contact or tap, so as to allow a variable proportion of the total resistance to be included in a circuit." EX1009, p. 595. EX1010 states that a potentiometer is a "variable resistor with three terminals" where "two terminals are connected to the opposite sides of the resistive element, and the third connects to a sliding contact that can be adjusted as a voltage divider." EX1010, p. 14. Indeed, potentiometers are "usually utilized as a voltage divider." EX1009, p. 595; EX1010, p. 14. EX1009 further explains that a "potentiometer is an example" of a "voltage divider that utilizes adjustable resistors to vary the voltage." EX1009, p. 15; EX1002, ¶315.

EX1013 explains that a voltage divider is a "set of series-connected resistors," and shows a circuit diagram for a voltage divider in Figure 3-5 using three resistors (any number of resistors, from two onward, in the same arrangement as shown can be used to implement a voltage divider). EX1013, p. 28. EX1013 shows a two resistor voltage divider in Figure 12.3, reproduced below. *Id.*, p. 274; EX1002, ¶316.

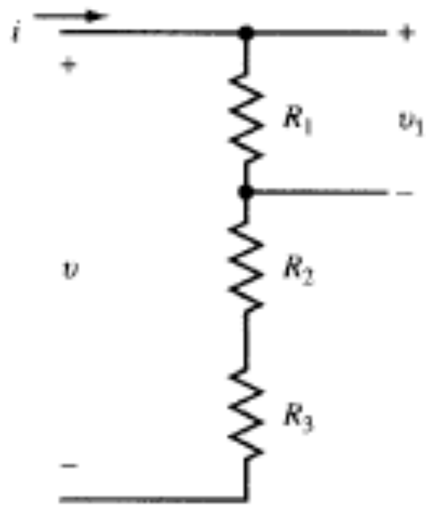


Fig. 3-5

EX1013, Fig. 3-5

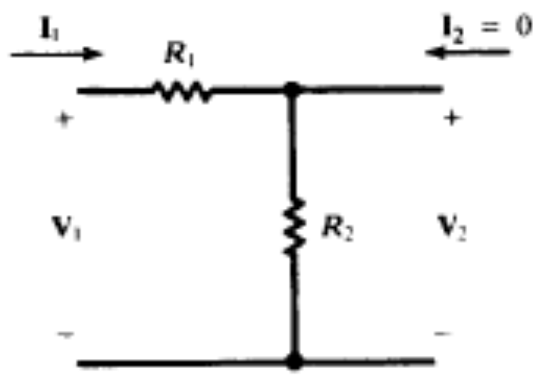


Fig. 12-3

EX1013, Fig. 12-3

EX1013 also shows the circuit diagram for a potentiometer (with exemplary resistor values), implemented by a two resistor voltage divider. EX1013, p. 31; EX1002, ¶317.

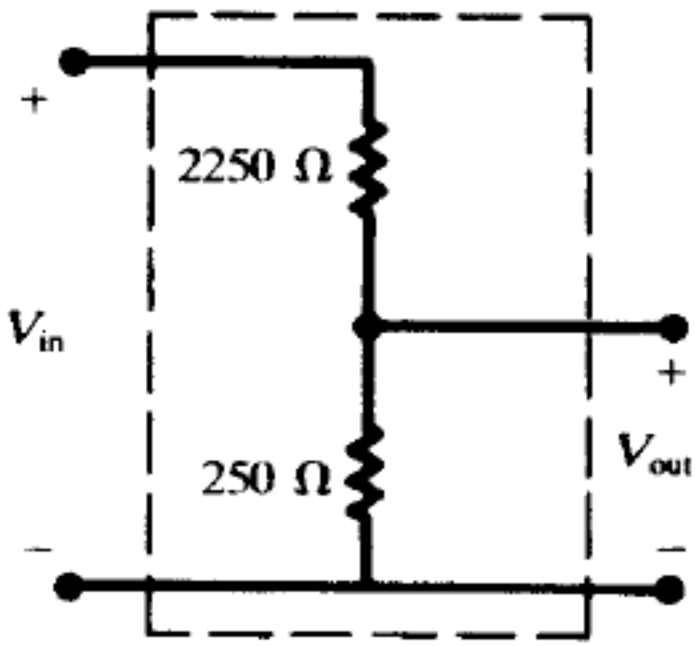
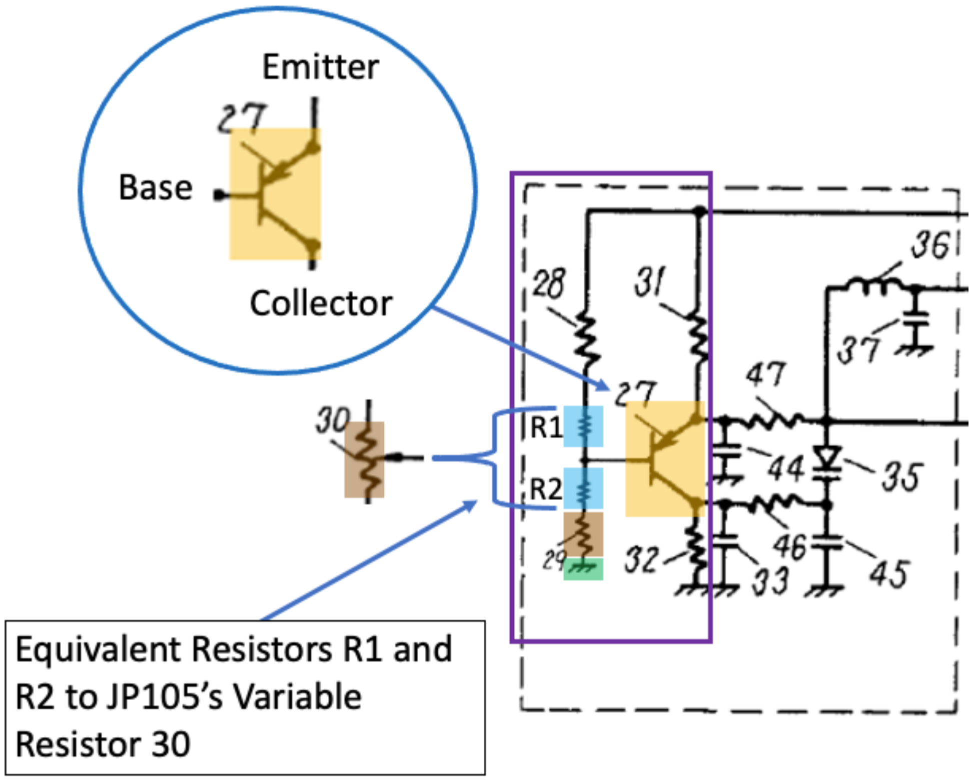


Fig. 3-13

EX1013, Fig. 3-13 (in part, without a load attached)

Thus, for the above reasons, POSITA would have understood that JP105's variable resistor 30 is implemented by a potentiometer, and that the resistor arrangement represented by variable resistor 30 is a voltage divider such as that shown by EX1013 in Figure 3-5, 12-3, and/or 3-13. EX1013, pp. 28, 31, 274; EX1009, pp. 595, 15. EX1010, p. 14; EX1006, 3:29-4:2, 4:22-27, 5:22-6:2, Fig. 8; EX1002, ¶318.

Thus, taking JP105's variable resistor 30 as a two resistor (R1 and R2) voltage divider, the equivalent circuit is shown below. The output voltage of the variable resistor, shown between R1 and R2 in the arrangement below, is formed at the base of transistor 27. EX1006, 3:29-4:2, 4:22-27, 5:22-6:2, Fig. 8; EX1002, ¶319.



EX1006, Fig. 8 (annotated, in part) (showing variable resistor 30's equivalent resistor arrangement formed by R1 and R2)

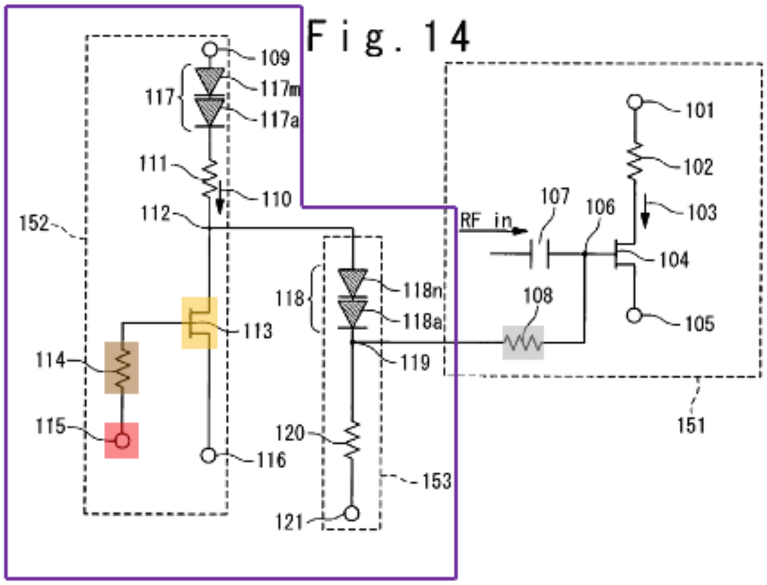
In this arrangement, resistor R2 is in series with resistor 29. Thus, summing the series resistance of resistor R2 and resistor 29 produces an equivalent single resistor to ground. EX1010, pp. 8-9 ("[i]f resistors are joined in series, the effective resistance (R_T) is the sum of individual resistances"). Thus, a POSITA would have understood that a resistance formed by resistors 29 and 30 in Figure 8 produces an equivalent single resistor. EX1006, 3:29-4:2, 5:22-6:2, Fig. 8; EX1002, ¶320.

It should be noted that variable resistor 30 could equally be implemented as any numbered resistor voltage divider and the analysis would be the same: summing the series resistances from the base of transistor 27 to ground to determine the equivalent single resistor of the these series resistances. EX1013, pp. 28, 31, 274; EX1009, pp. 595, 15. EX1010, p. 14; EX1006, 3:29-4:2, 4:22-27, 5:22-6:2, Fig. 8; EX1002, ¶321.

- **JP105-Kubo-Kokubo (Ground 3)**

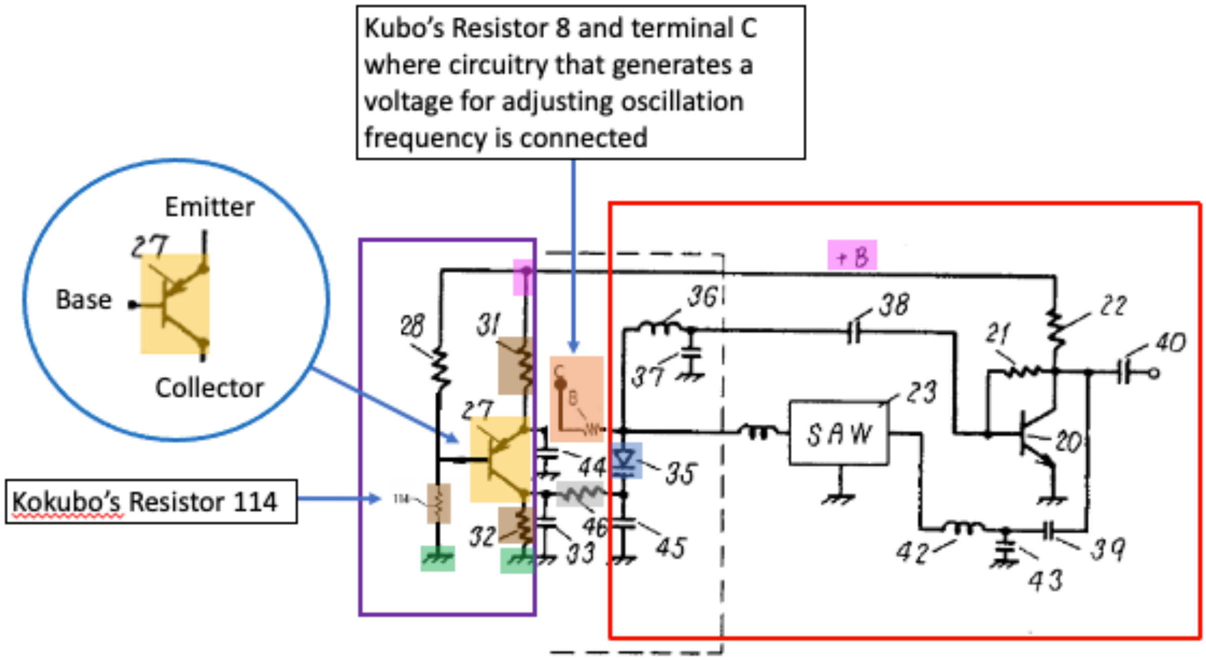
In this combination, JP105 discloses or at least renders obvious limitation [1h] in Ground 3 for the reasons discussed for Ground 2 above; EX1002, ¶322.

In this combination, Kokubo also discloses or at least renders obvious limitation [1h]. Kokubo describes a resistor 114 that is connected to the gate of Kokubo's transistor 113, where a "voltage 115 is applied to the gate of the transistor 113 through the resistance 114." EX1004, 7:21-30, 10:22-35, Fig. 14; EX1002, ¶323.



EX1004, Fig. 14 (annotated)

A POSITA would have combined the JP105-Kubo system with Kokubo such that JP105's circuitry (*the temperature compensation bias generation circuit*) uses Kokubo's resistor 114 (*second resistor*). EX1006, 3:29-4:2, 5:22-6:2, Fig. 8; EX1004, 7:21-30, 10:22-35, Fig. 14. In the combination, Kokubo's resistor 114 (*second resistor*) has a first end connected to the base of JP105's transistor 27 (*having a first end connected to the base or gate of the transistor*). *Id.* The result of the combination is shown below; EX1002, ¶324.



EX1006 (JP105) (Fig. 8) and EX1004 (Kokubo) (Fig. 14) combined (annotated)

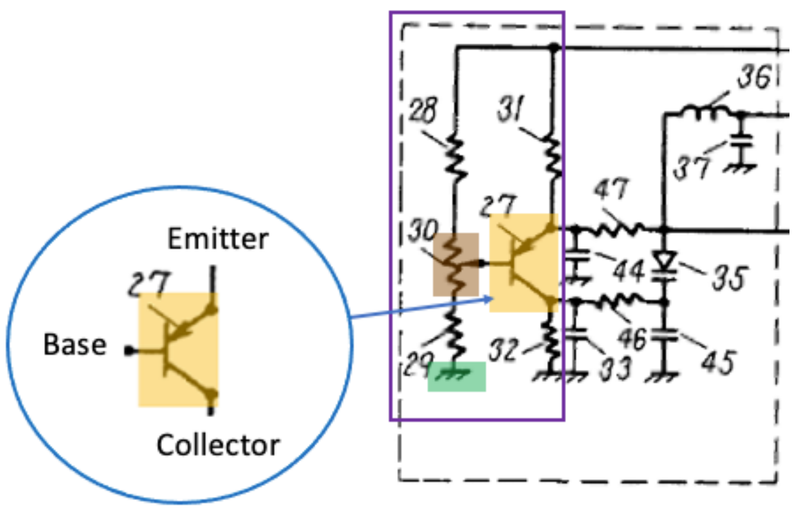
A POSITA would have been motivated to combine JP105, Kubo, and Kokubo in this manner for the reasons discussed in Section III.B.3.a.

i. [1i] "[the temperature compensation bias generation circuit having:] a base or gate bias application terminal connected to the other end of the second resistor;"

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least render obvious limitation [1i]. The analysis for each ground is discussed below; EX1002, ¶326.

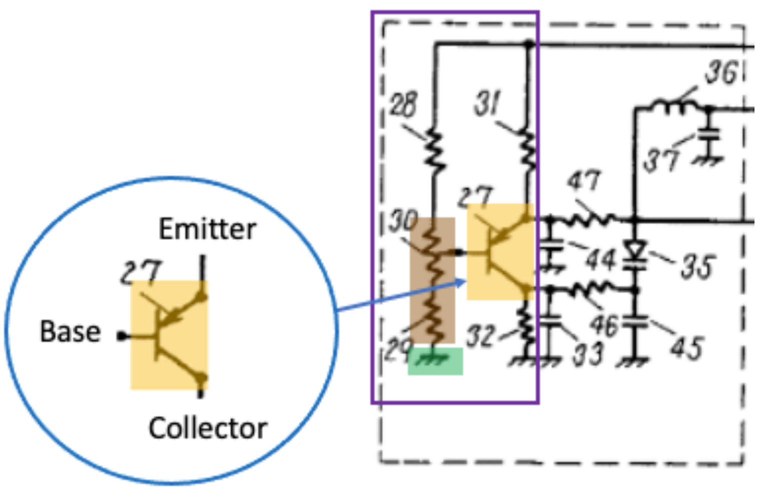
- **JP105-Kubo (Ground 2)**

In this combination, JP105 discloses the circuit formed by components 27 through 32 (*the temperature compensation bias generation circuit*) has a ground terminal that biases the base of transistor 27 (*a base or gate bias application terminal*) connected to another end of resistor 30 (*connected to the other end of the second resistor*) via resistor 29 as shown in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶327.



EX1006, Fig. 8 (partial view, annotated)

Additionally, as discussed for limitation [1h], a POSITA would have understood that a resistance formed by resistors 29 and 30 produces an equivalent single resistor (*a second resistor*) having one end connected to the base of transistor 27. *See* Section III.B.4.h. EX1006, 3:29-4:2, 5:22-6:2, Fig. 8. In such a case, a POSITA would have further understood that the circuit formed by components 27 through 32 (*the temperature compensation bias generation circuit*) has a ground terminal that biases the base of transistor 27 (*a base or gate bias application terminal*) connected to the other end of the equivalent single resistor formed by resistors 29 and 30 (*connected to the other end of the second resistor*) as shown in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8. This is because the equivalentequivalent resistance would have resulted in a single resistor having one end connected to a ground terminal and another end connected to the base of transistor 27. *Id.*; *See* Section III.B.4.h. ; EX1002, ¶328.



EX1006, Fig. 8 (partial view, annotated)

For both arguments above, a POSITA would have understood that JP105's ground terminal is a *base bias application terminal* because this grounding biases or adjusts the voltage at the transistor 27 base such that it takes a certain value. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8. In particular, the ground terminal creates a voltage drop across resistors 29 and 30, controlling the voltage that is present at the base of the transistor. *Id.* Indeed, resistors 29 and 30 are both referred to as "bias" resistors. EX1006, 4:1-2. By providing this control, the ground terminal (*base bias application terminal)* biases the base of transistor 27 to a bias voltage having a value set by the voltage divider formed by resistors 28, 29, and 30. *Id.*, 3:29-5:15, Fig. 8; EX1002, ¶329.

Further analysis of this concept is provided. EX1010's Fig. 24.27, reproduced below, is the same circuit as JP105's Figure 8, where R2 in Fig. 24.27 is equivalent to combined resistors 29 and 30. *See* EX1006, Fig. 8; EX1002, ¶330.

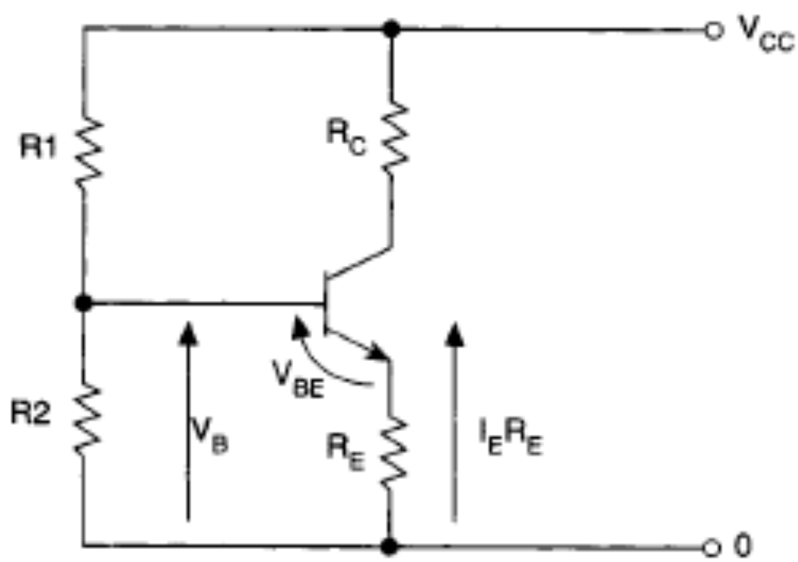


FIGURE 24.27 A transistor biasing circuit.

EX1010, Fig. 24.27

EX1010 explains that the voltage at the transistor base, V_B, is used to activate the transistor (when V_B is greater than V_{BE}) so that current flows from collector to emitter. EX1012, pp. 42-45; EX1010, pp. 646-648; EX1013, p. 28. The calculation of V_B can be determined from this equation in EX1010:

$$V_B \simeq \frac{V_{CC}R2}{R1 + R2}$$

EX1010, p. 648; EX1013, p. 28; EX1002, ¶331..

This equation can be manipulated as follows because the voltage over resistor R2 is $V_B - 0 = V_B$, where the zero is ground:

$$V_B*R1 + V_B*R2 = Vcc*R2$$

$$V_B*R1/R2 + V_B*R2/R2 = Vcc$$

$$V_B*R1/R2 + V_B = Vcc$$

Because V=I*R, in view of Figure 24.27, $V_B = I2*R2$, where I2 is the current through R2. Thus the following manipulations occur:

$$I2*R2*R1/R2 + V_B = Vcc$$

$$I2*R1 + V_B = Vcc$$

And because the current to the base of the transistor is very small (EX1010, p. 648), the current I2 is about equal to the current I1 through R1. And the voltage V1 = I1R1, where V1 is the voltage over R1. Thus, the following results (taking I1=I2):

$$I2*R1 + V_B = Vcc$$

$$I1*R1 + V_B = Vcc$$

$$V1 + V_B = Vcc$$

$$V_B = Vcc – V1$$

Thus, base voltage is simply Vcc minus the voltage V1 formed over R1. Thus, for JP105's same circuit in Figure 8, the voltage at the base of JP105's transistor equals the voltage at JP105's voltage terminal (+B) minus the voltage over resistor 28; EX1002, ¶¶331-335.

But if ground is not present and instead some non-zero voltage X (VX) is present in ground's place (i.e., in JP105's Figure 8, connected to resistor 29 instead of ground), the base voltage changes and must account for this difference. Now, the equation on p. 648 of EX1010 is adjusted to account for VX. *See also* EX1013, p. 28. The voltage over resistor R2 is now V_B – VX rather than V_B alone:

$$V_B - VX = Vcc*R2 / (R1 + R2)$$

Because the current to the base of the transistor is very small (EX1010, p. 648), the current I2 through R2 is about equal to the current I1 through R1. And for current through R2, the voltage is (V_B – VX), so V_B – VX = I1*R2 (taking I1=I2). Thus:

$$I1*R2 = Vcc*R2 / (R1 + R2)$$

$$I1*R2*R1 + I1*R2*R2 = Vcc*R2$$

$$I1*R1 + I1*R2 = Vcc$$

Now, V1 = I1*R1 and I1*R2 = (V_B – VX). Thus:

$$V1 + V_B - VX = Vcc$$

$$V_B = Vcc - V1 + VX$$

Thus, base voltage is Vcc minus the voltage V1 formed over R1 minus VX. Thus, for JP105's same circuit in Figure 8 in such a case, the voltage at the base of JP105's transistor equals the voltage at JP105's voltage terminal (+B) minus the voltage over resistor 29 minus the voltage VX. The voltage at the base of Kubo's transistor voltage is therefore configured by the presence of ground (i.e., 0 volts) because it changes when ground is not used. For both arguments above, a POSITA would have therefore understood that JP105's ground terminal is a *base bias application terminal* because this grounding biases or adjusts the voltage at the transistor 27 base such that it takes a certain value. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶¶336-339.

- **JP105-Kubo-Kokubo (Ground 3)**

In this combination, JP105 discloses or at least renders obvious limitation [1i] in Ground 3 for the reasons discussed for Ground 2 above; EX1002, ¶340.

Moreover, Kokubo is combined with the JP105-Kubo system in three different ways to disclose or at least render obvious limitation [1i]: (1) combining Kokubo's resistor 114 alone with the JP105-Kubo system; (2) combining Kokubo's terminal alone with the JP105-Kubo system; (3) combining Kokubo's terminal and resistor 114 with the JP105-Kubo system. Each is discussed below.

(1) Combining Kokubo's resistor 114 with the JP105-Kubo system

As discussed for limitation [1h], combining Kokubo's resistor 114 with the JP105-Kubo would have resulted in JP105's circuitry using Kokubo's resistor 114 (*second resistor*) having a first end connected to the base of JP105's transistor 27 (*having a first end connected to the base or gate of the transistor*). *See* Section III.B.4.h. Combined in this way, JP105's ground terminal that biases the base of transistor 27 (*a base or gate bias application terminal*) is connected to the other end of the resistor 114 (*connected to the other end of the second resistor*) as shown in the combined figure below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8. JP105's ground terminal is a *a base or gate bias application terminal* for the reasons discussed for this limitation in Ground 2 above; EX1002, ¶342.

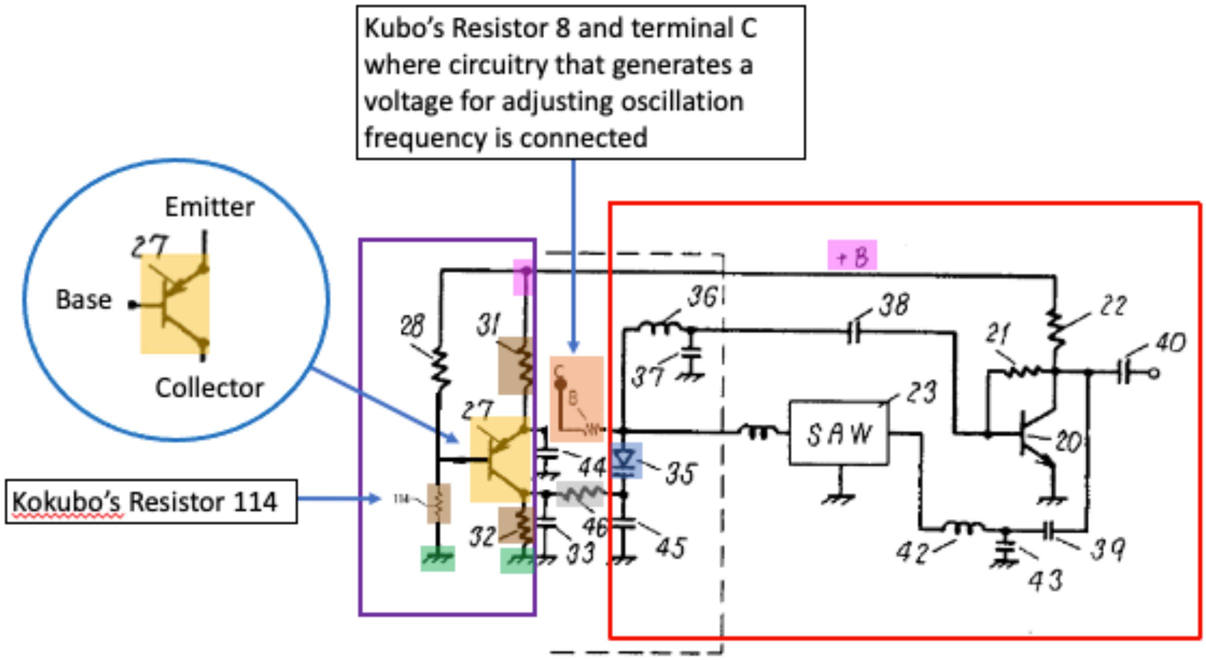


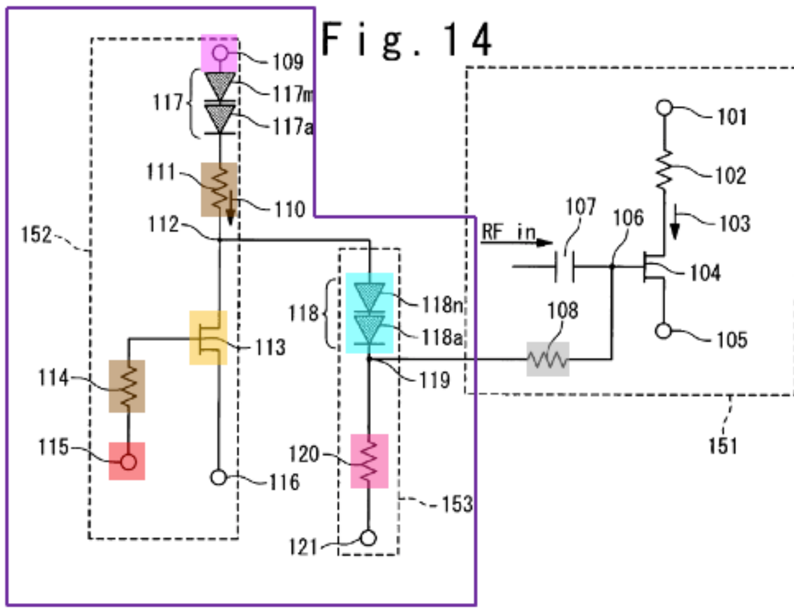
FIG. 8

EX1006 (JP105) (Fig. 8), EX1004 (Kokubo) (resistor 114 from Fig. 14), EX1003 (Kubo) (Resistor 8 and terminal C from Fig. 4) combined (annotated)

A POSITA would have been motivated to combine JP105, Kubo, and Kokubo in this manner for the reasons discussed in Section III.B.3.a.

(2) Combining Kokubo's terminal alone with the JP105-Kubo system

Kokubo discloses that its bias circuit has a resistor 114 with a second end that is connected to a base or gate bias application terminal in the form of a terminal that applies voltage 115 to the gate of transistor 113. EX1004, 7:26-30, 10:22-48, Fig. 14. The terminal is a base or gate bias application terminal because it receives voltage 115 which biases or changes the voltage applied at transistor 113's gate. *Id.*; EX1002, ¶344.



EX1004, Fig 14 (annotated)

Combined with JP105 and Kubo, the resulting circuit would have included Kokubo's terminal providing a voltage to the base of the JP105's PNP transistor 27 via resistors 29 and 30 (or the equivalent resistor formed by these resistors), as shown below. *Id.*

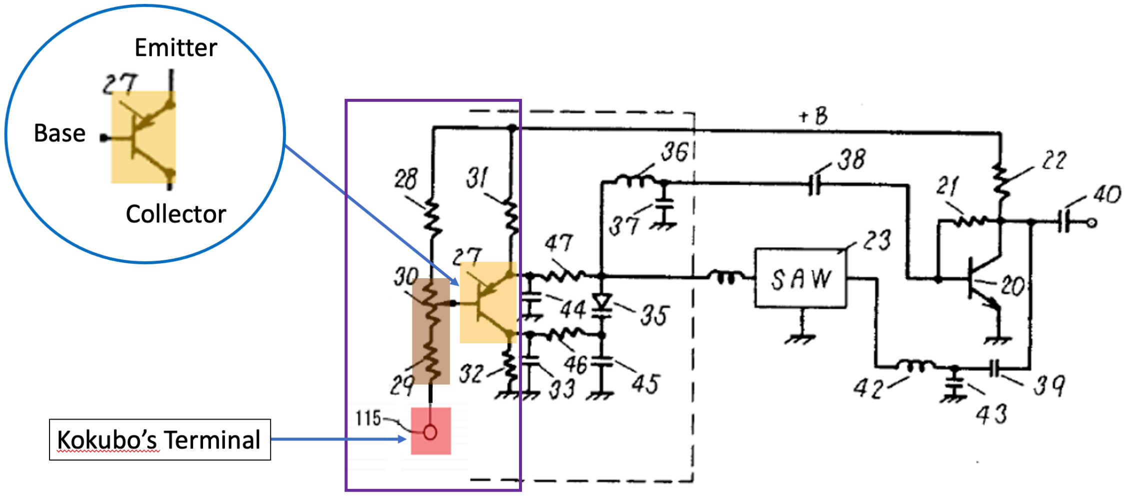


FIG. 8

EX1006 (JP105) (Fig. 8) and EX1004 (Kokubo) (Fig. 14) combined (annotated)

In combination, Kokubo's terminal discloses or at least renders obvious *a base or gate bias application terminal* because it applies a voltage to the base of JP105's transistor 27 via resistors 29 and 30 (or the equivalent resistor formed by these resistors), biasing the base to a voltage value; Kokubo's terminal is also (1) *connected to a second end of* resistor 30 (*the second resistor*) via resistor 29 and (2) in the alternative view *connected to a second end* of the equivalent resistor formed by resistors 29 and 30. *Id.*; EX1002, ¶¶344-346.

A POSITA would have been motivated to combine JP105, Kubo, and Kokubo in this manner for the reasons discussed in Section III.B.3.b.

(3) Combining Kokubo's resistor 114 and terminal with the JP105-Kubo system

Combining Kokubo's resistor 114 and terminal with the JP105-Kubo would have resulted in JP105's circuitry using Kokubo's resistor 114 (*second resistor*) having a first end connected to the base of JP105's transistor 27 (*having a first end connected to the base or gate of the transistor*) and terminal connected to resistor 114 that provides voltage 115. EX1004, 7:21-30, 10:22-35, Fig. 14; EX1006, 3:29-5:15, 5:22-6:2, Fig. 8. Here, Kokubo's terminal applies the voltage 115 to the base of JP105's transistor 27 via resistor 114, biasing the transistor, and is therefore a *base or gate bias application terminal*. *Id*. Kokubo's terminal is also *connected to the other end of* resistor 114 (*the second resistor*) that is not connected to the base of transistor 27. *Id.*; EX1002, ¶348.

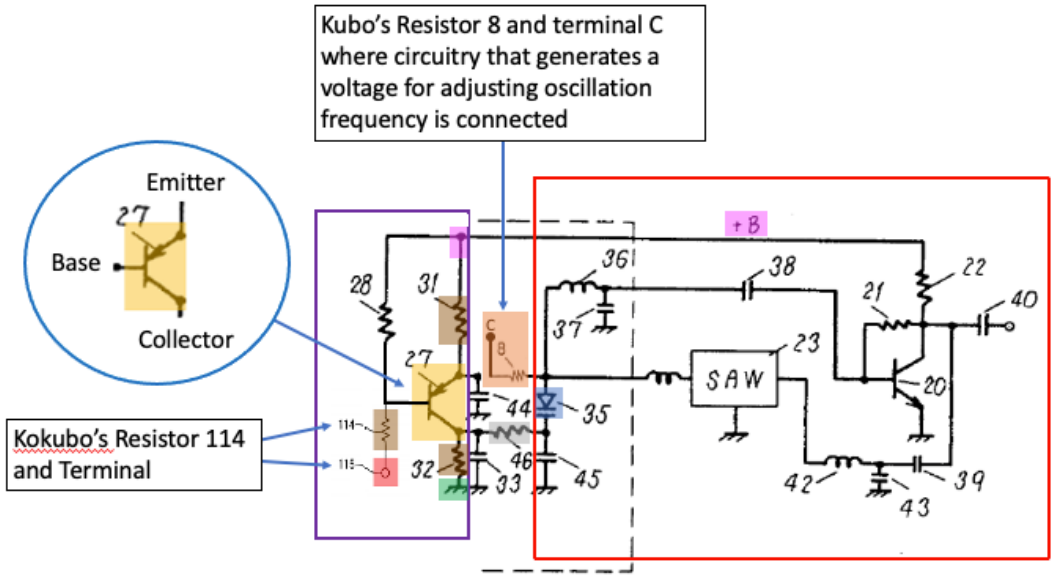


FIG. 8

EX1006 (JP105) (Fig. 8), EX1004 (Kokubo) (Resistor 114 and terminal from Fig. 14), EX1003 (Kubo) (Resistor 8 and terminal C from Fig. 4) combined (annotated)

A POSITA would have been motivated to combine JP105, Kubo, and Kokubo in this manner for the reasons discussed Section III.B.3.c.

j. [1j] "[the temperature compensation bias generation circuit having:] a third resistor having a first end connected to the emitter or source of the transistor; and"

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least renders obvious limitation [1j] in the same way. In both combinations, JP105 discloses the circuit formed by components 27 through 32 (*the temperature compensation bias generation circuit*) has a resistor 31 (*a third* *resistor*) having a first end connected to the emitter of transistor 27 (*having a first end connected to the emitter or source of the transistor*) as shown in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶350.

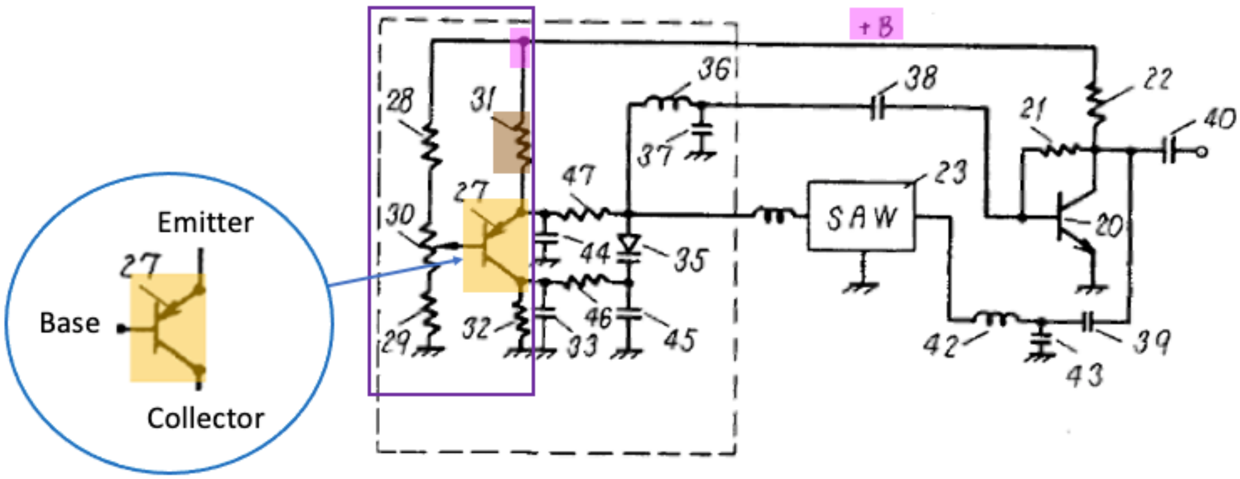


FIG. 8

EX1006, Fig. 8 (annotated)

k. [1k] "[the temperature compensation bias generation circuit having:] an emitter or source bias application terminal connected to the other end of the third resistor."

The JP105-Kubo (Ground 2) and JP105-Kubo-Kokubo (Ground 3) combinations disclose or at least renders obvious limitation [1k] in the same way. In both combinations, JP105 discloses the circuit formed by components 27 through 32 (*the temperature compensation bias generation circuit*) has a voltage terminal that applies a voltage "+B" to the emitter of transistor 27, biasing the voltage at the emitter to a value (*an emitter or source bias application terminal*), and is connected to the other end (*connected to the other end*) of resistor 31 (*the third resistor*) as shown in Figure 8 below. EX1006, 3:29-5:15, 5:22-6:2, Fig. 8; EX1002, ¶351.

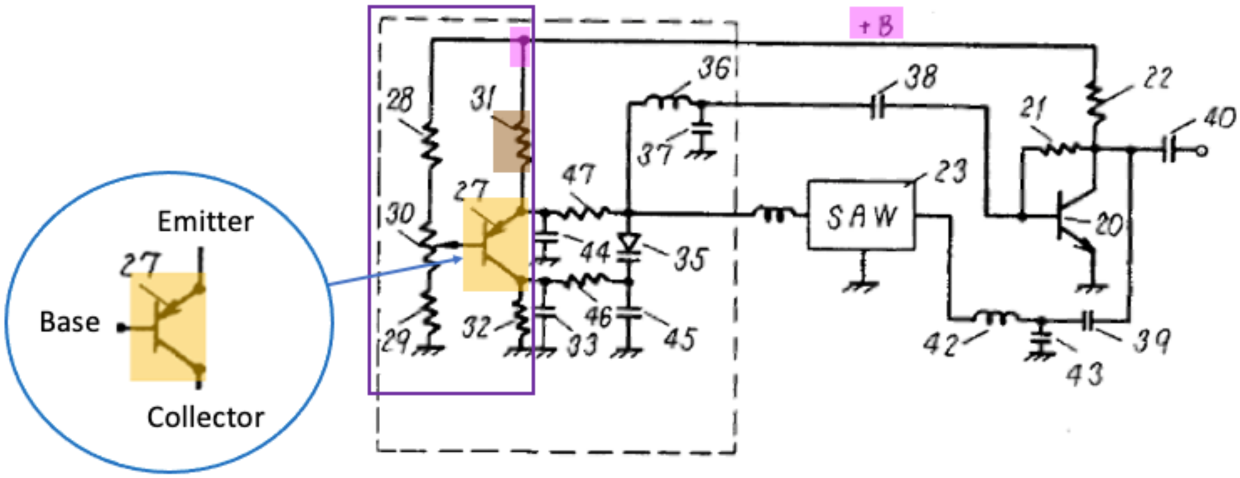


FIG. 8

EX1006, Fig. 8 (annotated)

IV. SECONDARY CONSIDERATIONS

This Request demonstrates that the Challenged Claims of the '318 Patent are unpatentable as obvious in view of the prior art references. The Applicant did not identify any evidence of secondary considerations during prosecution, and the clear teachings in the prior art cannot be overcome by any supposed secondary considerations. EX1002, ¶352.

V. DISCLOSURE OF CONCURRENT LITIGATION AND REEXAMINATION PROCEEDINGS

The ’318 Patent is the subject of 2 prior or pending District Court litigations and 1 prior or pending post-grant proceeding.

District Court Litigations
Arigna Technology Limited v. Volkswagen AG et al., 2:21-cv-00054-JRG (E.D. Tex.)
Conti Temic Microelectronic GmbH and ADC Automotive Distance Control Systems GmbH v. Arigna Technology Limited, 1:21-cv-00826 (E.D. Va.)
Post-Grant Proceedings
Volkswagen Group of America, Inc., v. Arigna Technology Limited, IPR2021-01263

VI. CONCLUSION

The Commissioner is hereby authorized to charge Deposit Account 50-6990 under Order No. ARI318 the *Ex Parte* Reexamination fee of $12,600 under 37 C.F.R. § 1.20(c)(1). Requester believes no other fee is due with this submission, however the Commissioner is hereby authorized to charge any fee deficiency or credit any over-payment to Deposit Account 50-6990.

Dated: July 20, 2021

Respectfully submitted,

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EXHIBIT LIST

Exhibit	Description
1001	U.S. Patent 7,397,318 (the "'318 patent")
1002	Declaration of R. Jacob Baker, Ph.D., P.E.
1003	U.S. Patent 4,751,475 ("Kubo")
1004	U.S. Patent 7,230,493 ("Kokubo")
1005	U.S. Patent 6,452,454 ("Shapiro")
1006	Certified Translation of Japanese Unexamined Patent Application S57-131105 ("JP105")
1007	Japanese Unexamined Patent Application S57-131105
1008	File History of U.S. Patent 7,397,318
1009	Excerpts from *Wiley Electrical and Electronics Engineering Dictionary*, 2004
1010	*The Electrical Engineering Handbook*, 2000
1011	Declaration of Christopher Field Regarding Certified Translation of Japanese Unexamined Patent Application S57-131105
1012	*Analog Integrated Circuit Design*, David A. Johns, Ken Martin, 1997
1013	*Schaum's Outlines, Electrical Circuits, Fourth Edition,* Mahmood Nahvi, Joseph A. Edminister, 2003
1014	*CMOS transconductor VCO with adjustable operating and centre frequencies*, B. Keeth et al., Electronics Letters , Vol. 31, No. 17, (17th August 1995)