

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Mercedes-Benz USA, LLC

Petitioner,

v.

Michigan Motor Technologies, LLC

Patent Owner.

IPR2023-01031

**DECLARATION OF GLENN R. BOWER, PH.D., IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 8,909,482**

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I. INTRODUCTION

I, Glenn R. Bower, Ph.D., declare as follows:

1. I have been retained on behalf of Mercedes-Benz USA, LLC (“MBUSA”) for the above-captioned *inter partes* review proceeding to provide my expert opinions and expert knowledge. I understand that this proceeding involves U.S. Patent No. 8,909,482 to Portabella (“the ’482 patent”), titled “Device for measuring power consumption and performance with respect to the environment of a power-consuming unit,” and that the ’482 patent is currently assigned to Michigan Motor Technologies LLC (“MMT”). I understand that the Petition submitted by MBUSA challenges automotive-relevant claims 1-2, 4-7, and 9-13 of the ’482 patent.

2. The ’482 patent describes systems and methods for measuring power and resource consumption of a power consuming unit and calculating an ecological parameter based on that consumption. I am familiar with the technology described in the ’482 patent as of its earliest possible priority date, July 18, 2008.

3. I have been asked to provide my independent technical review, analysis, insights, and opinions regarding the ’482 patent and the references that form the basis for the grounds of unpatentability set forth in the Petition for *inter partes* review of the ’482 patent filed by MBUSA.

4. In preparing this Declaration, I have reviewed and am familiar with all the documents cited herein. I have reviewed and am familiar with the ’482 patent

and its file history. I confirm that to the best of my knowledge the accompanying exhibits are true and accurate copies of what they purport to be, and that an expert in the field would reasonably rely on them to formulate opinions such as those set forth in this Declaration.

5. I am being compensated at my customary rate of \$575 per hour for my work on this case. My compensation is not dependent upon my opinions, my testimony, or the outcome of this case.

II. SUMMARY OF GROUNDS

Ground	'482 Patent Claims	References	Basis
1	1-2, 4-5	Luff, Amaratunga, Seem	§103
2	6	Luff, Amaratunga, Seem, Zuta	§103
3	7	Luff, Amaratunga, Seem, Zuta Breton	§103
4	9-11	Luff, Amaratunga	§103
5	12-13	Luff, Amaratunga, Zuta, Breton	§103

III. SUMMARY OF OPINIONS

6. In my opinion, the challenged claims of the '482 patent would have been obvious in view of the combinations of references that MBUSA asserts, as well as the state of the art in systems for measuring power and resource consumption on or before the year 2008, known to a person of ordinary skill in the art.

7. The '482 patent's independent claim 1 claims a system for measuring the resource consumption ("direct consumption") and waste production ("indirect

consumption”) of a “power-consuming unit,” and based on both calculating an ecological parameter representing the environmental impact of unit. Notably, the ’482 patent specification relies on existing measures of resource consumption, such as gas or electric meters, and waste production, such as rubber wastes, oil waste , as inputs to its parameter calculation, and describes using a general-purpose computer to generate its parameter. The ’482 patent does not claim to have invented new methods or devices for measuring resource consumption or waste production, a new type of formula for computing its parameter, or a new type of device for calculating its parameter.

8. There is nothing inventive about the ’482 patents approach of measuring resource consumption and waste production, comparing those measurements to reference values, and using that calculation to determine an environmental impact parameter. The prior art includes multiple references that disclose calculating an environmental impact parameter based on a comparison of measured values to reference values. For example, Luff and Amaratunga both measure waste production and resource consumption and use those measurements to calculate an environmental impact parameter.

9. Therefore, it is my opinion that the challenged claims would have been obvious in view of the disclosures in the asserted prior art references, as described in detail below

IV. QUALIFICATIONS

10. In forming the opinions expressed in this Declaration, I have considered and relied upon my education, background, and experience. In addition, I have reviewed and relied upon additional materials in preparation of this Declaration, as described below.

11. I am currently a Scientist III at the University of Wisconsin-Madison Engine Research Center and Teaching Faculty III in the University of Wisconsin-Madison Mechanical Engineering Department. A copy of my curriculum vitae and past 5 years of professional witness history is detailed in my curriculum vitae (“CV”), a copy of which is provided as Exhibit 1004. My CV also lists peer-reviewed publications on which I am the primary or a named author and identifies parties on behalf of whom I have previously provided expert testimony.

12. I have over 25 years of experience working with internal combustion engine technologies and vehicle integration. As detailed below, I have worked on many projects that are highly relevant to the subject matter of the ’482 patent.

13. I earned the degree of Bachelor of Science in Mechanical Engineering from the University of Wisconsin-Platteville, and a Master of Science and a Doctor of Philosophy degree from the University of Wisconsin-Madison, both in the Department of Mechanical Engineering. My graduate advisor was Professor David E. Foster, who specialized in engines, combustion, and chemical kinetics.

14. I have extensive hands-on experience in the fields of internal combustion engine design and testing, vehicle powertrain design, modeling and testing, and vehicle design and testing.

15. In my roles of Scientist III at the University of Wisconsin-Madison Engine Research Center and Teaching Faculty III in the University of Wisconsin-Madison Mechanical Engineering Department, I teach various courses including engineering economics, freshman design, thermodynamics, fluid mechanics, internal combustion engines, and senior design. I also oversee the college's automotive shop and conduct research at the Engine Research Center. I have been on the faculty at the University of Wisconsin-Madison since 1997.

16. In addition to my teaching activities, I am the automotive advisor to several undergraduate and graduate level student automotive teams from the University of Wisconsin, College of Engineering that are entered in international engineering design competitions. These competitions include the Society of Automotive Engineers (SAE) Clean Snowmobile Challenge, the Baja SAE, the Formula SAE, and the SAE Autodrive Challenge II programs. As the automotive advisor, I interact with approximately 50 students each semester that are enrolled in independent study. Each student selects his/her design project, some of which concentrate on calibrating an engine. To prepare each team for its international competition, I guide the students in designing, building, and testing all aspects of the

vehicles. I teach students at all levels not only the technical aspects of building a vehicle, but the intricacies of each of the engine's components and how it affects the overall engine/vehicle performance. Several of the automotive teams program and calibrate their respective engine/vehicle controllers.

17. I have been an active member of SAE International since 1988.

18. In addition to being the faculty advisor for the Formula SAE, the Formula SAE Electric, Baja SAE, SAE Clean Snowmobile and the Wisconsin Autonomous teams, I am the University of Wisconsin-SAE Student Section Faculty advisor. I have served as the SAE Milwaukee Section Nominating Committee Representative and routinely organize and chair technical sections for the SAE Small Engine Technology Conference. During my tenure, I have peer reviewed numerous technical papers.

19. I have been actively consulting since receiving my Ph. D. in 1992. I have developed and certified engine combustion analysis systems, been retained as a professional witness in personal injury cases and State of Wisconsin vehicular accident with injury cases, patent litigation, international arbitration and hybrid vehicle development.

20. I have extensive practical experience in automotive powertrains, including hybrids and electrics, alternative fuels, engine emissions, engine aftertreatment systems, vehicle testing, high speed photography and in-cylinder

engine combustion in addition to engine and hybrid controls. I am an experienced machinist and welder.

21. Starting in the 1997, I advised a student team conducting fuel economy and tailpipe emissions testing on a chassis dynamometer. The team tested their prototype on multiple occasions at Ford's most advanced testing facility and also at the Ann Arbor EPA vehicle testing facility.

22. In the fall of 1999, at the request of Ford Motor Company, the student's diesel-power, hybrid sedan was made available for a series of special tests by Ford Motor Company for inclusion in a special EPA vehicle study I personally accompanied the vehicle to the testing facility and ensured the vehicle was operating properly while also collecting and submitting our vehicle's logged engine and motor parameters.

23. Vehicle dynamometer testing collects emissions samples and flowrates from the tailpipe of a vehicle; using these collected samples, tailpipe emissions and vehicle fuel economy are reported.

24. In the early 2000's, these US DOE Advanced Vehicle Competitions started accounting for upstream ecological factors agreed upon in the scientific community in their energy and emissions calculations for both liquid and electrical inputs.

25. I have advised hundreds of independent study students over the past 20 years who, for one semester, concentrate on researching and documenting a topic of their choice. A popular topic for young engineers is renewable energy.

26. On several occasions, either in my design courses or advising an independent study, students have conducted full life cycle analysis of proposed systems and/or fuel types. These studies utilized US government generated data to complete a complete energy, cost and emissions analysis of a proposed system.

27. I have and/or currently communicate with alternative fuel producers – including ethanol and bio-diesel.

28. I have advised local companies on the benefits, costs and precautions of modifying their liquid fueled trucks to natural gas.

29. I am a Board Certified Registered Professional Engineer in the State of Wisconsin: license # 29717

30. I also have experience with the U. S. Patent system. I am a named inventor of U.S. Patent No. 6,231,135, entitled “Hybrid Braking System.”

V. SCOPE OF ASSIGNMENT

31. In forming my opinions regarding the validity of the ’482 patent, I have considered the ’482 patent’s specification, including the Abstract and the figures. I have also considered the language of the patent’s claims, as those terms would have been understood by a person having ordinary skill in the relevant field at least at the

time of the '482 patent's earliest possible priority date. I have also reviewed the prosecution (the "file history") of the '482 patent.

32. In forming my opinions, I have also considered the Exhibits that are listed in the Petition and any additional materials and information cited in this Declaration. I have also searched for and reviewed technical literature relevant to the field of the '482 patent.

33. I have relied on my personal knowledge, education, training, and professional experience in order to form my opinions concerning the '482 patent, including my experience in energy measurements, emissions measurements and programmable computers.

34. This Declaration explains, based on facts and information currently available to me, the subject matter and opinions related to this Proceeding. As such, I am prepared to provide expert testimony regarding opinions formed resulting from my analysis of the issues and materials considered in this declaration, if asked to do so by the Board or by the parties' attorneys.

35. Additionally, I may discuss my own work, teachings, and knowledge of the state of the art in the relevant time period. I may rely on handbooks, textbooks, technical literature, and the like to demonstrate the state of the art in the relevant period and the evolution of relevant technologies.

36. Throughout this Declaration, I refer to specific pages of the '482 patent and other documents. These citations are intended to be exemplary and are not intended to convey that the citations are the only source of evidence to support the propositions for which they are cited. I reserve my right to amend or alter my analysis and opinions in response to positions Patent Owner may take or upon the discovery of new information.

37. I am being compensated at my customary consulting rate of \$575 per hour for the time I spend on this matter. My compensation is in no way contingent on the nature of my opinions or the outcome of this or any other proceeding. I have no other interest in this proceeding. All of the opinions expressed in this Declaration are my own.

VI. LEGAL UNDERSTANDING

38. In this section I describe my understanding of certain legal standards that I have relied upon in forming my opinions set forth in this Declaration. I have been informed of these legal standards by MBUSA's attorneys. I am not an attorney and I have not thoroughly researched the relevant patent law. I am relying only on instructions from MBUSA's attorneys for these legal standards.

A. Person of Ordinary Skill in the Art

39. I am informed that patent validity is determined from the perspective of a person of ordinary skill in the pertinent art at the time of the invention

(“POSITA”). I understand that a POSITA is a hypothetical person who is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity—not an automaton.

40. In forming my opinions, I have relied on my personal knowledge and professional experience in energy, emissions, computers and on the documents and information referenced in this Declaration.

41. In deciding the level of ordinary skill in the art, I am informed that the following factors may be considered:

- the levels of education and experience of persons working in the field;
- the types of problems encountered in the field; and
- the sophistication of the technology.

B. Claim Construction

42. I am informed that a patent may include two types of claims, independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend from an independent claim or another dependent claim. I am informed that a dependent claim includes all the limitations that it recites, in addition to the limitations recited in the claim from which it depends.

43. I understand that patent claim terms can be interpreted, or “construed.” I understand that, in construing a claim, the words of patent claims are given their plain meaning, as a POSITA would understand them at the time of the invention,

view of the patent and file history, unless their meaning is defined or disclaimed. I am informed that dictionaries, treatises, and other “extrinsic” sources of evidence may assist in determining the plain meaning of a term, but they cannot override a meaning that is otherwise unambiguous based on the intrinsic evidence.

44. I understand that in IPR proceedings, a petitioner must identify specific portions of a patent specification that describe the structure, material, or acts corresponding to each claimed function of any means-plus-function claim term.

45. I have been informed by MBUSA’s counsel that claim construction is a matter of law for the arbiter of law to decide. I am informed that, in an *inter partes* review, the Patent Trial and Appeal Board (“PTAB”) interprets claims in the same way as a district court would. Likewise, I understand that a POSITA interprets claims in the same way in both types of proceedings.

46. I reserve my right to amend or alter my analysis and opinions in view of any claim constructions adopted by the arbiter of law.

C. Obviousness

47. I am informed that a patent claim is unpatentable and invalid if the subject matter of the claim as a whole would have been obvious to a person of ordinary skill in the art of the claimed subject matter as of the time of the inventions at issue. I am informed that the following factors must be evaluated to determine whether the claimed subject matter is obvious: (1) the scope and content of the prior

art; (2) the difference or differences, if any, between each claim of the patent and the prior art; and (3) the level of ordinary skill in the art at the time the patent was filed. Unlike anticipation, which allows consideration of only one item of prior art, I am informed that obviousness may be shown by considering more than one item of prior art. Moreover, I understand that objective indicia of non-obviousness, also known as “secondary considerations,” like the following also may be considered when assessing obviousness: (1) commercial success; (2) long-felt but unresolved needs; (3) copying of the invention by others in the field; (4) initial expressions of disbelief by experts in the field; (5) failure of others to solve the problem that the inventor solved; and (6) unexpected results. I also understand that evidence of objective indicia of non-obviousness must have a nexus with the claimed subject matter.

D. Priority Date

48. I understand that in order for a patent to claim priority from a provisional application, (1) the provisional application must support at least one claim of the patent and (2) the disclosure of the patent must have been carried forward from the provisional application.

VII. THE '482 PATENT

A. Level of Ordinary Skill in the Art

49. In my opinion, a POSITA at the time of the alleged invention would have had a B.S. degree in Electrical Engineering or Mechanical Engineering (or equivalent), as well as at least 2-3 years of industry experience, including experience

with statistical analysis, or, alternatively, at least an M.S. degree in Electrical Engineering or Mechanical Engineering and 1-2 years of industry experience, including experience with statistical analysis.

50. I am well qualified to determine the level of ordinary skill in the art. First, I am very familiar with the technology of the '482 patent as of the July 18, 2008 timeframe. My academic and teaching background in both Electrical and Mechanical Engineering also provides significant insight into the expectations of a person of a given academic level or graduate certification. As mentioned above, by 2008, I had acquired extensive experience relating to internal combustion engine design and testing, including developing systems for measuring vehicle emissions and emissions flowrates, and determining vehicle fuel economy based on those measurements.

B. Claims

51. The '482 patent contains 16 claims, 2 independent claims and 14 dependent claims. Claim 1 is representative and reproduced below:

A device for measuring power consumption and performance with respect to the environment of a power-consuming unit comprising

a data introduction module, which receives at least one power consumption value, measured by a measurement apparatus of the power-consuming unit;

an input device for inputting waste production data;

a display screen; and

a computer with a processor and a memory device having therein a plurality of instructions that, when executed by the processor, cause the processor to

(a) receive the at least one power consumption value from the data introduction module,

(b) receive the waste production data,

(c) calculate an ecological parameter based on the at least one power consumption value and the waste production data, and

(d) operate the display screen to display the calculated ecological parameter,

wherein the calculated ecological parameter is an adjusted mean of the sum of the deviations of the at least one power consumption value with respect to a reference value corresponding to the at least one power consumption value.

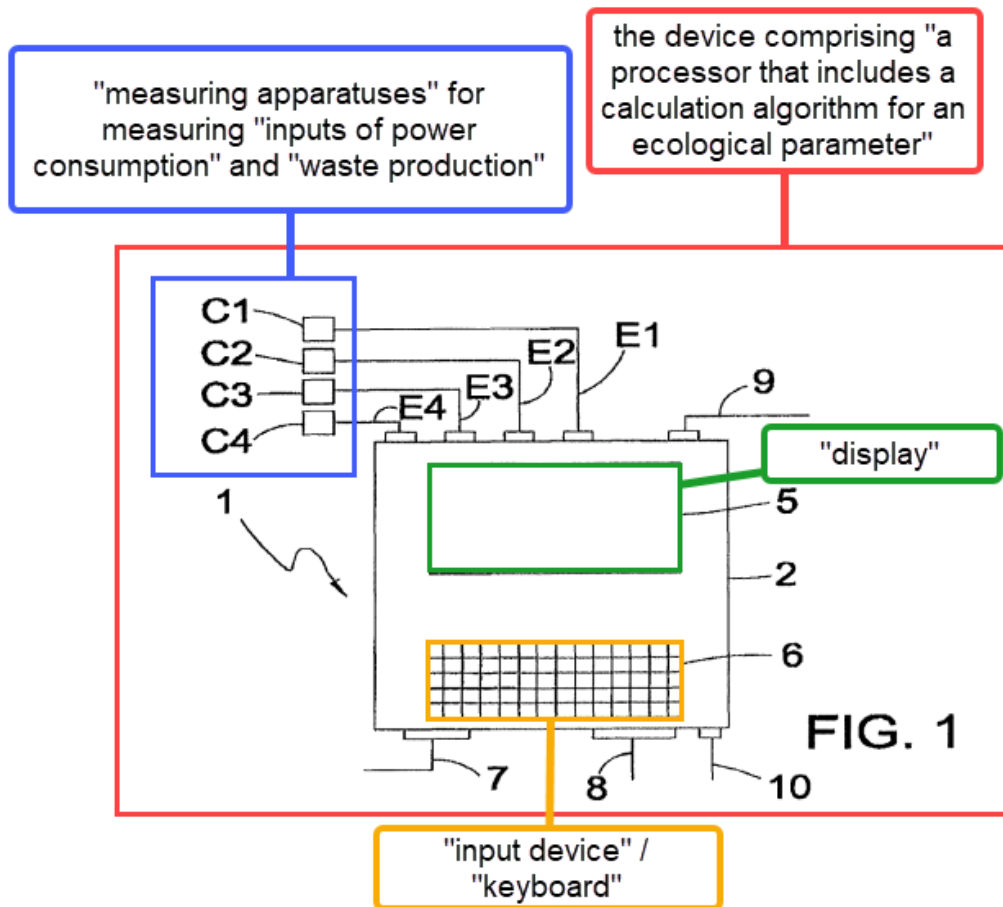
C. Specification

52. The '482 patent was issued December 9, 2014, from U.S. Application No. 13/054,355 ("the '355 application"), which was filed on January 14, 2011. Ex. 1001. The '482 patent claims priority to International Patent Application PCT/IB2009/053135, filed July 20, 2009, which itself claims priority to Spanish Patent Application 2008021529, filed on July 18, 2008. *Id.* at (30).

53. The claims of the '482 patent claim systems and methods for calculating an ecological parameter representing the environmental impact of a power-consuming unit based on measurements of the unit's power and resource consumption and waste production. See Ex. 1001 at Abstract. The '482 patent

specification discloses using a general-purpose computer to calculate a parameter that represents the environmental impact of commonly used resources, such as gas or electricity in the home. *See, e.g., Id.* at cl. 1, . The '482 patent teaches that its parameter is calculated based on inputs of waste production and power consumption measured using known measurement devices, such as meters for measuring gas or electricity consumption.

54. The '482 patent teaches that its “device for measuring power consumption” includes “a module for introducing data provided with inputs of power consumption values,” “a keyboard for introducing [waste production] data and selecting menus,” a “processor that includes a calculation algorithm for an ecological parameter,” and “a display screen to display the calculated ecological parameter.” *Id.* at 3:26-42. Figure 1 of the '482 patent, annotated below, shows one example of the claimed device including these components:



Id. at FIG. 1 (annotations added).

55. The '482 patent discloses measuring power consumption from a power-consuming unit, such as a building or vehicle. *Id.* at 1:18-29. The '482 patent teaches that its device uses known statistical formulas that include comparing resource consumption and waste production measurements to reference values to calculate its “ecological parameter.” *Id.* at Abstract; 3:22-25.

56. The '482 patent claims collecting resource consumption and waste production data using known devices, such as electric meters, and comparing that data to reference values to calculate an “ecological parameter.”

D. Prosecution History

57. I have reviewed the prosecution history of the '482 patent (Ex. 1001). The Examiner did not render any rejections based on any substantive consideration of prior art.

58. Based on my review of the first page of the '482 patent prosecution history, I see the patent issued from U.S. Application No. 13/054,355 ("the '355 application"), which was filed on January 14, 2011. Ex. 1001. I understand the '482 patent claims priority to International Patent Application PCT/IB2009/053135, filed July 20, 2009, which itself claims priority to Spanish Patent Application 2008021529, filed on July 18, 2008.

59. Based on my review of the prosecution history, I understand that none of the prior art references relied on in MBUSA's petition were considered by the Examiner during prosecution. Ex. 1002.

VIII. CHALLENGED CLAIMS

60. I have analyzed claims 1-2, 4-5, 6-7, and 9-13 ("Challenged Claims") of the '482 patent in connection with MBUSA's petition for *inter partes* review that accompanies this Declaration. The Challenged Claims are reproduced below for reference.

Claim 1

1[pre]	A device for measuring power consumption and performance with respect to the environment of a power-consuming unit comprising
1[a]	a data introduction module, which receives at least one power consumption value, measured by a measurement apparatus of the power-consuming unit;
1[b]	an input device for inputting waste production data;
1[c]	a display screen; and
1[d]	a computer with a processor and a memory device having therein a plurality of instructions that, when executed by the processor, cause the processor to
1[e]	(a) receive the at least one power consumption value from the data introduction module,
1[f]	(b) receive the waste production data,
1[g]	(c) calculate an ecological parameter based on the at least one power consumption value and the waste production data, and
1[h]	(d) operate the display screen to display the calculated ecological parameter,
1[i]	wherein the calculated ecological parameter is an adjusted mean of the sum of the deviations of the at least one power consumption value with respect to a reference value corresponding to the at least one power consumption value.

Claim 2	
2	The device of claim 1 further comprising a means for introducing values of waste production.

Claim 4

4	The device of claim 1 further comprising USB input for a serial data bus.
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Claim 5	
5[a]	The device of claim 1 wherein the at least one power consumption value includes at least two power consumption values selected from the group of:
5[b]	a water flow input from a corresponding first water flow meter;
5[c]	a combustible gas and liquid flow input from a second combustible gas and liquid flow meter;
5[d]	an electric power measurement input from a meter or analyser of electric mains; and
5[e]	a waste weight measurement input from a scale for weighting wastes.

Claim 6	
6[a]	The device of claim 1 wherein the at least one power consumption value includes a fuel flow input from a corresponding flow meter from the motor of an automobile;
6[b]	the waste production data corresponds to one of tire rubber wastes, motor oil wastes, coolant liquid wastes, closed circuit liquid wastes and metal wastes, and
6[c]	the fuel flow input and the waste production data are used to calculate the ecological parameter corresponding to the automobile.

Claim 7	
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7	The device of claim 6 wherein the at least one power consumption value includes an exhaust gas flow input from a corresponding flow meter of exhaust gases of a combustion system of the automobile.
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Claim 9	
9[pre]	A method of determining an ecological parameter by processor, comprising:
9[a]	receiving a first power consumption value of a power consuming unit,
9[b]	receiving a waste production data value,
9[c]	determining an ecological parameter based on the first power consumption value and the waste production data value, and
9[d]	outputting the determined ecological parameter for display on a display screen.

Claim 10	
10	The method of claim 9, wherein the first power consumption value corresponds to one of water flow, combustible gas flow, and electric power flow.

Claim 11	
11	The method of claim 10, wherein the waste production data corresponds to waste weight.

Claim 12	
12	The method of claim 9, wherein the first power consumption value corresponds to one of fuel flow and exhaust gas flow.

Claim 13	
13	The method of claim 12, wherein the waste production data corresponds to one of rubber wastes, oil waste, coolant liquid wastes, and metal.

IX. CLAIM CONSTRUCTION

61. It is my understanding that the challenged claims of the '482 patent are to be given their ordinary and customary meaning as understood by one of ordinary skill in the art at the time of the alleged invention in light of the specification and the prosecution history pertaining to the patent. Therefore, for the purposes of this Declaration, all claim terms are given their plain and ordinary meaning.

A. Claim 2: “means for introducing values of waste production”

62. It is my understanding that an IPR petition must identify the specific portions of the specification that describe the structure, material, or acts corresponding to each claimed function of any means-plus-function claim term. Claim 2 recites “The device of claim 1 further comprising a means for introducing values of waste production.” Ex. 1001 at cl. 2. I understand that this limitation is a means-plus-function term because it recites a function to be performed (“introducing values of waste production”) without reciting the corresponding structure or materials for performing the function. The '482 patent discloses a corresponding structure for this limitation at 3:45-47. The '482 patent specification discloses a that “[t]o introduce values of the waste production one of the inputs E4, digital o[r] analogical, can be used, from a weight apparatus, or they can be introduced manually through a keyboard.” *Id.* at 3:45-47. Accordingly, the structure corresponding to the “means for introducing values of waste production”

limitation should be construed as a “weight apparatus,” such as a weight sensor or scale, a keyboard, or the equivalents of these structures.

X. SUMMARY OF PRIOR ART

A. Luff

1. Priority Date

63. U.S. Patent No. 8,170,886 to Luff, “Systems, methods, and apparatus to generate an energy consumption index” (Ex. 1005, “Luff”), was filed March 30, 2009 and claims priority to U.S. Provisional Application No. 61/040,466 (“the ’466 provisional”), which was filed March 28, 2008. I understand that in order for Luff to claim priority to the 466 provisional (1) the provisional application must support at least one claim of Luff and (2) the disclosure of Luff must have been carried forward from the ’466 provisional.

64. First, the ’466 provisional does support at least one claim of the Luff patent. As shown in the table below, claim 1 of the ’466 provisional teaches the same steps as Luff’s claim 1 in the same order:

Luff Claim 1	’466 Provisional Claim 1
1. A method to generate an energy consumption index, the method comprising:	1. A method to generate a personal energy consumption index, comprising
measuring, via a first sensor, resources consumed at a home associated with a person and calculating a home energy value indicative of the resources consumed at the home;	receiving home resource consumption measurements associated with at least one of a household appliance, fixture or device;

measuring, via a second sensor, resources consumed by the person while located outside the home and calculating an out of home energy value indicative of the resources consumed by the person while located outside the home;	receiving remote resource consumption measurements associated with a person;
identifying goods purchased by the person and calculating a purchase energy value indicative of an amount of energy required to manufacture the goods and to manufacture packaging of the goods; and	receiving purchase information associated with the person; and
generating, via a logic circuit, an energy consumption index associated with the person based on the home energy value, the out of home energy value, and the purchase energy value.	generating a personal energy consumption index based on the received resource consumption measurements, remote resource consumption measurements, and purchase information.

65. Luff's claim 1 adds additional details to the claimed method steps. For example, Luff's claim 1 adds the detail that its resource consumption measurements are made via a sensor. Ex. 1005 at cl. 1. The '466 provisional also discloses these details in its specification. Ex. 1010 at ¶¶ 0036, 0041-42, 0048-49, 0057, FIGS. 3-4.

66. Second, the disclosures of Luff described in my analysis below were carried through from the '466 provisional application. Where my analysis relies on Luff, I have provided citations to both Luff and the '466 provisional.

67. Therefore, Luff may claim priority to the '466 provisional application.

2. Summary of Luff

68. Luff discloses the same systems and methods as the '482 patent for measuring resource consumption and waste production and calculating an environmental impact parameter based on the measurements. Luff discloses a “energy consumption ind[ices]” calculated based on measurements of resources consumed by a household, person, or vehicle. Ex. 1005 at Abstract. Also like the '482 patent's system, Luff discloses a data collector 110 that includes input devices such as a touch screen for inputting or modifying data, a processor and machine-readable instructions for generating Luff's energy consumption indices, and a display that may display the calculated energy consumption indices. *Id.* at 30:24-58. As shown in annotated Figure 1 of Luff below, Luff's system generally includes the same components as the system claimed in the '482 patent.

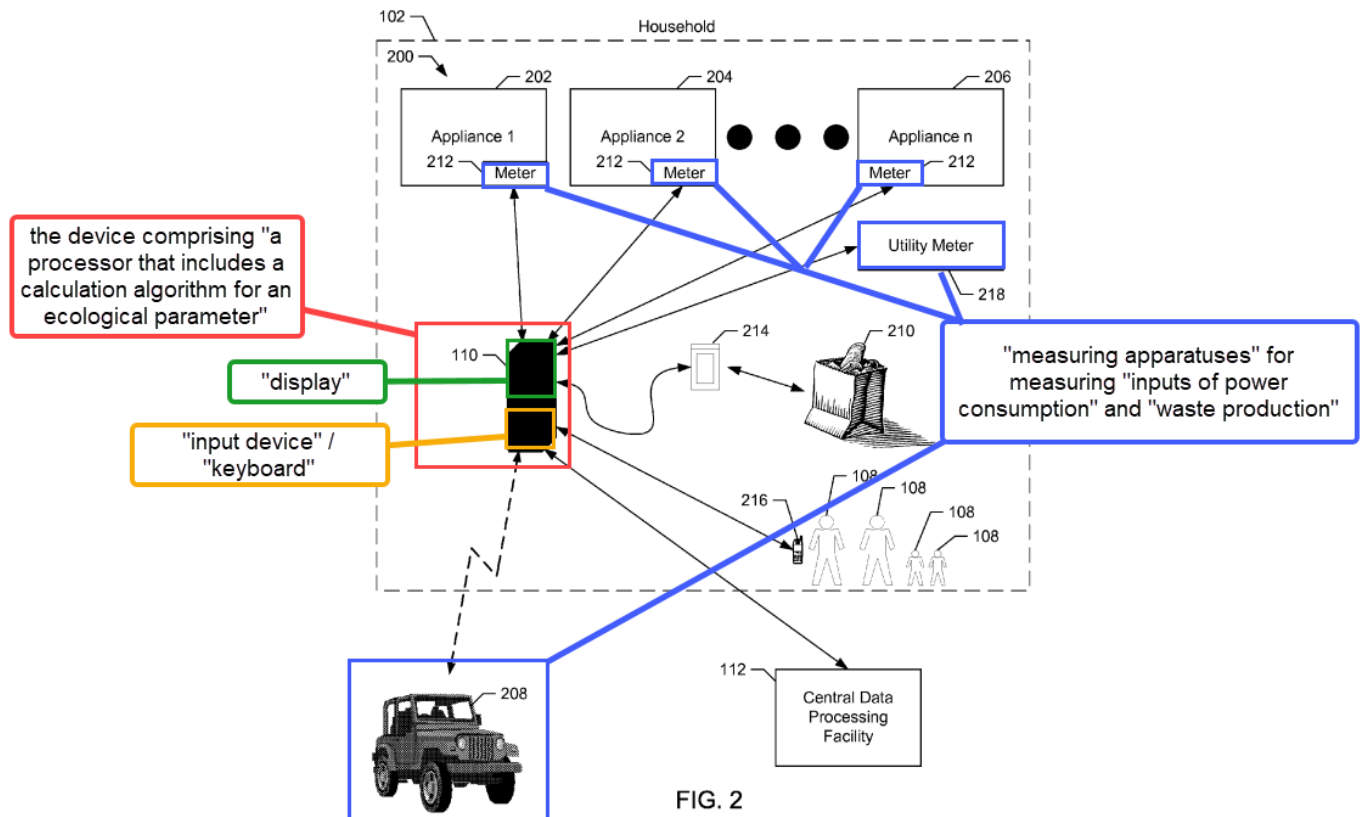


FIG. 2

Id. at FIG. 1 (annotations added).

69. As shown in annotated Figure 1 above, Luff discloses measuring resource and energy consumption via a variety of meters, such as electricity, gas, or water meters, or meters for measuring fuel consumed by a vehicle. *Id.* at 5:57-64. Luff generates its energy consumption indices based on these inputs. Luff teaches that its energy consumption indices “reflect the resource and/or energy usage patterns” over time. *Id.* at 3:17-21.

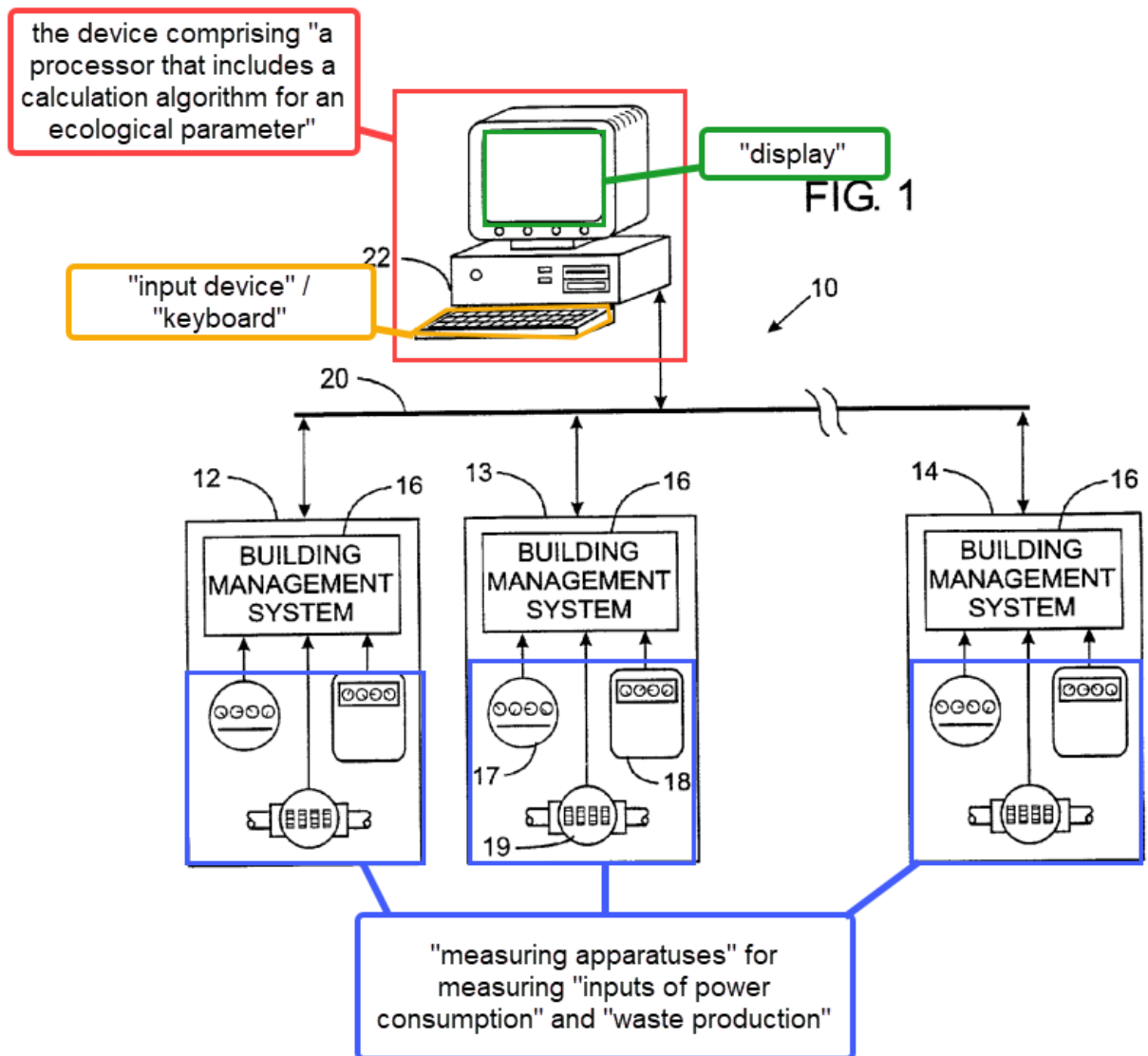
B. Amaratunga

70. Amaratunga discloses the same systems and methods as the '482 patent for measuring resource consumption and waste production and calculating an

71. Amaratunga's discloses "receiving information" regarding power consumption and waste production, "analyzing and evaluating the information" and comparing the measured information to "amounts of energy expected to be consumed" to determine the "operating efficiency of the energy consuming site." *Id.* at ¶¶ 0008, 0019.

C. Seem

72. Also like the '482 patent, Seem discloses systems and methods for measuring "utility use," "statistically analyz[ing]" those measurements, and using the statistical analysis of utility usage to compare the measured utility usage to expected or normal utility use. Ex. 1007 at Abstract. Seem discloses many of the components used in the '482 patent's system, including utility meters for measuring power consumption and a device used for analyzing utility consumption with respect to reference or normal values that includes an input device and a display. Annotated Figure 1 of Seem below demonstrates the components of the '482 patent's system disclosed in Seem:



Id. At FIG. 1 (annotations added).

73. Seem also uses the same formula claimed in the '482 patent to calculate its economic parameter. The '482 patent claims "an adjusted mean of the sum of the deviations of the at least one power consumption value with respect to a reference value corresponding to the at least one power consumption value." Ex. 1001 at cl. 1.

74. As shown in the annotated figure below, Seem discloses the same formula. Seem discloses a sum of deviations in the numerator shown below. Ex. 1007 at ¶ 39. Seem's sum of deviations is calculated with respect to Seem's robust mean $\bar{x}_{robust}$, which is a reference value. *Id.* Finally, Seem discloses calculating an adjusted mean of its sum by dividing sum by the number of measurements in the set, excluding the data sets outliers removed. *Id.*

The diagram shows the formula for s_{robust} with three callout boxes:

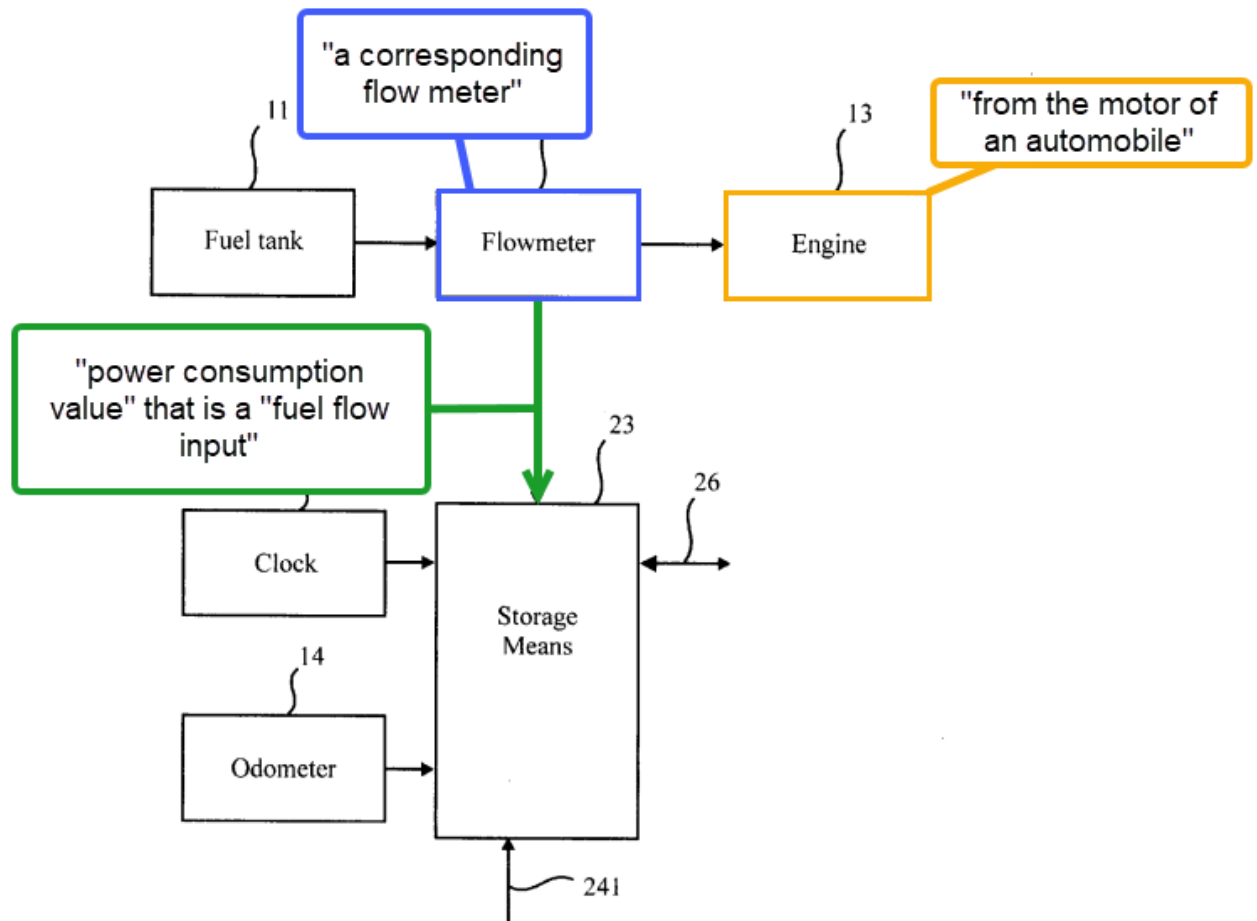
- A green box around the numerator $\sum_{j=1}^{n-n_{out}} (x_j - \bar{x}_{robust})^2$ is labeled "sum of deviations".
- A blue box around the term $\bar{x}_{robust}$ is labeled "with respect to a reference value".
- A red box around the entire fraction $\sqrt{\frac{\sum_{j=1}^{n-n_{out}} (x_j - \bar{x}_{robust})^2}{n - n_{out} - 1}}$ is labeled "an adjusted mean".

75. In the formula above, x is a set of utility measurements measured over a period of time, x_j is utility usage during time period j , n is the total number of utility measurements made during the time period, n_{out} is the number utility measurements in data set x that are outliers, and $\bar{x}_{robust}$ is a robust estimate of the mean utility usage. *Id.* 1007 at ¶¶ 0026, 0028, 0036, 0039.

D. Zuta

76. Zuta, just like the '482 patent, teaches measuring resource and energy consumption of a power-consuming unit. In Zuta's case, the power consuming unit is a vehicle. Zuta discloses "a fuel consumption measurement system" for a motor vehicle. Ex. 1008 at Abstract. Zuta's system measures fuel consumption via a

flowmeter that is installed between the vehicles fuel tank and engine. After measuring fuel flow, the fuel meter transmits the measured data to a digital storage means. *Id.* at ¶ 138 An example of Zuta's fuel consumption measurement system is shown in annotated Figure 1 below.

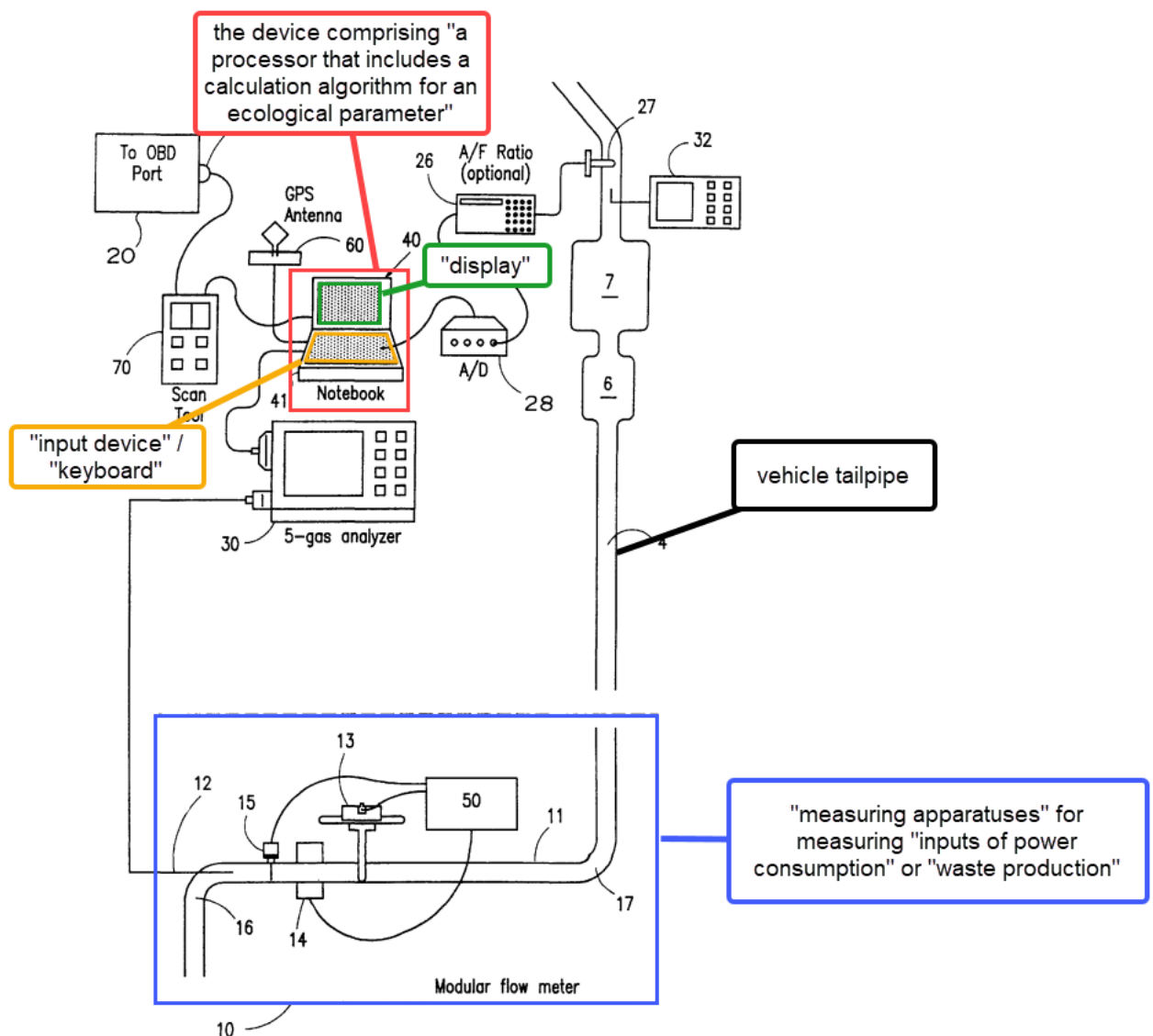


Id. at FIG. 1 (annotations added).

E. **Breton**

77. Breton teaches measuring resource and energy consumption from a power-consuming unit, just like the '482 patent. In Breton, the power consuming unit is a vehicle. Breton discloses an “on-board vehicle emissions testing system”

including a “module adapted to be detachably connected to the exhaust pipe of a vehicle to provide for . . . determination of flow rate of the exhaust gas” from the vehicle. Ex. 1009 at Abstract. Breton’s system analyzes “on-road emissions performance of a vehicle” and the emissions’ environmental impact based on the measured exhaust data to . *Id.* at 2:13-18. Annotated Figure 1 below shows an example of Breton’s system:



Id. at FIG. 1 (annotations added).

78. Breton discloses embodiments of its invention, such as the one shown in Figure 1 above, where the modular flow meter is attached to end of the vehicles tail pipe. *Id.* However, a POSITA would understand that it would be trivial to modify such an embodiment to incorporate the modular flow meter into the vehicle exhaust system (*i.e.*, under the body of the vehicle) such that it need not be connected to the end of the tail pipe.

XI. GROUND 1: THE COMBINATION OF LUFF, AMARATUNGA, AND SEEM RENDERS OBVIOUS CLAIMS 1-2 AND 4-5.

79. In my opinion, a POSITA at the time of the alleged invention would have found claims 1-2 and 4-5 obvious over Luff in view of Amaratunga and Seem.

A. Motivation to Combine Luff with Amaratunga and Seem

1. Combining Luff and Amaratunga

80. In my opinion, a POSITA in possession of Luff's system for measuring power and resource consumption would have been motivated to include a waste information unit for introducing waste production data as taught by Amaratunga for a variety of reasons.

81. Amaratunga teaches a "waste information unit 230" that measures "waste amounts" and provides the waste amount data to a data processing module because "waste amounts . . . influence the energy amounts used." Ex. 1006 at ¶ 0035. Amaratunga teaches that including a waste information unit for introducing

waste production data enables a system to make a more accurate and comprehensive “true assessment of the energy efficiency of [an] energy consuming site.” Ex. 1006 at ¶ 0019. In my opinion, the benefits of a waste information unit that introduces waste production data taught by Amaratunga would motivate a POSITA to modify Luff’s system to include such an automated waste information unit.

82. Accordingly, in my opinion a POSITA would have been motivated to modify Luff’s system to include a waste information unit as taught by Amaratunga more accurately and comprehensively calculate a “true assessment of the energy efficiency of [an] energy consuming site.” Ex. 1006 at ¶ 0019.

83. Additionally, in my opinion a POSITA would be motivated to modify Luff based on the teachings of Amaratunga because they are both in the same field of endeavor as the ’482 patent: measuring and analyzing power, energy, and resource consumption. Ex. 1001 at Abstract; Ex. 1010 at ¶ 0001; Ex. 1005 at Abstract; Ex. 1006 at Abstract. In my opinion, both Luff and Amaratunga also use similar techniques to solve the same problem as the ’482 patent. For example, Luff discloses nearly all of the limitations of claims 1-2, and 4-5, and Amaratunga discloses an input device for inputting waste production data and other related limitations.

84. Moreover, in my opinion a POSITA would have had a reasonable expectation of success of modifying Luff’s power consumption system to include a

waste information unit based on the teachings of Amaratunga, including at least because Luff already teaches that its power consumption system receives data from devices that measure and/or input resource consumption data, such as meters or user interfaces. Ex. 1005 at 9:24-31; Ex. 1010 at ¶ 0020. In my opinion, a POSITA would understand that the software in Luff's data collector and "Home Resource Consumption Management" or "HRCM" devices, which receive data from various inputs across Luff's system, could be modified to receive data from a waste information measuring or input module, and the waste information module could be added among the resource consumption measuring meters already disclosed in Luff.

2. Combining Luff with Amaratunga and Seem

85. In my opinion, a POSITA in possession of Luff's system for calculating energy consumption indices based on measurements of power and resource consumption would have been motivated to modify the system to calculate its energy consumption systems via an adjusted mean of the sum of the deviations of its one power consumption values with respect to a reference value corresponding to the at least one power consumption value as taught by Seem because, as Seem teaches, using such calculation methods would more quickly and efficiently identify whether current energy use is significantly outside the range of normal energy use. Ex. 1007 at ¶ 0012.

86. Seem teaches a robust standard deviation formula that is part of “robust data analysis” that can “automatically determine if the current energy use is significantly different than previous energy patterns.” Ex. 1007 at ¶¶ 0017, 0039-40. Seem teaches that using its sum of the deviations formula to calculate energy consumption parameters enables a system to more quickly and efficiently detect abnormal energy usage by “automatically determin[ing] if the current energy use is significantly different than previous energy patterns.” Ex. 1007 at ¶ 0012. In my opinion, a POSITA would have been motivated to modify Luff’s system and methods to use a robust standard deviation calculation as taught by Seem to calculate Luff’s energy consumption indices to more quickly and efficiently detect abnormal energy usage by “automatically determin[ing] if the current energy use is significantly different than previous energy patterns.” Ex. 1007 at ¶ 0012.

87. Additionally, in my opinion a POSITA would be motivated to modify Luff based on the teachings of Seem because they are both in the same field of endeavor as the ’482 patent: measuring and analyzing power, energy, and resource consumption. Ex. 1001 at Abstract; Ex. 1010 ¶ 0001; Ex. 1005 at Abstract; Ex. 1007 at Abstract. In my opinion, both Luff and Seem also use *similar* techniques to solve the same problem as the ’482 patent. For example, Luff discloses nearly all of the limitations of the ’482 patent’s claims 1-2 and 4-5, and Seem discloses an adjusted mean of the sum of the deviations of the at least one power consumption

value with respect to a reference value corresponding to the at least one power consumption value claimed in claim 1.

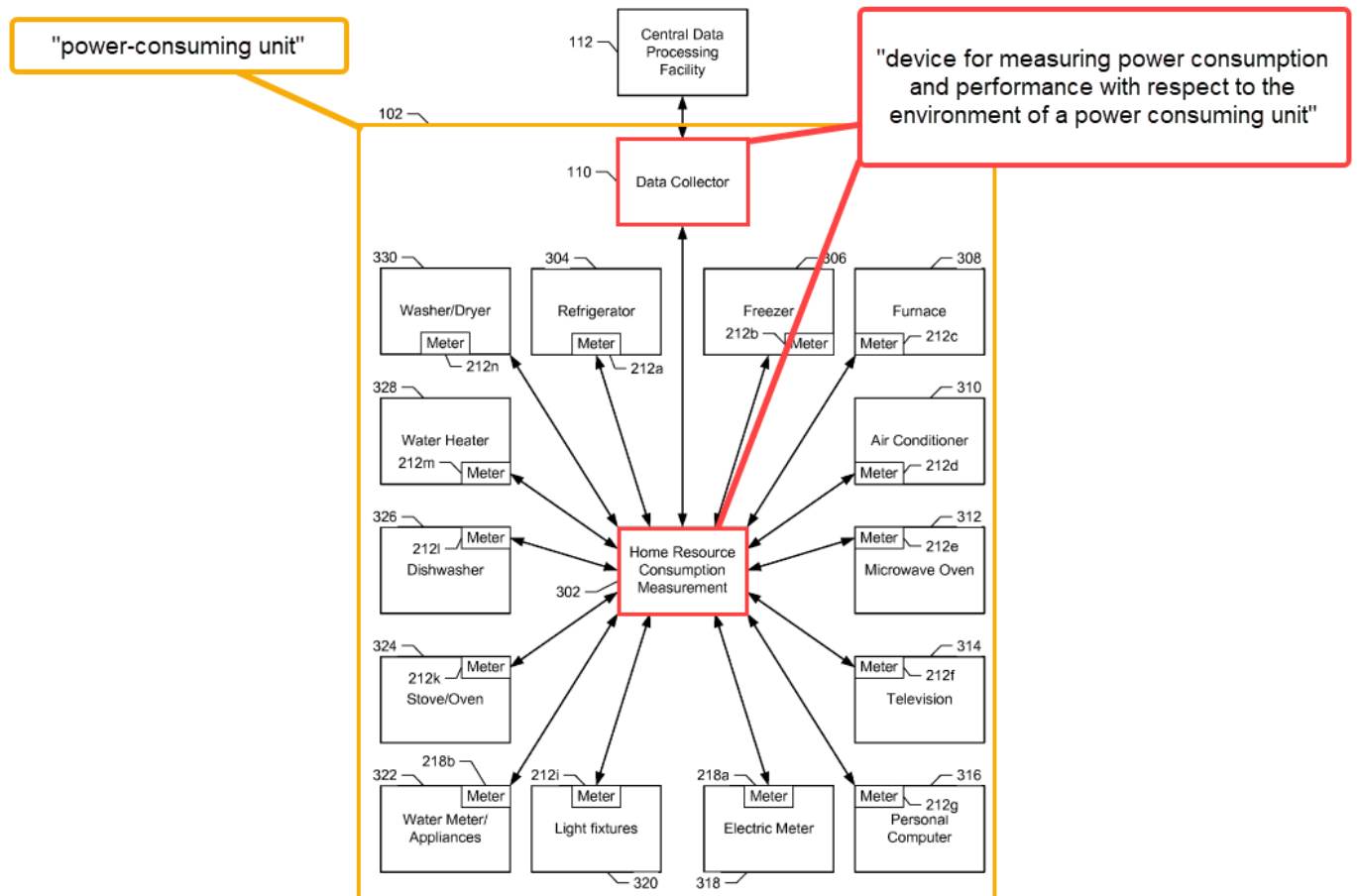
88. Moreover, in my opinion a POSITA would have had a reasonable expectation of success of modifying Luff's energy consumption indices calculating systems and method to use an adjusted mean of the sum of deviations as taught by Seem, including at least because Luff already discloses calculating energy consumption indices. Ex. 1005 at 1:55-65; Ex. 1010 at ¶ 0081. In my opinion, a POSITA would understand that the software in Luff's data collector device could be modified to calculate Luff's energy consumption indices using a sum of deviations formula as taught by Seem.

B. Claim 1

1. 1[pre]: “A device for measuring power consumption and performance with respect to the environment of a power-consuming unit comprising”

89. In my opinion, Luff discloses a device for measuring power consumption and performance with respect to the environment of a power-consuming unit. Luff teaches “systems, methods, apparatus, and articles used to measure, calculate, and/or identify resource and/or energy consumption” that “facilitate generation of an energy consumption index to reflect the resource and/or energy usage.” Ex. 1005 at 3:12-20; Ex. 1010 at ¶ 0083. Luff discloses a “Home Resource Consumption Management (HRCM) device” that “receives information

from a number of meters . . . associated with a household,” “aggregates resource consumption data,” and reports the raw and/or processed data to a “data collector.” Ex. 1005 at 3:30-36, 7:45-58; Ex. 1010 at ¶¶ 0035-0054. Luff’s HRCM and data collector collectively operate as a device for measuring power consumption. Ex. 1005 at 3:30-36, 7:45-58; Ex. 1010 at ¶¶ 0035-0054. Luff further discloses “calculat[ing] the energy associated with generating, transporting, disposing of, and/or otherwise utilizing the resources” via an “energy index generator . . . that may . . . implement the . . . data collector.” 1005 at 13:26-34; 14:30-33; Ex. 1010 at ¶¶ 0035-0061. Luff additionally teaches that its “energy index generator” implemented by the “data collector” may “illustrate how much energy a monitored entity consumes relative to a similar entity or a desired entity usage goal.” 1005 at 13:26-34; 14:30-33; Ex. 1010 at ¶¶ 0035-0061. Accordingly, Luff’s energy index generator is a device for measuring power consumption performance with respect to the environment. Ex. 1005 at 13:26-34; 14:30-33; Ex. 1010 at ¶¶ 0035-0061. As shown in Luff’s annotated Figure 3 below, the HRCM, data collector, and energy index generator collectively disclose a device for measuring power consumption and performance relative to the environment.



Ex. 1005 at FIG. 3 (annotations added); *see also* Ex. 1010 at FIG. 3.

90. Luff teaches that the HRCM and data collector measure a household's, *i.e.*, a power-consuming unit, power consumption. Ex. 1005 at 3:30-36, 7:45-58, 13:26-34; 14:30-33; Ex. 1010 at ¶¶ 0035-0061. The '482 patent similarly discloses that "The 'power consuming unit' . . . can be a house." Ex. 1001 at 3:5-12.

91. Luff also discloses embodiments in which the "HRCM . . . 302 may be integrated into the data collector 110 as software." Ex. 1005 at 8:50-51; Ex. 1010 at ¶ 0039. In such embodiments, as show in annotated Figure 2 below, the data collector directly receives information from a number of meters associated with a

household, *i.e.*, a device for measuring power consumption and performance with respect to the environment of a power-consuming unit. Ex. 1005 at 8:50-51; Ex. 1010 at ¶ 0039.

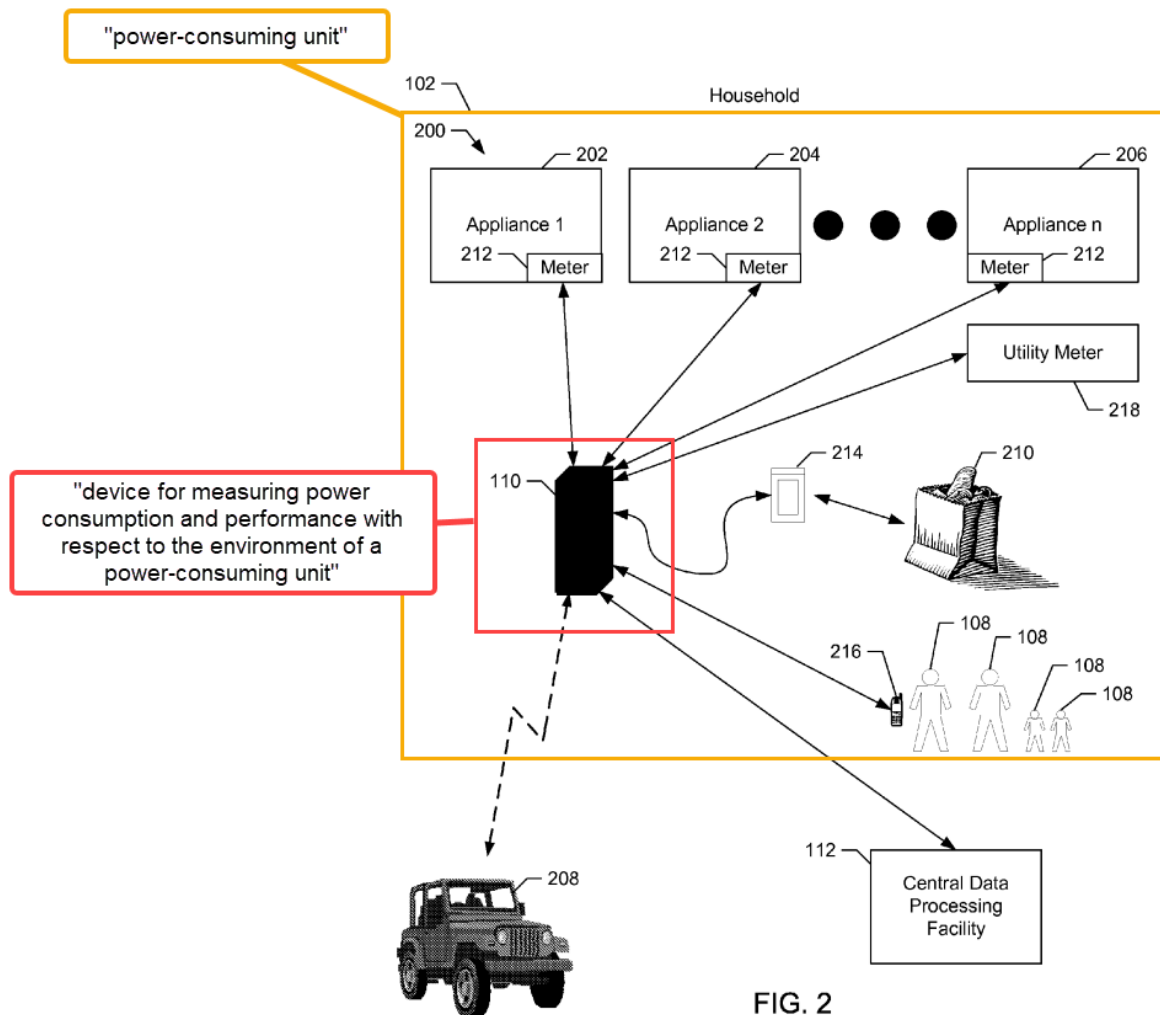


FIG. 2

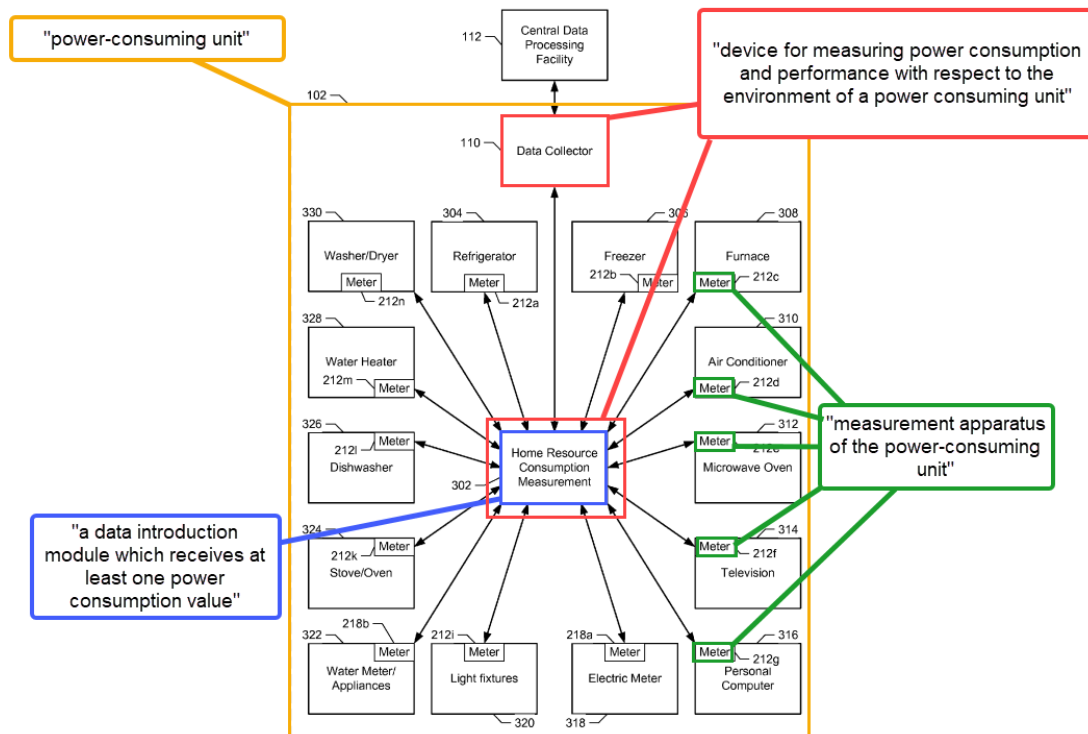
Ex. 1005 at FIG. 2 (annotations added); *see also* Ex. 1010 at FIG. 2.

92. Accordingly, in my opinion Luff discloses the preamble of claim 1.

2. 1[a]: “a data introduction module, which receives at least one power consumption value, measured by a measurement apparatus of the power-consuming unit;”

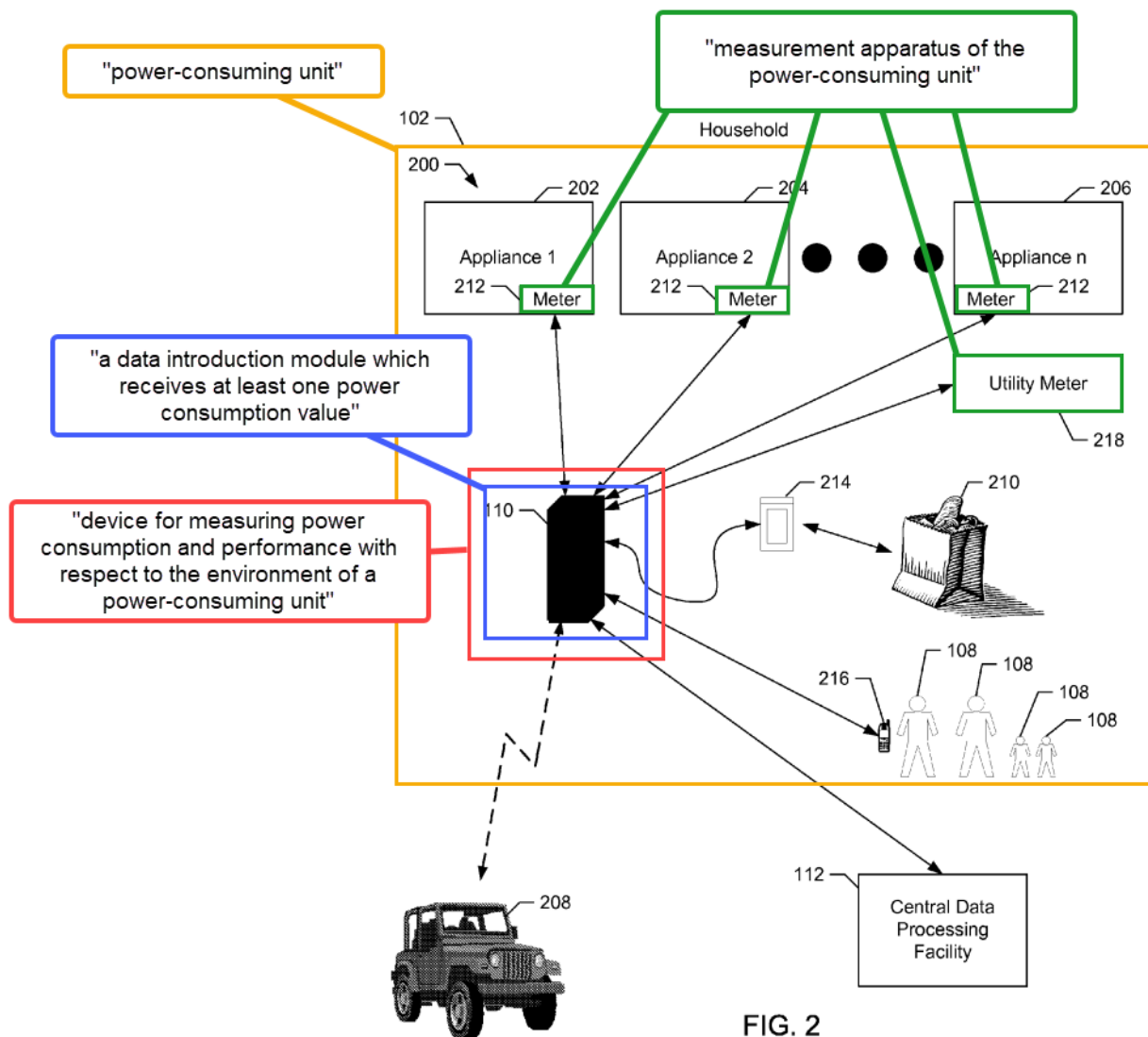
93. In my opinion, Luff discloses a data introduction module, which receives at least one power consumption value, measured by a measurement apparatus of the power-consuming unit.

94. Luff discloses that its “HRCM device 302 receives information from a number of meters . . . associated with [a] household,” *i.e.*, comprises a data introduction module that receives at least one power consumption value. Ex. 1005 at 7:47-50; Ex. 1010 at ¶¶ 0035-0054. The meters taught by Luff are “configured to measure and report resource consumption data,” *i.e.*, a measurement apparatus that measures at least one power consumption value. Ex. 1005 at 5:57-61; Ex. 1010 at ¶¶ 0035-0054. Luff discloses that its meters may measure “home energy values . . . from appliances associated with a measured household,” including, for example, an air conditioner, television, microwave, personal computer, or furnace,” *i.e.*, the power consumption values and measurements apparatuses are of the power-consuming unit. Ex. 1005 at 7:41-44; Ex. 1010 at ¶ 0020. Annotated Figure 3 of Luff below shows how the components of one embodiment of Luff’s system map to the claim terms of the ’482 patent.



Ex. 1005 at FIG. 3 (annotations added); *see also* Ex. 1010 at FIG. 3.

95. As shown in annotated Figure 2 below, Luff further teaches embodiments in which the “HRCM . . . 302 may be integrated into the data collector 110 as software” such that the data collector directly receives information from a number of meters associated with a household, *i.e.*, a data introduction module, which receives at least one power consumption value, measured by a measurement apparatus of the power-consuming unit. *Id.* at 8:50-51.



Ex. 1005 at FIG. 2 (annotations added); *see also* Ex. 1010 at FIG. 2.

96. Accordingly, in my opinion Luff discloses claim limitation 1[a].

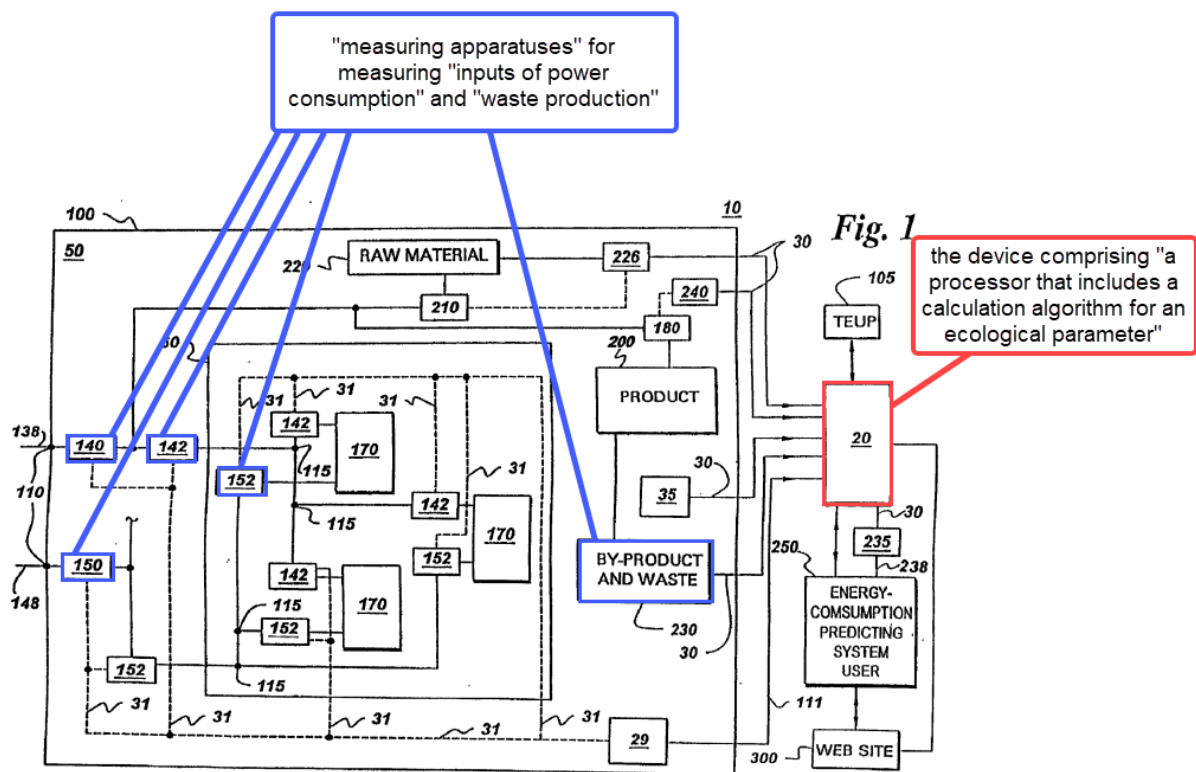
3. 1[b]: “an input device for inputting waste production data;”

97. In my opinion, Luff in view of Amaratunga discloses an input device for inputting waste production data.

98. Luff discloses “barcode scanners 214,” *i.e.*, an input device, that may be “communicatively coupled” to “the data collector 110.” Ex. 1005 at 5:57-6:26;

Ex. 1010 at ¶ 0031. The data collector receives product UPC codes from the barcode scanners that indicate, among other things, “an amount waste associated with the use of the product (e.g., landfill space requirements[]),” *i.e.*, the volume of space required to store the waste produced by the product or the amount of waste produced, *i.e.* the waste production data. Ex. 1005 at 5:57-6:26; Ex. 1010 at ¶ 0031. Accordingly, in my opinion Luff discloses an input device for inputting waste production data.

99. Luff further teaches that its “example data collector 110 include[s] a user interface to enter and/or adjust resource consumption information,” *i.e.*, an input device for inputting data. Ex. 1005 at 9:24-31; Ex. 1010 at ¶ 0042. Like Luff, Amaratunga discloses: a “by-product and waste information unit 230” that provides “by-product and waste information” to “a TEUP [total energy use module].” Ex. 1006 at ¶ 0032. As shown in annotated Figure 1 below, Amaratunga’s by-product and waste information unit transmits information over a communication link 30 to Amaratunga’s Data Processing Module 20. *Id.*



Id. at FIG. 1 (annotations added).

100. In my opinion, A POSITA would have understood that modifying the user interface of Luff's data collector based on the teachings of Amaratunga to enable input of waste production data would more comprehensively and accurately calculate a "true assessment of the energy efficiency of [an] energy consuming site." Ex. 1006 at ¶ 0019.

101. In my opinion, a POSITA also would have been able to easily modify the code of Luff's data collector based on the teachings of Amaratunga such that the data collector's user interface could additionally input waste production data.

102. Accordingly, in my opinion Luff in view of Amaratunga renders obvious claim limitation 1[b].

4. 1[c]: “a display screen; and”

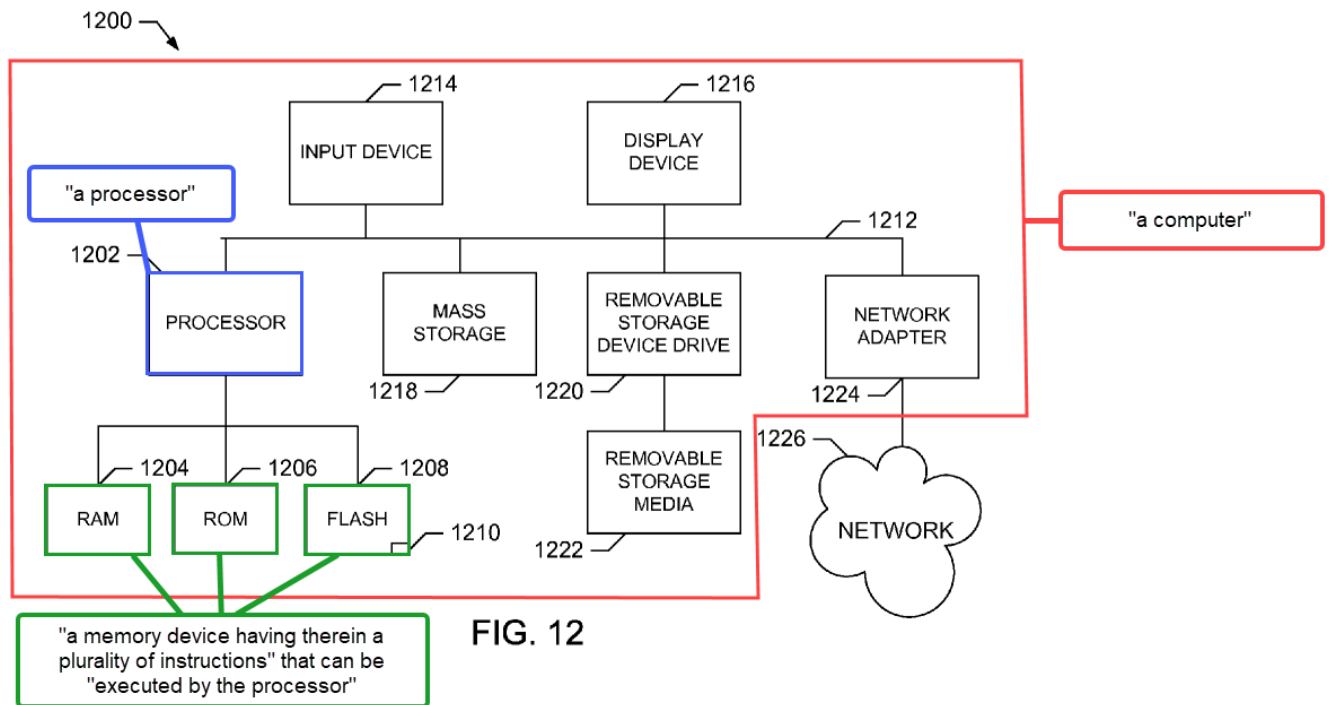
103. In my opinion, Luff discloses a display screen. Luff discloses its “[t]he example data collector 110 also has a display device . . . to provide output to a user” including screens such as “a liquid crystal display (LCD) monitor,” *i.e.*, a display screen. Ex. 1005 at 18:25-29, 30:53-55, FIG 12; Ex. 1010 at ¶ 0110.

104. Accordingly, in my opinion Luff discloses claim limitation 1[c].

5. 1[d]: “a computer with a processor and a memory device having therein a plurality of instructions that, when executed by the processor, cause the processor to”

105. In my opinion, Luff discloses a computer with a processor and a memory device having therein a plurality of instructions executable by the processor.

106. Luff’s data collector and HRCM both may be implemented by a “processor system” that may be a computer that executes “machine readable instructions.” Ex. 1005 at 1:66-2:3, 30:13-23; Ex. 1010 at ¶¶ 0107-0113. The processor system disclosed by Luff includes “a processor 1202,” “a random access memory (RAM) 1203,” “a read only memory (ROM) 1206,” and “a flash memory 1208” that store the processor system’s machine readable instructions executed and “fit the storage demands of the system.” Ex. 1005 at 30:23-48; Ex. 1010 at ¶¶ 0107-0113. Annotated Figure 12 below shows one embodiment of Luff’s processor system:



Ex. 1005 at FIG. 12; Ex. 1010 at FIG. 12.

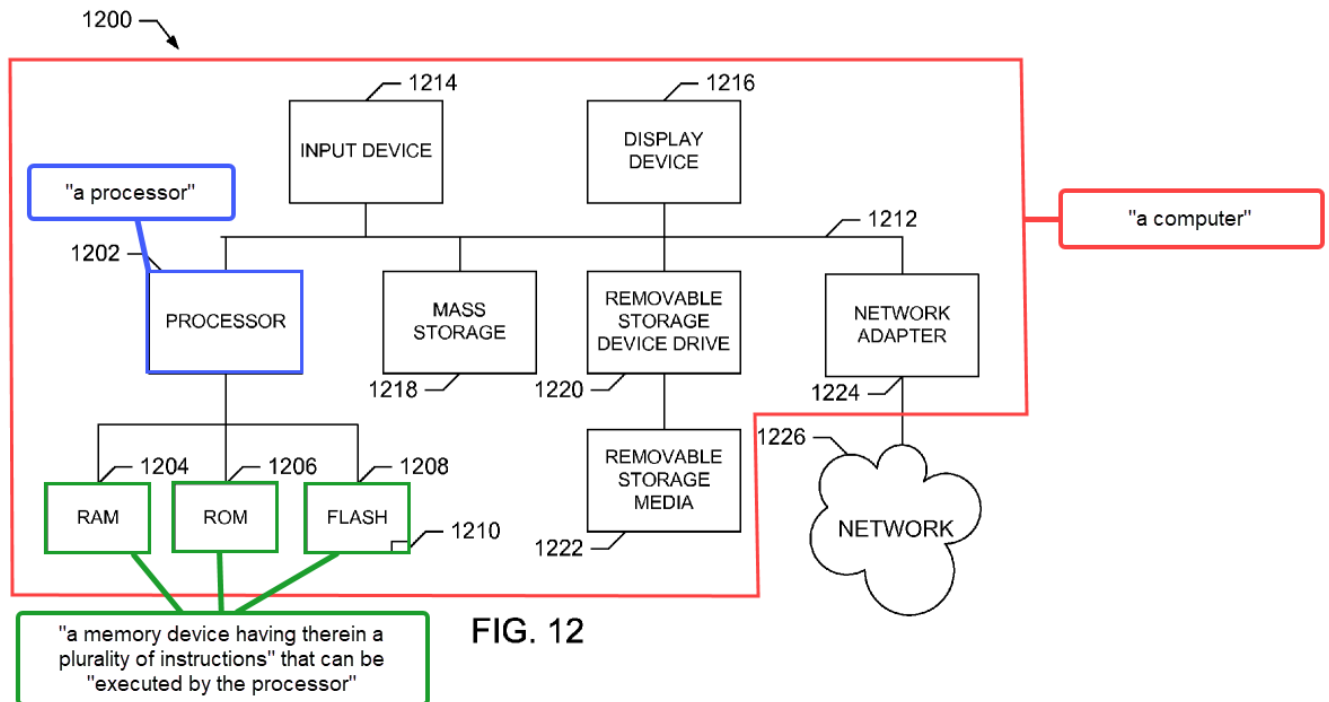
107. Accordingly, in my opinion Luff discloses claim limitation 1[d].

6. 1[e]: “(a) receive the at least one power consumption value from the data introduction module,”

108. In my opinion, Luff discloses a plurality of instructions that, when executed by the processor, causes the processor to receive at least one power consumption value from the data introduction module.

109. Luff’s data collector and HRCM both may be implemented by a “processor system” that may be a computer that executes “machine readable instructions.” Ex. 1005 at 1:66-2:3, 30:13-23; Ex. 1010 at ¶¶ 0107-0113. The processor system disclosed by Luff includes “a processor 1202,” “a random access memory (RAM) 1203,” “a read only memory (ROM) 1206,” and “a flash memory

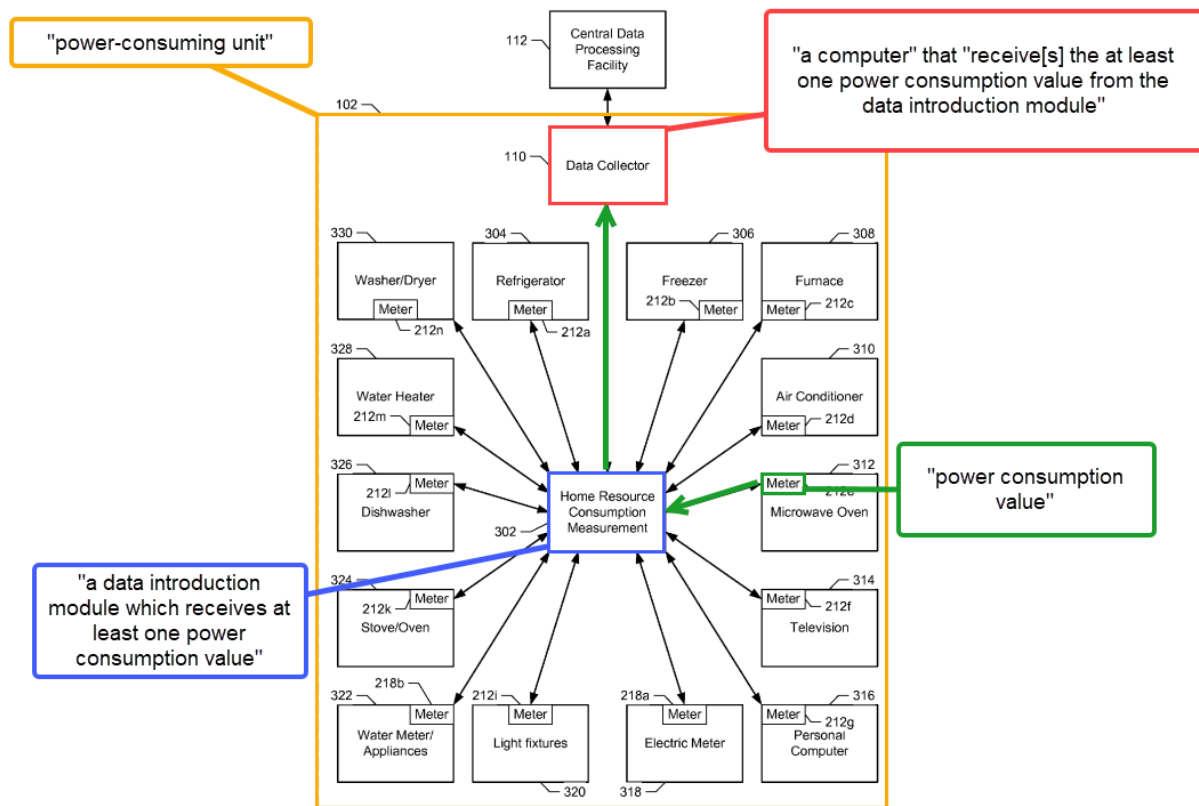
1208” that store the processor system’s machine readable instructions executed and “fit the storage demands of the system.” Ex. 1005 at 30:23-48; Ex. 1010 at ¶¶ 0107-0113. Annotated Figure 12 below shows one embodiment of Luff’s processor system:



Ex. 1005 at FIG. 12; Ex. 1010 at FIG. 12.

110. Luff’s data collector receives data, *i.e.*, power consumption values, from Luff’s meters. Ex. 1005 at 6:57-64, 8:28-47; Ex. 1010 at ¶ 0045. These power consumption values are transmitted to the data collector by the HRCM. Ex. 1005 at 6:57-64, 8:28-47; Ex. 1010 at ¶ 0045. In particular, Luff teaches that: “When the person 108 has finished [using an appliance] . . . [t]he meters . . . send resource consumption measurements . . . to the HRCM device 302, which . . .

transmits the data to the data collector 110”. Ex. 1005 at 6:57-64, 8:28-47; Ex. 1010 at ¶ 0045. Luff also teaches its HRCM and data collector “may actively request data,” *i.e.*, execute instructions that causes the processor to receive the data. Ex. 1005 at 8:33-37; Ex. 1010 at ¶ 0038. Annotated Figure 3 below shows how one embodiment of Luff’s system maps to the ’482 patent claim limitations:



Ex. 1005 at FIG. 3 (annotations added); *see also* Ex. 1010 at FIG. 3.

111. Accordingly, in my opinion Luff’s data collector discloses a plurality of instructions that, when executed by its processor, cause the data collector to receive the at least one power consumption value from the data introduction module, the HRCM.

112. Luff also teaches embodiments in which the “HRCM . . . 302 may be integrated into the data collector 110 as software” such that Luff’s data collector directly requests information from the meters, *i.e.*, a plurality of instructions that, when executed by the processor, causes the processor to receive at least one power consumption value from the data introduction module. Ex. 1005 at 8:50-51; Ex. 1010 at ¶ 0039. An example of one such embodiment is shown in annotated Figure 2 below:

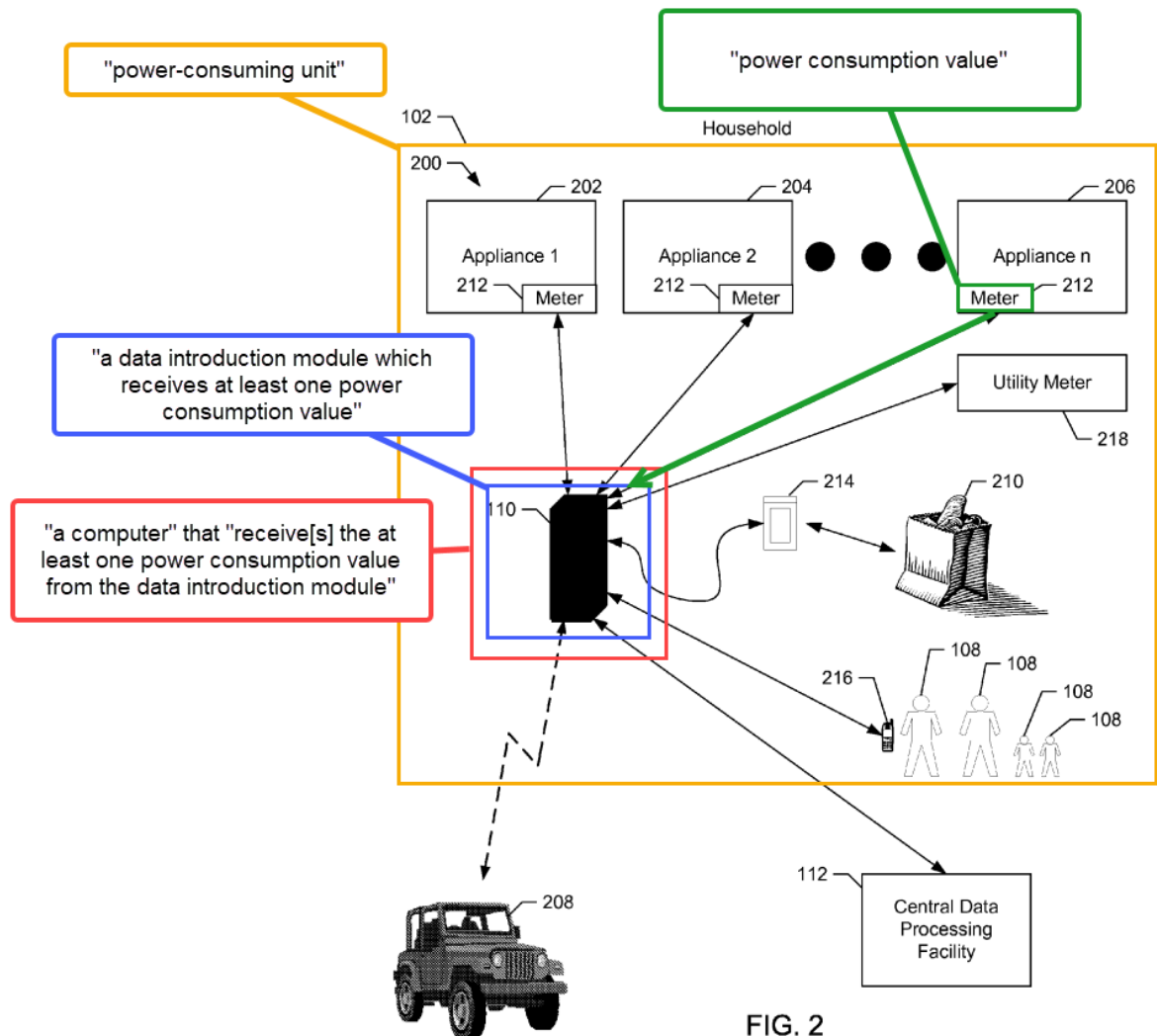


FIG. 2

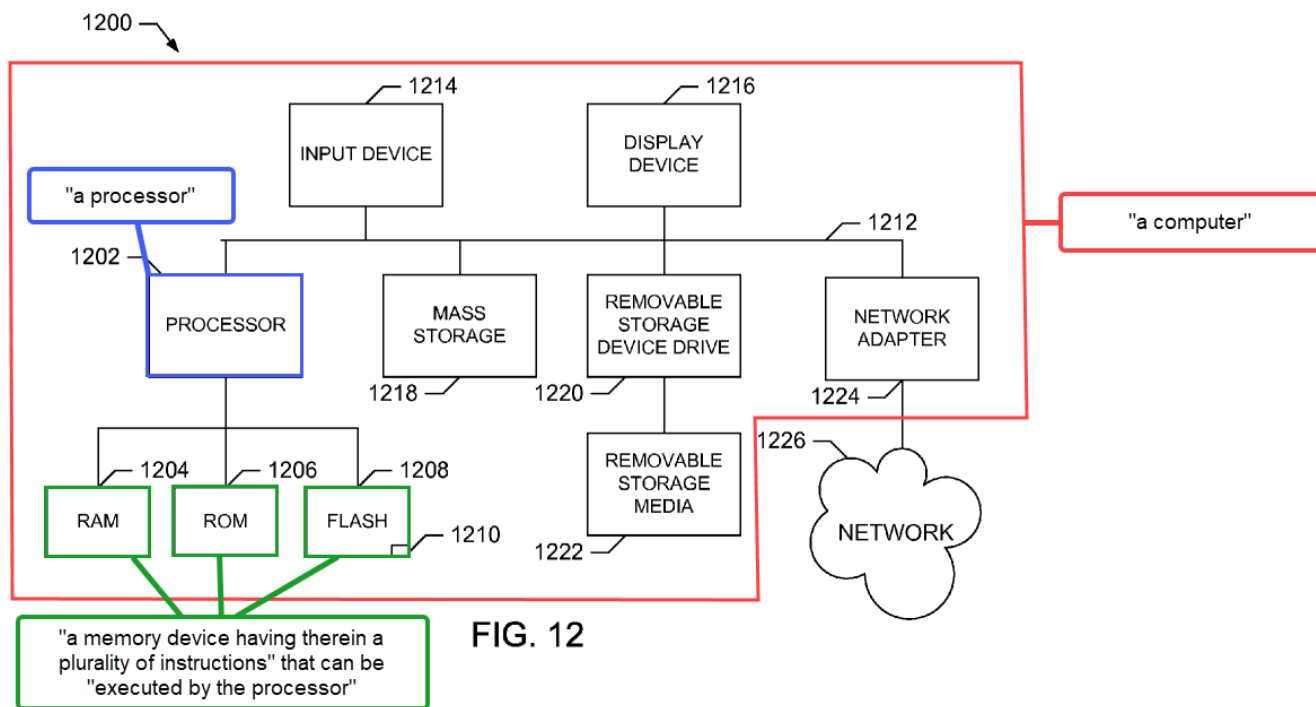
Ex. 1005 at FIG. 2 (annotations added); *see also* Ex. 1010 at FIG. 2.

113. Accordingly, in my opinion Luff discloses claim limitations 1[e].

7. 1[f]: “(b) receive the waste production data,”

114. In my opinion, Luff in view of Amaratunga renders obvious a plurality of instructions that, when executed by the processor, cause the processor to receive the waste production data.

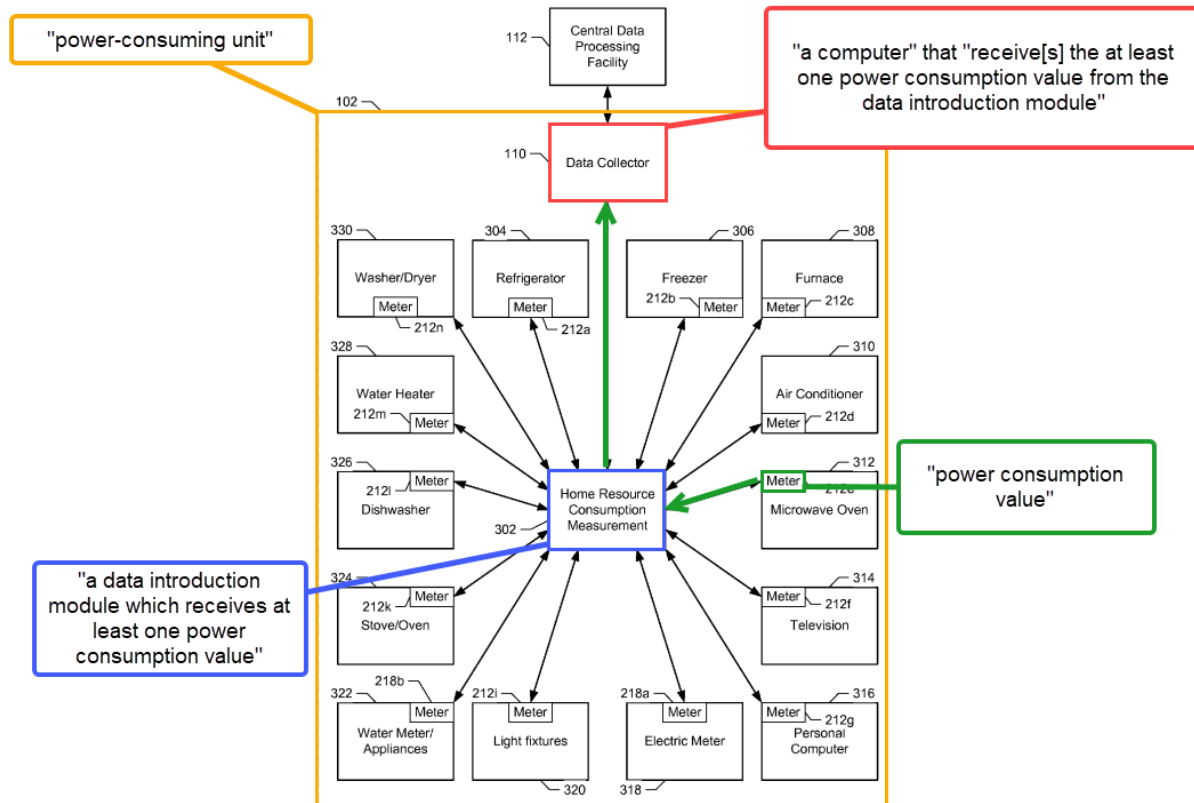
115. Luff’s data collector and HRCM both may be implemented by a “processor system” that may be a computer that executes “machine readable instructions.” Ex. 1005 at 1:66-2:3, 30:13-23; Ex. 1010 at ¶¶ 0107-0113. The processor system disclosed by Luff includes “a processor 1202,” “a random access memory (RAM) 1203,” “a read only memory (ROM) 1206,” and “a flash memory 1208” that store the processor system’s machine readable instructions executed and “fit the storage demands of the system.” Ex. 1005 at 30:23-48; Ex. 1010 at ¶¶ 0107-0113. Annotated Figure 12 below shows one embodiment of Luff’s processor system:



Ex. 1005 at FIG. 12; Ex. 1010 at FIG. 12.

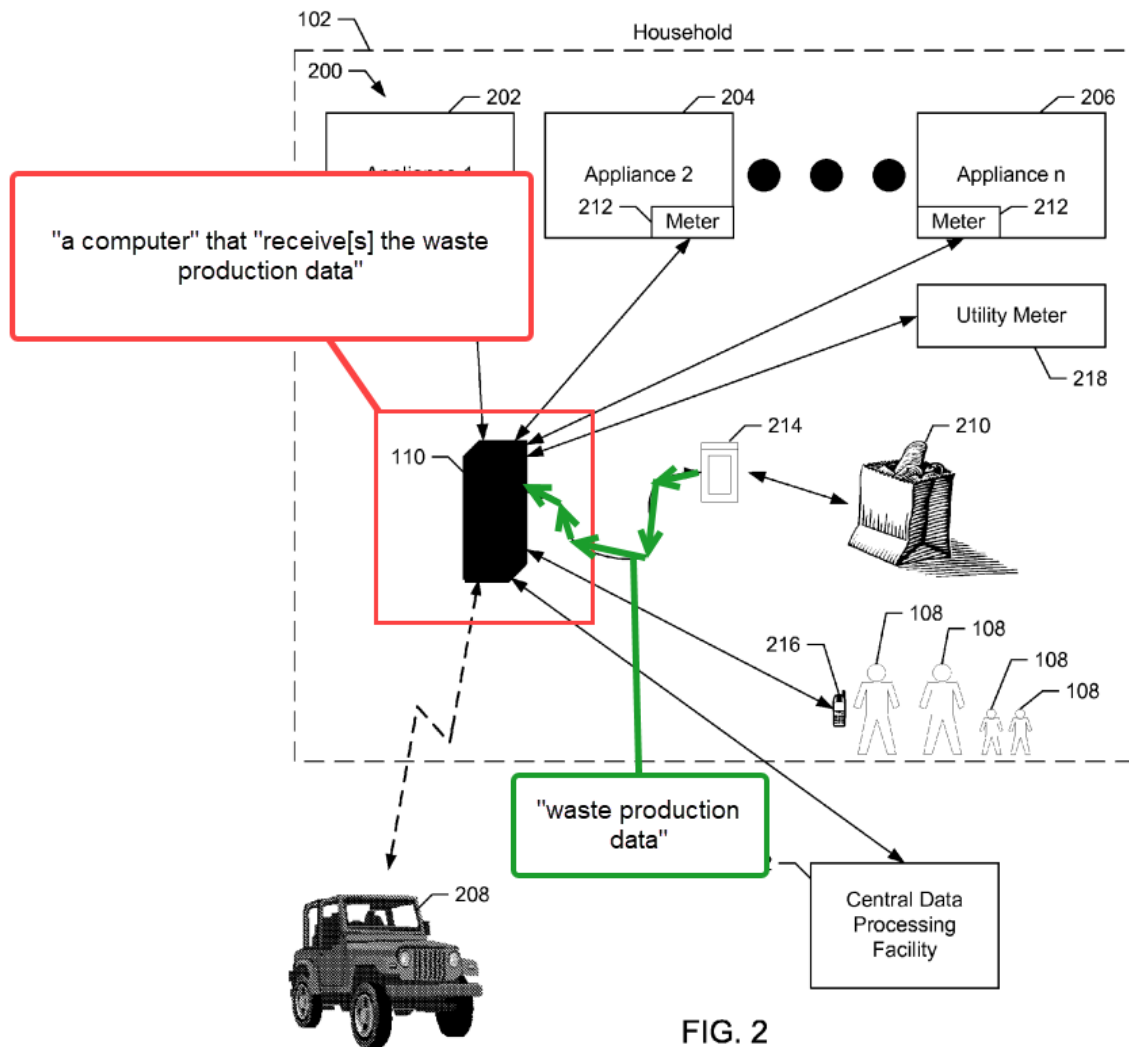
116. Luff's data collector receives data, *i.e.*, power consumption values, from Luff's meters. Ex. 1005 at 6:57-64, 8:28-47; Ex. 1010 at ¶ 0045. These power consumption values are transmitted to the data collector by the HRCM. Ex. 1005 at 6:57-64, 8:28-47; Ex. 1010 at ¶ 0045. In particular, Luff teaches that: "When the person 108 has finished [using an appliance] . . . [t]he meters . . . send resource consumption measurements . . . to the HRCM device 302, which . . . transmits the data to the data collector 110". Ex. 1005 at 6:57-64, 8:28-47; Ex. 1010 at ¶ 0045. Luff also teaches its HRCM and data collector "may actively request data," *i.e.*, execute instructions that causes the processor to receive the data.

Ex. 1005 at 8:33-37; Ex. 1010 at ¶ 0038. Annotated Figure 3 below shows how one embodiment of Luff's system maps to the '482 patent claim limitations:



Ex. 1005 at FIG. 3 (annotations added); *see also* Ex. 1010 at FIG. 3.

117. Luff also discloses “a data collector 110” that receives data from “barcode scanners 214” that may provide “an amount of waste associated with the use of the product (e.g., landfill space requirements[]),” *i.e.*, the volume of space required to store the waste produced by the product or the amount of waste produced, *i.e.*, the waste production data. Ex. 1005 at 5:57-6:26; Ex. 1010 at ¶ 0031.

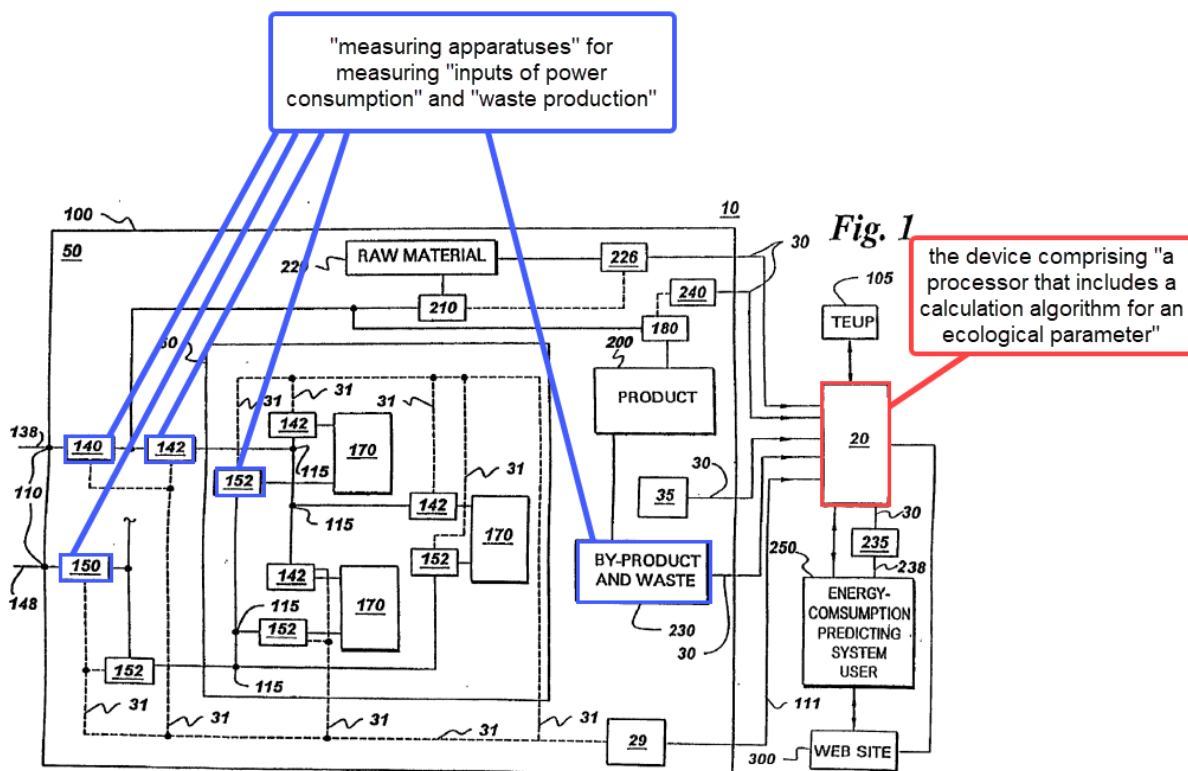


Ex. 1005 at FIG. 2 (annotations added); *see also* Ex. 1010 at FIG. 2.

118. Accordingly, in my opinion Luff discloses a plurality of instructions that, when executed by the processor, cause the processor to receive the waste production data.

119. Luff further teaches that its “example data collector 110 include[s] a user interface to enter and/or adjust resource consumption information,” *i.e.*, an input device for inputting data. Ex. 1005 at 9:24-31; Ex. 1010 at ¶ 0042. Like Luff,

Amaratunga discloses: a “by-product and waste information unit 230” that provides “by-product and waste information” to “a TEUP [total energy use module].” Ex. 1006 at ¶ 0032. As shown in annotated Figure 1 below, Amaratunga’s by-product and waste information unit transmits information over a communication link 30 to Amaratunga’s Data Processing Module 20. *Id.*



Id. at FIG. 1 (annotations added).

120. In my opinion, A POSITA would have understood that modifying the user interface of Luff’s data collector based on the teachings of Amaratunga to enable input of waste production data that would more comprehensively and accurately calculate a “true assessment of the energy efficiency of [an] energy consuming site.” Ex. 1006 at ¶ 0019.

121. Accordingly, Luff's data collector modified based on the teachings of Amaratunga renders obvious a plurality of instructions that, when executed by the processor, cause the processor to receive waste production data. Ex. 1005 at 30:13-23, 8:45-47; Ex. 1010 at ¶¶ 0038, 0045, 0107-0113; Ex. 1006 at ¶ 0035.

122. In my opinion, A POSITA would have understood that modifying the user interface of Luff's data collector based on the teachings of Amaratunga to enable integrated input of waste production data that would more comprehensively and accurately calculate a "true assessment of the energy efficiency of [an] energy consuming site." Ex. 1006 at ¶ 0019.

123. In my opinion, a POSITA also would have been able to easily modify the code of Luff's data collector based on the teachings of Amaratunga such that the data collector's user interface could additionally input waste production data.

124. Accordingly, in my opinion Luff in view of Amaratunga renders obvious claim limitation 1[f].

8. 1[g]: "(c) calculate an ecological parameter based on the at least one power consumption value and the waste production data, and"

125. In my opinion, Luff in view of Amaratunga discloses a plurality of instructions that, when executed by the processor, cause the processor to calculate an ecological parameter based on the at least one power consumption value and the waste production data.

126. Luff discloses that its “machine readable instructions,” *i.e.*, a plurality of instructions, “may be executed to generate a household energy consumption index,” *i.e.*, calculate an ecological parameter. Ex. 1005 at 1:58-60; Ex. 1010 at ¶¶ 0083-0088. Luff’s data collector, which is a computer with a processor that executes instructions, executes the machine-readable instructions that generate Luff’s household energy consumption index. Ex. 1005 at 22:60-67; Ex. 1010 at ¶¶ 0083-0088. Luff’s household energy consumption index is also calculated based on measurements, *i.e.*, power consumption values, from the meters for household appliances, and data regarding the landfill space required or volume of waste from purchased products, *i.e.*, waste production data, which is included in the calculation along with other item purchase information at step 912. Annotated Figure 9 below shows one example of Luff’s household energy consumption index calculating routine:

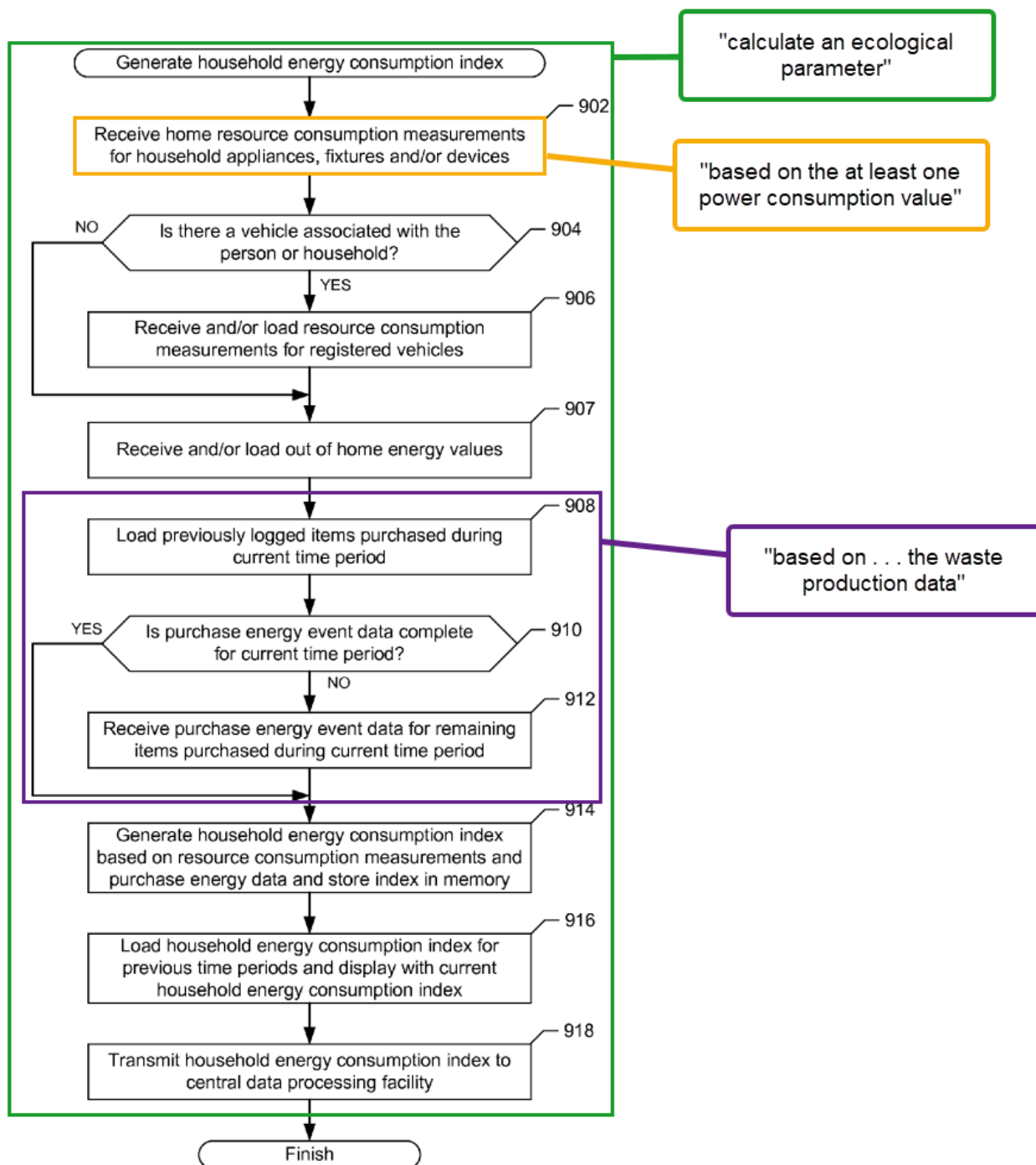


FIG. 9

Ex. 1005 at FIG. 9 (annotations added); *see also* Ex. 1010 at FIG. 9.

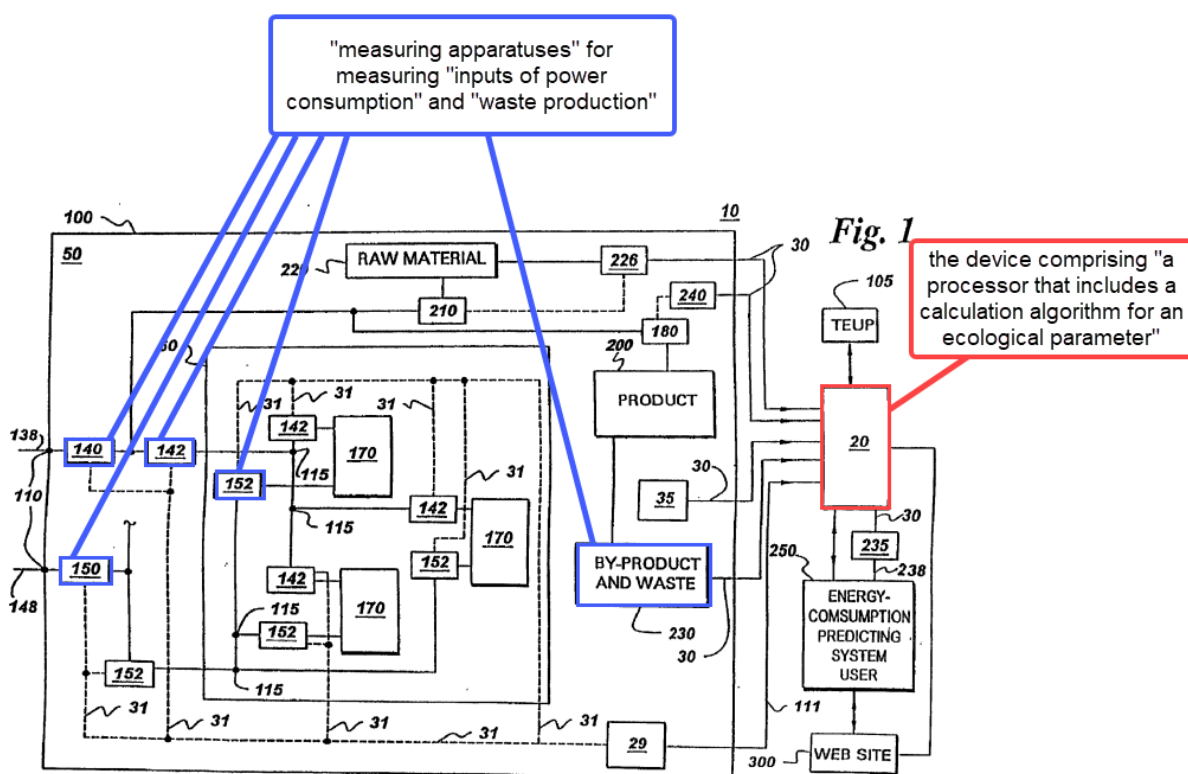
127. Luff also discloses “a data collector 110” that receives data from “barcode scanners 214” that may provide “an amount of waste associated with the

use of the product (e.g., landfill space requirements[]),” *i.e.*, the volume of space required to store the waste produced by the product or the amount of waste produced, *i.e.*, the waste production data. Ex. 1005 at 5:57-6:26; Ex. 1010 at ¶ 0031.

FIG. 2

128. Luff further teaches that its “example data collector 110 include[s] a user interface to enter and/or adjust resource consumption information,” *i.e.*, an input device for inputting data. Ex. 1005 at 9:24-31; Ex. 1010 at ¶ 0042. Like Luff,

Amaratunga discloses: a “by-product and waste information unit 230” that provides “by-product and waste information” to “a TEUP [total energy use module].” Ex. 1006 at ¶ 0032. As shown in annotated Figure 1 below, Amaratunga’s by-product and waste information unit transmits information over a communication link 30 to Amaratunga’s Data Processing Module 20. *Id.*



Id. at FIG. 1 (annotations added).

129. In my opinion, a POSITA would be motivated to modify Luff’s household energy index calculating machine-readable instructions to calculate the index based on a waste data amount based on the teachings of Amaratunga, because, as Amaratunga teaches, including the waste data amount in the calculation would more comprehensively and accurately calculate a “true assessment of the energy

efficiency of [an] energy consuming site.” Ex. 1005 at 30:13-23, 8:45-47; Ex. 1010 at ¶¶ 0107-0113; Ex. 1006 at ¶ 0035.

130. Moreover, in my opinion a POSITA would have been able to easily modify Luff’s machine-readable instructions that execute steps 908-912 of Figure 9 to calculate the energy consumption index using the waste data based on the teachings of Amaratunga, particularly given that Luff already considers waste volume amount in calculating the home energy consumption index.

131. Accordingly, in my opinion Luff in view of Amaratunga renders obvious claim limitation 1[g].

9. 1[h]: “(d) operate the display screen to display the calculated ecological parameter,”

132. In my opinion, Luff discloses a plurality of instructions that, when executed by the processor, cause the processor to operate the display screen to display the calculated ecological parameter.

133. Luff teaches displaying the household energy index as part of the household energy index calculation routine disclosed in Luff’s Figure 9, annotated below. Ex. 1005 at 24:9-12; Ex. 1010 at ¶¶ 0083-0088.

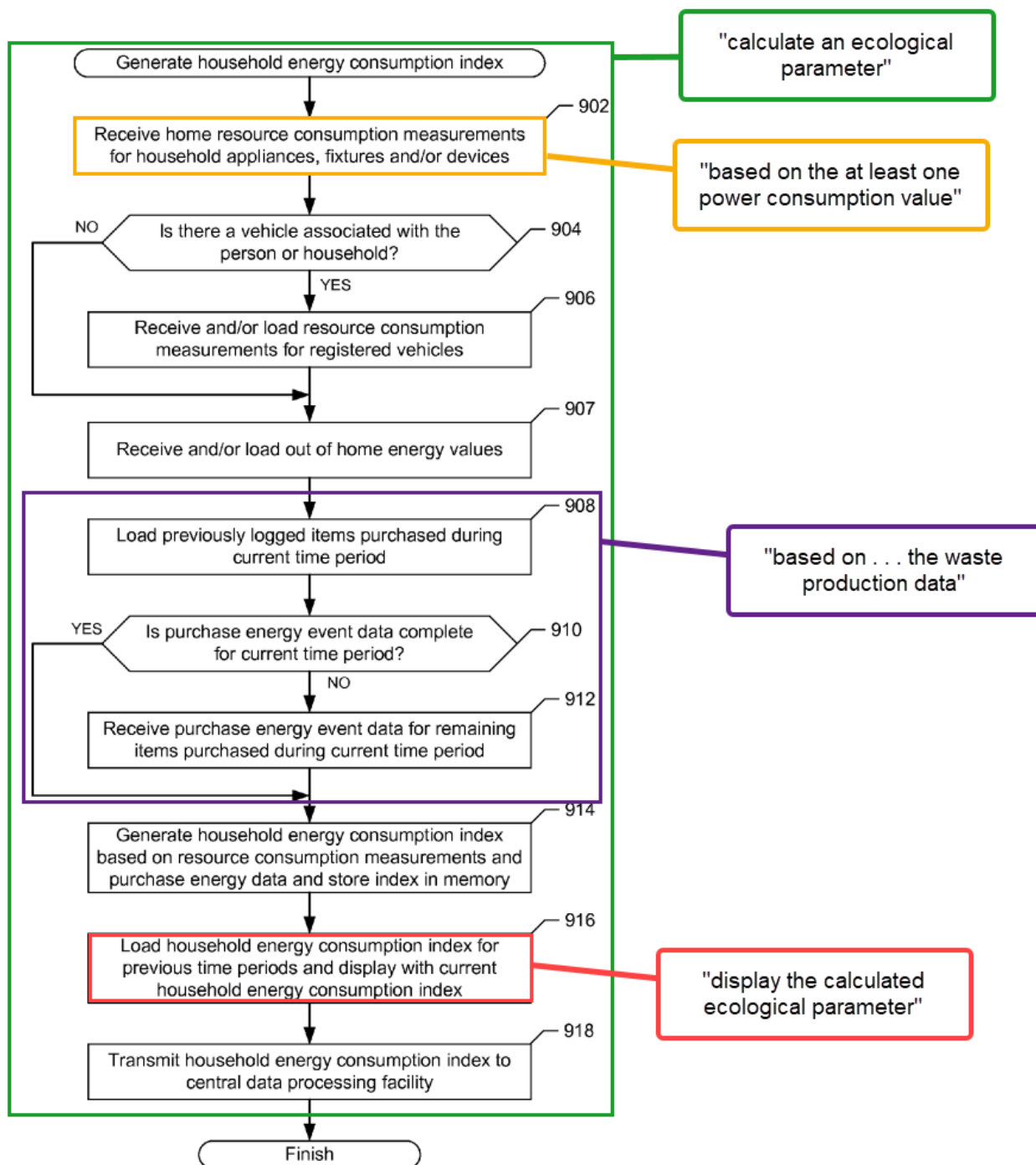


FIG. 9

Ex. 1005 at FIG. 9 (annotations added); *see also* Ex. 1010 at FIG. 9.

134. Luff also teaches that its data collector, which is a computer with a processor for executing instructions, performs Luff's home energy consumption

index calculating routine by executing “machine readable instructions,” *i.e.*, a plurality of instructions. Ex. 1005 at 1:58-60; 22:60-67; Ex. 1010 at ¶¶ 0083-0088. Luff also teaches that its data collector includes a display. Ex. 1005 at 18:25-29, 30:53-55; Ex. 1010 at ¶ 0065.

135. Accordingly, in my opinion Luff in view of Amaratunga discloses claim limitation 1[h].

10. 1[i]: “wherein the calculated ecological parameter is an adjusted mean of the sum of the deviations of the at least one power consumption value with respect to a reference value corresponding to the at least one power consumption value.”

136. In my opinion, Luff in view of Seem renders obvious calculating an ecological parameter that is an adjusted mean of the sum of the deviations of the at least one power consumption value with respect to a reference value corresponding to the at least one power consumption value.

137. Luff discloses that its “machine readable instructions,” *i.e.*, a plurality of instructions, “may be executed to generate a household energy consumption index,” *i.e.*, calculate an ecological parameter. Ex. 1005 at 1:58-60; Ex. 1010 at ¶¶ 0083-0088. Luff’s data collector, which is a computer with a processor that executes instructions, executes the machine-readable instructions that generate Luff’s household energy consumption index. Ex. 1005 at 22:60-67; Ex. 1010 at ¶¶ 0083-0088. Luff’s household energy consumption index is also calculated based

on measurements, *i.e.*, power consumption values, from the meters for household appliances, and data regarding the landfill space required or volume of waste from purchased products, *i.e.*, waste production data, which is included in the calculation along with other item purchase information at step 912.

138. As shown below, Seem also discloses particular functions for calculating an ecological parameter.

$$S_{robust} = \sqrt{\frac{\sum_{j=1}^{n-n_{out}} (x_j - \bar{x}_{robust})^2}{n - n_{out} - 1}}$$

The diagram shows the formula for S_{robust} with three colored boxes and arrows pointing to specific parts of the formula:

- A green box highlights the numerator $\sum_{j=1}^{n-n_{out}} (x_j - \bar{x}_{robust})^2$, with an arrow pointing to the text "sum of deviations".
- A blue box highlights the term $\bar{x}_{robust}$, with an arrow pointing to the text "with respect to a reference value".
- A red box highlights the entire formula, with an arrow pointing to the text "an adjusted mean".

Ex. 1007 at ¶¶ 0026, 0028, 0036, 0039

139. The above formula teaches a “robust estimate of the standard deviations (S_{robust}),” *i.e.*, an adjusted mean of the sum of the deviations. Ex. 1007 at ¶¶ 0026, 0028, 0036, 0039. Seem teaches that x is a set of utility measurements over a period of time, x_j is the utility usage during the time period j , n is the total number of utility measurements during the time period, n_{out} is the number of outliers in the set of utility measurements x , and $\bar{x}_{robust}$ is a robust estimate of the mean utility usage. Ex. 1007 at ¶¶ 0026, 0028, 0036, 0039. The numerator in Seem’s formula, highlighted in green above, teaches a sum of deviations, that is calculated with

respect to a reference value $\bar{x}_{\text{robust}}$, highlighted in blue above, and calculating an adjusted mean of that sum by dividing the sum by the number of measurements in the set with the outliers removed. *Id.* at ¶ 0036.

140. Seem teaches that its robust estimate of the standard deviation is a mean sum of deviations of at least one power consumption value with respect to a reference value corresponding to the at least one power consumption value. Seem’s “robust estimate[] of the . . . standard deviation” quantifies “the severity of the abnormal utility usage,” *i.e.*, it is a mean sum of deviations of the utility usage, *i.e.*, a power consumption value, with respect to the normal utility usage, *i.e.*, a reference value. *Id.* at ¶¶ 0040.

141. In my opinion, a POSITA would be motivated to modify the method Luff uses to calculate its energy consumption indices based on of the teachings of Seem because with such modifications, Luff’s system would more quickly and efficiently detect abnormal energy usage by “automatically determin[ing] if the current energy use is significantly different than previous energy patterns.” Ex. 1007 at ¶ 0012.

142. Additionally, a POSITA would also be able to easily modify Luff’s data collector based on the teachings of Seem to implement an adjusted mean of the sum of deviations. In my opinion, a POSITA would understand that the code defining the machine executable instructions Luff’s data collector uses to calculate energy

consumption indices could be modified based on the teachings of Seem to implement an adjusted mean of the sum of deviations formula.

143. Accordingly, in my opinion Luff in view of Seem renders obvious claim limitation 1[i].

C. Claim 2: “The device of claim 1 further comprising a means for introducing values of waste production.”

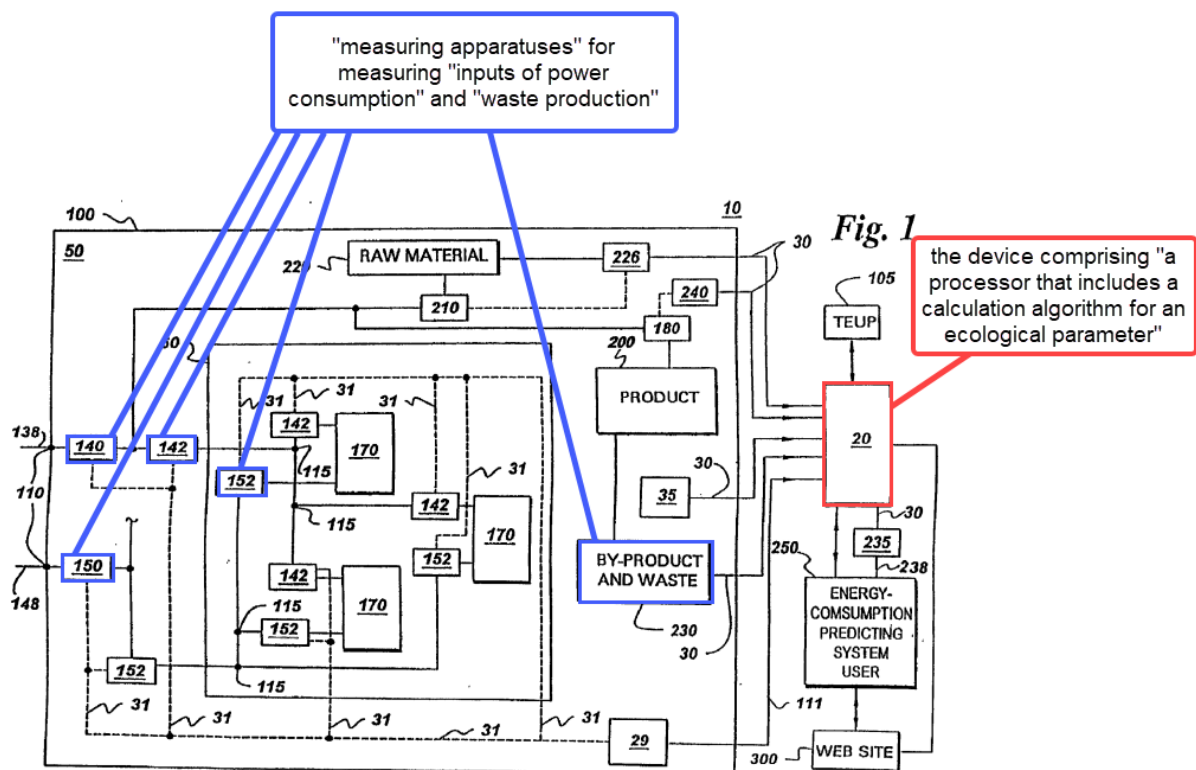
144. In my opinion, Luff in view of Amaratunga and Seem renders obvious the device of claim 1 further comprising a means for introducing values of waste production.

145. As I’ve discussed with regard to claim construction above, the ’482 patent’s “means for introducing values of waste production” should be construed as a weight apparatus (*e.g.*, a scale or weight sensor), a keyboard, or the equivalents of these structures.

146. Additionally, as I’ve explained with regard to claim 1 in Section XI.B above, Luff in view of Amaratunga and Seem renders obvious the device of claim 1.

147. Luff further discloses that its data collector “include[s] a user interface to enter and/or adjust resource consumption information.” Ex. 1005 at 9:24-31; Ex. 1010 at ¶ 0064. Luff’s user interface may be “**a keyboard**, a mouse, a touch screen, a track pad, a barcode scanner, or any other device that enables a user to provide information to [the data collector’s] processor.” Ex. 1005 at 30:49-52 (emphasis added); Ex. 1010 at ¶ 0064.

148. Luff further teaches that its “example data collector 110 include[s] a user interface to enter and/or adjust resource consumption information,” *i.e.*, an input device for inputting data. Ex. 1005 at 9:24-31; Ex. 1010 at ¶ 0042. Like Luff, Amaratunga discloses: a “by-product and waste information unit 230” that provides “by-product and waste information” to “a TEUP [total energy use module].” Ex. 1006 at ¶ 0032. As shown in annotated Figure 1 below, Amaratunga’s by-product and waste information unit transmits information over a communication link 30 to Amaratunga’s Data Processing Module 20. *Id.*



Id. at FIG. 1 (annotations added).

149. In my opinion, A POSITA would have understood that modifying the user interface of Luff’s data collector based on the teachings of Amaratunga to

enable input of waste production data would more comprehensively and accurately calculate a “true assessment of the energy efficiency of [an] energy consuming site.” Ex. 1006 at ¶ 0019.

150. Accordingly, in my opinion Luff discloses a means for introducing values of waste production a keyboard, and Luff in view of Amaratunga and Seem renders obvious claim 2.

D. Claim 4: “The device of claim 1 further comprising USB input for a serial data bus.”

151. In my opinion, Luff in view of Amaratunga and Seem renders obvious the device of claim 1 further comprising a means for introducing values of waste production.

152. As I’ve explained above, Luff in view of Amaratunga and Seem renders obvious the device of claim 1.

153. Luff additionally teaches its data collector may be communicatively coupled to a “central processor” that is coupled to “a USB flash drive,” *i.e.*, comprises a USB input. Ex. 1005 at 16:47-56; Ex. 1010 at ¶ 0058. Luff’s central processor also may have a bus for interfacing with other components, including its USB flash drive. Ex. 1005 at 30:13-30; Ex. 1010 at ¶ 0107. Additionally, USB stands for “Universal Serial Bus.” Therefore, Luff’s disclosure of a central processor that can be coupled to a USB flash drive discloses that its central processor has a USB input for a serial bus. Ex. 1005 at 16:47-56; Ex. 1010 at ¶ 0058.

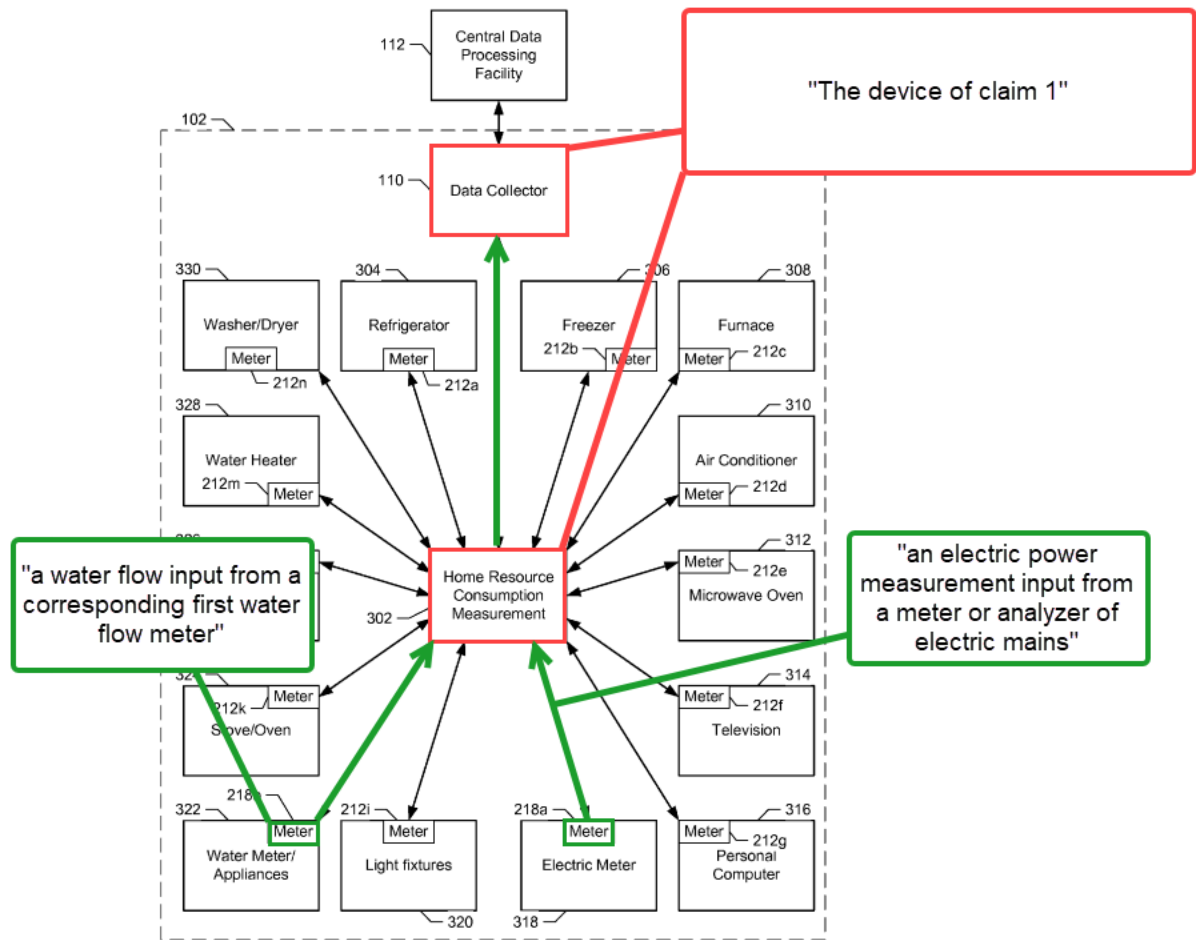
154. Accordingly, in my opinion Luff in view of Amaratunga and Seem renders obvious claim 4.

E. Claim 5:

- 1. 5[a]: “The device of claim 1 wherein the at least one power consumption value includes at least two power consumption values selected from the group of:”**

155. In my opinion, Luff in view of Amaratunga and Seem renders obvious the device of claim 1 further comprising a means for introducing values of waste production.

156. As explained above, Luff in view of Amaratunga and Seem renders obvious the device of claim 1, which also requires power consumption values. Further, as explained in the following sections, Luff in view of Amaratunga discloses each of the “power consumption values” recited in claim 5. For example, as shown in annotated Figure 3 of Luff below, Luff discloses an electric power measurement input from a meter or analyzer of electric mains and a water flow input from a corresponding first water flow meter.



Ex. 1006 at FIG. 3 (annotated).

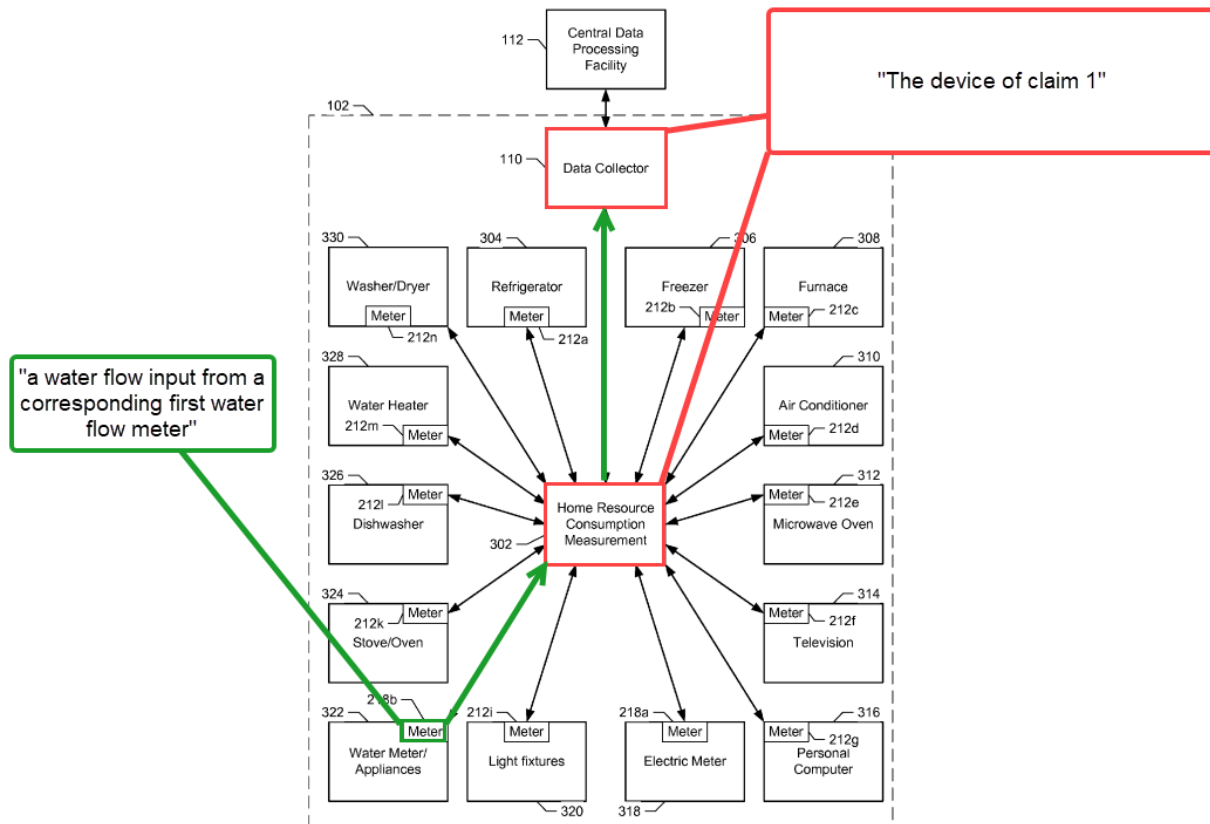
157. Accordingly, in my opinion Luff in view of Amaratunga and Seem renders obvious claim limitation 5[a].

2. 5[b]: “a water flow input from a corresponding first water flow meter;”

158. In my opinion, Luff discloses a water flow input from a corresponding first water flow meter.

159. Luff teaches a “first utility meter . . . used to meter the amount of water used by the house” and “water meters [that] measure water usage” within the home,

both of which are water flow meters. Ex. 1005 at 6:56-63; 9:10-14; Ex. 1010 at ¶ 0020. Luff also discloses that its data collector receives the measurements made by its first utility meter and other water meters, as explained with regard to claim limitation 1[pre] above, and shown in annotated Figures 2 and 3 below.



Ex. 1005 at FIG. 3 (annotations added); *see also* Ex. 1010 at FIG. 3.

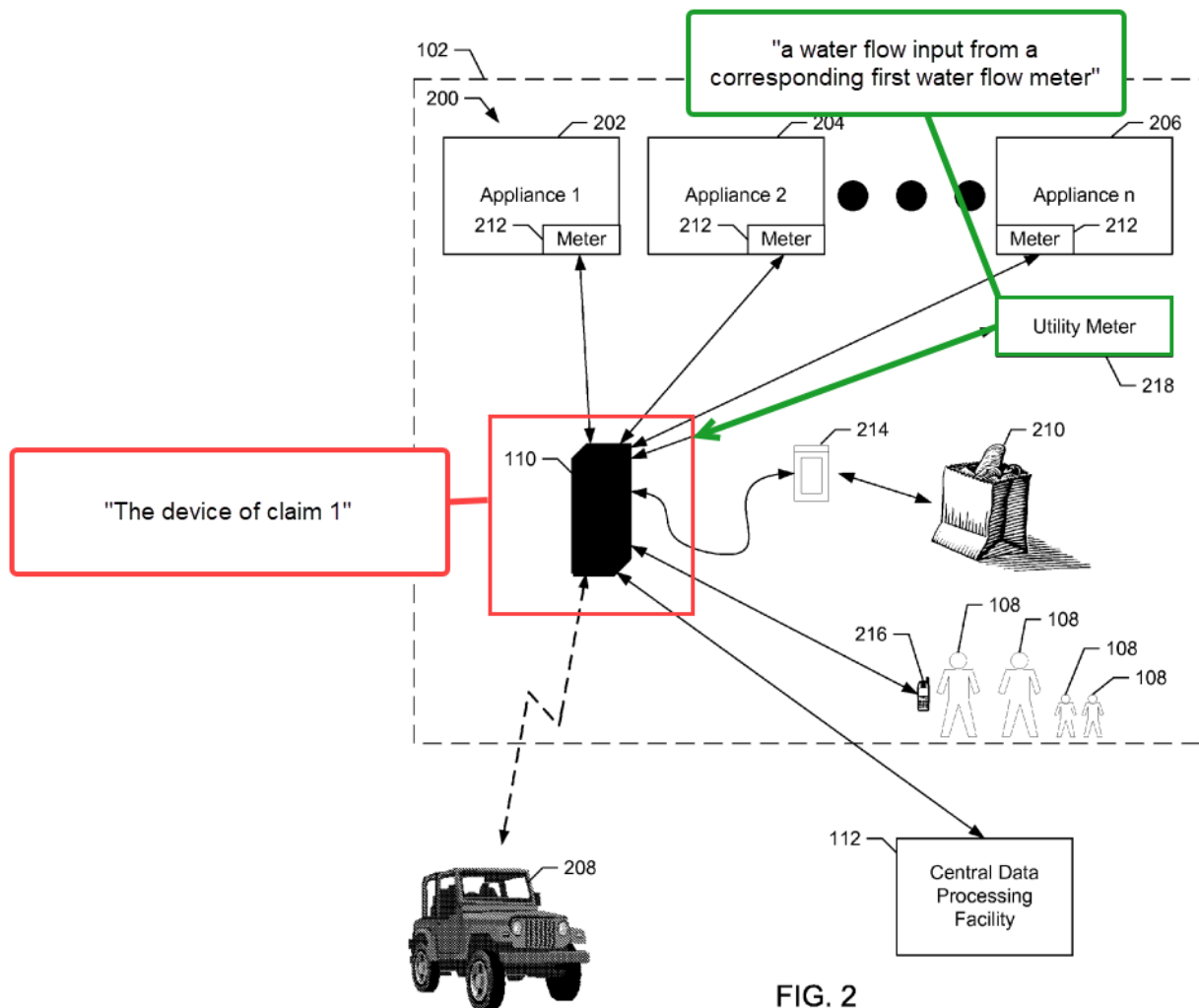


FIG. 2

Ex. 1005 at FIG. 2 (annotations added); *see also* Ex. 1010 at FIG. 2.

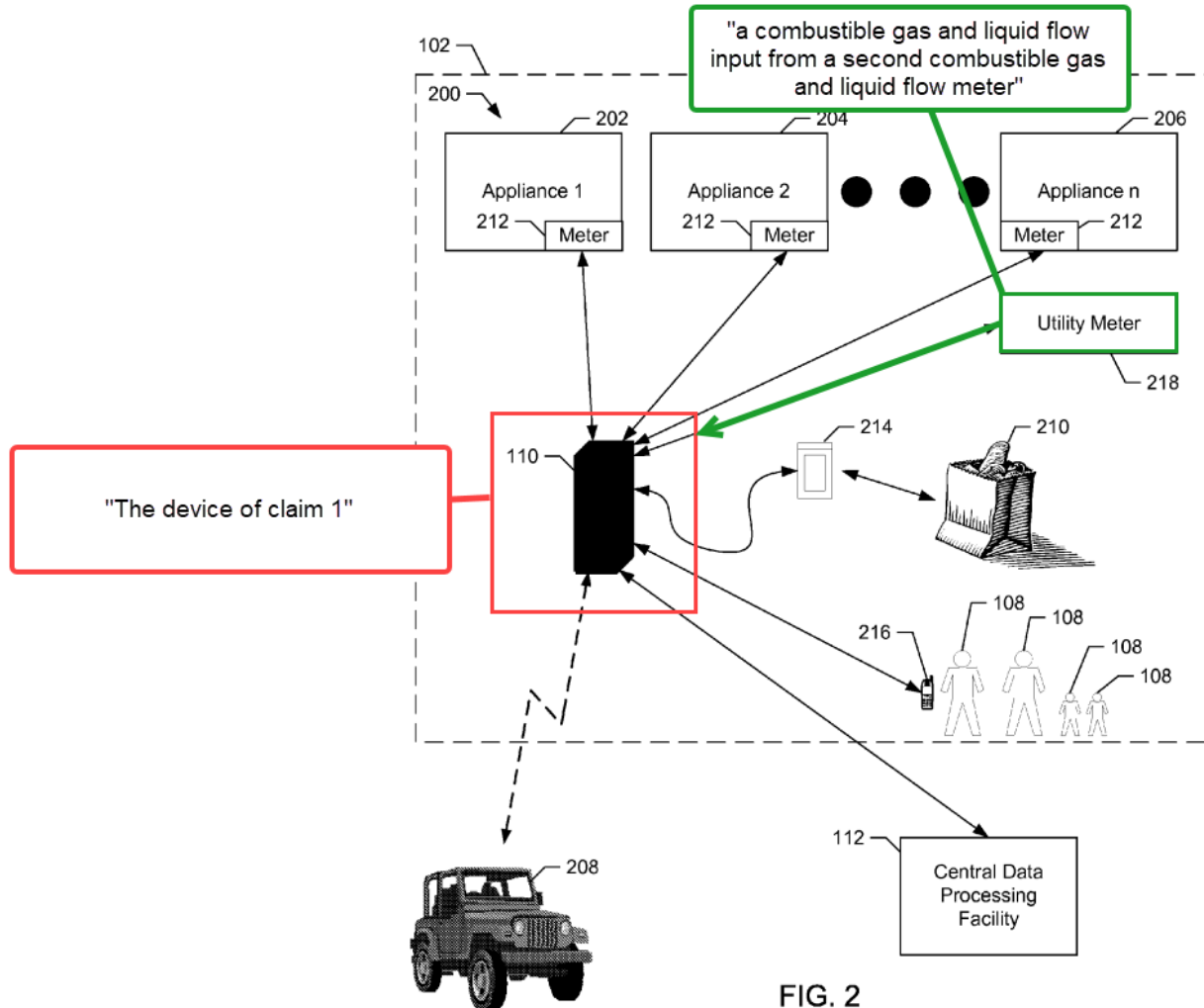
160. Accordingly, in my opinion Luff discloses claim limitation 5[b].

3. **5[c]: “a combustible gas and liquid flow input from a second combustible gas and liquid flow meter;”**

161. In my opinion, Luff discloses a combustible gas and liquid flow input from a second combustible gas and liquid flow meter.

162. Luff discloses measuring a household’s consumption of any type of resource including “natural gas, gasoline, fuel oil, kerosene, [or] propane,” *i.e.*, a

combustible gas. Ex. 1005 at 6:56-63; 9:10-14; Ex. 1010 at ¶ 0020. Luff also teaches that it measures a households gas consumption via a “second utility meter . . . used to measure the amount of natural (or other) gas used by the house,” *i.e.*, a gas and liquid flow meter. Ex. 1005 at 6:56-63; 9:10-14; Ex. 1010 at ¶ 0020. Luff also discloses that its data collector receives the measurements made by its second utility meter, as explained with regard to claim limitation 1[pre] above, and shown in annotated Figure 2 below.



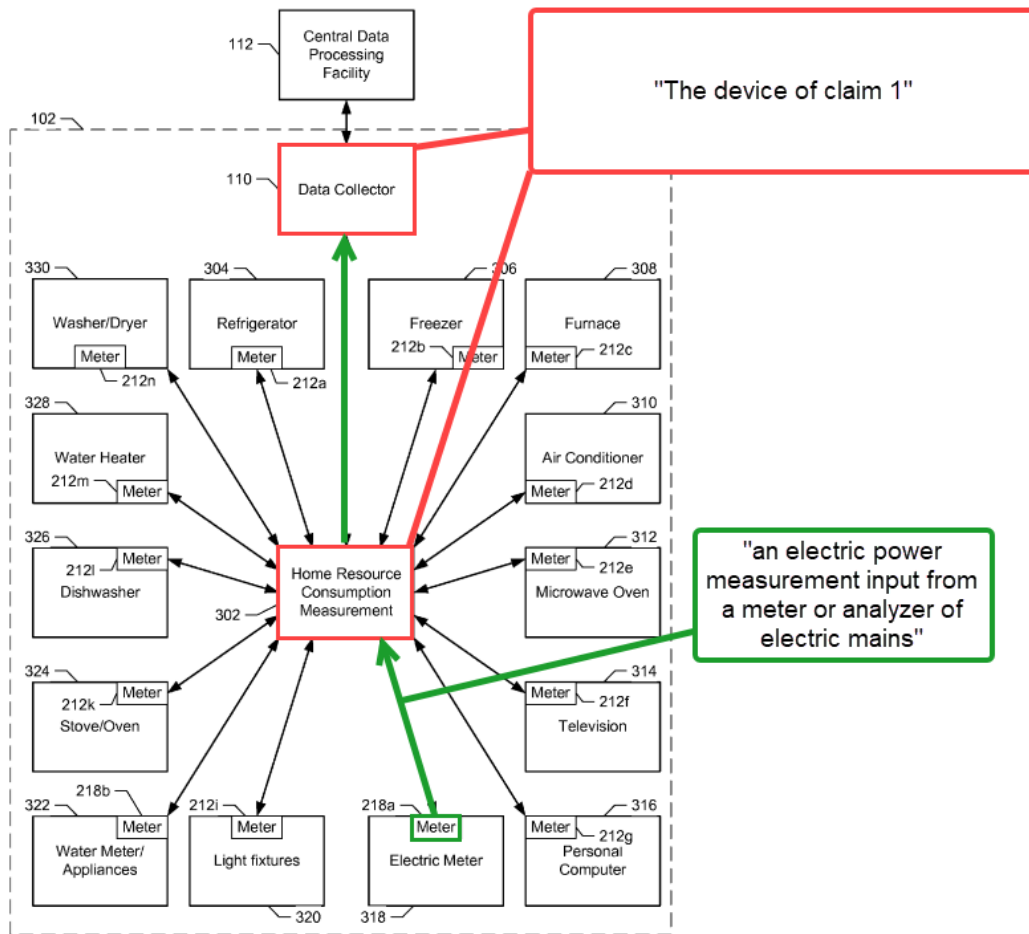
Ex. 1005 at FIG. 2 (annotations added); *see also* Ex. 1010 at FIG. 2.

163. Accordingly, in my opinion Luff discloses claim limitation 5[c].

4. 5[d]: “an electric power measurement input from a meter or analyser of electric mains; and”

164. In my opinion, Luff discloses an electric power measurement input from a meter or analyser of electric mains.

165. Luff teaches measuring a household’s electricity consumption, *i.e.*, an electric power measurement input, via a “third utility meter . . . used to measure the amount of electricity used by . . . a home,” *i.e.*, from a meter or analyser of electric mains. Ex. 1005 at 6:56-63; 9:10-14; Ex. 1010 at ¶ 0020. Luff also discloses that its data collector receives the measurements made by its second utility meter, as explained with regard to claim limitation 1[pre] above, and shown in annotated Figures 2 and 3 below.



Ex. 1005 at FIG. 3 (annotations added); *see also* Ex. 1010 at FIG. 3.

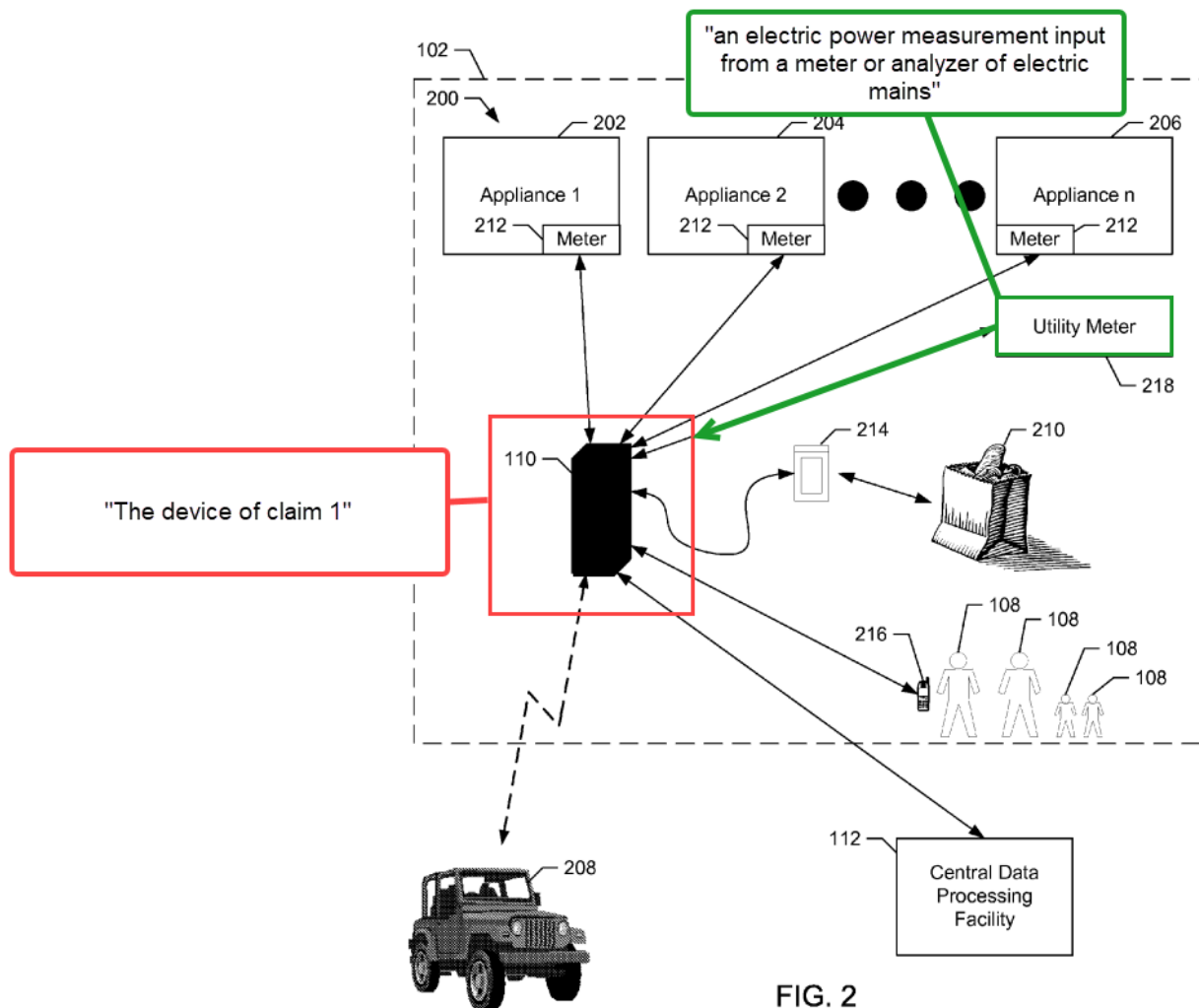


FIG. 2

Ex. 1005 at FIG. 2 (annotations added); *see also* Ex. 1010 at FIG. 2.

166. Accordingly, Luff discloses claim limitation 5[d].

5. **5[e]: “a waste weight measurement input from a scale for weighing wastes.”**

167. In my opinion, Luff in view of Amaratunga discloses a waste weight measurement input from a scale for weighing wastes.

168. Luff discloses a data collector that receives product UPC codes that include data regarding the “amount waste associated with the use of the product (e.g.,

landfill space requirements[]],” *i.e.*, the weight of the waste produced by the product.
Ex. 1005 at 6:19-26.

169. Like Luff, Amaratunga teaches a “waste information unit . . . that can measure . . . waste amounts,” *e.g.* a scale. Ex. 1006 at ¶ 0035.

170. In my opinion, a POSITA would have been motivated and have been able to easily modify the code of Luff’s data collector based on the teachings of Amaratunga such that the data collector received Luff’s waste weight data from a scale.

171. Accordingly, in my opinion Luff in view of Amaratunga discloses claim limitation 5[e].

XII. GROUND 2: THE COMBINATION OF LUFF, AMARATUNGA, SEEM, AND ZUTA RENDERS OBVIOUS CLAIM 6.

172. In my opinion, a POSITA at the time of the alleged invention would have found claim 6 obvious over Luff in view of Amaratunga, Seem, and Zuta.

A. Motivation to Combine Luff, Amaratunga, Seem, and Zuta

173. In my opinion, a POSITA in possession of Luff’s system for measuring power and resource consumption would have been motivated to modify the system based on the teachings of Zuta to include a fuel flow meter because doing so would enable more accurate and reliable measurement of a vehicle’s fuel consumption.

174. Zuta teaches a “novel . . . fuel consumption sensor” that is more reliable because it is “devised as to operate safely in a flammable environment” and more

precisely measures fuel flow by using “the Doppler effect to measure the rate of fuel flow.” *Id.* at ¶¶ 0084, 0308. Modifying Luff’s Figure 5 embodiment, which includes a vehicle power-consuming unit, to include a sensor as taught by Zuta that more accurately and reliably measures the vehicle’s fuel consumption would enable Luff’s system to more accurately and reliably calculate its energy consumption indices based on the vehicle’s fuel consumption.

175. Additionally, a POSITA would also be motivated to modify Luff based on the teachings of Zuta because they are both in the same field of endeavor as the ’482 patent: measuring and analyzing power, energy, and resource consumption. Ex. 1001 at Abstract; Ex. 1005 at Abstract; Ex. 1008 at Abstract. Both Luff and Zuta also use similar techniques to solve the same problem as the ’482 patent. Luff discloses nearly all of the limitations of claims 1-2, 4-6, and 8, and Zuta discloses the fuel flow input from a corresponding flow meter from the motor of an automobile claimed in claim 6.

176. A POSITA also would have had a reasonable expectation of success modifying Luff based on the teachings of Zuta. Luff already teaches that its data collector receives data regarding a vehicle’s fuel consumption. Ex. 1005 at 9:24-31. Therefore, a POSITA would easily be able to modify Luff’s system to include a fuel flowmeter, as taught by Zuta, and modify the code of Luff’s data collector to receive fuel consumption data from the flow meter. Ex. 1005 at 9:24-31.

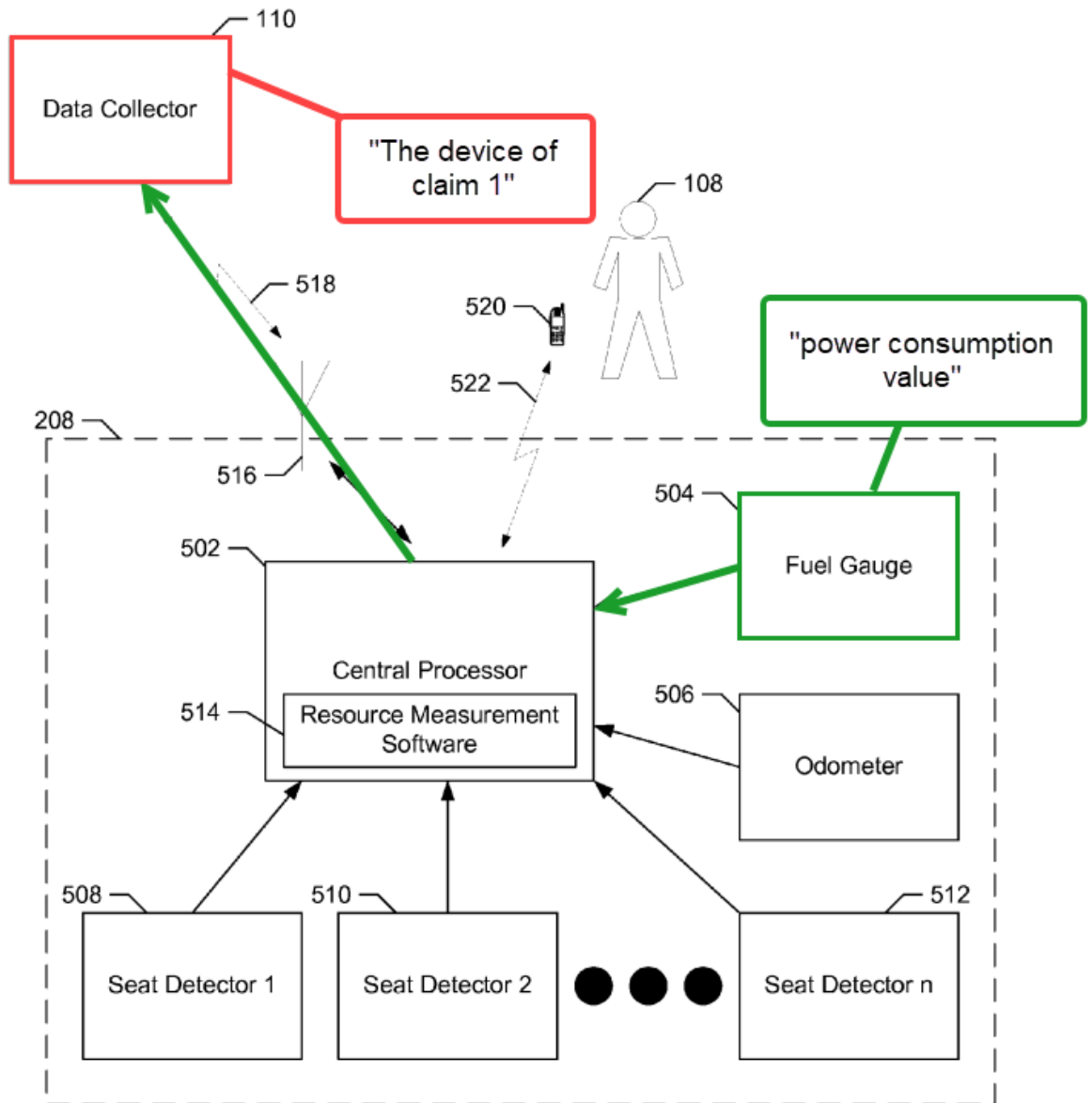
B. Claim 6:

- 1. 6[a]: “The device of claim 1 wherein the at least one power consumption value includes a fuel flow input from a corresponding flow meter from the motor of an automobile;”**

177. In my opinion, Luff in view of Amaratunga, Seem, and Zuta discloses the device of claim 1 wherein the at least one power consumption value includes a fuel flow input from a corresponding flow meter from the motor of an automobile.

178. As I’ve explained above, Luff in view of Amaratunga and Seem renders obvious the device of claim 1.

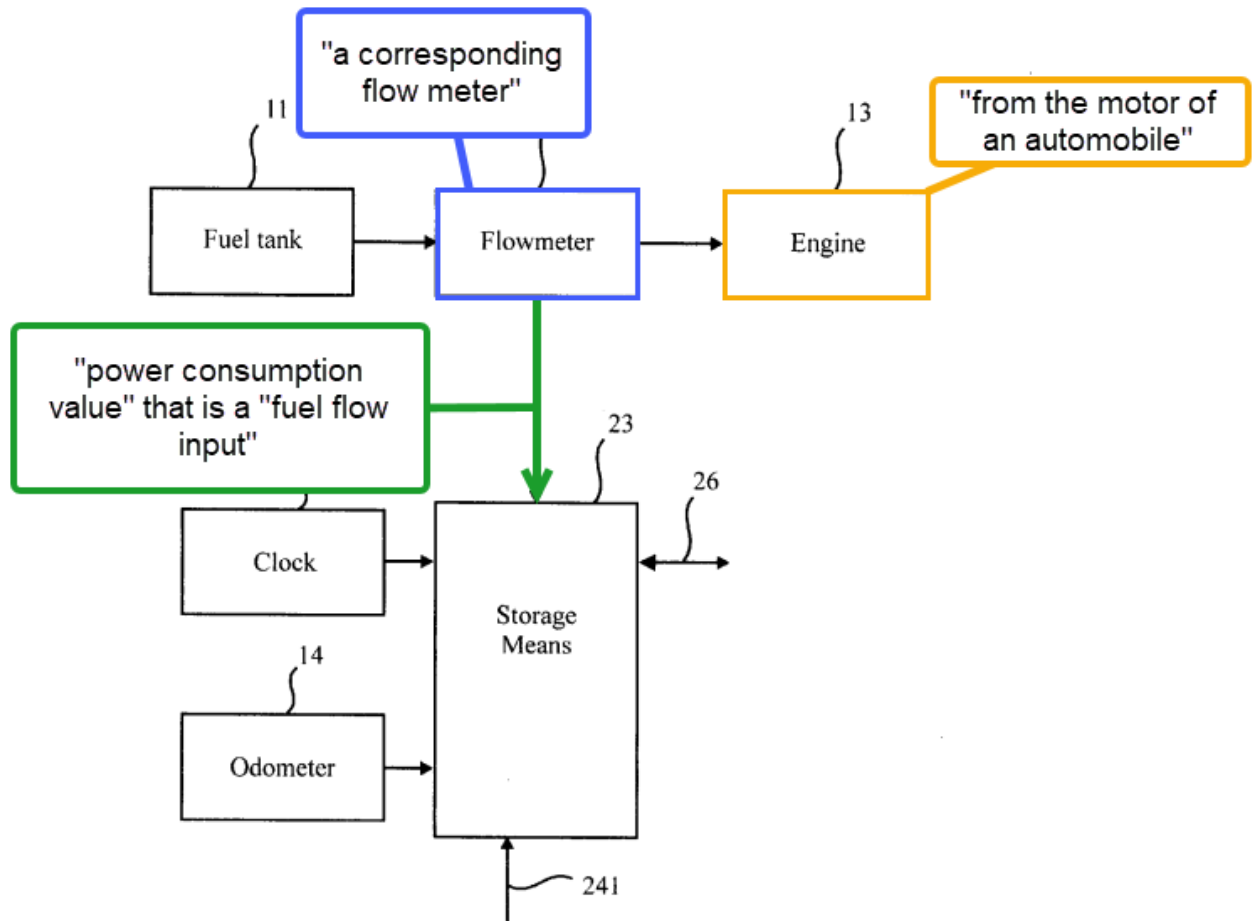
179. Luff also teaches that its system may “receive resource consumption information from a vehicle.” Ex. 1005 at 1:46-48. “The example vehicle 208 is equipped with a central processor 502” that “receives fuel gauge measurements from a fuel gauge 504” which may be used “to determine the energy consumed [during a] trip.” *Id.* at 16:4-11. The vehicle’s fuel gauge measurements are also an input provided to Luff’s data collector. *Id.* at FIG. 5. As explained with regard to claim limitation 1[a] above and shown in annotated Figure 5 below, the inputs of Luff’s data collector disclose power consumption values.



Id. at FIG. 5 (annotations added).

180. Zuta additionally discloses a “fuel flowmeter” “installed between [a fuel] tank and engine,” *i.e.*, a corresponding flow meter from the motor of an automobile, that transfers its output “to [a] digital storage means,” *i.e.*, a fuel flow

input. Ex. 1008 at ¶¶ 0069, 00142, 00138. One embodiment of Zuta's system is shown in annotated Figure 1 below.



Id. at FIG. 1 (annotations added).

181. In my opinion, a POSITA would have been motivated to modify Luff's Figure 5 embodiment to include a flow meter based on Zuta's teachings because the "novel . . . fuel consumption sensor" taught by Zuta is more reliable because it is "devised as to operate safely in a flammable environment" and measures fuel flow more precisely by using "the Doppler effect to measure the rate of fuel flow." *Id.* at ¶¶ 0084, 0308. Including a sensor that more accurately and reliably measures

the fuel used by vehicles in Luff's Figure 5 embodiment would enable Luff's system to more accurately and reliably calculate energy consumption indices.

182. A POSITA also would have been able to easily modify Luff's system based on the teachings of Zuta to include a fuel flowmeter by including a flowmeter among the measuring devices already included in Luff's vehicle, and by modifying the software on Luff's central processor and data collector to receive and process the flowmeter data.

183. Accordingly, in my opinion Luff in view of Amaratunga, Seem, and Zuta discloses claim limitation 6[a].

2. 6[b]: “the waste production data corresponds to one of tire rubber wastes, motor oil wastes, coolant liquid wastes, closed circuit liquid wastes and metal wastes, and”

184. In my opinion, Luff in view of Amaratunga discloses the waste production data corresponds to one of tire rubber wastes, motor oil wastes, coolant liquid wastes, closed circuit liquid wastes and metal wastes.

185. As I've discussed throughout this Declaration, Amaratunga discloses waste production data. Luff also measures a vehicle's resource consumption, including the vehicle's consumption of “tire rubber;” “engine fluids,” *i.e.*, motor oil, coolant liquid, or closed circuit liquid; and “fuel.” Ex. 1005 at 5:51-53.

186. In my opinion, A POSITA would have been motivated to modify Luff to based on the teachings of Amaratunga to collect data that represents the waste

amounts produced of tire rubber and engine fluids produced by the vehicle because such modification would enable Luff's system to more comprehensively and accurately calculate a "true assessment of the energy efficiency of [an] energy consuming site." Ex. 1006 at ¶ 0019.

187. A POSITA also would have been able to easily modify Luff's system based on Amaratunga's teachings by modifying the software of Luff's data collector such that it could additionally receive waste production data associated with waste amounts of tire rubber and engine liquids via its user interface, including at least because Luff already discloses collecting data regarding these waste products.

188. Accordingly, in my opinion Luff in view of Amaratunga renders obvious claim limitation 6[b].

3. 6[c]: "the fuel flow input and the waste production data are used to calculate the ecological parameter corresponding to the automobile."

189. In my opinion, Luff in view of Amaratunga, Zuta, and Seem discloses the fuel flow input and the waste production data are used to calculate the ecological parameter corresponding to the automobile.

190. Luff in view of Amaratunga discloses a plurality of instructions that, when executed by the processor, cause the processor to calculate an ecological parameter based on the at least one power consumption value and the waste production data.

191. Luff discloses that its “machine readable instructions,” *i.e.*, a plurality of instructions, “may be executed to generate a household energy consumption index,” *i.e.*, calculate an ecological parameter. Ex. 1005 at 1:58-60; Ex. 1010 at ¶¶ 0083-0088. Luff’s data collector, which is a computer with a processor that executes instructions, executes the machine-readable instructions that generate Luff’s household energy consumption index. Ex. 1005 at 22:60-67; Ex. 1010 at ¶¶ 0083-0088. Luff’s household energy consumption index is also calculated based on measurements, *i.e.*, power consumption values, from the meters for household appliances, and data regarding the landfill space required or volume of waste from purchased products, *i.e.*, waste production data, which is included in the calculation along with other item purchase information at step 912. Annotated Figure 9 below shows one example of Luff’s household energy consumption index calculating routine:

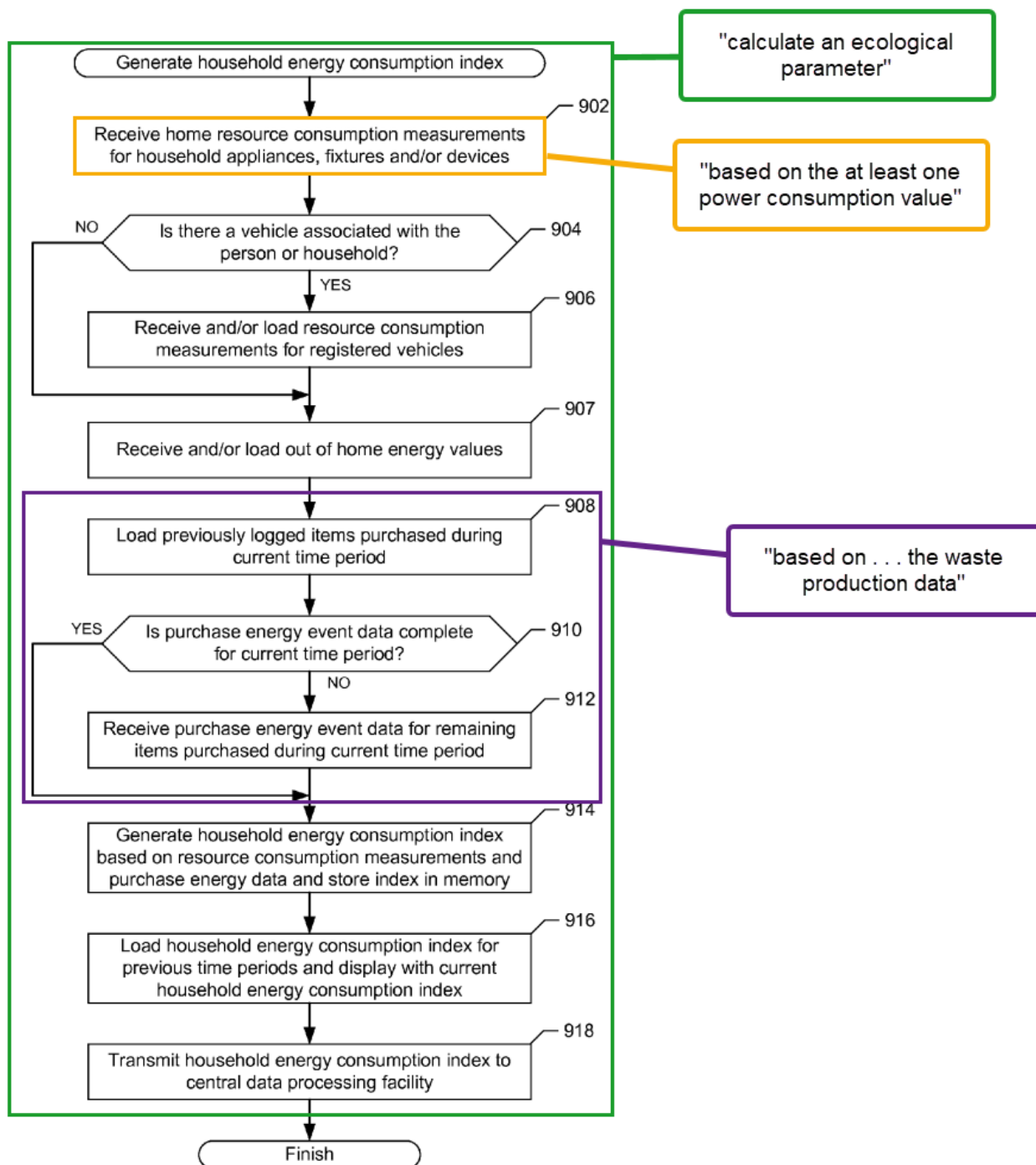
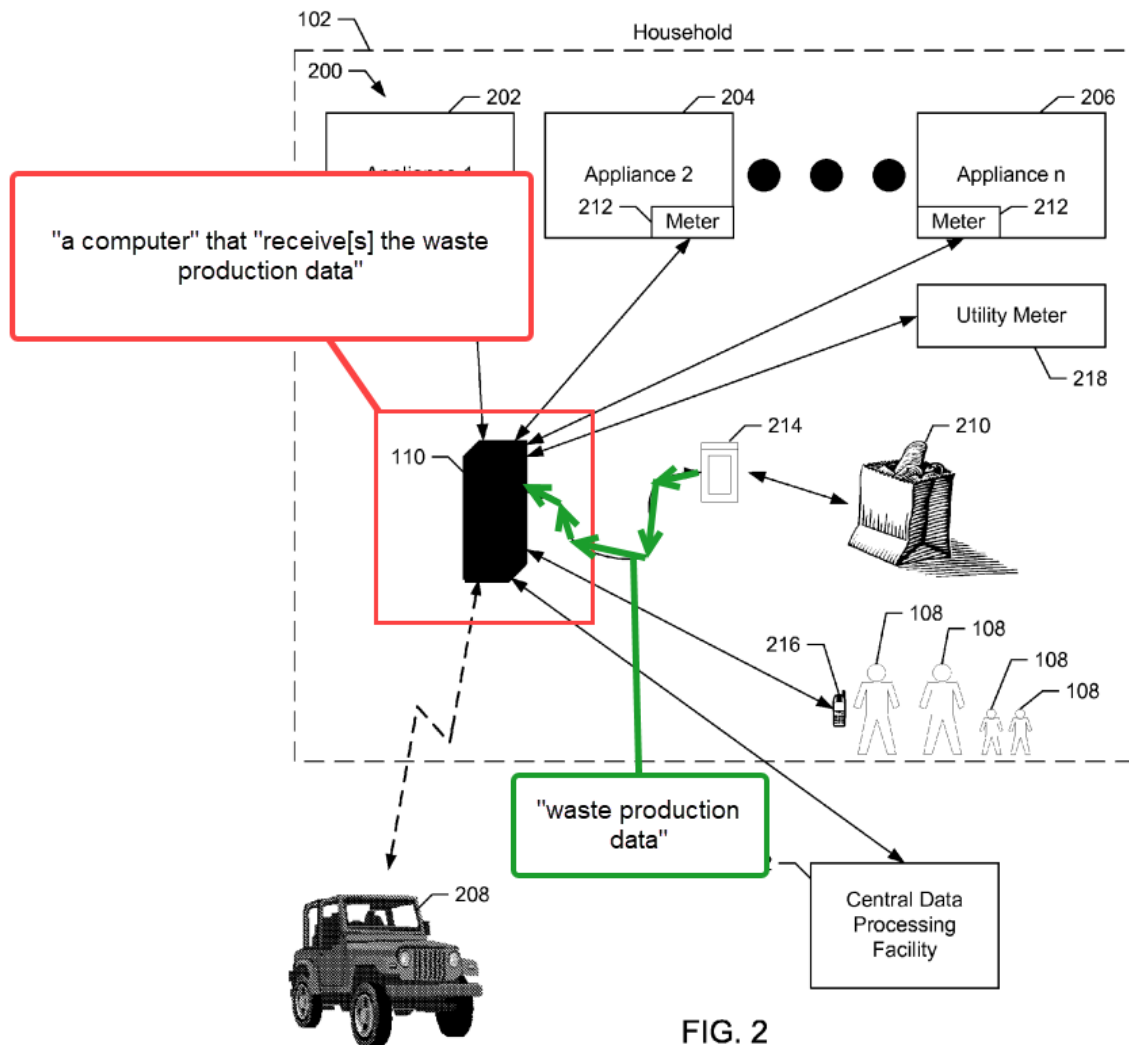


FIG. 9

Ex. 1005 at FIG. 9 (annotations added); *see also* Ex. 1010 at FIG. 9.

192. Luff also discloses “a data collector 110” that receives data from “barcode scanners 214” that may provide “an amount of waste associated with the

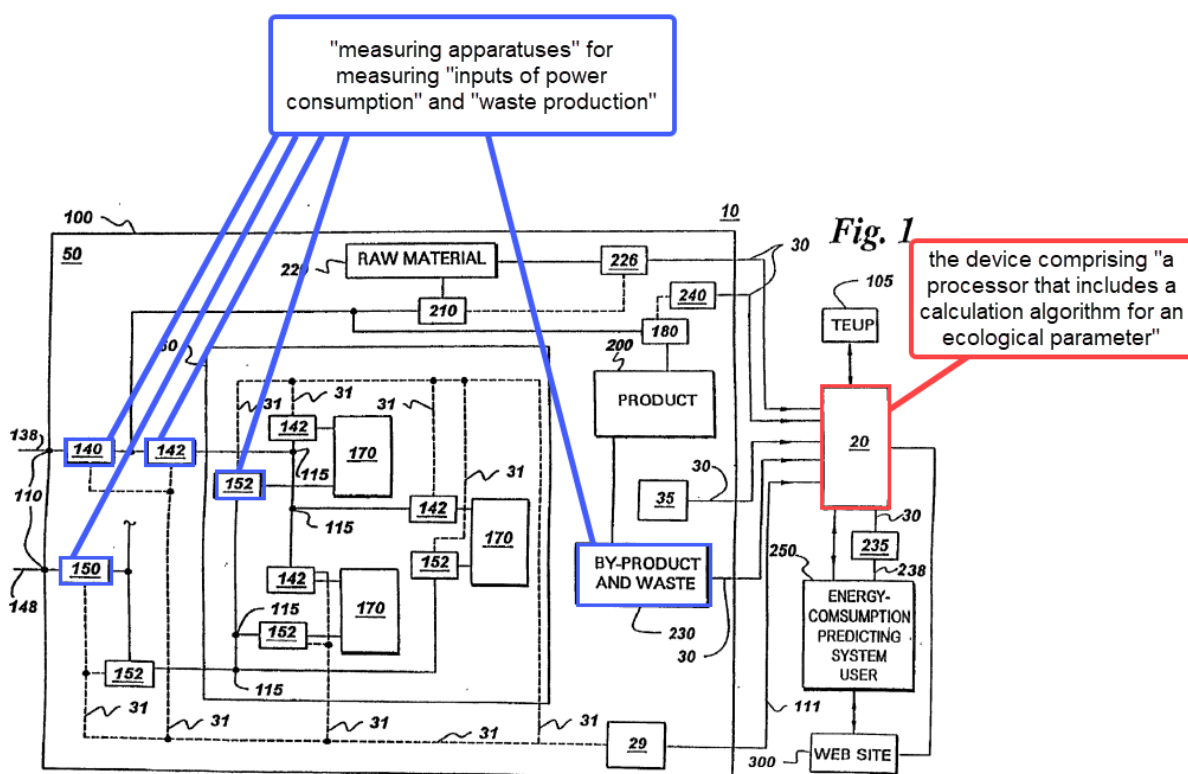
use of the product (e.g., landfill space requirements[]),” *i.e.*, the volume of space required to store the waste produced by the product or the amount of waste produced, *i.e.*, the waste production data. Ex. 1005 at 5:57-6:26; Ex. 1010 at ¶ 0031.



Ex. 1005 at FIG. 2 (annotations added); *see also* Ex. 1010 at FIG. 2.

193. Luff further teaches that its “example data collector 110 include[s] a user interface to enter and/or adjust resource consumption information,” *i.e.*, an input device for inputting data. Ex. 1005 at 9:24-31; Ex. 1010 at ¶ 0042. Like Luff,

Amaratunga discloses: a “by-product and waste information unit 230” that provides “by-product and waste information” to “a TEUP [total energy use module].” Ex. 1006 at ¶ 0032. As shown in annotated Figure 1 below, Amaratunga’s by-product and waste information unit transmits information over a communication link 30 to Amaratunga’s Data Processing Module 20. *Id.*



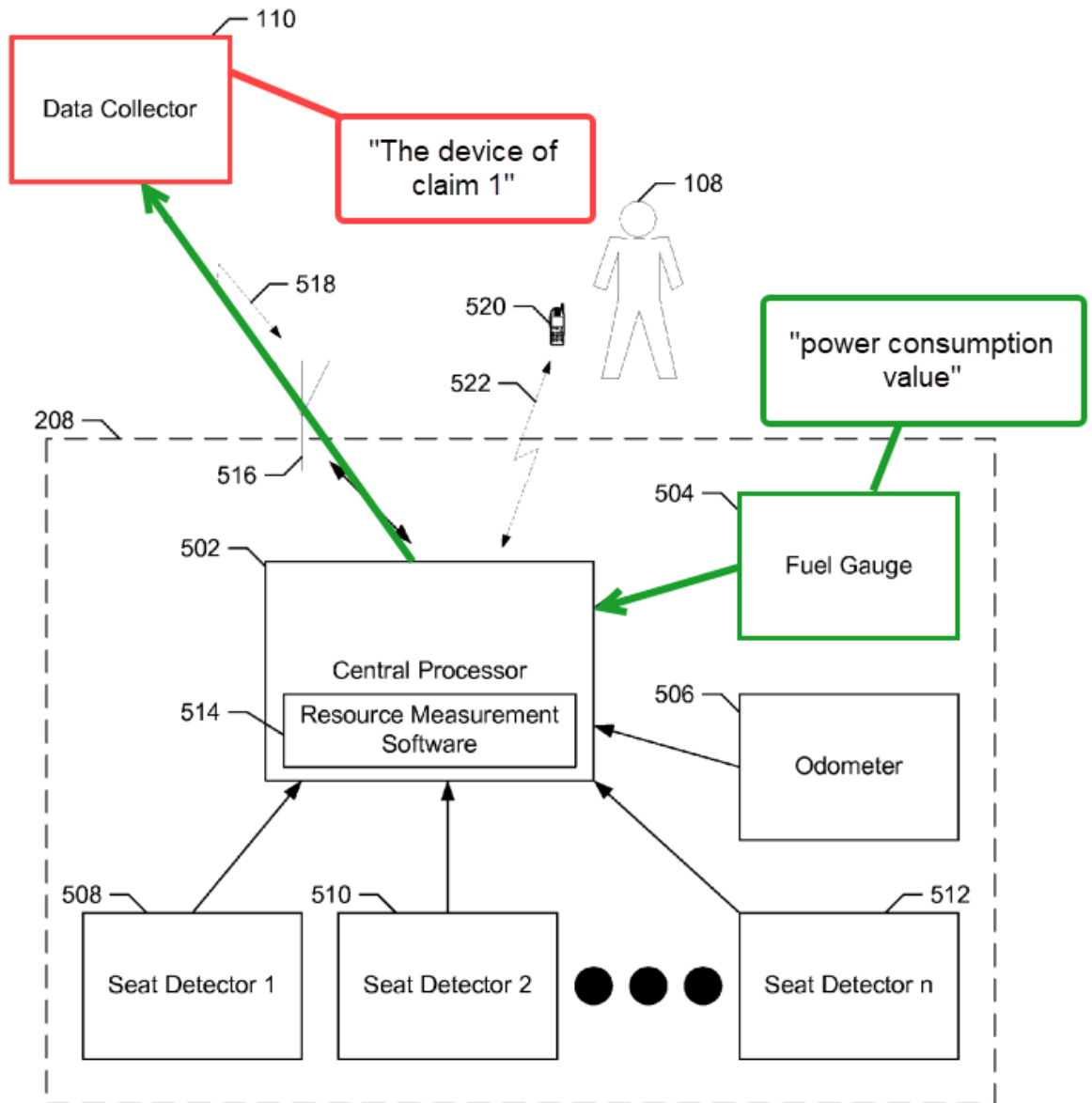
Id. at FIG. 1 (annotations added).

194. In my opinion, a POSITA would be motivated to modify Luff’s household energy index calculating machine-readable instructions to calculate the index based on a waste data amount based on the teachings of Amaratunga, because, as Amaratunga teaches, including the waste data amount in the calculation would more comprehensively and accurately calculate a “true assessment of the energy

efficiency of [an] energy consuming site.” Ex. 1005 at 30:13-23, 8:45-47; Ex. 1010 at ¶¶ 0107-0113; Ex. 1006 at ¶ 0035.

195. Moreover, in my opinion a POSITA would have been able to easily modify Luff’s machine-readable instructions that execute steps 908-912 of Figure 9 to calculate the energy consumption index using the waste data based on the teachings of Amaratunga, particularly given that Luff already considers waste volume amount in calculating the home energy consumption index.

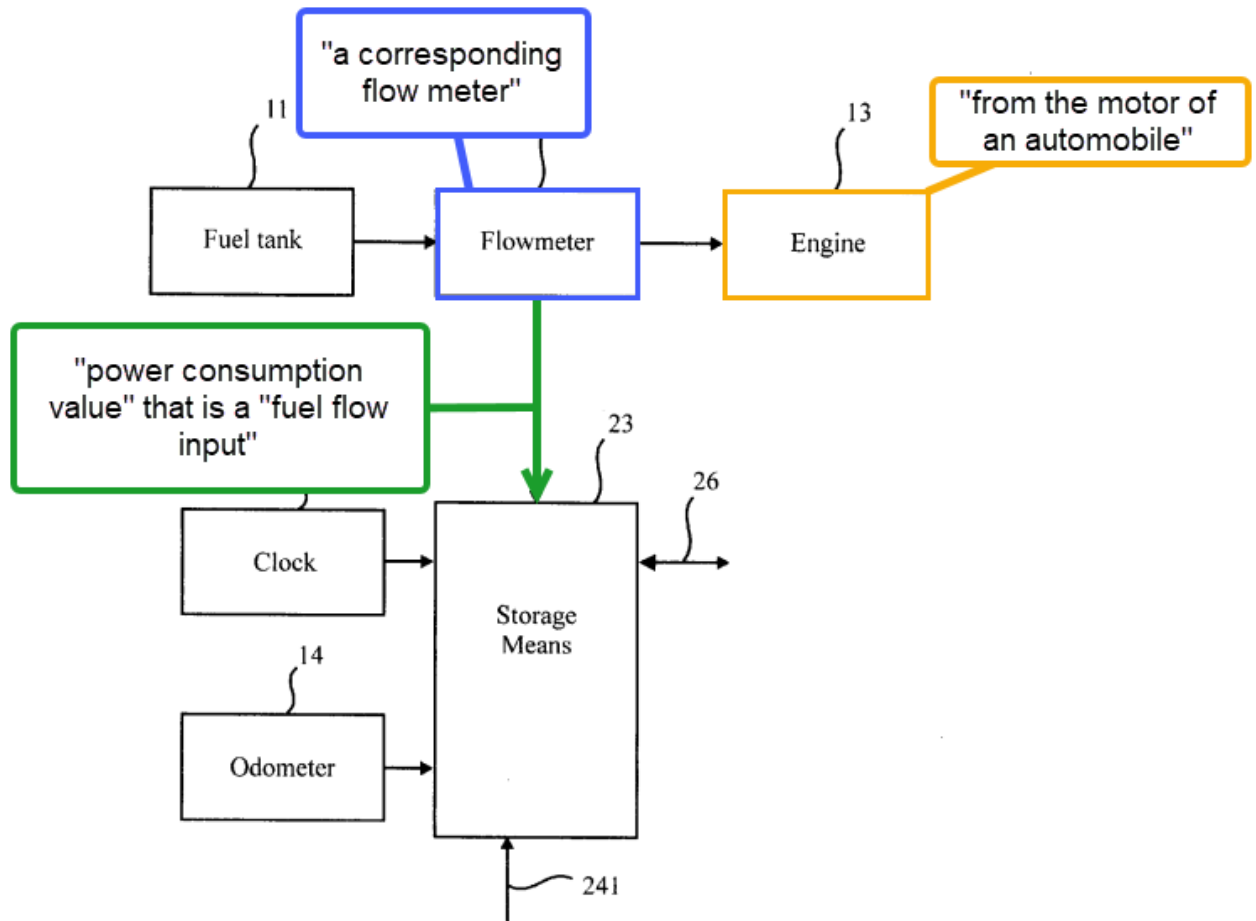
196. Luff also teaches that its system may “receive resource consumption information from a vehicle.” Ex. 1005 at 1:46-48. “The example vehicle 208 is equipped with a central processor 502” that “receives fuel gauge measurements from a fuel gauge 504” which may be used “to determine the energy consumed [during a] trip.” *Id.* at 16:4-11. The vehicle’s fuel gauge measurements are also an input provided to Luff’s data collector. *Id.* at FIG. 5. As explained with regard to claim limitation 1[a] above and shown in annotated Figure 5 below, the inputs of Luff’s data collector disclose power consumption values.



Id. at FIG. 5 (annotations added).

197. Zuta additionally discloses a “fuel flowmeter” “installed between [a fuel] tank and engine,” *i.e.*, a corresponding flow meter from the motor of an automobile, that transfers its output “to [a] digital storage means,” *i.e.*, a fuel flow

input. Ex. 1008 at ¶¶ 0069, 00142, 00138. One embodiment of Zuta’s system is shown in annotated Figure 1 below.



Id. at FIG. 1 (annotations added).

198. In my opinion, a POSITA would have been motivated to modify Luff’s Figure 5 embodiment to include a flow meter based on Zuta’s teachings because the “novel . . . fuel consumption sensor” taught by Zuta is more reliable because it is “devised as to operate safely in a flammable environment” and measures fuel flow more precisely by using “the Doppler effect to measure the rate of fuel flow.” *Id.* at ¶¶ 0084, 0308. Including a sensor that more accurately and reliably measures

the fuel used by vehicles in Luff's Figure 5 embodiment would enable Luff's system to more accurately and reliably calculate energy consumption indices.

199. A POSITA also would have been able to easily modify Luff's system based on the teachings of Zuta to include a fuel flowmeter by including a flowmeter among the measuring devices already included in Luff's vehicle, and by modifying the software on Luff's central processor and data collector to receive and process the flowmeter data.

200. Accordingly, in my opinion Luff in view of Zuta and Amaratunga discloses claim limitation 6[c].

XIII. GROUND 3: THE COMBINATION OF LUFF, AMARATUNGA, SEEM, ZUTA, AND BRETON RENDERS OBVIOUS CLAIM 7.

201. In my opinion, a POSITA at the time of the alleged invention would have found claim 7 obvious over Luff in view of Amaratunga, Seem, and Zuta and Breton.

A. Motivation to Combine Luff, Amaratunga, Seem, Zuta, and Breton

202. In my opinion, a POSITA in possession of Luff's system for measuring power and resource consumption would have been motivated to include a gas exhaust flow meter based on the teachings of Breton to increase the accuracy of Luff's resource consumption measurement.

203. Breton teaches a system with an exhaust gas flow meter that can be configured to “provide[] better accuracy” in measuring exhaust gas flow. Ex. 1009 at 2:14-20; 8:45-51. Breton teaches that such configurations enables the system to measure and analyze the environmental impact of the vehicle’s on-road emissions. *Id.* Luff states that one of the goals of its invention is to “use[] data received from a vehicle . . . to determine how much energy is consumed by each person for travelling activities” and “determine other resources that were used, such as tire wear, carbon emissions, and/or engine fluid contamination.” Ex. 1005 at 4:1-4, 16:15-18; Ex. 1010 at ¶ 0020. A POSITA would recognize that modifying Luff’s system based on the teachings of Breton to include a sensor that accurately measures exhaust gas flow and enables the measurement of the environmental impact of a vehicle’s on-road emissions would enable Luff to more accurately achieve its stated goal of calculating the total energy and resource consumption of the vehicle.

204. Additionally, a POSITA would be motivated to combine the teachings of Luff and Breton because they are both in the same field of endeavor as the ’482 patent: measuring and analyzing power, energy, and resource consumption. Ex. 1001 at Abstract; Ex. 1005 at Abstract; Ex. 1010 at ¶ 0001; Ex. 1009 at Abstract. Both Luff and Breton also use similar techniques to solve the same problem as the ’482 patent. Luff discloses nearly all of the limitations of claims 1-2 and 4-6, and Breton discloses a gas exhaust flowmeter as claimed in claim 7.

205. Finally, a POSITA would have had a reasonable expectation of success of modifying Luff's system to include a gas exhaust flowmeter based on the teachings of Breton. A POSITA would have been able to easily modify Luff's system by adding a flowmeter among the measuring devices already included in the vehicle disclosed in Luff, and modifying the software in Luff's central processor and data collector to receive and process the flowmeter data.

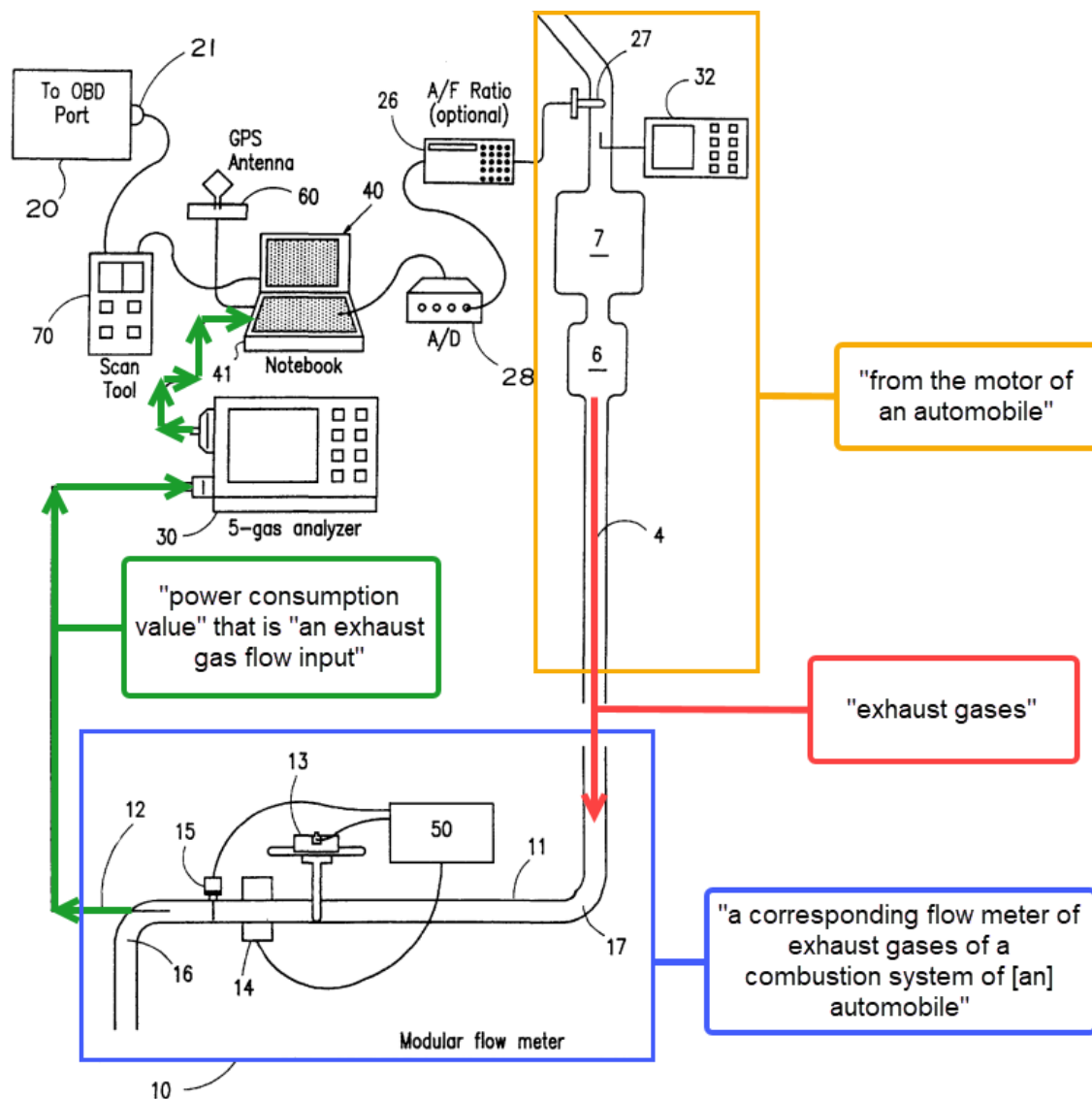
B. Claim 7: The device of claim 6 wherein the at least one power consumption value includes an exhaust gas flow input from a corresponding flow meter of exhaust gases of a combustion system of the automobile.

206. In my opinion, Luff in view of Amaratunga, Seem, Zuta, and Breton discloses the device of claim 6 wherein the at least one power consumption value includes an exhaust gas flow input from a corresponding flow meter of exhaust gases of a combustion system of the automobile.

207. As explained above, Luff in view of Amaratunga, Seem, and Zuta discloses the device of claim 6.

208. Breton also teaches "a flowmeter to measure the exhaust gas volume flow rate" that is "adapted for attachment to a tailpipe 4 of a vehicle," *i.e.*, a flow meter of exhaust gases of a combustion system of the automobile. Ex. 1009 at 4:35-40, 5:17-20. A POSITA would additionally understand that Breton's flowmeter could be incorporated within a vehicle exhaust gas system (*i.e.*, under the vehicle) rather than attached to the vehicle's tailpipe. As shown in annotated

Figure 1 below, Breton also discloses an emissions computer 40 that receives the flowmeter's output, *i.e.*, an exhaust gas flow input. *Id.* at 5:22-24.



Id. at FIG. 1 (annotations added).

209. A POSITA would have been motivated to modify Luff's Figure 5 embodiment based on the teachings of Breton to include a flow meter because Breton teaches that its flow meter more accurately measures exhaust gas flow and enables

the system to measure and analyze the environmental impact of the vehicle's on-road emissions. *Id.* at 2:14-20; 8:45-51. Modifying Luff's system to include a sensor that enables the system to measure the environmental impact of the vehicle's on-road emissions would enable Luff to more accurately calculate the total energy and resource consumption of the vehicle. Ex. 1005 at 4:1-4; Ex. 1010 at ¶ 0020.

210. A POSITA also would have been able to easily modify Luff's system based on the teachings of Breton to include a gas exhaust flowmeter by adding a flowmeter among the measuring devices already disclosed in Luff's vehicle, and by modifying the software of Luff's central processor and data collector to receive and process the flowmeter data.

211. Accordingly, in my opinion Luff in view of Amaratunga, Seem, Zuta, and Breton discloses claim 7.

XIV. GROUND 4: THE COMBINATION OF LUFF AND AMARATUNGA, RENDERS OBVIOUS CLAIMS 9-11.

212. In my opinion, a POSITA at the time of the alleged invention would have found claims 9-11 over Luff in view of Amaratunga.

A. Motivation to Combine Luff and Amaratunga

213. A POSITA would be motivated to modify Luff based on the teachings of Amaratunga for the reasons explained with regard to claim 1 above.

B. Claim 9

214. Claim 9 recites a method analogous to the apparatus of claim 1. The table below shows how the limitations of claim 9 relate to the limitations of claim 1:

Claim 9	Claim 1
9[pre]: A method of determining an ecological parameter by processor, comprising:	1[g]: a computer with a processor and a memory device having therein a plurality of instructions that, when executed by the processor, cause the processor to . . . © calculate an ecological parameter based on the at least one power consumption value and the waste production data
9[a]: receiving a first power consumption value of a power consuming unit,	1[e]: a computer with a processor and a memory device having therein a plurality of instructions that, when executed by the processor, cause the processor to . . . (a) receive the at least one power consumption value from the data introduction module
9[b]: receiving a waste production data value,	1[f]: a computer with a processor and a memory device having therein a plurality of instructions that, when executed by the processor, cause the processor to . . . (b) receive the waste production data
9[c]: determining an ecological parameter based on the first power consumption value and the waste production data value, and	1[g]: a computer with a processor and a memory device having therein a plurality of instructions that, when executed by the processor, cause the processor to . . . (c) calculate an ecological parameter based on the at least one power consumption value and the waste production data, and
9[d]: outputting the determined ecological parameter for display on a display screen.	1[h]: a computer with a processor and a memory device having therein a plurality of instructions that, when

	executed by the processor, cause the processor to . . . (d) operate the display screen to display the calculated ecological parameter
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215. As I’ve described in Section XI.B above, all of claim 1’s apparatus limitations that correspond to claim 9’s method limitations are disclosed by Luff in view of Amaratunga. Accordingly, for the reasons I’ve explained with regard to claim 1, in my opinion Luff in view of Amaratunga discloses the limitations of claim 9.

C. **Claim 10: “The method of claim 9, wherein the first power consumption value corresponds to one of water flow, combustible gas flow, and electric power flow.”**

216. Claim 10 recites a method analogous to the apparatus of claim 5. The table below shows how the limitations of claim 10 relate to the limitations of claim 5.

Claim 10	Claim 5
10[a]: The method of claim 9, wherein the first power consumption value corresponds to one of	5[a]: The device of claim 1 wherein the at least one power consumption value includes at least two power consumption values selected from the group of:
10[b]: water flow,	5[b]: a water flow input from a corresponding first water flow meter;
10[c]: combustible gas flow,	5[c]: a combustible gas and liquid flow input from a second combustible gas and liquid flow meter;

10[d]: and electric power flow.	5[d]: an electric power measurement input from a meter or analyser of electric mains; and
--	--

217. As I’ve described with regard to claim 5 in Section XI.E, all of claim 5’s apparatus claim limitations that correspond to claim 10’s method claim limitations are disclosed by Luff in view of Amaratunga. Accordingly, for the reasons I’ve explained with regard to claim 5, in my opinion Luff in view of Amaratunga discloses the limitations of claim 10.

D. Claim 11: “The method of claim 10, wherein the waste production data corresponds to waste weight.”

218. Claim 11 recites a method analogous to the apparatus of claim 5. The table below shows how the limitations of claim 11 relate to the limitations of claim 5.

Claim 11	Claim 5
11[a]: The method of claim 10	5[a-d]: The device of claim 1 wherein the at least one power consumption value includes at least two power consumption values selected from the group of: a water flow input from a corresponding first water flow meter; a combustible gas and liquid flow input from a second combustible gas and liquid flow meter; an electric power measurement input from a meter or analyser of electric mains; and
11[b]: wherein the waste production data corresponds to waste weight.	5[e]: a waste weight measurement input from a scale for weighting wastes.

219. As I’ve described with regard to claim 5 in Section XI.E, all of claim 5’s apparatus claim limitations that correspond to claim 11’s method claim limitations are disclosed by Luff in view of Amaratunga. Accordingly, for the reasons I’ve explained with regard to claim 5, in my opinion Luff in view of Amaratunga discloses the limitations of claim 11.

XV. GROUND 5: THE COMBINATION OF LUFF, AMARATUNGA, ZUTA, AND BRETON RENDERS OBVIOUS CLAIMS 12-13.

220. In my opinion, a POSITA at the time of the alleged invention would have found claims 12-13 obvious over Luff in view of Amaratunga, Zuta, and Breton.

A. Motivation to Combine Luff, Amaratunga, Zuta, and Breton

221. A POSITA would be motivated to modify Luff based on the teachings of Amaratunga, Zuta, and Breton for the reasons explained with regards to Grounds 1, 2, and 3 above.

B. Claim 12: “The method of claim 9, wherein the first power consumption value corresponds to one of fuel flow and exhaust gas flow.”

222. Claim 12 recites a method analogous to the apparatus of claims 6 and 7. The table below shows how the limitations of claim 12 relate to the limitations of claims 6 and 7:

Claim 12	Claim 6	Claim 7
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12[a]: The method of claim 9, wherein the first power consumption value corresponds to	6[a]: The device of claim 1 wherein the at least one power consumption value includes...	7: The device of claim 6 wherein the at least one power consumption value includes...
12[b]: fuel flow	6[a]: ... a fuel flow input from a corresponding flow meter from the motor of an automobile	
12[c]: and exhaust gas flow.		7: ... an exhaust gas flow input from a corresponding flow meter of exhaust gases of a combustion system of the automobile.

223. As explained in Sections XII.B.1 and XIII.B, Luff in view of Zuta, and Breton renders obvious all of claim 6 and 7's apparatus limitations that correspond to claim 12's method limitations. Accordingly, for the reasons I've explained with regard to claims 6 and 7, in my opinion Luff in view of Amaratunga, Zuta, and Breton renders obvious claim 12.

C. Claim 13: "The method of claim 12, wherein the waste production data corresponds to one of rubber wastes, oil waste, coolant liquid wastes, and metal."

224. Claim 13 recites a method analogous to the apparatus of claim 6. The table below shows how the limitations of claim 13 relate to the limitations of claim 6:

Claim 13	Claim 6
13: The method of claim 12, wherein the waste	6[a-b]: The device of claim 1 wherein ... the

production data corresponds to one of rubber wastes, oil waste, coolant liquid wastes, and metal.	waste production data corresponds to one of tire rubber wastes, motor oil wastes, coolant liquid wastes, closed circuit liquid wastes and metal wastes
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225. As I've explained with regard to claim 6 in Section XII.B, Luff in view of Amaratunga renders obvious all of claim 6's apparatus limitations that correspond to claim 13's method limitations. Accordingly, for the reasons explained with regard to claim 6, in my opinion Luff in view of Amaratunga renders obvious claim 13.

XVI. SECONDARY CONSIDERATIONS

226. I understand that "secondary considerations" may be legally relevant to an obviousness analysis. If MMT presents such evidence, I will consider it; however, I do not believe that any commercial success of the claimed invention or other objective evidence would be attributable to the merits of the claimed invention given my analysis of the lack of novelty and the obviousness of the '482 patent.

XVII. CONCLUSION

227. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within

the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

228. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on the information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

June 6, 2023

A handwritten signature in cursive script, reading "Glenn R. Bower", written over a horizontal line.

Glenn R. Bower, Ph.D.