

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WILLOW TECHNOLOGIES, LLC,
Petitioner,

v.

JOHNSON CONTROLS TECHNOLOGY COMPANY,
Patent Owner.

Case No. IPR2023-_____

U.S. PATENT NO. 7,031,880

**DECLARATION OF PATRICK HILLBERG, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW**

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DECLARATION OF PATRICK HILLBERG, PH.D.

1. I, Patrick Hillberg, make this declaration in connection with the proceedings identified above.

2. I have been retained on behalf of Petitioner Willow Technology Corporation Limited to offer my expert opinions in connection with the above-captioned proceeding relating to U.S. Patent 7,031,880 (the “’880 Patent”).

3. I am being compensated for my time in connection with this *inter partes* review (IPR) at my standard consulting rate. No part of my compensation depends on the outcome of this proceeding.

4. I have been asked to provide my opinions as to whether claims 1, 4, 15, 21, 24, 37, 39, 42, and 53 (the “Challenged Claims”) of the ’880 patent are invalid to a person having ordinary skill in the art at the time of the alleged invention.

5. In preparing this declaration, I have reviewed the ’880 Patent (Ex. 1001), the file history of the ’880 Patent (Ex. 1006), various pieces of prior art (Exs. 1004 and 1005), and all other materials referenced in this declaration (e.g., Ex. 1008).

6. In forming the opinions expressed in this declaration, I relied upon my education, training, knowledge, and experience in the art, and have considered the viewpoint of an ordinary artisan at the time of the invention.

I. BACKGROUND AND QUALIFICATIONS

7. I summarize in this section my educational background, career history, and other relevant qualifications. My full resume is attached as Exhibit A to this declaration.

8. I earned a Bachelor of Science in Computer Science from Michigan Technological University in 1984. I earned a Master of Science in Engineering in Industrial and Systems Engineering from the University of Michigan in 1989. I earned a Ph.D. in Systems Engineering from Oakland University in 2004.

9. I have been a Software Developer in Factory Automation Systems, specializing in Robotics and Machine Vision Systems from 1984 to 2001. At this point in my career, I devoted my efforts to my Ph.D. dissertation, titled “Opportunistic Preventive Maintenance” (2004). This work contemplated a digital reliability twin of a factory assembly line, collecting data from factory controllers (PLCs) to program artificial intelligence to recognize gaps in production flow and improve throughput. Following this, I was a data modeling architect, a solutions architect, and a sales lead for academic and workforce development.

10. From the time I completed my bachelor’s degree in 1984, I worked for the companies Automatix, Synthetic Vision Systems, Trellis Software, and FANUC Robotics, primarily as a software developer for robotic and vision systems. From 2004 to 2010 I was a data architect for Dassault Systemes DELMIA brand,

developing software to ingest and retrieve data in their PLM database. From 2011 to 2017 I was a Solution Architect for Siemens PLM division, leading teams in the implementation of large-scale engineering databases. From 2017 to 2019 I was the Academic and Workforce Development Lead for Siemens PLM, where my role was to help schools in teaching advanced engineering and manufacturing software.

11. During my tenure with FANUC, Dassault, Siemens, and Oakland University, I developed significant experience in many aspects relating to software development in automation, controls, and digital twin technology.

12. Since 2012, I have held the role of Adjunct Assistant Professor at Oakland University School of Engineering and Computer Science, where I teach the course “Product Lifecycle Management.” I am semi-retired and now professionally devote my time to teaching, mentoring, academic writing, and occasional consulting.

13. My continued involvement in the art of Digital Twins and Product Lifecycles is due primarily to teaching, academic writing, mentoring, and consulting.

II. LEGAL STANDARDS

14. I am not a lawyer or legal expert, and I do not offer any opinions regarding applicable legal standards. Below, I set forth my understanding of the law

as it has been explained to me, and I have applied this understanding in forming my opinions in this declaration.

A. Priority Date and Prior Art

15. I am informed that for these proceedings, the prior art to the challenged patent includes patents and printed publications in the relevant art that predate the priority date of the patent.

16. The '880 Patent issued on April 18, 2006, from U.S. Patent Application No. 10/841,107, filed on May 7, 2004. Ex. 1001 at Cover.

17. For purposes of this proceeding, I have been asked to consider May 7, 2004 as the priority date of the '880 Patent. I offer no opinions in this declaration as to whether that priority date is correct.

B. Claim Interpretation

18. I understand that in construing or interpreting a patent claim, the words of the claim are generally given their ordinary and customary meaning, which is the meaning that words would have had to a person of ordinary skill in the art in question at the time of the invention. The person of ordinary skill in the art is deemed to read the claim term in the context of not only the particular claim in which the disputed term appears, but also in the context of the entire patent, including the other claims and the specification, as well as the prosecution history of the patent. For purposes

of this proceeding, I understand the claim terms of the '880 Patent to have their ordinary and accustomed meaning.

C. Anticipation

19. To invalidate a patent claim as anticipated in the context of IPR, the petitioner bears the burden of showing by a preponderance of the evidence that a single prior art reference discloses every element required by the claim.

20. An element need not be expressly disclosed if it is inherent in the prior art, but the allegedly inherent characteristic must necessarily flow from the teachings of the applied prior art—in other words, the fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic.

D. Obviousness

21. To invalidate a patent claim as obvious in the context of an IPR proceeding, the petitioner bears the burden of showing by a preponderance of the evidence that the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious to a person of ordinary skill in the art to which the subject matter pertains at the time the claimed invention was made. Factors relevant to the determination of obviousness include (1) the scope and content of the prior art, (2) the level of ordinary skill in the art at the time of the invention, (3) differences between the claimed invention and the prior art, and

(4) “secondary considerations” or objective evidence of obviousness or nonobviousness.

22. I am informed that some non-exclusive rationales that may support a conclusion of obviousness include:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;
- Use of known technique to improve similar devices (methods, or products) in the same way;
- Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- "Obvious to try" – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art;

- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

23. **Reason to Combine.** Obviousness can be established by showing that a person of ordinary skill in the art would have combined or modified the teachings of the prior art to produce the claimed invention and would have had a reasonable expectation of success in achieving the claimed subject matter. There is no requirement that the prior art provide an express teaching, suggestion, or motivation to combine elements of the prior art, but a determination of obviousness requires more than showing that each element of a patent claim was independently known in the prior art. Rather, the petitioner in an IPR must identify some apparent reason why a person of ordinary skill in the art would have combined the elements or concepts from the prior art in the same way as in the claimed invention when considered as a whole. The motivation to combine may be implicit and may be found in the knowledge of a person of ordinary skill in the art, from the nature of the problem to be solved, market demand, or common sense.

24. **Hindsight.** A determination regarding obviousness must be based on the knowledge possessed by a person of ordinary skill in the art at the time when the invention was made, and one should not consider in hindsight what is known today or what is learned from the teachings of the patent. Thus, it is inappropriate to use

hindsight reconstruction of references to reach the claimed invention without any explanations as to how or why the references would be combined to produce the claimed invention.

25. **Analogous Art.** An obviousness analysis cannot be based on nonanalogous art. The rationale behind this rule is that when art is directed to a different purpose than a claimed invention, an inventor would have less motivation or occasion to consider it. Art is analogous when it is from the same field of endeavor as the claimed invention, or if the art is not from the same field of endeavor, when it is reasonably pertinent to the particular problem faced by the inventor. To be “reasonably pertinent,” art must “logically commend itself” to an inventor’s attention in considering his problem.

III. PERSON OF ORDINARY SKILL IN THE ART

26. I have been advised that there are multiple factors relevant to determining a person having a level of ordinary skill in the pertinent art, including the educational level of active workers in the field at the time of the alleged invention, the sophistication of the technology, the type of problems encountered in the art, and the prior art solutions to those problems.

27. I believe that the level of ordinary skill in the art relevant to the ’880 Patent would have both relevant education and several years of experience. Specifically, a person of ordinary skill in the art would have at least a bachelor’s

degree in computer science or a related field, and at least three years of experience in in the field of information and control systems used in buildings. Additional work experience may compensate for less educational experience, and vice versa.

28. I am informed that Patent Owner has, in other proceedings, asserted a person of ordinary skill in the art would have at least a bachelor's degree in computer science and/or engineering, or electrical engineering, or a closely related scientific field such as mathematics, and two years of work experience with digital twin and/or entity modeling software. I also understand Patent Owner asserted that, alternatively, any lack of experience could be remedied with additional education (e.g., a Master's degree), and likewise, a lack of education can be remedied with additional work experience (e.g., 6-8 years).

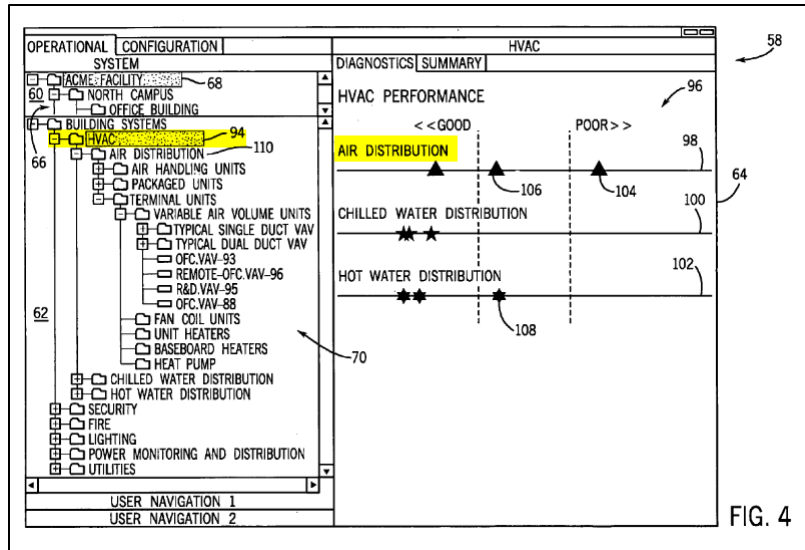
29. Though I believe my definition of the ordinary artisan is more accurate, the opinions I offer here would not change based on either definition. Based on either level of ordinary skill, I have been qualified as at least a person of ordinary skill in the art since well before 2004, and each of my opinions set forth in this declaration are presented from the standpoint of one skilled in the art. Thus, where I specify in the analysis below that I am rendering my opinion, it should be understood that my opinion is from the perspective of a person having the level of ordinary skill in the art that I have described at the time of the invention.

IV. OVERVIEW OF THE '880 PATENT

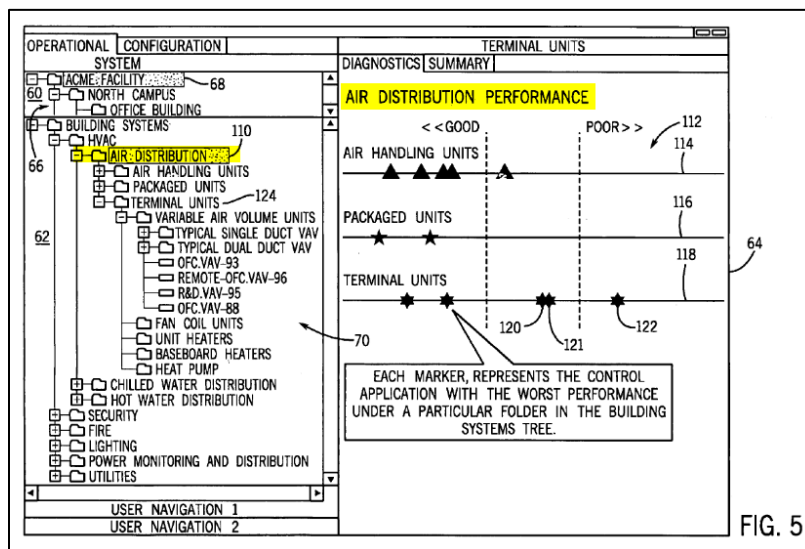
30. The '880 Patent relates to performance monitoring in an environmental control network. Ex. 1001, Abstract. In this regard, the Challenged Claims relate to various views that the system may provide a user. This includes “displaying performance indicators for the control applications using a first view that allows at least one control application exhibiting degraded performance to be identified” and “displaying performance indicators using a second view that provides additional details regarding the performance of the at least one control application.” *Id.*, Claim 21. The other challenged independent claims (1 and 39) are similar, providing method variations of apparatus Claim 21. Dependent claims add little else, including:

- A “summary view” and “more detailed view” (Claims 4, 24, 42)
- A “mechanical view” (Claims 15, 53)
- A “control diagram view” (Claim 37)

31. For example, a user can view a HVAC system in Figure 4, see a problem with the air distribution system, and then use the tree on the left to navigate to more information about the air distribution system in Figure 5:



Ex. 1001, Fig. 4 (color added).



Ex. 1001, Fig. 5 (color added).

V. OVERVIEW OF THE PRIOR ART

A. Eryurek (Ex. 1004)

32. Eryurek is a U.S. patent application published September 5, 2002 and entitled “Remote Analysis of Process Control Plant Data.” Ex. 1004, Cover. It describes “process control systems within process plants and, more particularly, []

the use of asset or process analysis tools by a remote processing facility to analyze process control plant data.” *Id.*, [0002]. Eryurek provides a system with data collection and presentation capabilities to allow a user to specifically identify problems in such systems. For example, Figure 20 depicts a high-level view where “each of the alarms within the banner 760 may also include an information button 770, which may be selected by a user to generate a pop-up window 775 containing more detailed information.”

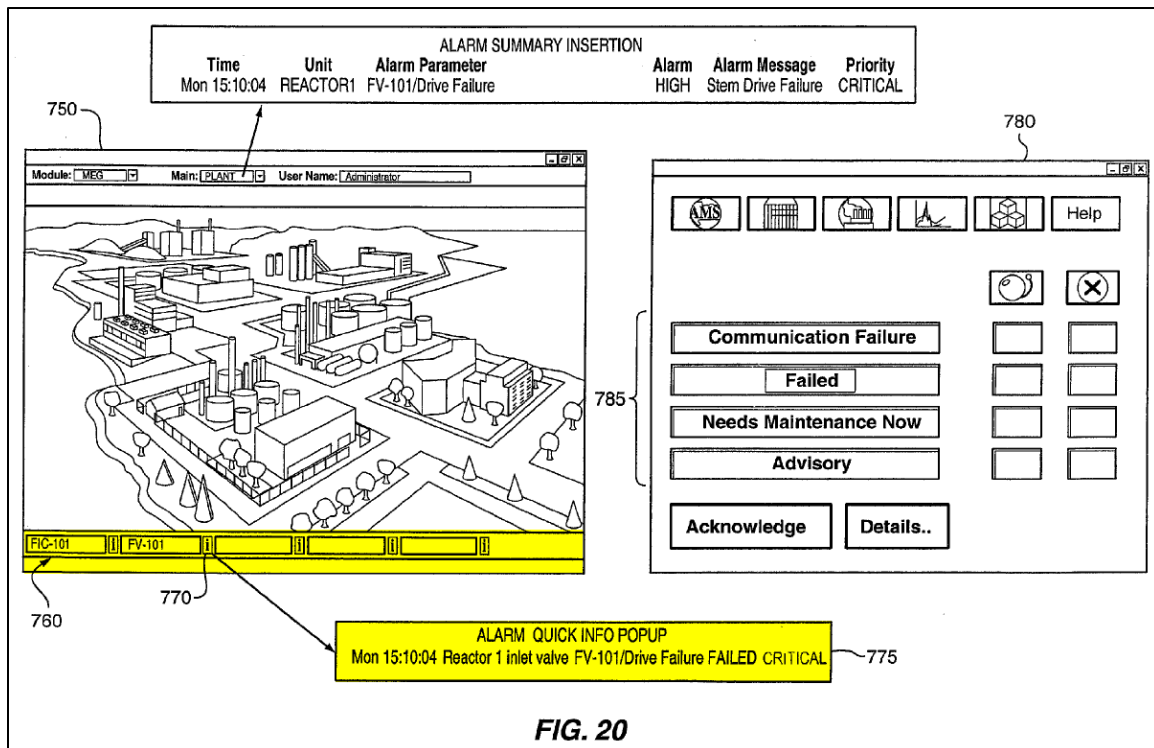
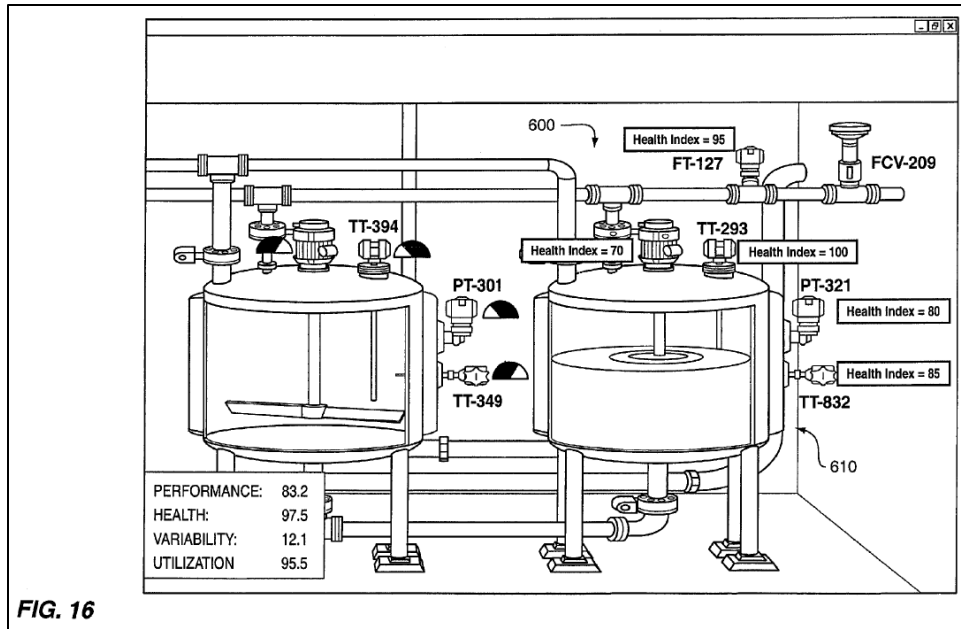


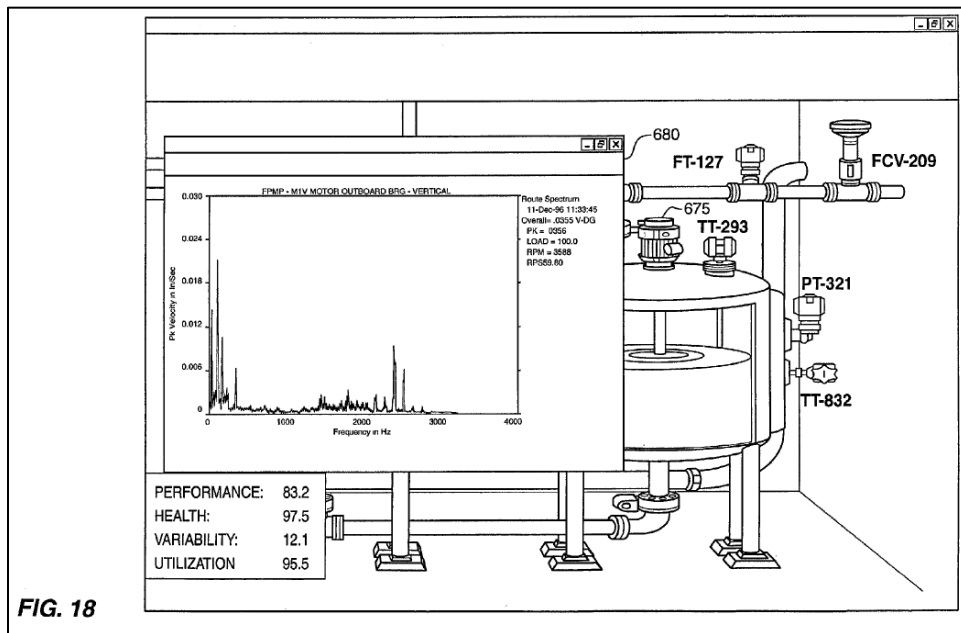
FIG. 20

Id., [0133], Fig. 20 (color added).

33. Eryurek additionally describes a number of views for focusing in on the details of various subsystems. For example, Figures 16 and 18 provide an overview and more detailed view of a process area within a plant. Ex. 1004, [0031], [0033].



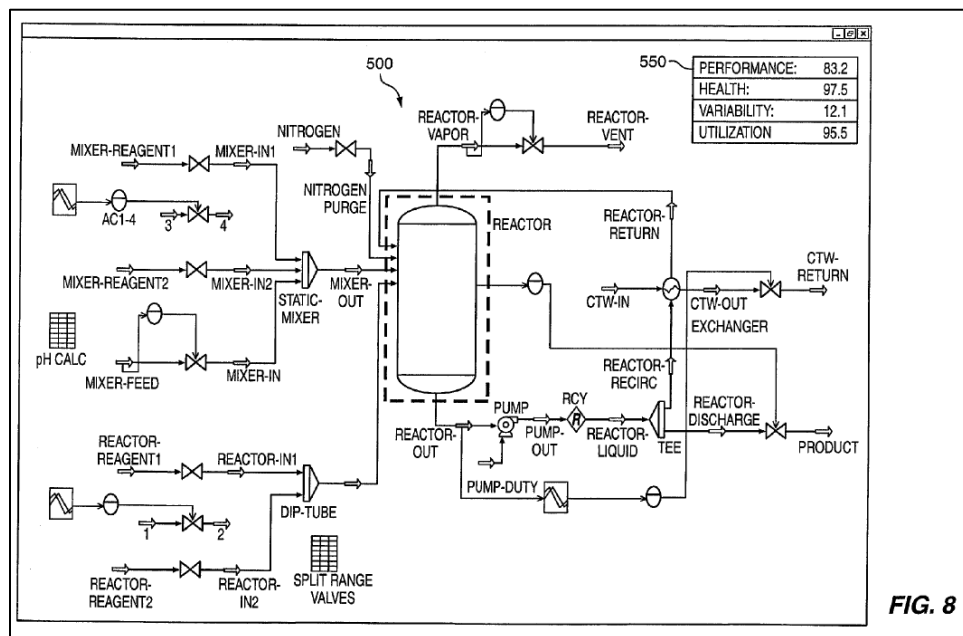
Id., Fig. 16.



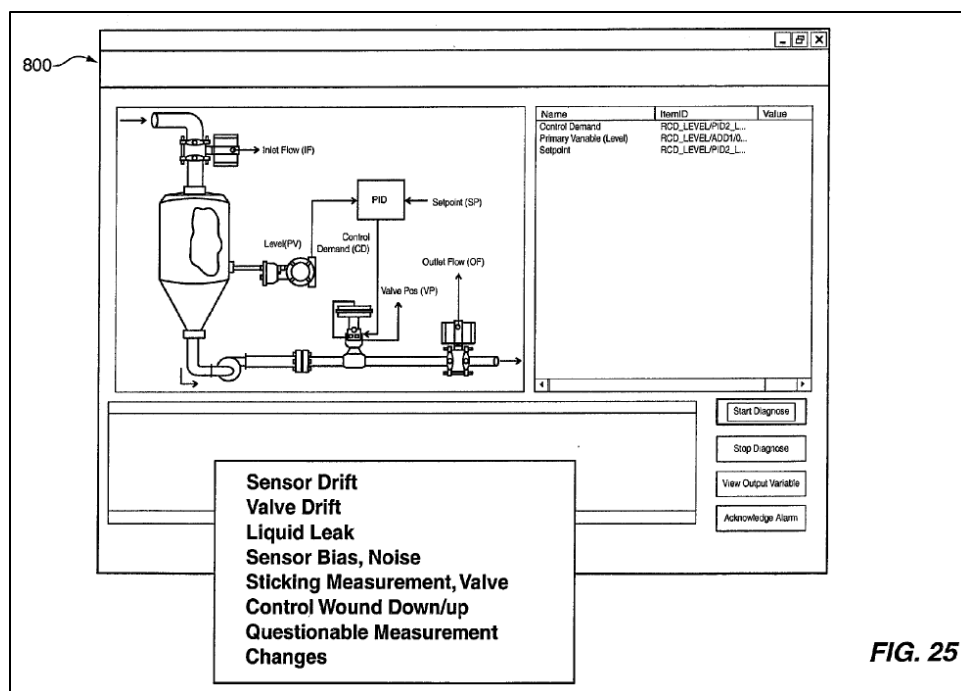
Id., Fig. 18.

34. Figure 8 of Eryurek depicts a view of “a plurality of devices such as, for example, valves, pumps, temperature transmitters, etc.” and “lines arrows, and

any other indicia to represent logical and physical interconnections between the various devices.” Ex. 1004, [0113], Fig. 8:

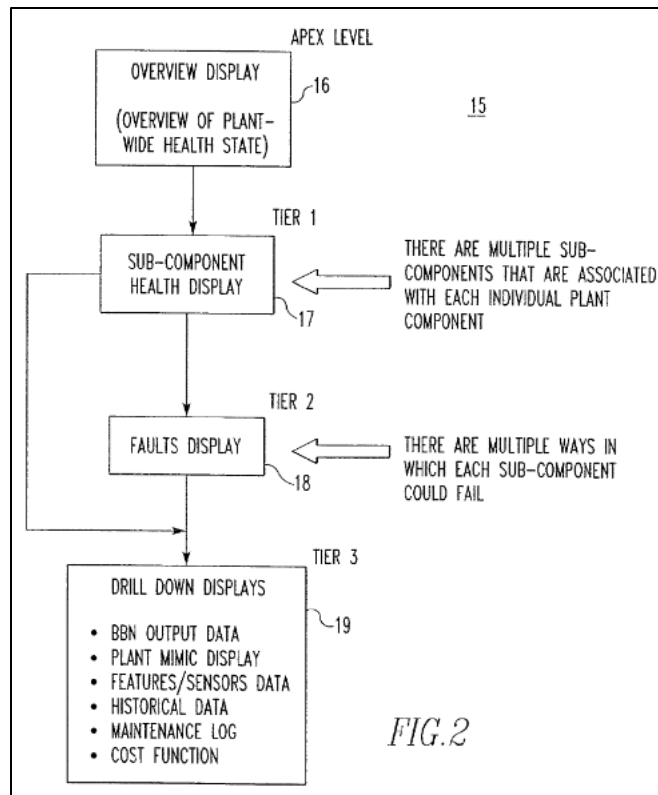


35. In addition, Figure 25 shows a view of a system setup, including a setpoint, PID, and various other control elements. Ex. 1004, [0135], Fig. 25:



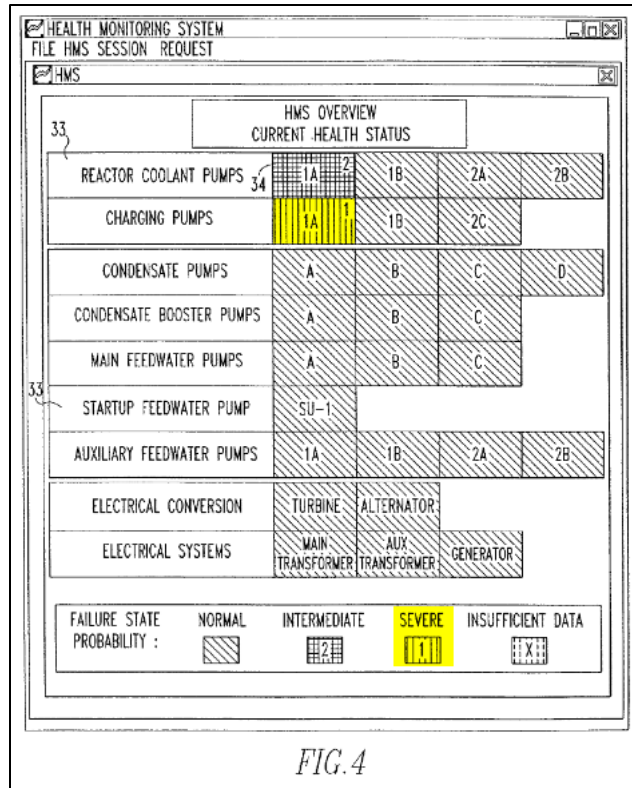
B. Ridolfo (Ex. 1005)

36. Ridolfo is a U.S. patent application published January 2, 2003 and entitled “Health monitoring display system for a complex plant.” Ex. 1005, Cover. It describes “[a] three-tier hierarchy of displays [that] provide details on the health status of the components and systems displayed on the enterprise wide level display in a manner that supports a logical drill down to the health status of sub-components on Tier 1 to expected faults of the sub-components on Tier 2 to specific information relative to expected sub-component failures on Tier 3.” Ex. 1005, Abstract. This hierarchy is shown in Figure 2:



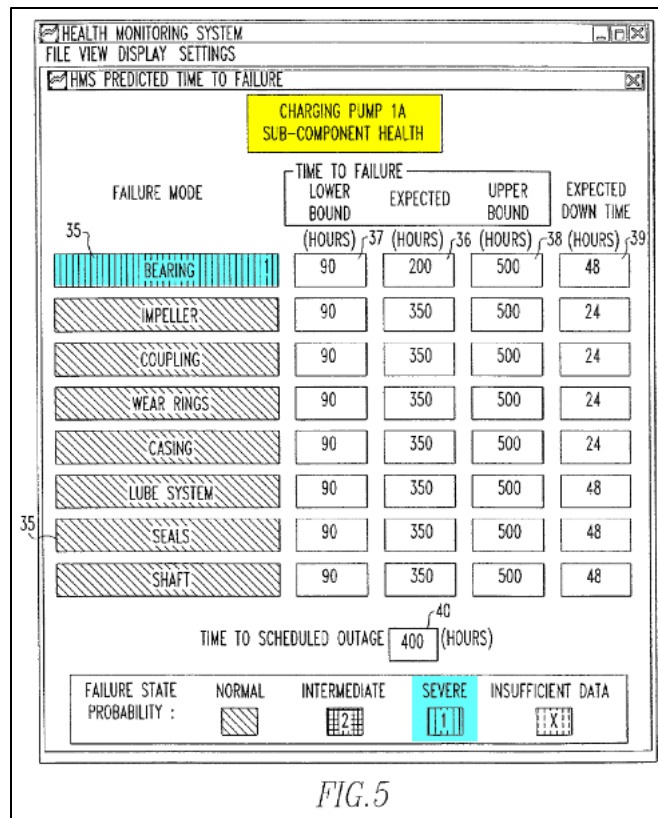
Id., Fig. 2.

37. Figure 4 of Ridolfo, for example, shows a summary view with Charging Pump 1A listed in a Severe health state. Ex. 1005, Fig. 4, [0104]-[0108].



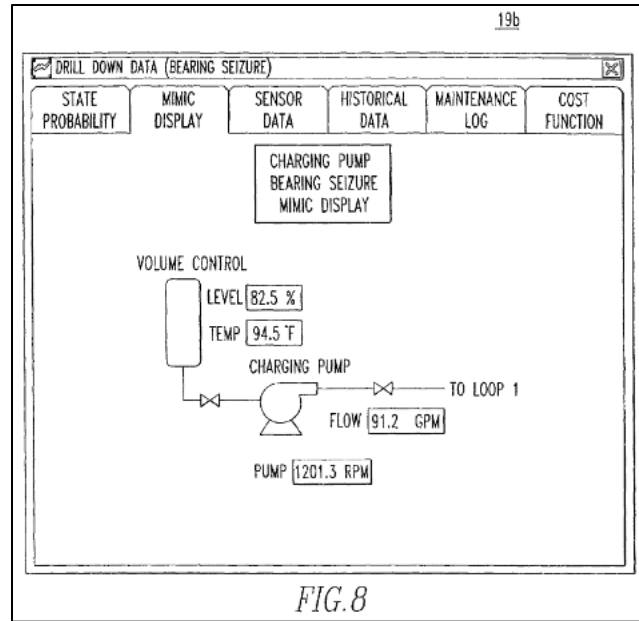
Id., Fig. 4 (color added).

38. The user may then select Charging Pump 1A to drill down on the cause of the health problem, e.g., the bearings as shown in the Figure. Ex. 1005, Figs. 4, 5, [0104]-[0112].

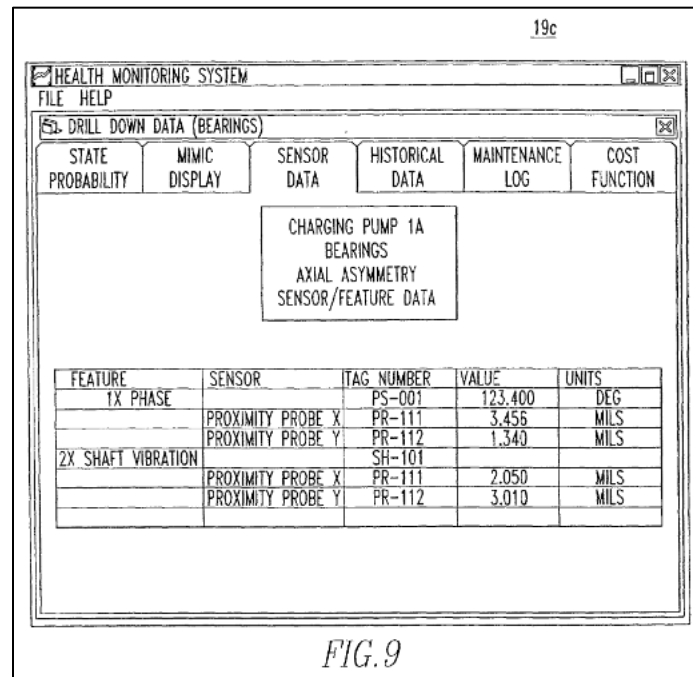


Id., Fig. 5 (color added).

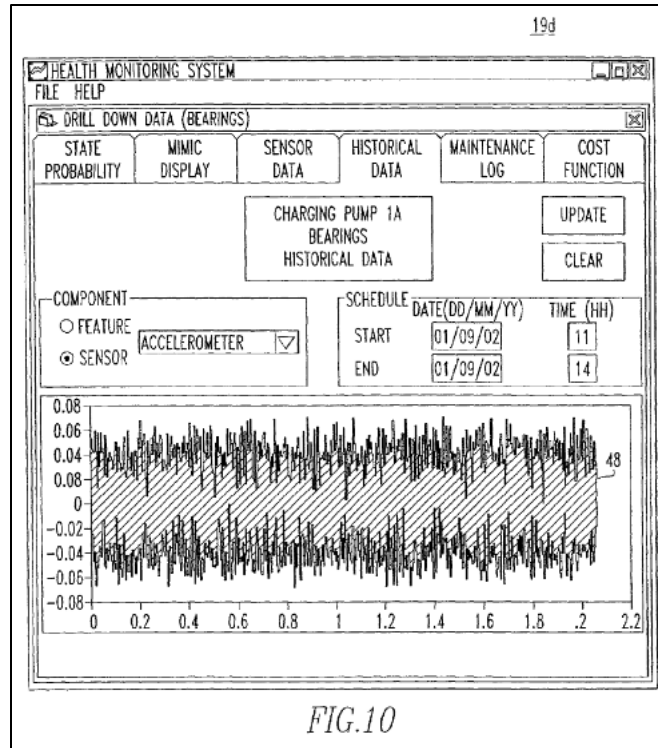
39. Ridolfo describes additional views with further information. Ex. 1005, Figs. 8-10.



Id., Fig. 8.



Id., Fig. 9.



Id., Fig. 10.

VI. THE CHALLENGED CLAIMS ARE UNPATENTABLE

40. It is my opinion that a person of ordinary skill in the art would have considered all of the Challenged Claims of the '880 Patent unpatentable, over either Eryurek or Ridolfo. I explain my opinions in detail below, on a claim-by-claim basis.

A. The Challenged Claims are Obvious over Eryurek in View of the Level of Skill in the Art

41. It is my opinion that Eryurek renders obvious claims 1, 4, 15, 21, 24, 37, 39, 42, and 53 of the '880 Patent.

1. Claim 1

- a. “1. A method for analyzing performance of control applications in an environmental control network, comprising:”

42. Eryurek discloses this element. For example, Eryurek describes “a system and method for analyzing a process collects process data within a process control plant and transmits the collected process data to a remote data processing facility. The remote data processing facility may analyze the process data to generate analysis data using one of a plurality asset or process analysis tools stored within a database of the remote data processing facility.” Ex. 1004, [0014]-[0015]. Accordingly, Eryurek discloses remotely analyzing the performance of control applications in a plant.

43. Eryurek also discloses that these control applications are in an environmental control network including, for example, controlling the environmental conditions within a tank, reactor, boiler, or furnace. Ex. 1004, [0074], [0099], [0104], [0129]-[0130], Figs. 4, 8, 16, 18, 20, 25. I note that the ’880 Patent discloses that the “environmental control network may be employed to control temperature, fluid flow, humidity, lighting, *boilers*, chillers, power, security and *similar systems* in the internal environment.” Ex. 1001, 1:16-22. In fact, the ’880 Patent broadly states that “[t]he controlled environment may be a room, hallway, building, a portion thereof, or *any other internal environment*.” *Id.*, 5:64-66.

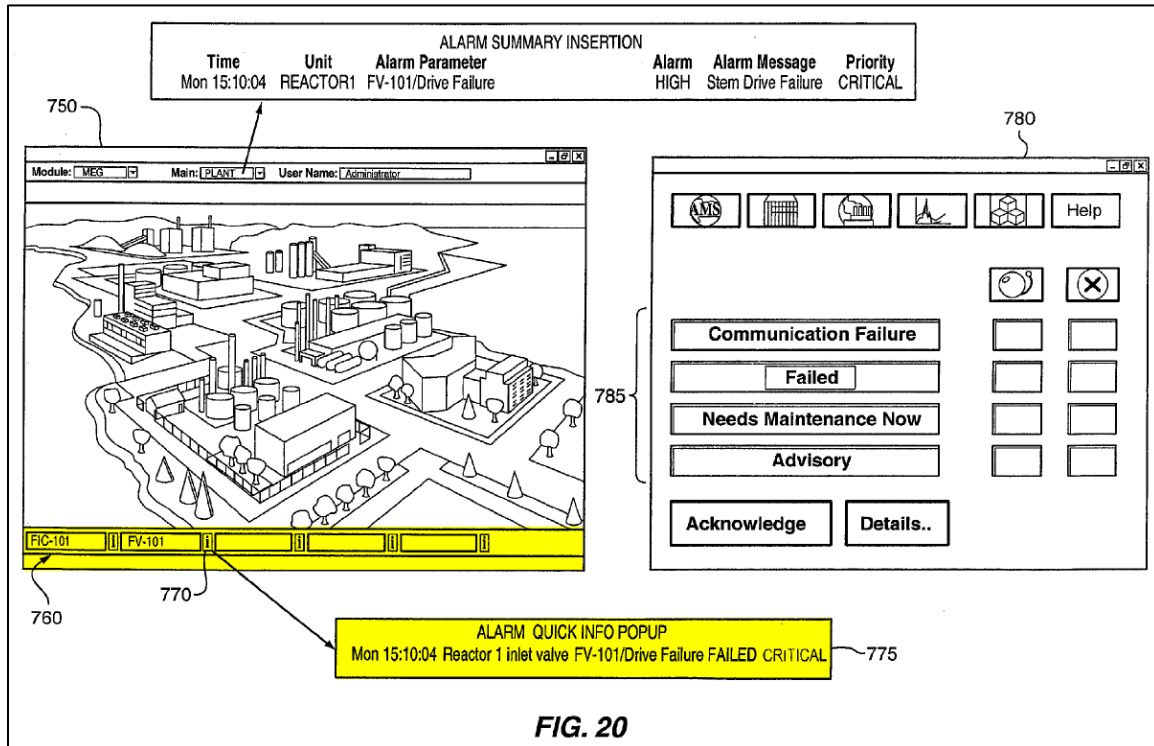
44. In addition, it would also have been obvious to apply the functionality of Eryurek to a different, more narrowly defined “environmental control network.” Eryurek explains a “process [to] control systems within process plants and, more particularly, [] the use of asset or process analysis tools by a remote processing facility to analyze process control plant data.” Ex. 1004, [0002]. The functionalities of Eryurek are readily used with numerous environmental control systems, including the most narrowly defined systems that may be described in the ’880 Patent. Note that, for example, the functionality depicted in Figures 4, 8, 16, 18, 20, and 25 of Eryurek resemble the very same functionality seen in the ’880 Patent, including monitoring and controlling various parameters (e.g., temperature, flow rate) of systems within a facility. The ’880 Patent also states that the “environmental control network may be employed to control *temperature, fluid flow*, humidity, lighting, boilers, chillers, power, security and similar systems in the internal environment.” Ex. 1001, 1:16-22. Similarly, Eryurek describes its “process control systems” as including “field devices” that control similar parameters including “sensors (e.g., *temperature*, pressure and *flow rate sensors*).” Ex. 1004, [0003]. A POSITA would have found it obvious to implement the functionality of Eryurek in an environmental control network, should the environmental control network be different than that of Eryurek, in order to provide similar monitoring functionality to such environment control networks.

- b. “receiving at least one performance indicator for each control application;”

45. Eryurek discloses this element. For example, Eryurek describes “a system and method for analyzing a process *collects process data within a process control plant* and *transmits the collected process data* to a remote data processing facility. The remote data processing facility may analyze the process data to generate analysis data using one of a plurality asset or process analysis tools stored within a database of the remote data processing facility.” Ex. 1004, [0014]-[0015]. Thus, the received process data reflects receiving at least one performance indicator for each control application.

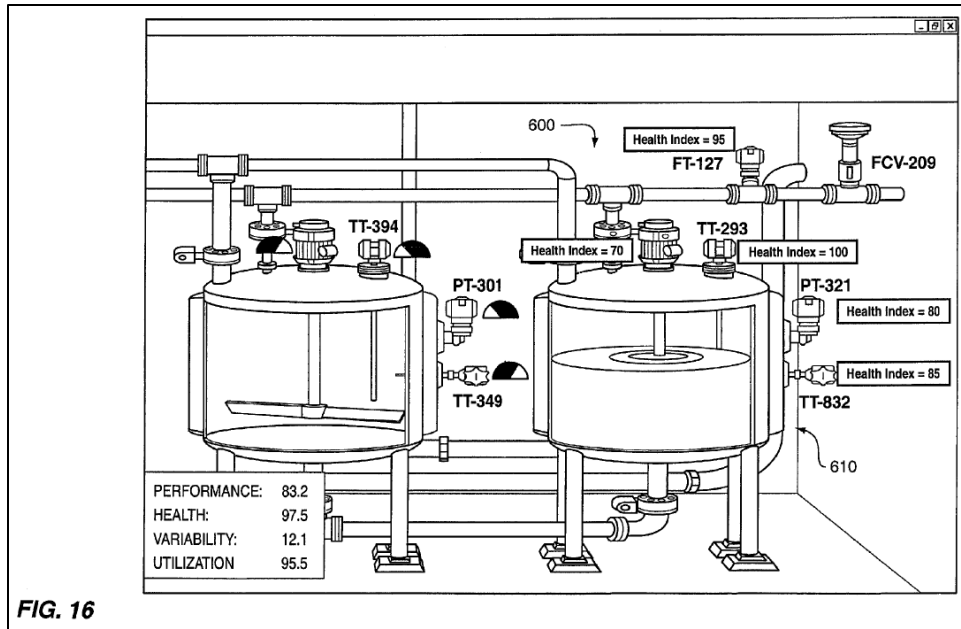
46. Furthermore, Eryurek describes field devices to collect data and pass this to process controllers. For example, “[f]ield devices, which may be, for example valves, valve positioners, switches, transmitters, and sensors (e.g., temperature, pressure and flow rate sensors), perform functions within the process such as opening or closing valves and measuring process parameters. The process controller receives signals indicative of process measurements or process variables made by or associated with the field devices and/or other information pertaining to the field devices.” Ex. 1004, [0003]. Then, “[p]rocess control operators also receive process variable information from the process via one or more process controllers which provide information to the operators about the operation of the process, including alarms generated within the process. This information may be provided to the

process control operator via a standard user interface.” *Id.*, [0006]. This is illustrated in Figure 20, where the received performance indicator is shown to the user (as an alarm flag in a first view, 760, and then with more details in a second view, 775). *Id.*, [0133].



Id., Fig. 20 (color added).

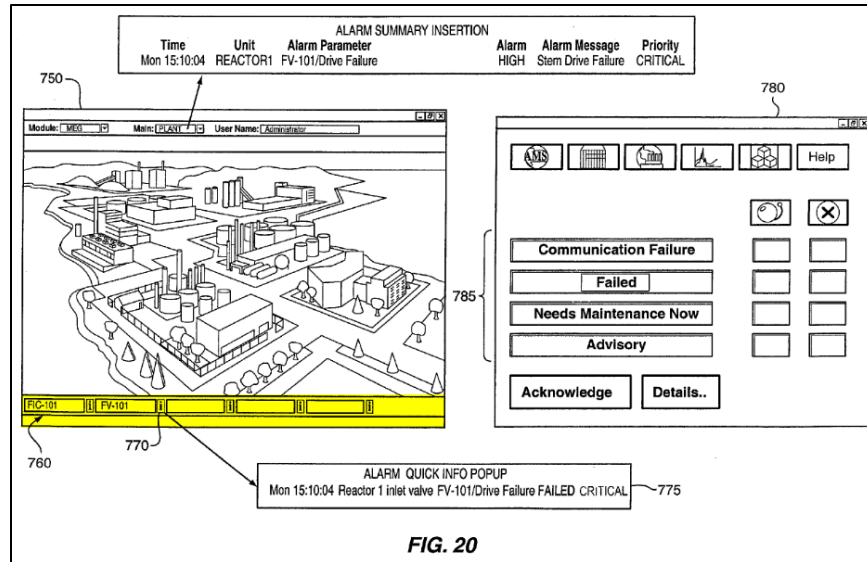
47. As another example, Eryurek describes an overview of a system in Figures 16 and 18 with a number of sensed parameters. Ex. 1004, [0129]-[0130], [0132], Figs. 16, 18. This overview reflects a number of performance indicators (e.g., health indices, shown in boxes, and meters, shown as half-circles) that are received from the control applications. *Id.*



Id., Fig. 16.

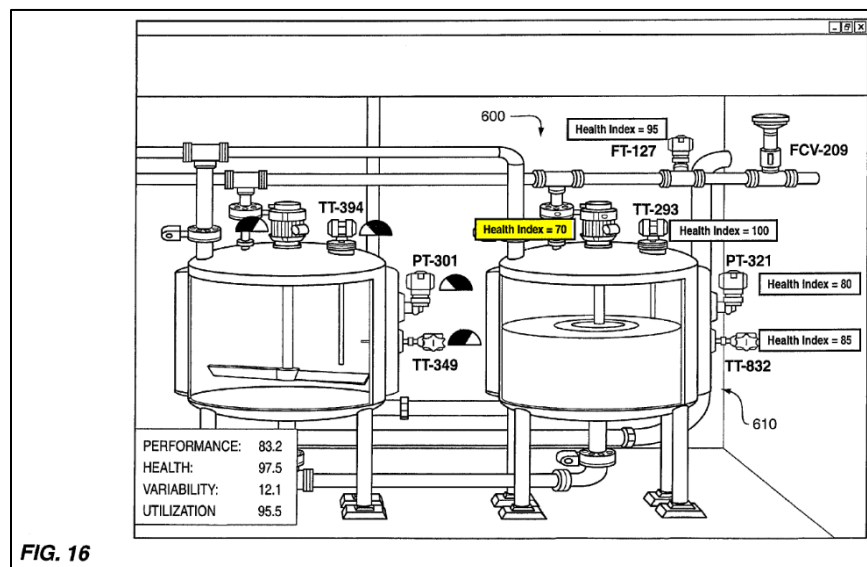
- c. “identifying at least one control application experiencing degraded performance using a first view of the performance indicators; and;”

48. Eryurek discloses this element. Continuing the discussion above (§VI.A.1.b), the user interface in Figure 20 identifies at least one control application experiencing degraded performance (*e.g.*, FV-101). Ex. 1004, [0133], Fig. 20. The identification uses a first view of the performance indicators (*e.g.*, alarm banner 760). *Id.*

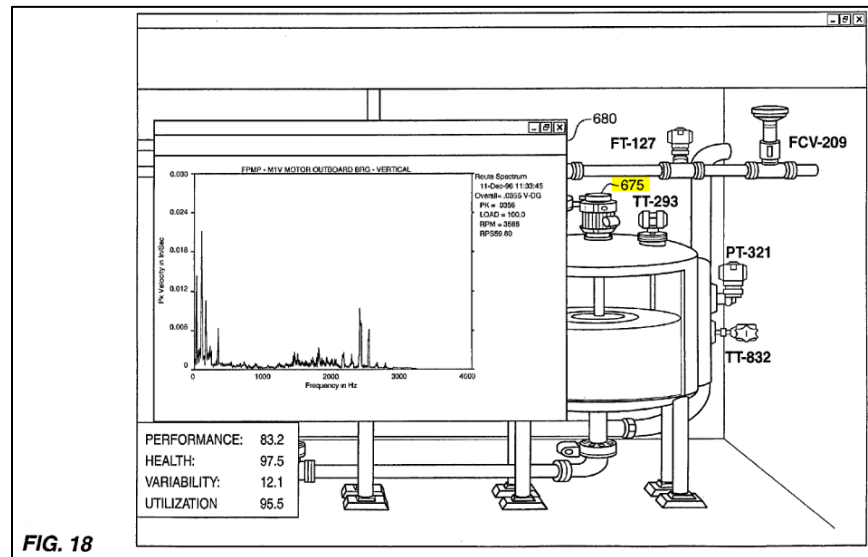


Id., Fig. 20 (color added).

49. Additionally, the user interface in Figures 16 and 18 of Eryurek identifies at least one control application experiencing degraded performance (*e.g.*, motor 675, labeled in Figure 18) with a lower health index. Ex. 1004, [0129]-[0130], [0132], Figs. 16, 18. Figure 16 depicts the claimed first view of the performance indicators:



Id., Fig. 16 (color added).

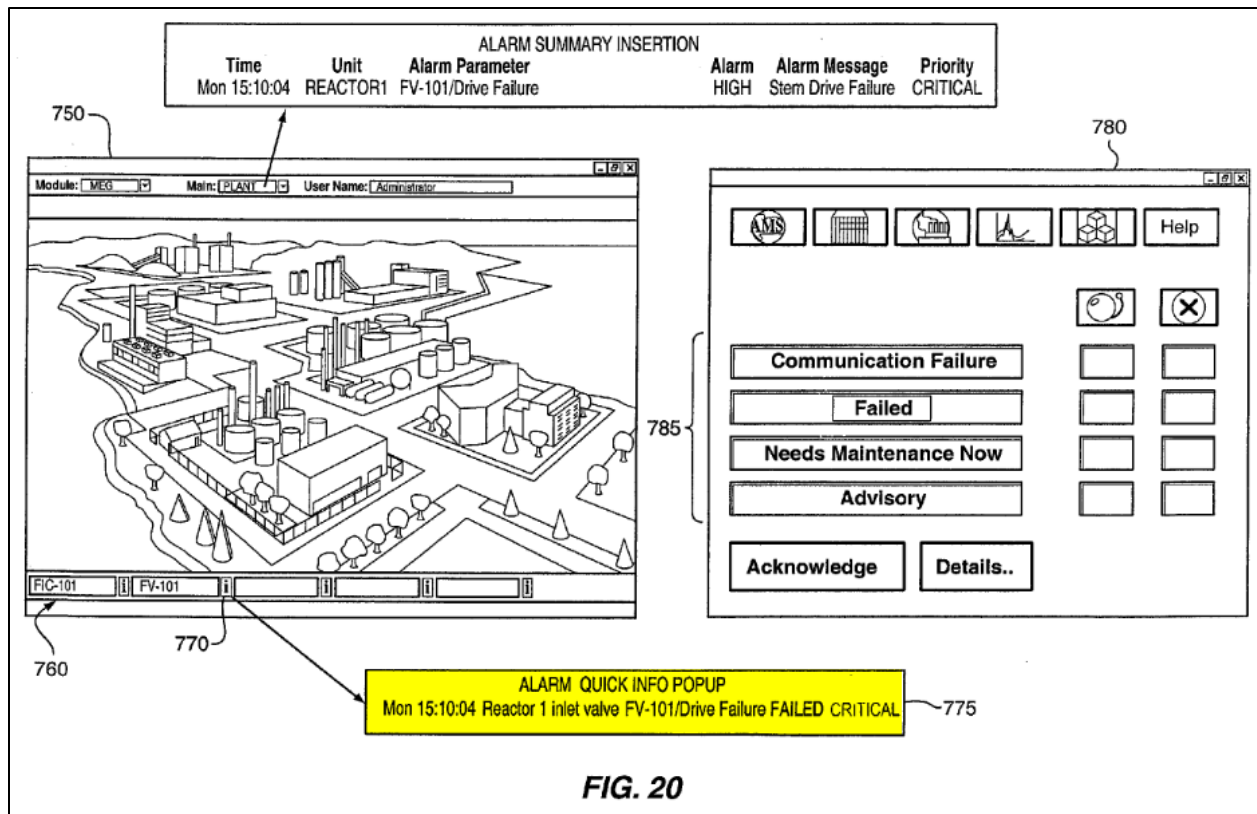


Id., Fig. 18 (color added).

- d. “obtaining additional information regarding the at least one control application using a second view of the performance indicators.”

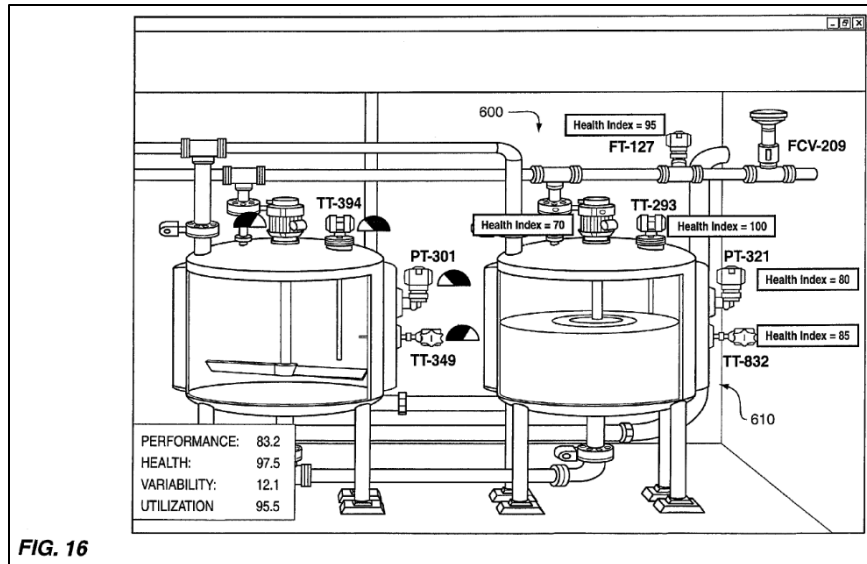
50. Eryurek discloses this element. Continuing the discussion above (§§VI.A.1.b, VI.A.1.c), the user interface in Figure 20 provides additional information regarding the at least one control application (*e.g.*, FV-101) using a second view of the performance indicators (*e.g.*, pop-up 775). Ex. 1004, [0133], Fig. 20. Eryurek explains that “each of the alarms within the banner 760 may also include an information button 770, which may be selected by a user to generate a pop-up window 775 containing more detailed information relating to that particular alarm.”

Id.

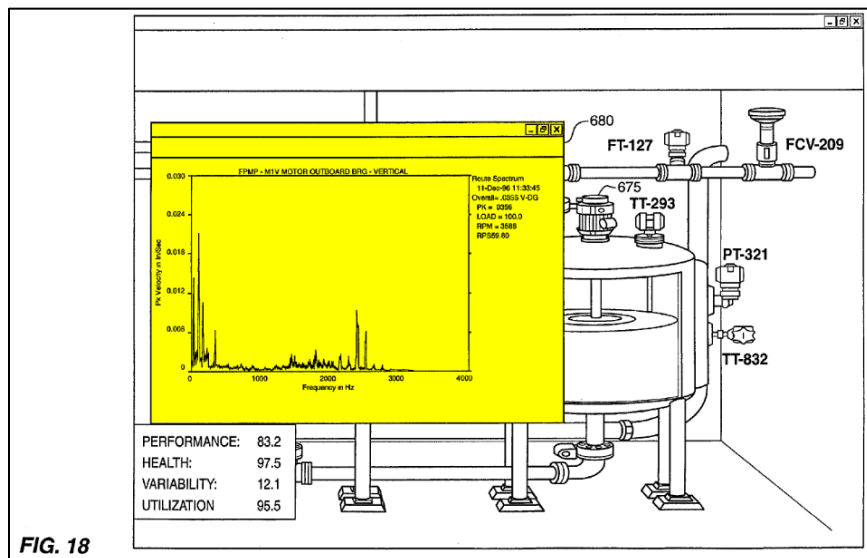


Id., Fig. 20 (color added).

51. In addition, the user interface depicted in Figures 16 and 18 obtains additional information (*e.g.*, vibration analysis) regarding the at least one control application (*e.g.*, motor 675) using a second view of the performance indicators (*e.g.*, Fig. 18's vibration analysis window shown in yellow below). Ex. 1004, [0129]-[0130], [0132], Figs. 16, 18. Eryurek explains "[a] user may request such a pop-up window in response to an abnormally high or an abnormally low index value for the unit affected by the motor 675 and/or may request the window if an index value associated with the motor is indicative of a possible problem." *Id.*, [0132].



Id., Fig. 16.



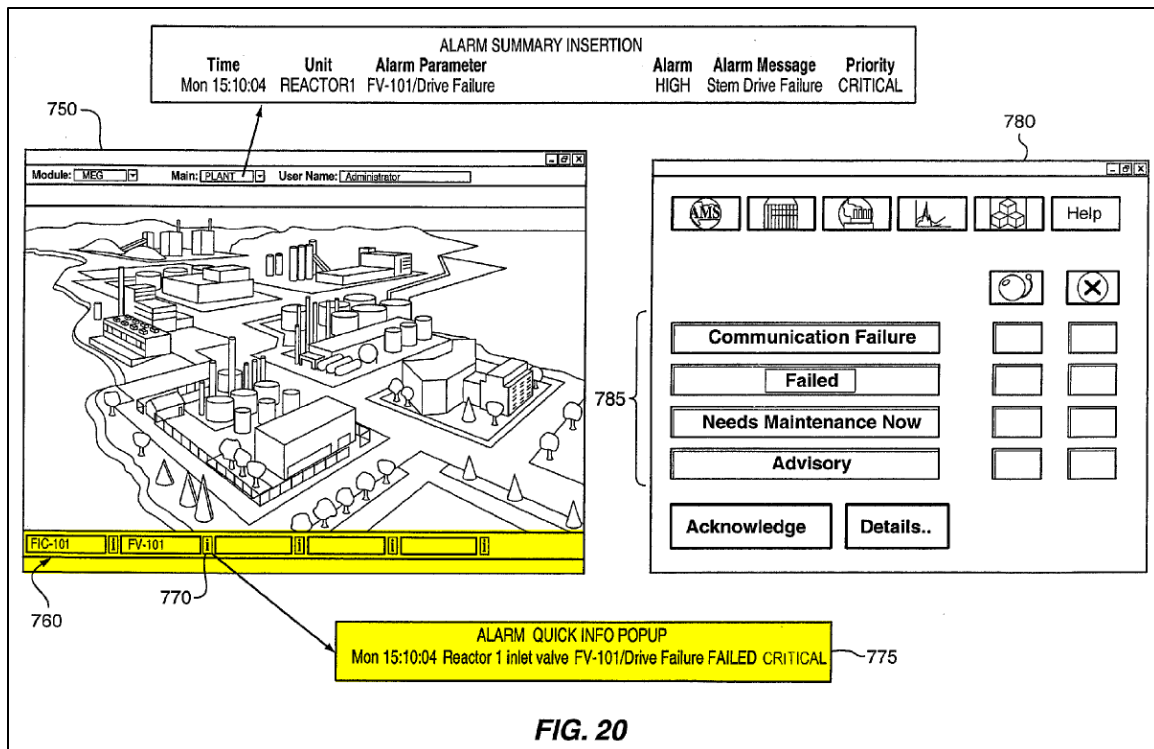
Id., Fig. 18 (color added).

2. Claim 4

- a. “4. The method of claim 1, wherein the first view is a summary view of the performance indicators and the

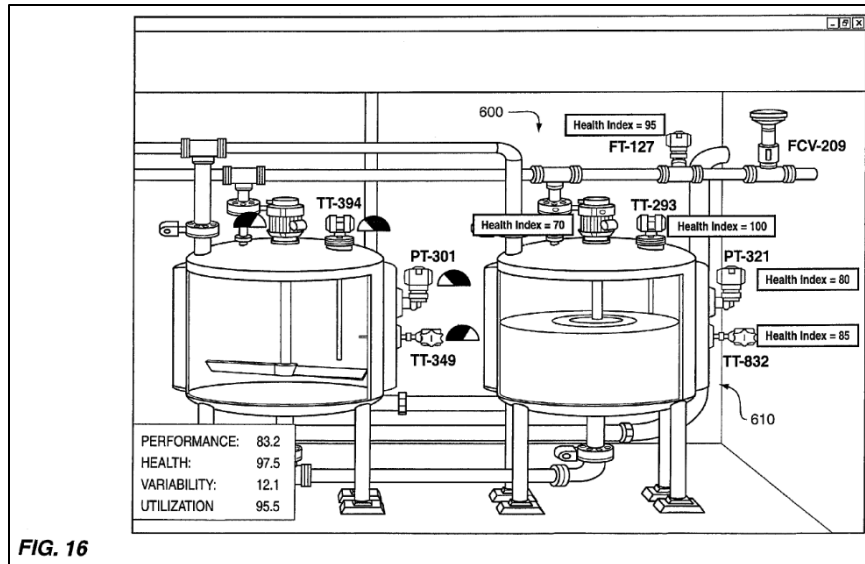
second view is a more detailed view of the performance indicators.”

52. Eryurek discloses this element. Continuing the discussion above (§VI.A.1), the banner 760 constitutes a first view of the performance indicators which is a summary view of the performance indicators. Ex. 1004, [0133], Fig. 20. In addition, the pop-up window 775 is a second view which is a more detailed view of the performance indicators. Eryurek explains that “[a] high level graphical view 750 of the plant 10 may include an alarm banner 760 having one or more pending alarms” and “each of the alarms within the banner 760 may also include an information button 770, which may be selected by a user to generate a pop-up window 775 containing more detailed information relating to that particular alarm.”
Id.

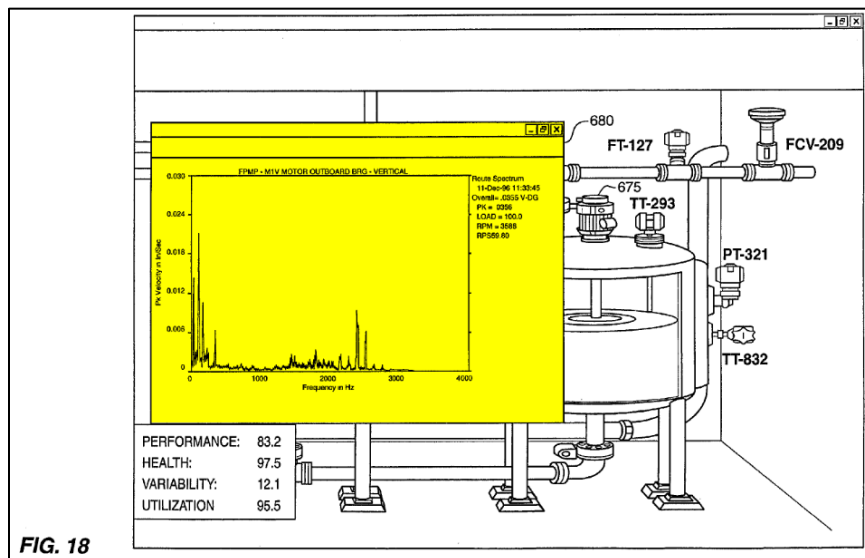


Id., Fig. 20 (color added).

53. In addition, Figures 16 and 18 depict the claimed first and second views, respectively. For example, “FIG. 16 is an exemplary graphical display that may be provided by a graphical user interface to enable a user to analyze the operational status and performance of a process area within a plant” and “FIG. 18 is an exemplary depiction of a display that may be provided by a graphical user interface to enable a user to perform a more detailed analysis of data used to generate one or more indexes for a device.” Ex. 1004, [0031], [0033], Figs. 16, 18. Therefore, Figure 16 is a first view which is a summary view of the performance indicators, and the vibration analysis window (yellow) in Figure 18 is a second view is a more detailed view of the performance indicators. *Id.*, [0129]-[0130], [0132], Figs. 16, 18.



Id., Fig. 16.



Id., Fig. 18 (color added).

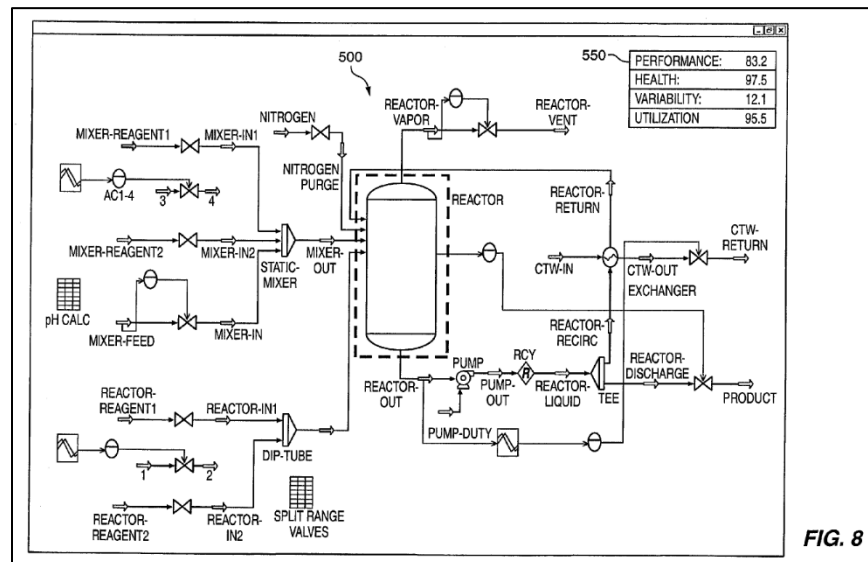
3. Claim 15

- a. “15. The method of claim 1, further including displaying a mechanical view of the environmental control network.”

54. Eryurek discloses this element. Continuing the discussion above (§VI.A.1), the user interface of Eryurek displays a mechanical view, as shown in,

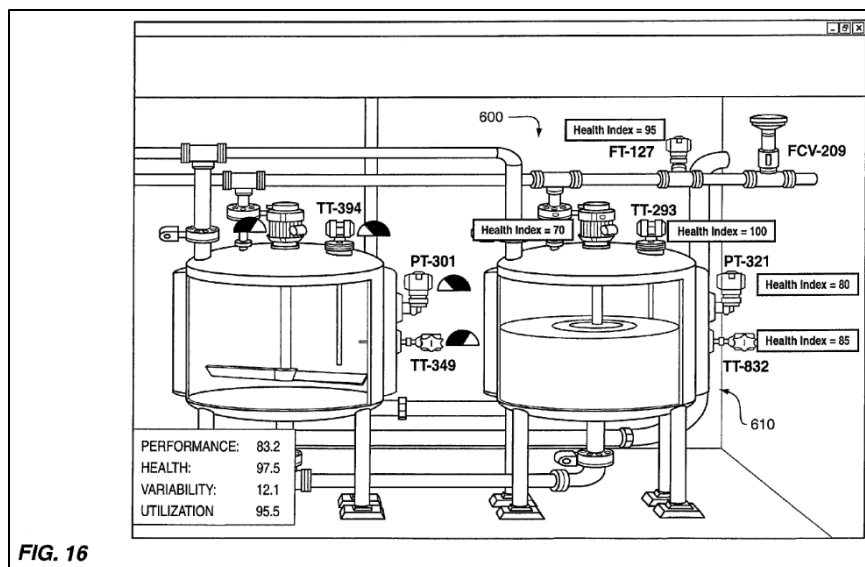
for example, in Figures 8, 16, and 25. Ex. 1004, [0023], [0031], [0038]. Each of these views shows a mechanical system layout.

55. Considering Figure 8, for example, “a plurality of devices such as, for example, valves, pumps, temperature transmitters, etc.” is shown, and the figure “include[s] lines arrows, and any other indicia to represent logical and physical interconnections between the various devices.” Ex. 1004, [0113], Fig. 8.



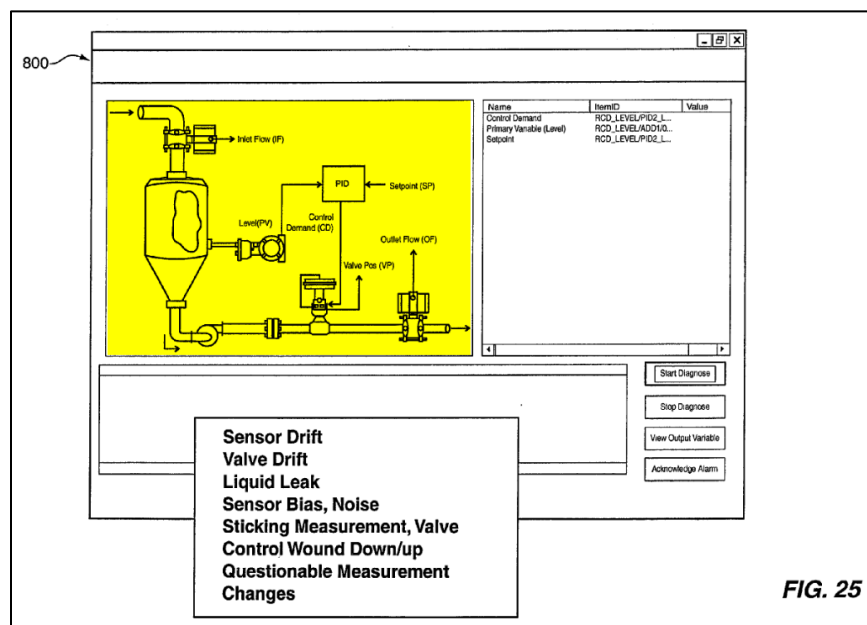
Id., Fig. 8.

56. Likewise, Figure 16 “depict[s] the physical equipment (and the interconnections therebetween).” Ex. 1004, [0129], Fig. 16.



Id., Fig. 16.

57. In addition, Figure 25 depicts various mechanical equipment (yellow) and their mechanical relationships. Ex. 1004, Fig. 25.



Id. (color added).

58. As discussed above (§VI.A.1.a), these views are of an environmental control network (*e.g.*, controlling the environment in reactors, tanks, boilers, furnaces, *etc.*). Furthermore, applying Eryurek to different environmental control networks would have been obvious to a POSITA.

4. Claim 21

- a. “21. A computer program product for analyzing performance of control applications in an environmental control network, the program product in combination with and embodied on a computer-readable medium and comprising machine-readable program code for causing, when executed, one or more machines to perform the following method steps:”

59. Eryurek discloses this element. As discussed above (§VI.A.1.a), Eryurek teaches a method for analyzing performance of control applications in an environmental control network. Moreover, applying Eryurek to other environmental control networks would have been obvious to a POSITA. *See* §VI.A.1.a.

60. Eryurek’s functionality is performed using a computer program product. For example, Eryurek discloses that “[w]hen implemented in software, the software routine may be stored in any computer readable memory.” Ex. 1004, [0159]. “Likewise, this software may be delivered to a user or a process control plant via any known or desired delivery method including, for example, on a computer readable disk or other transportable computer storage mechanism or over a communication channel such as a telephone line, the internet, *etc.*” *Id.* As such,

Eryurek discloses a computer program product (*e.g.*, software) for analyzing performance of control applications in an environmental control network (as discussed above, §VI.A.1.a), the program product in combination with and embodied on a computer-readable medium (*e.g.*, computer readable memory) and comprising machine-readable program code (*e.g.*, software or software routine) for causing, when executed, one or more machines to perform Eryurek’s functionality.

- b. “displaying performance indicators for the control applications using a first view that allows at least one control application exhibiting degraded performance to be identified; and”

61. Eryurek discloses this element. This element is the same first view functionality I discuss above with respect to Claim 1, where the user interface displays performance indicators for the control applications using a first view that allows at least one control application exhibiting degraded performance to be identified. See §VI.A.1.c.

- c. “displaying performance indicators using a second view that provides additional details regarding the performance of the at least one control application.”

62. Eryurek discloses this element. This element is the same second view functionality I discuss above with respect to Claim 1, where the user interface displays performance indicators using a second view that provides additional details regarding the performance of the at least one control application. *See* §VI.A.1.d.

5. Claim 24

- a. “24. The program product of claim 21, wherein the first view is a summary view of the performance indicators and the second view is a more detailed view of the performance indicators.”

63. Eryurek discloses this element. As I discuss above (§VI.A.2), the first view is a summary view of the performance indicators and the second view is a more detailed view of the performance indicators.

6. Claim 37

- a. “37. The program product of claim 21, the program code causes a control diagram view of the environmental control network to be displayed.”

64. Eryurek discloses this element. Continuing the discussion above (§§VI.A.1, VI.A.4), Eryurek teaches program code to display various views. Some of these views displayed by the user interface include a control diagram view, as shown in, for example, in Figures 8, 16, and 25. Ex. 1004, [0023], [0031], [0038]. Each of these views includes a control diagram view.

65. Considering Figure 8, for example, “process control system” is shown including various valves and other control features. Ex. 1004, [0113], Fig. 8. As highlighted in the annotated figure below, Figure 8 includes (a) a control valve system (yellow) for purging the reactor with nitrogen (an environmental control), (b) a venting control (blue) including a venting valve (red) coupled to a controller (purple) for venting the reactor based on vapor (another environmental control), and

(c) a pump control (green) for draining liquid from the reactor (another environmental control).

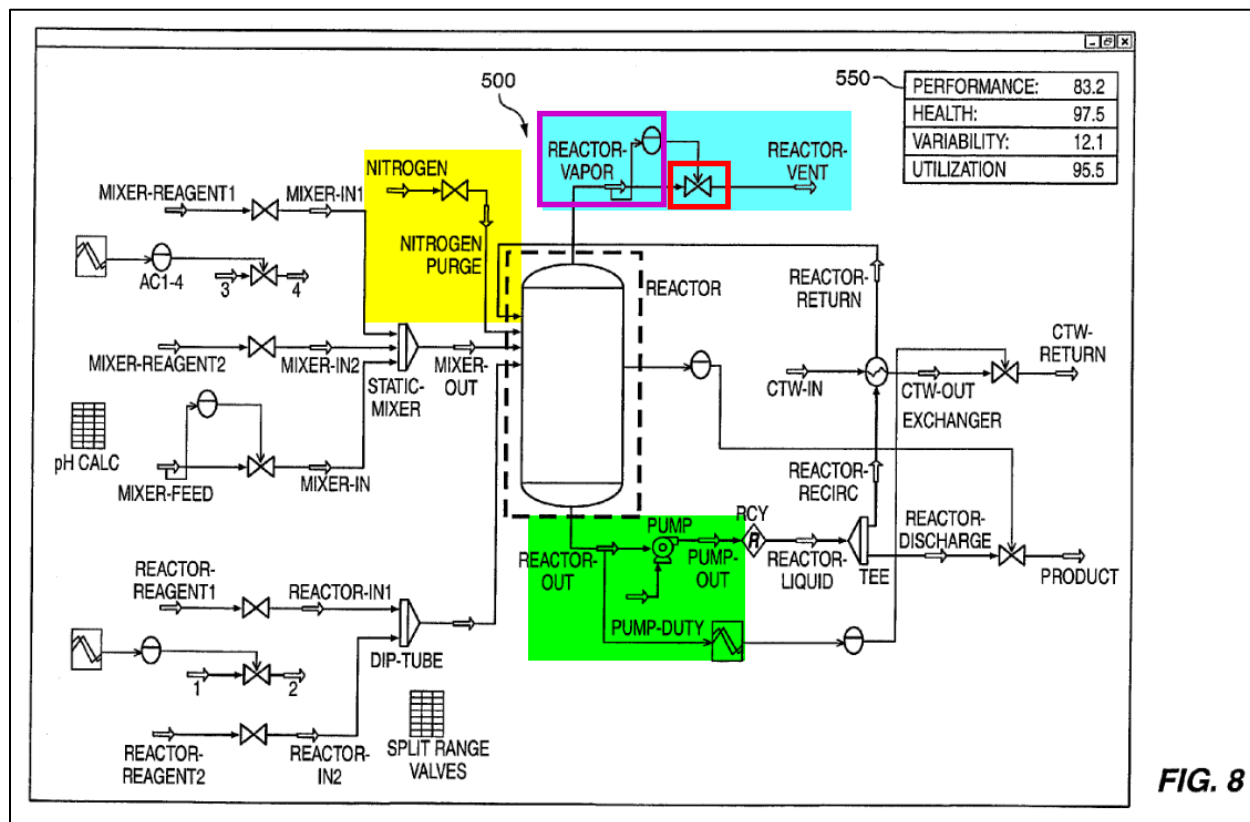
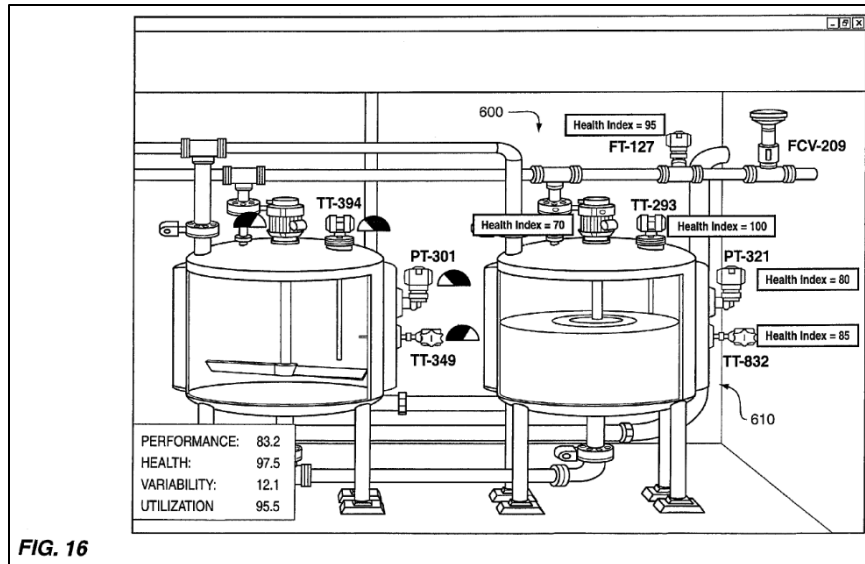


FIG. 8

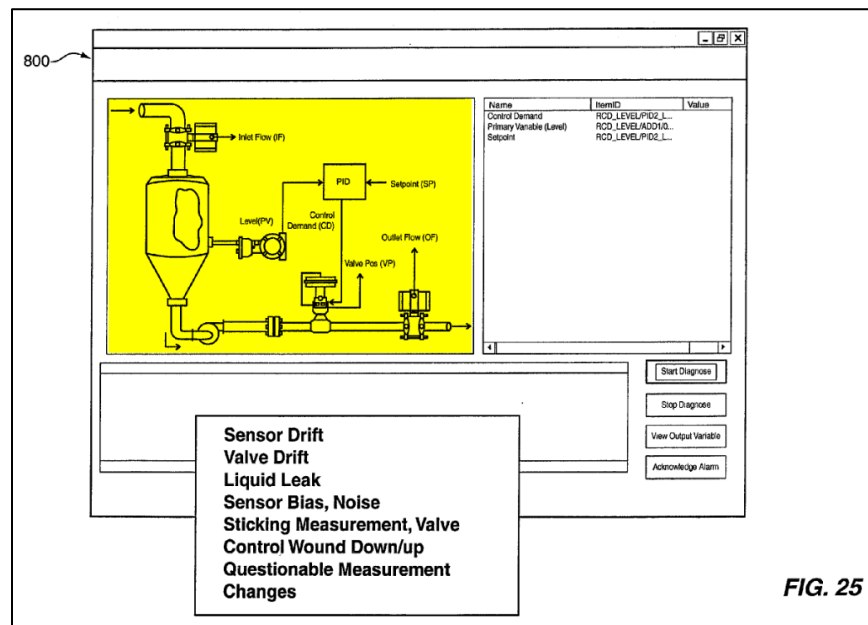
Id., Fig. 8 (color added).

66. Similarly, Figure 16 “depict[s] the physical equipment (and the interconnections therebetween),” which again includes various control elements such as motors and valves.



Ex. 1004, Fig. 16.

67. In addition, Figure 25 depicts various mechanical equipment (yellow), including a PID controller using data from a tank level sensor to control a valve based on a setpoint. Ex. 1004, Fig. 25.



Id. (color added).

68. As discussed above (§VI.A.1.a), these views are of an environmental control network (*e.g.*, controlling the environment in reactors, tanks, boilers, furnaces, *etc.*). Moreover, applying Eryurek to a different environmental control network would have been obvious to a POSITA. *See* §VI.A.1.a

7. Claim 39

- a. “39. A method for diagnosing performance of control applications in an environmental control network, comprising:”

69. Eryurek discloses this element. As discussed above (§VI.A.1.a), Eryurek describes a method for analyzing performance of control applications in an environmental control network. This analysis is done to diagnose issues. In describing the background of control process systems, Eryurek states that “[t]hese process control operators may use available tools for ***diagnosing*** and correcting process control problems within a process control system, including, for example, auto-tuners, loop analyzers, neural network systems, *etc.*” Ex. 1004, [0006].

70. Additionally, Eryurek describes that “a user may request device status information from a pop-up window such as the pop-up window 780 shown in FIG. 20. This detailed status information may provide one or more possible diagnoses of problems that may be responsible for the alarm condition (*i.e.*, failed communication, failed device, needs maintenance now, advisory, *etc.*).” Ex. 1004, [0134]. “FIGS. 21-24 are exemplary depictions of displays that may be provided by

the GUI in response to a user's further investigation of an alarm, alert or any other event associated with, for example, a device.” *Id.* For example, “in FIG. 24, a user may request detailed help from any status window. This detailed help may provide step by step instructions to guide the user or some other person in rectifying the problem diagnosed by the system.” *Id.*

- b. receiving at least one performance indicator for each control application;

71. See §VI.A.1.b.

- c. identifying at least one control application exhibiting degraded performance using a first view of the performance indicators; and

72. See §VI.A.1.c.

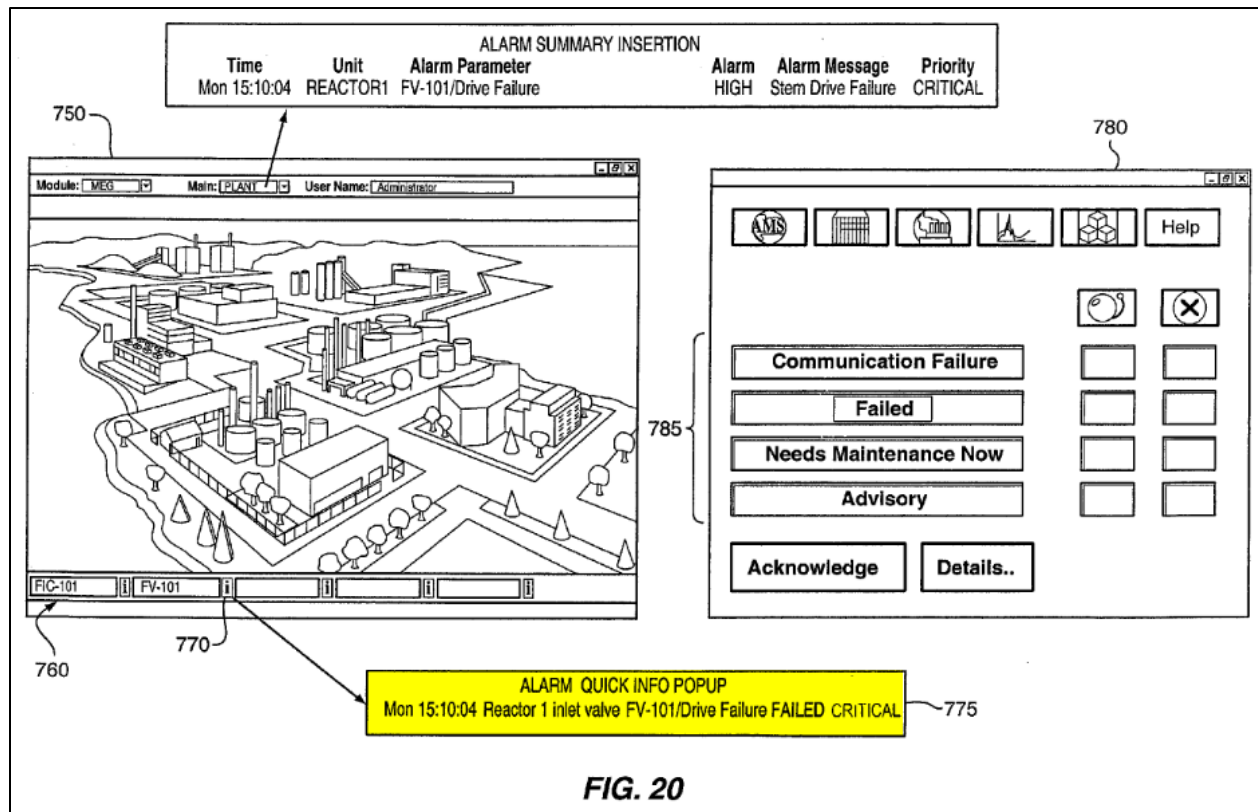
- d. obtaining additional information regarding the at least one control application using a second view of the performance indicators,

73. See §VI.A.1.d.

- e. the second view providing additional information on the at least one control application to permit a diagnosis of a possible cause of the degraded performance.

74. Eryurek discloses this element. Continuing with the discussion above (§VI.A.1.d), each of the second views provides additional information on the at least one control application to permit a diagnosis of a possible cause of the degraded performance. For example, “a user may request device status information from a *pop-up window* such as the pop-up window 780 shown in FIG. 20. *This detailed*

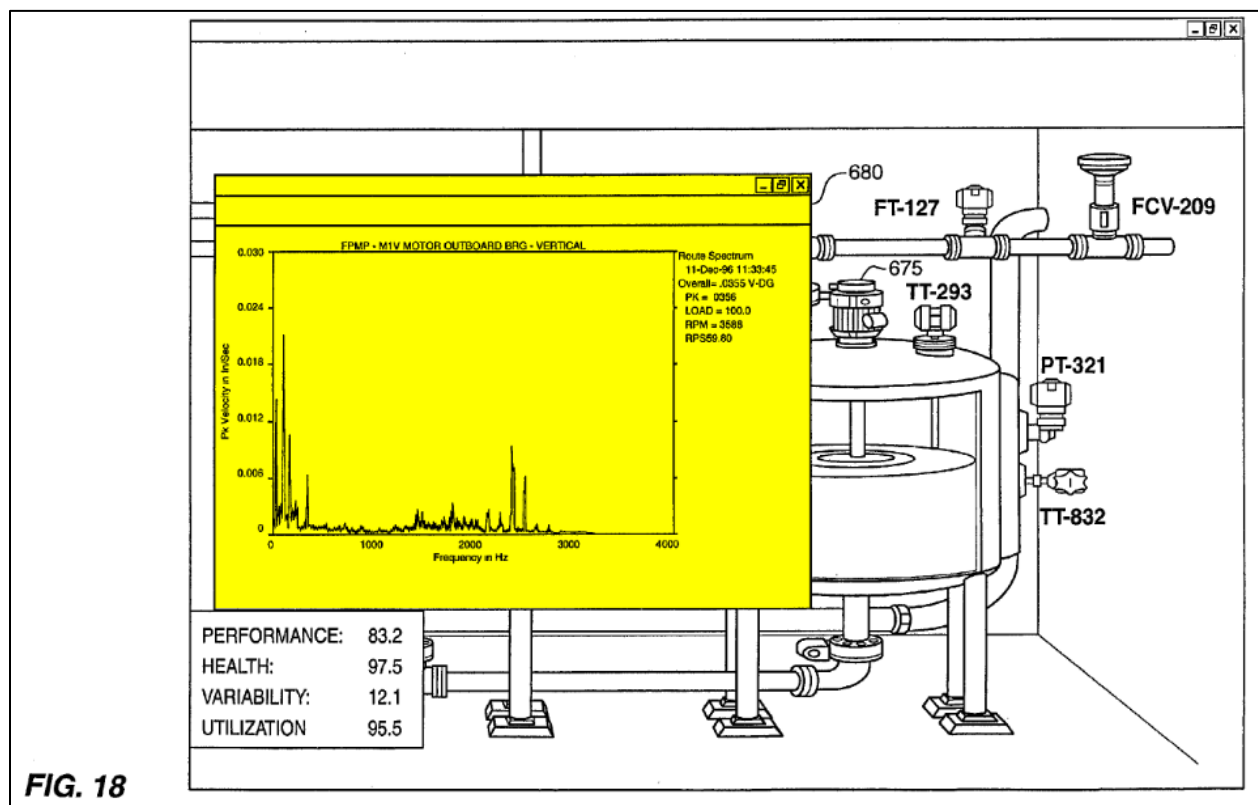
status information may provide one or more possible diagnoses of problems that may be responsible for the alarm condition (i.e., failed communication, failed device, needs maintenance now, advisory, etc.).” Ex. 1004, [0134]. Accordingly, the pop-up window 775 is a second view providing additional information on the process control application (e.g., FV-101) which is exhibiting degraded performance (e.g., alarm state) to permit a diagnosis of a possible cause of the degraded performance (e.g., “possible diagnoses of problems”).



Id., Fig. 20 (color added).

75. Additionally, as discussed above (§VI.A.1.d), Figure 18’s vibration analysis window (yellow) is a second view of the performance indicators. Ex. 1004,

[0129]-[0130], [0132], Figs. 16, 18. “A user may request such a pop-up window in response to an abnormally high or an abnormally low index value for the unit affected by the motor 675 and/or may request the window if an index value associated with the motor is indicative of a possible problem.” *Id.*, [0132]. A POSITA would have recognized that one reason to look at a vibration diagram in response to an abnormal state is to diagnose the problem. In fact, Eryurek explains using the vibration analysis to diagnose problems (*e.g.*, imbalance, misalignment, looseness, bearing wear). *Id.*, Figs. 28-31, [0132], [0139]



Id., Fig. 18 (color added).

8. Claim 42

- a. “42. The method of claim 39, wherein the first view is a summary view of the performance indicators and the second view is a more detailed view of the performance indicators.”

76. See §VI.A.2.a.

9. Claim 53

- a. “53. The method of claim 39, further including displaying a mechanical view of the environmental control network.”

77. See §VI.A.3.a.

B. The Challenged Claims are Obvious over Ridolfo in View of the Level of Skill in the Art

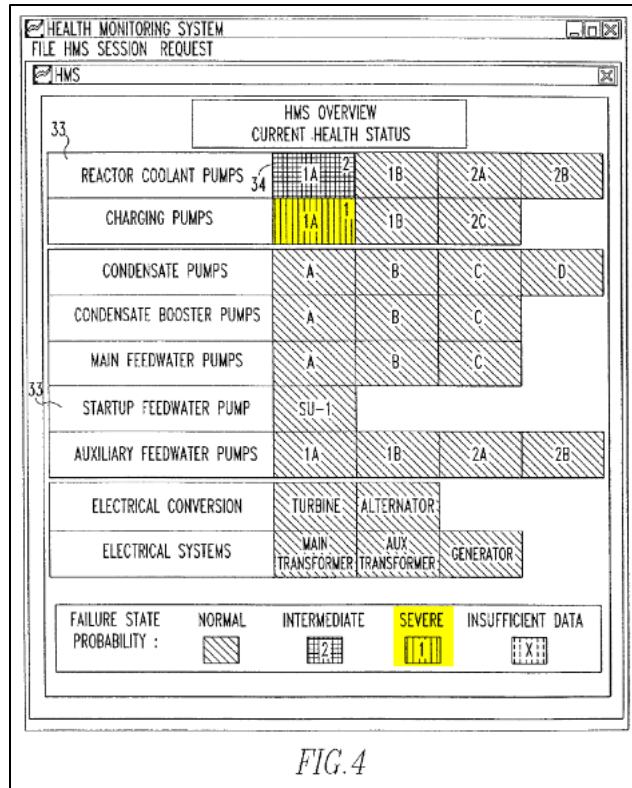
78. It is my opinion that Ridolfo renders obvious claims 1, 4, 15, 21, 24, 37, 39, 42, and 53 of the '880 Patent.

1. Claim 1

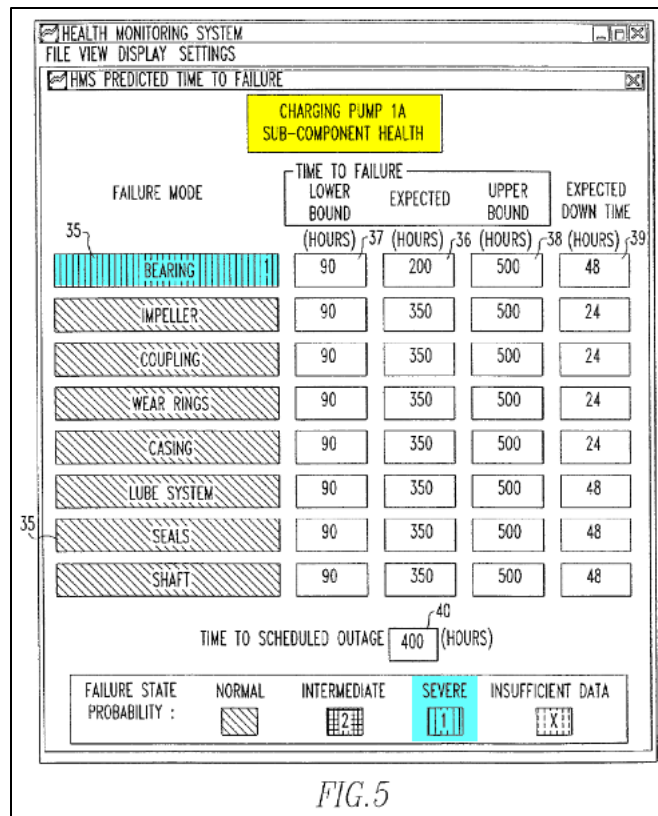
- a. “1. A method for analyzing performance of control applications in an environmental control network, comprising:”

79. Ridolfo discloses this element. Ridolfo describes “[a] three-tier hierarchy of displays provide *details on the health status* of the components and systems displayed on the enterprise wide level display in a manner that supports a logical drill down to the health status of sub-components on Tier 1 to expected faults of the sub-components on Tier 2 to specific information relative to expected sub-component failures on Tier 3.” Ex. 1005, Abstract.

80. For example, Ridolfo teaches an overview (with capability to drill down) on various systems. Ridolfo explains that “FIG. 4 illustrates the interactive display 16 for the Apex-level overall (plant-wide) health status page. ... Each plant component or system 33 that is being monitored for health status is indicated on the display by a uniquely identified box. The corresponding health status 34 for each component is designated on the display via color-coding of its corresponding box and by use of a numeric designator that is placed within a corner of the box.” Ex. 1005, [0104]. The ’880 Patent similarly provides an example of a control application as “an HVAC control loop controlling some HVAC process variable such as temperature or pressure [that] is designed to maintain the process variable at a setpoint.” Ex. 1001, 5:38-43. Likewise, the Charging Pump 1A includes a control application controlling variables of the Pump’s operation (i.e., health status). For example, Ridolfo depicts Charging Pump 1A as in a severe health state in Figure 4, while the additional detail in Figure 5 indicates a problem with the bearings of the Charging Pump. Ex. 1005, Fig. 4, [0104]-[0112].



Id., Fig. 4 (color added).



Id., Fig. 5 (color added).

81. Ridolfo also describes the method as applied to an environmental control network. In particular, Ridolfo describes environmental systems associated with controlling the environment inside a nuclear reactor by, for example, coolant and charging pumps.¹ Ex. 1005, [0059]. The '880 Patent broadly states that “[t]he controlled environment may be a room, hallway, building, a portion thereof, or *any*

¹ Coolant and charging pumps are used in reactor environmental systems. *See* Ex. 1008.

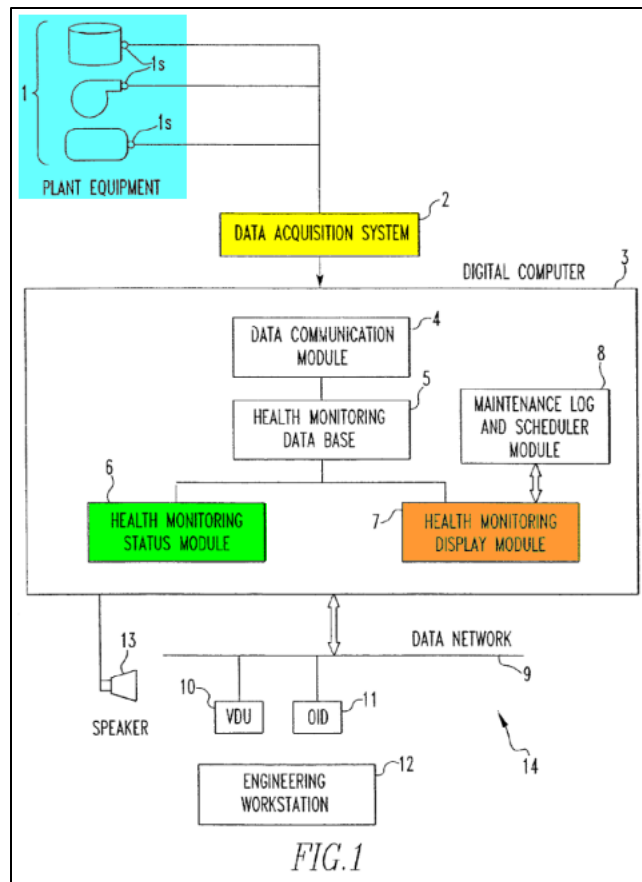
other internal environment.” Ex. 1001, 5:64-66. A nuclear reactor is an internal environment.

82. Furthermore, Ridolfo also explains that “[t]he exemplary complex plant to which the Health Monitoring Display System is applied [to] a nuclear power plant. However, it will be apparent that the invention has application to other types of complex plants.” Ex. 1005, [0059]. A POSITA would have found it obvious to apply Ridolfo’s teachings to a different environmental control network than a nuclear reactor. Ridolfo relates to a tiered hierarchy for health status, allowing a user to have a broad overview and drill down into systems with degraded performance. *Id.*, Abstract. These teachings are applicable to environmental control systems generally. For example, the ’880 Patent states that the “environmental control network may be employed to control *temperature, fluid flow*, humidity, lighting, boilers, chillers, power, security and similar systems in the internal environment.” Ex. 1001, 1:16-22. Similarly, Ridolfo describes its “Health Monitoring Display System” as including “Sensors” that “record plant and plant process parameters (such as *temperatures, flow rates*, pressures, radiation levels, valve positions, pump rotation speeds, vibration levels, acoustic signatures, etc.).” Ex. 1005, [0027]. A POSITA would have found it obvious to implement the functionality of Ridolfo in an environmental control network, should the environmental control network of the claims be

determined to be different than that of Ridolfo, in order to provide similar monitoring functionality to such environment control networks.

- b. “receiving at least one performance indicator for each control application;”

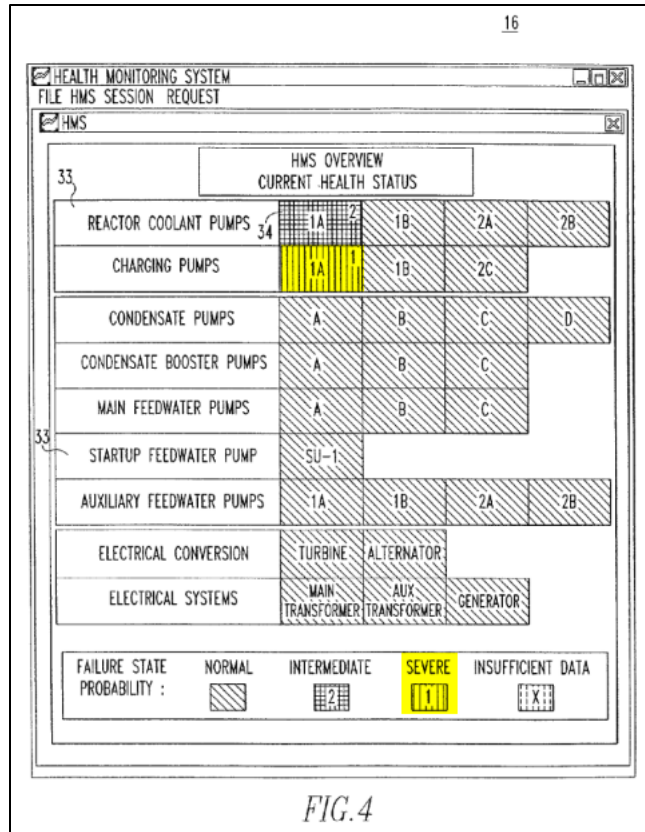
83. Ridolfo discloses this element. For example, Ridolfo describes a Data Acquisition System (yellow) to receive data from sensors located on plant equipment (blue), which is used by the Health Monitoring Status Module (green) to determine a health of a system (*i.e.*, control application), wherein the Health Monitoring Display Module (orange) then presents that health status to the user. Ex. 1005, [0027]-[0042], Fig. 1. The health status that is passed to the Health Monitoring Display Module constitutes receiving at least one performance indicator for each control application.



Id., Fig. 1.

- c. “identifying at least one control application experiencing degraded performance using a first view of the performance indicators; and;”

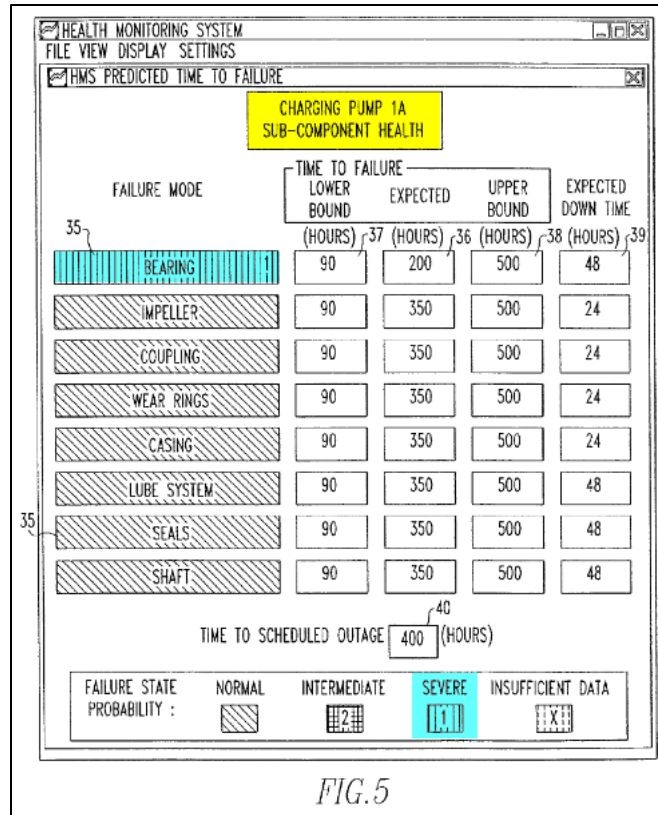
84. Ridolfo discloses this element. Continuing the discussion above (§VI.B.1.b), the Health Monitoring Display Module of Ridolfo displays the health status determined by the Health Monitoring Status Module. Ex. 1005, [0027]-[0042], Fig. 1. As shown in Figure 4, the user interface provided by the Health Monitoring Display Module identifies at least one control application experiencing degraded performance using a first view of the performance indicators (the apex view). *Id.*, [0104]-[0108].



Id., Fig. 4.

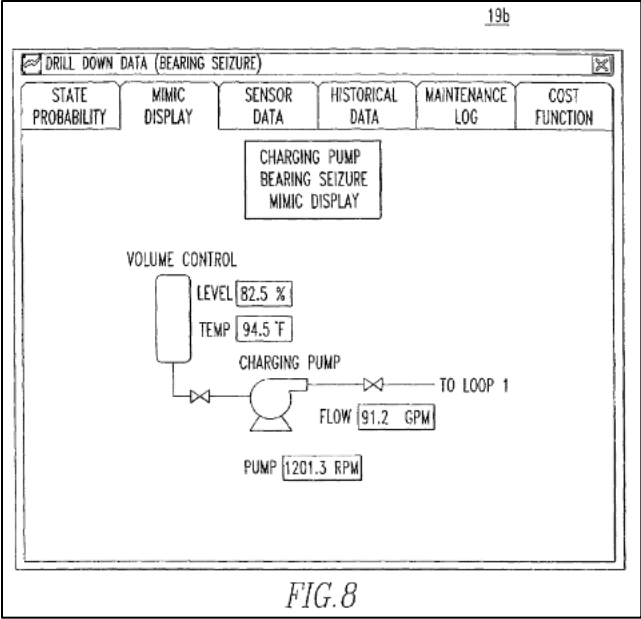
- d. “obtaining additional information regarding the at least one control application using a second view of the performance indicators.”

85. Ridolfo discloses this element. Continuing the discussion above (§VI.B.1.c), Ridolfo explains that the user interface allows a user to select the Charging Pumps and drill down to additional screens with additional information regarding the degraded performance. Ex. 1005, [0104]-[0112]. For example, one screen (Fig. 5) provides information indicating a problem with the bearings:

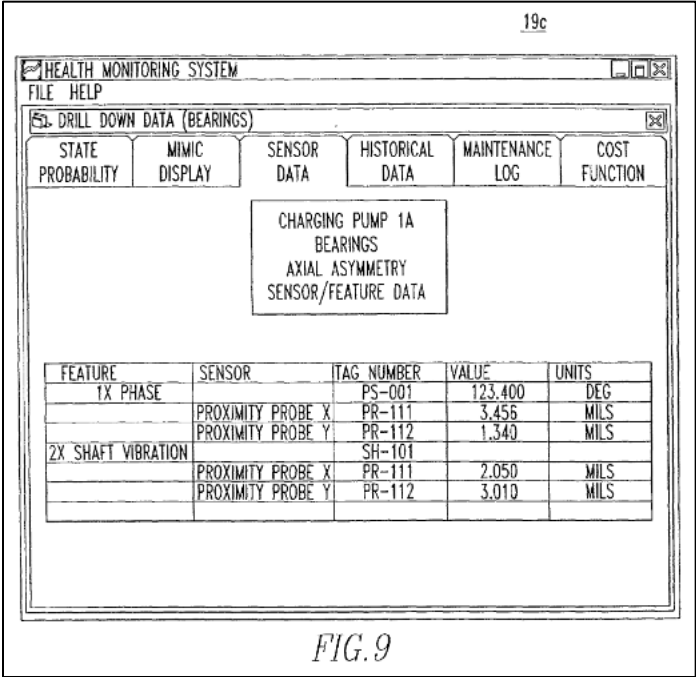


Id., Fig. 5 (color added).

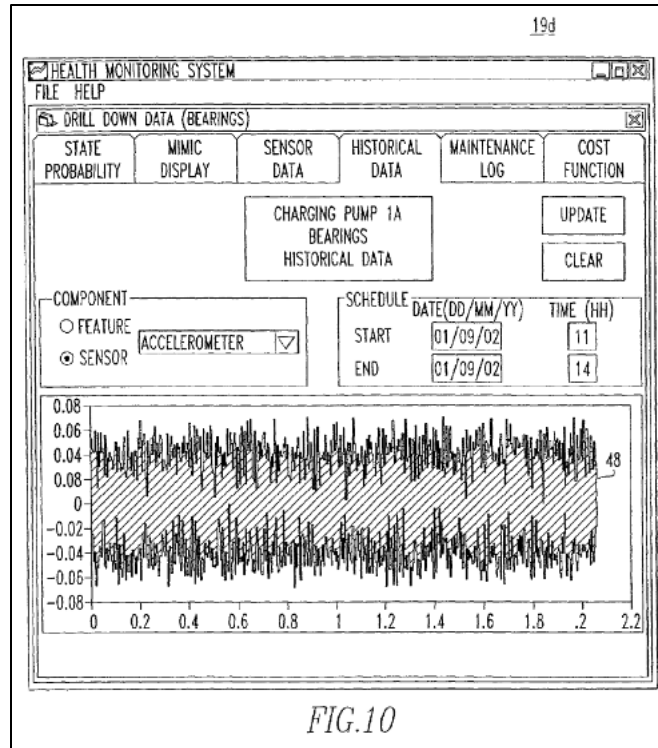
86. Likewise, more detailed information is available through other screens (*e.g.*, Figs. 8-10).



Ex. 1005, Fig. 8.



Id., Fig. 9.



Id., Fig. 10.

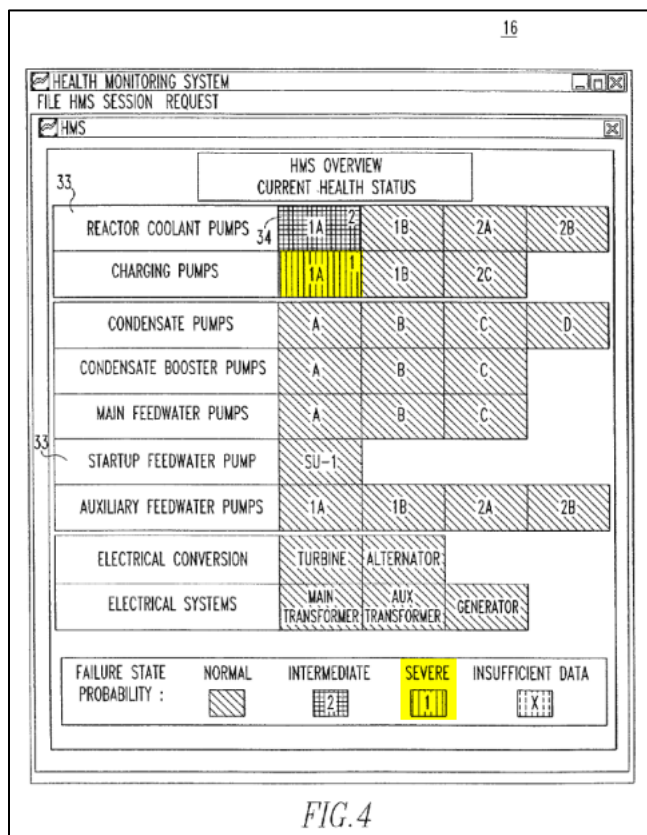
87. As such, the user interface of Ridolfo allows the user to obtain additional information regarding the at least one control application using a second view (*e.g.*, Figs. 5, 8, 9, or 10) of the performance indicators.

2. Claim 4

- a. “4. The method of claim 1, wherein the first view is a summary view of the performance indicators and the second view is a more detailed view of the performance indicators.”

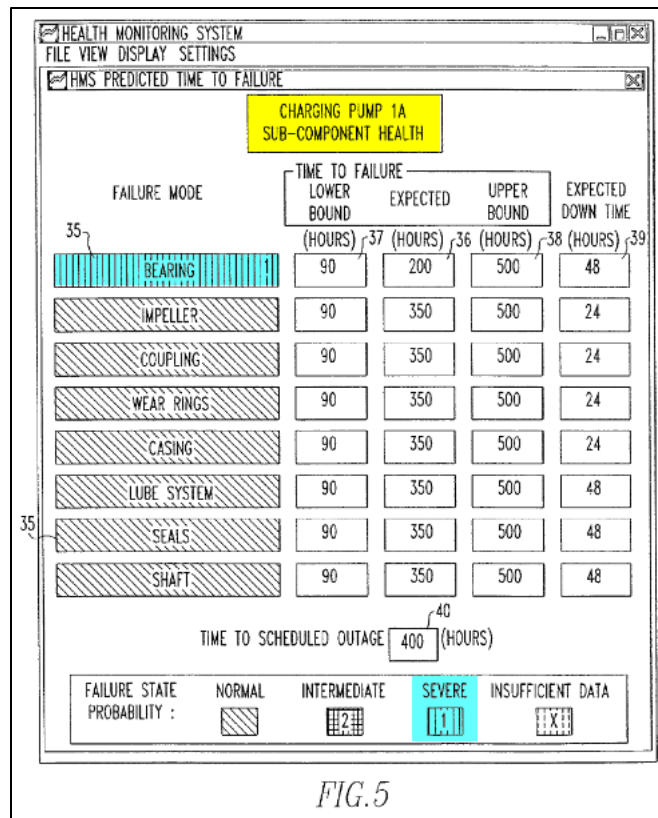
88. Ridolfo discloses this element. Continuing the discussion above (§§VI.B.1.c, VI.B.1.d), Ridolfo discloses the first view (*e.g.*, Fig. 4) is a summary view of the performance indicators while the second view (*e.g.*, Figs. 5, 8, 9, or 10) is a more detailed view of the performance indicators.

89. For example, Ridolfo explains that “[t]he format and design of the overall health status summary page (Apex display) allows the enterprise level health status to be quickly ascertained” where Figure 4 (first view) depicts the “the Apex-level overall (plant-wide) health status page.” Ex. 1005, [0104]-[0112], [0135].



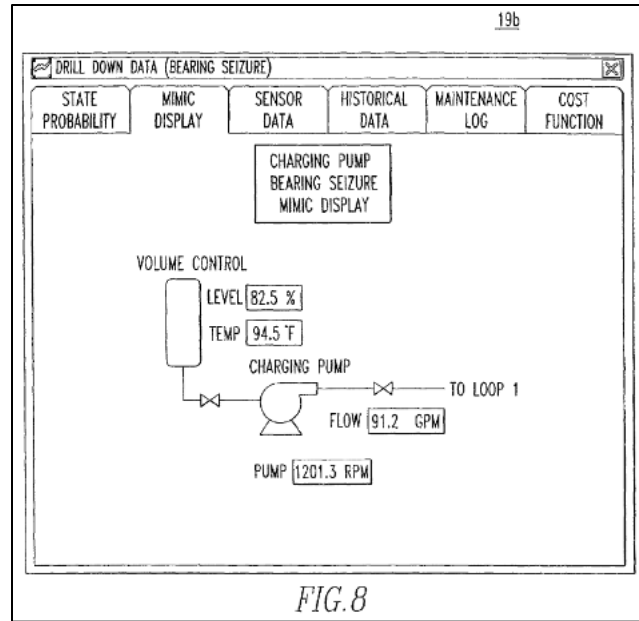
Id., Fig. 4 (color added).

90. Ridolfo discloses that Figure 5 (second view) is a more detailed view of the performance indicators (*e.g.*, Charging Pump 1A’s bearings in a severe health state). Ex. 1005, [0104]-[0112], Figs. 4-5.

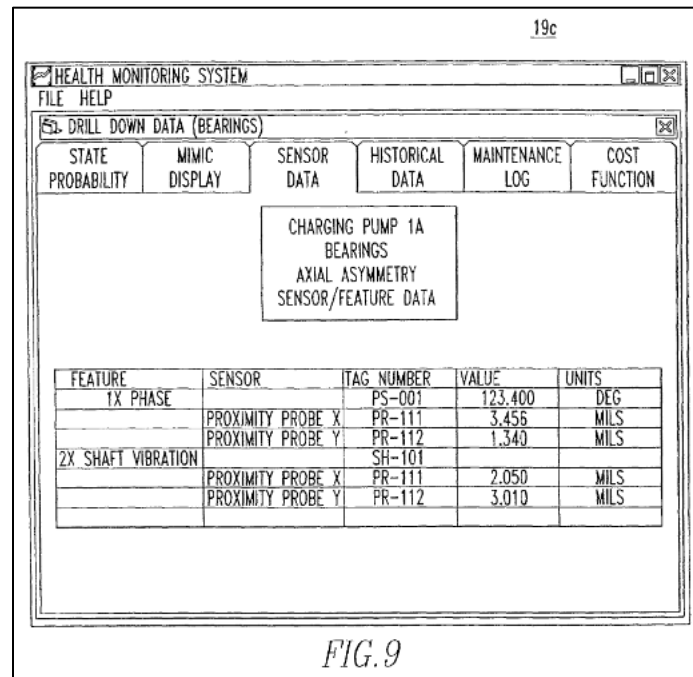


Id., Fig. 5 (color added).

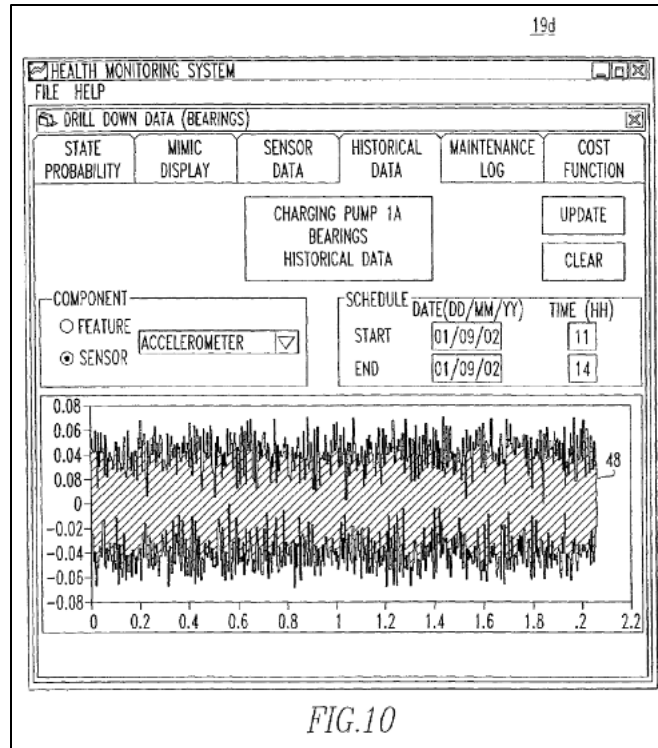
91. Similarly, additional second views (e.g. Figs. 8-10) “suppl[y] detailed low-level data which is used for analysis, diagnostics and repair planning purposes.” Ex. 1005, [0113], Figs. 8-10. Accordingly, Figs. 8-10 each represent second views which are more detailed view of the performance indicators.



Id., Fig. 8.



Id., Fig. 9.

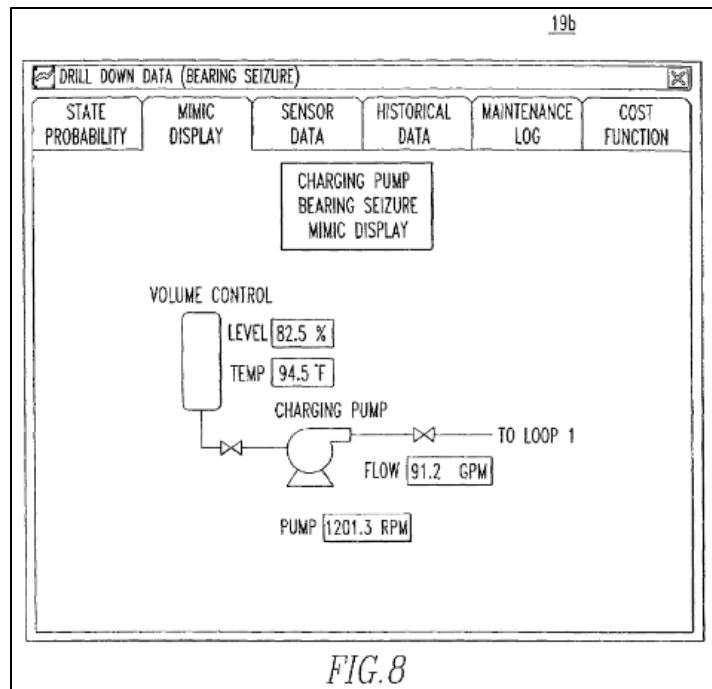


Id., Fig. 10.

3. Claim 15

- a. “15. The method of claim 1, further including displaying a mechanical view of the environmental control network.”

92. Ridolfo discloses this element. Continuing the discussion above (§VI.B.1), Ridolfo discloses that the user interface displays a mechanical view. The mechanical view is shown, for example, in the mechanical system layout of Figure 8. Ex. 1005, [0021], [0117]. Figure 8 shows a mechanical arrangement of components (*e.g.*, a tank connected to a charging pump to a loop) of the environmental control network (*e.g.*, the network controlling the reactor environment):



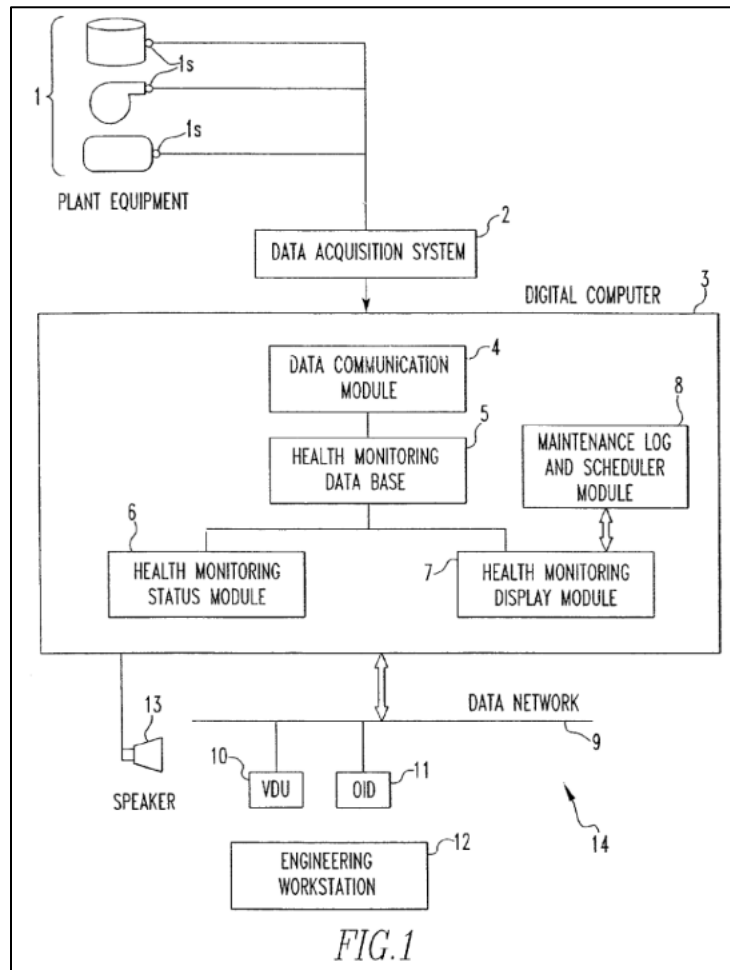
Id., Fig. 8.

4. Claim 21

- a. “21. A computer program product for analyzing performance of control applications in an environmental control network, the program product in combination with and embodied on a computer-readable medium and comprising machine-readable program code for causing, when executed, one or more machines to perform the following method steps:”

93. Ridolfo discloses this element. As discussed above (§VI.B.1.a), Ridolfo discloses a method for analyzing performance of control applications in an environmental control network. In addition, as noted above, applying Ridolfo to environmental control networks would have been obvious to a POSITA. *See* §VI.B.1.a.

94. Ridolfo's functionality is performed using a computer program product. For example, Ridolfo discloses a "digital computer" with "Video Display Units" and "Operator Input Devices" at "Engineering Workstations." Ex. 1005, [0027]-[0028], Fig. 1. Ridolfo provides extensive discussion of software modules to perform Ridolfo's teachings. *See, e.g., id.*, [0027]-[0035], Fig. 3.



Id., Fig. 1.

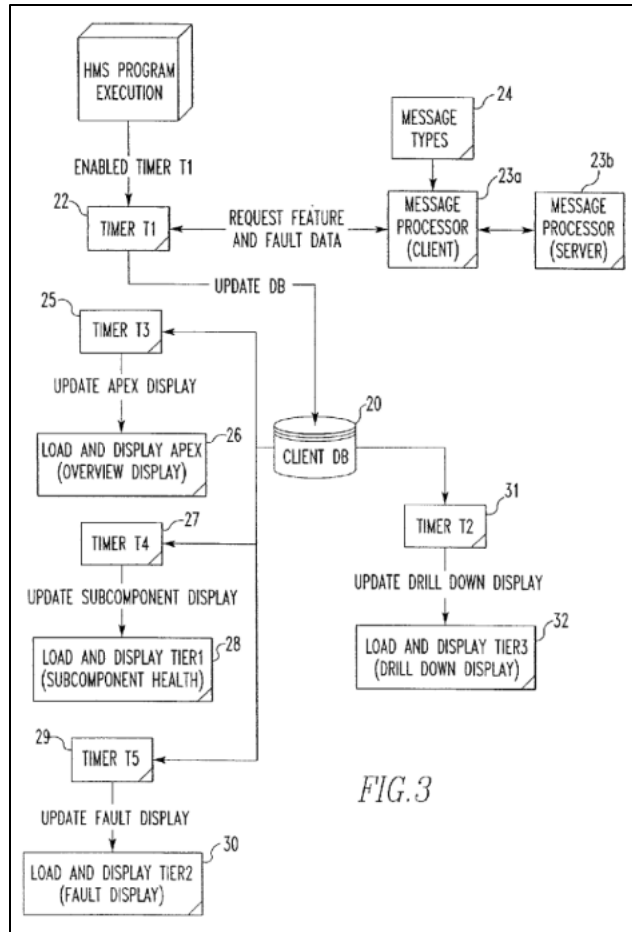


FIG. 3

Id., Fig. 3.

95. Accordingly, Ridolfo discloses a computer program product (*e.g.*, software) for analyzing performance of control applications in an environmental control network (as discussed above, §VI.B.1.a), the program product in combination with and embodied on a computer-readable medium (*e.g.*, computer) and comprising machine-readable program code (*e.g.*, software on a computer) for causing, when executed, one or more machines to perform Ridolfo's functionality.

96. To the extent it is considered that Ridolfo does not sufficiently disclose a computer program product for performing Ridolfo's functionality, the program

product in combination with and embodied on a computer-readable medium and comprising machine-readable program code for causing, when executed, one or more machines to perform Ridolfo's functionality, a POSITA would have found this element obvious, at the time of the claimed invention. Because Ridolfo teaches software for performing its functions, a POSITA would have considered it obvious to provide the software as a computer program product, so that the software could be distributed as a product. Further, a POSITA would have recognized that computers (*e.g.*, the computer and workstations of Ridolfo) comprise a computer-readable medium for storing machine-readable program code to perform operations (*i.e.*, software running on a computer). Simply put, it is not an invention to run software on a computer.

- b. “displaying performance indicators for the control applications using a first view that allows at least one control application exhibiting degraded performance to be identified; and”

97. Ridolfo discloses this element. This element is the same first view functionality as discussed above in Claim 1, where the user interface displays performance indicators for the control applications using a first view that allows at least one control application exhibiting degraded performance to be identified. *See* §VI.B.1.c.

- c. “displaying performance indicators using a second view that provides additional details regarding the performance of the at least one control application.”

98. Ridolfo discloses this element. This element is the same second view functionality as discussed above in Claim 1, where the user interface displays performance indicators using a second view that provides additional details regarding the performance of the at least one control application. *See* §VI.B.1.d.

5. Claim 24

- a. “24. The program product of claim 21, wherein the first view is a summary view of the performance indicators and the second view is a more detailed view of the performance indicators.”

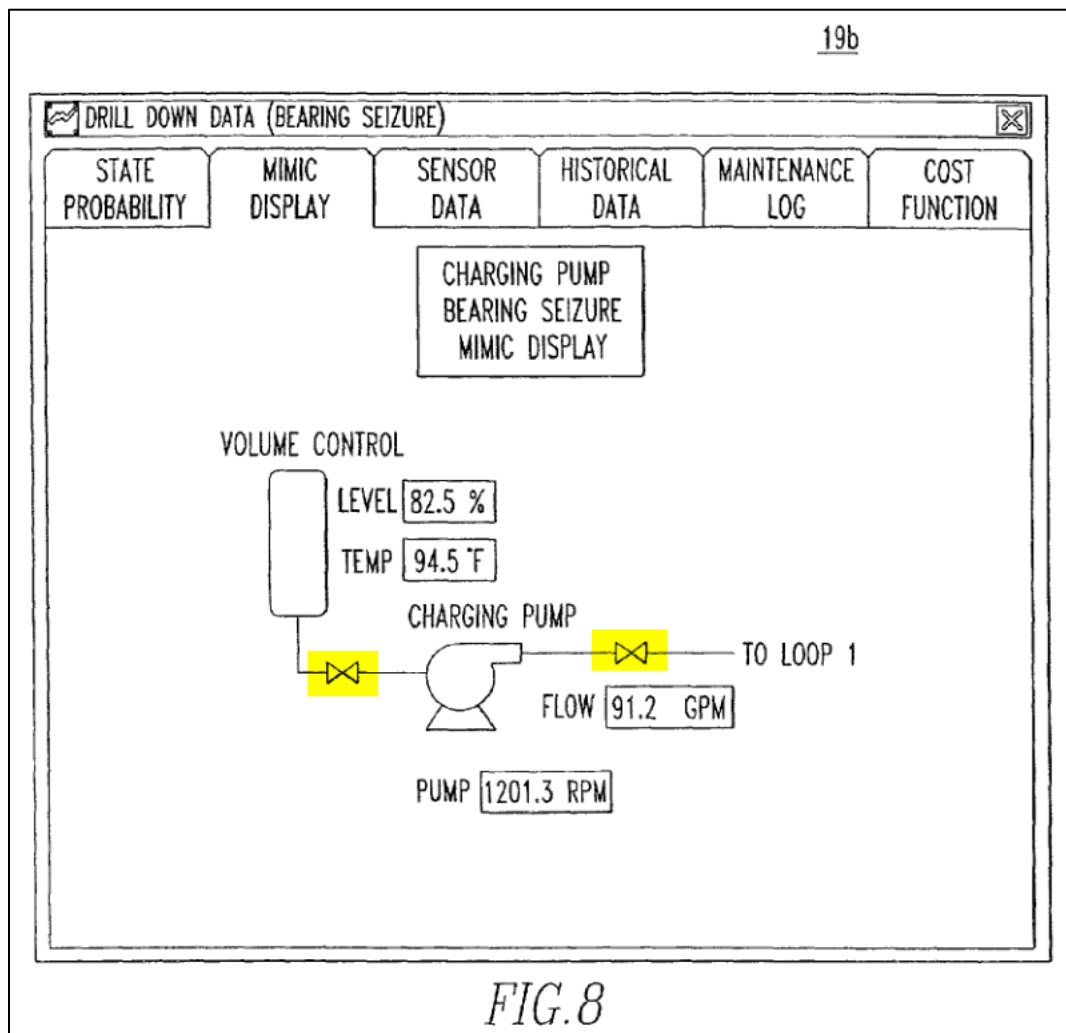
99. Ridolfo discloses this element. As discussed above (§VI.B.2), the first view of Ridolfo is a summary view of the performance indicators and each of the second views is a more detailed view of the performance indicators.

6. Claim 37

- a. “37. The program product of claim 21, the program code causes a control diagram view of the environmental control network to be displayed.”

100. Ridolfo discloses this element. Continuing the discussion above (§§VI.B.1, VI.B.4), Ridolfo teaches program code to display various views, and some which are displayed by the user interface include a control diagram view, as illustrated in Figure 8. Ex. 1005, [0021], [0117]. As shown, the control diagram view

includes various control components and their relations, such as valves (yellow) between the tank and charging pump and between the charging pump and loop.



Id., Fig. 8.

101. As discussed above (§VI.B.1.a), this view is of an environmental control network (*e.g.*, cooling system for a reactor). Moreover, applying Ridolfo to environmental control networks would have been obvious to a POSITA. *See* §VI.B.1.a.

7. Claim 39

- a. “39. A method for diagnosing performance of control applications in an environmental control network, comprising:”

102. Ridolfo discloses this element. As discussed above (§VI.B.1.a), Ridolfo discloses a method for analyzing performance of control applications in an environmental control network. This analysis is performed to diagnose issues, as explained by Ridolfo. For example, Ridolfo teaches a multi-tiered display where the upper level flags a problem (*e.g.* charging pumps in a severe health state) and lower levels are “used for analysis, *diagnostics* and repair planning purposes.” Ex. 1005, [0091]; *see also id.*, [0113], [0128], [0130], [0141], Fig. 2. Ridolfo describes numerous techniques that may be involved in the “incipient failure detection function” including “Trend Analysis,” “Pattern Recognition,” “Correlation Techniques,” “Data Comparison,” and other analyses. *Id.*, [0042]-[0083]. These techniques and analyses are manners of diagnosing the performance of the system.

- b. receiving at least one performance indicator for each control application;

103. *See* §VI.B.1.b.

- c. identifying at least one control application exhibiting degraded performance using a first view of the performance indicators; and

104. *See* §VI.B.1.c.

- d. obtaining additional information regarding the at least one control application using a second view of the performance indicators,

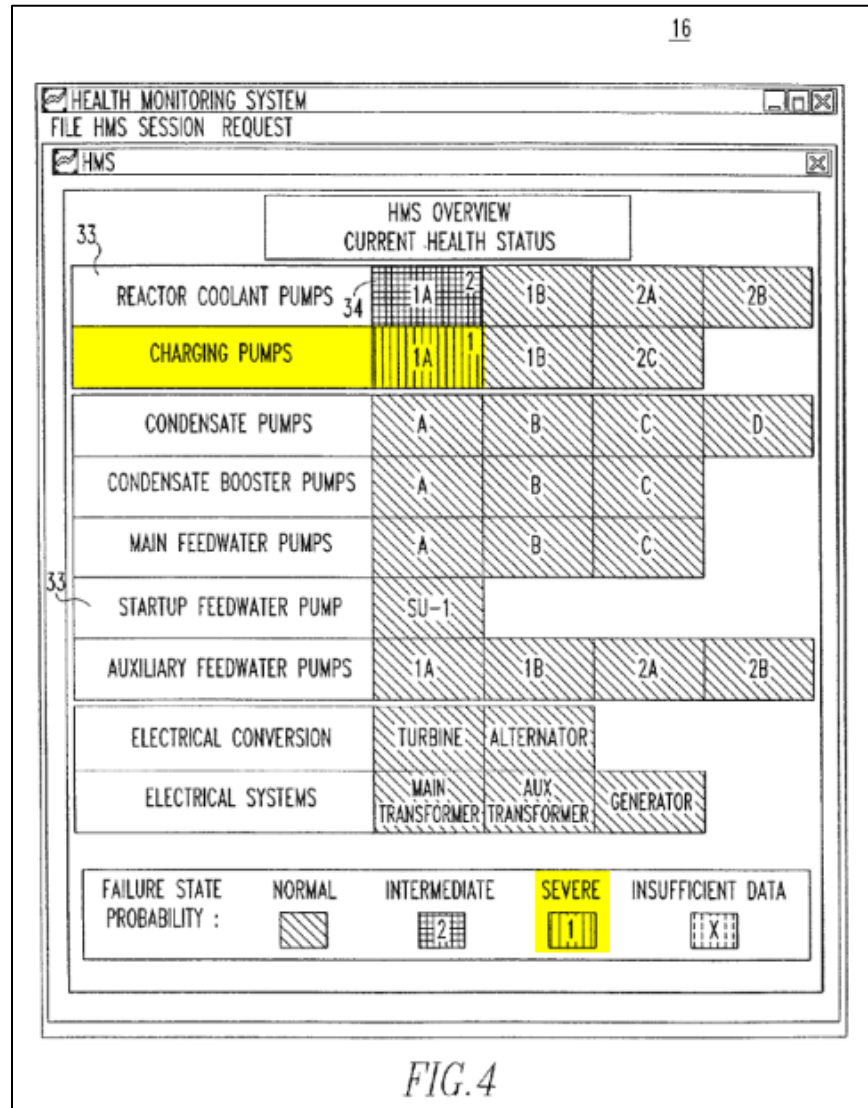
105. *See* §VI.B.1.d.

- e. the second view providing additional information on the at least one control application to permit a diagnosis of a possible cause of the degraded performance.

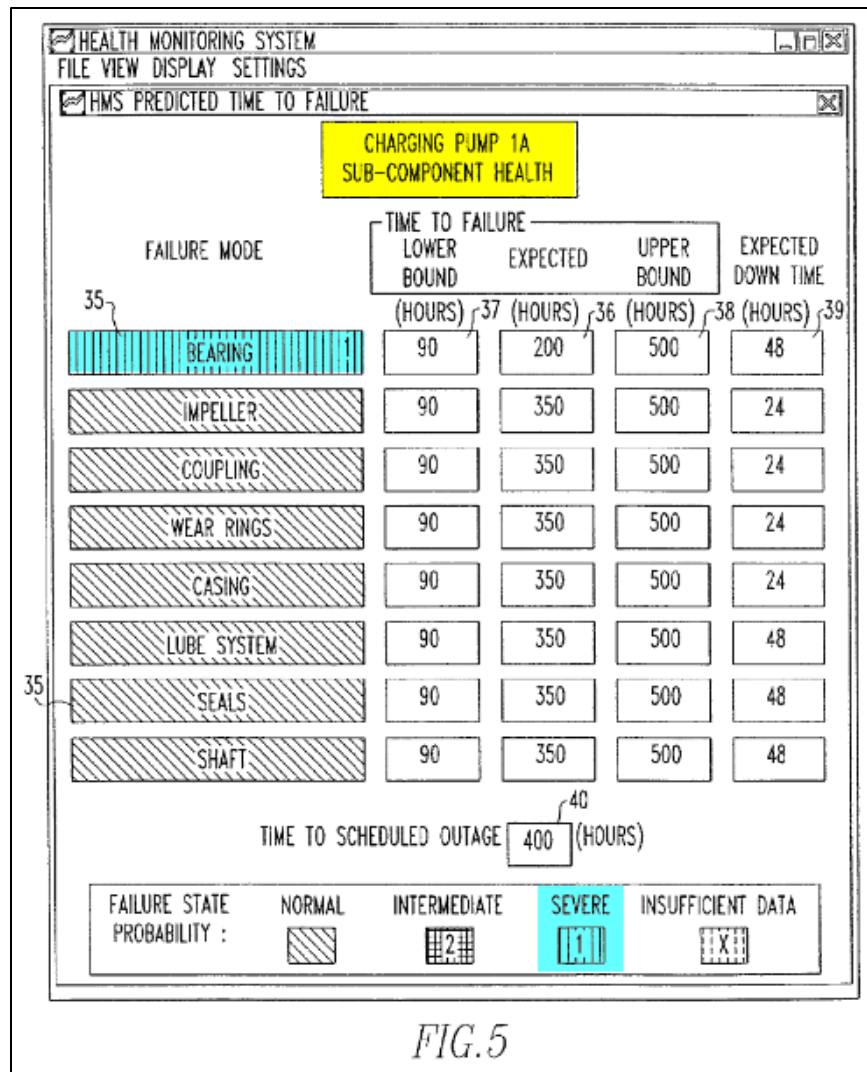
106. Ridolfo discloses this element. As discussed above (§VI.B.1.d), Ridolfo obtains additional information regarding the at least one control application using a second view of the performance indicators. Ridolfo describes a multi-tiered display where the upper level flags a problem (*e.g.* charging pumps in a severe health state) and lower levels are “used for analysis, diagnostics and repair planning purposes.” Ex. 1005, [0091]; *see also id.*, [0113], [0128], [0130], [0141], Fig. 2. As discussed above (§VI.B.7.a), Ridolfo teaches numerous techniques and analyses, the results of which are displayed in these lower levels of displays. *Id.*, [0042]-[0083].

107. The very point of being able to drill down on systems experiencing degraded performance is to permit diagnosis of possible causes of the degraded performance. For example, Ridolfo’s Figure 4 (first view) indicates Charging Pump 1A is experiencing degraded performance, and Figure 5 (second view) permits a diagnosis of a possible cause of the degraded performance (*e.g.*, bearings in a severe health state). Ex. 1005, [0104]-[0112], Figs. 4-5. Similarly, additional second views

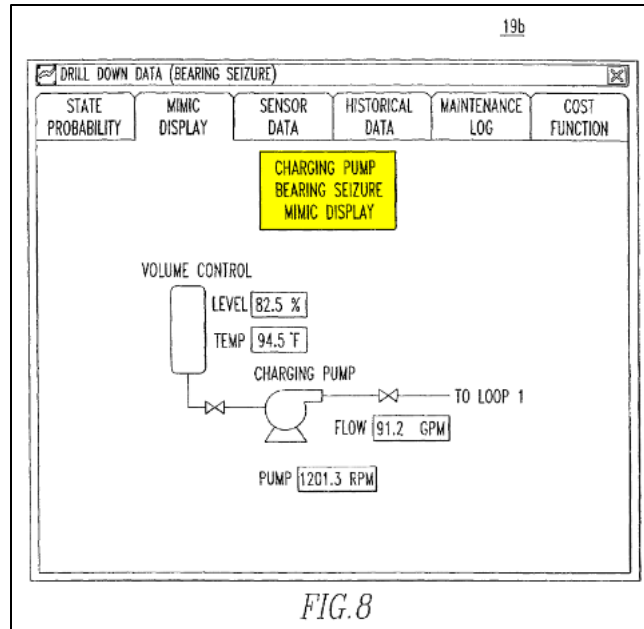
(e.g. Figs. 8-10) “suppl[y] detailed low-level data which is used for analysis, diagnostics and repair planning purposes.” *Id.*, [0113], Figs. 8-10.



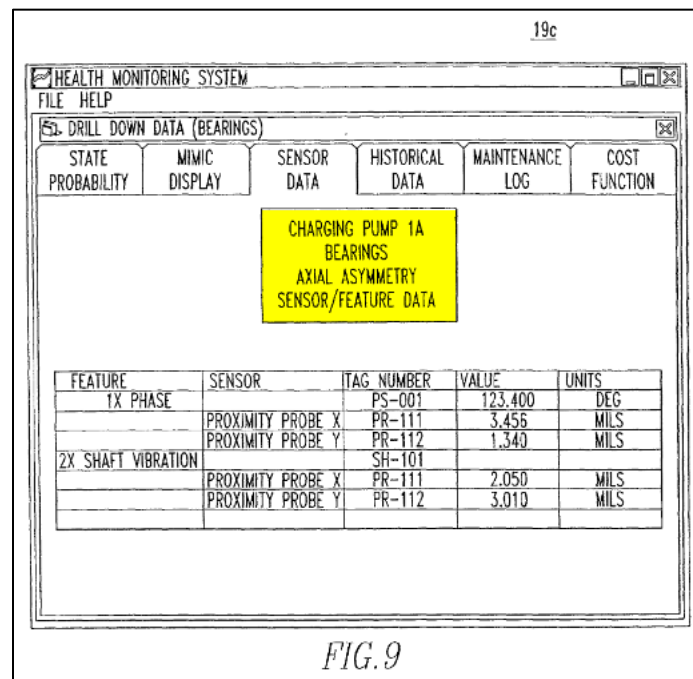
Id., Fig. 4 (color added).



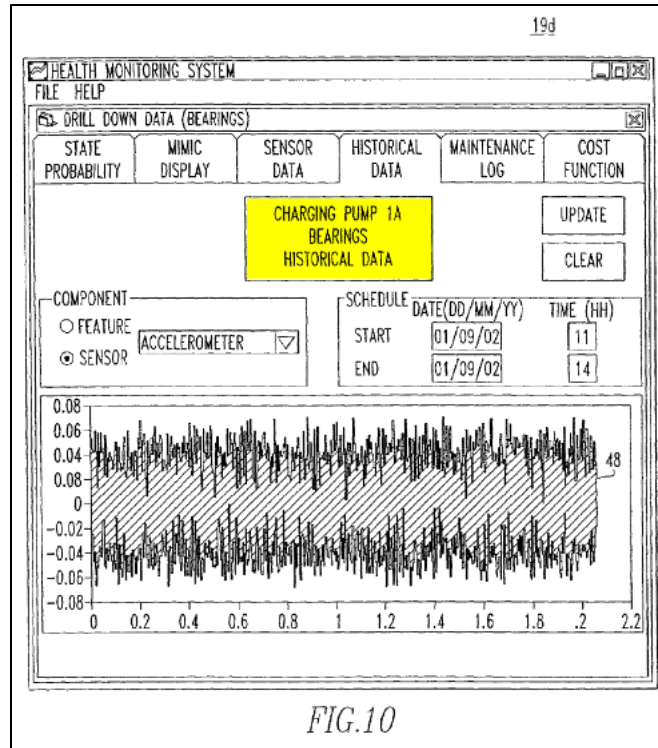
Id., Fig. 5 (color added).



Id., Fig. 8 (color added).



Id., Fig. 9 (color added).



Id., Fig. 10 (color added).

8. Claim 42

- a. “42. The method of claim 39, wherein the first view is a summary view of the performance indicators and the second view is a more detailed view of the performance indicators.”

108. *See* §VI.B.2.a.

9. Claim 53

- a. “53. The method of claim 39, further including displaying a mechanical view of the environmental control network.”

109. *See* §VI.B.3.a.

VII. CONCLUSION

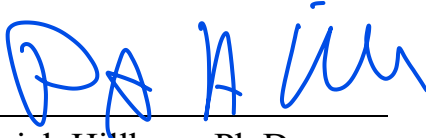
Based on the above, it is my opinion that the Challenged Claims of the '880 Patent are invalid and unpatentable. Each of the claims was known and/or obvious

over the prior art, and a POSITA would have readily appreciated that the claims were not inventive.

I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements are punishable by fine or imprisonment or both. *See* 18 U.S.C. § 1001.

Date: December 13, 2022

Respectfully submitted,

/s/ 
Patrick Hillberg, Ph.D.