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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* LAURENT DUVAL, AURELIEN SCHUTZ,  
and JEAN-MARC ZACCARDI

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Appeal 2018-008248  
Application 13/547,205<sup>1</sup>  
Technology Center 3700

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Before MICHAEL P. TIERNEY, *Vice Chief Administrative Patent Judge*,  
and ALLEN R. MacDONALD and MICHAEL T. CYGAN, *Administrative  
Patent Judges*.

CYGAN, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF CASE

*Introduction*

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's Final Rejection of claims 8–49. *See* App. Br. 7. Claims 1–7 were cancelled in a preliminary amendment. Appellants' Remarks 9 (July 12, 2012). We have jurisdiction under 35 U.S.C. § 6(b).

We reverse the rejection under 35 U.S.C. § 101.

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<sup>1</sup> According to Appellants, the real party in interest is IFP Energies Nouvelles. App. Br. 3.

*Disclosed Invention and Exemplary Claims*

The disclosed invention relates to the control of the combustion phase of an internal-combustion engine. Spec. ¶ 1. Specifically, the disclosed invention relates to a method for detecting an abnormal combustion so as to take steps during the detection cycle to prevent abnormal combustion in subsequent engine operation. Spec. ¶ 20. The disclosed method entails selecting combustion indicators that are determined from at least one detected signal representative of the state of the combustion in the engine. Spec. ¶ 21.

The combustion indicators are used to define a surface in a multidimensional space that encloses points representing normal combustion and excludes points representing abnormal combustion. Abstract. Combustion signals are then detected in real-time, their position in the multidimensional space is defined, and the combustion is classified as either abnormal or normal depending on whether the position of the real-time signal is enclosed by the surface representing normal combustion. Spec. ¶ 20. For signals classified as abnormal, the distance of a real-time combustion point from the surface is related to the severity of the abnormal combustion. *Id.* When the combustion is detected to be abnormal, the progress of the combustion is controlled as a function of the measured abnormality. Spec. ¶ 21; Fig. 2.

Independent claim 8 and dependent claim 9, reproduced below with modified formatting, exemplify the claimed invention:

8. A method for controlling combustion of a spark-ignition internal-combustion engine, wherein at least one signal representative of a state of the combustion is recorded by at least one detector in the engine, comprising:

selecting combustion indicators that can be determined from the at least one signal and defining a multidimensional space in which each dimension corresponds to one of the indicators and any combustion can be represented by a point in the space;

defining in the multidimensional space a closed surface surrounding the points corresponding to normal combustions and which does not surround points corresponding to abnormal combustions; and

for each combustion of an engine cycle representing the combustion of the cycle by a point in the multidimensional space, determining for the combustion indicators a position of the point with respect to the surface and determining therefrom any abnormal nature of the combustion, determining a distance between the point and the surface, and determining therefrom a severity of the abnormal nature of the combustion, and

controlling progress of the abnormal combustion as a function of severity of the abnormal nature of the combustion.

9. A method as claimed in claim 8, wherein:

the surface is defined by selecting an equation defining the surface with the equation comprising at least one parameter, carrying out a set of combustions wherein the normal combustions and the abnormal combustions are known and representing the set of combustions in the multidimensional space to form a cluster of points,

determining, by a principal component analysis, principal directions of the cluster of points and determining a dispersion of the points in each principal direction, and

modifying the at least one parameter so that the extension of the surface in each principal direction is equal to the dispersion in the principal direction.

Independent claim 49 recites a method having limitations commensurate with independent claim 8.

*Examiner's Rejection*

The Examiner rejects claims 8–49 under 35 U.S.C. § 101 as failing to claim eligible subject matter.

PRINCIPLES OF LAW

Patent-eligible subject matter is defined in 35 U.S.C. § 101 of the Patent Act, which recites:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

There is, however, an implicit, longstanding exception to patent-eligible subject matter in 35 U.S.C. § 101: “[l]aws of nature, natural phenomena, and abstract ideas.” *Alice Corp. v. CLS Bank Int’l*, 573 U.S. 208, 216 (2014). This exception precludes patenting of “the basic tools of scientific and technological work” from which all inventions spring. *Id.* at 216–17. Invention or discovery under § 101 is distinguished as being the application of such tools to an end otherwise satisfying the requirements of the patent statutes. *See Gottschalk v. Benson*, 409 U.S. 63, 67 (1972).

The Supreme Court has established a framework for this eligibility determination. Where a claim is directed towards a law of nature, natural phenomena, or abstract idea, the elements of the claim as a whole must ensure that the claim, in practice, amounts to significantly more than a patent on the law of nature, natural phenomena, or abstract idea itself. *Alice*, 573 U.S. at 217–18. In applying this eligibility analysis, our reviewing court has stated, “the decisional mechanism courts now apply is to examine earlier cases in which a similar or parallel descriptive nature can be seen . . . the

classic common law methodology for creating law when a single governing definitional context is not available.” *Amdocs (Isr.) Ltd. v. Openet Telecom, Inc.*, 841 F.3d 1288, 1294 (Fed. Cir. 2016) (citation omitted).

To address the growing body of precedent, the USPTO recently published revised examination guidance on the application of § 101. *2019 Revised Patent Subject Matter Eligibility Guidance*, 84 Fed. Reg. 50, 50 (Jan. 7, 2019) (hereinafter, “2019 Guidance”). The 2019 Guidance seeks to improve the clarity of the subject matter eligibility analysis and improve consistency of this analysis across the USPTO. *Id.*

Under the 2019 Guidance, we first look to whether the claim is directed to a judicial exception because:

- (1) the claim recites a law of nature, natural phenomenon, or abstract idea; the latter of which includes certain groupings, identified as mathematical concepts, certain methods of organizing human activity and mental processes; and
- (2) the claim as a whole fails to recite additional elements that integrate the judicial exception into a practical application (*see* MPEP § 2106.05(a)–(c), (e)–(h)).

Only if a claim (1) recites a judicial exception and (2) does not integrate that exception into a practical application, do we then look to whether the claim:

- (3) adds a specific limitation beyond the judicial exception that is not “well-understood, routine, conventional” in the field (*see* MPEP § 2106.05(d)); or

(4) simply appends well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality, to the judicial exception.

*See* 2019 Guidance, *passim*.

## ANALYSIS

We have reviewed the Examiner’s subject matter eligibility rejections (Final Act. 2–8) in light of Appellants’ contentions that the Examiner has erred (App. Br. 7–14). Further, we have reviewed the Examiner’s response to Appellants’ arguments. Ans. 2–3. We agree with Appellants’ contention that the Examiner erred in rejecting the pending claims 8–49 under 35 U.S.C. § 101.

### *“Recites an Abstract Idea”*

The Examiner has determined that the body of claim 8 recites certain “algorithm[ic]” limitations. Final Act 2, 6.<sup>2</sup> The limitations identified by the Examiner as being “algorithm[ic]” are reproduced here, with emphasis, in the context of the entirety of claim 8:

A method for controlling combustion of a spark-ignition internal-combustion engine, wherein at least one signal representative of a state of the combustion is recorded by at least one detector in the engine, comprising:

selecting combustion indicators that can be determined from the at least one signal and *defining a multidimensional space in which each dimension corresponds to one of the indicators and any combustion can be represented by a point in the space;*

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<sup>2</sup> The Final Action treats the “selecting combustion indicators that can be determined from the at least one signal” limitation as either part of the “algorithm” (Final Act. 6) or instead as “data gathering” (Final Act. 2). Our analysis does not turn upon such a distinction.

*defining in the multidimensional space a closed surface surrounding the points corresponding to normal combustions and which does not surround points corresponding to abnormal combustions; and*

*for each combustion of an engine cycle representing the combustion of the cycle by a point in the multidimensional space, determining for the combustion indicators a position of the point with respect to the surface and determining therefrom any abnormal nature of the combustion, determining a distance between the point and the surface, and determining therefrom a severity of the abnormal nature of the combustion, and controlling progress of the abnormal combustion as a function of severity of the abnormal nature of the combustion.*

Final Act. 2, 6.

The Examiner characterizes the above-identified limitations as “determining a distance of an abnormal combustion point with respect to a predefined area of normal combustion points[,] which amounts to nothing more than a mathematical relationship or an abstract idea.” Final Act. 5.

With respect to the limitations identified as reciting an abstract idea by the Examiner, Appellants acknowledge that these “arguably recit[e] abstractions.” App. Br. 14.

We agree that the abovementioned limitations recite an abstract idea. The manner by which the limitations of claims 8 and 49 act to create a boundary between normal and abnormal combustion indicators, and to classify new data as either normal or abnormal through a spatial relationship to the boundary, is a type of evaluation similar to those mental processes found to be abstract by our reviewing courts. *See* 2019 Guidance, 84 Fed. Reg. at 52, nn.14–15 (collecting cases).

In this determination, we are guided by prior court decisions, including the analysis set forth in *CyberSource Corp. v. Retail Decisions*,

*Inc.*, 654 F.3d 1366, 1370–74 (Fed. Cir. 2011). In *CyberSource*, the Federal Circuit reviewed a claim reciting steps of “constructing a map of credit card numbers based upon . . . transactions [and] utilizing the map of credit card numbers to determine if [a] credit card transaction is valid.” *Id.* at 1370–74. The court found the scope of the claim to include situations involving only a few transactions, such that the determination could be performed in the human mind. *Id.* at 1372. The *CyberSource* court found this claim to be “drawn to an unpatentable mental process – a subcategory of unpatentable abstract ideas.” *Id.* at 1371.

Appellants’ claim 8 similarly involves constructing a map of data points and utilizing that map to determine if further data points are normal or abnormal. Additionally, claim 8 does not provide any particular limitation on the manner of creating a surface in a multidimensional (e.g., more than one dimension) space. The limitations identified as being part of the abstract idea do not, by themselves, require any particular mathematical computation. These limitations would be met by, for example, establishing an abnormal/normal boundary (for example, manually plotting prior combustion indicator data and drawing a contiguous line representing a boundary between perceived abnormal and normal data points) and qualitatively determining whether current data values are outside the boundary, and if so, how far from the boundary those values are as a measure of the severity of the abnormality. We conclude that these limitations of claim 8 are indistinguishable from the type of evaluation found to be a mental process in *CyberSource* and in other prior cases.

To the extent that the evaluation involves further characterization of data points by determining the distance of a data point from the

normal/abnormal boundary, Appellants have not argued, nor is there any indication in the record, that this evaluation is of the type that cannot practically be “performed in the human mind, or by a human using a pen and paper.” *See* Spec. ¶ 72; *CyberSource*, 654 F.3d at 1372. Thus, we see no indication that the steps could not reasonably be performed in the human mind, such as whether a human could make such determinations in the context of actual engine operation. Accordingly, we determine that the identified evaluation is a type of mental process similar to those the courts have identified as abstract.

Although not necessary to the decision, we note that dependent claims 9–48 contain additional limitations which further limit the mental process of claim 8. Those limitations include defining the surface by an equation comprising at least one parameter, and determining principal directions of the cluster of points by a principal component analysis, and modifying the at least one parameter so that the extension of the surface in each principal direction is equal to the dispersion in the principal direction. Claim 9. To the extent that these steps define an equation, and operations to be taken on at least one parameter, these limitations further reduce the mental process set forth in claim 8 to mathematical relationships and/or calculations. Although these limitations in the dependent claims provide further mathematical detail to the mental evaluation of claim 8, these limitations do not distinguish the claims from mental processes and mathematical formulas. 2019 Guidance, 84 Fed. Reg. at 52 (synthesizing those concepts found by the courts to be directed to an abstract idea); *see id.* at 52 n.12 (citing *Bilski v. Kappos*, 561 U.S. 593, 611 (2011) (“The concept of hedging, described in claim 1 and

reduced to a mathematical formula in claim 4, is an unpatentable abstract idea”)).

*“Directed to an Abstract Idea”*

Having found the claims to recite an abstract idea, we next determine whether the claims are directed to that abstract idea, or whether the claim integrates the abstract idea into a practical application of the abstract idea. 2019 Guidance, 84 Fed. Reg. at 54. We therefore start with the Examiner’s and the Appellants’ respective characterizations of the elements additional to the abstract idea.<sup>3</sup>

The Examiner finds claim 8 to be “mostly [an] algorithm with little else.” Final Act. 2. The Examiner identifies the additional limitations as “selecting combustion indicators that can be determined from the at least one signal” and “controlling progress of the abnormal combustion as a function of the severity of the abnormal nature of the combustion.” *Id.* The Examiner also identifies “at least one detector” and “a spark-ignition internal-combustion engine” as additional elements. Final Act. 6. The Examiner also finds claim 8 to recite generic computer components, but to lack recitation of a computer program controlling the abnormal combustion. Final Act. 2–4.

Appellants assert, “processes for controlling combustion in an internal combustion engine have always been statutory subject matter and are not in any way a judicial exception as suggested by the Examiner.” App. Br. 12. Appellants further assert, “the claims as a whole pertain to a statutory

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<sup>3</sup> We defer any issues of whether such elements are “well-understood, routine, conventional” to a later step in the analysis, should the claims not be found eligible at this step. 2019 Guidance, 84 Fed. Reg. at 55–56.

process and the presence of a patent ineligible concept within the claims (the multidimensional space) does not render the claims nonstatutory.” *Id.* Appellants further assert, “[c]ontrol of abnormal combustion is not an abstraction and saves an engine from catastrophic destruction [in some instances],” and that such control is a “real-world highly technological process.” *Id.* at 14. Appellants contend that the Examiner’s reduction of the claims as “mostly the algorithm with little else” is not in accord with precedent. *Id.* at 10–13, citing *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327 (Fed. Cir. 2016) and *Thales Visionix Inc. v. United States*, 850 F.3d 1343 (Fed. Cir. 2017).

We are persuaded by Appellants’ assertions that the Examiner erred in characterizing the additional elements as being “little else.” A claim that integrates the abstract idea into a practical application of the abstract idea may be recognized by additional limitation(s) such that the claim as a whole is directed to, for example, an improvement in the functioning of a computer or another technology or technical field, a transformation of a particular article to a different state or thing, or other such meaningful limitation. *See* 2019 Guidance, 84 Fed. Reg. at 55, nn.25–29 (collecting cases). We determine that Appellants’ claims 8 and 49 meet this characterization.

Appellants’ claims set forth additional elements relating to a process of controlling abnormal combustion, including a spark-ignition internal-combustion engine having a detector therein providing signal(s) representative of a state of the combustion, selecting combustion indicators that can be determined from the signal(s), and controlling progress of the abnormal combustion as a function of the severity of the abnormal nature. Claims 8, 49. These limitations apply the abstract idea; i.e., the mental

process of determining the presence and extent of abnormal operation through a specific evaluation. In view of the entirety of the other steps in the process, the claims are not an attempt to patent the idea of a certain manner of determining the presence and extent of abnormal operation. Instead, the claims are directed to a process for controlling abnormal combustion, beginning with generation of a signal from a spark-ignition internal-combustion engine and ending with the control of the combustion occurring in the engine.

Our determination that the additional elements improve the functioning of a technology is supported by *Diamond v. Diehr*, 450 U.S. 175 (1981), cited in the 2019 Guidance as an exemplar of an exception integrated into a practical application. 2019 Guidance, 84 Fed. Reg. at 55, n.29. In *Diehr*, the Court determined that claims recited an abstract idea in the form of a mathematical equation. *Diamond v. Diehr*, 450 U.S. at 187. The Court found the additional elements to employ the mathematical equation in conjunction with the other steps of the claimed process, stating “[W]e do not view respondents’ claims as an attempt to patent a mathematical formula, but rather to be drawn to an industrial process” that begins with “the loading of the mold and end[s] with the opening of the press and production of a synthetic rubber product.” *Id.* at 192–93, n.15. In the claims under appeal, we similarly find the additional limitations to employ the identified abstract idea in conjunction with the other steps of the claimed process for abnormal combustion, such that the claims are drawn to the technology of controlling combustion in a spark-ignition internal-combustion engine.

The claims do not present a situation such that the claim as a whole remains directed to the abstract idea. Such a situation occurs where the

additional limitations amount to no more than, for example, insignificant extra-solution activity, restricting the abstract idea to a particular field of use, a directive to “apply [the abstract idea],” or merely using a computer as a tool to perform an abstract idea. *See* 2019 Guidance, 84 Fed. Reg. at 55, nn.30–32 (collecting cases).

We contrast the situation presented in the claims under appeal with situations in which the additional limitations were not found sufficient to cause the claim to be directed to other than the recited abstract idea. In *CyberSource*, the court found the claim to be directed to a recited mental process. *CyberSource*, 654 F.3d at 1374 (cited by 2019 Guidance, 84 Fed. Reg. at 55, n.31). In *CyberSource*, the claimed invention involved three steps, each of which the court characterized as capable of being entirely performed in the human mind. The first step, “obtaining information,” was determined to be capable of being performed by a human “who simply reads records . . . from a preexisting database.” *CyberSource*, 654 F.3d at 1372. The second step, “constructing a map,” was determined to be capable of being performed by a human “writing down a list” of the obtained information. *Id.* at 1372–73. The third step, “utilizing the map . . . to determine if the . . . transaction is valid,” was determined to be capable of performed by “the simple observation that numerous transactions . . . all originated from the same IP address.” *Id.* at 1373. Thus, in *CyberSource*, the entirety of the process claim was considered to be a mental process.

However, unlike the situation presented in *CyberSource*, the claimed invention, considered as a whole, cannot be practically performed in the human mind. In the claims under appeal, there are steps that cannot be practically performed in the human mind; i.e., additional limitations to the

claimed mental process. As identified above, these additional limitations include “at least one detector” and “a spark-ignition internal-combustion engine,” used with the steps of “selecting combustion indicators that can be determined from the at least one signal” and “controlling progress of the abnormal combustion as a function of the severity of the abnormal nature of the combustion.” The Examiner has not stated, nor do we determine, that these additional limitations result in a process that could be practically performed in the human mind in its entirety. Accordingly, the invention in the claims on appeal is distinguishable from the claims at issue in *CyberSource*.

Nor do we view the additional limitations merely as limiting the end-use of the evaluation to, supplying only insignificant activity to, or merely saying “apply it” to, spark-plug type internal combustion engines. Additional limitations of such character were identified in the claims of *Parker v. Flook*, 437 U.S. 584, 590 (1978). 2019 Guidance, 84 Fed. Reg. at 55, nn.31–32. In *Flook*, the Court determined that the Specification did not purport to explain how to select the required variables used in the claimed mathematical operation, or to explain how the mathematical operation related to the claimed field of hydrocarbon catalytic conversion.<sup>4</sup> The Court

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<sup>4</sup> Our reviewing courts have looked to the Specification to understand the process being claimed. See *Tilghman v. Proctor*, 102 U.S. 707, 722 (1881) (in discussing the eligibility of a prior patent, stating, “[t]he apparatus for performing the process was not patented, and was not material. The patent pointed out how the process could be effected, and that was deemed sufficient”); *In re TLI Commc’ns LLC Patent Litig.*, 823 F.3d 607, 611–12 (Fed. Cir. 2016) (in analyzing subject matter eligibility, referring to the specification in determining what the patent was directed to); *United States v. Adams*, 383 U.S. 39, 49 (1966) (“[I]t is fundamental that claims are to be

later characterized the limitations in *Flook* as “fail[ing] to limit the claim to a particular application.” *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 81 (2012).

Unlike the situation in *Flook*, in Appellants’ Specification, the additional elements are described in further detail in the Specification as to the specifics of the implementation in the spark-ignition internal combustion engine. For example, the additional element of “controlling progress of the abnormal combustion as a function of severity of the abnormal nature of the combustion” does not merely represent updating a numerical value, or a general instruction to “apply” a particular normal/abnormal classification scheme when operating an internal combustion engine. When read in view of the disclosure, this additional element represents altering the configuration of a spark-type internal combustion engine, such as by “fuel re-injection at a predetermined crank angle [through valves]” or by “throttle closure.” Spec. ¶¶ 84, 87. Accordingly, the claim limitations are more than merely insignificant activity, or field of use limitation, to the recited mental evaluation.

Further, our analysis is not affected by the lack of a computer in the claims. We do not agree with the Examiner’s finding of a computer in any of the claims (Final Act. 3), because none is expressly recited. We concur with the Examiner’s finding that a computer program executed on a disclosed engine calculator is not part of the claimed invention, because no engine calculator (computerized or otherwise) is expressly recited. Final Act. 4. While the written description in the originally-filed patent

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construed in the light of the specifications and both are to be read with a view to ascertaining the invention.”).

application disclosure may aid understanding of the claim language, “it is important not to import into a claim limitations that are not a part of the claim.” *SuperGuide Corp. v. DirecTV Enters., Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004). However, we note that the *Diehr* patent contained both a claim that did recite a computer (claim 1) and a claim that did not recite a computer (claim 11), with both being found eligible under the same analysis. *Diehr*, 450 U.S. at 179–81. Similarly, the absence of a computer in performing the claimed steps of controlling combustion does not affect our § 101 analysis in this situation. Whether the claimed controlling is explicitly performed via computer or no particular mechanism is recited for performing the claimed controlling, the step of controlling progress of the abnormal combustion is a part of the claimed practical application of the abstract idea identified in the claims.

Accordingly, we disagree with the conclusion of the Examiner that the additional elements are “little else” in the sense that they are only drafting efforts, in the form of insignificant post-solution activity or a field-of-use limitation, such that the claims are directed to the identified abstract idea. Instead, we agree with the Appellants’ assertion that the claims contain additional elements such that the claims as a whole are directed to a process for controlling combustion, which, as an improvement to a technology or technological field (such as by saving an engine from “catastrophic destruction”), integrates the abstract idea into a practical application of the abstract idea. App. Br. 13–14.

Dependent claims 9–48 recite additional limitations to the equation defining the closed surface in the multidimensional space, and to other mathematical relationships defining the determinations used to control the

progress of the abnormal combustion. These additional limitations further define the abstract idea, but do not detract from the above determination that the claims are directed to a practical application for controlling combustion.

Having determined the claims are directed to a process for controlling combustion, we determine that the claims improve a technology or technical field, and, thereby, integrate the abstract idea into a practical application of the abstract idea. The claims, therefore, are not directed to an abstract idea, and no further eligibility analysis is required. 2019 Guidance, 84 Fed. Reg. at 51; *Enfish*, 822 F.3d at 1339; *Thales Visionix*, 850 F.3d at 1349. Accordingly, claims 8–49 are eligible, and the Examiner’s rejection under 35 U.S.C. § 101 is reversed.

#### DECISION

For the above-described reasons, we reverse the Examiner’s rejection of claims 8–49 under 35 U.S.C. § 101.

REVERSED