In re Abele and Marshall

United States Court of Customs and Patent Appeals
August 5, 1982
684 F.2d 902, 214 USPQ 682

[Editor's note: This case is discussed in *Legal Protection of Digital Information* in: Chapter 5, Section II.A. (After Diehr).]

Nies, J.

This appeal is from the decision of the Patent and Trademark Office Board of Appeals (board) affirming the rejection of claims 5-7 and 33-47[1] in their application serial No. 850,892, filed November 15, 1977, for "Tomographic Scanner." The claims stand rejected under 35 USC 101[2] as being drawn to nonstatutory subject matter. We *affirm* the rejection of claims 5 and 7 and *reverse* with respect to all remaining claims on appeal.

The Invention

Appellants' invention is in the field of image processing particularly as applied to computerized axial tomography or CAT scans. Specifically, appellants' invention is directed to an improvement in computed tomography whereby the exposure to X-ray is reduced while the reliability of the produced image is improved. Some understanding of tomography, both conventional and computed, is necessary as background for the subsequent analysis of the present invention.

Conventional tomography, also known as laminography,employs the simultaneous movement in opposite directions of an X-ray source and an X-ray film. The method produces a well-defined image of a plane through the body parallel to the plane of the X-ray film. In contrast to an ordinary X-ray, shadows of body structure which lie outside the plane of investigation are blurred so that they <214 USPQ 684> do not interfere with a focused image of the plane under investigation. Conventional tomographic systems are not practical when a visualized cross-section transverse to the body axis is desired. Computed tomography was developed to overcome this deficiency among others.

Basically, computed tomography provides an image representing a transverse slice of the body. This slicing is accomplished by rotating an X-ray source and a detection means around the perimeter of the section to be viewed. The source and detection means are placed 180º from each other to allow the detection means to measure the attenuation of the beam as it passes through the plane of interest. When enough measurements have been taken, a computer is implemented to mathematically interpret the data, which is then displayed as a reconstruction of the slice on, inter alia, a television screen for diagnostic purposes. Computed tomography is also useful for looking at only a section of a slice. Thus, if the plane of interest were in the abdomen region of a human, but only the liver were of concern, the computed tomography <684 F.2d 904> machine would act in the manner of a conventional tomograph and blur the images outside of this "Region of Interest." It has, however, been necessary that a spread of X-rays "S" be sufficiently wide to subtend the entire body in order to produce an image of the region of interest "R" by this blurring method, as illustrated by the following drawing: [Figure omitted.]

Appellants have discovered that it is unnecessary to expose the body in the above fashion. Rather, they have discovered that the spread of X-ray, S, can be reduced so as to subtend only the region R thus: [Figure omitted.]

Narrowing the beam is advantageous not only because the exposure of a body to X-ray is thereby reduced but also because computer calculation time to produce the image is shortened inasmuch as the amount of data to be processed is less. However, because fewer data can be collected due to the

narrower beam, there is insufficient information to cancel out an object, n, such as a piece of rib, for example, which is in the beam bath. Thus, the resultant image shows the region R with an artifact[3] appearing therein due to that object, n: [Figure omitted.]

Appellants' invention is directed to an improvement in CAT scan imaging technique whereby the body is exposed to less radiation and, through use of a weighting function in the calculations producing the image, the artifacts are eliminated.

The Rejection

The examiner rejected the claims on appeal under the authority of Parker v. *Flook*, 437 U.S. 584, 198 USPQ 193 (1978). In the final rejection and in the examiner's answer before the board, the examiner construed *Flook* as mandating the following test:

> Taking each claim as a whole, it is assumed, for analysis purposes only, that any mathematical calculation in the claim is part of the prior art. If what is left is new and unobvious, then the claim, taken as a whole, protects more than a mathematical calculation and it is deemed statutory. But if the remainder of the claim is not novel nor unobvious, then the claim, taken as a whole, merely seeks to protect the mathematical calculation and, as such, does not comprise statutory subject matter.

Applying the above test, the examiner determined that, apart from the mathematical calculations, the remaining steps were well known or were "merely a necessary antecedent step to provide values for solving the mathematical equations," and, thus, were directed to nonstatutory subject matter, citing *In re Richman*, 563 F.2d 1026, 195 USPQ 340 (CCPA 1977). <214 USPQ 685>

The Board's Decision

The board did not address the examiner's contentions, relying instead of *In re Freeman*, 573 F.2d 1237, 197 USPQ 464 (CCPA 1978), as modified by *In re Walter*, 618 F.2d 758, 205 USPQ 397 (CCPA 1980). Without resort to detailed claim language, the board affirmed the rejection under 35 USC 101 as follows:<684 F.2d 905>

> When the claims are analyzed in [the manner dictated by Walter], it is manifest that the mathematical algorithm is not implemented in a manner to define structural relationships between physical elements in the apparatus claims or to refine or limit claim steps in the process claims. The claims do no more than present and solve a mathematical algorithm and are manifestly nonstatutory.

One member dissented with respect to rejection of claims 6 and 33-47 concluding that these claims are directed to "producing a product, an improved tomographic X-ray image," and are, therefore, directed to statutory subject matter citing *Diamond v. Diehr*, 450 U.S. 175, 209 USPQ 1 (1981).

Opinion

I.

A.

We agree with the board that a two-part analysis[4] is the proper vehicle for resolution of issues here presented under 35 USC 101. However, we agree with appellants that the second step of the analysis is not as limited as the board held it to be.

B.

In *Gottschalk v. Benson*, 409 U.S. 63, 175 USPQ 673 (1972), the Supreme Court concluded that claims directed to a particular "algorithm," conversion of binary coded decimal numbers to binary numbers, did not define patentable subject matter. In that case the Court defined the term "algorithm" as "[a] procedure for solving a given type of mathematical problem." *Id*. at 65, at 674 . The Court's holding in Benson became the basis for the first part of the two-part analysis set forth by this court in *In re Freeman*, 573 F.2d 1237, 197 USPQ 464 (CCPA 1978).

In *Freeman*, 573 F.2d at 1245, 197 USPQ at 470 , this court concluded:

> As a bare minimum, application of Benson in a particular case requires a careful analysis of the claims, to determine whether, as in Benson, they recite a "procedure for solving a given type of mathematical problem." [Citation omitted. Emphasis in original.]

Hence, the first part of the analysis requires:

> First, it must be determined whether the claim directly or indirectly recites an "algorithm" in the Benson sense of that term * * *.

Id. at 1245, 197 USPQ at 471 .

The second part of the *Freeman* analysis is derived from the further holding in *Benson*, 409 U.S. at 72, at 676 , that any patent issued in that case "would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself." Thus, it was concluded that the presence of an "algorithm" in a claim would not render a claimed invention nonstatutory unless the invention claimed only the "algorithm." Stating this conclusion in the language of *Benson*, this court declared:

> Second, the claim must be further analyzed to ascertain whether in its entirety it wholly preempts that algorithm.
> *Freeman*, *Id*. at 1245, 197 USPQ at 471.

This latter step in the *Freeman* analysis was not reached because of this court's conclusion that the claims did not recite an "algorithm." In *In re Toma*,575 F.2d 872, 197 USPQ 852 (CCPA 1978), the same test was discussed but, again, the second part of the analysis was not reached. Subsequently, the Supreme Court handed down its decision in *Parker v. Flook*,437 U.S. 584, 198 USPQ 193 (1978), making clear that the second part of <684 F.2d 906> the above analysis was erroneous. The Court held that the claim need "not * * * cover every conceivable application of the formula" to be nonstatutory. *Id*. at 586, at 195 .

In sum, the Court's decisions have made clear that a claim does not present patentable subject matter if it would wholly preempt an algorithm, Benson, supra, or if it would preempt the algorithm but for limiting its use to a particular technological environment, *Flook*,supra.However, these decisions leave undefined what does constitute statutory subject matter.

In *In Re Johnson*,589 F.2d 1070, 1075, 200 USPQ 199, 205 (CCPA 1978), this court held that, while reciting an algorithm, the <214 USPQ 686> claims did not merely define a method of solving a mathematical equation because:

> any calculations which may be performed in practicing the process * * * are but a part of the process which includes the other recited steps.
> * * * [They] are incident to producing a noise-free signal trace from a reference trace.

Id. at 1080, 200 USPQ at 209 (emphasis added).

This conclusion rests on the premise that an otherwise statutory process remains statutory when implemented by a computer, *id* . at 1078, 200 USPQ at 207 no.8 ,a premise subsequently approved by the Supreme Court in *Diamond v. Diehr*, 450 U.S. 175, 209 USPQ 1 (1981). Accord, *In re Bradley*,600 F.2d 807, 202 USPQ 480 (CCPA 1979), aff'd sub nom by equally divided court, *Diamond v. Bradley*, 450 U.S. 381, 209 USPQ 97 (1981) (Burger, C.J., not participating).

In *Johnson*, *supra*, the interrelationship of the algorithm to the remaining limitations of a claim was held to be determinative of whether the claim defined statutory subject matter. Relying on the same

reasoning, in *In re Walter*,618 F.2d 758, 205 USPQ 397 (CCPA 1980), the second part of the two-step analysis[5] was defined as follows:

> If it appears that the mathematical algorithm is implemented in a specific manner to define structural relationships between the physical elements of the claim (in apparatus claims) or to refine or limit claim steps (in process claims), the claim being otherwise statutory , the claim passes muster under §101. If, however, the mathematical algorithm is merely presented and solved by the claimed invention, as was the case in *Benson* and *Flook*, and is not applied in any manner to physical elements or process steps, no amount of post-solution activity will render the claim statutory; nor is it saved by a preamble merely reciting the field of use of the mathematical algorithm.

Id. at 767, 205 USPQ at 407 (emphasis added).

In *Walter*, the claims were directed to a process[6] for correlating and cross-correlating signals. All of the claims steps were algorithm steps for performing the correlation or cross-correlation. There were no limitations in the claims, other than a field of use set forth in the preamble of the claims which stated that the algorithm was for use in connection with seismic surveying. The court concluded that the claims were directed to claiming only the algorithm, were not applied in any manner to any process steps, and were, therefore, directed to nonstatutory subject matter. *Id*.at 769, 205 USPQ at 409 .

Appellants summarize the *Walter* test as setting forth two ends of a spectrum: what is now clearly nonstatutory, i.e., claims in which an algorithm is merely presented and solved by the claimed invention (preemption), and what is clearly statutory, i.e., claims in which an algorithm is implemented in a specific manner to define structural relationships between the physical elements <684 F.2d 907> of the claim (in an apparatus claim) or to refine or limit claim steps (in a process). Appellants urge that the statement of the test in Walter fails to provide a useful tool for analyzing claims in the "gray area" which falls between the two ends of that spectrum. We agree that the board's understanding and application of the *Walter* analysis justifies appellant's position. However, the *Walter* analysis quoted above does not limit patentable subject matter only to claims in which structural relationships or process steps are defined, limited or refined by the application of the algorithm.

Rather, *Walter* should be read as requiring no more than that the algorithm be "applied in any manner to physical elements or process steps," provided that its application is circumscribed by more than a field of use limitation or non-essential post-solution activity. Thus, if the claim would be "otherwise statutory," *id*.,albeit inoperative or less useful without the algorithm, the claim likewise presents statutory subject matter when the algorithm is included. This broad reading of *Walter*, we conclude, is in accord with the Supreme Court decisions.

In *Diamond v. Diehr*, *supra*,the Court held that a process for curing synthetic rubber constituted patentable subject matter notwithstanding that the process used an equation for controlling the in-mold time which was constantly updated by a digital computer. In *Diehr*, were the claim to be read without the algorithm, the process would still be a process for curing rubber, although it might not work as well since the in-mold time would not be as accurately controlled. Hence, the Court concluded that the claimed invention fell within §101 because it presented "an application of a law of nature or mathematical formula to a known structure or process." *Id*.at 187 (emphasis in original).[7] Accord, *Mackay Radio &* <214 USPQ 687> *Telegraph Co. v. Radio Corp. of America*,306U.S. 86 (1939).

Finally, the purpose of the two-part analysis supports the view taken here. The goal is to answer the question "What did applicants invent?" If the claimed invention is a mathematical algorithm, it is improper subject matter for patent protection, whereas if the claimed invention is an application of the algorithm, §101 will not bar the grant of a patent.

In answering that question,

> [e]ach invention must be evaluated as claimed; yet semantogenic considerations preclude a determination based solely on words appearing in the claims. In the final

> analysis under §101, the claimed invention, as a whole, must be evaluated for what it is.

In re Sarkar, 588 F.2d 1330, 1333, 200 USPQ 132, 137 (CCPA 1978) (footnote omitted).

Hence, the analysis "requires careful interpretation of each claim in light of its supporting disclosure * *." *In re Johnson*,589 F.2d at 1079, 200 USPQ at 208 .

II.

In this case, each of the independent claims and, necessarily, each of the dependent claims, includes the limitation "calculating * * * the difference" either as a step in a process or as a means in an apparatus. Accordingly, all of the claims may be directed to nonstatutory subject matter as each presents a mathematical formula or a sequence of mathematical operations. See, e.g., *Diehr*,supra, wherein the claims included a limitation requiring "calculating." Cf. *Johnson*,589 F.2d at 1078, 200 USPQ at 208 (use of term "compute" at least suggests the execution of a mathematical algorithm). In any event, appellants concede that their claims "implement a mathematical algorithm."

III.

A.

We now turn to the second part of our analysis to determine whether what is <684 F.2d 908> claimed is a statutory process or apparatus or a nonstatutory algorithm.

We begin by contrasting the two broadest process claims, claims 5 and 6:

> 5. A method of displaying data in a field comprising the steps of
>
> calculating the difference between the local value of the data at a data point in the field and the average value of the data in a region of the field which surrounds said point for each point in said field, and
>
> displaying the value of said difference as a signed gray scale at a point in a picture which corresponds to said data point.
>
> 6. The method of claim 5 wherein said data is X-ray attenuation data produced in a two dimensional field by a computed tomography scanner.

We conclude that claim 5 is directed solely to the mathematical algorithm portion of appellants' invention and is, thus, not statutory subject matter under § 101. We reach the opposite conclusion with respect to claim 6.

The method of claim 6, unlike that of claim 5, requires "X-ray attenuation data." The specification indicates that such attenuation data is available only when an X-ray beam is produced by a CAT scanner, passed through an object, and detected upon its exit. Only after these steps have been completed is the algorithm performed,[8] and the resultant modified data displayed in the required format.[9]

Were we to view the claim absent the algorithm, the production, detection and display steps would still be present and would result in a conventional CAT-scan process. Accordingly, production and detection cannot be considered mere antecedent steps to obtain values for solving the algorithm as in *In re Richman*, cited by the examiner. Indeed, claim 6 presents data gathering steps not dictated by the algorithm but by other limitations which require certain antecedent steps.[10] It is these antecedent steps that dictate what type of data must be obtained. Compare*In re Sarkar*, 588 F.2d at 1336, <214 USPQ 688> 200 USPQ at 139 n.18 , where we did not reach the effect of data gathering steps which are not dictated by the algorithm. In any event, we view the production, detection, and display steps as manifestly statutory subject matter and are not swayed from this conclusion by the presence of an

algorithm in the claimed method.

In *Flook*, *supra*,"[t]he patent application did not 'explain how to select * * * any of the variables" used in the algorithm and, thus, no process other than the algorithm was present. *Diehr*,450 U.S. at 186 n. 10, 209 USPQ at 8 n.10 , quoting *Flook*,437 U.S. at 586, at 195 .A fortiori, no process steps to which the algorithm could be applied were present. Accord, *Walter*,*supra*. In the instant case, claim 6 defines the variables and places the algorithm in a particular relationship to a series of steps in a particular type of process, permitting the algorithm to be applied as a further process step. *In re Taner*, No. 81-598, Slip Op. at 7 (CCPA June 10, 1982).

The algorithm, when properly viewed, is merely applied to the "attenuation data" to eliminate what would otherwise appear as <684 F.2d 909> artifacts upon display of the data in the manner claimed. The algorithm does not necessarily refine or limit the earlier steps of production and detection as would be required to achieve the status of patentable subject matter by the board's narrow reading of *Walter*. What appellants have done is to discover an application of an algorithm to process steps which are themselves part of an overall process which is statutory. Hence, claim 6 cannot be construed as a mere procedure for solving a given mathematical problem. As was the case in *Diehr* and *Johnson*, both supra, the algorithm is but a part of the overall claimed process.

We are faced simply with an improved CAT-scan process comparable to the improved process for curing synthetic rubber in *Diehr*,*supra*. The improvement in either case resides in the application of a mathematical formula within the context of a process which encompasses significantly more than the algorithm alone.

B.

We do not reach the same conclusion with respect to claim 5. This claim presents no more than the calculation of a number and display of the result, albeit in a particular format.

The specification provides no greater meaning to "data in a field" than a matrix of numbers regardless of by what method generated. Thus, the algorithm is neither explicitly nor implicitly applied to any certain process. Moreover, that the result is displayed as a shade of gray rather than as simply a number provides no greater or better information, considering the broad range of applications encompassed by the claim. Indeed, this claim does not even attempt to "limit the use of the formula to a particular technological environment," *Diehr*, 450 U.S. at 191, 209 USPQ at 10 , as was done in *Flook*,*supra*.Hence, we view claim 5 as directed merely to a mathematical formula which is not proper subject matter under §101.

C.

Appellants do not argue and, in any event, we see no basis for treating their apparatus claims differently from their method claims.

If the functionally-defined disclosed means and their equivalents are so broad that they encompass any and every means for performing the recited functions, the apparatus claim is an attempt to exalt form over substance since the claim is really to the method or series of functions itself. In computer-related inventions, the recited means often perform the function of "number crunching" (solving mathematical algorithms and making calculations). In such cases the burden must be placed on the applicant to demonstrate that the claims are truly drawn to specific apparatus distinct from other apparatus capable of performing the identical functions.

If this burden has not been discharged, the apparatus claim will be treated as if it were drawn to the method or process which encompasses all of the claimed "means." *In re Walter*, 618 F.2d at 768, 205 USPQ at 408 .

Thus, claim 7, the apparatus counterpart to claim 5, suffers the same defects as does claim 5.

7. Apparatus for displaying data values representative of values at data points in a two dimensional field comprising:

means for calculating the differences between the local values of each data point and the average value at data points in a limited region of said field surrounding each said data point, and

means for displaying the value of said differences as signed gray scale values at points in a picture which correspond to said data points.

D.

What was said about claim 6 applies equally to independent method claim 33 and its apparatus counterpart claim 36.

33. A method of computed tomography comprising the steps of: <214 USPQ 689> <684 F.2d 910>

measuring the values of the line integrals of an incoherent propagation along a plurality of paths through a region of interest in a body;

calculating, from the values of said integrals at each of a number of reconstruction points in said region of interest, the difference between the local value of a characteristic at said point and the average value of the characteristic in a local region surrounding said point; and

reconstructing a representation of features in said region of interest by displaying the calculated value for each reconstruction point at a point in a picture which corresponds to said reconstruction point.

36. Computed tomography apparatus comprising:

means for measuring the values of the line integrals of an incoherent propagation along a plurality of paths through a region of interest in a body;

calculating means, connnected to receive the values of said integrals from said means for measuring and to calculate, at each of a number of reconstruction points in said region of interest, the difference between the local value of a characteristic at said point and the average value of said characteristics in a local region surrounding said point; and

means for reconstructing a representation of features in said region which function to receive said calculated values from said calculating means and to display the calculated value for each reconstruction point at a point in a picture which corresponds to said reconstruction point.

Indeed, the step of "measuring * * * line integrals of an incoherent propagation * * * through * * * a body" explicitly requires the same steps implicit in claim 6, viz., production of a beam and detection of the beam after it is attenuated by passing through a body. Moreover, while the display of claims 33 and 36 is only of a number, we have already disposed of the contention that the last step of a claim not be a number. *See In re Taner*,*supra*,overruling *In re Christensen*, 478 F.2d 1392, 178 USPQ 35 (CCPA 1973). See also n. 9, *supra*.

E.

In view of our holding with respect to independent claims 33 and 36, the remaining claims, all of which depend from claim 33 or 36, must likewise be proper subject matter for patenting under 35 USC

101. The remaining claims on appeal appear in the Appendix for reference purposes.

Modified.

Appendix

34. The method of claim 33 wherein said characteristic is a radiation attenuation coefficient.

35. The method of claim 33 wherein said region of interest lies in the body plane and comprises less than the entire area of said body plane.

37. The apparatus of claim 36 wherein said means for measuring comprises tomographic scanner means which function to direct one or more beams of penetrating radiation through said body, to determine the attenuation of said beams within said body, and to sequentially redirect said beams with respect to said region of interest whereby each of the reconstruction points in said region of interest is scanned by said beams from a plurality of different orientations.

38. The apparatus of claim 37 wherein said radiation is X-radiation.

39. The apparatus of claim 37 wherein said region of interest is an area in a plane passing through said body which area includes less than all of a body plane and wherein said scanner beams function to direct and redirect said beams to scan all reconstruction points within said region of interest from all of said orientations and to scan points in said body plane outside of said region [of] interest from less than all of said orientations.

40. The apparatus of claim 39 wherein said calculating means function to calculate the values of said difference by first <684 F.2d 911> assigning assumed values of said characteristic to points which are outside said region of interest.

41. The apparatus of claim 40 wherein said assumed values correspond to the value of the characteristic at adjacent reconstruction points at the boundary of said region of interest.

42. The apparatus of claim 36 wherein said calculating means function to calculate the values of said difference in accordance with the formula [Formula omitted.]

43. The apparatus of claim 42 wherein said calculating means further function to apply a weighting function in said calculations which reduces interpolation errors in said calculation.

44. The apparatus of claims 43 wherein said weighing function is a Gaussian function. <214 USPQ 690>

45. The apparatus of claim 36 wherein the calculating means include a general purpose digital computer which includes a stored program which effects the calculation.

46. The apparatus of claim 36 wherein the means for reconstructing includes a display device which displays said calculated values as gray scale values.

47. The method of claim 46 wherein neutral gray represents zero values of said calculated values and wherein shades lighter and darker than neutral gray represent non-zero positive or negative signed values.

Miller, J.,dissenting in part.

I am in substantial agreement with the majority opinion, as I interpret it. However, I would also reverse the rejections under 35 USC 101 of claims 5 and 7.

The majority opinion states that each claim as a whole should be examined under 35 USC 101 by looking beyond the limitations directed to a mathematical algorithm and determining whether the remainder of the claim is directed to statutory subject matter; if it is, then the mere inclusion of a mathematical formula or algorithm would not require a rejection under 35 USC 101.[11] This approach is supported by the Supreme Court's opinion in *Diamond v. Diehr,* 450U.S. 175, 187, 209 USPQ 1, (1981), in which the Court stated:

> Our earlier opinions lend support to our present conclusion that a claim drawn to

> subject matter otherwise statutory does not become nonstatutory simply because it uses a mathematical formula, computer program, or digital computer. * * * It is now commonplace that application of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection.

This approach is also supported by prior decisions of this court holding that dependent claims containing mathematical formulae or algorithms do not render nonstatutory the claims from which they depend. See *In re Johnson*, 589 F.2d 1070, 200 USPQ 199 (CCPA 1979); *In re Freeman*,573 F.2d 1237, 197 USPQ 464 (CCPA 1978); *In re Chatfield*, 545 F.2d 152, 191 USPQ 730 (CCPA 1976).

It is the majority opinion's application of this approach to method claim 5 (and apparatus claim 7) that prompts my partial dissent. The claim language involved is: "displaying the [calculated] value * * * as a signed gray scale [i.e., shade of gray] <684 F.2d 912> at a point in a picture * * *.[12]]" I am persuaded that such a display is essentially different from a display of a number calculated by a mathematical algorithm and that, absent the algorithm, the shade of gray display at a point in a picture is patentable subject matter. Whether display of a number calculated by a mathematical algorithm provides "greater or better information" – a point made by the majority opinion – may be relevant to a rejection under 35 USC 103, but its relevance to a rejection under 35 USC 101 escapes me. Similarly, the majority opinion's point that claim 5 (and claim 7) "does not even attempt to 'limit the use of the formula to a particular technological environment' " does not appear relevant to the approach supported by *Diamond v. Diehr*.

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[1] Claims 2, 3, 8-9, 23 and 48 have been allowed. Claims 49-57 were withdrawn in accordance with 37 CFR 1.142(b).

[2] 35 USC 101 provides:

> 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.

[3] The classical determination of computed tomography images may be viewed as the process of solving a large number of simultaneous equations for an equal number of unknown variables. An artifact-free calculation requires that a sufficient number of line integral measurements be made to determine the unknown variables at all image points.

[4] We reject as unsound the examiner's reading of *Flook*. The Supreme Court rejected similar reasoning in *Diamond v. Diehr*,450 U.S. 175, 189 n.12, 209 USPQ 1, 9, n.12 (1981), as has this court. *In re Sarkar*, 588 F.2d 1330, 1333-34, 200 USPQ 132 , 137-38 n.10 (CCPA 1978); *In re Freeman*, 573 F.2d 1237, 197 USPQ 464 (CCPA 1978); *In re Chatfield*, 545 F.2d 152, 191 USPQ 730 (CCPA 1976), cert. denied sub nom,*Dann v. Noll*,195 USPQ 465 , 434 U.S. 875 (1977).

[5] The first part of our analysis was not altered because the definition of an algorithm used by the Court in *Flook* was identical to that used in *Benson*, *Flook*,437 U.S. at 585 n.1, 195 n.1 ,quoting *Benson*, 409 U.S. at 65, 175 USPQ at 674 .

[6] Some of the claims were apparatus claims but were drafted as "means for" clauses in place of process steps. They were treated as process steps.

[7] We do not construe the Court's reference to a known structure or process as a limitation. An essential

purpose of the patent laws is to foster the creation of heretofore unknown structures or processes.

[8] The algorithm, calculating the difference, is defined in the specification as a Gaussian weighting function which modifies the X-ray attenuation data before it is displayed. It is the weighting that results in removal of the artifacts from the display.

[9] While we conclude that the resultant display is an important feature of the claimed invention, because it provides a more useful tool for a doctor's diagnosis, for example, than would numbers alone, we do not rest our holding with respect to claim 6 on the "non-triviality" of post-solution activity. Even without the final step of displaying the data in a more usable form, "the fact that [the] equation is the final step is not determinative of the section 101 issue." *In re Richman*,563 F.2d at 1030, 195 USPQ at 343 . Accord, *In re Taner*, No. 81-598 (CCPA June 10, 1982), overruling *In re Christensen*,478 F.2d 1392, 178 USPQ 35(CCPA 1973).

[10] It appears that examination did not proceed beyond the § 101 rejection of the subject claims. This opinion should not be read as implicitly finding the claims adequate under 35 USC 112 .

[11] The majority opinion states:

> Where we to view the claim absent the algorithm, the production, detection and display steps would still be present and would result in a conventional CAT-scan process. * * * In any event, we view the production, detection, and display steps as manifestly statutory subject matter and are not swayed from this conclusion by the presence of an algorithm in the claimed method.

[12] In claim 7, the pertinent language is: "means for displaying the [calculated] value * * * as signed gray scale [i.e., shade of gray] values at points in a picture * * *."