10-1980

Diamond v. Diehr

Lewis F. Powell Jr.

This case is straight-line with 79-855 Diamond v Bradley. SG urges cert to grant both & consolidate.

Discuss. I could be persuaded to grant

Ct. below seems to have muffed this patent case (what I don't understand), & SG urges a grant.

PRELIMINARY MEMORANDUM

March 14, 1980 Conference
List 1, Sheet 1

Cert to U.S. Ct. Cus.& Pat. Apps (Rich, for ct)

No. 79-1112-COX

DIAMOND (Comm'r Patents)

v.

DIEHR

Federal/civil

Timely

1. SUMMARY. Whether a new process for calculating the cure time for molded rubber products, involving use of a computer to constantly recalculate cure time is patentable subject matter under 35 U.S.C. § 101.

2. FACTS. Rubber products from a molded press must be cured in the press for a certain time, depending on the temperature inside the press. Uncontrolled variables make it difficult to arrive at an exact temperature for purposes of calculating the cure time. The time the press is open while

Discuss— if CCPA is going off the beam of this recurring Q, this case & No. 79-855, Diamond v. Bradley, should be granted & consolidated.

being loaded affects the temperature inside and thus influences the time it takes the press to heat to the desired temperature. Industry practice has been to assume a "reasonable amount of mold-opening time" during loading and unloading. This often results in overcuring or undercuring, since the calculations can only be as precise as the temperature estimations.

Diehr's claimed invention makes calculation of the cure time much more accurate. The invention involves taking continuous (for example, every ten seconds) temperature readings from inside the closed press and feeding these readings into a digital computer. The computer then uses a well-known mathematical formula, the Arrhenius equation, to continuously recalculate the cure time based on the actual temperature in the mold. When the proper time has elapsed, the computer opens the door of the mold.

The patent examiner rejected Diehr's invention as drawn to nonstatutory subject matter under 35 U.S.C. § 101. Those steps carried out by computer are nonpatentable under Gottschalk v. Benson, 409 U.S. 63, and the remaining steps -- which relate to the method of manufacturing molded articles, such as opening, closing and heating of the mold -- are "conventional."

The PTO Board of Appeals affirmed. The constant measurement of the mold temperature was within the prior art, and the method of calculating the cure time was a nonpatentable mathematical algorithm.

3. OPINION BELOW. The CCPA reversed. It first noted that resps strenuously disputed the factual conclusion made by both the examiner and the board that the step of continuously measuring the temperature inside the mold is old in the art. Resps also argued that the PTO erred by dissecting their claims into novel and nonnovel elements.

The CCPA was "inclined to agree with [resps] that the record is devoid of any evidence that [the step of continually measuring the temperature in the mold cavity] was ever performed by persons other than [resps]." Petn 13a. However, the court found this issue to be irrelevant. Considerations of novelty and obviousness have no bearing on compliance with § 101. Thus it was error for the Board to divide up the claim into novel and nonnovel parts. The focus should be on whether is claim as a whole is directed to a method of calculation or a mathematical formula.

The CCPA found that resps' claim was not an attempt to patent a mathematical formula. Granting of resps' patent would not precude others from using the Arrhenius equation. Resps claimed a process for molding rubber articles, which improved previous processes by opening the door at exactly the proper time.

4. CONTENTIONS.

The SG contends that this is the second time in two months that the CCPA has refused to apply Parker v. Flook, 437 U.S. 538 (1978). The SG suggests that this case be considered in tandem with Diamond v. Bradley, 79-855 (straight-lined with this case).

The SG finds Flook indistinguishable. The application there described a three-step method for a computer to update the alarm limits in catalytic conversion processes. The steps were measurement of the present value of the process variable, for example, temperature; use of a mathematical formula in a computer to calculate an updated alarm value; and adjustment of the alarm value to the updated value. The application at issue here also describes a three-step process: measurement of the present value of the process variable, temperature; use of a mathematical formula in a computer to calculate an updated cure time; and direction of the mold press to open in accordance with the updated time. The Board performed the proper analysis when it isolated the computer algorithm from the rest of the claim and then rejected the claim because what remained was old in the art.

The basis of the CCPA's conclusion was that "as a whole" the claim stated "a process involving the manipulation of apparatus resulting in chemical and physical change of starting material," whose calculation, unlike Flook's was "intimately entwined with the rubber molding process recited." Petn 16a, 17a.

The SG maintains that the holding below emasculates Flook. Flook mandates the analysis performed by the Board. The only new element in resps' claim was the use of a computer to recalculate cure time. Since the mathematical algorithm cannot be patented, the patent application was properly denied.

Resps urge that their process is chemical and mechanical, not mathematical. They are not attempting to patent a computer program. Merely because their new invention has as one of its elements use of a computer program does not make it unpatentable. Resps' chemical-mechanical process starts with uncured rubber and ends with a precisely cured product.

Resps also maintain that considerations of novelty and obviousness are inappropriate under § 101. Section 101 is a threshold determination. Thus the CCPA was correct in rejecting the PTO's separation of resps' claim into novel and nonnovel elements.

Finally, resps argue that this case should not be consolidated with Diamond v. Bradley, supra. The only common ground in the two cases is that in each the SG improperly urges that an attempt to patent a computer program is involved.

5. DISCUSSION. In Flook, the claimants attempted to patent a new mathematical formula which they discovered. Here, resps are attempting to patent the idea of combining a thermometer with a computer. The only distinction I see between this case and Flook is that resps here, unlike resps in Flook, do not concede that all the elements of their invention other than the formula are nonnovel. They argued below that taking continuous temperature readings was a novel idea. The Court in Flook stated: "Even though a phenomenon of nature or mathematical formula may be well known, an inventive application of the principle may be patented. Conversely, the discovery of such a phenomenon cannot support a patent unless there is some other inventive concept in its application. Here it is absolutely

clear that respondent's application contains no claim of patentable invention. The chemical processes involved in catalytic conversion of hydrocarbons are well known, as are the practice of monitoring the chemical process variables, the use of alarm limit limits to trigger alarms, the notion that alarm limit values must be recomputed and readjusted, and the use of computers for 'automatic monitoring-alarming.'" 437 U.S., at 594.

I think the CCPA erred when it concluded that it is irrelevant under § 101 whether resps' idea to take continuous temperature readings and to use a computer to recompute the cure time was novel. Flook makes this factor relevant. In this case as in Bradley, supra, the CCPA has interpreted Flook as not requiring segregation of the nonpatentable algorithm and examination of the rest of the invention for novelty. I recommend granting the petn and consolidating the case with Bradley, as suggested in the Preliminary on Bradley.

There is a response.

2-27-80 Hair Op in petn

March 14, 1980

Court .....
Argued ....., 19...
Submitted ....., 19...

Voted on ....., 19...
Assigned ....., 19...
Announced ....., 19...

No. 79-1112

DIAMOND, COMMR. PATENTS

vs.

DIEHR

Can't consolidate with 79-855 as issues are different

Grant.

	HOLD FOR	CERT.		JURISDICTIONAL STATEMENT				MERITS		MOTION		ABSENT	NOT VOTING
		G	D	N	POST	DIS	AFF	REV	AFF	G	D		
Burger, Ch. J.													
Brennan, J.													
Stewart, J.													
White, J.													
Marshall, J.													
Blackmun, J.													
Powell, J.													
Rehnquist, J.													
Stevens, J.													

Send Vote as 79-855

Reviewed 10/12. Extremely helpful.
Persuasive that my vote in Flook was error

pwc 10/11/80

BENCH MEMORANDUM

TO: Mr. Justice Powell

FROM: Paul Cane

DATE: October 11, 1980

RE: No. 79-1112, Diamond v. Diehr (1)

Question Presented

Does 35 U.S.C. § 101 permit the issuance of a patent for a process that uses a thermometer linked with a computer program to regulate the curing time of rubber products?

Background

This case is confusing. But its resolution turns principally on an application of a single Supreme Court case, Parker v. Flook, 437 U.S. 584 (1978). It is therefore instructive to review the analysis contained in Justice Stevens' majority opinion in Flook (which you joined), and Justice Stewart's dissenting opinion.

Flook controls - Q is what it holds & is it right

Flook had developed a "Method for Updating Alarm Limits." During the process of catalytic conversion, variables such as temperature, air pressure, and flow rates need to be watched for abnormal conditions. An "alarm limit" is a number derived from these variables that, if outside a certain range, reveals hazardous conditions. Traditional computations fail to take into account changes in the variables. Flook's method "updates" measurement of variables throughout the process and uses an algorithm, or formula, continually to recompute the "alarm limit." Although the calculations can be made by pencil and paper, the formula is particularly useful if programmed into a computer.

Flook's patent application did not, however, explain what the proper range of "alarm limits" should be, nor did it explain a method of automatically triggering an alarm system. The sole novel feature of the method was the formula.

In Flook, as in the instant case, patent officials had denied a patent, but the Court of Customs and Patent Appeals reversed. The Supreme Court in turn reversed. Justice Stevens wrote a majority opinion for six justices, which held that "a claim for an improved method of calculation, even when tied to a specific end use, is unpatentable subject matter under § 101," id. at 595 n.18, "unless there is some other inventive concept in its application," id. at 594. The Flook application, as was noted above, contained no novel feature except for the formula itself, so it was not patentable.

We denied patent, reversing CCPA

Justice Stewart dissented, writing also for the Chief Justice and Justice Rehnquist. The dissenters saw the issue as "whether a claimed process loses its status of subject-matter patentability simply because one step in the process would not be patentable subject matter if considered in isolation." Id. at 599 (emphasis in original). The Court's reasoning was defective, according to the dissenters, because it "import[ed] into its inquiry under 35 U.S.C. § 101 the criteria of novelty and inventiveness." Id. at 600. By focusing on novelty, the Court ignored the fact that

> Section 101 is concerned only with subject-matter patentability. Whether a patent will actually issue depends upon the criteria of §§ 102 and 103, which include novelty and inventiveness, among many others. It may well be that under the criteria of §§ 102 and 103 no patent should issue on the process claimed in this case, because of anticipation, abandonment, obviousness, or for some other reason. But in my view the claimed process clearly meets the standards of subject-matter patentability of § 101.

Id.

In sum, the majority recognized that the use of a formula, or computer program, did not foreclose a process from patentability under § 101. But the Court seemed to require that there be, in addition to a useful application of the mathematical principle, also some component of the process that is new. Thus, as I read Flook, the question of novelty is highly relevant to § 101 analysis as well as analysis under §§ 102 and 103.

In Flook novelty was thought relevant

Discussion

Petr, the Commissioner of Patents, contends that this case differs from Flook in no significant way. It therefore will be useful briefly to describe the technology of "curing" rubber and the improved process sought to be patented.

Rubber must be cured, or vulcanized, before it can be used. The time needed for curing depends on the temperature inside the press, which is roughly controlled by a thermostat. Other factors relevant to curing time are the geometric configuration of the press, and the viscosity of the rubber when it enters the press. A well-known formula, called the Arrhenius equation, permits calculation of the curing time. That formula, however, does not itself yield a precise curing time unless the temperature is constant throughout. But constant temperature is impossible to achieve because the thermostat controls the temperature only within a range around the desired temperature. Thus, curing time cannot be determined precisely. This makes curing a risky business. If rubber is taken out of the mold too soon, it is useless and must be discarded. If left in too long, time is wasted and there is minor deterioration of the rubber's quality. Because the risk of undercuring is greater than the risk of overcuring, manufacturers deliberately overcure; that is, they leave the rubber in the mold long enough to be certain that it is cured even if the actual temperature is on the low side of the range permitted by the thermostat.

Resp Diehr has developed a "process" that more

accurately computes curing time. Resp installed a special thermometer in the closed press that continuously reports the precise temperature inside the press. With each reported temperature reading, a computer using the Arrhenius equation constantly recomputes the necessary curing time. Because the precise temperature is known, the precise curing time also is known. The computer at the appropriate time signals a device to open the mold. Thus, resp's process means that manufacturers no longer have to conservatively estimate cure time to ensure that rubber will not be removed from the mold too soon.

This process has significant cost advantages. For example, resp's employer has increased productivity 20% because it no longer must deliberately overcure. Also, the elimination of deliberate overcuring has eliminated the small quality deteriorations caused by overcure. Resp claims that his company has saved about $400 million in the six years it has been using his process.

A. Petr's Arguments

Petr says this case "is Flook revisited." The only step of the process that resp says is novel is that of continuously measuring the temperature near the mold. But the Patent Board found that this was old, and that the computer program -- which clearly is not patentable -- was resp's sole novel "contribution." Flook, therefore, establishes that the entire process is nonstatutory subject matter under § 101.

The key to the inquiry is whether there is an aspect

of the process, including its application, that truly is new. Flook, 437 U.S. at 594, 595 n.18. Petr says there is none. A patent application by Gould & Davis earlier identified a similar process and application. The only difference between resp's scheme and that of Gould & Davis is that the point at which the temperature is measured.

Resp's sole contribution, if there is one at all, is programming the computer to control the process. But Flook established that a computer program itself was insufficient to render patentable an otherwise unpatentable process.

Nor was it sufficient that resp tacked obvious "post-solution" steps onto the process. Patentability does not turn on the draftsmenship of the claim.

B. Resp's Arguments

Resp emphatically argues that it is *not attempting* to *patent a computer program*. It is attempting to patent a process that happens to work best when a computer is used. Resp tacitly concedes that language in Flook may have introduced the question of novelty into the § 101 inquiry. Resp therefore argues in the alternative that (1) novelty should be irrelevant under § 101, and (2) even if novelty is relevant, the process is novel because it involves continuously measuring the actual temperature without distorting the molded rubber.

(1) Petr says that novelty is irrelevant for essentially the same reasons argued by Justice Stewart in his Flook dissent: novelty is properly only at issue in §§ 102 and

103.

(2) Even if novelty is relevant, it is present here. The Gould & Davis patent did not measure temperature the same way. Gould & Davis measured temperature inside the molded item. That is entirely inappropriate for rubber items that must conform to precise specifications, because the thermometer's presence distorts the shape of the item. Resp says its method measures temperature closely adjacent to, but not inside the mold. Thus, its measurement device is sufficiently new to render the entire process sufficiently new.

C. Criticism & Analysis

Dissent in Flook had merit

I would have though that there was much merit to Justice Stewart's dissent in Flook. It seems to me that novelty ought to be irrelevant to the § 101 inquiry. Novelty can be assessed under §§ 102 and 103. The inquiry under § 101 ought to be confined to examining whether the subject matter of the process is patentable, assuming novelty arguendo. Flook involved the patentability of a process the only novel element of which was a computer program. I would have thought that his patent should not have been denied as obvious under § 101, but rather under §§ 102 and 103.

My view, however, seems to have been rejected by the Court (and by you) in Flook. That case seems to hold that some discrete element of a process involving a computer must be new even to be patentable subject matter under § 101.

Unless the Court is willing to clarify or reconsider

Flook, the instant case seems to turn on whether any element of resp's process is new. The answer to that question, unfortunately, is not well presented for decision on this record. Resp says that the placement of the thermometer, and its use in permitting continuous calculations, are the novel elements of its process. But the Patent Board found that this was old. Pet. 24a, 60a. The CCPA, although observing in passing that it was "inclined to" think that the Patent Board erred in this factual determination, had dismissed the issue as irrelevant because "[c]onsiderations of novelty and obviousness have no bearing" in the § 101 inquiry. Thus, the CCPA did not review the Patent Board's factual finding that the placement and measurement aspects of the process were old. If the Court wants to reaffirm Flook, and insist on novelty as an element of the § 101 showing, it should remand so that the CCPA can determine whether any component of resp's process was novel.

Summary

Flook imported considerations of novelty and obviousness into the § 101 inquiry. Along with the three dissenters in that case, I think the Court -- if it meant what it said -- was wrong. In any event, the CCPA continues to treat those issues as irrelevant in the § 101 inquiry. The confusion that Flook has created in the patent office and CCPA is manifested by this case. The patent office found that resp's process was old because all of its aspects, including the

placement of the thermometer and system of immediate calculations, were old. The CCPA treated novelty as irrelevant and reversed.

If the Court wishes to stand by Flook and all of its language, a remand is necessary here to give the CCPA an opportunity to review the Patent Board's factual finding on novelty.

My preference, however, would be to clarify Flook and affirm. Resp does not want to patent a computer program, but rather a process. If the process is old, of course no patent should be granted. But the denial should be based on § 102 or § 103; considerations of novelty should not be addressed in § 101.

Ellen Richey in her cert annotation to Bradley, the companion case to Diehr, concisely summarized the options open to the Court. She wrote:

> The CCPA is purposefully disregarding Flook. Perhaps they have valid objections. If not, the Court must bring them back into line."

Paul

P.W.C. 10/11/80

79-1112 DIAMOND v. DIEHR AND LUTTON Argued 10/14/80

(Second case involving meaning of Flook)

Wallace (56)

Facts of Benson "very similar" to those in Flook.

"Algorithm" is like a "program" — but broader: it is a process involving step by ~~st~~ steps. Here we consider only a series of mathematical steps.

Bradley involved a "machine". Here, as in Flook, this case involves a "process".

[C.J. noted that Chakrabarty (n. 7?) said that Flook decided nothing new.

[P.S.: "Scope of patent is measured by its claims".

Flook must be more than a guide as to how claims should be drafted — whether claims are patentable not just a question of drafting

No novelty here in any of elements of this patent.

Flook requires some novelty other than a scientific principle. A new use of a principle may be patentable.

Results reached in Chakrabarty is consistent with Flook

Wallace (Cont)

BRW asked if govt disagreed that no computer program ~~[illegible]~~ is patentable. Wallace agreed this is Govt's position.

But processes & machines may be patentable even tho they include a program.

JPS noted that formula for curing rubber was well known. Here the claim is that the patent claimed an invention by using computers to apply the formula. JPS said this may be different from Flook. Wallace disagreed.

Wichenhauser (Resp)

Heat used in curing rubber. But could heat a mold ~~[illegible]~~ to cure rubber, but there was no way to know – except within broad bands – the temperature in the mold. The invention involves use of computer to calculate temperature continuously.

Different from Flook: alarm limit in Flook was a precise "number." Also only claimed novelty in Flook was a process to determine a single number.

Novelty here is continuous temperature reading w/o opening the rubber. This is different from ~~[illegible]~~ from Flook

Wickersham (cont.)

The mold opens automatically when the curing is complete.

More than $400,000,000 have been made with these products

The claims here were drawn before Flook. The mathematical formula was well known, & is not claimed

? § 101 issue should be decided without reaching "prior art" issue

The product here is a rubber ring used, e.g. to line inner area of a steel ring to prevent oil leaks in auto engines; on railway cars to prevent over heating of ball bearings, etc.

∴ § 101 contemplates something "physical composition" (e.g. machine or a tangible product or article).

→ Responding to JPS, this case & Bradley are different. No machine here. A computer is useless w/o a program. Here one computer controls 60 machines. Not interested in patenting the computer - nor in patenting a computer program. Resp. is not trying to protect anything except the process used in molding the rubber.

Wallace (Kelly)

Presence of this can be patented
– but not this one.

(I should check the Gould patent
– referred to in argument & briefs)

Affirm 5-4

79-1112 Diamond v. Diehr and Lutton Conf. 10/17/80

The Chief Justice Affirm

Process claim - transforming uncured rubber into seals to prevent oil leakage.

Flook dealt with a ~~formula~~ computer program. Here the "process" involves transformation of material into different state. Flook does not control.

Must more that some abstract principle. We should not read §101 narrowly. It is intended to encourage invention.

Mr. Justice Brennan Reverse

Flook can't be distinguished.

Mr. Justice Stewart Affirm

Agree with C. J.

Mr. Justice White Affirm

Agree with C.J.

Closer case than Bradley -

but Flook doesn't control.

Is patentable.

Don't need to reach J. Rich's

erroneous language.

× × × ×

Byron answered J Ps by saying his argument is addressed to 102 & 103 - not 101

Mr. Justice Marshall Reverse

Mr. Justice Blackmun Reverse

Mere presence of ~~computation~~ computer

process doesn't

Agree with memo of what CJ & BRW said.

Mr. Justice Powell Affirm

The claimed invention involves use of a computer to calculate temperature continuously in the process of molding rubber by heat into the inner lining of a ring (washer) to prevent oil leakage. (or method)

Not a machine, but is a process involving computer & programming. The process has significant cost advantages. The "method of continuous measuring" is only patentable feature

Years of experimentation & large investments have gone into this. Despite Flook, novelty should be irrelevant under §101. I could agree there is novelty

Mr. Justice Rehnquist Affirm

New & unobvious invention -

As to 101 patentable "subject-matter", this is "exactly what Patent Law is about"

Flook did not exclude all computer processes ...

No 102 or 103 issue presented

Mr. Justice Stevens Reverse - or Remand on Flook (?)

This is a poor art patent for 15 claims. Only claim 16 purports to be new, & as to this the computer is used to do more efficiently.

The idea is that the process is simply a faster way to do something that was not new.

Supreme Court of the United States
Washington, D. C. 20543

CHAMBERS OF
JUSTICE JOHN PAUL STEVENS

November 13, 1980

Re: 79-1112 - Diamond v. Diehr

Dear Bill:

In due course I shall circulate a dissent in this case.

Respectfully,

John

Mr. Justice Rehnquist

Copies to the Conference

Bowen + Flook distinguished - 10

Not a math formula - 11

A process - 11

But it does not include in protection of the claims the math formula used in the process. - 11

Claims embracing the process must be viewed as a whole - 13

To: The Chief Justice
Mr. Justice Brennan
Mr. Justice Stewart
Mr. Justice White
Mr. Justice Marshall
Mr. Justice Blackmun
Mr. Justice Powell
Mr. Justice Stevens

From: Mr. Justice Rehnquist

Circulated: NOV 13 1980

Recirculated:

1st DRAFT

SUPREME COURT OF THE UNITED STATES

§ 102 - not § 101 - addresses "novelty" - 13, 14

No. 79-1112

Do not decide novelty issue - 15, 16

Sidney A. Diamond, Commissioner of Patents and Trademarks, Petitioner, v. James R. Diehr, II and Theodore A. Lutton,	On Writ of Certiorari to the United States Court of Customs and Patent Appeals,

[November —, 1980]

MR. JUSTICE REHNQUIST delivered the opinion of the Court.

We granted certiorari to determine whether a process for curing synthetic rubber which includes in several of its steps the use of a mathematical formula and a programmed digital computer is patentable subject matter under 35 U. S. C. § 101.

Renewed 11/17

Probably Join (I may await dissent)

I

The patent application at issue was filed by the respondents on August 6, 1975. The claimed invention is a process for molding raw, uncured synthetic rubber into cured precision products. The process uses a mold for precisely shaping the uncured material under heat and pressure and then curing the synthetic rubber in the mold so that the product will retain its shape and be functionally operative after the molding is completed.[1]

Respondents claim that their process ensures the production of molded articles which are properly cured. Achieving

[1] A "cure" is obtained by mixing curing agents into the uncured polymer in advance of molding, and then applying heat over a period of time. If the synthetic rubber is cured for the right length of time at the right temperature, it becomes a useable product.

the perfect cure depends upon several factors including the thickness of the article to be molded, the temperature of the molding process, and the amount of time that the article is allowed to remain in the press. It is possible using well-known time, temperature, and cure relationships to calculate by means of the Arrhenius equation [2] when to open the press and remove the cured product. Nonetheless, according to the respondents, the industry has not been able to obtain uniformly accurate cures because the temperature of the molding press could not be precisely measured thus making it difficult to do the necessary computations to determine cure time.[3] Because the temperature *inside* the press has heretofore been viewed as an uncontrollable variable, the conventional industry practice has been to calculate the cure time as the shortest time in which all parts of the product will definitely be cured, assuming a reasonable amount of mold-opening time during loading and unloading. But the shortcoming of this practice is that operating with an uncontrollable variable inevitably led in some instances to overestimating the mold-opening time and overcuring the rubber, and in other in-

[2] The equation is named after its discoverer Svante Arrhenius and has long been used to calculate the cure time in rubber molding presses. The equation can be expressed as follows:

$$\ln v = CZ + x$$

wherein ln v is the natural logarithm of v, the total required cure time; C is the activation constant, a unique figure for each batch of each compound being molded, determined in accordance with rheometer measurements of each batch; Z is the temperature in the mold; and x is a constant dependent on the geometry of the particular mold in the press. A rheometer is an instrument to measure flow of viscous substances.

[3] During the time a press is open for loading, it will cool. The longer it is open, the cooler it becomes and the longer it takes to re-heat the press to the desired temperature range. Thus, the time necessary to raise the mold temperature to curing temperature is an unpredictable variable. The respondents claim to have overcome this problem by continuously measuring the actual temperature in the closed press through the use of a thermocouple.

stances to underestimating that time and undercuring the product.[4]

Respondents characterize their contribution to the art to reside in the process of constantly measuring the actual temperature inside the mold. These temperature measurements are then automatically fed into a computer which repeatedly recalculates the cure time by use of the Arrhenius equation. When the recalculated time equals the actual time that has elapsed since the press was closed, the computer signals a device to open the press. According to the respondents, the continuous measuring of the temperature inside the mold cavity, the feeding of this information to a digital computer which constantly recalculates the cure time, and the signaling by the computer to open the press, are all new in the art.

The patent examiner rejected the respondents' claims on the sole ground that they were drawn to nonstatutory subject matter under 35 U. S. C. § 101.[5] He determined that those

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[4] We note that the Government does not seriously contest the respondents' assertions regarding the inability of the industry to obtain accurate cures on a uniform basis. See Brief of Petitioner, at 3.

[5] Respondents' application contained 11 different claims. Three examples are claims 1, 2, and 11 which provide:

"1. A method of operating a rubber-molding press for precision molded compounds with the aid of a digital computer, comprising:

"providing said computer with a data base for said press including at least,

"natural logarithm conversion data (ln)

"the activation energy constant (C) unique to each batch of said compound being molded, and

"a constant (x) dependent upon the geometry of the particular mold of the press,

"initiating an interval timer in said computer upon the closure of the press for monitoring the elapsed time of said closure,

"constantly determining the temperature (Z) of the mold at a location closely adjacent to the mold cavity in the press during molding,

"constantly providing the computer with the temperature (Z),

"repetitively calculating in the computer at frequent intervals during

steps in respondents' claims that are carried out by a computer under control of a stored program constitute nonstatutory subject matter under this Court's decision in *Gottschalk* v.

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each cure, the Arrhenius equation for reaction time during the cure, which is

"ln v=CZ+x

"where *v* is the total required cure time,

"repetitively comparing in the computer at said frequent intervals during the cure each said calculation of the total required cure time calculated with the Arrhenius equation and said elapsed time, and

"opening the press automatically when a said comparison indicates equivalence.

"2. The method of claim 1 including measuring the activation energy constant for the compound being molded in the press with a rheometer and automatically updating said data base within the computer in the event of changes in the compound being molded in said press as measured by said rheometer.

"11. A method of manufacturing precision molded articles from selected synthetic rubber compounds in an openable rubber molding press having at least one heated precision mold, comprising:

"(a) heating said mold to a temperature range approximating a predetermined rubber curing temperature,

"(b) installing prepared unmolded synthetic rubber of a known compound in a molding cavity of a predetermined geometry as defined by said mold,

"(c) closing said press to mold said rubber to occupy said cavity in conformance with the contour of said mold and to cure said rubber by transfer of heat thereto from said mold,

"(d) initiating an interval timer upon the closure of said press for monitoring the elapsed time of said closure,

"(e) heating said mold during said closure to maintain the temperature thereof within said range approximating said rubber curing temperature,

"(f) constantly determining the temperature of said mold at a location closely adjacent said cavity thereof throughout closure of said press,

"(g) repetitively calculating at frequent periodic intervals throughout closure of said press the Arrhenius equation for reaction time of said rubber to determine total required cure time *v* as follows:

"ln v=cz+x

"wherein c is an activation energy constant determined for said rubber being molded and cured in said press, z is the temperature of said mold at

Benson, 409 U. S. 63 (1972). The remaining steps—installing rubber in the press and the subsequent closing of the press—were "conventional in nature and cannot be the basis of patentability." The examiner concluded that respondents' claims defined and sought protection of a computer program for operating a rubber molding press.

The Patent and Trademark Office Board of Appeals agreed with the examiner, but the Court of Customs and Patent Appeals reversed. The court noted that a claim drawn to subject matter otherwise statutory does not become nonstatutory because a computer is involved. The respondents' claims were not directed to a mathematical algorithm or an improved method of calculation but rather recited an improved process for molding rubber articles by solving a practical problem which had arisen in the molding of rubber products.

The Government sought certiorari arguing that the decision of the Court of Customs and Patent Appeals was inconsistent with prior decisions of this Court. Because of the importance of the question presented, we granted the writ.

II

Last Term in *Diamond* v. *Chakrabarty*, — U. S. — (1980), this Court discussed the historical purposes of the patent laws and in particular 35 U. S. C. § 101. As in *Chakrabarty*, we must here construe 35 U. S. C. § 101 which provides:

"Whoever invents or discovers any new or useful *process*,

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the time of each calculation of said Arrhenius equation, and x is a constant which is a function of said predetermined geometry of said mold,

"(h) for each repetition of calculation of said Arrhenius equation herein, comparing the resultant calcualted total required cure time with the monitored elapsed time measured by said interval timer,

"(i) opening said press when a said comparison of calculated total required cure time and monitored elapsed time indicates equivalence, and

"(j) removing from said mold the resultant precision molded and cured rubber article."

machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefrom, subject to the conditions and requirements of this Title."[5]

In cases of statutory construction, we begin with the language of the statute. Unless otherwise defined, "words will be interpreted as taking their ordinary, contemporary, common meaning," *Perrin* v. *United States*, — U. S. — (1979), and, in dealing with the patent laws, we have more than once cautioned that "courts 'should not read into the patent laws limitations and conditions which a legislature has not expressed.'" *Diamond* v. *Chakrabarty*, — U. S., at —, quoting *United States* v. *Dubilier Condensor Corp.*, 289 U. S. 178, 199 (1933).

The Patent Act of 1793 defined statutory subject matter as "any new and useful art, machine, manufacture or composition of matter, or any new or useful improvement [thereof]." Act of Feb. 21, 1793, ch. 11, § 1, 1 Stat. 318. Not until the patent laws were recodified in 1952 did Congress replace the word "art" with the word "process." It is that latter word which we confront today, and in order to determine its meaning we may not be unmindful of the Committee Reports accompanying the 1952 Act which inform us that Congress intended statutory subject matter to "include anything under the sun that is made by man." S. Rep. No. 1979, 82d Cong., 2d Sess., 5 (1952). H. R. Rep No. 1923, 82d Cong., Sec. 2d Sess., 6 (1952).

Although the term "process" was not added to 35 U. S. C. § 101 until 1952, a process has historically enjoyed patent protection because it was considered a form of "art" as that

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[5] The word "process" is defined in 35 U. S. C. § 100 (b):
"The term 'process' means process, or method, and includes a new use of a known process machine, manufacture, composition of matter, or material."

term was used in the 1793 Act.[7] In defining the nature of a patentable process, the Court stated:

> "That a proces may be patentable, irrespective of the particular form of the instrumentalities used, cannot be disputed. . . . A process is a mode of treatment of

[7] In *Corning* v. *Burden*, 15 How. 252, 267–268 (1853), this Court explained:

"A process, *eo nomine*, is not made the subject of a patent in our act of Congress. It is included under the general term "useful art." An art may require one or more processes or machines in order to produce a certain result or manufacture. The term machine includes every mechanical device or combination of mechanical powers and devices to perform some function and produce a certain effect or result. But where the result or effect is produced by chemical action, by the operation or application of some element or power of nature, or of one substance to another, such modes, methods, or operations, are called processes. A new process is usually the result of discovery, a machine, of invention. The arts of tanning, dyeing, making waterproof cloth, vulcanizing India rubber, smelting ores, and numerous others, are usually carried on by processes as distinguished from machines. One may discover a new and useful improvement in the process of tanning, dyeing, &c., irrespective of any particular form of machinery or mechanical device. And another may invent a labor-saving machine by which this operation or process may be performed, and each may be entitled to his patent. As, for instance, A has discovered that by exposing India rubber to a certain degree of heat, in mixture or connection with certain metalic salts, he can produce a valuable product, or manufacture, he is entitled to a patent for his discovery, as a process or improvement in the art, irrespective of any machine or mechanical device. B, on the contrary, may invent a new furnace or stove, or steam apparatus, by which this process may be carried on with much saving of labor, and expensive fuel; and he will be entitled to a patent for his machine, as an improvement in the art. Yet A could not have a patent for a machine, or B for a process; but each would have a patent for the means or method of producing a certain result, or effect, and not for the result or effect produced. It is for the discovery or invention of some practical method or means of producing a beneficial result or effect, that a patent is granted and not for the result or effect itself. It is when the term process is used to represent the means or method of producing a result that it is patentable, and it will include all methods or means which are not effected by mechanism or mechanical combinations."

> certain materials to produce a given result. It is an act, or a series of acts, performed upon the subject matter to be transformed and reduced to a different state or thing. If new and useful, it is just as patentable as is a piece of machinery. In the language of the patent law, it is an art. The machinery pointed out as suitable to perform the process may or may not be new or patentable; whilst the process itself may be altogether new, and produce an entirely new result. The process requires that certain things should be done with certain substances, and in a certain order; but the tools to be used in doing this may be of secondary consequence." *Cochrane* v. *Deener*, 94 U. S. 780, 787–788 (1876).

Analysis of the eligibility of a claim of patent protection for a "process" did not change with the addition of that term to § 101. Recently, in *Gottschalk* v. *Benson*, 409 U. S. 663 (1972), we repeated the above definition recited in *Cochrane* v. *Deener*, adding "Transformation and reduction of an article 'to a different state or thing' is the clue to the patentability of a process claim that does not include particular machines." *Id.*, at 70.

Analyzing respondents' claims according to the above statements from our cases, we think that a physical and chemical process for molding precision synthetic rubber products falls within the § 101 categories of possibly patentable subject matter. That respondents' claims involve the transformation of an article, in this case raw uncured synthetic rubber, into a different state or thing cannot be disputed. The respondents' claims describe in detail a step-by-step method for accomplishing such beginning with the loading of a mold with raw uncured rubber and ending with the eventual opening of the press at the conclusion of the cure. Industrial processes such as this are the type which have historically been eligible to receive the protection of our patent laws.[5]

This patent claim

[5] We note that as early as 1853 this Court has approvingly referred to

III

Our conclusion regarding respondents' claims is not altered by the fact that in several steps of the process a mathematical equation and a programmed digital computer are utilized. This Court has undoubtedly recognized limits to § 101 and every discovery is not embraced within the statutory terms. Excluded from such patent protection are laws of nature, physical phenomena and abstract ideas. See *Parker* v. *Flook*, 437 U. S. 584 (1978); *Gottschalk* v. *Benson*, 409 U. S. 63, 67 (1973); *Funk Bros. Seed Co.* v. *Kalo Co.*, 333 U. S. 127, 130 (1948). "An idea of itself is not patentable." *Rubber-Tip Pencil Co.* v. *Howard*, 20 Wall. 498, 507 (1874). "A principle, in the abstract, is a fundamental truth; an original cause; a motive; these cannot be patented, as no one can claim in either of them an exclusive right." *Le Roy* v. *Tatham*, 14 How. 156, 175 (1852). Only last Term, we explained:

> "[A] new mineral discovered in the earth or a new plant found in the wild is not patentable subject matter. Likewise, Einstein could not patent his celebrated law that $E=mc^2$, nor could Newton have patented the law of nature, free to all men and reserved exclusively to none.'"

Diamond v. *Chakrabarty*, — U. S. —, —, quoting

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patent eligibility of processes for curing rubber. See *Corning* v. *Burden*, 15 How. 252, 267 (1853); n. 7, *supra*. In *Tilghman* v. *Proctor*, 102 U. S. 707, 722 (1880), we referred to the original patent Charles Goodyear received on his process for "vulcanizing" or curing rubber. We stated:

"That a patent can be granted for a process, there can be no doubt. The patent law is not confined to new machines and new compositions of matter, but extends to any new and useful art or manufacture. A manufacture is clearly an art, within the meaning of the law. Goodyear's patent was for a process, namely, the process of vulcanizing india-rubber by subjecting it to a high degree of heat when mixed with sulphur and a mineral salt. The 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."

Funk Bros. Seed Co. v. *Kalo Co.*, 333 U. S. 127, 130 (1948).

Our recent holdings in *Gottschalk* v. *Benson*, *supra*, and *Parker* v. *Flook*, *supra*, both of which are computer-related, stand for no more than these long established principles. In *Benson*, we held unpatentable claims for an algorithm used to convert binary code decimal numbers to equivalent pure binary numbers. The sole practical application of the algorithm was in connection with the programming of a general purpose digital computer. We defined "algorithm" as a "procedure for solving a given type of mathematical problem,[5]" and we concluded that such an algorithm, or mathematical formula, is like a law of nature, which cannot be the subject of a patent.

Parker v. *Flook*, *supra*, presented a similar situation. The claims were drawn to a method for computing an "alarm limit." An "alarm limit" is simply a number and the Court concluded that the application sought to protect a formula for computing this number. Using this formula, the updated alarm limit could be calculated if several other variables were known. The application, however, did not purport to ex-

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[5] The term "algorithm" is subject to a variety of definitions. The Government defines the term to mean:

"1. A fixed step-by-step procedure for accomplishing a given result; usually a simplified procedure for solving a complex problem, also a full statement of a finite number of steps. 2. A defined process or set of rules that leads [*sic*] and assures development of a desired output from a given input. A sequence of formulas and/or algebraic/logical steps to calculate or determine a given task, processing rules."

This definition is significantly broader than the definition this Court employed in *Benson* and *Flook*. Our previous decisions regarding the patentability of "algorithms" are necessarily limited to the more narrow definition employed by the Court and we do not pass judgment on whether processes falling outside the definition previously utilized by this Court, but within the definition offered by the Government, would be patentable subject matter.

plain how these other variables were to be determined,[10] nor did it purport "to contain any disclosure relating to the chemical processes at work, the monitoring of process variables, or the means of setting off an alarm system. All that is provided is a formula for computing an updated alarm limit." 437 U. S., at 586.

In contrast, the respondents here do not seek to patent a mathematical formula. Instead, they seek patent protection for a "process" of curing synthetic rubber. Their process admittedly employs a well known mathematical equation, but they do not seek to pre-empt the use of that equation. Rather, they seek only to foreclose from others the use of that equation in conjunction with all of the other steps in their claimed process. These include installing rubber in a press, closing the mold, constantly determining the temperature of the mold, constantly recalculating the appropriate cure time through the use of the formula and a digital computer, and automatically opening the press at the proper time. Obviously, one does not need a "computer" to cure natural or synthetic rubber, but if the computer use incorporated in the process patent significantly lessens the possibility of "overcuring" or "undercuring," the process as whole does not thereby become unpatentable material.

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 utilizes a mathematical formula, computer program or digital computer. In *Gottschalk* v. *Benson*, *supra*, we noted "It is said

[10] As we explained in *Flook*, in order for an operator using the formula to calculate an up-dated alarm limit the operator would need to know the original alarm base, the appropriate margin of safety, the time interval that should elapse between each updating, the current temperature (or other process variable) and the appropriate weighing factor to be used to average the alarm base and the current temperature. 437 U. S. 584, 586. The patent application did not "explain how to select the approximate margin of safety, the weighing factor or any of the other variables." *Ibid.*

In Flook

But here - not a math formula.

a process. It include a math formula, but it is not covered by patent claims

that the decision precludes a patent for any program servicing a computer. We do not so hold." 409 U. S., at 71. Similarly, in *Parker* v. *Flook*, *supra*, we stated, "A process is not unpatentable simply because it contains a law of nature or a mathematical algorithm." 437 U. S., at 590. It is now commonplace that an *application* of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection. See, *e. g.*, *Funk Bros. Seed Co.* v. *Kalo Co.*, 333 U. S. 127 (1948); *Eibel Process Co.* v. *Minnesota & Ontario Paper Co.*, 261 U. S. 45 (1923); *Cochrane* v. *Deener*, 94 U. S. 780 (1876); *O'Reilly* v. *Morse*, 15 How. 62 (1853); and *Le Roy* v. *Tatham*, 14 How. 156 (1852). As Mr. Justice Stone explained four decades ago:

> "While a scientific truth, or the mathematical expression of it, is not a patentable invention, a novel and useful structure created with the aid of knowledge of scientific truth may be." *Mackay Radio Corp. & Telegraph Co.* v. *Radio Corp. of America*, 306 U. S. 86, 94 (1939).[11]

We think this statement in *Mackay* takes us a long way toward the correct answer in this case. Arrhenius' equation is not patentable in isolation, but when a process for curing rubber is devised which incorporates in it a more efficient solution of the equation, that process is at the very least not barred at the threshold by § 101.

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[11] We noted in *Funk Bros. Seed Co.* v. *Kalo Co.*, 333 U. S. 127, 130 (1948):

"He who discovers a hitherto unknown phenomenon of nature has no claim to a monopoly of it which the law recognizes. If there is to be an invention from such a discovery, it must come from the application of the law of nature to a new and useful end."

Although we were dealing with a "product" claim in *Funk Bros.*, the same principle applies to a process claim. *Gottschalk* v. *Benson*, 409 U. S. 63, 68.

In determining the eligibility of respondents' claimed process for patent protection under § 101, their claims must be considered as a whole. It is inappropriate to dissect the claims into old and new elements and then to ignore the presence of the old elements in the analysis. This is particularly true in a process claim because a new combination of steps in a process may be patentable even though all the constituents of the combination were well known and in common use before the combination was made. The "novelty" of any element or steps in a process, or even of the process itself, is of no relevance in determining whether the subject matter of a claim falls within the § 101 categories of possibly patentable subject matter.[12]

It has been urged that novelty is an appropriate consideration under § 101. Presumably, this argument results from the language in § 101 referring to any "new and useful" process, machine, etc. Section 101, however, is a general statement of the type of subject matter that is eligible for patent protection "subject to the conditions and requirements of this title." Specific conditions for patentability follow

[12] It is argued that the procedure of dissecting a claim into old and new elements is mandated by our decision in *Flook* which noted that a mathematical algorithm must be assumed to be within the "prior art." It is from this language that the Government premises its argument that if everything other than the algorithm is determined to be old in the art, then the claim cannot recite statutory subject matter. The fallacy in this argument is that we did not hold in *Flook* that the mathematical algorithm could not be considered at all when making the § 101 determination. To accept the analysis proffered by the Government would, if carried to its extreme, make all inventions unpatentable because all inventions can be reduced to underlying principles of nature which, once known, make their implementation obvious. The analysis suggested by the Government would also undermine our earlier decisions regarding the criteria to consider in determining the eligibility of a process for patent protection. See, *e. g.*, *Gottschalk* v. *Benson*, 409 U. S. 63 (1973); and *Cochrane* v. *Deener*, 94 U. S. 780 (1876).

and § 102 covers in detail the conditions relating to novelty.[13] The question therefore of whether a particular invention is novel is "fully apart from whether the invention falls into a category of statutory subject matter." *In re Bergey*, 596 F. 2d 952, 961 (CCPA 1979). See also *Nickolas* v. *Peterson*, 580 F. 2d 898 (CA6 1978). The legislative history of the 1952 Patent Act is in accord with this reasoning. The Senate Report provided:

> "Section 101 sets forth the subject matter that can be patented, 'subject to the conditions and requirement of

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[13] Section 102 is titled 'Conditions for patentability; novelty and loss of right to patent,' and provides:

"A person shall be entitled to a patent unless—

"(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or

"(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in the country, more than one year prior to the date of the application for patent in the United States, or

"(c) he has abandoned the invention, or

"(d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States, or

"(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or

"(f) he did not himself invent the subject matter sought to be patented, or

"(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other."

> this title.' The conditions under which a patent may be obtained follow, and *Section 102 covers the conditions relating to novelty.*" S. Rep. No. 1979, 82d Cong., 2d Sess., 5 (1952) (emphasis supplied).

It is later stated in the same report:

> "Section 102, in general, may be said to describe the statutory novelty required for patentability, and includes, in effect, the amplification and definition of 'new' in Section 101." *Id.*, at 6.

Finally, it is stated in the "Revision Notes":

> "The corresponding section of [the] existing statute is split into two sections, Section 101 relating to the subject matter for which patents may be obtained, and Section 102 defining statutory novelty and stating other conditions for patentability." *Id.*, at 17.

See also H. R. Rep. No. 1923, 82d Cong., 2d Sess. (1952), at 6, 7, and 17.

In this case, it may later be determined that the respondents' process is not deserving of patent protection because it fails to satisfy the statutory conditions of novelty under § 102 or nonobviousness under § 103. A rejection on either of these grounds does not affect the determination that respondents' claims recited subject matter which was eligible for patent protection under § 101.

IV

We have before us today only the question of whether respondents' claims fall within the § 101 categories of possibly patentable subject matter. We view respondents' claims as nothing more than a process for molding rubber products and not as an attempt to patent a mathematical formula. We recognize, of course, that when a claim recites a mathematical formula (or scientific principle or phenomenon of nature), an inquiry must be made into whether the claim is seeking patent protection for that formula in the abstract.

A mathematical formula as such is not accorded the protection of our patent laws, *Gottschalk* v. *Benson*, *supra*, and this principle cannot be circumvented by attempting to limit the use of the formula to a particular technological environment. *Parker* v. *Flook*, *supra*. Similarly, insignificant post-solution activity will not transform an unpatentable principle into a patentable process. *Ibid.*[11] To hold otherwise would allow a competent draftsman evade the recognized limitations on the type of subject matter eligible for patent protection. On the other hand, when a claim containing a mathematical formula implements or applies that formula in a structure or process which, when considered as a whole, is performing a function which the patent laws were designed to

[11] Arguably, the claims in *Flook* did more than present a mathematical formula. The claims also solved the calculation in order to produce a new number or "alarm limit" and then replaced the old number with the number newly produced. The claims covered all uses of the formula in processes "comprising the catalytic chemical conversion of hydrocarbons." There are numerous such processes in the petrochemical and oil refinery industries and the claims therefore covered a broad range of potential uses. 437 U. S., at 586. The claims, however, did not cover every conceivable application of the formula. We rejected in *Flook* the argument that because all possible uses of the mathematical formula were not pre-empted, the claim should be eligible for patent protection. Our reasoning in *Flook* is in no way inconsistent with our reasoning here. A mathematical formula does not suddenly become patentable subject matter simply by having the applicant acquiesce to limiting the reach of the patent for the formula to a particular technological use. A mathematical formula in the abstract is nonstatutory subject matter regardless of whether the patent is intended to cover all uses of the formula or only limited uses. Similarly, a mathematical formula does not become patentable subject matter merely by including in the claim for the formula token post-solution activity such as the type claimed in *Flook*. We were careful to note in *Flook* that the patent application did not purport to explain how the variables used in the formula were to be selected, nor did the application contain any disclosure relating to chemical processes at work or the means of setting off an alarm or adjusting the alarm limit. 437 U. S., at 586. All the application provided was a "formula for computing an updated alarm limit." 437 U. S., at 586.

protect (*e. g.*, transforming or reducing an article to a different state or thing), then the claim satisfies the requirements of § 101. Because we do not view respondents' claims as an attempt to patent a mathematical formula, but rather to be drawn to an industrial process for the molding of rubber products, we affirm the judgment of the Court of Customs and Patent Appeals.