No 71- 485



# TRANSCRIPT OF RECORD

# United States Court of Customs and Patent Appeals

PATENT APPEAL DOCKET

No. 8376

IN THE MATTER OF THE APPLICATION OF
GARY R. BENSON AND ARTHUR C. TABBOT

APPEAL FROM BOARD OF APPEALS

Serial No. 315,050

FILED APRIL 3, 1968
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INDEX.

IN THE

# United States Court of Customs and Patent Appeals

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## PATENT APPEAL

## No. 8376

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Appeal No. 768-60

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In re application of Gary R. Benson; Arthur C. Tabbot; Case: 1-1; Serial No. 315,050; Filed: October 9, 1963; Subject: CONVERSION OF NUMERICAL INFORMATION; Group 238

### Petition of Appeal

To the United States Court of Customs
and Patent Appeals:

Your petitioners, Gary R. Benson of 512 Hickory Drive in the town of Itasca, County of DuPage, and State of Illinois, and Arthur C. Tabbot, of 20 Mount Auburn Street in the town of Chelmsford, County of Middlesex, and State of Massachusetts, respectfully represent:

That they are the original, first and joint inventors of certain new and useful improvements in Conversion of Numerical Information;

That on the 9th day of October, 1963, in the manner prescribed by law, they presented their application to the Patent Office, praying that a patent be issued to them for the said invention;

That such proceedings were had in said Patent Office upon said application; that on the 31st day of January, 1968, it was rejected by the Board of Appeals and a patent for said invention was refused them;

That on the 26th day of February, 1968, your petitioners pursuant to Sections 141 and 142, United States Code, Title 35, gave notice to the Commissioner of Patents of their appeal to this Honorable Court from the refusal to issue a patent to them for said invention upon said application as aforesaid, and filed with him, in writing, the special reasons of appeal required by law; and

That the Commissioner of Patents is causing to be prepared and forwarded to the Clerk of this Honorable Court a certified Transcript of the record and proceedings relating to said application for patent, including the notice and reasons of appeal, which Transcript is to be filed herewith when received from the Commissioner of Patents and is to be deemed and taken a part hereof.

Wherefore your petitioners pray that their said appeal may be heard upon and for the reasons assigned therefore to the Commissioner of Patents as aforesaid, and that said appeal may be determined and the decision of the Commissioner be revised and reversed, that justice may be done in the premises.

Respectfully,

GARY R. BENSON
ARTHUR C. TABBOT

BY ROBERT O. NIMTZ
Attorney

Bell Telephone Laboratories, Incorporated—Murray Hill, N. J. 07974

Date March 29, 1968

Indorsed: United States Court of Customs and Patent Appeals. Filed Apr 3 1968. George E. Hutchinson, Clerk.

emj

U. S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT OFFICE

March 29, 1968
(Date)

THIS IS TO CERTIFY that the annexed is a true copy from the records of this office of Certain Requested Documents, said Documents being the Record for the United States Court of Customs and Patent Appeals, in the matter of the

Pending Application of
Gary R. Benson and
Arthur C. Tabbot,

Filed October 9, 1963 Serial Number 315,050

for
Conversion of Numerical Information.

By authority of the
COMMISSIONER OF PATENTS

OBIE C. DODSON
(SEAL) Certifying Officer.

1 **Application of Gary R. Benson and Arthur C. Tabbot, filed October 9, 1963, Serial Number 315,050, for Conversion of Numerical Information.**

This invention relates to the processing of data by program and more particularly to the programmed conversion of numerical information.

A program is a set of instructions for processing data in a preassigned fashion. The program consists of a series of steps, each of which includes one or more instructions whose location in storage is given by an accompanying address. During processing the storage is addressed to extract the instructions as needed, in a form that is compatible with the processing equipment.

The form of the data is governed by the kind of processing being undertaken. Where the data are received in one form, but are to be processed in another, conversion takes place beforehand, either by auxiliary equipment or by consigning a portion of the program for that purpose.

In the case of numerical information, the conversion is ordinarily made by adding different data constituents that are either weighted according to position or derived from a memory table. Unfortunately, when this kind of conversion is undertaken by programmed data processing, the number of steps becomes appreciable and some of the steps relativly complex. Because of their number and complexity, such steps significantly increase the amount of storage required, as well as the likelihood of error in the execution of a program.

Accordingly, it is an object of the invention to expedite the conversion of information from one form to another. A related object is to facilitate the programmed conversion of information.

2 Another object is to curtail the extent and complexity of the programming operations required. A related object is to dispense with the repetitive storing and retrieval of partially converted information.

A further object is to reduce the probability of error by eliminating the need for interchanging signals among various equipment components. A still further object is to accomplish the conversion without the need for auxiliary equipment.

In accomplishing the foregoing and related objects, the invention provides for the recurrent addition of a fixed quantity to registered signals representing a number being converted. The signals are shifted with respect to a fixed storage position at which the addition takes place. This produces, in effect, the addition of a variable quantity to a quantity which is itself variable.

Because the addition is made to take place recurrently, the number of programming steps, which involve distinctive operations, is significantly reduced. Since both the position of the addition and the quantity being added are fixed in fact, although variable in effect, numerous error-producing steps are eliminated.

In the case of a binary coded decimal number, for which each decimal digit is represented by four binary digits, the conversion to ordinary binary is undertaken by storing signals representing the coded number, shifting the signals with respect to a fixed storage position, masking the storage position immediately preceding the fixed position during preassigned shifting operations, and adding a fixed
quantity to the fixed position for each shifting
3 operation. The masking prevents unwanted carry
propagation during preassigned adding operations.

Other aspects of the invention will become apparent after considering an illustrative embodiment taken in conjunction with the figure which is a block diagram of a data processing system.

Considering, first, the data processing environment of the invention shown in the figure, a program store 10, operating through an instruction register 20 and a decoder 30, serves as a source of instructions for manipulating data originating in a data store 60 and entered into various data register 70 and 71. For simplicity the program store is separate from the data store, but the same unit, for example, a magnetic core matrix, of standard design, may be used for both.

Before an instruction can be executed, it is extracted from storage by a program address register 40 whose coded output gives the location of the instruction in the program store. After the code signals forming the address are dispatched in parallel through a gate 11 to the program store, the associated instruction enters the instruction register through another gate 12. Both gates are enabled from a timing network (not shown). They, as well as the timing network, are of conventional construction. The instruction entering the register has at least two portions—one of which is a command, the other of which is an operand. The operand is frequently either a data or a transfer address but it includes any item dispatched according to the command. The commands are translated by the decoder to energize distinctive output terminals. Generally, the decoder outputs enable various gates and other components.

4 Where the program steps are executed in sequence, each succeeding address is obtained by adding unit magnitude to its predecessor. This is accomplished by the operation of a standard increment circuit 41 through an associated gate 42.

When a transfer is to take place to a nonsequential address, the operand contents of the instruction register are sent through a gate 43 into the program address register. This gating is often contingent upon the existence of a prescribed condition, as determined by various comparator components 44 and 45. For one of the comparators, an associated counter 46 is present through a gate 47 and decremented for each enablement from the decoder. The associated comparator 45 produces an output only when the prese_t count has been reduced to a prescribed level.

In the data section of the figure the data register 70 is made re-entrant so that each shifting operation causes the contents of the first stage to enter the last stage. The extent of the shifting operation is established by a standard shift control network 72 which produces a number of shift signals determined by the operand contents of the instruction register after an enablement from the decoder.

Besides being re-entrant, the data register 70 includes a number of adder stages that are controlled from decoder leads shown at the top, right-hand section of the register. A single-stage output from the data register enables the comparator 44; its multi-stage output enters either the auxiliary data register 71 or a data store address register

73 through respective gates 74 and 75. Data store addressing takes place through gate 61. Other gates 76, 77 and 78 respectively link the data register 70 with the instruction register 20, the data store 60 and the auxiliary register 71. The data store gates 77 allow entry into, or extraction from, the data store in accordance with the instruction being decoded.

Turning now to a representative conversion of numerical information in accordance with the invention, the data processing system of the figure is employed to transform binary coded decimal data into ordinary binary. Such a conversion takes place in the binary processing of telephone information where dial signals are received in binary coded decimal form.

For simplicity, abbreviated dialing is considered where two decimal digits are sufficient to designate a desired connection. Each decimal digit is transmitted as four binary pulse signals. Thus the two-digit decimal number 53 appears in binary coded decimal notation as 0101 0011. A group of pulse signals representing the binary coded decimal notation is entered into the data register 70. The signals are obtained either from the auxiliary data register 71 or from an input-output section of the data store 60.

The units group of binary digits 0011, associated with the units decimal digit 3, is already in its regular binary form, and only the tens group 0101, associated with the tens decimal digit 5, requires conversion.

In the tens group, which is to be converted, each binary digit has its regular binary weighting multiplied by ten. Thus the first digit of the group, taken from the right, being a 1, has a weighting of ten. Ordinarily the conversion of this digit would necessitate adding the binary equivalent of ten to the *per*-existing digits of the units group. However, according to the invention, the first digit of the tens group is converted by shifting it with respect to a position where unit binary additions will produce the equivalent of adding ten. Since the binary system is based on powers of the number 2, the amounts to be added to form ten are eight and two. If the digit signals representing the number to be converted are shifted three places to the right, the position formerly occupied by the first digit signal will now correspond to a position with the weighting of eight units. Consequently, a signal binary digit added at that position will augment the pre-existing contents of the register by eight. To prevent the addition from disturbing higher order digit signals remaining to be coverted, the position occupied by the digit signal being converted is masked by being set to zero prior to addition.

In the example, the register is initially occupied by the binary groups 0101 0011, whose various digits are designated 8765 4321. After a shift of three places, the register, being re-entrant, is occupied by 0110 1010, where the digit designations are 3218 7654. Since the weighting of any binary position is $2^{n-1}$, where $n$ is the digit designation, the position of the first digit from the right has a weighting of eight. The masking and adding operations convert the groups to 0110 1000 and then to 0110 1001.

Subsequently the signals are shifted two places to the left so that the position formerly occupied by the first digit signal corresponds to a position with the two units. Here a unit addition converts the illustrative register contents to
1010 0110.

7 A procedure similar to the foregoing is repeated for digit signals, i.e., 1's, of higher order remaining to be converted. For the 0's, e.g., the second and third digits of the tens group, there is no conversion. They produce only shifting operations. At the end of the second cycle, associated with the second digit of the tens group, of the third cycle, the contents are 1101 0100. By the fourth cycle, the register contains 0110 1010. A final shift produces 0011 0101, which is the desired result.

To illustrate the entire procedure in detail a representative program is set forth in the table for converting a two-digit binary coded decimal number to ordinary binary.

*TABLE*

| *Program Store Address* | *Instruction* | |
|---|---|---|
| 108 | STC | 4 |
| 109 | CGT | ADR x DR |
| 110 | SHR | 3 |
| 111 | 2BT | 114 |
| 112 | SHR | 1 |
| 113 | TRA | 119 |
| 114 | SSB | 0 |
| 115 | AD1 | DR |
| 116 | SHL | 2 |
| 117 | AD1 | DR |
| 118 | SHR | 3 |
| 119 | TIX | 111 |
| 120 | SHR | 1 |

8 When the program store address is the binary equivalent of 108, the first instruction enters the instruction register. The command portion STC (Set Counter) of the instruction is decoded to operate gate 47 and set counter 46 to a reading of 4, given by the address portion of the instruction. The setting is determined by the maximum number of recurrences anticipated. Here the conversion is taking place with respect to the tens group of binary coded decimal digits in the number 53 and only four recurrences are needed. Since the counter is decremented at the end of each recurrence, it is set at 4.

On the next instruction 109, the command CGT (Clear and Gate) initiates the particular clearing and gating operation specified in the address ADR x DR (Auxiliary Data Register to Data Register). At this point the contents placed earlier in the auxiliary register 71, illustratively the binary coded decimal counterpart of 53, enter the data register 70.

The third instruction, at address 110, causes the contents of the data register 70 to be shifted to the right by three bit positions. This is accomplished by the command portion SHR (Shift Right) which activates the shift control network 72. The address portion 3 determines the number of shifts. When the shift control network 72 takes the form of a counter, the count is decremented for each shift so that at the conclusion of three such shifts, the network is in a zero state. Because the data register 70 is re-entrant, the prior three low order bits become the three high order bits after traversing a re-entry path from the right side to the left side of the register.

9 The fourth instruction 111 tests the second bit position of the data register for a ''zero'' or a ''one''. The command portion 2BT (2nd Bit Test) activates the comparator 44. If the second bit of the register 70 is a zero, the program proceeds to the next instruction 112 which the command portion SHR (Shift Right) places the next bit of the tens group in the data register in a position for conversion, again employing the shift control network.

The command TRA (Transfer) of the ensuing instruction 113 operates gate 43 and allows the address 119 to enter the address register. As a result, instruction 119 appears at the next cycle of operation in preparation for a reiteration.

Instruction 119 is necessary to control the number of iterations required. The command portion TIX (Transfer and Index) operates the comparator 45. The latter decrements the counter 46 that was set earlier to a count of four by instruction 108. As long as the count exceeds unity, the comparator 45 operates gate 43 and allows the address 111 to enter the address register 40. After four iterations, the program proceeds to address 120 and beyond.

For any iteration, if the test undertaken by instruction 111 indicates a one in the second bit position, a transfer is made to instruction 114. The command portion SSB (Set Second Bit) of instruction 114 sets the second bit position of the data register 70 to zero. The command portion AD1 (Add 1) of the succeeding instruction 115 increments the contents of the data register to produce an equivalent addition of 8, 16, 32 or 64 according to whether the iteration is in the first, second, third or fourth cycle.

10 For instruction 116 the command portion SHL (Shift Left) shifts the contents of the data register to the left by two positions. This operation is followed by instruction 117 which increments the contents of the data register 70 for an equivalent addition of 2, 4, 8 or 16 according to the iteration cycle.

Finally, instruction 118 shifts the contents of the data register to the right by three places with the result that after a transition beyond instruction 120 the contents of the data register contain the desired binary indications, the original indication having been variously supplemented by the binary equivalents of 10, 20, 40 and 80, according to the test specified by instruction 111.

Other adaptations and employments of the invention, together with numerous modifications, will occur to those skilled in the art.

What is Claimed is:

* * *

For Claim 8, see Rejected Claim 8.

11 Case 1-1

IN THE

UNITED STATES PATENT OFFICE

OATH, PETITION AND POWER OF ATTORNEY

State of New Jersey }
County of Monmouth } ss.:

Being duly sworn, we, Gary R. Benson and Arthur C. Tabbot depose and say that we are citizens of the United States, and residents of Hazlet and Freehold Township in the County of Monmouth, and State of New Jersey, respectively, that our post-office addresses are 3 Knoll Terrace, Hazlet, New Jersey; and 74 Koenig Lane, Freehold, New Jersey, respectively, and that we verily believe ourselves to be the original, first, and joint inventors of the invention in Conversion of Numerical Information described and claimed in the foregoing specification; that we do not know and do not believe that the same was ever known or used before our invention thereof; patented or described in any printed publication in any country before our invention thereof, or more than one year prior to this application, or in public use or on sale in the United States for more than one year prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by us or our legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said invention has been filed by us or our legal representatives or assigns in any country foreign to the United States.

Wherefore we pray that Letters Patent be granted to us for said invention; and we hereby appoint R. J. Guenther (Reg. No. 13465), and William L. Keefauver (Reg. No. 16301) of Bell Telephone Laboratories, Incorporated, Murray Hill, New Jersey, severally our attorneys, with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

12 Case 1-1

It is respectfully requested that all communications from the Patent Office in connection with this application be addressed to R. J. Guenther, Bell Telephone Laboratories, Incorporated, Murray Hill, New Jersey.

GARY R. BENSON
ARTHUR C. TABBOT

Sworn to and subscribed before me this 8th day of Oct., 1963

GENEVIEVE L. BEVERIDGE
Notary Public of New Jersey
My Commission Expires Jan. 4, 1967

## ASSOCIATE POWER OF ATTORNEY

Please recognize George E. Kersey (Reg. No. 20136) of Bell Telephone Laboratories, Incorporated, Murray Hill, New Jersey, as my associate attorney in the above-mentioned application, with full power to prosecute said application, to make alterations and amendments therein, to sign the drawings, and to transact all business in the Patent Office connected therewith.

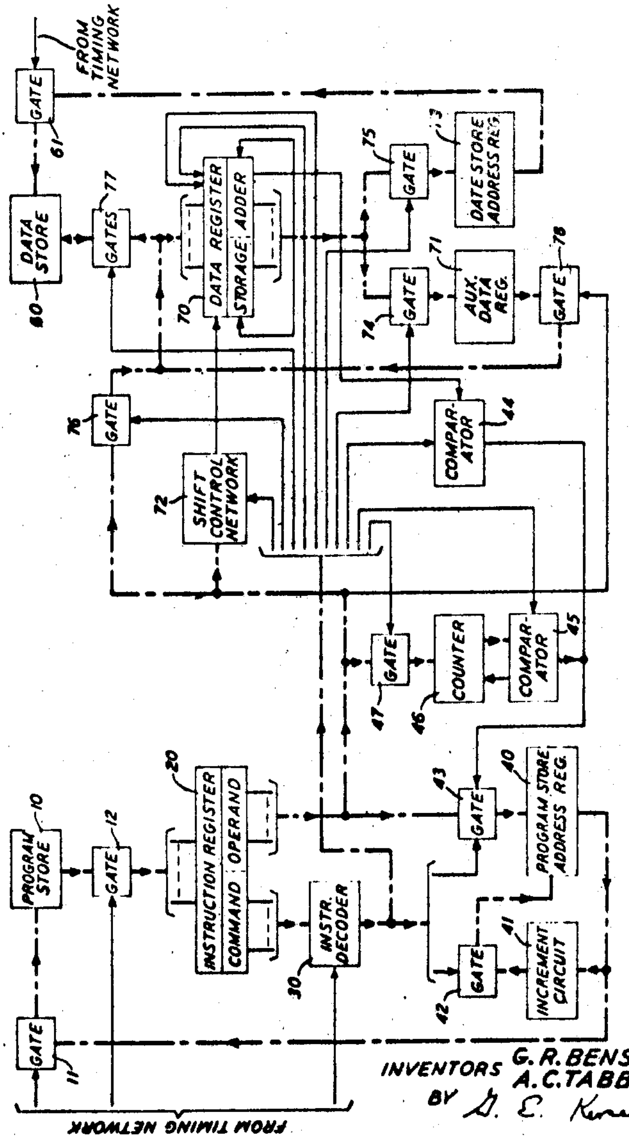
All communications, however, are to be addressed as above requested.

W. L. KEEFAUVER
W. L. KEEFAUVER, Attorney for Applicants

Pt. 4J-A 8-63

315050

PRINT OF DRAWING AS ORIGINALLY FILED




INVENTORS G.R. BENSON
A.C. TABBOT
BY G. E. Kerry
ATTORNEY

13

14 **Letter of Examiner, March 18, 1966**

This application has been examined.

References made of record:

| | | | |
|---|---|---|---|
| 2,970,765 | 2-1961 | Bird | 235-155 |

Claims 1-10 appear in this case.

1. Claims 1, 3, 7, are rejected as fully met by Bird under 35 U.S.C. 102. In Bird a signal is stored, the stored signal is shifted through the register, and a fixed quantity may be added at a fixed position. This process is repeated for each part of the stored signal. These steps are the same as those claimed by the applicant.

2. Claim 2 is rejected as fully met by Bird under 35 U.S.C. 102. Bird shows means for storing instructions (1); means for storing signals (4); means responsive to instructions to shift signals (12); and means responsive to instructions to add (3). This is same combination as claimed.

3. Claims 4, 5 are rejected as obvious over Bird under 35 U.S.C. 103. Bird shows all of the combination claimed as set forth in paragraph 2 except for means to enter the signal in the shift register. Bird states that the
15 signal to be converted is to be stored in the shift
register but doesn't show the specific input means. Since input means could be merely a wire connection this would be obvious to anyone skilled in the art.

4. Claims 1-5, 7 are further rejected as not clearly and distinctly claiming the invention under 35 U.S.C. 112. The claims are indefinite in that they don't disclose the inventive concept of the invention. As evidence of this is the fact that the Bird reference, which operates in a completely different manner than the application is read on by the claims.

5. Claim 8 is rejected as not clearly and distinctly claiming the invention under 35 U.S.C. 112. The steps of claim 8 will not perform the desired conversion in that the step of masking is omitted.

6. Claims 1, 3, 6, 7 are rejected as not clearly and distinctly claiming the invention under 35 U.S.C. 112. These claims are rejected as unpatentable since they are drawn to the inherent operation of the apparatus as claimed. The method cannot be carried out by hand or by a substantially different machine. See In re Gartner and Roeber, 106 U.S.P.Q. 273.

7. Claims 8-10 are rejected as drawn to non-statutory method claims for failure to define a process under 35 U.S.C. 101. The method claimed is merely a program which is a set of instructions to control the operation of a computer. The instructions are not a statutory process such as a method of manufacturing an article, but a
16 logical list of mental steps which can be applied to a computer to allow it to imitate the mental steps.

Claims 1-10 are rejected.

A Shortened Statutory Period for Response to this Action is Set to Expire Three Months from the Date of this Letter.

MAYNARD R. WILBUR

Maynard R. Wilbur
Examiner

17 **Amendment May 10, 1966**

The Commissioner of Patents,
Washington 25, D. C.

Sir:

In response to the Office action of March 18, 1966, please amend the above-identified application as follows:
Page 9, line 8, after the period insert [—]

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If the second bit of the register 70 is a "one," on the
A[1] other hand, the program proceeds to instruction 114 as will be described below. [—.]

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Claim 1, line 7, after "quantity insert —to said shifted signal—.

[Matter enclosed between brackets erased in copy.]

Claim 2, line 10, after "quantity" insert —to said shifted signal—.

Cancel claim 3.

Claim 8, after line 7 add

---

A² [—](3) masking out said binary "1" in said second position of said register, [ —, ]

---

line 8, change "(3)" to —(4)—;
line 10, change "(4)" to —(5)—;
18 line 12, change "(5)" to —(6)—;
line 13, change "(6)" to —(7)—.

Cancel claim 10.

Substitute the following claims for claims 3 and 10:

---

[—] 11. The data processing method for converting binary coded decimal number representations into binary representations comprising the steps of

(1) testing each binary digit position of a more significant decimal digit representation for a binary "one" representation, and

(2) in response to each binary "one" representation so found, adding a fixed binary digit pattern to the next lesser significant decimal digit representation, the binary

D

significance of said pattern with respect to said lesser significant decimal digit representation bearing a fixed relationship to the binary significance of the corresponding binary "one" in said more significant decimal digit representation.

12. The data processing method according to claim 11 further comprising the steps of

(1) storing said decimal digit representations in contiguous positions in a register; and

(2) resetting each said binary "one" representation found before adding said binary digit pattern.

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* * *

For Claim 13, see Rejected Claim 13.

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[Matter enclosed between brackets erased in copy.]
[Matter enclosed between rules erased in copy.]

19 * * *

*Remarks*

A clarifying insertion has been made at page 9 of the specification and claims 1, 2, and 8 have been amended to clarify and more clearly distinguish applicants' invention from the cited reference. The subject matter of claims 3 and 10 has been rewritten in newly added claims 11 through 13.

Claims 1, 3, and 7 were rejected as fully met by R. Bird patent 2,970,765, granted February 7, 1961. The Bird patent discloses several related means for translating or converting a binary number into the equivalent binary-coded decimal number. In the embodiment of Fig. 1,
20 for example, the binary-coded decimal equivalent of each binary position is stored on drum 1. These equivalents are accumulated in shift-register 9 for all those binary positions in which the binary number in shift register 4 has a "one". As noted by Bird (Col. 2, lines 23-30) this requires the storage of twenty-seven different decimal equivalents, each thirty-two digits long, a total of 864 digits to be stored.

As noted in applicants' specification (page 1, lines 16-25) it is systems just such as Bird's which applicants' invention is intended to be an improvement over. The "memory table" on Bird's track 2 (864 digits) represents considerable storage. Moreover, each step requires a complicated addition operation, increasing the likelihood of error. It is also noted that applicants provide a method for converting BCD to binary while Bird is concerned with converting binary to BCD.

Applicants require no separate storage of conversion values. The conversion value is instead available in the two simple "add one" instructions at store addresses 115 and 117 (Table, page 7). By shifting the number so as to make these simple additions at binary digit positions of successively greater significance, these same two instructions serve to generate all of the conversion values required. Moreover, since the overall conversion involves no more than the iteration of a short, simple sequence, less storage is required and errors are less likely to occur.

Turning to claim 1, the third step, as amended, calls for "adding a fixed quantity to said shifted signal at said fixed position for each shifting operation." Bird adds successively larger quantities (Fig. 1), not to the
21 shifted signal (in shift register 4), but to the previously accumulated sum in shift register 9. These differences are major. Since applicants add a "fixed quantity", the storage of equivalent values is not required. Since addition takes place in the same register in which the original number is stored, no accumulator register is required.

Claim 3 has been cancelled and claims 11 and 12 substituted therefor. Claim 11 even more specifically calls for "adding a fixed binary digit pattern to the next lesser significant decimal digit representation." Clearly Bird does not add a "fixed binary digit pattern."

Claim 7 similarly calls for "adding . . . a fixed quantity to said fixed position." Again, Bird adds successively increasing quantities.

Claim 2 was also rejected as being fully met by Bird. Claim 2, as amended, similarly calls for "means . . . for adding a fixed quantity to said shifted signals. . . ."

Claims 4 and 5 were rejected as obvious over the Bird patent, the Examiner commenting that "Bird shows all of the combination claimed as set forth in paragraph 2 except for means to enter the signal in the shift register." Claims 4 and 5, however, both call for "means . . . for adding a fixed quantity" as described with reference to claims 1, 2, 3, and 7 above.

Claims 1 through 5 and 7 were further rejected as not clearly and distinctly claiming the invention under 35 U.S.C. 112. The Examiner states:

> "The claims are indefinite in that they don't disclose the inventive concept of the invention. As evidence of

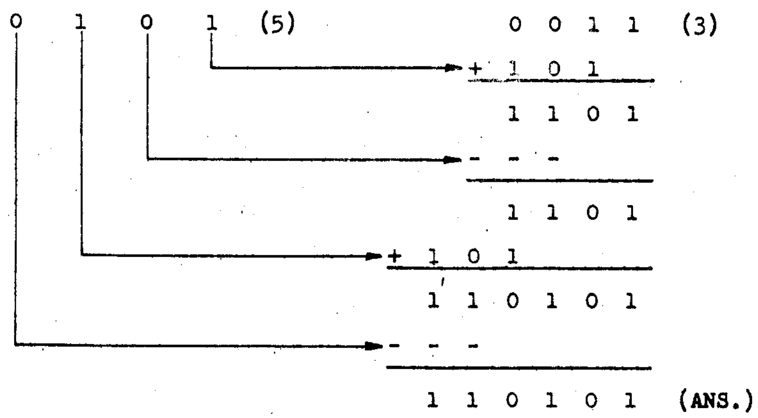
> this is the fact that the Bird reference, which operates in a completely different manner than the application is read on by the claims."

22 Applicants agree that Bird's arrangement "operates in a completely different manner than the application." Applicants do not agree, however, that the claims read on Bird. As noted above, each and every one of these claims includes a limitation clearly distinguishing it from the reference. Moreover, these limitations ("fixed quantity") are precisely and exactly the crux of applicants' invention. If the Examiner wishes to pursue this rejection, applicants would appreciate a statement of where, and in what way, these claims are indefinite.

Claim 8 was rejected as not clearly and distinctly claiming the invention under 35 U.S.C. 112 in that "The steps of claim 8 will not perform the desired conversion in that the step of masking is omitted." This objection is well taken. Claim 8 has been amended to recite such a masking operation.

Claims 1, 3, 6 and 7 were rejected as not clearly and distinctly claiming the invention under 35 U.S.C. 112 "since they are drawn to the inherent operation of the apparatus as claimed." The Examiner goes on to state that "The method cannot be carried out by hand or by a substantially different machine." It is clear, however, that applicants teach, in the table on page 7, how to practice the method on a stored program computer. It is also clear that special purpose computing elements, such as Bird's could easily be arranged to practice the method. Finally, the Patent Office Board of Appeals has recognized that many additional computers and machines can be simulated by a general purpose computer (*Ex parte King et al.* 146 U.S.P.Q. 590, page 591). It therefore appears that many substantially different machines could carry out the method. Indeed, it is a truism among those skilled in the art that any computing function which can be implemented by a special purpose computing machine can also be implemented by properly programming a general purpose computer, and vice versa.

Finally, the method represented by these claims can also be carried out by hand, the shifting and adding operations being manual. The example used in the specification can be done by hand as follows:




It therefore appears that the rule in In re Gartner and Roeber (106 U.S.P.Q. 273) is not applicable.

Claims 8 through 10 were also rejected as being drawn to non-statutory method claims for failure to define a process under 35 U.S.C. 101. The Examiner goes on to comment:

> "The method claimed is merely a program which is a set of instructions to control the operation of a computer. The instructions are not a statutory process such as a method of manufacturing an article, but a logical list of mental steps which can be applied to a computer to allow it to imitate the mental steps."



315,050

24 Applicants take exception to this entire line of argument. Concededly, applicants' methods *can* be implemented by a set of instructions which are used to control the operation of a computer. As noted above, they can also be implemented by circuitry which is wired to perform the function. They can even be practiced by hand. The method is therefore *not* merely a program, but is a method. Even if it could only be practiced by a programmed computer, it is difficult to see why the type of commercial apparatus available to practice a method should determine its patentability.

The Examiner's comment that "The instructions are not a statutory process such as a method of manufacturing an article" begs the question. Clearly, "articles" are not the only products which will support a method claim (*Ex parte Egan*, 129 U.S.P.Q. 23). On the other hand, we have today an entire industry set up for the express purpose of writing computer programs and selling them as articles of commerce.

The Examiner further states that this method is "a logical list of mental steps which can be applied to a computer to allow it to initiate the mental steps." It is difficult to see how a series of steps, intended to be carried out by a senseless piece of machinery, without human intervention, can be characterized as "mental" steps. The rational for the "mental step" cases was that the processes therein considered depended upon human calculations and reactions (See *Johnson v. Duquesne*, 29 F2 784) or that no physical subject matter is operated upon (see *Ex parte Star*, 24 U.S.P.Q. 91). Neither is the case here. No human intervention is required in the process, and the data involved must be embodied in a physical form ("signals" or "repre-
sentations") in which it can be operated upon. The
25 result is a "signal" or "representation" which not
only is physical subject matter, but can be used immediately, without human intervention, to control some further apparatus (chemical process, machine tool operation, etc.).

It should be noted that the term "computer program" is used indiscriminately to describe (1) a list of data processing steps independent of any specific computing machine, i.e., a higher order symbolic language program such as FORTRAN, COBOL, etc.; (2) a list of data processing steps which correspond, one-for-one to the program order words or instructions of a specific computer, i.e., a source program in symbolic language such as FAP or MAP; (3) a list of numerical symbols which express the program order words as instructions in purely digital terms, i.e., an object program or binary listing; and (4) the permutations of signals or states in the storage medium of a given computer. It is the last only which is immediately effective to accomplish the desired results.

It should be recalled that all of the above-described "programs" are merely descriptions. They all describe exactly the same *process*, but are "written" in notations which are different. The different notations, of course, are provided to render the process description meaningful to the user of that notation, i.e., symbolic notations for human programmers and electronic notations for electronic computer elements. The fact that programmers have devised notations more useful to them, however, should not obscure the basic fact that all of these descriptions are descriptions of processes. These processes are, of their very nature,
methods carried out by machine. All of the
26 popular myths concerning machines "thinking" are
just that and should not be interjected into the
present argument.

To further confuse the situation, each of the above-described levels of program notation can be recorded in a variety of ways, i.e., handwritten, printed, punched tape, magnetic tape or disk, photographic, electronic signals, electronic states, optical signals and so forth. The particular language used to describe a process, and the particular medium in which this description is recorded, however, cannot and do not change the fact that a process is involved.

It is respectfully submitted that the term "useful arts" in Article 1, Section 8 of the U. S. Constitution, the terms "process, art or method" in 35 U.S.C. 100 and the term "process" in 35 U.S.C. 101, should not arbitrarily be construed so as to exclude the single most important achievement of modern science.

In one of the landmark cases in this field (*Cochrone v. Deener,* 94 U. S. 780) the Supreme Court decided that:

> "A process is a mode of treatment of 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."

In following this line of reasoning, the Supreme Court, in *The Telephone Cases* (126 U. S. 1) decided that acts performed upon electrical signals constituted an "art" within the meaning of the statute.

27 It would therefore appear that methods for processing electrical signals are clearly within the statute. Indeed, the Patent Office continually grants such patents in the areas of telephony, radio, television, etc. The fact that, in a computer programming case, the signals represent numerical data rather than analogue data can hardly be controlling, particularly since analogue and digital representations are universally recognized as fully equivalent.

All of the claims in this case are believed to be clearly allowable and such allowance and passage to issue are respectfully requested.

Respectfully,

GARY R. BENSON
ARTHUR C. TABBOT

By Robert O. Nimtz
Attorney

28 **Letter of Examiner, August 23, 1966**

This is in response to the amendment filed May 10, 1966.

Claims 1, 2, 4-9, 11-13 remain in this case.

1. Claims 1, 2 are rejected as obvious over Bird under 35 U.S.C. 103. The difference between the claims and the reference as described in the previous Office action, paragraphs 1, 2, resides in the amendment to the original claims. That difference is the adding of a fixed quantity to the shifted signal. Bird shows the fixed quantities being added to a separate register. However it would be obvious to anyone skilled in the art that the fixed quantities could be reduced the proper amount and be added directly to the shifted signal thereby obtaining the same results. Applicant argues that Bird adds successively larger quantities rather than a single fixed quantity in all the cycles. This is conceded to be true, however, Bird does add a fixed quantity in each cycle, that the particular fixed quantity changes in a predetermined order does not
29 make the quantity a random one. Applicant may argue that this is not the intent of his usage in which case he is directed to the decision In re Richard Cleminson Cussons and Douglas Pevar, 148 USPQ 277 which assigns to words in a claim the "broadest applicable meaning."

2. Claims 4, 5, are rejected as obvious over Bird under 35 U.S.C. 103, as in the previous Office action paragraph 3. Applicants' arguments with regard to "a fixed quantity" are treated in paragraph 1, above.

3. Claim 7 is rejected as fully met by Bird under 35 U.S.C. 102 as in the previous Office action paragraph 1. Again applicants' arguments with regard to "a fixed quantity" are treated in paragraph 1, above.

4. Claims 1, 2, 4, 5, 7 are further rejected as vague and indefinite under 35 U.S.C. 112, as in the previous Office action. This rejection is applied because the claims do not particularly point out and distinctly claim the invention. Applicant and Examiner agree that Bird's invention operates in a different manner than does applicants' inven-

tion which implies that claims particularly pointing out and distinctly claiming applicants' invention should not be capable of being construed as reading on Bird. However the claims in question quite readily read on Bird which leads deductively to the conclusion that the claims do not particularly point out and distinctly claim the invention.

5. Claims 1, 6-9, 11-13 are rejected as not clearly
30 and distinctly claiming the invention under 35 U.S.C.
112. These claims are unpatentable since they are drawn to the inherent function of the apparatus. Applicant traverses this rejection for two reasons. First he states that the method can be used to program a computer, and that special purpose computing elements could easily be arranged to practice the method. As to the former part of this reason applicant is implicitly trying to obtain a patent for a computer program which are not processes or methods as described in 35 U.S.C. 101. A computer program is a list of instructions which are the result of the mental processes of the programmer to cause the computer to perform various steps which it is designed to do. Just as an old product cannot be the basis for a new patent because a new use is found for it neither should a computer be the basis for a new patent because a new arrangement of instructions which it can be used for is found, especially since the ability to accept various instructions to perform mathematical manipulations was precisely the purpose of the computer when conceived. As to the latter part of the reason, it does not overcome the rejection since it is not obvious what the arrangement would be, and whether or not the rearranged elements would be the same as the apparatus disclosed or its equivalent. This does not meet the criteria set down by In re Gartner and Roeber of a "substantially different machine." The second reason stated by applicant is that the method can be carried out by hand and exemplifies this method by writing out
31 manually the mathematical steps involved. This,
however, is not a manual process. The manual steps are merely recording on paper the mental processes in-

volved in the mathematics. The only manual method involved, contemplated by 35 U.S.C. 101, would be the method of writing the numbers which is certainly not part of the inventive concept.

6. Claims 8, 9, 13 are rejected as drawn to non-statutory method claims for failure to define a process under 35 U.S.C. 101. The method claimed is merely a program for a computer. In addition to the reasons stated in the previous Office action, paragraph 7, and in paragraph 5 above the examiner would like to point out further reasons for this rejection. First to clarify a statement in the previous Office action, the examiner did not intend to imply that a computer imitates mental steps by any method related to thinking. What was intended is that the computer is designed to electronically perform such steps as adding or subtracting and choosing by their locations in storage the proper numbers to be operated on. These individual steps produce the same result as the mental step of for instance adding two numbers. This was the "imitation of mental steps" implied. A program merely instructs the computer to perform the steps which it was designed to perform in a specific sequence and with specific numbers. Thus the only method illustrated by a program is the application of mental logic to arrange the solution of a problem in a form which can be used by the computer.
32 The solutions are mathematical calculations which are not patentable methods and therefore their translation to a form palatable to the computer should not be patentable methods either. Applicant cites The Telephone Cases, 126 U.S. 1 to show that acts performed upon electrical signals are patentable subject matter. This is not argued, however, a program performs no novel acts upon electrical signals, it merely specifies a sequence in which already known acts are performed on electric signals in a contemplated manner.

No claims are allowed.

This is a Final Rejection.

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS ACTION IS SET TO EXPIRE THREE MONTHS FROM THE DATE OF THIS LETTER.

MAYNARD R. WILBUR

MAYNARD R. WILBUR
Examiner

33 **Amendment, October 24, 1966**

THE COMMISSIONER OF PATENTS,
WASHINGTON 25, D. C.

SIR:

In response to the Office action of August 23, 1966, please amend the above-identified application as follows:

Claim 1, line 7, change "a fixed" to —*the same*—.
Claim 2, line 9, change "a fixed" to —*the same*—.
Claim 4, line 9, change "a fixed" to —*the same preselected*—.
Claim 5, line 8, change "a fixed" to —*the same preselected*—.
Claim 6, line 11, cancel "a";
line 12, change "fixed" to —*the same*—.
Claim 7, line 8, change "a fixed" to —*the same preselected*—.

*Remarks*

Applicants' attorney would like to thank the Examiner in Group 230B for the courtesies extended to him in a recent interview in the Patent Office.

Claims 1, 2, 4, 5, and 7 were rejected as fully met by, or obvious over, R. Bird patent 2,970,765, granted February 7, 1961. The Examiner comments that the term
34 "fixed" in these claims does not distinguish from
Bird who shows a "fixed" quantity added during each cycle, even though different quantities are added on different cycles. To avoid this rejection, applicants here-

with propose amendments to claims 1, 2, 4, 5, 6 and 7 substituting "the same" for "fixed." As noted during the recent Office interview, these amendments appear to overcome these particular grounds of rejection.

Claims 1, 2, 4, 5 and 7 were further rejected as vague and indefinite in not particularly pointing out and distinctly claiming the invention. The Examiner notes that "Applicant and Examiner agree that Bird's invention operates in a different manner than does applicants' invention," that the claims read on Bird, and therefore do not particularly point out and distinctly claim applicants' invention. Since the readibility of these claims in Bird is believed to be overcome by the previously noted amendments, this further rejection is likewise believed to be no longer applicable.

Claims 1, 6 through 9, and 11 through 13, were rejected "as not clearly and distinctly claiming the invention under 35 U.S.C. 112" because "they are drawn to the inherent function of the apparatus." This rejection, also raised by the Examiner on the last Office action, is respectfully traversed.

In support of his position, the Examiner makes many allegations concerning computer programs and mathematical manipulations. Rather than taking them up individually, applicants first would like to clarify the terminology.

> A program is a series of ordered steps specifying the detailed changes in state of the circuits of a data processor.

Subgroups of these changes can be evoked by a single instruction, and the entire series evoked by the successive *execution* of a plurality of these instructions. For convenience of use, each of these instructions have been given a name such that a list of names can be used to unambiguously specify the sequence of machine operations.

Each instruction must be related unambiguously and repeatedly to exactly the same subgroup of elemental machine operations. Each instruction, therefore, represents one such preselected subgroup, and the preselection is made by the computer designer. Thus, each instruction represents a machine operation, or operations, which are old in the patent sense.

A modern computer, however, has a large number of such preassigned instructions, 247 in the IBM 7094. The possible permutations of these instructions, even when each one is used and used only once, is so large ($>10^{433}$) as to be inexpressible. (100 billion computers, each producing one new permutation every 1/100 billionth of a second, would produce in 100 billion years only about 3 x $10^{40}$ permutations, an absolutely insignificant fraction of the total). While the computer manufacturer does provide the capability of performing each instruction, and does contemplate that these instructions will be combined in various different permutations, it can hardly be said that he contemplated any particular permutation out of the innumerable possibilities, much less all of them. One might much more readily assert that all possible (and impossible) chemical compositions are unpatentable in view of the finite set of chemical elements available.

36 The Examiner states that "the ability to accept various instructions to perform mathematical manipulations was precisely the purpose of the computer when conceived." Agreed. It does not follow, however, that a method using the old machine is not patentable. Most chemical processes, for example, also use previously known pieces of apparatus—pieces of apparatus, moreover, which operate in exactly the manner in which their designers intended. Novelty and patentability of applicants' claims obviously lie in the *combination* of steps, and not in any step taken alone.

Assertions that computer programs are not processes or methods under the statute are such that a determination can only be made after first determining what a program is. If it is a list, as the Examiner suggests (and such is given on page 7 of the specification), then it is clear that applicants' claims are *not* directed to the structure of such a list itself, but to the method implemented by a computer executing the instructions of the list.

To avoid further difficulties, it is here expressly admitted that applicants' method claims are directed to a machine algorithm for converting binary-coded-decimal representations into binary representations. By "algorithm" is meant a self-consistent set of ordered steps specifying definable operations and leading to a desired result. The program described symbolically on page 7 is just one way of implementing this algorithm.

To return to the heart of the rejection, i.e., that this algorithm is the inherent function of the disclosed apparatus, it is here submitted that the legal as well as the technical grounds for this rejection are not available in
37 this case. The case of *In re Gartner and Roeber,* 106
U.S.P.Q. 273 (CCPA 1955), the cases cited therein, and, indeed, all of the cases ever decided which involve this legal principle, are easily distinguished from the present application. In every one of those cases, a special purpose apparatus, specifically designed to practice the claimed method, and able to practice nothing but the claimed method or obvious variations thereof, was disclosed. Indeed, the only rational basis for these decisions was the inability to separate the claimed method from the necessary operation of the apparatus. If "inherent" is to mean anything at all, it least means more than the fact that the apparatus is *capable* of performing the method. In general, it would seem to mean that the apparatus was inescapably driven to perform just that method and no other by the rules of its own internal structure. Such is clearly not the case for a general purpose computer. As noted above, such a computer has the ability to perform incalculable numbers of different sequences, and has absolutely no internal preference for any one of them.

Even if this law were applicable to the present case, it is also clear that the methods of the present invention could be practiced by many other substantially different kinds of apparatus. In the previous amendment, appli-

cants attempted to demonstrate how this method might be practiced using a pencil and a piece of paper. Applicants, unfortunately, characterized this implementation as being "by hand" when a simple binary summing step was required. While it should be clear to the Examiner that binary summation can be accomplished with simple
38 mechanical, hydraulic, and optical devices, as well as electronic devices, the Examiner's point is not fully understood. If he has, in fact, shown that the process described by applicants is not entirely "by hand," what of it? Neither the cases nor common sense require this showing, but only that the method can be practiced in a substantially different manner than on the disclosed apparatus. However, to obviate the Examiner's evident difficulty with mental steps, this aspect of the example can be easily avoided. In order to relieve the person doing the paper-and-pencil implementation of any mental steps, the following table is supplied as an entire replacement of the mental aspects of these summing steps:

| *Addend Bit* | *Augend Bit* | *Sum Bit* | *Carry Bit* |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 |

Using this table and the format of the last amendment, the method can be practiced without any mental effort whatsoever.

Applicants also stated in the previous amendment that the method of his invention could be practiced on apparatus similar to Bird's in an obvious manner. The Examiner found it unobvious to himself, however. Such an implementation is therefore attached to this statement in the form of a sketch. A brief description of the operation of this apparatus is included on the attached sheet.

In view of any or all of the above considerations, it is respectfully requested that the rejection on the grounds of inherent function be withdrawn.

39 Claims 8, 9 and 13 were rejected "as drawn to non-statutory method claims for failure to define a process under 35 U.S.C. 101." The grounds on which the Examiner has drawn a distinction between these claims and the other method claims are not apparent to applicants' attorney. During the Office interview, the Examiner was not sure but what this rejection should be extended to all of the method claims. In view of these uncertainties, applicants will argue the general principles involved, and not the particular language of any of the claims.

The Examiner reapplies the previous reasons for this rejection (Office action of March 16, 1966) which read as follows:

> "The method claimed is merely a program which as a set of instructions to control the operation of a computer. The instructions are not a statutory process such as a method of manufacturing an article, but a logical list of mental steps which can be applied to a computer to allow it to imitate the mental steps."

The Examiner concedes that the machine does not actually think, but insists that it does "produce the same result as the mental step." The machine, however, produces, for example, electrical signals in binary form; the mental step does not. Moreover, a transcontinental television system only "produces the same result" as the human eye does at closer range. Data processing machines clearly do not operate by mental steps and hence the mental step doctrine is not applicable.

40 The Examiner further states that "The solutions [to problems] are mathematical calculations which are not patentable methods and therefore their translation to a form palatable to the computer should not be patentable methods either." Applicants challenge the Examiner to cite any decision of any court or other tribunal in which it is stated that mathematical calculations, per se, as distinguished from the mental process of performing such calculations, are unpatentable. Applicants' attorney has

been unable to do so. Claims involving adding, subtracting and so on appear in numerous issued patents. Claims are continually issued to circuit arrangements for adding, multiplying and so forth. Furthemore, a "solution" to the problem is not the novel subject matter here. Bird has already supplied that. It is a new method of solving the same problem, a method, moreover, which has large and unique advantages.

The Examiner notes that a program "merely specifies a sequence in which already known acts are performed on electrical signals." But the essence of a method is just such a sequence. The fact that all of the steps are individually old is irrelevant.

Applicants have tried to answer all of the rejections of the Examiner. It is hoped that at least the rejections on art and on inherent function have been overcome so as to limit the issues on appeal. Applicants appreciate the fact that the issues of non-statutory subject matter is one of first impression and cannot be decided by the Examiner contrary to Patent Office policy. It is hoped, however, that the issue can, at least, be thus narrowed.

41 If the Examiner has any questions or suggestions as to how to put this case in better form for appeal, he is invited to call applicants' attorney collect by dialing the Bell Telephone Laboratories-Washington, D. C. tie-line 965-3660 and asking the operator for Murray Hill extension 3772.

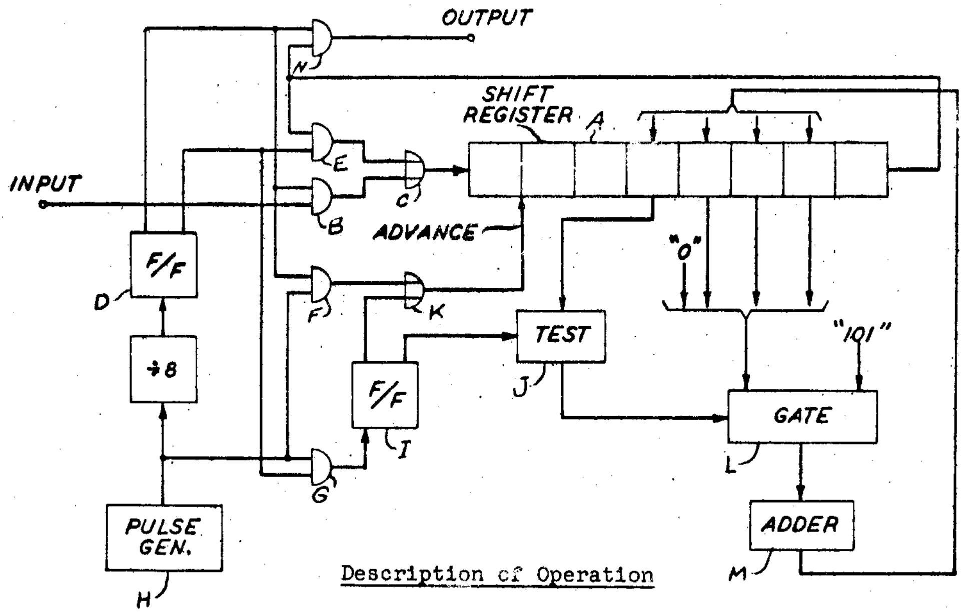
In the event that the Examiner does not find that this amendment places the case in a condition for allowance, it is respectfully requested that this amendment be entered as placing the case in better form for appeal.

Respectfully,

GARY R. BENSON
ARTHUR C. TABBOT

By Robert O. Nimtz
Attorney

BINARY-CODED-DECIMAL TO BINARY CONVERTER




Description of Operation

Initially, eight BCD bits are entered into shift register A through AND gate B and OR gate C. Flip-flop D then resets, enabling AND gates E and G. On alternate pulses from source H, flip-flop I sets and resets, alternately enabling test circuit J and advancing shift register A via OR gate K. Test circuit J tests the fifth bit position of register A and, if a "1" is detected, enables gate L. Gate L transfers the value "101" and the second through the fourth bit positions of register A to adder M, which adds them together and returns the sum to the second through fifth bit positions of register A. On alternate pulses from source H, shift register A is advanced one bit position, the bit leaving the right end entering the left end through AND gate E and OR gate C. After four such alternate tests and shifts, flip-flop D sets to enable AND gates B, F, and N, thus reading out the converted number via AND gate N, and reading in a new BCD number via AND gate B.

42

315,050

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43 **Letter of Examiner, November 29, 1966**

This is in response to the amendment filed October 24, 1966.

Reference cited:

| | | | |
|---|---|---|---|
| 3,019,426 | 1/30/62 | Gilbert | 340-347 |

Claims 1, 2, 4-9, 11-13 remain in this case.

In view of the amendment and remarks and the newly found reference the requirement of final rejection made in the Office action mailed August 23, 1966 is hereby withdrawn.

1. Claims 1, 7 are rejected as fully met by Gilbert under 35 U. S. C. 102. Gilbert shows a clock pulse connected to a counter. The clock pulse stores a signal in the counter causes the signal to be shifted and adds the same quantity to a fixed position of the counter.

2. Claims 1, 2, 6, 7, 9 are rejected as being inoperative under 35 U. S. C. 101. Each of the claims recite adding the same or a fixed signal for each shifting operation.
However, the invention as disclosed will not
44 produce the correct results, if such a step is followed. The invention requires a masking operation and addition of the same fixed quantity if a "1" signal is present in a specific stage.

3. Claims 4, 5 are rejected as being vague and indefinite under 35 U. S. C. 112. The claims are ambiguous in that they specify adding the same quantity in response to the presence of a signal in a preceding stage, and it is not specified that it must be a "1" signal present. The language presently used can refer to both a "1" or a "0" signal.

4. Claims 1, 2, 6 are rejected as being vague and indefinite under 35 U. S. C. 112. The claims are ambiguous in that they recite adding "the same quantity" which infers that either an equal quantity is added each time or the quantity added is the same as some other previous quan-

tity. The examiner would like to suggest that amending the claims to read "the same preselected" or "the same fixed" quantity would be given favorable consideration in overcoming this particular rejection.

5. Claims 11-13 are rejected as drawn to new matter under Rule 118. These claims are drawn to a method of operation which is not disclosed in the application as originally filed. They refer to a method where the binary equivalent of each bit of the binary coded decimal digits other than the units digit is added to the units digit in a single step of addition. The method claimed and disclosed in the original application is a specific way of adding in the equivalent of each bit including: storing the binary coded
decimal digits in a single shift register, shifting
45 the signal, masking a specific stage if a "1" signal
is present, adding the same fixed signal to another
specified stage, shifting the signal again and adding said same fixed signal again. This method being repeated for each remaining bit. This is certainly not the same method as the one in the claims in question. Claims 11-13 are hereby required to be cancelled.

6. The examiner would further like to point out that the "manual" method and alternative embodiment included in the amendments filed May 10, 1966 and October 24, 1966 respectively are not considered pertinent since they do not practice the method claimed. They both merely add in the binary equivalent of each bit of the "tens" digit separately in contradistinction to the specific method claimed as discussed in paragraph 5 above.

7. The examiner would like to suggest that to avoid confusion the specification be amended to refer to the individual binary digits of the decimal digits as bits. This would avoid possible confusion especially on page 6 where "digits" refers to the whole decimal one, in one phrase and the individual binary one in another.

8. Claims 8, 9 are further rejected as drawn to non statutory method claims for failure to define a process under 35

U. S. C. 101. The reasons for this are the same as those stated in the previous Office action paragraph 6. Paper No. 7.

No claims are allowed.

This is a Final Rejection.

A Shortened Statutory Period for Response to This Action is Set to Expire Three Months From the Date of This Letter.

MAYNARD R. WILBUR

Maynard R. Wilbur
Examiner

46 **Amendment, February 13, 1967**

The Commissioner of Patents,
Washington, D. C. 20231

Sir:

In response to the Office action of November 29, 1966, please amend the above-identified application as follows:

Page 2, line 25, change "digits" to —*bits*—.
Page 5, line 23, change "digits" to —*bits*—;
line 28, change "digit" to —*bit*—;
line 29, change "digit" to —*bit*—.
Page 6, line 1, change "digit" to —*bit*—;
line 2, change "digits" to —*bits*—;
line 3, change "digit" to —*bit*—;
line 8, change "digit" to —*bit*—;
line 10, change "digit" to —*bit*—;
line 12, change "digit" to —*bit*—;
line 15, change "digit" to —*bit*—;
line 16, change "digit" to —*bit*—;
line 19, change "digits" to —*bits*—;
line 22, change "digit" to —*bit*—;
line 23, change "digit" to —*bit*—;
47 line 24, change "digit" to —*bit*—;
line 29, change "digit" to —*bit*—;

Page 7, line 2, change "digit" to —*bit*—;
line 3, change "digits" to —*bits*—;
line 6, change "digit" to —*bit*—.
Claim 1, line 7, cancel the amendment of October 24, 1966 and change "a" to —*the same*—;
line 8, after "operation" and before the period insert —

which transfers a signal condition of a first kind into
[$C^1$] D
a selected storage position

—.
Claim 2, line 9, before "adding" insert —*selectively*—;
line 10, before "quantity" insert —*preselected*—.
Claim 6, line 11, before "adding" insert —*selectively*—;
line 12, before "quantity" insert —*preselected*—.
Claim 7, line 8, before "adding" insert —*selectively*—.
Claim 9, line 9, before "supplementing" insert —*selectively*—;
line 12, before "supplementing" insert —*selectively*—.

*Remarks*

Applicants' attorney would like to thank the Examiner in Group 238 for the courtesies extended to him during the recent interview in the Patent Office.

The final rejection made in the last Office action (Paper No. 7, August 23, 1966) was withdrawn and a new final rejection made, adding five new grounds of rejection as well as restating one of the old grounds (non-statutory subject matter).

48-
49 Claims 1 and 7 were newly rejected as fully met by J. Gilbert patent 3,019,426, granted January 30, 1962. The Gilbert patent is directed to a digital-to-analog converter and discloses (Fig. 3) a complementary analog-

[Matter enclosed between brackets erased in copy.]

to-digital converter involving a reversible counter 128 which is caused to count to the digital equivalent of an analog signal by an error signal representing the difference between the analog signal and the decoded counter output. The use made of this reference by the Examiner would seem to be restricted entirely to the counter, per se, and any digital counter would seem to have done as well.

The burden of the Examiner's argument is that the clock pulses applied to any counter stores a signal in the counter, shifts the stored signal and adds a fixed quantity to a fixed position in the counter. While this description of the operation of a binary counter is somewhat fanciful, and requires all three steps of applicants' method to be read on the same single operation in the reference, it is felt that this objection can be most easily avoided by amending the claims. Claims 1 and 7 have therefore been amended to recite "*selectively* adding the same fixed quantity to said shifted signal at said fixed position for each shifting operation." Claim 7 similarly calls for "*selectively* adding, for each net shift, the same preselected quantity to said fixed position." Whatever else Gilbert's counter does, it clearly does not add selectively on shifts. Gilbert's shift is no more than the carry propagation from the add operation. The Examiner agreed at the interview that these amendments avoided the Gilbert reference.

Claims 1, 2, 6, 7, and 9 were rejected as being inoperative, the Examiner commenting that "The invention requires a masking operation and addition of the same fixed quantity if a '1' signal is present in a specific stage." Insofar as masking is concerned, it is obvious that masking is required only if the binary coded decimal digits are all registered contiguously in the same register. If they are in separate registers, for example, masking is totally unnecessary. Masking merely prevents carry propagation between BCD digits of different significance when they are stored in immediate adjacency. In the general case, therefore, masking is not an essential step in applicants' invention and its absence by no means renders the claims inoperative. The Examiner agreed at the interview.

The objection to the lack of a positive recital of the conditional nature of the adding operation, however, is well taken. Claims 1, 2, 6, 7 and 9 have, as noted above, all been amended to recite "*selectively* adding (supplementing)" and are believed thereby to avoid this objection. The Examiner agreed at the office interview.

Claims 4 and 5 were rejected as being vague and indefinite in not specifying that the signal must be a "1" to cause the "adding" operation. Claim 4 calls for the "presence" of a signal while claim 5 calls for "occupancy" by a signal. The designations "1" and "0", however, are entirely arbitrary and each can refer to the presence or absence of a current or voltage. Moreover, the BCD number could be stored in complementary form, as numbers often are in computer registers, and in that case, the "signal" would have to be a "0". It therefore appears that the term "signal," by itself, is neither vague nor indefinite, but merely broad enough to cover the various possible contingencies. The Examiner indicated his agreement at the interview.

Claims 1, 2 and 6 were rejected as being vague and indefinite in reciting "the same quantity," and the Examiner has suggested alternate language. Since the scope
51 of these claims does not appear to be affected by the
changes, the Examiner's suggestions have been incorporated into these claims.

Claims 11, 12 and 13 were rejected as drawn to "new matter." The Examiner apparently distinguishes between the repeated, serial, single-bit additions of the program in the Table on page 7 of applicants' specification, and the parallel, simultaneous, bit additions shown in the hardware implementation found in the appendix to applicants' last amendment (Paper No. 8, October 24, 1966). While it might be argued that the embodiment in the aforesaid appendix was itself "new matter," it is clear that claims

11, 12, and 13 do not fall into the same category. Each of these claims reads quite readily on the embodiment of the program at page 7 of the originally-filed application. The fact that they are broad enough to read on the other embodiment is a question of scope, not of subject matter. With art no closer than that cited by the Examiners, such scope is believed to be fully warranted.

Claim 11, for example, calls for "adding a fixed binary digit pattern to the next lesser significant decimal digit representation." The claim is silent as to whether the "binary digit pattern" is added in a series of one bit steps, or all at once, in parallel. Claim 12 is dependent on claim 11.

Claim 13, even more significantly, calls for "adding a binary '1' to the (i + 1)th and (i + 3)th least significant binary digit positions of the next lesser significant decimal digit representation." Clearly the (i + 1)th and (i + 3)th bit additions could be accomplished serially as well as in parallel.

52 In view of the above fact, i.e., that the added claims 11, 12 and 13 clearly read directly on the original disclosure, it is believed that the rejection on the grounds of new matter is totally unwarranted. It is further noted that a careful reading of applicants' original disclosure, except where the specific embodiment is described, leads to the conclusion that other embodiments were originally intended to be included. The general description of the invention at page 2, line 10 through page 3, line 2, for example, can be just as easily applied to the embodiment in the appendix to applicants' last amendment as to the embodiment of the original specification. The Examiner indicated his agreement to withdraw the rejection by telephone on January 31, 1967.

The Examiner further notes that the "manual" method and the alternative embodiment in the appendix of applicants' last amendment are not considered pertinent since they do not practice the method claimed. This argument is really the obverse of the one considered above. It is welcomed by applicants because it serves to point out, better than applicants themselves have been able to do so far, the necessity for various different kinds of claim coverage.

In the first place, since the Examiner has not seen fit to repeat the rejection of the last Office action, based on the grounds of "inherent function of the apparatus," his objection to the "manual" method and the special purpose circuit embodiment seems moot. Without this rejection, no showing of alternative embodiments is required.

In the second place, even if the above rejection had been repeated, it is clear that claims 1 and 4, originally in the case, read directly on the alternative embodi-
53 ment. Indeed, this is precisely the reason that method claims were included in the first place. The very fact that such distinctly different embodiments of the invention fall under the terms of the claims is almost conclusive of the need for both apparatus and method claims. While it might be argued that the alternative embodiment is "new matter," clearly the original claims are not.

The Examiner has suggested that confusion can be avoided by substituting "bits" for "binary digits." This suggestion is believed to be extremely valuable and has been adopted.

Claims 8 and 9 were further rejected as being drawn to non-statutory subject matter "for failure to define a process under 35 U. S. C. 101."

Although this rejection was discussed in considerable detail at the interview, the Examiner stated that this rejection would not be withdrawn. Since it is believed that agreement has been reached on all other issues, entry of this amendment is requested as placing the case in better condition for appeal.

Applicants would appreciate a specific restatement of the grounds of rejection of claims 8 and 9, and of the authorities relied on to support these grounds, so that they may better address themselves to these grounds on appeal.

Applicants' attorney continues to be available by telephone as indicated in the prior formal responses.

Respectfully,

GARY R. BENSON
ARTHUR C. TABBOT

By ROBERT O. NIMTZ
Attorney

54 **Appeal to Board of Appeals, February 27, 1967**

The Commissioner of Patents
Washington, D. C. 20231

Sir:

Appeal is herewith taken to the Board of Appeals from the action of the Primary Examiner finally rejecting claims 1, 2, 4, 5, 6, 7, 8, 9, 11, 12, and 13 of the above-entitled application.

A check for fifty dollars ($50.00) to cover the appeal fee is transmitted herewith.

An oral hearing is requested.

Respectfully,

GARY R. BENSON
ARTHUR C. TABBOT

By ROBERT O. NIMTZ
Attorney

55 **Office Letter, April 18, 1967**

Applicant's first response to the final rejection, filed Feb. 21, 1967, has been considered with the following effect, but it is not deemed to place the application in condition for allowance:

1. [ ] The entire response, including any proposed amendments to the claims, will be entered for appeal purposes.
2. [x] The proposed amendments to the claims will not be entered because:

a. [ ] There is no convincing showing under Rule 116(b).
b. [x] They raise new issues that would require further consideration and/or search.
c. [ ] They raise the issue of new matter.
d. [x] They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal.
e. [ ] They present additional claims without cancelling a corresponding number of finally rejected claims.

3. [ ] The affidavit or exhibit has been entered but does not overcome the rejection.
4. [x] For purposes of appeal, the status of the claims is as follows:
   a. [ ] Claims .................... stand allowed.
   b. [x] Claims 1, 2, 4-9, 11-13 stand rejected. However:
      (1) [ ] The rejection of claims ........ on references is deemed to be overcome by applicant's response.
      (2) [ ] The rejection of claims ........ on non-reference grounds only is deemed to be overcome by applicant's response.
5. [ ] The response was not timely filed. The application stands abandoned.
6. [ ]

NOTE: No further amendment will be entered unless it is apparent on its face that it places the application in condition for allowance.

THE PERIOD FOR RESPONSE CONTINUES TO BE THAT SET IN THE FINAL REJECTION.

MAYNARD R. WILBUR

MAYNARD R. WILBUR
Examiner

56 **Brief, April 21, 1967**

I. *INTRODUCTION*

This is an appeal from the final rejection of claims 1, 2, 4, 5, 6, 7, 8, 9, 11, 12 and 13 (all of the claims) of the above-identified application. These claims appear in Appendix A to this brief.

Claims 1 and 7 stand rejected as fully met by J. Gilbert patent 3,019,426, granted January 30, 1962, under 35 U. S. C. 102.

Claims 1, 2, 6, 7 and 9 stand rejected as being inoperative under 35 U. S. C. 101.

Claims 4 and 5 stand rejected as being vague and indefinite under 35 U. S. C. 112.

Claims 1, 2 and 6 stand rejected as being vague and indefinite under 35 U. S. C. 112.

Claims 11, 12 and 13 stand rejected as being drawn to new matter under Rule 118.

Claims 8 and 9 stand rejected as drawn to non-statutory methods in failing to define a process under 35 U. S. C. 101.

Appellants' attorney apologizes for the multiplicity of grounds of rejection from which this appeal is taken. Appellants' attorney has attempted, throughout the prosecution of this case, to present the issue of non-statutory method claims (the last ground cited above) in as clear and uncluttered a fashion as possible. Appellants' attorney believes this to be an important issue, the resolution of which would benefit both the Patent Office and the patent bar. Unfortunately, however, due to a change in personnel in the Patent Office, agreements reached with one Examiner
57 were unpersuasive to the succeeding Examiner. As
late as April 13, 1967, appellants' attorney interviewed the Examiner and his Primary in the Patent Office in an attempt to reduce these issues. At that time, they were unwilling to even discuss the merits of this case.

It will be noted that five new grounds of rejection were introduced in the second final rejection, including newly cited art, and that appellants were given only three months to respond. Having responded, after oral agreement with the Examiner, within the required period, appellants are now back in the same position they were when the final rejection was initially written.

## II. *THE INVENTION*

The present invention comprises methods of and apparatus for converting binary-coded-decimal (BCD) numerical representations into conventional binary (binary) numerical representations. More specifically, the present invention is directed toward simplifying such numerical conversions by simplifying the apparatus necessary to achieve this conversion and increasing the speed at which conversion can be accomplished. (See specification, page 2, lines 1 through 9.)

### A. *State of the Art*

To aid in an understanding of the subject matter of this case, the following definitions are provided:

*Number:* A symbolic representation of quantity in a discrete, quantized form.

*Binary Number:* A number expressed in the binary notation, using a radix of two.

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*Decimal Number:* A number expressed in the decimal notation, using a radix of ten.

*Binary Bit:* One of the set of symbols used to express binary numbers. The binary bits are 0 and 1.

*Decimal Digit:* One of the set of symbols used to express decimal numbers. The decimal digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

*Binary-Coded-Decimal (BCD) Number:* A decimal number expressed in binary notation. Specifically, a number in which each decimal digit is expressed by a different binary number.

*Significance:* The weighting applied to each bit or digit of a number due to its relative position in the number.

It is well known that modern digital data processing circuits are best adapted to process two-state signals and that binary representations are best suited for describing such signals. Most human beings, on the other hand, have become accustomed, through long years of habit, to decimal representations of numerical information. It has therefore become usual to translate between the two notations—binary and decimal—at the man-machine interface.

The job of translating between the decimal and binary notation is best done by a machine. Since the machine is desirably restricted to two state (binary) representations, binary-coded-decimal (BCD) notation was adopted for representation of decimal information inside of the machine.* According to this notation, each decimal digit is represented in the machine by a permutation of a
59 plurality (usually four) of binary bits. As an example, the decimal number "53" is represented *in BCD* by

"0101 0011"

where "0101" is the conventional binary representation of the decimal digit "5" and "0011" is the conventional binary representation of the decimal digit "3". This is to be distinguished from the conventional *binary* representation of the decimal number "53", which is "110101."

Since numerical operations in the machine are most easily accomplished in the binary notation, a translation

* See E. G. Andrews, "Telephone Switching and the Early Bell Laboratories Computers," *Bell System Technical Journal,* Vol. XLII, No. 2, March 1963, page 341.

between BCD and binary must be accomplished. The present invention is a method of and apparatus for just such a translation, *from* binary-coded-decimal notation *to* binary notation.

The prior art BCD-to-binary translators are typified by the primary reference in this case, R. Bird patent 2,970,765, granted February 7, 1961. This art recognizes that each binary bit in a BCD number has a fixed binary conversion value. For example, the right-most, least significant (if these numbers are thought of as being written in normal pencil notation) binary bit of the BCD tens digit is equivalent to the decimal value "10", which is "1010" in binary notation. Similarly, the next more significant binary bit has the conversion value "20", or "10100" in binary notation. The remaining two bits have decimal values 40 and 80, respectively. In the same way, the binary bits of the BCD hundreds digit have the weights 100, 200, 400 and 800, respectively. A table of the lower conversion values is given in Appendix F.

If all of these conversion values are stored, selected ones can be added, by binary addition, to obtain the binary equivalent of any BCD number. It is merely necessary to check for a binary "1" in the BCD number and, if it is present, to add in the appropriate conversion value. When all of the BCD bits are exhausted, the conversion is complete. The prior art algorithm, then, consists of testing each BCD bit and, if a "one" is detected, adding in the corresponding conversion value.

It will be appreciated that the above-described conversion algorithm requires a readily accessible storage medium for all possible conversion values. (See Birds' magnetic drum 1, Fig. 1 which holds 32, twenty-seven bit conversion values.) While such a storage medium is usually possible, it is clear that such storage facilities, and the circuitry required for gaining access thereto, represent a sizable cost in the conversion circuitry. Moreover, since the access speed for most storage facilities exceeds the time required to test binary bits, a time delay is also introduced while waiting for the conversion values from storage. Finally, the added complexity increases the possibility of failure and therefore lowers the reliability of the conversion circuits.

B. *Appellants' Contribution*

In order to overcome the disadvantages of the prior art conversion procedures, appellants have invented a completely different algorithm or method for BCD-to-binary conversion. In general, appellants avoid the necessity for storing a large number of conversion values by taking advantage of certain logical relationships between
61 these values. These relationships can be most easily
seen from the following table of tens digit conversion values, taken from Appendix F.

| *Decimal Representation* | *Binary Representation* |
|---|---|
| 10 | 1010 |
| 20 | 10100 |
| 40 | 101000 |
| 80 | 1010000 |

It will be noted that these binary values each involve the binary pattern "101" followed by a different number of zeros. These conversion values can therefore all be generated merely by shifting this pattern an appropriate number of places to the left. Alternatively, the pattern "101" can be held in a fixed position and the augend to which it is to be added shifted an appropriate number of places to the right. Appellants, in their preferred embodiment, have chosen the latter alternative.

In its broadest outline, appellants' preferred algorithm is as follows:

1) Store two multibit binary-coded-decimal (BCD) digits in a shifting register;

2) Test the more significant BCD digit, beginning at the least significant bit, for ones and zeros;

3) For each binary one detected, add the binary pattern "101" to the lesser significant BCD digit at the ap-

propriate bit positions, displaced a fixed distance from the tested bit;

4) For each binary zero detected, add nothing; and

62 5) Shift the BCD digits one place to the right and repeat steps 2 through 5.

When implementing the algorithm with digit significance increasing to the left, it is apparent that the bit test shifts one bit to the left for each test and the addition likewise shifts one bit to the left for each "1" detected. The test and addition can therefore take place at fixed positions and the BCD bits shifted to the right.

The algorithm has been described above only with respect to two-digit decimal numbers. It can be applied in a straightforward manner to BCD numbers having any number of binary-coded-decimal digits. That is, the ten-to-one relationship between adjacent BCD digits is true for all adjacent digits and not only the two least significant digits. In order to convert a BCD number with a greater number of digits, it is only necessary to start at the two most significant BCD digits, converting the most significant into the second most significant BCD digit. This augmented second most significant BCD digit is then converted to the third most significant BCD digit, and so forth, until the entire number is converted to the least significant BCD digit. Since the least significant BCD digit is already expressed in the ordinary binary notation, the conversion is then complete.

It will be noted that, in the above-described conversion of multidigit BCD numbers, the bit tests and the pattern to be added remain the same, the only difference being the significance of binary positions at which such tests and additions take place. This algorithm, therefore, is ideally suited to machine implementation.

63 Once it is understood, this algorithm can be implemented in many different ways. In appellants' specification, an implementation on one type of general purpose computer is diclosed. This implementation requires the programming of the computer to perform the steps of

shifting, testing and adding in the appropriate sequence.

During the course of prosecution (in response to a rejection of method claims as reciting the inherent function of the apparatus), appellants submitted a disclosure of a special purpose circuit arrangement which also implements the algorithm. This implementation is shown in the attached Appendix B. The patent disclosure was made in terms of programming a general purpose computer, however, because this is "the best mode contemplated by the inventor of carrying out his invention." (35 U. S. C. 112.)

Turning to the detailed implementation of appellants' invention as shown in the specification, the single figure shows a register 70 in which a BCD number can be stored, a shift control network 72 to control successive shifts, and an adder network associated with register 70 to perform the necessary additions. The remaining components of the figure are utilized to retrieve the program instructions and execute them according to the algorithm.

Considering the program listing on page 7 of appellants' specification, it can be seen that this series of instructions implements BCD-to-binary conversion according to appellants' invention. These instructions are reproduced here for convenience.

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| *Address* | *Instruction* |
|---|---|
| 108 | STC 4 |
| 109 | CGT ADR x DR |
| 110 | SHR 3 |
| 111 | 2BT 114 |
| 112 | SHR 1 |
| 113 | TRA 119 |
| 114 | SSB 0 |
| 115 | AD1 DR |
| 116 | SHL 2 |
| 117 | AD1 DR |
| 118 | SHR 3 |
| 119 | TIX 111 |
| 120 | SHR 1 |

Instruction 108 (STC)* causes the counter 46 to be set to the value "4", representing the four binary bits in each BCD digit. Instruction 109 registers the BCD number in the shifting register 70. Instruction 110 causes the BCD number to be shifted to the right three places. In this connection, it should be noted that register 70 is re-entrant and bits passing out of register 70 to the right re-enter from the left, preventing any loss of bits.

The purpose of instruction 110 is to place the BCD bits in position for the bit test at instruction 111. Thus, instruction 11 tests the second bit from the right for a "1" or a "0". If a "1" is detected, a transfer is initiated to instruction 114 (where conversion values are added in). If a "0" is detected, control passes to instruction 112 where the BCD bits are shifted right one place in preparation for the test on the next bit position. At instruction 113, control is transferred to instruction 119.

If a "1" is detected at instruction 111, instruction 114 is executed, setting this "1" to a "0". This is necessary in this implementation of the algorithm because the BCD digits are stored contiguously, and additions to the lesser significant BCD digit could otherwise cause carry propagation into the higher significant BCD digit.

At instruction 115, a binary "1" is added to the contents of the shift register 70. As a result of the right shift in instruction 110, this addition takes place at the fourth least significant bit position of the lower significant BCD digit. This addition therefore has a binary weight of "8".

At instruction 116, the contents of register 70 are shifted left two places and, at instruction 117, a binary "1" again added. This addition takes place at the second least significant bit position of the least significant BCD digit and therefore has a binary weight of "2". Together, therefore, the additions at instructions 115 and 117 have the effect of adding the pattern "101" to the least significant BCD digit.

* Note: STC,CGT, etc. are mnemonic codes representing binary operation codes which cause the machine to execute the described operations.

This is exactly the required conversion value for the least significant bit of the more significant BCD digit. At instruction 118, the contents of register 70 are shifted right three positions in preparation for the next bit test at instruction 111. At instruction 119, the count in counter 46 is decremented one, tested for "0", and, if not zero, control is transferred to instruction 111.

The single bit additions and shifts of instructions 115 through 118 are provided to allow this algorithm to be performed using a register 70 having only single bit addition (counting) facilities. With circuitry having an expanded adding capacity, both bits can be added
66 simultaneously, further reducing the number of steps
in the implementation. This is illustrated by the implementation of the same algorithm on the IBM 7094 computer in the program listing in Appendix C, attached hereto.

When control is returned to instruction 111 by instruction 119, the same test and additions take place, this time, however, displaced by one shift to the right. Together, these additions have the effect of adding "20" to the binary number. Similarly, the third and fourth cycles add "40" and "80", respectively, if ones are detected at instruction 111.

It can be seen that appellants' most basic contribution to the art of digital data processing is in the *method* of translating BCD character representations to ordinary binary number representations. This overall method appellants have termed an "algorithm" in accordance with common usage in the programming art. This algorithm or method can be equally well implemented by conventional circuitry (see Appendix B) or by programming another general purpose computer (see Appendix C). Moreover, each of these implementations is obvious from the others (appellants' attorney prepared the implementations of Appendices B and C without technical assistance). For these reasons, method claims were included in the present application.

## III. *THE REJECTIONS*

### A. *In General*

All of the rejections in this case, made in the final rejection of November 29, 1966 (Paper No. 9), were made by an Examiner no longer in the employ of the Patent Office. These rejections were discussed with that Examiner,
67 by telephone and in a personal interview, and agreements reached as to the resolution of all grounds of rejection except non-statutory subject matter. These agreements are summarized in appellants' proposed amendment of February 13, 1967 (Paper No. 10, a copy of which is attached hereto as Appendix E).

Since appellants' attorney reached an understanding with the previous Examiner as to the meaning of his rejections and of the amendments necessary to overcome these rejections, and since all of the necessary amendments have been proposed, appellants' attorney is at a disadvantage with the new Examiner. Appellants' attorney realizes that the new Examiner is not strictly bound by the previous Examiner's agreements, nor are appellants entitled to entry of their amendment as a matter of right. On the other hand, the mutual understanding of appellants' attorney and the previous Examiner, apparently not shared by the new Examiner, is the only basis on which appellants' attorney is able to discuss the issues. As of the time of writing this brief, appellants' attorney does not have the benefit of the new Examiner's views. After having believed that the proposed amendment would be entered by the previous Examiner, appellants' attorney discovered, on April 7, 1967 (39 days after filing his Notice of Appeal), that the proposed amendment would *not* be entered, not even for the purposes of this appeal. At this time, therefore, appellants' attorney can do no more than reiterate the arguments made in the proposed amendment of February 13, 1967, and await the new Examiner's views in his Answer.

### 68 B. *Claims 1 and 7 Fully Met by Gilbert*

Claims 1 and 7 were rejected as fully met by J. Gilbert patent 3,019,426, granted January 30, 1962. The Gilbert patent is directed to analog-to-digital and digital-to-analog converters. In Fig. 3 there is disclosed an analog-to-digital converter in which a reversible binary counter 128 is caused to count to the digital equivalent of an analog signal by an error signal. The error signal represents the signed difference between the analog signal and a decoded counterpart of the counter output. The use made of this reference, and the previous Examiner's admissions, indicate that the counter, per se, is the only structure relied upon.

As is well known (although not shown in Gilbert's Fig. 3), a binary counter includes a plurality of binary stages to which pulses to be counted are applied. The counter operates to count these pulses by changing its state for each application of a pulse. In general, a first stage changes state with a first pulse and changes back to its original state with a second pulse, simultaneously forcing the second stage to change state. This forcing of the next higher stage to change state is usually called "carry propagation." The first stage continues to change state with succeeding pulses, forcing ever higher order stages to change state by cumulative carry propagations.

As appellants' attorney understands the rejection, the Examiner argued that the clock pulses applied to the counter served to "store" a signal in the counter (by a change of state), shifts this stored signal by carry propagation, and adds a fixed quantity by the applica-
69 tion of successive clock pulses. Although appel-
lants' attorney finds the language of claims 1 and 7 (storing, shifting and adding) considerably strained when read on the incrementing of a binary counter by the application of clock pulses, appellants proposed to amend these claims to recite "*selectively* adding." In this way, it was felt that any vestige of a possibility of applying those claims to the reference was avoided since the reference does

not *"selectively* add" for each shift. Indeed, Gilbert's "shift" is no more than the carry propagation from the previous "addition." The "addition" is not selective in any manner, but *must* occur for each clock pulse applied. Similarly, the "shift" *must* occur when dictated by the circuitry in response to the "addition."

Appellants' attorney and the previous Examiner both agreed that the operation of the reference and appellants' claimed methods were substantially different. The only difficulty of the Examiner was having to insure that the claim language clearly excluded the reference. The proposed amendment, it was agreed, accomplished this result. Appellants continue ready to amend these claims as proposed or in any other reasonable manner to avoid this reference.

### C. *Claims 1, 2, 6, 7 and 9 Inoperative*

Claims 1, 2, 6, 7 and 9 were rejected as inoperative under 35 U. S. C. 101. The Examiner contended that the claimed method and apparatus would not operate without a masking operation or apparatus.

This rejection can be best understood if it is recalled that each addition in appellants' invention can cause carry propagation. If these carry propagations are allowed to change the next higher order BCD digit before it is completely converted, errors will occur.

70 Appellants pointed out in their proposed amendment, and again point out here, that carry propagation can take place between the BCD digits only if they are registered in immediately adjacent stages in the register ("store"). There is no absolute requirement, however, for these BCD digits to be adjacent or, for that matter, even in the same register. The BCD digit of higher significance can, for example, be tested in one register and the addition take place in a separate register. No masking would then be required.

Since appellants' methods and apparatus would operate equally well without a masking operation (if the BCD digits are non-contiguous), it is submitted that the lack of a masking step or apparatus does not render these claims inoperative.

The Examiner further noted in this rejection that the claims also do not require the addition operation to be conditional on the detection of a "1" in the higher significant BCD digit. Appellants proposed to amend claims 1, 2, 6, 7 and 9 to insert "selectively" before "adding" and "supplementing." The previous Examiner agreed. Appellants continue ready to make these amendments or any other reasonable amendments to avoid this rejection.

D. *Claims 4 and 5 Indefinite Without "1"*

Claims 4 and 5 were rejected as being vague and indefinite under 35 U. S. C. 112 in failing to specify that a "1" signal must be present as a precondition to adding. As noted in appellants' proposed amendment, claim 4 calls for the "presence" of a signal while claim 5 calls for "occupancy"
by a signal. The designations "1" and "0" are en-
71 tirely arbitrary and each can refer to the presence
or absence of a current or voltage (a signal). Since it is often the practice in computer registers to store numbers in their complementary form (in index registers, for example), and since in that form the signal would have to be a "0", the requirement for specifying a "1" is not believed to be well founded. The term "signal" by itself is neither vague nor indefinite, but merely broad enough to encompass the obvious possible alternatives.

The previous Examiner indicated his agreement with this position. Without the benefit of the new Examiner's views, appellants' attorney is at a loss to carry the argument any further.

E. *Claims 1, 2, and 6 Indefinite With "Same Quantity"*

Claims 1, 2, and 6 were rejected as being vague and indefinite in reciting "the same quantity" for the addition. While the language is broad, it is clearly *is* not vague and, in the absence of closer prior art, should be allowed. However, the previous Examiner suggested alternative language which appellants adopted in their proposed amendment to avoid further delay due to this issue. Appellants continue ready to make these amendments or any other reasonable amendments to resolve this issue.

### F. *Claims 11, 12, and 13 New Matter*

Claims 11, 12 and 13 were rejected as being drawn to new matter under Rule 118. The previous Examiner distinguished between the algorithm of the program in the Table on page 7 of appellants' disclosure and the
72 algorithm practiced by the special purpose circuitry
of Appendix B. In the program algorithms, the bit pattern "101" is added by two successive one bit additions displaced by two bit positions. In the circuit algorithm, the entire pattern "101" is added as a unit. The Examiner's position, then, was that because claims 11, 12 and 13 read on the embodiment of Appendix B, they therefore were directed to new matter.

Appellants argued in their proposed amendment, and again argue here, that the test for "new matter" is *not* whether or not the new claims read on the new embodiment (so do original claims 1, 2, 4, 5 and 7), but whether or not these new claims read on the original embodiment. As stated in Rule 118, ". . . all amendments of the drawings or specifications, and all additions thereto, must conform to at least one of them as it was at the time of the filing of the application." The issue, then, is whether or not added claims 11, 12 and 13 can be applied to the program embodiment of the invention in the original disclosure.

Claim 11 calls for "adding a fixed binary digit pattern to the next lesser significant decimal digit representation." The claim is silent as to whether the "binary digit pattern" is added in a series of spaced, one-bit steps, or all at once, in parallel, as a complete pattern. It is concluded that claim 13 *does* read on the original disclosure and hence is not new matter.

Claim 12 is dependent on claim 11 and merely recites the added step of masking by "resetting" the tested bit before addition. This step is clearly disclosed in the original disclosure (Instruction 114, Table 1, page 7, of the original specification).

73 Claim 13, even more significantly, calls for "adding a binary '1' to the (i + 1)th and (i + 3)th least significant binary digit positions of the next lesser significant decimal digit representation." Clearly, the (i + 1)th and (i + 3)th bit additions can be accomplished serially as well as in parallel. Indeed, by separating these two single-bit additions, claim 13 reads even more easily on the original disclosure than on the new embodiment of Appendix B.

Furthermore, a careful reading of the general description of appellants' invention at page 2, line 10 through page 3, line 2, of the original disclosure, indicates that embodiments such as that of Appendix B are well within the scope of the invention. Clearly, there is no language which specifically excludes such an embodiment.

It is concluded that appellants' added claims are not directed to "new matter" simply because they are broad enough to include obvious alternatives to the preferred embodiment of the original disclosure. The original Examiner agreed with this conclusion.

### G. *Claims 8 and 9 Non-Statutory Methods*

#### 1. *The Rejection*

Claims 8 and 9 were rejected as drawn to non-statutory subject matter. This is the only ground upon which appellants and the original Examiner were unable to reach a resolution of the issue. Since appellants' attorney has had great difficulty in summarizing the Examiner's position, his rejections are here repeated in full.

74 a. *Paper No. 4, Rejection of March 18, 1966:*

"Claims 8-10 [claim 10 was since cancelled] are rejected as drawn to non-statutory method claims for failure to define a process under 35 U.S.C. 101. The method claimed is merely a program which is a set of instructions to control the operation of a computer. The instructions are not a statutory process such as a method of manufacturing an article but a logical list of mental steps which can be applied to a computer to allow it to imitate the mental steps."

b. *Paper No. 7, Final Rejection of August 23, 1966:*

"Claims 8, 9, 13 are rejected as drawn to non-statutory method claims for failure to define a process under 35 U.S.C. 101. The method claimed is merely a program for a computer. In addition to the reasons stated in the previous Office action, paragraph 7, and in paragraph 5 above the Examiner would like to point out further reasons for this rejection. First to clarify a statement in the previous Office action, the Examiner did not intend to imply that a computer imitates mental steps by any method related to thinking. What was intended is that the computer is designed to electronically perform such steps as adding or subtracting and choosing by their locations in storage the proper numbers to be operated on. These individual steps produce the same result as the mental step of for instance adding two numbers. This was the 'imitation of mental steps' implied. A program merely instructs the computer to perform the steps which it was designed to perform in a specific sequence and with specific numbers. Thus the only method illustrated by a program is the application of mental logic to arrange the solution of a problem in a form which can be used by the computer. The solutions are mathematical calculations which are not patentable methods and therefore their translation to a form palatable to the computer should not be patentable methods either. Applicant cites The Telephone Cases, 126 U.S. 1 to show that acts performed upon electrical signals are patentable subject matter. This is not argued, however, a program performs no novel acts upon electrical signals, it merely specifies a sequence in which already known acts are performed on electric signals in a contemplated manner."

75 c. *Paper No. 9, Second Final Rejection of November 27, 1966:*

"Claims 8, 9 are further rejected as drawn to non-statutory method claims for failure to define a process under 35 U.S.C. 101. The reasons for this are the same as those stated in the previous Office action paragraph 6; Paper No. 7."

Summarizing, it appears that these rejections are based on one or all of the following reasons:

1) The claimed methods are "merely" programs;
2) The claims recite mental steps; or
3) The claims recite mathematical calculations.

### 2. *Arguments*

#### a. *Programs in General*

It should be first noted that appellants' attorney has deliberately described appellants' invention in terms of the nomenclature of the dialogue recently instituted between the Patent Office and the patent bar ("Guidelines to Computer Programs," 829 O.G. 1, August 2, 1966). At that time, the Patent Office published proposed guidelines for Examiners and invited the patent bar to comment. Appellants' attorney, among others, accepted this invitation and filed in the Patent Office the "Comments on 'Guidelines to Examination of Programs,'" attached hereto as Appendix D. It therefore appears that one of the basic issues to be decided herein is fundamental to a large body of technology and that a substantial doubt as to the proper resolution of this issue continues to exist in the Patent Office and the patent bar.

It should also be noted that there is, at the present time, no statutory or judicial law holding directly on this
76 issue. Most arguments, therefore, must proceed from
public policy considerations and from analogies with related but different holdings. The public policy considerations will be discussed in this section and the analogous case law in sections b and c.

It is believed that the processing of data, as is accomplished by the general purpose computer, is a "useful art" within the meaning of Article 1, Section 8, of the United States Constitution, and a "useful process" within the meaning of Section 101 of Title 35 of the United States Code. Even a cursory review of the history of the patent laws of this country indicates a continual expansion of the meanings of these terms to include the economically *useful* technological activities of each generation. Convinced, along with the framers of our Constitution, that patents do serve to "promote the progress of science and useful arts," the Supreme Court has extended the statutory language to a multitude of new arts never conceived of by the framers of the statutory provisions. In 1843, for example, the Supreme Court held that the patent laws extended to cover metallurgical processes (*McClurg v. Kingsland,* 42 U.S. 202); in 1853 to chemical processes (*Corning v. Burden,* 56 U.S. 252); in 1877 to food processing (*Cochrane v. Diener,* 94 U.S. 780); in 1887 to mechanical processes (*Eames v. Andrews,* 122 U.S. 40); and in 1888 to electrical processes (*The Telephone Cases,* 126 U.S. 1). Thus, as the various technologies were introduced, the patent laws were used to insure their growth and to bring their benfits to the American people.

The next large step forward has taken place. No one today can doubt the technological importance of data
77 processing nor the fact it will seep into and affect the

lives of each and every person in this country. It has the capacity for creating a greater effect on the quality of human life than all of the other technological advances combined. Indeed, these other technological advances may well all become themselves dependent upon data processing. It would therefore be no less than catastrophic if the patent laws failed to perform their usual function as midwife to this emerging art. The *possibility* of suppression of innovation, secrecy and stagnation is just as real in this technology as in any other, and maybe even more. The *effects* of such suppression, however, will be manifestly much greater than in the much narrower fields that most advances represent.

In order to see modern data processing in a proper perspective, it is necessary to first disassociate it from the legend and myth surrounding its birth. All of the early publicity about machines "thinking" and replacing human beings is no more than the fanciful concoction of imaginative minds more concerned with selling their product than with informing their audiences. The computer relieves human beings of burdensome tasks much like the steam shovel and the airplane. It allows the undertaking of tasks heretofore impossible, just like the steam shovel and the airplane. The tasks are more subtle and sophisticated by comparison, but these are just the tasks our modern world needs to have accomplished.

Data processing is not new. The fundamental idea of representing physical variables by electrical analogies gave rise to the first physical data representation. The need
to do something with these electrical analogies gave
78 rise to data processing. Bell's telephone, Marconi's
wireless, telegraphy, television, and radar, are all
data processing. All of the existing systems of communication and remote control are vast data processing systems.

The modern computer, then, is just another way of carrying on this data processing. Its high speed and great flexibility have made it competitive with many of the prior art data processing systems. Indeed, it is the computer "program" which enables this machine to be economically competitive with prior art unprogrammed machines.

It is important to remember here that the computer is just another way of performing the tasks we want done. Each and every one of these tasks could be performed (albeit not always economically) by other classes of apparatus. At this late date, we can no longer decide that data processing by analog circuitry, for example, is unpatentable. Almost a hundred years of practice has gone by, all of which dictates the contrary. If it is granted that the real contribution to the advancement of science and the useful arts is the method of processing signals to get the desired results, then it should not matter whether this method is practiced on analog circuitry or on general purpose digital computers. As Section 103 of the patent laws states, "Patentability shall not be negatived by the manner in which the invention was made."

The fear of many individuals that the patentability of data processing methods will allow the patenting
79 of laws of nature, mathematical formulas, etc., is
totally unfounded and indicates a lack of full appreciation of what is involved. The frequently cited $E = mc^2$, for example, is a mathematical formula representing a relationship between physical constants, a "law of nature" if you will. The only data processing involved, if any, is squaring one quantity and securing the product of that square and another quantity. Thus, the data processing method is not only old, it is trivial.

Not all equations, however, are relationships between physical measureables. Mathematics, after all, is a language, and is being continuously expanded to cover all quantitative relationships possible. Some equations, chemical equations, for example, are merely shorthand descriptions of processes. Iterative algorithms are often described by equations. The facility of the mathematician to expand his language, after all, should not be the test of patentability.

No one, of course, wishes to patent the equation as such. What one would like to patent is the physical reality, whether apparatus, process or method, which the mathematics describes. It is this subject matter which the Patent Office is asked to consider.

The computer program, as a "series of instructions," is likewise merely a description. No one wishes to patent the description any more than they would like to patent a schematic drawing. (The fact that such descriptions, and schematic drawings for that matter, can be registered in the Copyright Office is of little solace.) It seems most appropriate that the Patent Office look at the actual
80 subject matter claimed (e.g., a method of converting
BCD signals to binary signals) and make their judgment as to statutory subject matter on that basis, and not as some arbitrary rule concerning computer programs. If, for example, the subject matter of the claim is clearly patentable if implemented without the use of a computer (Appendix B, for example), the fact that it can also be implemented by programming a computer should not take away the statutory classification. We should not penalize the inventor for this added contribution to technology.

b. *Mental Step Doctrine*

The Examiner initially commented (Paper No. 4, March 18, 1966) that the program instructions are merely "a logical list of mental steps which can be applied to a computer to allow it to imitate the mental steps." The mental step doctrine was enunciated in a line of cases including *Haliburton v. Walker et al.*, 146 F.2d 817 (9 Cir. 1944), *In re Abrams*, 188 F.2d 165, (C.C.P.A. 1951), and *In re Shao Wen Yuan*, 188 F.2d 377 (C.C.P.A. 1951). As pointed out by appellants during prosecution, this doctrine is based on the proposition that acts taking place in the mind of man are unsuitable for patent control. As stated in the *Haliburton* case (supra, page 821): ". . . anybody with a rudimentary knowledge of arithmetic will be able to do

what Walker claims a monopoly of doing." Similarly, in the *Abrams* case (supra, page 167): ". . . the sole question is whether the novelty thus assumed is the result of a physical act or is simply a mental concept." The *Yuan*
case (supra, page 382) quotes with approval *In re*
81 *Heritage,* 150 F.2d 554 (C.C.P.A. 1945) as follows:
"Such purely mental acts are not proper subject matter for protection under the patent statutes . . . ."

It therefore appears that the rule is applicable in only those situations in which method steps actually take place in the mind of man. How else, after all, could we define steps as "mental"?

The Examiner seemed to agree that appellants' machine did not think. In the next Office action (Paper No. 7, August 23, 1966) it is stated that ". . . the Examiner did not intend to imply that a computer imitates mental steps by any method related to thinking." Having conceded away the very grounds on which the case law holdings depended, the Examiner still felt his rejection applicable. He felt that appellants' steps "produced the same results as mental steps" and hence comprise an "imitation of mental steps." But "producing the same result as" a person thinking is not the same thing as a mental step, just as taking a picture by a camera is not the same thing as seeing, and synthetically producing hormones is not the same thing as the naturally occurring act. Indeed, is not much of technology directed to doing the same thing as people do, but doing it better, faster, more reliably, at a greater distance or on a more difficult subject? As a general proposition, any rule which would render unpatentable all improvements on natural acts of human beings would go a long way toward abolishing the patent system.

An even more difficult question arises from the Examiner's view of the law. If a step can be characterized
82 as "mental" even though it is disclosed only as being
performed with a machine, then what is the meaning of "mental" in this context? Are we to freeze the

status quo of the time just before the birth of the computer and say that all things that could only be done mentally *at that time* are forever to be unpatentable method steps? Indeed, even those things that no one ever thought of doing at that time, mentally or with apparatus (such as appellants' method), are to be considered mental because, *at that time,* they could only be done mentally. This is indeed a strange interpretation of "promoting the progress of science and the useful arts."

In the case of appellants' claim 8, the operative method steps are "storing," "shifting" and "adding" *signals.* It is difficult to see how these steps *could* be performed mentally if the "signals" are considered an essential part of the step. Even more basically, "shifting" is not a step which could be considered mental even according to the Examiner's definition. The human mind has no operation corresponding to "shifting." Similarly, "storing" is not a mental step at all, unless interpreted to mean mere "remembering." Likewise, "setting" the signal to zero is not a step which could be done mentally in the normal sense.

It is therefore submitted that appellants' claims 8 and 9 are not directed to non-statutory mental steps. It is believed that the mental step doctrine, if it is to have any validity at all, must be restricted to the interpretative, aesthetic or judgment facilities of a human being, exercised by a human being, without benefit of apparatus.

83 c. *Mathematical Calculations, Formulas*

The Examiner's comments that "the solutions are mathematical calculations which are not patentable methods and therefore their translation to a form palatable to the computer should not be patentable methods either." Again, the Examiner is attempting to extrapolate a rule out of the context which gave it sense and meaning. No one would argue that a mathematical formula, as such, was patentable. It is not a process, machine, manufacture, or a composition of matter (35 U.S.C. 101). To characterize a *process* as mathematical, however, is not the same thing. A process operates on certain subject matter and specifies certain types of acts to be performed thereon. The fact that mathematical symbols, as well as linguistic symbols, can be used to describe the process should not be determinative. It is more a tribute to the versatility of the mathematician than a characterization of the process. As noted previously, mathematics is a language. Large numbers of mathematicians are continually attempting to expand this language to cover new and different processes. Should patentability depend upon the degree of success which rewards their search?

It is common for chemical reactions, after the details of their operations are well understood, to be represented by chemical equations. These processes, of course, are, by that time, unpatentable due to their lack of novelty. But suppose claims to the process are still in force. Do they become invalid as non-statutory because of the *later* formulation in mathematical symbols? Clearly, no one would argue this way. It is likewise difficult to see why a
process should be non-statutory merely because the
84 mathematical description was conceived concurrently
with the process itself.

It is therefore important to distinguish between the mathematical expression itself and the reality which is thereby represented. If the mathematics describes an otherwise patentable process, the mere fact that it can be so represented should not render it non-statutory. On the other hand, if the mathematical expression describes a law of nature ($E=mc^2$, $s=vt$, etc.) which would be unpatentable even if described in any other fashion, the mere fact that it can be so represented should not render it patentable. Finally, the novelty of a data processing method, whether represented mathematically or not, should depend on the novelty and unobviousness of that data processing method with respect to prior art data processing, whether manual, mental, analog or digital, and not merely on the fact that it is described by means of a novel symbolic notation.

The present case, it will be noted, does not describe the claimed method by means of a formula. Such a formula could be devised, but no real value would be promoted by doing so. The rejected claims do, however, use terms such *as storing, shifting and adding. These terms, particularly* adding, do have a mathematical flavor and do suggest a mathematical calculation. It should be noted, however, that the problem solved by appellants' invention is not a mathematical problem. The translation of binary-coded-decimal numbers to binary numbers was solved long ago, indeed, as soon as BCD numbers were thought of in the first instance. Rather, the problem solved by appellants' invention is a machine problem, the slow speed and large storage capacity required for prior art translators. Appellants' solution to this problem is mathematical only in the sense that such a translation must be governed broadly by the required mathematical equivalences of the results. The inventiveness of the actual methods claimed, however, lies in the special use of the machine capabilities (adding, shifting, testing) to solve the problem. That is, ordering the machine operations as specified in appellants' claims does speed up the translation and does reduce the storage requirements.

It is therefore submitted that appellants' claims 8 and 9 are not directed to non-statutory subject matter in being directed to mathematical calculations or formulas. Formulas and descriptions of mathematical calculations are linguistic conventions and patentability should depend upon the underlying reality represented by the mathematical terms, and not the mere fact that such representation is possible or available.

## IV. *CONCLUSIONS*

It is respectfully submitted that the Examiner erred in his final rejection of claims 1, 2, 4, 5, 6, 7, 8, 9, 11, 12 and 13 for the following reasons:

A. Claims 1 and 7 are not fully met by the reference Gilbert because_

1. Gilbert's binary counter does not operate to shift and add, as called for, but to count and propagate carries. These distinctions are clear and obvious to any one of ordinary skill in the art.

86 2. If amended as proposed by appellants, the *selectivity* of the addition surely distinguishes from Gilbert.

B. Claims 1, 2, 6, 7 and 9 are fully operative, even without any mention of masking tested bits because:

1. Masking is necessary only if BCD digits are stored contiguously, and

2. There is no absolute necessity for storing BCD digits in contiguity.

C. Claims 4 and 5 are not vague or indefinite in failing to specify that a "1" signal must be present before adding because:

1. The claims call for the presence or the occupancy by a signal before adding. Although broader, these terms are clear and unambiguous.

2. Since BCD numbers could be stored in complementary form the signal requiring addition could be a "0" and hence not included within the language of the Examiner's suggested amendment.

D. Claims 1, 2 and 6 are not vague and indefinite without further qualification of the "same quantity" as fixed or preselected because:

1. The term as called for is clear and unambiguous, even though it is broader in scope than that suggested by the Examiner.

2. Appellants stand ready to accept the Examiner's proposed language as evidenced in their proposed amendment.

E. Claims 11, 12 and 13 are not new matter nor directed to new matter because:

1. The test for new matter is whether adequate support for the claims is found in the original disclosure.

87 2. The claims are silent as to whether addition is serial or in parallel and the original disclosure shows serial addition.

F. Claims 8 and 9 are not directed to non-statutory subject matter because:

1. The programmed computer is just one more way of implementing data processing methods. No reason is seen for denying patentability on the grounds that a particular method can be, or is disclosed as being, implemented on this particular kind of apparatus.

2. The execution of a data processing algorithm by a senseless piece of machinery cannot be realistically characterized as a series of "mental" steps. Appellants are entitled to have the claims "construed to cover the corresponding . . . acts described in the specification and equivalents thereof." (35 U.S.C. 112).

3. The fact that a process can be described in mathematical terms should not be used to militate against patentability. The process itself, independently of the forms of the linguistic convention used to describe it, should be controlling. Appellants' methods are clearly statutory when considered independently of the program implementation.

For the reasons set forth above, it is believed that
88 the final rejections of claims 1, 2, 4, 5, 6, 7, 8, 9, 11, 12 and 13 are in error. Reversal of these rejections is therefore respectfully requested.

An oral hearing is requested in accordance with Rule 192.

Respectfully,

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89 APPENDIX A

Appeal No. 768-60
Benson-Tabbot 1-1

*CLAIMS*

1. The method of processing signals which comprises the steps of

(1) storing the signals,

(2) recurrently shifting the stored signals by at least one storage position with respect to a fixed storage position, and

(3) adding the same quantity to said shifted signal at said fixed position for each shifting operation.

2. Apparatus for processing signals which comprises

means for storing instructions for carrying out preassigned operations on the signals,

means for storing the signals,

means responsive to said instructions for recurrently shifting the stored signals by at least one storage position with respect to a fixed storage position,

and means responsive to said instructions for adding the same quantity to said shifted signal at said fixed position for each shifting operation.

4. Apparatus comprising

a shift register having a plurality of stages,

means for entering signals into the stages of said register,

means for shifting said signals recurrently by at least one stage with respect to a preassigned stage of said register,

90 means for testing cyclically the stage preceding said preassigned stage for the presence of a signal,

and means, responsive to each tested presence of said signal, for adding the same preselected quantity to said preassigned stage.

5. Apparatus comprising

a shift register having a first and second plurality of stages,

means for entering signals into said register,

means for shifting said signals until each signal entered into said second plurality of stages successively occupies the second stage in the first plurality of said stages,

and means for adding the same preselected quantity to the first stage of the first plurality for each occupancy of said second stage by a signal originating in said second plurality of stages.

6. The method of converting a group of signals from one numerical form to another, which comprises the steps of

(1) storing the signals of said group in a shift register,

(2) recurrently shifting the signals with respect to a fixed position of said register,

(3) masking the position immediately preceding said fixed position following alternate shifting operations, and

(4) adding, for each shifting operation, the same quantity at said fixed position.

91 7. The method of processing signals representing numerical information which comprises the steps of

(1) storing the signals in a shift register,

(2) shifting the stored signals with respect to a fixed position of the register so that, for each signal to be converted, the net shift is a power of one of its weighting constituents, and

(3) adding, for each net shift, the same preselected quantity to said fixed position.

* * *

For Claim 8, see Rejected Claim 8.

9. The method of converting signals representing numerical information which comprises the steps of

92 (1) storing the signals in a shift register,

(2) shifting the stored signals until the first of those remaining to be converted is in a preassigned position,

(3) setting the signal at said preassigned position to zero to prevent carry propagation,

(4) supplementing said signals below the test position,

(5) further shifting said signals,

(6) further supplementing the shifted signals below said preassigned position, and

(7) repeating the preceding steps 2 through 6 for each signal remaining to be converted.

11. The data processing method for converting binary coded decimal number representations into binary representations comprising the steps of

(1) testing each binary digit position of a more significant decimal digit representation for a binary "one" representation, and

(2) in response to each binary "one" representation so found, adding a fixed binary digit pattern to the next lesser significant decimal digit representation, the binary significance of said pattern with respect to said lesser significant decimal digit representation bearing a fixed relationship to the binary significance of the corresponding binary "one" in said more significant decimal digit representation.

93 12. The data processing method according to claim 11 further comprising the steps of

(1) storing said decimal digit representations in contiguous positions in a register; and

(2) resetting each said binary "one" representation found before adding said binary digit pattern.

* * *

For Claim 13, see Rejected Claim 13.

94 APPENDIX C

Appeal No. 768-60
Benson-Tabbot 1-1

*FAP COMPUTER PROGRAM FOR THE IBM 7094*

| | | | |
|---|---|---|---|
| | LXA | 4, 1 | Load "4" into Index Register 1 |
| | CAL | BCD | Load a BCD number into Accumulator |
| | LRS | 4 | Right shift four places |
| TEST | LBT | | Test lowest order bit |
| | TRA | SHFT | If 0, transfer to "SHFT" |
| | ANA | =Ø1 | If 1, mask out tested bit |
| | LLS | 3 | Left shift 3 places |
| | ADD | =Ø5 | Add pattern "101" |
| | LRS | 3 | Right shift 3 places |
| SHFT | LRS | 1 | Left shift 1 place |
| | TIX | TEST, 1, 0 | Test, clear XRl & transfer to "TEST" if > 0 |
| | LLS | 8 | If 0 or less, left shift 8 places |

95 APPENDIX D

Appeal No. 768-60

*COMMENTS ON*
*"GUIDELINES TO EXAMINATION OF PROGRAMS"*

I. INTRODUCTION

The efforts of the Commissioner of Patents and his staff to establish guidelines for evaluating patent applications in the area of computer programming are deeply appreciated by the members of the patent bar. The practice among the various Examiners has not always been consistent with regard to this subject matter, and some standardization is necessary. Moreover due to the wide divergenc_es of legal opinion in the area, and due to the conceptual difficulties inherent in the subject matter, practitioners in the field have often found great difficulty in presenting, in an appropriate manner, programming subject matter for Patent Office consideration.

96 The publication by the Patent Office of a set of guidelines of adequate scope and particularity would be of great assistance to the patent bar. This opportunity to participate in the formulation of such guidelines is therefore greatly appreciated. It is hoped that the insight gained by those practitioners who have struggled with the problems in this area, both legal and practical, will be of some assistance to the Patent Examining Staff.

## II. THE PATENT OFFICE GUIDELINES

The following comments are intended to point out some of the basic deficiencies in the "guidelines" published by the Patent Office.

### A. *The Basic Question Unanswered*

IS DATA PROCESSING A CONSTITUTIONAL "USEFUL ART" AND STATUTORY "PROCESS, ART OR METHOD"?

The guidelines published by the Patent Office while attempting to meet some of the legal issues raised in connection with the patenting of computers and programs, ignore or assume the answer to the most basic legal problem. Simply formulated, it is this: Is "data processing," *per se*, as accomplished by programmable machines, a "useful art" within the meaning of the United States Constitution, and thus a "process, art or method" within the mean-
97 ing of Sections 100 and 101 of Title 35 of the United States Code? Any "guidelines" for the examination of program applications must necessarily be, to a large extent, determined by the answer. Although not explicitly stated, the published guidelines seem to be based upon a negative answer to the above question. This in spite of the fact that no tribunal, administrative or judicial, has ruled on the issue. Until this question is answered definitively, all guidelines must be tentative. It is felt, how-

ever, that an objective interpretation of judicial decisions leads quite easily to a conclusion opposite to that implicit in the guidelines.

### B. *The "Algorithm" Definition*

AN "ALGORITHM" IS NEITHER A MATHEMATICAL NOR INTELLECTUAL PROCESS. RATHER, IT IS ESSENTIALLY, A METHOD OR PROCESS AND PATENTABILITY MUST BE DETERMINED BY THE SUBJECT MATTER ACTUALLY INVOLVED. THE DEFINITION OF THE PATENT OFFICE GUIDELINES IS INCONSISTENT WITH TECHNICAL USAGE.

In an attempt to solve the problems inherent in the programming area, and in order to provide a logical basis for excluding data processing, *per se,* from the field of statutory subject matter, the Patent Office guidelines propose a new and different category of non-statutory subject
98 matter called an "algorithm" and defined as "conclusions based upon a precise or mathematical premise and line of reasoning." Aside from being inappropriate, this definition attempts to subsume many, if not all, of the recognized classes of non-statutory subject matter under the name "algorithm." Thus, "mathematical formulae," "mathematical processes," and "processes of doing business" are all alleged to be algorithms or "characterized by" algorithms. This, however, glosses over the recognized and real differences between the various categories.

There are very few, if any inventions, apparatus or method, mechanical, electrical or chemical, which cannot be said to be "characterized by" a conclusion "based upon a precise or mathematical premise and line of reasoning." Since an invention is no more than the implementation of an inventor's intellectual conception, and since conception is no more than the conclusion that desirable results will follow if the precise structure, steps or combinations thereof are observed, then an "algorithm," as defined by the Patent Office guidelines, can be said to be no more than the human element in all invention.

An algorithm, more properly speaking, is a sequence of adequately defined steps which lead to a desired result. It is essentially a method or process, and patentability must be determined by the subject matter actually involved, not that the mere fact that the process is "logical."

99 Aside from any specific meaning given to the term "algorithm," care must also be taken to distinguish between mathematical (or other abstract) relationships, (e.g., formulae), manipulative processes taking advantage of such relationships (e.g., algorithms), and sequences of arrangements of machine components resulting in a desired output (e.g., programs). The first is essentially useful only as an aid to thought in the mind of man; the latter two can be manifestations of valuable property rights in the commercial world. Clearly, the former cannot be subject to exclusive property rights; just as clearly, the latter two can be.

A mathematical formula, in and by itself, has no inherent utility except in the world of thought (i.e., $e = mc^2$). A process (algorithm) which treats physical subject matter (e.g., electrical signals) by machine operations to produce physical results (e.g., more useful electrical signals), even though being capable of description in mathematical nomenclature, is a commercially useful thing. The output signals can be applied directly to control apparatus (as in numerically controlled machines) or processes (as in a chemical processing plant).

### 100 C. *"Result" versus "Function" of Method Steps*

THE PROPOSED DISTINCTION BETWEEN "ALGORITHM" PROCESSES AND "UTILITY" PROCESSES IS A SUBJECTIVE TEST WHICH FAILS TO DEFINE, CORRECTLY OR PRECISELY, THE BORDERLINE BETWEEN PATENTABLE AND NON-PATENTABLE SUBJECT MATTER.

The Patent Office guidelines attempt to distinguish between "algorithm" processes and "utility" processes in terms of "result" and "function" of the method steps. The "result" of a programmed operation is said to be "the mathematical transformation of data according to an algorithm'' while the ''functioning'' of the computer is said to be "the change in state of certain electrical or mechanical devices within the computer according to the algorithm." The former is said to be a non-statutory algorithm process while the latter is characterized as a statutory utility process.

In the first place, the operation of each and every data processing device, mechanical, as well as electrical, can be described as the "mathematical transformation of data." The same is true even of analog devices. For example, a cam transforms the analog data represented by the cam's variable radius into analog data representing the movement of the cam follower. All data in a digital machine can be interpreted as numerical. All manipulations
101 of this data can be thought of as "mathematical transformations'' since digital representation always allows of a numerical (i.e., mathematical) interpretation. The rule suggested in the guidelines thus could be, and undoubtedly would be, used to exclude all processes practiced on digital data. However, even pulse code modulation (PCM) coding, transmission and decoding can be interpreted as a "mathematical" (i.e., numerical) transformation of data "based upon a precise or mathematical premise and line of reasoning." Consistency would seem to require an uncalled for reappraisal of practice in the PCM field.

In the second place, since, even in digital machines, the data is actually in the form of physical (electrical, optical, magnetic, etc.) signals, the machine must be capable of operating on these signals. Indeed, all computing machines are directly dependent on physical signals having physical effects in the physical world. In this sense, a computer is capable of carrying out nothing but "utility" processes as defined in the Patent Office guidelines.

As a matter of fact, the suggested distinction between algorithm and utility processes is entirely in the mind of the observer. It is an intellectual judgment as to the significance to be attributed to the operations claimed. This significance will, of course, depend directly upon the use to which the observer wishes to put his judgment.
102 A mathematician, not particularly well-versed in the circuit arts, will characterize a *method* for translating binary-coded-decimal signals to binary signals as a "mathematical transformation of data." To an electronic switching system designer, on the other hand, interested in obtaining signals in the best form for operating a switching tree, the same *method,* expressed in the same terms, is a series of changes "in state of certain electrical . . . devices within the computer."

Each instruction associated with a programmable computer is, upon execution, determinatively related to a sequence of changes of state of devices within that computer. There is an inescapable equivalence between the program instruction and the functioning of the various specific devices. A number of such sequential functionings is precisely a "utility process" as defined in the Patent Office guidelines. Since these sequential functionings are unambiguously representable by a set of program instructions, it would seem that the program steps themselves constitute such a utility process. That is, the program is nothing but an easily recognizable, readily mutable shorthand for the complex succession of device machinations. To require the explicit recitation of each state change of each device in the appropriate sequence would be to lay an intolerable burden on both the Patent Office and the patent bar,
103 even when dealing with programs of only nominal length. No "guidelines" should force the patent bar to act in this direction.

The limitations of language have forced the computer programmer to use familiar terms. To "add" in a computer is to operate upon signals, which can be interpreted as addend and augend, to produce other signals, which can be interpreted as a sum. To "add" does *not* mean to perform a purely intellectual exercise in order to increase our knowledge. The processes are analogous, but clearly not identical. Indeed, the technique employed by the computer in performing even the most simple operations often appears illogical to a layman familiar only with the analogous mental operations. Innumerable similar shorthand descriptions of machine operations have found their way into the programming art. This is the language the programmer speaks. The language symbols, however, should not be interpreted to mean the human analog of the machine operation.

Unlike a pure mathematician, the computer programmer can never forget machine limitations such as, for example, sizes of registers, overflow, storage allocations, and so forth. Indeed, many inventions in the field of programming lie precisely in taking advantage of, or overcoming the limitations of, the peculiarities of a machine.

104 D. *"Means" plus "Function" in Section 112*

A DISTINCTION SHOULD BE OBSERVED BETWEEN AN INTERMEDIATE RESULT SPECIFIED AS THE "FUNCTION" IN A "MEANS PLUS FUNCTION" CLAUSE AND THE ULTIMATE RESULT TO BE ACCOMPLISHED BY A CLAIMED COMBINATION OF ELEMENTS OR STEPS. THE CRITERION FOR COMPLIANCE WITH SECTION 112 IS THE PROXIMITY OF THE INTERMEDIATE RESULT TO THE ULTIMATE RESULT.

The Patent Office guidelines have seen fit, in both process and apparatus sections, to call attention to the third paragraph of Section 112 of the Patent Laws. It is there stated:

> An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claims shall be con-

> strued to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The guidelines attempt to distinguish between function as "a means to an end" and function as "the end or result itself." This distinction is mischievous, not in the terms in which it is stated, but in the use to which it is usually put. The finality of any function is always relative. Moreover, the range of finality between actual structure and ultimate result is continuous. In Section 112, "function," properly speaking, is the thing to be done—the "re-
105 sult" to be accomplished. A realistic interpretation
of this Section, therefore, should insist upon a proper proportion between the intermediate result specified in the "function" and the ultimate result to be accomplished by the combination of elements or steps as a whole. Such an "intermediate result" can, of course, be characterized as "a means to an end" (the ultimate result). Unfortunately, it can also be characterized as "the end or result itself" (the intermediate result). The proximity of these "results" to the ultimate purpose of the entire combination should be the deciding factor. This determination, however, is very difficult to make on the basis of the terms given in the Patent Office guidelines.

Since this problem is not uniquely related to computers and programs, however, it is probably best left out of these guidelines. An alternate set of proposed guidelines, to be found in the appendix to this paper, makes no reference to Section 112.

### E. *Preference for Circuit Disclosures in the Guidelines*

THE PREJUDICE IN FAVOR OF CIRCUIT DISCLOSURES LEADS TO INCONSISTENCIES AND AMBIGUITIES IN TREATING PROGRAMMING SUBJECT MATTER.

In addition to the shortcomings pointed out above, the Patent Office guidelines involve many ambiguous and

106 inconsistent assertions concerning this subject matter. As practical guidelines for the use of the Examining Staff, they might turn out to be worse than useless. They pretend to answer all of the significant questions in the area, but in fact, do not even deal with many of them. In essence, data processing is dealt with from the point of view of a circuit designer. This one-sided approach to the problem leads to such things as a definition of algorithm totally inconsistent with current useage. It leads to the inconsistency of requiring method steps to include apparatus limitations. It leads to the untenable position of characterizing machine operations as ''mental.'' It leads to conceptual phrases with little or no discriminatory content, such as ''characterized by an algorithm,'' ''mere expressions of an algorithm,'' ''utility process,'' and ''non-statutory features.''

The Patent Office guidelines dispense with definitions on the grounds that "programs" and "computers" are "merely adaptations of the concept of 'automatic control,'" and can be treated in the same manner as Jacquard looms and player pianos. While there are some similarities to these devices, the differences are so great as to render the comparison almost useless.

## 107 III. LEGAL CONSIDERATIONS

### A. *Introduction*

The Extrapolation From the Basic Proposition That Patentable Processes Must Deal With Tangible Things to the Conclusion that the Manipulation of Data is Unpatentable is Totally Unwarranted.

The proposed Patent Office guidelines are prefaced by the statement that they are "not an analysis of judicial holdings," but rather that they are a "theoretical analysis of applicable statutory law." Consideration of a statute, in vacuo, however, is a meaningless exercise since, to some extent at least, the "judicial holdings" have already determined the "theoretical analysis." It is quite clear from the Patent Office guidelines, for example, that judicial holdings *are* relied upon, and that these judicial holdings, or rather specific interpretations thereof, are implicit in the entire discussion.

This is seen in a most basic sense in the use of the proposition, advanced in a leading case on statutory processes, that such processes must deal with materials, substances, or tangible things. COCHRANE v. DEENER, 94 U. S. 780 (1877). There is, of course, no disagreement with this proposition at the basic conceptual level. The function of the patent laws, after all, is to advance the "useful
108 arts," and in order to be useful they in turn must
be related to "materials, substances or tangible things," i.e., the "stuff" of the real world. However, the extrapolation from this basic proposition to the conclusion that the transformation or manipulation of data is not an operation on tangible things in the real world is totally unwarranted. The conclusion is supported by neither technical knowledge nor analysis of the judicial holdings. It evidences an almost mystical concept of data and data processors—that, in some way, data is unreal, intangible.

B. *The Processing of Data*

A PROGRAM STATEMENT CORRESPONDS EXACTLY TO A SEQUENCE OF PHYSICAL OPERATIONS IN A COMPUTER. THE TERMS USED IN THE STATEMENT ARE THE PROGRAMMERS' SHORTHAND DESCRIPTION FOR THESE PHYSICAL OPERATIONS.

It may be well first to consider what the transformation or manipulation of data, i.e., the data processing step, entails. A data processing step is a more or less elemental change in a physical representation of some external reality. The physical representation may be digital or analog, the change may be simple or complex. In a *program,* the step is represented by an instruction, a program statement, an order. Each program instruction corresponds *exactly* to

a sequence of physical operations and, indeed, is the
109 programmer's specification of those operations. In
an electronic digital computer, for example, a simple direction to add, subtract, etc., involves a multiplicity of machine functions such as changes in polarity, enabling conductive paths, initiation of timing signals and other similar circuit operations. It is because this sequence is repeated so often that the computer designer has chosen to provide the computer user with a simple command which forces the machine to respond automatically with the complicated sequence. The *name* of this sequence (add, subtract, etc.) is chosen to be suggestive, but certainly, for that reason, does not take the specified operations outside of the physical world. Such operations, and logical sequences of such operations, do in fact deal with "materials, substances and tangible things." The processing of data by machine *is* a "useful art" under the Constitution, and hence a "process, art or method" under 35 U. S. C. § 101.

C. *Useful Arts, Programs and the Law*

DATA PROCESSING IS A "MODE OF TREATMENT" OF DATA. DATA IS A PHYSICAL MANIFESTATION OF INFORMATION. A COMPUTER IS A MACHINE FOR MANIPULATING CONCRETE, PHYSICAL THINGS AND DOES NOT AND CANNOT MANIPULATE ABSTRACT MENTAL CONCEPTS.

It is true that no court has come to grips with the particular problem of the patentability of computer
110 programs. There is no decision in which the hold-
ing of the case, *per se,* is compelling. On the other hand, it cannot be expected that judges, particularly those of the nineteenth century, would forsee the technical advances of our times. The basic philosophy of the cases, the definition of the term "useful arts" and its relationship to the constitutional purpose of fostering economic growth via the vehicle of utilitarian improvements, provide a conceptual framework within which to attack the problem.

Chief Justice Marshall, in GRANT v. RAYMOND, 31 U. S.

218 (1832), speaking for a liberal interpretation of the patent laws, states:

> . . . it cannot be doubted that the settled purpose of the United States has ever been, and continues to be, to confer on the authors of useful inventions an exclusive right in their inventions for the time mentioned in the patent. It is the reward stipulated for the advantages derived by the public for the exertions of the individual, and is intended as a stimulus to those exertions. The laws which are passed to give effect to this purpose ought, we think, to be construed in the spirit in which they have been made . . . . (31 U. S. at 241).

In accordance with such a liberal interpretation, the patent laws were held to extend to metallurgical processes. McClurg v. Kingsland, 42 U. S. 202 (1843), chemical processes, Corning v. Burden, 56 U. S. 252 (1853),
111 food processing, Cochrane v. Deener, 94 U. S. 780 (1877), purely mechanical processes, Eames v. Andrews, 122 U. S. 40 (1887), and electrical processes, The Telephone Cases, 126 U. S. 1 (1888).

The oft-cited language of the Cochrane case defines a "process" as follows:

> A process is a mode of treatment of 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 in a certain order, but the tools to be used in doing this may be of secondary consequence. (Cochrane v. Deener, supra, at 787).

Data processing is a "mode of treatment" of data. Data is a physical manifestation of information. While we might regard information itself as intangible, the physical manifestation thereof is, by definition, *physical*. Indeed, it is only by rendering information in a physical form that machine processing becomes possible. In modern electronic computers, this form is usually electrical or magnetic. In an electronic computer, it is the electrical signals which are manipulated, *and not the information*. This bears
112 repeating. A computer is a machine for manipulating concrete, physical things (data) and does not and cannot manipulate abstract mental concepts.

Before the advent of the digital computer, the processing of information represented by signals was consistently treated as statutory subject matter. Not only telephone signals, but television, telegraphic, facsimile, and all of the other signals harnessed in the service of man, were the subject matter of patents which the courts consistently upheld as statutory. Furthermore, not only analog signals, but digital signals (as in pulse-code-modulation) were so treated. Data processing, *per se*, is not new. What is new is the extremely high speed and general purpose character of modern data processing machines—that, and the extensive use of programmed control. The apparatus available for practicing a process, however, and the specific control mechanism for getting this apparatus to do the job desired, do not change the nature of what is being done. It is the machine processing of signals, and no more.

D. *What Data Processing is Not*

DECISIONS RELATING TO "MENTAL STEPS," "SCIENTIFIC PRINCIPLES" OR "ABSTRACT IDEAS" ARE NEITHER APPROPRIATE NOR APPLICABLE TO THE ART OF DATA PROCESSING.

113 Some of the more recent cases are often cited as authority for the unpatentability of data processing

methods. HALLIBURTON v. WALKER et al., 146 F. 2d 817 (9 Cir. 1944), dealt with a method for locating obstructions in oil wells, and included steps requiring computation of unknown quantities from measured quantities. The claim was held to be invalid in requiring mental steps at the exact point of novelty. No apparatus was disclosed for performing these steps, and hence a human being was required for their execution. Since a programmed computer does not require human intervention, no mental steps can be involved.

Similarly, In re ABRAMS, 38 C. C. P. A. 945, 188 F. 2d 165 (1951), dealt with a similar method for determining the physical properties of an oil well by making computations from measured data. This claim was also held invalid as "predominantly involving a mental process." Again, no apparatus was disclosed to perform the steps except a human being. Computer programs, however, require no human being for their execution. Indeed, it is usually true that the *algorithm* used in a computer to achieve certain results is quite *different* from the
114 *human procedure* in achieving the same results. The
programmed algorithm usually takes advantage of, or overcomes, the peculiar machine limitations of the data processor.

Reported in the same volume as the ABRAMS case is In re SHAO WEN YUAN, 38 C. C. P. A. 967, 188 F. 2d 377 (1951). The method presented there was for the generation of an airfoil cross section by computing points in accordance with stated formulae. This claim was likewise held unpatentable as requiring mental steps. Again, the disclosure was devoid of any machine or apparatus for actually performing the computations. It should again be noted that an *equation* expressing the relationships between quantities is not the same thing as an *algorithm* for generating one of these quantities from the others. While algorithms are sometimes obvious from simple combinational equations, this is definitely not true when the equations involved are, for example, integral or differential equations.

Attempts to interpret these cases by the Patent Office Board of Appeals have indicated the same liberal tendency first suggested by Chief Justice Marshall. Ex parte MONROE, 105 U. S. P. Q. 376 (1955), for example, held valid a method claim for controlling fluid constitutents which included the steps of "measuring" and "regulating."

115 The Board stated:

> We do not believe that the step of "measuring" as required in the claim on appeal is in itself a wholly mental step which requires condemnation of the claim. (105 U. S. P. Q. at 377).

In this case, the specification did disclose apparatus for carrying out the claimed step.

Ex parte EGAN et al., 129 U. S.P. Q. 23 (1960) dealt with a method for determining geological information from test measurements by using precalculated charts. The Examiner argued that this method "is but a mathematical procedure that is not patentable since a process of mathematical computation is not embraced by the statutes" and that the "process under consideration is properly analogous to a method of operating a computer, since the charts employed are quite analogous to a preconstructed computer." In holding the claim valid, the Board made this interesting observation:

> The method operations in operating a computer are distinct from the method of computation itself. It is perfectly possible to have a patentable process in which apparatus is used in a particular way to get a useful result. (129 U. S. P. Q. at 26).

In Ex parte KING et al., 146 U. S. P. Q. 590 (1964), the Board dealt with apparatus claims to a digital com-
116 puter operating according to a program. While the

claims were held unpatentable over the prior art, the Examiner did argue that the only difference between the programmed machine and the prior art programmable machine was the program, and since the program was unpatentable, the combination was also. The Board did not agree:

> To deny patent protection to a novel structure, it must be shown that the same was obvious at the time the invention was made. A program for a computer which is not made obvious by the prior art but only by appellant's disclosure is not available to teach applicant's invention. (146 U. S. P. Q. at 591).

The same, of course, is true of methods of operating a computer.

E. *Summary*

THE PATENT OFFICE SHOULD PROMOTE THE PROGRESS OF THE USEFUL ARTS BY BEING RECEPTIVE TO TECHNOLOGICAL ADVANCES, PARTICULARLY WHEN NO LAW WOULD MILITATE AGAINST THE TAKING OF SUCH A POSITION.

In summary, it appears that the guidelines are, in many respects, an unwarranted departure from the development of the law up to this time. It is believed that a more liberal position would place the Patent Office more nearly in
117 line with the current developments in the law. There
is no published determination of any court or of any administrative tribunal which would militate against taking such a position. Admittedly, the computer field involves many unsolved problems, both legal and practical. The problems arising in this field, however, are not insoluble. They can, and will, be met and solved. The Patent Office itself can contribute much to these solutions by remaining open-minded, as it has in the past, to new approaches to claims and disclosures.

## IV. PRACTICAL CONSIDERATIONS

### A. *Programmed Data Processors and Data Processing Circuitry*

THE PATENT OFFICE GUIDELINES FAIL TO TAKE INTO ACCOUNT THE FULL EQUIVALENCY OF THE WORK PRODUCT OF THE CIRCUIT DESIGNER AND THE PROGRAMMER. THEY INVITE THE DISCLOSURE OF PROGRAMS IN THE GARB OF SPECIAL PURPOSE CIRCUITRY CONTRARY TO THE EXPLICIT MANDATES OF RULE 71.

It is often said, and it is a truism among those skilled in the art, that *any* data processing method can *always* be practiced by both special purpose circuitry and by an appropriately programmed general purpose computer. The inventive contribution (i. e., the unobvious method) is sometimes provided by the circuit expert and is sometimes provided by the programmer. Often, each can take the other's work and implement it in an obvious fashion
118 in his own field. Under current Patent Office practice, the circuit expert has little difficulty in obtaining claims to his invention disclosed as circuitry. The programmer, on the other hand, is assured of a rejection on the grounds of non-statutory subject matter. This is true, unfortunately, even if claims are couched in similar, or even identical, language.

An even greater difficulty is found in ascertaining the scope of claims granted. A machine or apparatus claim, for example, may be granted on a special purpose circuit; method claims may also be granted since such methods are presently considered statutory. The apparatus claims can usually be applied in an obvious manner to a programmed general purpose computer when programmed to have the same organization as the special purpose circuit. Similarly, the method claims dominate the operation of the general purpose computer when programmed to follow the patented method. Apparently, however, an initial disclosure of the programmed general purpose computer is sufficiently different from the special purpose circuitry to raise the question of non-statutory subject matter. The Patent Office clearly prefers a circuit disclosure to a program disclosure.

In view of the distinctly different approaches taken in the Patent Office when confronted with program and apparatus *disclosures,* some segments of the Patent Bar have understandably sought to satisfy the apparent de-
119 sires of the Office. Novel data processing methods,
conceived by programmers and reduced to practice by programming a general purpose computer, are often disclosed to the Patent Office in the form of the equivalent special purpose circuitry. Since this special purpose circuitry is usually obvious when the novel data processing method is understood, it is usually possible, and often necessary, for the patent attorney to author this circuitry. Because many programmers tend to have mathematical rather than engineering backgrounds, it is often true then that the inventor of the data processing method does not understand the patent disclosure of his own invention until it is explained to him by the patent attorney. He finds it difficult to understand the apparent prejudice against the tools of his trade.

So, it has come to pass that the patent literature is seeing more and more data processing disclosures which have no counterpart in reality. The special purpose circuitry often has not been, and was never intended to be, actually constructed. Indeed, the special purpose computer often has no economic value (due to its inflexibility) while the corresponding general purpose computer program is invaluable. While this substitutive procedure is adequate for many purposes, it does place an unusually heavy
120 burden on the patent attorney. Even more signifi-
cantly, however, such disclosures directly contravene one of the basic purposes of the patent system—a full and adequate disclosure to those skilled in an art so as to promote the progress of that art.

Rule 71 requires that the invention be described "in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which the invention or discovery appertains, or with which it is most nearly connected, to make and use the same.'' Unfortunately, under current Patent Office practice, the programmer-inventor is risking enormous prosecution difficulties in disclosing his invention to those ''skilled in the art'' of programming.

Rule 71 goes on to state ''The best mode *contemplated by the inventor* of carrying out his invention must be set forth'' (emphasis added). Again, the programmer-inventor is discouraged by current Office practice from obeying the dictates of this rule.

The basic inconsistency of the Patent Office in this regard leads to many other similar difficulties. Any time an invention can be practiced by two different and alternate forms of structures, a decision to allow patents to one and deny to the other invites inventors and the patent
121 bar to follow the line of least resistance. In the
present case, this state of affairs could result in direct harm to the patent system. Rather than disclosing the invention in terms meaningful to the ''person skilled in the art,'' present practice might hide the invention from just those persons most likely to profit by its disclosure, contravening the constitutional purpose (''to promote the progress of ... the useful arts'').

## B. *Technological Importance*

TECHNOLOGICAL ADVANCES WILL BECOME INCREASINGLY DEPENDENT UPON MACHINE PROCESSING OF DATA. THE UNDESIRABLE EFFECTS OF FORECLOSING THIS FIELD TO THE BENEFITS OF THE PATENT LAWS WILL BE GREAT, EVEN THOUGH NOT FULLY FORESEEN AT THE PRESENT TIME.

As is readily attested to by the greatly increased activity in the field, modern technology is becoming increasingly dependent upon the machine processing of data. Indeed, great efforts are being made to bring the computational capabilities of large, expensive data processing facilities under the immediate and direct control of the average scientist and engineer. At the same time, the size, complexity and sophistication of the components, devices and systems which this scientist or engineer is asked to utilize and/or design have changed radically over the years.

122 It may be readily envisioned that, at some point in the not too distant future, the work product of these scientists and engineers cannot be used or appreciated without understanding the data processing aspects of their contributions. (This has already occurred in the field of program-controlled electronic telephone systems). Problems heretofore thought of as electrical or mechanical design problems have been recast as computational problems. This is true of problems which were usually solved empirically (printed circuit board layouts, for example) as well as problems which have had absolutely no hope of solution prior to the advent of high speed electronic computers (exact meteorological forecasting, for example).

In view of these factors, it seems that technological advances will be become increasingly dependent upon machine processing of data. Without legal protection for the machine processing aspects of new inventions, it is unlikely that free disclosure of this subject matter will take place. It therefore seems probable that an increasingly greater percentage of technical advances will be treated as trade secrets, assuming that this remains the only means of protecting these advances. This is true, not only of data processing methods and techniques themselves, but also of apparatus and components whose design or use is heavily dependent upon machine processing of data.

123 In conclusion, it would seem that the administrators of the U. S. patent system should carefully evaluate the technological facts and their implications before deciding to exclude from the patent system what may well prove to be the single most important technical art developed in our modern scientific age.

### C. *Secrecy and Disclosure*

THE PATENTING OF COMPUTER PROGRAMS WILL INCREASE THE WIDE DISSEMINATION OF PROGRAMS. THE PREVIOUS FREE INTERCHANGE OF NEW PROGRAMS IS WANING BECAUSE OF THE GROWING COMMERCIAL IMPORTANCE OF THESE PROGRAMS. WITHOUT LEGAL PROTECTION, COMPUTER PROGRAMMING WILL BE FORCED INTO THE STERILE ATMOSPHERE OF TRADE SECRETS.

It has been argued that the data processing field has, up until this time, benefited greatly from the extensive interchange of information, ideas, and programs themselves. It is said that free interchange of programs (in arrangements such as SHARE, for example) have allowed the field of data processing to expand at the rapid rate at which it so obviously has. It is further argued by some that the patenting of programs would limit this free exchange and thus stifle the development of the field.

The early phase of the development of computer programming has been, to a large extent, fundamen-
124 tally a research or experimental endeavor. These developments have been made largely in academic institutions, whose main concern has been the increase of knowledge for its own sake, and by computer manufacturers predominantly interested in the commercial sale or lease of equipment, and who therefore have an interest in wide, unrestricted use of programming techniques. The developments that did take place in more commercially oriented enterprises were inadequately understood by those responsible for business decisions. It is not surprising, therefore, that rapid dissemination was possible without too much thought of proprietary rights.

This era is passing, however. American business has found modern data processing to be an important, and possibly indispensable, adjunct to its enterprises. Businessmen are becoming increasingly sophisticated in the use of computers. Moreover, they are beginning to realize the vast development costs of programs and the competitive advantages these programs represent. The increased effort toward obtaining patents in this area is evidence of this realization.

Without the benefit of the protection offered by the patent laws, it is clear that recourse must be had to other means of protection. Secrecy is the most obvious
125 choice. A businessman, faced with the choice between giving away to his competitors data processing techniques, obtained at great cost to him, or keeping them secret, must apt for secrecy. Fortunately, the patent laws were created to deal with just such a situation.

It is therefore believed that the patenting of computer programs will increase, and not decrease, the wide dissemination of these programs. This conclusion lies at the very heart of the entire patent system. If not true for computer programs, there seems to be no compelling reason why it should be true for any other field of technology.

## V. CONCLUSIONS

Guidelines are critically needed in the area of programs and computers. The proposed Patent Office guidelines, while attempting to provide guidance for the Examiners, have many deficiencies:

1. The answer to the basic question dealing with data processing as a useful art under the Constitution is assumed without the benefit of judicial guidance and, indeed, in a manner not completely consistent with the judicial holdings now available.

126 2. The only explicit definition found in the text ("algorithm") does not agree with current technical usage and is sufficiently vague to further confuse the real distinctions between human and machine operations.

3. The distinction made between "algorithm" and "utility" processes is an entirely subjective one and does not reflect the realities involved in computer operations.

4. The interpolation of the third paragraph of Section 112 into the discussion is neither necessary nor helpful.

5. The profound bias of the guidelines in favor of conventional circuitry severely limits their usefulness in the computer and programming area.

The early cases dealing with statutory subject matter emphasize the need for ''objectivized'' concrete subject matter and steps in process claims. The processing of data by machine, however, is just such a process. Indeed, it is only by rendering data and data processing steps in an objective, physical form that modern data processing became possible. The real difficulties are semantic rather than conceptual.

Since there is no direct judicial holding on the pat-
entability of data processing methods, these methods
127 must be analyzed critically to determine what, in
fact, is their nature. When so analyzed, it becomes
apparent that these methods are statutory.

While data processing is the *kind* of thing which heretofore could only be done mentally, it is clear that such processing can now actually be done by machine. The law on ''mental steps'' is not applicable. This fact has already been recognized by the recent Board of Appeals decisions.

The technological fact is that circuit and program solutions to the same problem are fully equivalent. By treating them differently, the Patent Office has entangled itself in a mire of inconsistencies and is in danger of obscuring the basic constitutional mandate to promote progress of the useful arts. Data processing is becoming extremely important technologically, not only in its own right, but as an adjunct to the other sciences. The dangers of secrecy are probably more far-reaching than can be clearly foreseen at the present time.

There are undoubtedly great problems involved in determination of patentability in the data processing field. It is to be expected, however, that problems will arise with the advent of any new technological art. In the data processing field, it is felt that these problems can be most easily
met and solved if an adejuate foundation is laid at
128 this time. It is therefore vital that a consistent,
rational and practical basis be established for con-

sidering these questions. The alternate proposed guidelines in the attached appendix have therefore emphasized the importance of usable definitions.

129 APPENDIX

## Alternate Proposed Guidelines to Examination of Programs

*Introduction*

Special problems of patentability arise with regard to data processors, programs and algorithms due to the many similarities between the machine processing of data and the human or mental manipulation of intellectual concepts. Due to these similarities, there is a tendency among those skilled in the art to use the same terms to specify the analogous machine and mental operations. Great care must therefore be taken to distinguish between true mental steps (necessarily requiring the interpretive, aesthetic or judgment faculties of a human being) and descriptions of machine operations using analogous terminology. Most of the difficulties which arise in this area are purely semantic and can be best dealt with by clear and consistent definitions.

The following definitions, while not final or complete in any sense, would very probably be agreed to by the majority of those skilled in the programming art. They or some equivalent are felt to be absolutely essential to a discussion of the subject matter.

130 1. The term "data processor" or "computer" means any machine or apparatus which is particularly adapted for manipulating data manifested in a concrete, physical form. Analog data processors are machines adapted to manipulate data manifested by analog or continuous representations. Digital data processors are machines adapted to manipulate data manifested by digital or discrete representations. A data processor is "programmed" when it is made to perform a particular se-

quence of operations. This may be accomplished permanently, by wiring the components of a processor together, or temporarily, by providing a replaceable constituent (i.e., a programming device) directing equivalent connections.

2. The term "program" means any self-consistent set of ordered steps specifying the internal changes of state of physical (e.g., electrical or mechanical) devices within a particular data processor. This set of ordered steps may be *recorded* on many different media, including printed or handwritten lists on paper, holes in cards or tapes, magnetic discontinuities on tape, a wired plugboard, or as the state of components within the data processor itself. Moreover, a program can be written in many different notations, including standard English text, artificially created symbolic languages, or pure numbers. The program itself, however, is the set of ordered steps; it is *not* the *pro-*
131 *gramming* device by which the program is manifested and which, when in proper relation to a data processor, causes the execution of the desired steps, nor is it the *programmed* data processor resulting therefrom. Every program implies either a particular data processor or a class of data processors by which the steps can be executed.

3. The term "algorithm" means any self-consistent set of ordered steps specifying definable operations upon data and leading to a particular result. An algorithm, unlike a program, does not necessarily imply a machine for carrying it out. An algorithm is a procedure specifying the manipulative operations in terms of the interpretation of the data (multiplication by successive additions, for example); a program is also a procedure, but specifies the manipulative operations with respect to the components of a particular data processor or class of data processors. An algorithm may be embodied in, and implemented by, a program, but the same algorithm can be embodied in, and implemented by, many different programs.

*Process*

The patentability of processes depends upon, among other things, the presence of statutory subject matter. Although the process itself is an abstraction from
132 any particular means for its implementation, the
steps of the process must be concerned with the manipulation of things which are physical or material. Special problems arise in the field of data processing in determining the actual subject matter to which a particular claim relates. Thus, each claim must be interpreted in the light of the specification to which it is appended, and the presence or lack of statutory subject matter decided after viewing *the application as a whole.*

A mathematical formula, as such, for example, does not come within the statutory classes as a "process, machine, manufacture, or composition of matter, or . . . improvement thereof." A formula is merely the abstract expression of a relationship between intellectual concepts. It is not a machine, manufacture or composition of matter. It fails as a statutory process as defined by the Supreme Court in COCHRANE v. DEENER, 94 U. S. 780 (1877), since it is not a treatment of "materials or substances."

An algorithm, as defined above, is in essence a process. Its patentability depends upon the presence of statutory subject matter. It is therefore necessary to determine if the algorithm process, *as disclosed and claimed,* operates upon physical and material substances. In this connection, it is to be noted that the Supreme Court has held that the utilization of electrical signals is appropriate
133 subject matter for statutory processes in THE TELE-
PHONE CASES, 126 U. S. 1 (1887).

In ascertaining statutory subject matter, consideration must be given, not only to the subject matter which the process acts upon, but also to the steps of the process themselves. It is necessary that the steps themselves be capable of precise definition and be suitable for exclusive control. Thus, processes involving "mental steps" at the exact point of novelty, i.e., steps which, *as claimed and disclosed,* cannot be executed without the interpretive, aesthetic or judgment faculties of a human being, were held to be unpatentable in:

In re ABRAMS, 38 C. C. P. A. 945, 188 F. 2d 165 (1951), and

In re SHAO WEN YUAN, 38 C. C. P. A. 967, 188 F.2d 577 (1951).

A patentable algorithm, therefore, must not only operate *upon* data manifested by physical "materials or substances," but must also specify steps capable of execution by a machine. A non-patentable algorithm, on the other hand, may be non-statutory subject matter because that which is operated upon (mental concepts) is not physical, or because it specifies mental steps required for its execution, or both.

134 In considering algorithms, a reasonable latitude must be given in the use of "shorthand" phrases to summarize the more complicated machine sequences, just as such latitude is allowed in claims to other classes of subject matter. Care must be taken, therefore, to distinguish between purely mental operations which actually require (as disclosed) the interpretive, aesthetic or judgment faculties of a human being, and phrases evolved in the programming art by analogy with human processes, but which actually represent operations performed by machines. This distinction can, in many cases, be made only by reference to the disclosure of the specification to determine what was actually meant by the use of the term or phrase.

A program, as defined above, is essentially a machine process. Since the steps of the program are normally all individually old, the patentability of a claim to the process involving these steps depends upon the new, useful and unobvious *combination* of these steps.

In summary, a mathematical formula, as such, is nonstatutory. An algorithm process is statutory subject matter if it deals with the manipulation of physical (e.g., electrical) elements and does not involve purely mental steps

at the point of novelty. Even if an algorithm process is statutory subject matter, it is unpatentable over the prior art where the prior art, including mathematical for-
135 mulae and non-statutory algorithms, shows (i.e.,
makes obvious) the algorithm steps. It should be noted that mathematical formulae can usually be *solved* by many different algorithms, and not all of these algorithms are necessarily obvious from the formula.

A program, as a series of steps for changing the state of components of a data processor, is a statutory process. Its patentability depends upon the new and unobvious combination of such steps. A program is very often the specific implementation of an algorithm, but need not implement any algorithm. Moreover, the same algorithm can be implemented by many different programs, and not all of these programs are necessarily obvious from the algorithm.

*Apparatus*

Apparatus is sometimes claimed in terms of a paraphrase of a process definition, i.e., in terms of "means" for carrying out the "function" supplied by each step of that process. By analogy with the distinction set forth above for processes, if the "function" is a function of a machine element, or elements, and that machine element, or elements, is adequately disclosed and described as having that function, the claimed means encompasses statutory subject matter. Where the function is intellectual, or can be performed only by a human being exercising interpre-
136 tive, aesthetic or judgment faculties, and no physical
or material means are actually disclosed to perform that function, then the subject matter is non-statutory.

A clear line of distinction should be maintained between 1) a programm*able* device or manufacture, 2) a programm*ed* device or manufacture, and 3) a programm*ing* device or manufacture.

In the case of the programmable device (i.e., the computer), considered separately from any programs with which it may be used, evaluation of the patentability of the combination claimed can be handled in the same manner as any other machine or manufacture. Patentability depends upon the structural elements claimed and the structural interrelationships of those elements.

A programmable device or machine, such as a general purpose computer, is a combination of subsidiary equipments which have not yet been organized to perform any specific function. As such, the programmable machine may represent a patentable combination. The same machine, when associated with an appropriate programm*ing* device, becomes a programm*ed* machine. The programmed machine is a different machine from the programmable (but unprogrammed) machine. It is now a machine which may be a new and useful combination in its own right due to the new interrelation of parts. In other words, the fact
137 that it is a prior art machine which can have its parts
interrelated in a new way to carry out new functions of a specialized character, does not prevent this new combination from being patentable. The fact that a portion of the complete machine takes the form of a replaceable programming device is of no moment.

The programm*ing* device, that is, the device in which the program steps are embodied and which serves to cause the data processor to execute those steps, can itself be a device or article of manufacture. It may take on many different forms, such as a printed list, a coded arrangement of physical discontinuities on a recording medium, or a series of cam-like protuberances and recesses on a mechanical device. A programm*ing* device which can be defined and distinguished by means of novel structure, and does not differ from prior art devices only in the *meaning* to be attributed to the structural elements, is a statutory device or article of manufacture. Where the only distinction over the prior art is in the meaning or intelligence conveyed, this being the sole novelty and being non-statutory subject matter, it cannot impart patentability to that which is old.

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APPENDIX E
Appeal No. 768-60

IN THE
UNITED STATES PATENT OFFICE
GROUP 238

Feb 10 1967

Copy Sent to
Curphey & Erickson

Gary R. Benson
—Arthur C. Tabbot

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W. E. Pat. Dept. B'Way

| | |
|---|---|
| Case | 1-1 |
| Serial No. | 315,050 |
| Filed | October 9, 1963 |
| Subject | Conversion of Numerical Information |

---

THE COMMISSIONER OF PATENTS
WASHINGTON 25, D. C.

SIR:

In response to the Office action of November 29, 1966, please amend the above-identified application as follows:

Page 2, line 25, change "digits" to —bits—.
Page 5, line 23, change "digits" to —bits—;
line 28, change "digit" to —bit—;
line 29, change "digit" to —bit—.
Page 6, line 1, change "digit" to —bit—;
line 2, change "digits" to —bits—;
line 3, change "digit" to —bit—;
line 8, change "digit" to —bit—;
line 10, change "digit" to —bit—;
line 12, change "digit" to —bit—;
line 15, change "digit" to —bit—;

line 16, change "digit" to —bit—;
line 19, change "digits" to —bits—;
line 22, change "digit" to —bit—;
line 23, change "digit" to —bit—;
139 line 24, change "digit" to —bit—;
line 29, change "digit" to —bit—;
Page 7, line 2, change "digit" to —bit—;
line 3, change "digits" to —bits—;
line 6, change "digit" to —bit—.
Claim 1, line 7, cancel the amendment of October 24, 1966 and change "a" to —the same—;
line 8, after "operation" and before the period insert —which transfers a signal condition of a first kind into a selected storage position—.
Claim 2, line 9, before "adding" insert —selectively—;
line 10, before "quantity" insert —preselected—.
Claim 6, line 11, before "adding" insert —selectively—;
line 12, before "quantity" insert —preselected—.
Claim 7, line 8, before "adding" insert —selectively—.
Claim 9, line 9, before "supplementing" insert —selectively—;
line 12, before "supplementing" insert —selectively—.

*Remarks*

Applicants' attorney would like to thank the Examiner in Group 238 for the courtesies extended to him during the recent interview in the Patent Office.

The final rejection made in the last Office action (Paper No. 7, August 23, 1966) was withdrawn and a new final rejection made, adding five new grounds of rejection as well as restating one of the old grounds (non-statutory subject matter).

140 Claims 1 and 7 were newly rejected as fully met by J. Gilbert patent 3,019,426, granted January 30, 1962. The Gilbert patent is directed to a digital-to-analog converter and discloses (Fig. 3) a complementary analog-

to-digital converter involving a reversible counter 128 which is caused to count to the digital equivalent of an analog signal by an error signal representing the difference between the analog signal and the decoded counter output. The use made of this reference by the Examiner would seem to be restricted entirely to the counter per se, and any digital counter would seem to have done as well.

The burden of the Examiner's argument is that the clock pulses applied to any counter stores a signal in the counter, shifts the stored signal and adds a fixed quantity to a fixed position in the counter. While this description of the operation of a binary counter is somewhat fanciful, and requires all three steps of applicants' method to be read on the same single operation in the reference, it is felt that this objection can be most easily avoided by amending the claims. Claims 1 and 7 have therefore been amended to recite "*selectively* adding the same fixed quantity to said shifted signal at said fixed position for each shifting operation." Claim 7 similarly calls for "*selectively* adding, for each net shift, the same preselected quantity to said fixed position." Whatever else Gilbert's counter does, it clearly does not add selectively on shifts. Gilbert's shift is no more than the carry propagation from the add operation. The Examiner agreed at the interview that these amendments avoided the Gilbert reference.

Claims 1, 2, 6, 7, and 9 were rejected as being inoperative, the Examiner commenting that "The invention requires a masking operation and addition of the
141 same fixed quantity if a '1' signal is present in a
specific stage." Insofar as masking is concerned, it is obvious that masking is required only if the binary coded decimal digits are all registered contiguously in the same register. If they are in separate registers, for example, masking is totally unnecessary. Masking merely prevents carry propagation between BCD digits of different significance when they are stored in immediate adjacency. In the general case, therefore, masking is not an essential step in appellants' invention and its absence

by no means renders the claims inoperative. The Examiner agreed at the interview.

Th objection to the lack of a positive recital of the conditional nature of the adding operation, however, is well taken. Claims 1, 2, 6, 7 and 9 have, as noted above, all been amended to recite "*selectively* adding (supplementing)" and are believed thereby to avoid this objection. The Examiner agreed at the office interview.

Claims 4 and 5 were rejected as being vague and indefinite in not specifying that the signal must be a "1" to cause the "adding" operation. Claim 4 calls for the "presence" of a signal while claim 5 calls for "occupancy" by a signal. The designations "1" and "0", however, are entirely arbitrary and each can refer to the presence or absence of a current or voltage. Moreover, the BCD number could be stored in complementary form, as numbers often are in computer registers, and in that case, the "signal" would have to be a "0". It therefore appears that the term "signal," by itself, is neither vague nor definite, but merely broad enough to cover the various possible contingencies. The Examiner indicated his agreement at the interview.

Claims 1, 2 and 6 were rejected as being vague and indefinite in reciting "the same quantity," and the Examiner has suggested alternate language. Since the scope
142 of these claims does not appear to be affected by
the changes, the Examiner's suggestions have been incorporated into these claims.

Claims 11, 12 and 13 were rejected as drawn to "new matter." The Examiner apparently distinguishes between the repeated, serial, single-bit additions of the program in the Table on page 7 of applicants' specification, and the parallel, simultaneous, bit additions shown in the hardware implementation found in the appendix to applicants' last amendment (Paper No. 8, October 24, 1966). While it might be argued that the embodiment in the aforesaid appendix was itself "new matter," it is clear that claims 11, 12, and 13 do not fall into the same category. Each of these claims reads quite readily on the embodiment of the program at page 7 of the originally-filed application. The fact that they are broad enough to read on the other embodiment is a question of scope, not of subject matter. With art no closer than that cited by the Examiners, such scope is believed to be fully warranted.

Claim 11, for example, calls for "adding a fixed binary digit pattern to the next lesser significant decimal digit representation." The claim is silent as to whether the "binary digit pattern" is added in a series of one bit steps, or all at once, in parallel. Claim 12 is dependent on claim 11.

Claim 13, even more significantly, calls for "adding a binary '1' to the (i + 1)th and (i + 3)th least significant binary digit positions of the next lesser significant decimal digit representation." Clearly the (i + 1)th and (i + 3)th bit additions could be accomplished serially as well as in parallel.

143 In view of the above fact, i.e., that the added claims 11, 12 and 13 clearly read directly on the original disclosure, it is believed that the rejection on the grounds of new matter is totally unwarranted. It is further noted that a careful reading of applicants' original disclosure, except where the specific embodiment is described, leads to the conclusion that other embodiments were originally intended to be included. The general description of the invention at page 2, line 10 through page 3, line 2, for example, can be just as easily applied to the embodiment in the appendix to applicants' last amendment as to the embodiment of the original specification. The Examiner indicated his agreement to withdraw the rejection by telephone on January 31, 1967.

The Examiner further notes that the "manual" method and the alternative embodiment in the appendix of applicants' last amendment are not considered pertinent since they do not practice the method claimed. This argument is really the obverse of the one considered above.

It is welcomed by applicants because it serves to point out, better than applicants themselves have been able to do so far, the necessity for various different kinds of claim coverage.

In the first place, since the Examiner has not seen fit to repeat the rejection of the last Office action, based on the grounds of "inherent function of the apparatus," his objection to the "manual" method and the special purpose circuit embodiment seems moot. Without this rejection, no showing of alternative embodiments is required.

In the second place, even if the above rejection had been repeated, it is clear that claims 1 and 4, originally in the case, read directly on the alternative embodi-
144 ment. Indeed, this is precisely the reason that
method claims were included in the first place. The very fact that such distinctly different embodiments of the invention fall under the terms of the claims is almost conclusive of the need for both apparatus and method claims. While it might be argued that the alternative embodiment is "new matter," clearly the original claims are not.

The Examiner has suggested that confusion can be avoided by substituting "bits" for "binary digits." This suggestion is believed to be extremely valuable and has been adopted.

Claims 8 and 9 were further rejected as being drawn to non-statutory subject matter "for failure to define a process under 35 U. S. C. 101."

Although this rejection was discussed in considerable detail at the interview, the Examiner stated that this rejection would not be withdrawn. Since it is believed that agreement has been reached on all other issues, entry of this amendment is requested as placing the case in better condition for appeal.

Applicants would appreciate a specific restatement of the grounds of rejection of claims 8 and 9, and of the authorities relied on to support these grounds, so that they may better address themselves to these grounds on appeal.

Applicants' attorney continues to be available by telephone as indicated in the prior formal responses.

Respectfully,

GARY R. BENSON
ARTHUR C. TABBOT

By Original Signed By
Robert O. Nimtz, Attorney

Bell Telephone Laboratories, Incorporated
Murray Hill, New Jersey, Feb. 10, 1957

RON:PT

APPENDIX F

Appeal No. 768-60
Benson-Tabbot 1-1

CONVERSION TABLE
BCD to BINARY
(Prior Art)

Binary-Coded-Decimal Number (4398)

. . . . 0 1 0 0   0 0 1 1   1 0 0 1   1 0 0 0

| Conversion Values | |
|---|---|
| Binary | Decimal |
| 0000000000001 | 1 |
| 0000000000010 | 2 |
| 0000000000100 | 4 |
| 0000000001000 | 8 |
| 0000000001010 | 10 |
| 0000000010100 | 20 |
| 0000000101000 | 40 |
| 0000001010000 | 80 |
| 0000001100100 | 100 |
| 0000011001000 | 200 |
| 0000110010000 | 400 |
| 0001100100000 | 800 |
| 0001111101000 | 1000 |
| 0011111010000 | 2000 |
| 0111110100000 | 4000 |
| 1111101000000 | 8000 |
| . . . . | |

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315050

146 **Examiner's Answer, July 25, 1967**

1. This is an appeal from the final rejection of claims 1, 2, 4-9 and 11-13. No claim is allowed.

2. A correct copy of the appealed claims appears as Appendix A of Appellants' Brief. This version of the claims does not incorporate amendments submitted after the final rejection. See paragraph 7 below.

3. The reference of record relied on is:

3,019,426 1-30-1962 Gilbert 340-347

4. The new reference made of record is:

3,026,035 3-20-1962 Couleur 235-155

147 5. A correct statement of the grounds of rejection appears on pages 11-20 of Appellants' Brief.

6. A correct summary of appellants' algorithm or program appears on pages 5-11 of Appellants' Brief.

7. On further consideration, appellants' amendment submitted after the final rejection and not previously entered is now entered.

8. On further consideration of appellants' amendments and arguments, all grounds of rejection are withdrawn *except* the art rejections and nonstatutory subject matter rejections. Thus the rejections listed as III. C., III. D., III_ E., and III. F. in Appellants' Brief are withdrawn and the rejections listed as III. B. (claims 1 and 7 fully met by Gilbert) and III. G. (claims 8 and 9 nonstatutory subject matter) remain.

9. New grounds of rejection:

(a) Claims 1, 2, 4, 5, 7, 11, and 12 are rejected as fully met by Couleur. 35 U. S. C. 102.

(b) Claims 6 and 9 are rejected as merely obvious modifications of Couleur. 35 U. S. C. 103.

(c) Claims 1, 2, 6, 7 and 11-13 are rejected as nonstatutory subject matter.

10. Arguments:

(a) Claims 1 and 7 are fully met by Gilbert. 35 U. S. C. 102. Even as amended after final these claims read di-

rectly on an ordinary binary counter such as found in Gilbert and explained in detail on pages 14-15 of Appellants' Brief. It should be noted, however, contrary to appellants' assertion, that binary counters do
148 not experience carry propogation on every input pulse but rather propogate a carry signal "*selectively*" depending upon the state of the lower order member. It is noted in passing that claims 2 and 4-6 also read directly on an ordinary binary counter but no new rejection based on this fact is submitted in view of the new Couleur rejections. See paragraph 9 above and subparagraphs 10(b) and 10(c) below.

(b) Claims 1, 2, 4, 5, 7, 11, and 12 are fully met by Couleur. 35 U. S. C. 102. The algorithm and apparatus of Couleur are easily understood from inspection of the figures and the specification. Although the operation of the Couleur device uses a different algorithm or mathematical scheme, the above claims read directly on the reference.

(c) Claims 6 and 9 are merely obvious modifications of Couleur. 35 U. S. C. 103. The only step in each of these method claims not found in the reference is "masking" or carry propogation blocking. Such a step is not required in the reference since the algorithm used is such that there will never be a carry signal. See columns 4 and 5 of the reference. It would be obvious to one skilled in the art to "mask" when using an algorithm which would otherwise cause a carry propogation.

(d) Claims 1, 2, 6-9, and 11-13 are not patentable subject matter. 35 U. S. C. 101, U. S. Const. Art. I, sec-
149 tion 8. In amendment B, Paper No. 8, filed October 24, 1966, page 4, appellants' state that

> . . . it is here expressly admitted that applicants' method claims [claims 1, 6-9, 11-13] are directed to a machine algorithm . . .

It should be noted that claim 2, while purporting to be an apparatus claim, consists entirely of means elements with no apparatus limitations. Thus it would embrace every method of performing the algorithm including use of the human brain.

Mental processes and mathematical steps have consistently been held to be outside the constitutional and statutory categories of patentable invention, *i.e.,* they are not an art within the meaning of the constitutional limitation.

The generally accepted definition of process is found in *Cochrane v. Deener,* 94 U. S. 780, 788 (1877):

> . . . A process is a mode of treatment of certain materials to produce a given result. It is an act or series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing.

The Court of Customs and Patent Appeals and other courts have consistently held that mental processes are not included within the patentable processes catagory. *In re Venner,* 262 F. 2d 91, 46 C. C. P. A. (Patents) 754, 120 U. S. P. Q. 192 (1958); *In re Yuan,* 188 F. 2d 377, 38 C. C. P. A. (Patents) 967, 89 U. S. P. Q. (1951); *In re Abrams,* 188 F. 2d 165, 38 C. C. P. A. (Patents) 945, 89 U. S. P. Q. 266 (1951).

150 Mathematical steps or algorithms are considered unpatentable mental processes. In *Halliburton Oil Well Cementing Co. v. Walker,* 146 F. 2d 817, 64 U. S. P. Q. 278 (9th Cir. 1944), it was held that "determining", "registering," "counting," "observing," "measuring," "comparing," "recording," and "computing" are unpatentable mental processes. This proposition was cited with approval by the Court of Customs and Patent Appeals in *Abrams* and *Yuan, supra.* See also *Ex parte Jenny,* 130 U. S. P. Q. 318 (Board of Appeals 1960).

Thus the authorities clearly demonstrate that mathematical algorithms are not patentable subject matter.

11. In view of the new grounds of rejection appellants have sixty days within which they may file a reply to this

Answer. Such reply may include any amendment or material appropriate to the new ground and may request remand to the Examiner to consider such amendment as material. Prosecution otherwise remains closed. Failure to respond to the new grounds of rejection may be construed as an acquiesence in this rejection. See Rule 193(b) and M. P. E. P. 1208.01.

DARYL W. COOK
Acting Examiner

Conferees: D. W. Cook dc
W. J. Kopacz
WJK

151 **Reply Brief, August 31, 1967**

I. INTRODUCTION

This is a reply brief being filed under the provisions of the second sentence of subsection (b) of Rule 193 of the Rules of Practice of the United States Patent Office. The Examiner's Answer of July 25, 1967 (Paper No. 14) cited new prior art and raised new grounds of rejection. In reply thereto, appellants herewith file this reply brief and submit the attached proposed amendment to the claims. This amendment forms Appendix A to this brief.

In his Answer, the Examiner withdrew four of the six grounds of rejections in this case (Paragraph 8, Paper No. 14) and added three new grounds of rejection (Paragraph 9, Paper No. 14). In the proposed amendment attached hereto as Appendix A, applicants propose cancelling nine of the eleven claims pending. The remaining claims, claims 8 and 13, are reproduced in the attached Appendix B with the herewith proposed amendments indicated as suggested in the Commissioner's Notice of May 12, 1967 (838 O. G. 1587).

The remaining claims have been finally rejected as "drawn to non-statutory method claims for failure to define a process under 35 U. S. C. 101'' (Claim 8, Paper No. 9, Paragraph 8) and as ''not patentable subject matter. 35 U. S. C. 101, U. S. Const. Art. 1, section 8,'' (Claims 8 and 13, Paper No. 14, Paragraph 10(d) ).

## II. THE INVENTION

The statement of the invention contained in appellants' Main Brief (Paper No. 13, Section II) is complete and detailed and will not be repeated here. It will be noted, however, that, in view of the newly cited art in the Examiner's Answer (J. F. Couleur pat-
152 ent 3,026,035, granted March 20, 1962), applicants
have cancelled all of the generic claims to the algorithmic process and apparatus and have retained only the two method claims which recite the specific species of the machine process disclosed in the specification. In general, the retained claims recite a binary-coded-decimal-to-binary conversion process which requires the addition of a binary ''1'' at two specified bit positions. Since the remaining claims have not been rejected on the new reference, no further discussion of the invention is deemed to be warranted.

## III. THE REJECTIONS

The rejections of the two remaining claims are essentially the same although made at different times during prosecution and by different Examiners. In essence, these rejections are that these claims are non-statutory under 35 U. S. C. 101 in reciting mental steps and/or mathematical processes. These rejections were taken up in general in the Main Brief (Paper No. 13) at Section III, G, 2, and will not be repeated here. In his Answer, however, the Examiner has argued this rejection in a somewhat different manner and has applied different case law. The remainder of this reply brief will be directed to the arguments in section 10(d) of the Examiner's Answer (Paper No. 14).

## IV. ARGUMENTS

In outline form, the Examiner's arguments seem to be as follows:

1. Appellants have admitted that these claims are directed to "algorithms". Paper No. 8, page 4, third paragraph.

2. Mental processes and mathematical steps have consistently been held non-statutory. *Cochrane v. Deener,* 94 U. S. 780, 24 Law. Ed. 139 (Sup. Ct., 1877); *In re Venner,* 262 F. 2d 91, 46 C. C. P. A. 754, 120 U. S. P. Q. 192 (CCPA, 1958); *In re Yuan,* 188 F. 2d 377, 38 C. C. P. A. 967, 89 U. S. P. Q. 324 (CCPA, 1951); *In re Abrams,* 188 F. 2d 165, 35 C. C. P. A. 945, 89 U. S. P. Q. 266, (CCPA, 1951).

153 3. Mathematical steps or algorithms are unpatentable mental processes. *Halliburton Oil Well Cementing Co. v. Walker,* 146 F. 2d 817, 64 U. S. P. Q. 278 (CCA 9, 1944); *In re Abrams,* supra; *In re Yuan,* supra; *Ex parte Jenny,* 130 U. S. P. Q. 318 (BA, 1960).

These arguments will be taken up in the order named.

### *A. Appellants' Admission of "Algorithm"*

In order to place this admission in its proper context, the entire paragraph from which it is taken is reproduced here:

> "To avoid further difficulties, it is here expressly admitted that applicants' method claims are directed to a machine algorithm for converting binary-coded-decimal representations into binary representations. By 'algorithm' is meant a self-consistent set of ordered steps specifying definable operations and leading to a desired result. The program described symbolically on page 7 is just one way of implementing this algorithm." (Paper No. 8, page 4).

It therefore appears that appellants have admitted no more than the fact that the appealed method claims are directed to a *machine* algorithm, where algorithm is defined broadly enough to cover *any* process. This terminology was used deliberately to force the Examiner to understand the commonly-accepted meaning of the term "algorithm" in the data processing art. It will be noted that the term is peculiar to the data processing art although the definition given is broad enough to include chemical and mechanical processes, as well as data processing. The term was borrowed from the mathematical arts because most early programmers were mathematicians. It has currently come to include, however, data processing machine methods as well as purely mathematical methods.

The man skilled in the data processing art today uses the term algorithm to refer to data processing methods which are unrelated to mathematics, i.e., text matching, sorting, input-output handling, and so forth. The
154 Examiner would like to restrict the meaning to the
purely mathematical realm. To do so, however, is to deny reality and insist on terminology which is twenty years out of date. It is for this reason, and this reason alone, that applicants have insisted on the term "algorithm". The Examiner has apparently used this admission to imply the opposite of what was actually intended. This play on words would seem to be unbecoming to the vast importance of the issues at stake here.

Again, appellants would urge the Board to look behind the verbal descriptions, which are so necessary to patent disclosures, but which are so fraught with possibilities of misunderstanding, and consider the actual processes involved. It is the actual claimed methods which are statutory or non-statutory, and not any particular linguistic facade selected for their identification.

### *B. The Mental Step Doctrine*

The Examiner properly notes that, in general, mental processes have long been held to be non-statutory. With this position, appellants heartily agree. As noted in appellants' Main Brief, however, a mental process is one which *requires* the interpretive, aesthetic or judgment faculties of a human being. In each of the cited cases (*Venner, Yuan* and *Abrams*), it was the failure of the applicant to disclose apparatus for performing the desired step which led to the conclusion that the step was mental. The opposite conclusion was reached in the following cases where apparatus for performing the step was in fact disclosed.

In *Ex parte Kreuzer* et al, 84 U. S. P. Q. 432 (BA, 1950), the steps of "detecting" and "recording" in method claims was held *not* to render the claims non-statutory, the Board commenting (page 434):

155 > " . . . no observations and computations . . . by the operator are required as a necessary step in the method."

Likewise, in *Ex parte Monroe,* 105 U. S. P. Q. 376 (BA, 1955), the Board held that the steps of "measuring" and "regulating" do not render the method claims non-statutory, e.g.:

> "We do not believe that the step of 'measuring' as required in the claim on appeal is in itself a wholly mental step which requires condemnation of the claim." (page 377)

In the recent case *In re Jones,* 373 F. 2d 1007, 153 U. S. P. Q. 77 (CCPA, 1967), the Solicitor himself argued that the court ". . . should regard it [step of adding] as a mental step *in the absence of a disclosure of some actual means to accomplish this step in the application* . . ." (emphasis added, supra, 153 U. S. P. Q., at page 82.) It would seem that the Solicitor's Office also agrees with appellants' interpretation of the law.

The Examiner goes beyond the mental step doctrine, however. He goes so far as to state that "mental processes *and* mathematical steps" are non-statutory. None of the cases cited support this addendum to the rule. In these cases, the mathematical steps (if there were any) were held to be non-statutory because they were *mental,* not because they were mathematical. This theme will be taken up in more detail in the following section.

*C. Mathematical Steps or Algorithms as Mental Processes*

The Examiner asserts that "Mathematical steps or algorithms are considered unpatentable mental processes," citing the *Halliburton, Abrams, Yuan* and *Jenny* decisions, supra.

In the first place, the Examiner's position is based on the assumption that a machine algorithm, as defined by appellants, is a mathematical process. He bases
156 this conclusion solely on appellants' use of the term "algorithm" to characterize their methods, without any actual analysis of the steps of the rejected claims. As noted in appellants' Main Brief, (Paper No. 13, page 27), it is not at all clear that the steps of claim 8 are, or even can be considered to be, mathematical in any straightforward sense. Even more so, claim 13, as amended, calls for "converting *electrical signals* representing binary coded decimal numbers into *electrical signals* representing binary numbers". It is difficult to conceive of a more specific means for excluding mathematical steps from the purview of a claim.

On the other hand, even if it could be established that some or all of the appellants' steps were "mathematical", it is not clear that this is objectionable. As noted in appellants' Main Brief (Paper No. 13, page 28), mathematics is just one of many ways of describing reality quantitatively. The fact that it can also be used to describe pure abstractions (four dimensional objects, for example) does not render these forms of descriptions mental. Indeed, chemical processes are often described by mathematical formulas, as are physical systems. As noted in the recent case of *Ex parte Luigs,* 153 U. S. P. Q. 677 (BA, 1966), the mathematical description of the spacing of physical parts is a structural limitation and not a mental step.

The cases cited by the Examiner to support his proposition do not, in fact, afford any such support. These cases will be discussed one at a time.

The *Halliburton* case holds, as noted by the Examiner, that the steps of "determining", "registering", "counting", "observing", "measuring", "comparing", "recording" and "computing" rendered the method
157 claims unpatentable. The basis of this holding is clear as noted at 64 U. S. P. Q., page 282:

> "We think these mental steps, even if novel, are not patentable."

The "arithmetic process" was involved in the discussion only because no apparatus for performing these steps was disclosed and the court was convinced that "no other method of making the determination of pressure, density and production capacity is suggested except the graphic one, and it is well understood that a graph may be used to define mathematical formulae and processes as accurately as numbers or symbols" (supra, page 284), and that such processes were therefore mental. That is, the steps happened to be mathematical as well as mental. The court therefore did not find it necessary to distinguish between the two in the absence of any suggestion of apparatus for making these determinations.

The *Abrams* case involved the steps of "measuring", "determining" and "comparing" and again disclosed no apparatus by which these steps could be performed. Again the court was quite clear on the grounds on which the rejection was sustained (89, U. S. P. Q., page 269):

> "Citation of authority in support of the principle that claims to mental concepts which constitute the very substance of an alleged invention are not patentable is unnecessary. It is self-evident that thought is not patentable."

The court then relied on the applicant's specification to interpret the steps of the claims. Since the applicant stated that some of the calculations needed for "comparing" in his method "may be done by use of calculation involving the gas laws in the manner well known to the art" (89 U. S. P. Q., page 271), the court concluded that this step was mental. Again, however, it was the lack
158 of apparatus disclosure, and *not* the mathematical
characterization of the step, which rendered it non-statutory.

The *Yuan* case involved both apparatus and method claims relating to airfoil design. With respect to the method claim, the court *assumed* the step to be mental and held, (89 U. S. P. Q., page 327):

> "This court has deemed it to have been thoroughly established by decisions of various courts that purely mental steps do not form a process which falls within the scope of patentability as defined by statute."

After reviewing the history of the patent laws and the mental step doctrine, the court concluded that this doctrine was amply supported. The court does not, at any time, suggest that a mathematically described step is unpatentable for any other reason than that it is disclosed as a mental step. The issue remains, therefore, as to whether or not a mathematical description of a machine step renders that step unpatentable regardless of whether or not it is, in fact, mental. It is this latter issue which the Examiner has decided to appellants' detriment.

The *Jenny* case deals with a method of preparing certain types of graphs from other types of graphs by steps called "chording", "splining" and "plotting". The appellant in that case admitted that the step of "plotting" constituted printed matter. The court concluded that the step of "chording" was either a mental step or printed matter and hence non-statutory. Similarly, the step of "splining" was concluded to be either a conventional step or printed matter, in which case it could not lend patentability to the claim. This case, however, includes language on which the Examiner appears to be relying.

159 With respect to the step of "chording" the court notes (130 U. S. P. Q., page 320):

> "While instrumentalities are disclosed to facilitate carrying out the step . . ., neither the step nor the term 'chording', as broadly described in the claim, requires its use."
>
> * * *
>
> "It seems to us that the chording step, as broadly described in claim 23, is not a physical step as contemplated by the statute but merely the graphic representation of a mathematical solution of a problem. A mathematical solution of a problem is a mental rather than a physical step under the doctrine of *In re Shao Wen Yuan* . . .."

It should be first noted that the *Jenny* decision does not depend upon the mental step doctrine for its holdings since each step was concluded to involve printed matter.

It should also be noted, however, that *Jenny* disclosed simple, hand-operated apparatus for performing the steps of "chording" and "splining". The court, as noted above, concluded that the claims were not limited to this apparatus.

The *Jenny* case poses a dilemma to both the Patent Office and the patent bar. If it is to be used as the Examiner apparently proposes to use it, virtually all of the signal processing patents heretofore granted will be cast under a cloud of possible invalidity. There are virtually no analog signal processors (amplifiers, limiters, filters, modulators, detectors, delays, demodulators, etc.) which cannot be analyzed mathematically or graphically, this matematical scheme applied to arbitrary input signals, and the processed signals represented mathematically or graphically. In the case of digital signal processors (encoders, decoders, gates, registers, comparators, etc.) there are absolutely no exceptions to this ability.

Even more incongruously, in order to obtain method claims in signal processing application (in addi-
160 tion to apparatus claims), the applicant is often forced to the necessity of demonstrating how his method can be performed by hand (with the aid of a human being as the operator). Having done so, however, he has proved the very thing which the present Examiner would contend renders his method claims non-statutory. Up to the present time, this Board has consistently refused to so hold. For example, in the recent case of *Ex parte Bond*, 135 U. S. P. Q. 160 (BA, 1961), at page 162, it was held that ". . . a method is not per se unpatentable merely because its practice requires that the operator thereof must think." Similarly, in discussing manual steps, the Board in *Ex parte McNabb et al,* 127 U. S. P. Q. 456 (1960) held that "Such steps, however are not *purely* mental or *interpretive* mental steps and are not the kind which are prohibited by the decisions relating to purely mental steps." (emphasis added).

It is therefore contended that the *Jenny* case cannot be cited for the proposition that a method claim which possibly could be interpreted to include manual manipulation of mathematical symbols is non-statutory, simply because of the possibility. Construed within its proper fact situation, *Jenny* states no more than the previous cases, i.e., that a method claim is directed to mental steps if it *necessarily* requires the exercise of the interpretive, aesthetic or judgment faculties of a human being. The *Jenny* decision is easily reconciled with this statement of the rule since even the disclosed apparatus required the exercise of judgment on the part of the operator, not to mention the concurrent finding of non-statutory printed matter.

It is further noted that the *Jenny* decision cites the *Yuan* case as authority for the proposition
161 that "A mathematical solution of a problem is a mental rather than a physical step . . .". As noted above, the *Yuan* case merely holds that a mathematical step

is non-statutory *if* it is mental, i.e., if no apparatus is disclosed for its implementation.

It is respectfully submitted that the appealed method claims are not directed to non-statutory subject matter simply because they might be construed to include mental steps, particularly where the specification clearly discloses apparatus for the performance of the desired steps.

Even if the Board does not subscribe to this interpretation of the law, it is further submitted that the terms "signals" (claim 8) and "electrical signals" (claim 13) prevent any possibility of interpretation of these claims so as to include mental steps.

## V. CONCLUSIONS

It is respectfully submitted that the Examiner erred in his final rejection of claims 8 and 13 as drawn to non-statutory subject matter for the following reasons:

1. The use of the term "algorithm" does not determine the issue since this term is used in the art to represent machine processes as well as mathematical procedures.

2. While mental steps may render a claim non-statutory, such claims come within the rule because they necessarily require the interpretive, aesthetic or judgment faculties of a human being. None of the cases in which this rule is applied involved the present situation where apparatus is disclosed to perform the method steps without any intervention of human beings.

3. Mathematical steps, i.e., steps calling for operations described in mathematical terms, are not necessarily mental steps and hence not necessarily non-statutory.

   The issue is not whether or not a non-statutory claim
162 can be sustained by a statutory disclosure, but whether or not the claim is non-statutory in the first place. The only way applicants' claims can be construed to include mental steps is to construe them contrary to the disclosure rather than in accord therewith.

4. The terms "signals" and "electrical signals" in the appealed claims prevent, positively, any possibility of interpreting them to read on mental steps.

For the reasons set forth above, it is believed that the final rejection of claims 8 and 13 is in error. Reversal of these rejections is therefore respectfully requested.

The request for an oral hearing under the provisions of Rule 192 is again asserted

Respectfully,

GARY R. BENSON
ARTHUR C. TABBOT

By ROBERT O. NIMTZ
Attorney

163 APPENDIX A

IN THE
UNITED STATES PATENT OFFICE

Group 238

Gary R. Benson
Arthur C. Tabbot

Case 1-1

Serial No. 315,050

Filed October 9, 1963

Subject Conversion of Numerical Information

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The Commissioner of Patents,
Washington 25, D. C. 20231

Sir:

In reply to the new grounds of rejection in the Examiner's Answer of July 25, 1967, please amend the above-identified application as follows:

Cancel claims 1, 2, 4, 5, 6, 7, 9, 11 and 12.

Claim 13, line 1, after "converting" insert —electrical signals representing—,
change "number" to —numbers—;
line 2, cancel "representations",
after "into" insert —electrical signals representing—,
change "number" to —numbers—;
line 3, cancel "representations";
line 11, after the semicolon insert —and—;
line 18, change the semicolon to a period;
Cancel lines 19 through 26.

*REMARKS*

In view of the new grounds of rejections cited by the Examiner in his Answer of July 25, 1967, ap-
164 plicants have herewith amended the case by can-
celling all of the claims except claims 8 and 13. In addition, claim 13 has been amended so as to more clearly overcome the Examiner's rejection.

These amendments are being presented to the Board of Appeals in accordance with Rule 193(b) of the Rules of Practice.

Respectfully,

GARY R. BENSON
ARTHUR C. TABBOT

By Robert O. Nimtz
Robert O. Nimtz, Attorney

Bell Telephone Laboratories, Incorporated
Dated ..............................

165 **Remand to Examiner, September 25, 1967**

In view of the amendment filed August 31, 1967 in the above-entitled case, the application is hereby remanded to the Examiner under the provisions of Rule 193(b) for such prompt disposition of said paper as may be deemed proper.

By Order of the Board of Appeals.

MARY S. OLKOWSKI
Clerk of Board

166 **Examiner's Answer on Remand, October 9, 1967**

Applicants' amendment filed Aug. 31, 1967 (paper no. 16) in response to the new ground of rejection in the Examiner's Answer (paper no. 14) has been entered in part to the extent that claims 1, 2, 4, 5, 6, 7, 9, 11 and 12 are cancelled. Entry of the proposed amendments to claim 13 is denied, inasmuch as applicant has failed to point out in said paper how said amendments "overcome the Examiner's rejection". In this respect the requirements of Rule 111(c) have not been met. Further said amendments apparently raise issues not previously presented or considered.

Claims 8 and 13 now remain in the case and stand rejected for the reasons and on the same grounds clearly set forth in the Examiner's answer, paper no. 14. A correct copy of the appealed claims appears on pages 15 of
167 appellant's reply brief, paper no. 15. As to the copy of claim 13, entry of the underlined portions has been denied, and the copy should be read absent the parentheses, but including the material therein.

In summary, the remaining [of] ground of rejection of claims 8 and 13 now in the case is that these claims are directed to non-statutory subject matter. The method set forth is by applicants' own assertion "directed to a machine algorithm"; and as understood recites a series of steps for man*u*pulation of data required to be carried out by a programmed computer. Such a method, set forth in this manner, is not considered to properly set forth a process within the meaning of 35 USC 101, in light of prior de-

[Matter enclosed between brackets erased in copy.]

cisions and the requirements of 35 USC 112. The subject matter of the claims is thus deemed non-statutory.

The application is returned to the Board of Appeals for continuation of the appeal.

MAYNARD R. WILBUR
Examiner

168 **Decision of Board of Appeals, January 31, 1968**

Before Kreek, Keely and Andrews, Examiners-in-Chief.

Andrews, Examiner-in-Chief.

This is an appeal from the final rejection of claims 1, 2, 4 to 9, 11, 12 and 13. Subsequent to the appeal appellants directed the cancellation of claims 1, 2, 4 to 7, 9, 11 and 12, in a portion of an amendment entered by the Exam-
169 iner, so that the appeal as to these claims herewith is dismissed. This leaves for our consideration on appeal claims 8 and 13, which are all the claims remaining in the application. The amendments to claim 13 as proposed by the amendment of August 31, 1967, were not entered by the Examiner and will not be considered by us.

Claims 8 and 13 read as follows:

8. The method of converting signals from binary coded decimal form into binary which comprises the steps of

(1) storing the binary coded decimal signals in a reentrant shift register,

(2) shifting the signals to the right by at least three places, until there is a binary ''1' in the second position of said register,

(3) masking out said binary ''1'' in said second position of said register,

(4) adding a binary ''1'' to the first position of said register,

(5) shifting the signals to the left by two positions,

(6) adding a ''1'' to said first position, and

(7) shifting the signals to the right by at least three positions in preparation for a succeeding binary ''1'' in the second position of said register.

13. A data processing method for converting binary coded decimal number representations into binary number representations comprising the steps of

(1) testing each binary digit position 1, beginning with the least significant binary digit position, of the most significant decimal digit representation for a binary "0" or a binary "1";

(2) if a binary "0" is detected, repeating step (1) for the next least significant binary digit position of said most significant decimal digit representation;

(3) if a binary "1" is detected, adding a binary "1" at the $(i + 1)$th and $(i + 3)$th least significant binary digit positions of the next lesser significant decimal digit
170 representation, and repeating step (1) for the next least significant binary digit position of said most significant decimal digit representation;

(4) upon exhausting the binary digit positions of said most significant decimal digit representation, repeating steps (1) through (3) for the next lesser significant decimal digit representation as modified by the previous execution of steps (1) through (3); and

(5) repeating steps (1) through (4) until the second least significant decimal digit representation has been so processed.

Since neither of the references cited in the Examiner's Answer was applied against either claim before us on appeal, we need not consider these references.

Claims 8 and 13 stand rejected as for subject matter not embraced by 35 U. S. C. 101 in that they set forth "mental processes" and "mathematical steps," neither being an "art" as construed by a long line of decisions, such as:

Cochrane et al. v. Deener et al., 1877 C. D. 242, 94 U. S. 780, 11 O. G. 687

*In re* Abrams, 38 CCPA 945, 188 F. 2d 165, 1951 C. D. 264, 648 O. G. 663, 89 USPQ 266

Halliburton Oil Well Cementing Company v. Walker et al., 146 F. 2d 817, 64 USPQ 278

*In re* Yuan, 38 CCPA 967, 188 F. 2d 377, 1951 C. D. 286, 648 O. G. 967, 89 USPQ 324
*In re* Venner et al., 46 CCPA 754, 262 F. 2d 91, 1959 C. D. 174, 739 O. G. 812, 120 USPQ 192
*Ex parte* Jenny, 773 O. G. 913, 130 USPQ 318

Appellants by their brief and reply brief and at the hearing strongly urge that the instant claims should be construed to be within the statutes and that the prior decisions should not be extended to bar claims to a process even though capable of being carried out in the mind
171 where there is a disclosure in the specification that
the process could be carried out also on a machine, such as a stored program electronic computer. Appellants include, as Appendix D of their brief, appellants' attorney's comments on the proposed "Guidelines to Examination of Programs," as published in 829 O. G. 1, August 2, 1966.

We have reviewed the rejection of claims 8 and 13 against the background of the cases cited by both the Examiner and the appellants together with the comments by each and we find we are in agreement with the position of the Examiner that the appealed claims set forth subject matter not embraced by 35 U. S. C. 101 within the term "art" as interpreted in Cochrane et al. v. Deener et al., *supra*.

We are not convinced by appellants' arguments to the effect that the disclosure in an application, not the claims thereof, should be the proper basis for judging whether the claims are drawn to subject matter outside the statute. Certainly a claim which embraces that which was already in the prior art or was obvious therefrom could not be sustained under 35 U. S. C. 102 or 103 merely because there may have been something patentable disclosed in the specification. 35 U. S. C. 112 requires the claim to point out the subject matter which the applicant regards as his invention so that a claim which is so broad and indistinct as to embrace within its terms subject matter that can not be patented under section 101 of the statute, similarly must be unpatentable.

We note particularly that claim 13 is so broad as to read on the mental activity alone of a mathematician
172 while carrying out a set of rules or, more precisely, an algorithm, that expresses a relation of one arbitrary system of symbolizing an abstract number to another system for symbolizing the same abstract number. There is no physical act on a physical thing suggested by this claim and it is merely the definition of a mathematical algorithm.

The fact that a mathematician may, as an aid to his memory, routinely elect to record on a suitable medium the symbols incident to his following the procedure specified by an algorithm, such as pencil and paper or other conventional computational apparatus, does not change the basic character of the process from its being an intangible, abstract line of reasoning.

In fact it is generally recognized that any algorithm suggests the use of such aids to understanding, as for example in:

> Knuth "What Is An Algorithm?" *Datamation,* October, 1967, pp. 30-32

it is stated at page 31:

> "So much for the form of algorithms; now let us perform one. It should be mentioned immediately that the reader *should not expect to read an algorithm* like he reads a novel; such an attempt would make it pretty difficult to understand what is going on. An algorithm must be seen to be believed, and the best way to learn what an algorithm is all about is to try it. The reader should always take *pencil and paper* and work through an example of each algorithm immediately upon encountering it in the text. Usually the outline of a worked example will be given, or else the reader can easily conjure up one. This is a simple and painless method for obtaining an understanding of a given algorithm, and *all other approaches are generally unsuccessful.*" (Emphasis added).

Thus it is to be seen that denying to the mathema-
173 tician, as the appealed claims would do, access to the
usual tools of his profession, such as pencil and
paper or a programmable computer, is to deny him an opportunity to understand appellants' mathematical algorithm. Such denial is a restriction on mental process and is tantamount to granting a patent thereon. It is not seen how such restriction on mental processes could promote science or the useful arts.

Appellants argue that restriction of the claimed method by terms such as "signals" in claim 8 or "electrical signals," as they unsuccessfully proposed to amend claim 13, prevents the reading of the claims on mental steps.

A reading of the claims shows that the method is not a physical act_on anything but is dealing with a manipulation of the *meaning* represented by signals. Note that claim 8 does not purport to operate on the physical signals themselves but only on the *coded* form thereof and claim 13 clearly specifies operation on the *representation* in coded form.

The *coding* of or the *representation* made by an arrangement of signals is, itself, merely a mental interpretation and has significance only where there is a prearranged understanding of some meaning or thought to be expressed and these vary with the person involved. For example, a series of four successive vertical marks or "ones," to a tally clerk, means a count of *four;* to a student of decimal arithmetic, means the decimal number *1,111;* to a program-
mer of an octal computer, means *17* and to a pro-
174 grammer of a hexadecimal computer means *F or 15.*
Thus a method, as here, which deals with manipulations of the meanings or representations made by signals is a method of manipulating mental concepts and not of physical things.

Claim 8 specifies the step of storing signals in a "shift register." This requires no more than the writing of the symbols constituting the augend on a piece of paper as an aid to one's memory since the paper can be shifted right or left any number of intervals so as to align the augend with a fixed position of the addend. Furthermore it is a trivial choice in the programming of a computer whether the relative shifting is accomplished by use of the conventional shift register for the augend or by modification of the relative address in the instruction directing the addition of the addend, as is also routine. The relative efficiency of either choice to a mathematician or programmer would be obvious from the computer employed.

Since this Board is of the opinion that the methods here claimed are non-statutory, consonant with a long line of decisions, it doubts the wisdom of here attempting to arrive at an opposite conclusion as to the same statute solely on the basis of an ex parte showing of advantage.

For the reasons set forth above as well as for the reasons advanced by the Examiner, the rejection of claims 8 and 13 is sustained.

175 The decision of the Examiner is affirmed.

*AFFIRMED*

**176 Notice of Appeal to the United States Court of Customs and Patent Appeals, February 26, 1968**

The Commissioner of Patents
Washington, D. C. 20231

Sir:

Please take notice that the above-named applicants for Letters Patent hereby appeal to the United States Court of Customs and Patent Appeals from the decision of the Board of Appeals of the United States Patent Office rendered on the 31st day of January, 1968, rejecting claims 8 and 13 of the above-identified application.

The following are assigned as the Reasons for Appeal:

1. The Board of Appeals erred in affirming the Examiner's rejection of claims 8 and 13 as being directed to subject matter not embraced by 35 U. S. C. 101 and, more

particularly, that the appealed claims set forth mental processes and mathematical steps.

2. The Board of Appeals erred in sustaining the Examiner's rejection of claims 8 and 13 as failing to point out the subject matter which appellants regard as their invention under 35 U. S.C. 112 in that the claims are so
177 broad and indistinct as to embrace within their terms subject matter that can not be patented under 35 U. S. C. 101.

3. The Board of Appeals erred in sustaining the Examiner's rejection of claims 8 and 13 as being directed to algorithms and that the basic character of the processes of the appealed claims is an intangible, abstract line of reasoning.

4. The Board of Appeals erred in sustaining the rejection of the Examiner "for the reasons advanced by the Examiner."

Respectfully,

GARY R. BENSON
ARTHUR C. TABBOT

By ROBERT O. NIMTZ, Attorney

Bell Telephone Laboratories, Incorporated
Date Feb 23 1968

178 **Rejected Claims**

8. The method of converting signals from binary coded decimal form into binary which comprises the steps of

(1) storing the binary coded decimal signals in a reentrant shift register,

(2) shifting the signals to the right by at least three places, until there is a binary "1" in the second position of said register,

(3) masking out said binary "1" in said second position of said register,

(4) adding a binary "1" to the first position of said register,

(5) shifting the signals to the left by two positions,

(6) adding a ‘‘1’’ to said first position, and

(7) shifting the signals to the right by at least three positions in preparation for a succeeding binary ‘‘1’’ in the second position of said register.

13. A data processing method for converting binary coded decimal number representations into binary number representations comprising the steps of

(1) testing each binary digit position *i*, beginning with the least significant binary digit position, of the most significant decimal digit representation for a binary ‘‘0’’ or a binary ‘‘1’’;

(2) if a binary ‘‘0’’ is detected, repeating step (1) for the next least significant binary digit position of said most significant decimal digit representation;

(3) if a binary ‘‘1’’ is detected, adding a binary ‘‘1’’ at the (i + 1)th and (i + 3)th least significant binary digit positions of the next lesser significant decimal digit
179 representation, and repeating step (1) for the next least significant binary digit position of said most significant decimal digit representation;

(4) upon exhausting the binary digit positions of said most significant decimal digit representation, repeating steps (1) through (3) for the next lesser significant decimal digit representation as modified by the previous execution of steps (1) through (3); and

(5) repeating steps (1) through (4) until the second least significant decimal digit representation has been so processed.

Indorsed: United States Court of Customs and Patent Appeals. Filed Apr 8 1968. George E. Hutchinson, Clerk.

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