

Description

Typically, in order to solve mathematical equations using calculating devices, it has been first necessary for a user of a calculating device to manipulate or reduce an equation or in some other way conform to a lengthy, often difficult means to prepare an equation before solving the equation using the calculating device. For these reasons, often the amount of effort, such as the number of key strokes required by a user to perform useful functions on a calculator, has been excessive.

There have been efforts to make calculating devices more friendly to users. For instance, one prior art solution allowed for the permanent assigning of keys to variables in a single mathematical equation. See GENERAL PURPOSE CALCULATOR WITH CAPABILITY FOR PERFORMING INTERDISCIPLINARY BUSINESS CALCULATIONS, Rodes et al., United States Patent Serial Number 3,863,080, which is hereby incorporated by reference. Although the interface in Rodes et al. was efficient to use, there was no flexibility in the choice of mathematical equation. If more such equations were added to a calculating device severe problems with key density on the calculating device could result.

Summary of the Invention

In a first aspect, the invention provides a calculating device comprising:

means allowing a user to enter a mathematical equation into the calculating device;

display means for displaying a plurality of variables from the mathematical equation;

a plurality of alphanumeric keys;

a plurality of special keys;

means for associating each displayed variable in the plurality of variables with a respective key from the plurality of special keys;

means for assigning input data to a variable in the plurality of variables when the respective special key with which the variable is associated is pressed after a sequence of keys from the plurality of alphanumeric keys has been pressed;

means for solving the mathematical equation for a first variable in the plurality of variables when the respective special key with which the variable is associated is pressed immediately in succession after any key from the plurality of special keys has been pressed.

In a second aspect, the invention provides a method of operation of a calculating device comprising the steps of:

receiving a mathematical equation entered by a user into the calculating device;

displaying on display means a plurality of storage variables from the mathematical equation;

associating each of the variables from the mathematical equation with a respective one of a plurality of special keys of the calculating device;

assigning input data to a variable in the plurality of storage variables when the respective special key associated with that variable is pressed after a sequence of keys from a plurality of alphanumeric input keys has been pressed; and

solving the mathematical equation for a first variable in the plurality of variables when the respective special key associated with that variable is pressed immediately in succession after any key from the plurality of special keys has been pressed.

In a related aspect, the invention provides an input controller for use in the calculating device of claim 1, the input controller comprising:

means allowing a user to enter a mathematical equation;

display means for displaying a plurality of storage variable names from the mathematical equation;

a plurality of alphanumeric input keys;

a plurality of special keys;

means for associating each displayed variable in the plurality of variables with a respective key from the plurality of special keys;

means for detecting when a special key is pressed after a sequence of keys from the plurality of alphanumeric input keys has been pressed, said means being responsive to the special key for assigning the input data to the respective variable which is associated with that special key; and

means for detecting when a special key is pressed immediately in succession after any special key has been pressed, said means being responsive to control the calculating device to solve the mathematical equation for the respective variable associated with said special key pressed second in the succession.

In accordance with the preferred embodiment of the present invention a user-to-calculating device interface for the solution of mathematical equations is set out. The interface allows for the simple

construction of equations which may be utilized or stored.

Once an equation has been constructed, it may be solved. The preferred embodiment shows a device wherein equations may be solved utilizing a minimum key stroke interface. The user interface comprises a top-row-keys interface, in which each menu key within a plurality of menu key are used to both store and to calculate a variable. If two labelled menu keys are pressed in succession, the machine calculates a result for the second. Otherwise, pressing a labelled menu key performs an assignment ("=") operation and then stores a number and displays the number in a display line as a variable represented by the menu key pressed. Pressing an unlabelled menu key does nothing.

In the known art, DE-A-3508548 describes an electronic calculator with a means (an alphanumeric keyboard) for inputting an equation with variable names and operators. The variable names are displayed on a screen, and a user enters data for the variables in sequence, as prompted by a cursor on the screen. The user enters values using numeric keys and a general enter [ENT] key which causes the cursor to move to the next variable in the sequence. When a value for the last variable has been entered, the calculator executes the equation and displays the result. The calculator does not solve the equation for any user selected missing variable.

Also, GB-A-2068153 describes an electronic calculator with means (an alphanumeric keyboard) for inputting an equation with numbers and operators, and means for extracting the numbers from the equation and identifying them as letter variables (A-J). The equation is displayed with letter variables on a screen. To display current data of a letter variable, a [RCL] key is pressed followed by the appropriate letter key. To enter fresh data, a [STO] key is pressed followed by the letter key of the letter variable in which the data is to be stored. The equation is evaluated as entered, and the result displayed. The calculator also evaluates the equation with any fresh data entered for the letter variables. It does not solve the equation for any user-selected missing variable.

Also, GB-A-2111266 describes a programmable electronic calculator. The calculator includes an alphanumeric keyboard for inputting instructions, data, and programming commands. It also includes a display for displaying input data, program lines, operating mode and functions. A number of user definable "reserve" keys are arranged adjacent the display. A user selectable key sequence can be assigned or "reserved" and later recalled by pressing a selected one of these keys. A user defined label can also be input by the user, for display at a position adjacent the key to indicate the respective function or key sequence which the user has defined (typed-in) for each "reserve" key. The calculator is not described for displaying, and allocating keys to, specific variables in an equation to be solved. The calculator does not automatically solve an input equation for any user-selected missing variable.

Brief Description of the Drawings

Figure 1 shows the keyboard and display of a calculating device in accordance with a preferred embodiment of the present invention.

Figure 2A is a block diagram of a program implementing an equation solving interface in accordance with the preferred embodiment of the present invention.

Figure 2B is a flowchart of a program which implements the calculating portion of the equation solving interface shown in Figure 2A.

Figure 2C is a flowchart of a program which shows how new values and their labels are added to a history stack.

Figure 3A shows the internal chip-level architecture of the calculating device shown in Figure 1.

Figures 3B, and 3C show memory configuration of the calculating device shown in Figure 1.

Figures 4-41 and Figures 42A, 42B, and 42C show various outputs on a display of the calculating device shown in Figure 1.

Description of the Preferred Embodiment

In Figure 1, a calculating device 100 is shown having a first section 101 and a second section 102. First section 101 includes a plurality of keys 103 which include keys to be utilized for entering alphabetical symbols.

Second section 102 includes a display 111. In the preferred embodiment display 111 is a liquid crystal display which displays four lines of twenty-three characters. Second section 102 also contains a plurality of keys 104, which include numeric keys and function keys as labelled. A scrolling key 112 and a scrolling key 113 are labelled as shown.

Additionally, second section 102 includes a multifunction key 105, a multifunction key 106, a multifunction key 107, a multifunction key 108, a multifunction key 109 and a multifunction key 110. Multifunction keys 105-110 are variable function keys which may have associated with them a function or the value of a variable. The term "key" is used generically to mean a means of entering data. For instance, the term key includes not only mechanical means of input but also may include entry of data through a touch sensitive screen.

Figure 3A shows the internal chip-level architecture of calculating device 100. A central processing unit (CPU) 301, a read only memory (ROM) 302, a combination display controller and a random access memory (Display/RAM) 303 and a Display/RAM 304 are shown coupled to a bus 305. A keyboard 307 is shown coupled to CPU 301. Keyboard 307 may include plurality of keys 103 and plurality of keys 104. A random access memory (RAM) 306 is also shown in Figure 3A. RAM 306 is the total RAM from Display RAM 303 and Display RAM 304 which is available to be accessed by CPU 301.

Figure 3B shows a memory location 310, a memory location 311, a memory location 312, a memory location 313, a memory location 320, a memory location 321, a memory location 322, a memory location 323, a memory location 314 and a memory location 324. Memory locations 310-314 and 320-324 are permanently assigned memory locations within RAM 306. Memory locations 310-313 each contain 64-bit binary-encoded decimal numbers. Memory locations 314, and 320-324 each contain 20-bit addresses that point to other memory locations in RAM 306. Memory locations pointed to by memory locations 320-323 contain alphanumeric strings. Display 111 displays alphanumeric strings pointed to by memory locations 320-322 and 64-bit arithmetic numbers contained in memory locations 310-312. In display 111 the alphanumeric string pointed to by 320 (called "XLABEL") is displayed adjacent to the ASCII form of the number stored in memory location 310 (called "X"). Similarly, the alphanumeric string pointed to by 321 (called "YLABEL") is displayed adjacent to the ASCII form of the number stored in memory location 311 (called "Y"), and the alphanumeric string pointed to by 322 (called "ZLABEL") is displayed adjacent to the ASCII form of the number stored in memory location 312 (called "Z").

X, Y, and Z with their associated labels are treated as a stack. Memory location 313 (called "T") and memory location 323 (called "TLABEL") are the top of the stack and are not displayed. X, Y, Z and T and their associated labels may contain the nothing. Figure 2C is a flowchart of a program for adding and deleting entries from the stack. Additional details about the stack performance is evident from the discussion below.

Memory location 314 and memory location 324 are also permanently assigned memory locations. Memory location 314 contains the null set or a 20-bit address of alphanumeric string which is used as a current equation, as explained below. Memory location 324 contains the null set or a twenty-bit address of a memory location containing the parsed version of the alphanumeric string pointed to by memory location 314, as explained below.

Figure 2A is a block diagram of a program implementing an equation solving interface. The program can be in an entry mode 202 or a calculating mode 203. In entry mode 202 plurality of keys 103 and 104 can be used to enter an equation into calculating device 100. The equation is entered as an alphanumeric string pointed to by memory location 314. More discussion on exactly how to enter an equation and how an equation is displayed by display 111 is found below.

Once an equation has been entered into calculating device 100, a user may enter into calculation mode. The actual steps necessary for a user to perform are discussed more fully below. Calculating device 100 parses the equation displayed by display 111 in order to extract mathematical variables and to determine the mathematical relationship between the variables. Also, calculating device 100 verifies that the entered equation does define a legitimate mathematical relationship. A parsed version of the alphanumeric equation shown by display 111 is placed in a memory location pointed to by equation 324. Parsing is well-understood in the art, and a discussion thereof may be found, for instance in Principles of Compiler Design, Alfred V. Aho, Jeffrey D. Ullman, Addison-Wesley Publishing Company, 1977, esp. Chapters 3,4,5.

When parsing the equation, calculating device 100 extracts the variables and compares the variables to variables in a variable list 330 (sometimes referred to herein as "the variable list"), shown in Figure 3C. Variable list 330 is a linked list in which each variable location includes a pointer to the next variable in the list. Variable list 330 resides in RAM 306. Variable list 330 is shown to have entries 331, 332, 333, 334 and top of list 335. Entry 331 is shown divided into four segments. A segment 331a contains a twenty-bit address of the next entry into variable list 330, or the null set if there is no next entry. A segment 331c contains an alphanumeric variable name. A segment 331b contains the length of the alphanumeric variable name contained in segment 331c. A segment 331d contains a 64-bit number representing the current value of the variable of entry 331. Entries 332-334 are formatted similarly to entry 331. Entry 335 is a top of stack pointer and contains a segment 335a which points to entry 334.

If after parsing, an equation is verified to be of appropriate format, the equation, in unparsed form, is placed in a formula list 340 (sometimes referred to herein as "the formula list") which stores equations. Formula list 340 is shown to have entries 341, 342, 343, 344 and top of list 345. Entry 341 is shown divided into three segments. A segment 341a contains a twenty-bit address of the next entry into formula list 340, or the null set if there is no next entry. A segment 341c contains the equation in unparsed form. A segment 341b contains the length of the equation contained in segment 341c.

Once in calculating mode the equation to be calculated is displayed by display 111. Additionally, each variable of the equation is associated with one of the multifunction keys 105-110. For each variable associated with a multifunction key a label with the name of the variable appears on display 111 right above the multifunction key associated with the variable, as further described below.

Calculating device 100 when in calculating mode enters the programming loop described by the flowchart shown in Figure 2B. A monitor loops until a key on calculating device 100 is depressed. Once a key is depressed calculating device 100 checks to see if it was one of multifunction keys 105-110. If the key depressed is not one of multifunction keys 105-110, calculator 100 enters the value, into a current calculate line, as described further below. The calculator then reenters the monitor loop.

If the key depressed is one of multifunction keys 105-110, calculator 100 checks to see whether the last prior key depressed was from multifunction keys 105-110. If the last prior key depressed was not from multifunction keys 105-110, the value in the calculator line is entered into a variable associated with the multifunction key depressed. The variable and its current value is then displayed.

If the last key depressed was from multifunction keys 105-110, the variable of the currently depressed multifunction key is calculated using the values of the other variables. The variable calculated and its current value is then displayed.

The following is a hands-on description of the interface which serves to illustrate the details of function of calculating device 100.

Display 111 is shown in Figure 4. Calculating device 100 is in a condition such that no equations have been entered into formula list 340. In Figure 4, display 111 shows the main menu of calculating device 110. Display 111 is set to round to two decimal places.

To enter the SOLVE application, press [(SOLVE)]. What is meant by "press [(SOLVE)]" is to press a multifunction key from multifunction keys 105-110 which is immediately below the label SOLVE in display 111. As shown in Figure 4, this would mean depressing multifunction key 109.--In the following, a variable name surrounded by "[]" means that the variable may be selected by depressing one of multifunction keys 105-110. A name surrounded by "[]" means that the function may be selected by depressing one of plurality of keys 103 or 104 which is thus labelled.--If there are no formulas in formula list 340 when you press [(SOLVE)], Figure 5 shows what will be seen.

THE GENERAL PROCEDURE

The general procedure is given below:

- o Type in a formula.
- o Press [(CALC)] to calculate using the variables in the formula in the top-row-keys interface.
- o Press [EXIT] to return to the SOLVE menu.
- o Type in another formula.
- o Press [(CALC)] to calculate using the second formula.
- o And so forth ...

PUTTING THE FIRST FORMULA INTO FORMULA LIST 340

Suppose that display 111 is as shown in Figure 6. The calculator line is in alphanumeric mode and the calculator history stack described in Figure 3B is masked and can not be seen. A pointer (bold arrow) 601 points to the current formula. A cursor 602 is to the right of pointer 601, indicating the beginning of the formula that you will type in.

The [EXIT] key, shown labelled in Figure 1, has either of two effects in the SOLVE menu if the cursor is on:

- o If formula list 340 is empty, the main menu returns.
- o If formula list 340 is not empty, the SOLVE menu remains, the edit line disappears, and the previous current formula returns as the current formula.

Let us presume that you wish to enter the following monetary conversion formula into formula list 340 and to calculate the number of French francs that are equivalent to \$73.35 if the conversion rate is 9.68

French francs to 1 U.S. dollar.

Formula: $\text{DOLLARS} = \text{FRANCS} / \text{DFOB}$ (DFOB is francs-to-dollar rate).

The procedure is to type in a formula and to press [(CALC)]. In this procedure, after you type in the formula completely, but before you press [(CALC)], display 111 will display as seen in Figure 7. In this embodiment a variable name must begin with an alphabetic character and cannot contain the characters that are arithmetic operators.

If the formula is more than 22 characters long, the formula scrolls up to line 2, with the continuation in line 3, with no indentation.

You can use spaces between variables and operators, but you can not put spaces within a variable name. Spaces in a valid formula are retained in formula list 340. There are no implied operators. Thus, $A-(B+1)=X$ is not valid

CALCULATING USING THE FORMULA

Now that you have completed typing in the formula, press [(CALC)] and display 111 will appear as shown in Figure 8.

The formula is entered into formula list 340 and placed into line 1, indented one space. The calculator line is active. As you calculate and store numbers and the history stack lifts, the formula in line 1 disappears (see flowchart in Figure 2C).

Variables in the formula that do not already exist are created and initialized to zero. The variables will exist in variable list 330 and consume space in RAM 306 until the variables are deleted using either the [(delete)] or [(shift)] [CLEAR ALL] keys.

Having pressed [(CALC)], the menu key labels display the first four or five characters of the variable names in the formula, depending on the characters used, in the order in which they appear in the formula. You are now able to calculate using these menu keys.

While the formula is being interpreted after you press [(CALC)], display 111 displays the message "VERIFYING FORMULA" in line 1.

If the formula is not valid, the error message "INVALID FORMULA" is displayed and the cursor is placed over the character that is detected as causing the error. You can edit the formula to correct it. If there is more than one error in the formula, the errors are detected one at a time, as you correct them and press [(CALC)].

To calculate the answer to the example above, key in 73.35 and press [(DOLLA)] and display 111 will appear as shown in Figure 9.

The three lines again display the stack and the formula is no longer displayed.

Key in 9.68 and press [(DFOB)] and display 111 will appear as shown in Figure 10.

To solve for the number of French francs, press [(FRANC)] and display 111 will appear as shown in Figure 11.

The calculator solves for the variable FRANCS and displays the answer. While it is solving for a variable, you will see "CALCULATING..." in line 1.

If the price of a sweater is 1000 francs, you can easily calculate the equivalent in U.S. dollars. Directly from the previous display, key in 1000 and press [(FRANC)] and display 111 will appear as shown in Figure 12.

Then press [(DOLLA)] and display 111 will appear as shown in Figure 13.

You can press [(shift)] [MAIN] to leave SOLVE and return to the main menu. The history stack would still be displayed as seen above, but the menu keys would show the main menu labels.

You can also press [EXIT] to return to the SOLVE menu so that other formulas can be typed into formula list 340.

In either case, the numbers that are now stored in the machine as values for DOLLARS, FRANCS, and DFOB are retained in memory for you to use when you return to this formula in SOLVE. The values for the variables will default to zero if you change the formula.

Although it is not necessary for you to do so, if you wish to clear the values for these variables to zeroes, press [(shift)] [CLEAR ALL] at any time you are in the CALC menu.

The present embodiment returns solution using both numeric and symbolic methods. Future embodiments still being developed will utilize the symbolic method to return not only a value, but other types of data as well.

PUTTING ADDITIONAL FORMULAS INTO THE FORMULA LIST

It is quite easy to put additional formulas into formula list 340 following the formula that you are working on. Suppose that you wish to put in two additional formulas: $\text{DOLLARS} = \text{LIRE} / \text{DTOL}$ for conversion
 5 between U.S. dollars and Italian lire, and $\text{DOLLARS} = \text{POUNDS} / \text{DTOP}$ for conversions between U.S. dollars and British pounds.

To do so, press [EXIT] to return to the SOLVE menu. Display 111 will appear as shown in Figure 14.

This display again masks the calculator history stack you saw in the CALC display previously.

The bold arrow pointing at the dollars/francs conversion formula indicates that it is the current formula in
 10 formula list 340. This display indicates that the current formula is at the top of formula list because there is no other formula shown above it in display 111; lines 1 and 2 are blank. (We will see something there after we type in other formulas).

If you press [shift] [CLEAR ALL] with this display, you get a display that shows two options concerning clearing formula list 340.

15 Press [v] (labelled as Key 112 in Figure 1) and display 111 will appear as shown in Figure 15.

This display indicates that the dollars/francs formula is also the last formula in formula list 340, since there is no current formula (no bold arrow pointing at a formula) and the cursor is blinking at the left of line 3, indented one space.

If you were to press [(CALC)] with the blank line at the pointer, nothing happens.

20 With the blinking cursor in this position, you can begin typing in a formula as the next formula in formula list 340. Display 111 as shown in Figure 16 shows what you will see if you now type in the dollars/lire conversion formula.

You can now press [(CALC)] and calculate using the formula. However, let us enter the formula without calculating so that a third formula can be typed in. To do after you type the second formula, press [INPUT],
 25 which enters the formula into formula list 340 but does not go to the CALC menu, as does [(CALC)]. So, press [INPUT] and display 111 will appear as shown in Figure 17.

Now you see the first formula in line 2 and the second formula as the current formula in line 3.

The bold arrow is a pointer to the current formula; the pointer stays in line 3. The other lines are a window over the preceding two formulas in formula list 340. At this time there is only one other formula,
 30 thus line 1 is blank.

Since dollar/lire formula is the last formula in formula list 340, you could press [v] to move the pointer from the current formula to add the third formula to the end of formula list 340. However, in order to demonstrate the automatic insert feature of the SOLVE enter/edit mode, press [] (labelled as key 113 in
 Figure 1) to make the first formula the current formula. Display 111 will appear as shown in Figure 18.

35 Now the first formula is the current formula and the menu keys would show its variables if [(CALC)] were pressed.

We know also that the second formula is below it in formula list 340, but it is not seen.

We have the dollars/pounds conversion formula to put into formula list 340. Let us suppose that, rather
 40 than putting it at the bottom of formula list 340, we wish to insert it between the dollars/francs and the dollars/lire formulas now in formula list 340. To do so with display 111 as shown in Figure 18, merely start typing!

Type the first character, [D], and display 111 will appear as shown in Figure 19.

The current formula automatically moves up to line 2, the character you typed appears at the left of line 3, and the blinking cursor is to its right. You are typing the formula in and it will be placed between the two
 45 formulas now in formula list 340 -- automatically. Complete the typing of the formula and press [INPUT] or [(CALC)]. The formula will be entered and become the current formula.

If you finish typing the dollars/pounds formula and press [INPUT], display 111 will appear as shown in Figure 20.

If you had pressed [(CALC)] before pressing [INPUT], or if you press [(CALC)] now, display 111 will
 50 appear as shown in Figure 21.

The variables in the current formula appear as the menu keys, the calculator history stack returns with the current formula in line 1, and the previous contents of the calculator line return undisturbed.

In CALC mode, the [] and [v] keys roll the history stack. If you wish to change formulas, press [EXIT] to return to the SOLVE menu. In that menu, the [] and [v] keys move up and down in formula list 340.

55 If you move to another formula, the formulas share variables of the same name. Thus, the three conversion formulas in formula list 340 share the variable named DOLLARS. In the present example dollars has the value 103.31. Suppose that the dollars/lire formula is the current formula in CALC mode and the variables in the dollars/francs formula have not been cleared. If the conversion of lire to dollars is 1949 lire

to \$1, you can calculate the lire equivalent to \$103.31 at this time by keying in 1949 and pressing [(DTOL)] and display 111 will appear as shown in Figure 22.

Then pressing [(LIRE)], and display 111 will appear as shown in Figure 23.

Press [EXIT] to return to the SOLVE menu and display 111 will appear as shown in Figure 24.

5 The dollars/lire conversion formula is shown as the current formula and the other two formulas in formula list 340 at this time are shown above it. You can immediately begin typing another formula (which would be inserted after the current formula), or press [v] to find the bottom of formula list 340. If you press [shift] [v] the pointer will be placed just past the last formula in formula list 340. You could also press [- (CALC)] again to continue calculating with the current formula.

10 The method for finding a solution for a variable is complicated and is discussed in the section "NUMERICAL METHOD SOLUTIONS IN [(CALC)] MODE".

You could press either of the other two menu keys in the SOLVE menu. The remainder of this chapter explains the features of these keys.

The following is a brief description of the function of each of the menu keys:

- 15 o CALC -- brings up the current formula variables as menu keys for calculation.
- o EDIT -- puts the current formula into edit mode.
- o DELET -- deletes the current formula (no insert is needed, since it is automatic; see the previous section).

20 DELETING A FORMULA, THE [(DELET)] KEY

Formulas may be selectively deleted using the [(DELET)] menu key.

Suppose display 111 is as shown in Figure 25.

To delete the current formula, the formula indicated by the bold arrow, from formula list 340, press [- (DELET)] and display 111 will appear as shown in Figure 26.

Press [EXIT] to return to the previous display.

If you press [(VARS)], the variables in the current formula are deleted from variable list 330, thus freeing space in RAM 306. The formula itself is retained in formula list 340. If you press [(BOTH)], the formula and the variables in the formula are deleted. It is not possible to delete just the formula and retain the variables.

30 When a formula is deleted formula list 340 of formulas move up from below to fill the gap in formula list 340. If the formula that is deleted is the last formula in formula list 340, the formula is deleted and formula list 340 moves down. This displays the new "last" formula as the current formula.

EDITING A FORMULA, THE [(EDIT)] MENU KEY

35 The [(EDIT)] menu key permits you to edit the current formula. Once it is edited, press [INPUT] or [- (CALC)] as before. The edited formula is read and replaces the old version of the formula in formula list 340. [(EDIT)] is your access to the entire formula for review and editing, since the appearance of the formula in line 3 is usually only the first 22 characters. If you press [(EDIT)] display 111 will appear as shown in Figure 27.

40 The cursor blinks over the first character to the left and the formula can be typed over. The edit keys [INS], [DEL], [->], and [-<] are active for editing the formula. If the formula is longer than 22 characters, the first 22 characters appear in lines 1 or 2, depending on the length of the formula, and editing can take place in all three lines of the display. See the section "LONG FORMULAS IN THE DISPLAY" near the end of this chapter for description of this feature.

45 If you press [(EDIT)] or [(DELET)] in SOLVE while you are editing a formula, there is a beep and nothing else happens.

NAMING A FORMULA FOR EASY VISUAL REFERENCE IN THE LIST

50 You can type in any string of characters that follow the rules below, and the string with a colon (:) will begin typing your formula. This string becomes the name of the formula for visual reference to the formula in the list. The name can be any string of characters except that

- o although there can be leading and trailing spaces, the name cannot have spaces within it,
- 55 o the characters +, -, *, /, <, >, =, (,), and : can not be used in the name.

You can type in a name as you originally type in the formula, or you can edit an existing formula to a name at the front of the formula.

Suppose display 111 is as shown in Figure 28 and you wish to put the name EXCHANGE at the front of

first conversion formula.

Move the dollars/francs formula to the current position by pressing [] and display 111 will appear as shown in Figure 29.

Press [(EDIT)] and display 111 will appear as shown in Figure 30.

5 Press [INS] nine times (the number of characters in the word EXCHANGE plus one character position for the colon) and type EXCHANGE: and display 111 will appear as shown in Figure 31.

Then press [INPUT] and display 111 will appear as shown in Figure 32.

10 When you move the pointer up and down in formula list 340, the word EXCHANGE will appear whenever this formula is in the display. The name does not affect the formula that you have typed in. You are permitted to have duplicate names for formulas and Champion does not distinguish between them. They are visual references only.

CLEARING THE FORMULA LIST

15 If the display is showing the SOLVE menu and formulas, you can clear the formulas from formula list 340.

Press [shift] [CLEAR ALL] and display 111 will appear as shown in Figure 33.

Press [EXIT] to return to the previous display. If you press [(VARS)], the space in RAM 306 used to store values for the variables in all of the formulas is freed for other uses. However, the formulas remain intact in formula list 340.

20 If you press [(BOTH)], all of the formulas in formula list 340 and all variables in variable list 330 are deleted.

OPERATORS AND FUNCTIONS THAT THE FORMULA SOLVER UNDERSTANDS

25 The following is a list of the operators and functions that can be included in formulas in the SOLVE application:

30	+	addition
	-	subtraction
	*	multiplication
	/	division
		exponentiation
	(	left parenthesis
	)	right parenthesis
35	=	equals
	PI	the constant pi to 12 places
	LOG(x)	log base 10
	ALOG(x)	inverse log base 10
	LN(x)	natural log
40	EXP(x)	inverse natural log
	SQRT(x)	square root
	IP(x)	integer part
	FP(x)	fractional part
	RND(x:y)	round x to y places
45	TRN(x:y)	truncate x to y places

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	MAX(x:y)	maximum of either x or y
	MIN(x:n)	minimum of either x or n
	ABS(x)	absolute value
5	DDAYS(d1:d2:c)	days between dates, d1 and d2 valid date in current date format, c = 1 (actual calendar) or 2 (360 day calendar) or 3 (365 day calendar)
10	DATE(d1:n)	actual calendar date in current date format, d1 in current date format, n an integer
15	LNPI(x)	$\ln(1+x)$
	FACT(x)	factorial of positive integers
	EXPM1(x)	$e^x - 1$
	SPFV(i:n)	$(1+i)^n$, i is %
	SPPV(i:n)	$1/SPFV(i:n)$, i is %
	USFV(i:n)	$(SPFV(i:n)-1)/i$, i is %
20	USPV(i:n)	$USFV(i:n)/SPFV(i:n)$, i is %
	INT(x)	greatest integer less than or equal to x
	MOD(x:y)	x reduced modulo y, that is $x-y*INT(x/y)$
	IF(logical expression:x:y)	(see "SOLVER SYNTAX" section) with logical operators NOT, AND, OR, XOR
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If you type in a function that does not exist or is not specified as required by the syntax, display 111 displays "INVALID FORMULA".

NAMING VARIABLES AND RESERVED WORDS

A variable name must start with an alphabetic character. The remainder may be any combination of characters available on the machine except the space, (,), <, >, ., multiply, divide, +, -, :, and =. If these characters are used, the machine interprets them as operators rather than part of the variable name. A space in a variable name separates the string into two strings, which will cause "INVALID FORMULA" to be displayed.

If the number of characters in a variable name is greater than ten characters or the name that you type is not valid, the error message "INVALID FORMULA" is displayed.

The letter combinations IF, NOT, AND, OR, XOR, and PI can not be used as a variable name, as they are reserved for their context as an advanced function (see formula list 340 above). If you type $CAKE = PI + FLOUR + EGGS - FILLING$ as a formula, the variables will be CAKE, FLOUR, EGGS, and FILLING and a constant 3.14.... However, letters IF and PI can be used as a part of a variable name, such as SIFT and PIE.

LONG FORMULAS IN THE DISPLAY

Some formulas will exceed the length of one line of the display. There are three cases:

- o The formula is in the display when the SOLVE menu is in the display, but the cursor is not present.
- o A formula is being typed in or edited, that is, when the SOLVE menu is present and the cursor is present.
- o The case in which the formula is displayed in CALC mode.

They will be discussed in order.

Suppose that the following formula is in formula list 340:

PROFIT = (PRICE-VARIABLECOST)*UNITS-FIXEDCOST

Suppose that it is the only formula in formula list 340 and is the current formula. If you press solve display 111 will appear as shown in Figure 34.

If you press [v] you display 111 will appear as shown in Figure 35.

If the formula had the name BREAKEVEN, display 111 would appear as shown in Figure 36.

When the SOLVE menu is in the display and the current formula is not in edit mode, you see only the first 22 characters of the formula. You are not able to access the portion of the formula to the right.

5 The second case appears to have two subcases: typing in the formula the first time and editing it after it is entered.

Suppose that the display is the one above and that you wish to type in the following formula:

TOTALCOST = LENGTH*WIDTH*HEIGHT/12*UNITCOST*(1 + MARKUP%/100)

10 Type to the first character past the end of the first line and display 111 will appear as shown in Figure 37.

Continue typing to the first character past the end of this new line display will appear as shown in Figure 38.

15 Continue typing the rest of the formula display 111 will appear as shown in Figure 39.

When you press [INPUT] display 111 will appear as shown in Figure 40.

Two formulas are now in formula list 340.

20 If you press [(EDIT)] for this long formula it appears in edit mode using as much of the display as necessary to show up to the first three lines of the formula. If there are fewer than 22 characters, it will appear in line 3; if 23 through 45, it will appear in lines 2 and 3 (with the pointer in line 2); if greater than 45, it will appear beginning in line 1.

The third case is the long formula in CALC mode. Press [(CALC)] in the display above display 111 will appear as shown in Figure 41

25 When you enter CALC mode the first 22 characters of the current formula are placed in line 1. The display is the history stack and the portion of the formula that you see will disappear when there is a stack lift.

MORE THAN SIX VARIABLES IN A FORMULA

30 If there are more than six variables in a formula the menu keys in [(CALC)] show sets of five variables and a sixth labeled [(MORE)].

If the formula is $A + B + C + D + E + F + G + H + I + K = L$, the three sets of menu keys look as shown in Figure 42A, 42B and 42C.

35 Press [(MORE)] in any of the three and the next menu in the sequence is displayed. Press [EXIT] while any of the three menus is displayed and the SOLVE menu returns. Pressing [(CALC)] always brings up the first in the set.

HOW SOLVE WORKS

40 The solver has two ways of finding an answer. First, the solver tries to find a direct solution by "isolating" the user-variable you are solving for (frequently called the "unknown"). Isolating a variable involves rearranging the formula so that the unknown is by itself on the left-hand side of the formula. For example, if you enter the formula:

45 PROFIT = PRICE-COST

and solve for COST (COST is the unknown), the solver uses rules of algebra to rearrange the formula to:

COST = PRICE-PROFIT

50 Then the solver takes the values you entered for PRICE and PROFIT and calculates COST using the rearranged formula. Answers calculated this way are called direct solutions.

For certain formulas, the unknown can be isolated, but an answer cannot be calculated with the values you store. Then, display 111 displays:

55 SOLUTION NOT FOUND

For example, if you enter a formula:

AREA = LxW

and then enter 17 for AREA and 0 for W, the solver rearranges the formula to:

$$L = \text{AREA}/W$$

in order to calculate L. However, since you entered the value 0 for W, the solver cannot find an answer because division by zero is not allowed.

The solver can isolate the unknown variable if your formula meets these conditions:

- o The unknown variable occurs only once in the formula.
- o The only operators involving the unknown variable are +, -, x, /, and .
- o The unknown variable does not appear as an exponent.
- o The only functions in which the unknown variable appears are LN, EXP, SQRT, LOG, ALOG, LNP1, and EXPM1.

Note: When you are solving for a variable which is raised to power, there may be more than one solution. This may happen if the power is a positive even integer. However, if calculating device 100 can solve your formula directly, it will find only one of the solutions. For example, if you type in the formula:

$$A^2 = 4$$

and solve for A, calculating device 100 will rearrange your formula as

$$A = \text{SQRT}(4)$$

and calculate the answer to be 2. If you want calculating device 100 to choose another solution (in the above example it is -2) then put a minus sign before the quantity that is being raised to a power. In the above example, if you want the other solution type in the formula as:

$$(-A)^2 = 4$$

calculating device 100 will then rearrange your formula as

$$A = -\text{SQRT}(4)$$

and calculate the answer to be -2.

Methods for using a calculating device to directly solve equations is well known, for instance see Computer Algebra EUOROCAM '82, European Computer Algebra Conference Marseille, France, April 1982, edited by Jacques Calmet, Springer-Verlag Berlin Heidelberg New York (esp. p. 111).

NUMERICAL SOLUTIONS IN SOLVE

If the solver is not able to isolate the unknown variable, it can not provide a direct solution. In these cases, the solver automatically starts to search for a solution numerically. Calculating device 100 uses a very sophisticated trial and error method to try to find a solution for the unknown. This involves searching for the answer by making a set of estimates, seeing how close they are to a solution, and then making another set of estimates. When the solver is searching for an answer numerically, calculating device 100 displays the current estimates. If those estimates don't appear to be proceeding towards your guess of what the answer should be, you may want to halt the numerical process, enter your own guesses, and then restart the search. Using calculating devices to find iterative solutions to equations is well known, see for instance, Numerical Methods, Germund Dahlquist, Ake Bjorck, Prentice-Hall Inc., Engelwood Cliffs, New Jersey, 1974, (esp. pages 227-243).

HALTING THE NUMERICAL SEARCH

Whenever calculating device 100 is displaying a series of estimates, the numerical search is taking place. You can halt the search at any time by simply pressing any key once. Display 111 will display INTERRUPTED in line 1. The best estimate it has found so far is displayed in the calculator line.

INPUTING GUESSES

Entering your own guesses serves two purposes. First, it can save time by telling the solver where to start searching. Secondly, if more than one solution exists, entering guesses can help the solver select the answer you want. You can enter one or two guesses. If you enter one guess, the solver makes the second guess. If you enter two guesses, calculating device 100 searches for a solution starting with your two guesses.

The closer your guesses are to the answer you want, the better chance the solver has of finding it. Furthermore, the solver works best if the answer you want is in between your two starting guesses.

For example, if you are confident that the solution is bigger than 3 and smaller than 5, then you should enter 3 and 5 as the starting guesses.

Guesses must be entered immediately before starting or restarting a calculation, after you've stored a value for every variable except the unknown variable.

To enter two starting guesses:

- o Key in the value for the first guess and press the menu key corresponding to the unknown variable.
- o Key in the value for the second guess and press the menu key again.
- o To start (or restart) the search, press the menu key again.

For example, 45 [(A)] 90 [(A)] [(A)] enters the values 45 and 90 for the two starting guesses and starts the calculation. To enter one starting guess (letting calculating device 100 choose the second one), simply skip step 2 above.

If the both estimates are zero, calculating device 100 sets one estimate equal to 1. If both estimates are equal but non-zero, calculating device 100 increments one of the estimates by one in the seventh digit position. If the increment overflows, calculating device 100 decrements the estimate by one in the seventh digit position.

Claims

1. A calculating device (100) comprising:

means (307) allowing a user to enter a mathematical equation into the calculating device;
display means (111) for displaying a plurality of variables from the mathematical equation;
a plurality of alphanumerical keys (103, 104);
a plurality of special keys (105-110);

means (301, 302) for associating each displayed variable in the plurality of variables with a respective key from the plurality of special keys;

means (301, 302) for assigning input data to a variable in the plurality of variables when the respective special key (105-110) with which the variable is associated is pressed after a sequence of keys from the plurality of alphanumerical keys has been pressed; and

means (301, 302) for solving the mathematical equation for a first variable in the plurality of variables when the respective special key (105-110) with which the variable is associated is pressed immediately in succession after any key from the plurality of special keys has been pressed.

2. A device according to claim 1 wherein the display means (111) includes a first line (line 1; line 2; line 3) of display displaying the mathematical equation, and a second line of display displaying each variable from the plurality of variables.

3. A device according to claim 2, wherein each variable name is displayed adjacent the corresponding special key (105-110) associated with the variable.

4. A device according to claim 2 or 3 wherein the display means additional includes a third line of display (line 1; line 2; line 3) displaying numbers assigned to each variable in the plurality of variables.

5. A device according to claim 4 wherein numbers displayed in the third line of display are displayed adjacent to variables in the second line of display to which the numbers are assigned.

6. A device according to any of claims 1 to 5, wherein the display means includes a scroll means (303, 304) for allowing a user to view a first set of variables from the plurality of variables separately from a second set of variables from the plurality of variables when the display means is not large enough to display all the variables from the plurality of variables simultaneously.

INPUTING GUESSES

Entering your own guesses serves two purposes. First, it can save time by telling the solver where to start searching. Secondly, if more than one solution exists, entering guesses can help the solver select the answer you want. You can enter one or two guesses. If you enter one guess, the solver makes the second guess. If you enter two guesses, calculating device 100 searches for a solution starting with your two guesses.

The closer your guesses are to the answer you want, the better chance the solver has of finding it. Furthermore, the solver works best if the answer you want is in between your two starting guesses.

For example, if you are confident that the solution is bigger than 3 and smaller than 5, then you should enter 3 and 5 as the starting guesses.

Guesses must be entered immediately before starting or restarting a calculation, after you've stored a value for every variable except the unknown variable.

To enter two starting guesses:

- o Key in the value for the first guess and press the menu key corresponding to the unknown variable.
- o Key in the value for the second guess and press the menu key again.
- o To start (or restart) the search, press the menu key again.

For example, 45 [(A)] 90 [(A)] [(A)] enters the values 45 and 90 for the two starting guesses and starts the calculation. To enter one starting guess (letting calculating device 100 choose the second one), simply skip step 2 above.

If the both estimates are zero, calculating device 100 sets one estimate equal to 1. If both estimates are equal but non-zero, calculating device 100 increments one of the estimates by one in the seventh digit position. If the increment overflows, calculating device 100 decrements the estimate by one in the seventh digit position.

Claims

1. A calculating device (100) comprising:

means (307) allowing a user to enter a mathematical equation into the calculating device;
display means (111) for displaying a plurality of variables from the mathematical equation;
a plurality of alphanumeric keys (103, 104);
a plurality of special keys (105-110);

means (301, 302) for associating each displayed variable in the plurality of variables with a respective key from the plurality of special keys;

means (301, 302) for assigning input data to a variable in the plurality of variables when the respective special key (105-110) with which the variable is associated is pressed after a sequence of keys from the plurality of alphanumeric keys has been pressed; and

means (301, 302) for solving the mathematical equation for a first variable in the plurality of variables when the respective special key (105-110) with which the variable is associated is pressed immediately in succession after any key from the plurality of special keys has been pressed.

2. A device according to claim 1 wherein the display means (111) includes a first line (line 1; line 2; line 3) of display displaying the mathematical equation, and a second line of display displaying each variable from the plurality of variables.

3. A device according to claim 2, wherein each variable name is displayed adjacent the corresponding special key (105-110) associated with the variable.

4. A device according to claim 2 or 3 wherein the display means additional includes a third line of display (line 1; line 2; line 3) displaying numbers assigned to each variable in the plurality of variables.

5. A device according to claim 4 wherein numbers displayed in the third line of display are displayed adjacent to variables in the second line of display to which the numbers are assigned.

6. A device according to any of claims 1 to 5, wherein the display means includes a scroll means (303, 304) for allowing a user to view a first set of variables from the plurality of variables separately from a second set of variables from the plurality of variables when the display means is not large enough to display all the variables from the plurality of variables simultaneously.



7. A method of operation of a calculating device (100) comprising the steps of:
 receiving a mathematical equation entered by a user into the calculating device;
 displaying on display means (111) a plurality of storage variables from the mathematical equation;
 associating each of the variables from the mathematical equation with a respective one of a
 plurality of special keys (105-110) of the calculating device;
 assigning input data to a variable in the plurality of storage variables when the respective special
 key (105-110) associated with that variable is pressed after a sequence of keys from a plurality of
 alphanumeric input keys (103, 104) has been pressed; and
 solving the mathematical equation for a first variable in the plurality of variables when the
 respective special key (105-110) associated with that variable is pressed immediately in succession
 after any key from the plurality of special keys (105-110) has been pressed.
8. A method according to claim 7, wherein the step of displaying comprises displaying a variable name
 from the mathematical equation adjacent to the respective special key (105-110) associated with that
 variable.
9. An input controller for use in the calculating device (100) of claim 1, the input controller comprising:
 means (307) allowing a user to enter a mathematical equation;
 display means (111) for displaying a plurality of storage variable names from the mathematical
 equation;
 a plurality of alphanumeric input keys (103, 104);
 a plurality of special keys (105-110);
 means (301, 302) for associating each displayed variable in the plurality of variables with a
 respective key from the plurality of special keys;
 means (301, 302) for detecting when a special key is pressed after a sequence of keys from the
 plurality of alphanumeric input keys has been pressed, said means being responsive to the special
 key for assigning the input data to the respective variable of the equation associated with that special
 key; and
 means (301, 302) for detecting when a special key (105-110) is pressed immediately in succession
 after any special key (105-110) has been pressed, said means being responsive to control the
 calculating device to solve the mathematical equation for the respective variable associated with said
 special key pressed second in the succession.

Patentansprüche

1. Recheneinrichtung (100), mit
 einer Vorrichtung (307), mit der ein Benutzer eine mathematische Gleichung in die Recheneinrichtung
 eingeben kann,
 einer Anzeigevorrichtung (111) zum Anzeigen mehrerer Variablen aus der mathematischen Gleichung,
 mehreren alphanumerischen Tasten (103, 104),
 mehreren Spezialtasten (105 - 110),
 einer Vorrichtung (301, 302) zum Zuordnen jeder angezeigten Variable der mehreren Variablen zu einer
 entsprechenden Taste der mehreren Spezialtasten,
 einer Vorrichtung (301, 302) zum Zuweisen von Eingangsdaten zu einer Variablen der mehreren
 Variablen, wenn die entsprechende Spezialtaste (105 - 110), der die Variable zugeordnet ist, gedrückt
 wird, nachdem eine Folge von Tasten aus den mehreren alphanumerischen Tasten gedrückt wurde,
 und
 einer Vorrichtung (301, 302) zum Lösen der mathematischen Gleichung für eine erste Variable der
 mehreren Variablen, wenn die entsprechende Spezialtaste (105 - 110), der die Variable zugeordnet ist,
 gedrückt wurde, unmittelbar in Folge nachdem eine Taste der mehreren Spezialtasten gedrückt wurde.
2. Einrichtung nach Anspruch 1, bei der die Anzeigevorrichtung eine erste Anzeigzeile (Zeile 1; Zeile 2;
 Zeile 3) zum Anzeigen der mathematischen Gleichung und eine zweite Anzeigzeile zum Anzeigen
 jeder Variablen der mehreren Variablen aufweist.
3. Einrichtung nach Anspruch 2, bei der jeder Variablenname benachbart der entsprechenden, der
 Variablen zugeordneten Spezialtaste (105 - 110) angezeigt wird.



4. Einrichtung nach Anspruch 2 oder 3, bei der die Anzeigevorrichtung zusätzlich eine dritte Anzeigzeile (Zeile 1; Zeile 2; Zeile 3) aufweist, die Nummern anzeigt, welche jeder Variablen der mehreren Variablen zugewiesen sind.
5. Einrichtung nach Anspruch 4, bei der die in der dritten Anzeigzeile angezeigten Nummern den Variablen in der zweiten Anzeigzeile, denen die Nummern zugewiesen sind, benachbart angezeigt werden.
6. Einrichtung nach einem der Ansprüche 1 bis 5, bei der die Anzeigevorrichtung eine Bildschirmrollvorrichtung (303, 304) aufweist, mit der ein Benutzer einen ersten Variablensatz aus den mehreren Variablen getrennt von einem zweiten Variablensatz aus den mehreren Variablen ansehen kann, wenn die Anzeigevorrichtung nicht groß genug ist, um alle Variablen der mehreren Variablen gleichzeitig anzuzeigen.
7. Verfahren zum Betreiben einer Rechenvorrichtung (100), mit den Verfahrensschritten:
Empfangen einer von einem Benutzer in die Rechenvorrichtung eingegebenen, mathematischen Gleichung,
Anzeigen mehrerer Speichervariablen aus der mathematischen Gleichung auf einer Anzeigevorrichtung (111),
Zuordnen jeder Variablen aus der mathematischen Gleichung zu einer entsprechenden von mehreren Spezialtasten (105 - 110) der Rechenvorrichtung,
Zuweisen von Eingangsdaten zu einer Variablen von den mehreren Speichervariablen, wenn die entsprechende Spezialtaste (105 - 110), die dieser Variablen zugeordnet ist, gedrückt wurde, nachdem eine Tastenfolge aus mehreren alphanumerischen Eingabetasten (103, 104) gedrückt wurde, und
Lösen der mathematischen Gleichung für eine erste Variable der mehreren Variablen, wenn die entsprechende Spezialtaste (105 - 110), die dieser Variablen zugeordnet ist, gedrückt wurde, unmittelbar in Folge nachdem eine Taste von den mehreren Spezialtasten (105 - 110) gedrückt wurde.
8. Verfahren nach Anspruch 7, bei dem beim Anzeigen ein Variablenname aus der mathematischen Gleichung benachbart der entsprechenden Spezialtaste (105 - 110), die dieser Variablen zugeordnet ist, angezeigt wird.
9. Eingabesteuervorrichtung für die Recheneinrichtung (100) nach Anspruch 1, mit
einer Vorrichtung (307), mit der ein Benutzer eine mathematische Gleichung eingeben kann,
einer Anzeigeeinrichtung (111) zum Anzeigen mehrerer Speichervariablennamen aus der mathematischen Gleichung,
mehreren alphanumerischen Eingabetasten (103 104), mehreren Spezialtasten (105 - 110),
einer Vorrichtung (301, 302) zum Zuordnen jeder angezeigten Variablen der mehreren Variablen zu einer entsprechenden Taste der mehreren Spezialtasten,
einer Vorrichtung (301, 302) zum Erfassen, ob eine Spezialtaste gedrückt wurde, nachdem eine Tastenfolge aus den mehreren alphanumerischen Eingabetasten gedrückt wurde, wobei diese Vorrichtung auf die Spezialtaste anspricht, um den Eingangsdaten entsprechende Variablen der Gleichung zuzuweisen, die dieser Spezialtaste zugeordnet sind, und
einer Vorrichtung (301, 302) zum Erfassen, daß eine Spezialtaste (105 - 110) gedrückt wurde, unmittelbar in Folge nachdem irgendeine Spezialtaste (105 - 110) gedrückt wurde, wobei diese Vorrichtung die Recheneinrichtung so steuern kann, daß sie die mathematische Gleichung für jeweils die Variable löst, die der an zweiter Stelle in der Folge gedrückten Spezialtaste zugeordnet ist.

Revendications

1. Un dispositif calculeur (100) comprenant:
un moyen (307) permettant à un utilisateur d'entrer une équation mathématique dans le dispositif calculeur;
un moyen d'affichage (111) pour afficher une série de variables de l'équation mathématique;
une série de touches alphanumériques (103, 104);
une série de touches spéciales (105 à 110);
un moyen (301, 302) d'association, à une touche respective de la série des touches spéciales, de chaque variable affichée de la série de variables;



un moyen (301, 302) d'assignation d'une donnée d'entrée à une variable de la série des variables lorsque la touche respective spéciale (105 à 110) à laquelle la variable est associée est actionnée après une séquence d'actionnement de touches de la série des touches alphanumériques; et

un moyen (301, 302) de résolution de l'équation mathématique pour une première variable de la série des variables lorsque la touche spéciale respective (105 à 110) à laquelle la variable est associée, est actionnée immédiatement après un actionnement d'une touche quelconque de la série des touches spéciales.

2. Un dispositif selon la revendication 1 dans lequel le moyen d'affichage (111) inclut une première ligne (ligne 1.; ligne 2; ligne 3) d'affichage qui affiche l'équation mathématique, et une deuxième ligne d'affichage qui affiche chaque variable de la série des variables.

3. Un dispositif selon la revendication 2 dans lequel chaque nom de variable est affiché près de la touche correspondante spéciale (105 à 110) associée à la variable.

4. Un dispositif selon la revendication 2 ou 3 dans lequel le moyen d'affichage additionnel inclut une troisième ligne d'affichage (ligne 1; ligne 2; ligne 3) affichant des numéros assignés à chaque variable de la série des variables.

5. Un dispositif selon la revendication 4 dans lequel des numéros affichés dans la troisième ligne d'affichage sont affichés près de variables de la deuxième ligne d'affichage auxquelles les numéros sont assignés.

6. Un dispositif selon l'une quelconque des revendications 1 à 5 dans lequel le moyen d'affichage inclut un moyen de défilement (303, 304) de manière à permettre à un utilisateur de visualiser un premier ensemble de variables de la série de variables séparément d'un deuxième ensemble de variables de la série de variables lorsque le moyen d'affichage n'est pas suffisamment grand pour afficher simultanément toutes les variables de la série des variables.

7. Un procédé de mise en œuvre d'un dispositif calculateur (100) comprenant les étapes consistant à recevoir une équation mathématique entrée par un utilisateur dans le dispositif calculateur; afficher sur un moyen d'affichage (111) une série de variables de mémorisation venant de l'équation mathématique; associer chacune des variables des équations mathématiques à une touche respective d'une série de touches spéciales (105 à 110) du dispositif calculateur; assigner une entrée de donnée à une variable de la série de variables de mémorisation lorsque la touche spéciale respective (105 à 110) associée à cette variable est actionnée après un actionnement d'une séquence de touches de la série des touches d'entrée alphanumériques (103, 104); et résoudre l'équation mathématique pour une première variable de la série des variables lorsque la touche respective spéciale (105 à 110) associée à cette variable est actionnée immédiatement après un actionnement d'une touche quelconque de la série des touches spéciales (105 à 110).

8. Un procédé selon la revendication 7, dans lequel l'étape d'affichage comprend l'affichage d'un nom variable venant de l'équation mathématique près de la touche spéciale respective (105 à 110) associée à cette variable.

9. Un dispositif de commande d'entrée à utiliser dans un dispositif calculateur (100) selon la revendication 1, le dispositif de commande d'entrée comprenant un moyen (307) permettant à un utilisateur d'entrer l'équation mathématique; un moyen d'affichage (111) servant à afficher une série de noms de variables de mémorisation de l'équation mathématique; une série de touches alphanumériques d'entrée (103, 104); une série de touches spéciales (105 à 110); un moyen (301, 302) d'association de chaque variable affichée de la série de variables à une touche respective de la série de touches spéciales;

un moyen (301, 302) de détection de l'instant où une touche spéciale est actionnée après un actionnement d'une séquence de touches de la série des touches alphanumériques d'entrée, ledit moyen étant sensible à la touche spéciale pour assigner la donnée d'entrée à la variable respective de



l'équation associée à cette touche spéciale; et

un moyen (301, 302) de détection de l'instant où une touche spéciale (105 à 110) est actionnée immédiatement après l'actionnement d'une touche spéciale quelconque (105 à 110), ledit moyen étant sensible pour commander le dispositif calculeur de manière à résoudre l'équation mathématique pour la variable respective associée à ladite deuxième touche spéciale qui a été actionnée en deuxième lieu dans l'ordre.

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