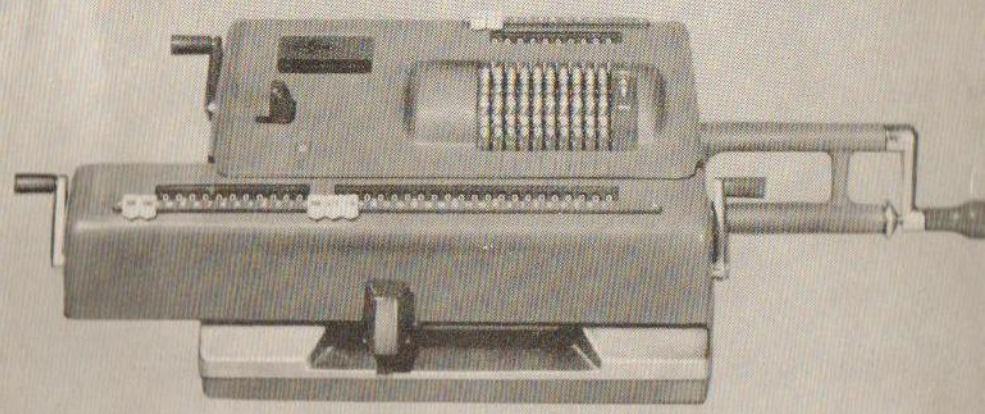
NIPPON CALCULATING MACHINE CO., LTD.

Printed in Japan

EXPLANATIONS OF NIPPON CALCULATOR HL-21 AND ACTUAL EXAMPLES OF COMPUTATION



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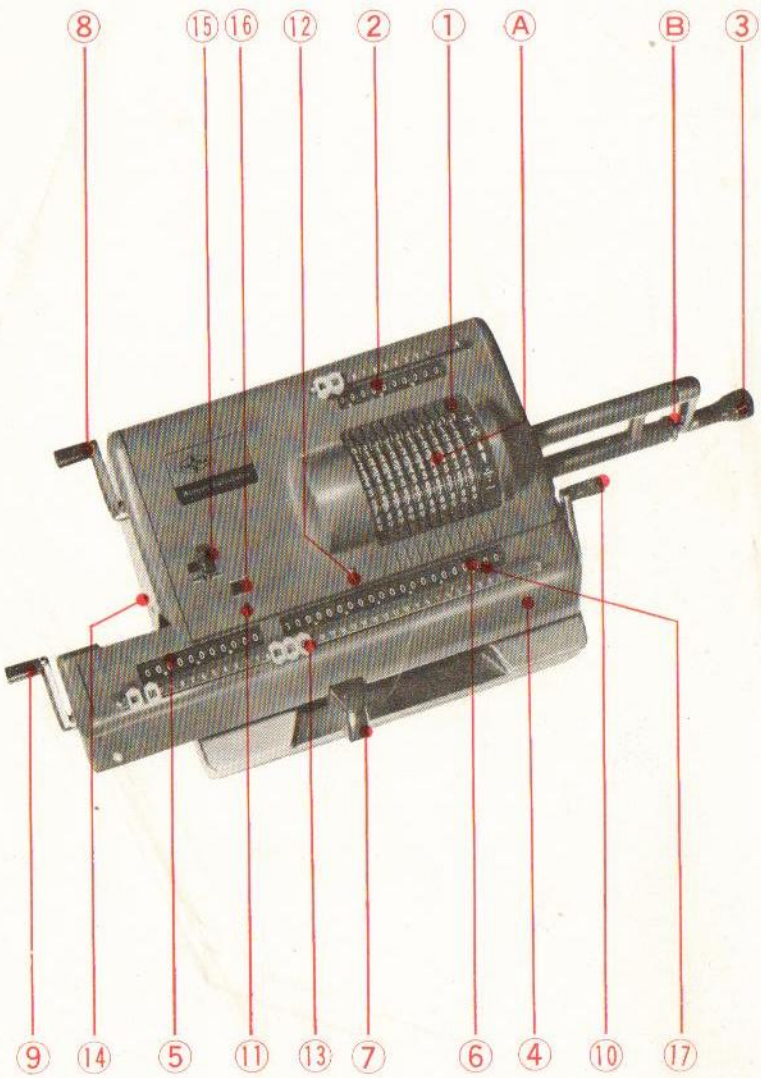
NIPPON CALCULATOR HL-21



① Setting Lever
② Setting Register
③ Crank Handle
④ Carriage
⑤ Quotient Register
⑥ Product Register
⑦ Shift Knob
⑧ Clearing Lever-S (Setting Register)
⑨ Clearing Lever-Q (Quotient Register)
⑩ Clearing Lever-P (Product Register)
⑪ Position Indicator
⑫ Indicator of Carry-Over
⑬ Decimal Indicator
⑭ Lock Pin
⑮ Transfer Knob
⑯ Revolution Direction Indicator
⑰ Three-Digit Point

Ⓐ Drum Cover
Ⓑ Bracket Mouth Piece

FOREWORD

Nippon Calculator, HL-21, is a excellent product from the modern plant of Nippon Calculating Machine Co., Ltd. with a long glorious history and up-to-date techniques.

This Calculator features brighter color, lighter weight, and more powerful strength than any other calculators.

Computations can be made in a comfortable mood thanks to the rise of a pleasant rhythm from the quiet operating sounds and the smooth mechanical rovolutions.

Besides, attentive consideration is given to such excellent devices as the automatic revolution for multiplication or division, the decimal transmission mechanism for the 14 digits on the Product Register, the continuous multiplication of the speedy operation, the lock system for the complete prevention of troubles, and the Dust-Proof Covers for all the registers.

This Calculator is exported to various overseas markets. It can make complex computations as well as addition, subtraction, multiplication, and division.

EXPLANATIONS OF PARTS OF NIPPON CALCULATOR HL-21

※ Read with Reference to Inserted Explanatory Photograph.

① Setting Lever

The Setting Lever moves along the groove stamped with the figures of 0, 1, 2, ····· 9.

Push down the lever lightly with the forefinger and set it to the desired figure. Then the figure will be placed.

② Setting Register

The figures placed by the Setting Lever are shown in a line on the Setting Register.

③ Crank Handle

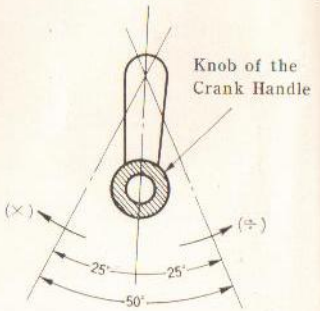
Computation is made by turning round the Crank Handle. The arrow marks (▲ and ▼) on the right of the drum cover indicate the turning directions. Turn the Crank Handle in the direction of the arrow mark ▲ ⊕ for addition and multiplication and in the direction of the arrow mark ▼ ⊖ for subtraction and division.

Attention

→ **Turniug of the Crank Handle:**

Turn the Crank Handle smoothly, while pulling its knob a little. When it is turned round too much or in the opposite direction, be sure to turn it round reversely after the revolution of its direction is finished.

The automatic clutch is, as shown in the right diagram, converted and set to either ⊗ or ⊜ from its



④ Carriage

The Carriage is fitted with the Product Register ⑤, the Quotient Register ⑥, the Clearing Lever-Q ⑨, and the Clearing Lever-P ⑩. It can be shifted left or right by the Shift Knob ⑦.

⑤ Quotient Register

The part equipped with 11 windows on the left of the Carriage is called the Quotient Register.

The register indicates the multiplier for ⊗ and the quotient for ⊜.

⑥ Product Register

The part equipped with 21 windows on the right of the Carriage is called the Product Register.

The register indicates the product for ⊗ and the dividend for ⊜.

⑦ Shift Knob

The Shift Knob is located at the forefront of the Carriage and is used for shifting the Carriage left or right.

One digit Shift: Push the Shift Knob to the left, and the place of the digit will be shifted by one to the left. Push the Shift Knob to the right likewise, and the place of the digit will be shifted by one to the right.

Overall Shift: Move it left or right while pushing the Shift Knob forward, and the Carriage will be shifted to any optional place at once.

neutral position within the limit of about 50° (about 25° each toward ⊕ and ⊖) centering on its regular position. When it is transfered to ⊜ Revolution Direction Indicator (16) shows the red signal for the ⊖ direction.

Be sure to turn the Crank Handle once accurately at first. The set direction of the automatic clutch will not be changed even when the Crank Handle is subsequently turned round in any direction. The automatic clutch will return to its neutral position if any Register is cleared.

⑧ Clearing Lever-S (Setting Register)

The Clearing Lever-S is located on the upper left. When it is pulled backward, both the Setting Lever and the Setting Register return to zero simulltaneously.
(The action of returning each register to zero will be hereafter called "clearing".)

⑨ Clearing Lever-Q (Quotient Register)

The Clearing Lever-Q is located at the left end of the Carriage and is designed to clear the figures on the Quotient Register.
Pull it backward completely, and the figures will be cleared.

⑩ Clearing Lever-P (Product Register)

The Clearing Lever-P is located at the right end of the Carriage and is designed to clear the figures on the Product Register.
Its operation is the same as that of the Clearing Lever-Q.

Attention —> **When Pulling the Clearing Lever :**

Touch the surface of the Carriage lightly with the thumb and hook the second joint of the forefinger onto the lever.
Then pull the lever with a jerk.
It is most effective to operate the lever in the way as mentioned above, because its movement is related to that of returning the automatic clutch to its neutral position.

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⑪ Position Indicator

The position indicator is the arrow mark ▼ located above the Quotient Register and indicates the digit for computation.

⑫ Indicator of Carry-Over

The indicator of Carry-Over is the arrow mark ▼ located above the Product Register and indicates the decimalizing range of the register.

⑬ Decimal Indicator

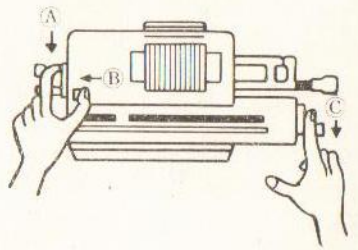
Move the Decimal Indicator properly to determine the decimal place or to divide the figures. When it is moved midway between two windows of the register, a figure appears in its square window.
The figure indicates the number of valid digits downward.

⑭ Lock Pin

The metal fitting projecting from the lower left side of the Calculator is called the Lock Pin and acts as a brake for prevention of the reverse turning of the Crank Handle.
If the turning of the Crank Handle comes to a halt due to the erroneous performance of two different operations at the same time, turn the handle while pushing the Lock Pin strongly in its falling direction. Then the handle will return to its normal position.

⑮ Transfer Knob

The Transfer Knob is located under the brand plate. When making continuous multiplications move the Carriage to the place of the required digit beforehand, pull the Clearing lever-S (A) backward to clear the Setting Lever and the Setting Register.
Keep the Clearing Lever-S in its completely pulled position, and clear the Product Register (C) while pushing the knob (B) in the left direction. Then the figures indicated on the product Register will automatically move to the Setting Levers and they will appear on the Setting Register.



⑯ Revolution Direction Indicator

The Revolution Direction Indicator shows the red signal for the ⊖ direction only when the Automatic Clutch is set to ⊕. Pull the Clearing Lever-S and both Clearing Levers of Q and P completely, and the red signal will disappear.

⑰ Three-Digit Point

The Three-Digit Point is a white circle pointed between windows of each register at intervals of three digits and is used to mark the decimal point or divide the figures.

Attention ⟶ **Lock System:**

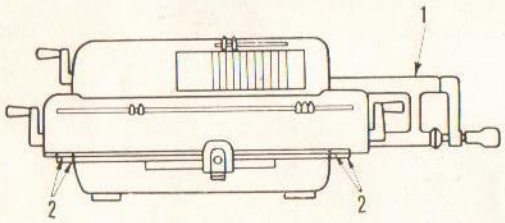
The Nippon Calculator is fitted with the lock system for the purpose of maintaining its computing accuracy and durability. The system brings the Calculator to a halt if any part is at an irregular position.

When shifting the place of a digit, one tends to turn the Crank Hand before the Carriage proceeds to the next digit place.

Double operations of this kind may damage the Calculator.

Therefore, be sure to operate the Calculator with all of its parts at their regular positions.

⟶ **Oiling Required at Least Once a Month:**



1. The bearing for the shaft of the Crank Handle.
2. The bottom and the back and front sliding parts of the Carriage.

Be sure not to oil other parts.

Oiling should be made only to the extent of forming a thin oil film.

The oil should be a nonadhesive pure mineral oil.

⟶ **Excessive Oiling Should not be Given to:**

1. Setting Lever Device (Drum).
2. Friction surfaces of the Quotient and the Product Register and Setting Register.

OPERATING INSTRUCTONS

1. Addition and Subtraction

When making addition and subtraction, set the Carriage ④ to have the Position Indicator ⑪ point the least significant digit's place on the Quotient Register ⑤.

a. Addition

Example : 5 + 35 + 482 = 522

1. Set the Setting Lever to 5 at the least significant digit place and turn round the Crank Handle ③ once in the ⊕ direction.
2. Set the levers to 35 and turn round the handle once in the ⊕ direction.
3. Set the levers to 482 and turn the handle once in the ⊕ direction.

   Then the Product Register ⑥ will show the sum of 522.

b. Subtraction

Example: 736 − 415 = 321

1. Set the Setting Levers to 736 at the places of the first three digits and turn the Crank Handle once in the ⊕ direction to shift the figure to the Product Register.
2. Set the levers to 415 and turn the handle once in the ⊖ direction.

   Then the Product Register will show the remainder of 321.

2. Multiplication

a. Multiplication of Integers

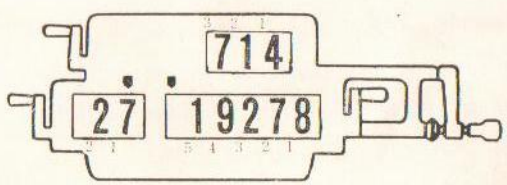
In order to place calculator at its regular position for multiplication, set the Carriage, so the Position Indicator ⑪ points to the place of the most significant digit of multiplier on the Quotient Register ⑤.

Example: 714 × 27 = 19278

1. Set the Carriage to have the Position Indicator ⑪ point to the place of the second digit on the Quotient Register ⑤.

2. Set the Setting Levers to the multiplicand of 714 at the places of the first three digits.
3. Turn the Crank Handle twice in the ⊕ direction.

4. Shift the places of the digits by one to the right by pushing the Shift Knob ⑦ to the left in order to have the Position Indicator point to the place of the least significant digit on the Quotient Register.
5. Turn round the Crank Handle seven times in the ⊕ direction, and the Product Register will show the product of 19278.



b. Method for Decreasing the Turning Number of the Crank Handle

When the multiplier includes the figure of 7, 8 or 9, it is feasible to decrease the turning number of the Crank Handle by utilizing the decimalizing system of the Quotient Register.

For example, when a certain figure is multiplied by 9, first multiply it by 10 and subtract it from the product.

Example : 238 × 186 = 44268

When the ordinary method is compared with the decreasing method, the turning number of the Crank Handle becomes as follows:

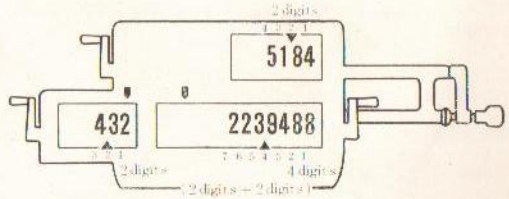
No. of Digits on Quotient Register	Ordinary Method: Turning Direction of Handle	Ordinary Method: Turning No. of Handle	Ordinary Method: Figure Appearing on Quotient Register	Decreasing Method: Turning Direction of Handle	Decreasing Method: Turning No. of Handle	Decreasing Method: Figure Appearing on Quotient Register
3	⊕	1	100	⊕	2	200
2	⊕	8	180	⊖	1	190
1	⊕	6	186	○	4	186
		15			7	

c. Multiplication of Decimal Fraction

When a decimal fraction is included in making a multiplication, determine the decimal point beforehand.

Example : 51.84 × 4.32 = 223.9488

1. Set the Setting Levers to 51.84 at the places of the first four digits and put the Decimal Indicator ⑬ between figure 1 and 8. At this time, the figure 2 appearing in the window of the decimal Indicator shows the number of digits below the decimal point.
2. Set the Decimal Indicator for the Quotient Register to have its window show the figure 2, because the multiplier 4.32 has two digits below the decimal point.
3. On the Product Register, set the four digits which show the sum of the two digits below the decimal point for the Setting Levers and the other two on the Quotient Register (between the fourth and the fifth digits, namely the place where the indicator's window shows the figure 4).
4. When 4.32 is shown on the Quotient Register, the product 223. 9488 appears on the Product Register.



d. Several Multiplications by constant Multiplier

Example : 305 × 123 = 37515
423 × 123 = 52029
296 × 123 = 36408

1. Set the Setting Levers to the constant multiplier 123.
2. Make a normal multiplication and obtain the answer 37515 to the first question. Then jot down the answer.
3. Then convert the figure 305 on the Quotient Register to 423 according to the method for decreasing the turning number of the Crank Handle, while leaving other parts as they are.
   Then the answer 52029 will be obtained.
4. Convert the last figure on the Quotient Register by turning the Crank Handle.

e. Continuous Multiplications

Example : 54 × 23 × 321 = 398682

1. Multiply 54 by 23.
2. Move the Carriage, so the figure 1242 comes within the reach of the Setting Levers.
3. Pull the Transfer Knob ⑮ with the thumb completely to the left while leaving Setting Levers cleared. Clear the Product Register, and the figure 1242 will be set for the levers.
4. Clear the Quotient Register, and show the second multiplier 321 by turning the Crank Handle in the ⊕ direction, the Product Register will show the product 398682 of the three figures.

f. Computation for Obtaining Sum of Products and Remainder of Products

Example 1 : $\underset{ⓐ}{654\times341}+\underset{ⓑ}{486\times13}-\underset{ⓒ}{346\times921}+\underset{ⓓ}{451\times16}=555214$

1. Make a normal multiplication of 654 × 341 and obtain the product 223014 of ⓐ.
2. Clear the Setting Levers and the Quotient Register, leaving only the figure 223014 on the Product Register.

3. Then compute 486 × 13, and the sum 229332 of the products ⓐ and ⓑ will be obtained on the Product Register.
4. Compute ⓒ and ⓓ likewise, leaving the answers on the Product Register, and the four products will be added and their total sum 555214 will appear on the Product Register.

Example 2 : $\underset{ⓐ}{981\times286}-\underset{ⓑ}{432\times42}+\underset{ⓒ}{693\times263}-\underset{ⓓ}{152\times53}=436625$

1. Compute 981 × 286
2. Clear the Setting Levers and the Quotient Register, leaving only the figure 280566 on the Product Register.
3. Set the Setting Levers to 432 and indicate 42 on the Quotient Register by the ⊖ turning. Then the remainder 262422 of ⓐ − ⓑ will be obtained on the Product Register.
4. Compute ⓒ and ⓓ, turning the Crank Handle in the ⊕ and ⊖ directions respectively. Then the remainder 436625 will be obtained on the Product Register.

g. Multiplications by constant multipliers with Addend or Subtrahend

Example 1 : 23 × 365 + 562 = 8957
41 × 365 + 562 = 15527
36 × 365 + 562 = 13702

1. Set the Setting Levers to 562 and shift the figure to the Product Register.
2. Clear the Quotient Register and the Setting Levers, set the levers to the constant multiplier 365, and turn the Crank Handle according to the Multiplications by constant multiplier as shown in d. Then each answer will be obtained.

Example 2 : 11 × 427 − 245 = 4452
25 × 427 − 245 = 10430
36 × 427 − 245 = 15127

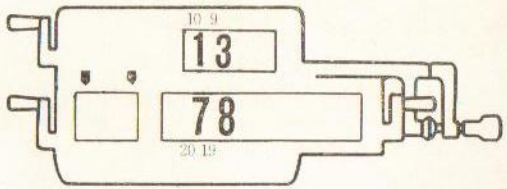
1. Set the Setting Levers to 245 and turn the Crank Handle once in the ⊖ direction.
2. The Product Register Indicates 99···99755 (The bell rings).
3. Clear the Quotient Register and the Setting Levers and set the levers to the constant multiplier 427, and obtain each answer according to the method described in Example 1.
4. On this computation, be careful to indicate the multiplier 427 at the places of the same digits from which 245 was subtracted.

3. Division

a. Division of Integers

The regular position of the calculator for making a division can be obtained by shifting the Carriage completely to the right and setting the Position Indicator to the 11th digit at the left end of the Quotient Register.

Example : 78 ÷ 13 = 6



1. Set the Setting Levers to the dividend 78 from the place of the most significant digit downward, shift the figure to the Product Register by turning round the Crank Handle in the ⊕ direction.
2. Clear the levers and the Quotient Register.
3. Set the levers to the divisor 13 from the place of the most significant digit downward.
4. Start computing by repeatedly turning the handle in the ⊖ direction. Then the warning bell will ring.

5. The sound of the bell is a warning against an excessive division. Therefore, turn the handle reversely in the ⊕ direction, and the bell will ring again. This time, the sound is the signal that the correction has been completed.

   At this time, the Quotient Register will indicate the quotient 6.

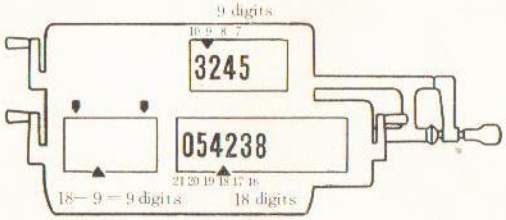
b. Division of Decimal Fractions

When a decimal fraction is included in making a division determine the place of the decimal point of the quotient beforehand. On the Quotient Register, take the number of digits for the quotient which is the remainder of the number of digits below the decimal point of the dividend minus that of the divisor.

Example : 54.238 ÷ 3.245 = 16.7143·····0.0000965

1. Set the Setting Levers to the dividend 54.238 from the place of the most significant digit downward, shift the figure to the Product Register, and set the decimal indicator between 4 and 2. Then the Decimal Indicator's window will show the figure 18.
2. Clear the Quotient Register and set the levers to the divisor 3.245 from the place of the most significant digit downward, and set the Decimal Indicator between 3 and 2. Then the indicator's window will show 9.
3. Since the number of digits below the decimal point of the dividend is 18 and that of the divisor is 9, that of the quotient is 18−9 =9. Set the Decimal Indicator to have its window show the figure 9 on the Quotient Register.
4. Then start computing in the same way for division of the integer. When repeatedly turning the Crank Handle in the ⊖ direction, the Quotient Register indicates the figure 2 and the bell rings simultaneously. The sound of the bell is a warning against an excessive division. Therefore, turn the handle reversely in the ⊕ direction, and the bell will ring again. Then shift the Carriage by one digit to the left. Continue this process repeatedly, and the quotient 16.7143 will be obtained on the Quotient Register with the residual 0.0000965 on the Product Register.

5. When seeking more figures below the decimal point, repeat the process.



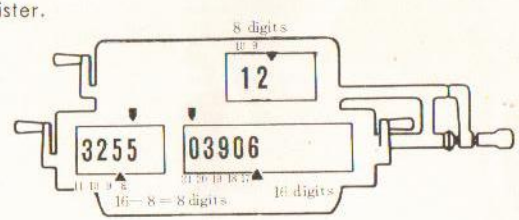
c. Division by Multiplication (Trial Multiplication)

The previously mentioned division is based on the idea of A ÷ B = (X) (how many times B can be subtracted from A), but the basic idea of this dividing formula is A = Bx (X) (how many times B should be added to make A).

Example : 3906 ÷ 12 = 325.5

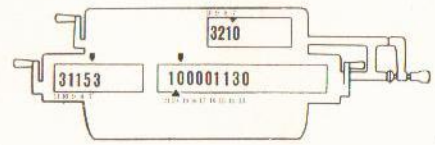
1. Shift the Carriage to the right end, and put the Setting Levers to 12 from the most significant digit (with the Decimal Indicator on the 8th digit of the rail).
2. As the divided 3906 is four figures, put the Decimal Indicator on 4+1 digits, namely, the fifth digit from the most significant (the 16th digit on the rail).
3. As the number of digits on the right of the Decimal Indicator is 16 for the dividend and 8 for the divisor, that for the quotient is 8. Set the Decimal Indicator on the Quotient Register to the 8th digit.
4. Now the preparations have been finished. Let's start the calculation. Turn the Crank Handle in the ⊕ direction and indicate the figures of 3, 9, 0, and 6 in turn from the 20th digit of the Product Register, and the quotient of 325.5 will be indicated on the Quotient Register.

Note: It the dividend cannot be divided completely, make as close a figure as it. Then the quotient can be obtained up to 11 digits.



d. Computation of Reciprocals

Example : $\frac{1}{321}$ = 0.00311526479·····



1. Shift the Carriage to the right end and set the Setting Levers to 321 from the place of the most significant digit downward.
2. Continue divison **in the form of multiplication** as described **c** turning the Crank Handle in the ⊕ direction to indicate the figure 1 at the place of the 21st digit of the Product Register.
3. Since the number of digits below the decimal point of the dividend is 20 and that of the divisor is 7, that of the quotient is 13. Consequently, jot down 0.00 to make up for the shortage of the number of digits on the Quotient Register and put the obtained answer after the figure.

Note : 1. In making a division in the form of multiplication, the dividend appears from the place of the 20th digit downward. In computing reciprocals (when the divisor is greater than the dividend), it is easier to determine the decimal point by showing the dividend from the place of the 21st digit downward. The number of zeroes is equal to that of digits of the integer of the divisor. In the case of the above example, the number of zeroes is three-0.00 because the figure 321 has three digits.

In the case of $\frac{1}{271.5}$ the number of zeroes is three —0.00 because the integral portion of 271.5 has three digits.

2. Among other computing methods is one of showing 99000 ·····by turning round the Crank Handle in the ⊖ direction.

e. Division by a Constant Divisor

Example : 2645 ÷ 321 = 8.23987·····
4538 ÷ 321 = 14.13707·····
5889 ÷ 321 = 18.34579·····
6329 ÷ 321 = 19.71651·····

Make a computation by the following methods because it takes a long time to set figures by making the ordinary division.

A. Trial Manipulation Method (See c)

1. Set the Setting Levers to the divisor 321. Take the decimal point at the place of the 9th digit on the Quotient Register, because the number of digits below the decimal point of the dividend is 16 and that of the divisor is 7.
2. Turn the Crank Handle in the ⊕ direction to show the dividend 2645 on the Product Register.
3. The first quotient 8.23987 can be obtained on the Quotient Register while each part remains stationary.
4. Change the figure on the Product Register to 4538, 5889, and 6329 in turn, each quotient will be obtained on the Quotient Register.

B. Reciprocal Method (See d)

The formula $2645 \div 321$ should be replaced by another one $2645 \times \frac{1}{321}$.

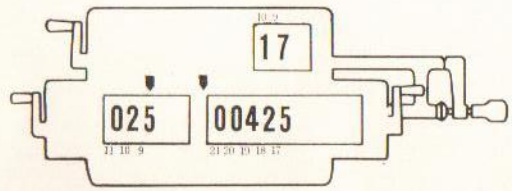
1. Obtain the figure 0.003115264797 from $\frac{1}{321}$
2. Set the Setting Levers to the figure.
3. Take the decimal point at the place of the 12th digit on the Product Register, because the number of digits below the decimal point of the figure (the number of digits appearing on the Quotient Register) is 12 and that on the Quotient Register is 0.
4. Thus all preparations are complete. Indicate 2645, 4539, 5889, and 6329 on the Quotient Register in turn by **the formula for multiplication by constant multiplier**, and each quotient will be obtained on the Product Register.

Note : The adoption of either the A or the B method is dependent on the number of figures in the formulate to be computed as well as on the required number of digits of the quotient. If their number is large, it is advisable to adopt the B method.

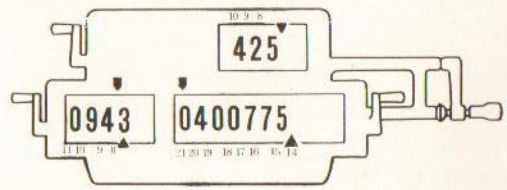
f. Continuous Divisions

Example : 400755 ÷ 17 ÷ 25 = 943

1. Replace the left member of the formula by $400775 \times \frac{1}{17 \times 25}$ and compute $17 \times 25 = 425$ at the places of the most significatnt digits on the Product Register.



2. Set the Setting Levers to the figure 425 by using **the continuous multiplication method**, and clear the Quotient Register.
3. Show the figure 400775 on the Product Register by **the division method in the form of multiplication**, and the Quotient Register will show the quotient 943 of the formula $400775 \div 17 \div 25$.



Note : When making a multiplication at the places of the most significant digits, start at the place of the 10th digit on the Quotient Register.

g. **Computation for Obtaining Sum of Quotients and Remainder of Quotients.** As mentioned before, the answers to the computations for the sum of products and the remainder of products were aggregated on the Product Register, but those to the computations for the sum of quotients and the remainder of quotients should be aggregated on the Quotient Register.

Example : $\frac{568}{323} - \frac{121}{568} + \frac{250}{896} - \frac{39}{281} = 1.6857135844$

1. All divisors and dividends have three digits or less. Take the decimal point at the place of the 7th digit for the Setting Levers, ot the 17th digit on the Product Register, and at the 10th digit on the Quotient Register.
2. Shift the Carriage to the right end and set the Setting Levers to the divisor 323.
3. Show the dividend 568 on the product Register by **the multiplication formula,** turning the Crank Handle in the ⊕ direction. (The first quotient 1.7585139319 will appear on the Quotient Register.)
4. Clear the Product Register and the Setting Levers while leaving the Quotient Register untouched.
5. Set the Setting Levers to the second divisor 568, and turn the Crank Handle once in the ⊖ direction and then once in ⊕ direction. (The Clutch will be changed over to ÷.)
6. Show the second dividend 121 on the Product Register by the multiplication formula. (The remainder 1.5454857628 of the first and second quotients will be obtained.)
7. Clear the Product Register and the Setting Levers while leaving the Quotient Register untouched.
8. Set the Setting Levers to the third divisor 896, and show the third dividend 250 on the Product Register by the multiplication formula, turning the Crank Handle in the ⊕ direction. (The answer (1.8245036200 to the computation for the first through the third quotients will be obtained.)
9. Clear the Product Register and the Setting Levers.
10. Set the Setting Levers to the fourth divisor 281, and change the Clutch over to ÷ in the same way as 5.

11. Show the fourth dividend 39 on the Product Register by the multiplication formula, turning the Crank Handle in the ⊕ direction. (The answer 1.6857135844 to the computation for the first through the fourth quotients will be obtained)

4. Power Computation

Example 1 : $7^7 = 823543$

1. First, compute $7^2 = 49$ on the Product Register by the ordinary method, and leave each part as it is.
2. Turn round the Crank Handle until the figure 49 on the Product Register appears on the Quotient Register as well.
3. Repeat this method according to the following table, and the Product Register will show $7^7 = 823543$.

	Setting Lever	Quotient Register	Product Register
7^2	7	7	49
7^3	7	49	343
7^4	7	343 →	2401
7^5	7	2401 →	16807
7^6	7	16807 →	117649
7^7	7	117649 →	823543

Note :

1. This method is the application of **the multiplication by a constant multiplier.**
2. In the case of shifting the figure on the Product Register to the Quotient Register, it is convenient to do so from the most significant digit downward.
3. The index is the sum of the number of times of shifting figures from the Product Register to the Quotient Register and 2.
4. The answer can be obtained by using the continuous multiplication method.

Example 2: $6^{10} = 60466176$

In making this sort of high power computations, divide the index properly according to the index law.

$$6^{10} = (6^5)^2$$

1. Compute $6^5 = 7776$ by the method of Example 1.
2. $(7776)^2 = 60466176$ can be obtained by the continuous multiplication method.

5. Evolution

When odd numbers — 1, 3, 5, 7, 9, ····· —, are subtracted from the original figure in turn until subtraction is no longer possible (until the bell rings). The number of subtracting times becomes the root, which oppears on the Quotient Register of the calculator. In subtracting, the original figure should be divided into groups of 2 digits each. A figure above the decimal point should be divided leftwards from the decimal point, and a figure below the decimal point rightwards. Start computing from the digit second only to the most significant digit group.

Example : $\sqrt{7\ 2\ 9} = 27$

1. Shift the Carriage to the right end.
2. Divide the original figure 729 into groups by 2 digits each. Subtract odd numbers — 1, 3, 5, 7, ····· —, in turn from the figure 7 at the digit second only to the most significant digit group. When the warning bell rings, turn the Crank Handle reversely until the bell rings again (until the correction is completed).
3. Return the Setting Levers quick by one (for instance, from 3 to 2 and from 5 to 4) to shift the Carriage by one digit to the left.
4. Then repeat the subtraction of 1, 3, 5, 7,····· in turn at the digit.

The relations between the Quotient Register, the Setting Levers, the Product Register and the turning direction of the Crank Handle in this computing method are as follows:

Setting Lever	Turning Direction of Crank Handle	Product Register	Quotient Register
0		0729	0
1	⊖	0629	1
3	⊖	0329	2
Bell (Warning) 5	⊖	9829	3
Bell (Correction) 5	⊕	0329	2
(Shift the Carriage by one digit to the left)			
41	⊖	0288	21
43	⊖	0245	22
45	⊖	0200	23
47	⊖	0153	24
49	⊖	0104	25
51*	⊖	0053	26
53	⊖	0000	27
Bell (Warning) 55	⊖	9945	28
Bell (Correction) 55	⊕	0000	27

* If the bell does not ring even after subtracting 1, 3, 5, 7, 9, in turn, add the next higher digit like 11, 13,····· and subtract 1, 3, 5, 7, 9 ·····, in turn again.

6. Applied Computations

a. Percentage Computation

In the percentage computation, individual figures should be divided by the sum total. However, inasmuch as the sum total always remains constant, the computation should be made by **the division by a constant divisor.**

Example: Obtain the percentage of the following figures for the sum total:

	Turnover	%
A	$ 444,500	12.42
B	$ 669,700	18.72
C	$ 191,600	5.35
D	$ 91,600	2.56
E	$ 491,810	13.74
F	$ 1,689,500	47.21
	$ 3,578,710	100.00

1. Obtain the sum total $3,578,710.
2. Obtain the reciprocal 0.0000002794303 of the figure, and set the Setting Levers to the reciprocal.
3. Show the figures of A, B, ·····, F in turn on the Quotient Register, and the percentage of each figure will appear on the Product Register.

Note: Take the position of the decimal point in the same way as that for the ordinary multiplication method, but shift the Decimal Indicator by two digits to the left because percentage is for 100.

b. Interest Computation

The computation of interest means the continuous multiplications of the amount × the daily interest × the number of days. Therefore, it can be made easily by **the continuous multiplication method.**

Example: Obtain the discount rates of the following bills:

Face Value	No. of Days	Daily Interest(%)	Discount Rate
$ 3,485,852	60	0.023	$ 48,105
$ 3,856,780	45	0.023	$ 39,916

Make the continuous multiplications of $\frac{3,485,852}{100} \times 60 \times 0.023$

c. Wage Computation

Example: Obtain the wage of each one of the following persons:

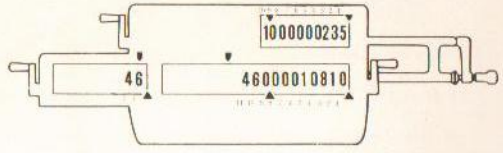
Name	Overtime Hours	Wage Per Hour	Overtime(%) Premium	Wage
A	20	$1.50	17	$ 35.10
B	15	$1.00	15	$ 17.25
C	10	$0.50	20	$ 6.00

In the case of Mr. A, his wage can be found by the continuous multiplications of $20 \times 1.50 \times (1 + 0.17)$.

d. Computation of Average Unit Price

Example: Obtain the total number of pieces, the total amount, and the average unit price:

Commodity name	@	No. of Pieces	Amount
A	$ 235	46	
B	$ 328	38	
C	$ 456	23	
D	$ 435	49	
TOTAL		156	$ 55,077 Average Unit Price $ 353



1. Set the Setting Lever to the figure 1 at the place of the most significant digit.
2. Set the Setting Levers to the unit price (multiplicand) 235 from the third digit downward.
3. Show the number of pieces (multiplier) 46 on the Quotient Register.

The total number of pieces (multiplier) and the total amount (product) will appear on the Product Register.

4. Clear the Quotient Register. Don't clear the figure 235 of the Setting **Levers** but change it to the next figure 328 by hand.
5. Aggregate the answers appearing on the Product Register by **the method of obtaining the sum of products,** and the total number of pieces 156 and the total amount $ 55,077 will appear on the Product Register.
6. The average unit price $ 353 can be obtained by dividing $55,077 by 156.

Note : In the computation of the sum of products by the dual multiplication method, the figures, whose sum is required, (the number of pieces in this case) should be shown on the Quotient Register.

e. Computation of Redemption by Annual Installment

This requires mixed computations. The question, therefore, is in what order such computations should be made.

> Example : A loan of $2,000,000 was granted on the conditions of 6% interest per annum and annual payments covering a period of 20 years.
> Then how much should be paid per annum?

The computing formula is $\frac{Ar\ (1+r)^n}{(1+r)^n - 1}$

A	principal
r	Interest Rate
n	Period

The answer can be obtained from $\frac{2{,}000{,}000 \times 0.06\ (1+0.06)^{20}}{(1+0.06)^{20} - 1}$

1. Obtain $2{,}000{,}000 \times 0.06 = 120{,}000$
2. Obtain 3.207135463 from $(1+0.06)^{20}$ by the power computation.
3. Set the Setting Levers to the figure by the continuous multiplication method, and show 120,000 on the Quotient Register from the place of the 10th digit downward by turning the Crank Handle in the ⊕ direction. Then the Product Register will show the answer 384,856,255 from the numerators $2{,}000{,}000 \times 0.06\ (1+0.06)^{20}$ of the above formula.
4. Clear the Quotient Register.
5. Subtract 1 from 3.207135463 on the Setting Lever and the answer 2.207135463 will be obtained from the denominators $(1+0.06)^{20}-1$. Then make a division.
6. The Quotient Register will show $ 174,369.11 ····· This is the annual equal redemptive amount.