(No Model.)

L. M. CARMICAL.

CALCULATOR.

No. 346,805. Patented Aug. 3, 1886.

Fig. 1.

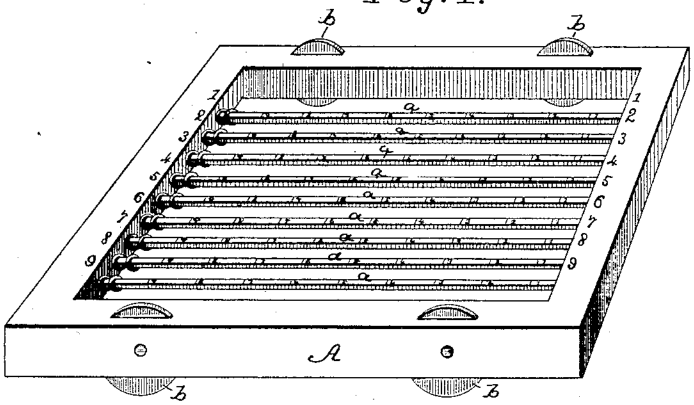


Fig. 2.

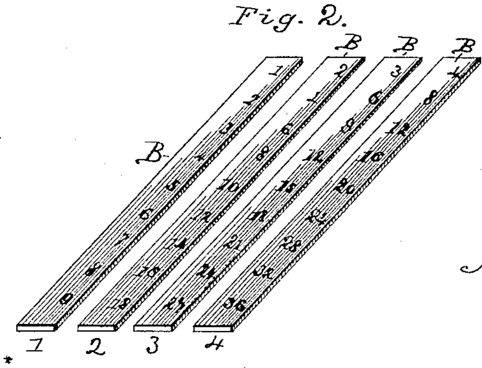


Fig. 3.

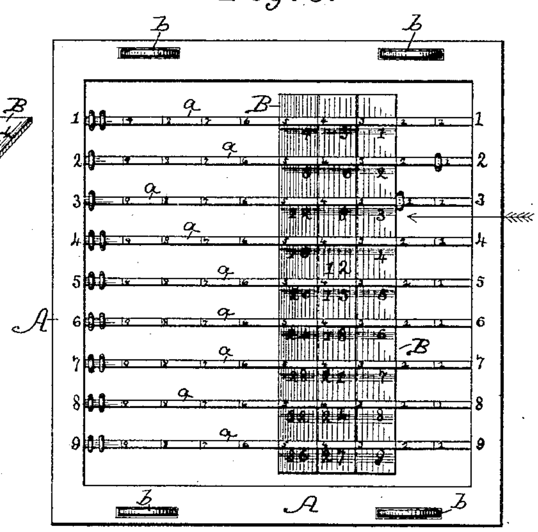


Fig. 4.

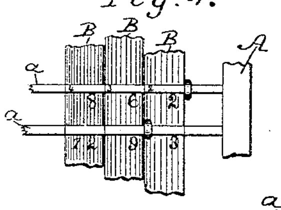


Fig. 5.

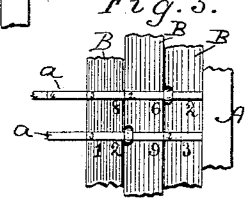
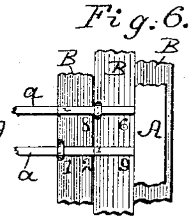


Fig. 6.



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LUTHER MELANCTHON CARMICAL, OF JONESVILLE, VIRGINIA.

CALCULATOR.

SPECIFICATION forming part of Letters Patent No. 346,805, dated August 3, 1886.

Application filed August 29, 1885. Serial No. 175,503. (No model.)

To all whom it may concern:

Be it known that I, LUTHER MELANCTHON CARMICAL, a citizen of the United States, residing at Jonesville, in the county of Lee and State of Virginia, have invented a new and useful Improvement in Calculators, of which the following is a description.

My invention is an improved apparatus for performing arithmetical calculations, more particularly multiplications.

The apparatus consists of two parts—to wit, first, a device having considerable resemblance to the well-known abacus, but provided with supporting-wheels, and with nine parallel bars each bearing nine equidistant marks; and, secondly, of a series of tables or tablets, one of which is inscribed with the nine digits arranged in a vertical column, and the remainder with multiples of the digits, also in columns. By adjustment of certain rings on the bars of said device, so as to correspond to and indicate the multiplier, and by selecting tablets whose first numbers correspond to those of the multiplicand, and then moving the device from right to left over such selected tablets, the desired product will be indicated by the numbers over which the placed rings pass, all as hereinafter more particularly described.

In the accompanying drawings, Figure 1 is a perspective of the wheeled frame or movable abacus. Fig. 2 is a perspective view of several tablets. Fig. 3 is a plan view showing the wheeled frame or abacus and certain tablets arranged as required for use in making a certain computation. Figs. 4, 5, and 6 further illustrate the relative position of the same parts in succeeding steps or stages of the same computation.

That portion of the apparatus which resembles an abacus consists of a rectangular frame, A, having nine parallel bars, *a*, and four small supporting-wheels, *b*. The said bars *a* extend between and join the right and left hand sides of the frame A, and the wheels are arranged in slots formed in the opposite or top and bottom sides thereof. On each bar are two small rings which are adapted to slide easily. The bars are numbered from the top down, the first being denominated No. 1, the second No. 2, and so on. The bars are also marked at regular distances, beginning at the right, and from 1 to 9, inclusive. In other words, each of the nine bars has nine marks separated by uniform distances and numbered consecutively from right to left.

The numerical tablets B, Fig. 2, are oblong rectangular plates formed of wood, ivory, pasteboard, or any other suitable material, and inscribed with numbers, as follows: Tablet No. 1 has the nine digits arranged in regular order in a vertical column. The remaining tablets have similar columns of multiples of the digits, also arranged in regular order.

The practical use of the apparatus may be illustrated by the following examples: Suppose it be required to multiply the number 431 by the number 23. A ring on second bar of the device A is moved to the point indicated by 1. In this place it stands for the tens of the multiplier. A ring on the third bar is moved to the point marked "2," which is the units-place, although at the left of the tens. Thus we have two tens and three units indicated as the multiplier. It will thus be understood that in enumeration we begin on the right and read decreasingly to the left, or we may begin on the left and read increasingly to the right. Having now prepared the device A for performing the required multiplication, the next step is to select the tablets suitable to be used. We select tablets having at the top the numerals 4 3 1, respectively, and place them together or side by side, as shown in Fig. 3, so that the multiplicand 431 appears at the top. The third step consists in placing the device A over these three tablets so that the upper bar is directly over or slightly above the upper row of figures, (431,) as shown in Fig. 3. Then the device A is moved to the left and the numbers on the tablets which the two rings (previously placed as specified) pass over or are contiguous to are taken down, and constitute the product sought. In this instance the ring on third bar first indicates the number 3 on first plate, and 3 is accordingly the first or unit number of the product. Two numbers will be next indicated simultaneously by both rings—to-wit, 2 and 9, Fig. 4, on first and second tablets, respectively. The indicated numbers being added amount to 11, which must enter into the product as 10+1—that is to say, 10 will be carried and the one will be put in the tens place. By the farther movement of the device A the numbers 6 and 12, Fig. 5, will be pointed out, and these taken together amount to 18, which must occupy the hundreds and thousands place in the product. The last number indicated on the tables, Fig. 6, is 8, and we accordingly place it in the last or thousands place. Now, adding these several partial products, we have 9,913 as the whole product.

The better to explain the above operation or series of operations we may indicate the several factors or parts of the products as obtained: thus, 3+ 9+2+ 6+12+ 8; or thus:

3
11
18
8
———
9913 (product.)

If it be desired to multiply 431 by 55 shift rings on the bar 5 of device A to the first and second marks thereon. Then move device A to the left, as before, and add, as before, the numbers indicated by said rings—to wit, 5, then 5+5, then 5+1, then 2+1, then 2, or the result may be indicated thus:

5
10
6
3
2
———
23705 (product.)

In more explicit elucidation of the principle or operation of the invention, I will state as follows: It is to be understood that the tablets 4 3 1 contain every multiple of 431 by the nine digits, and it is therefore manifest that we may, by addition alone, obtain the product of any number whatsoever into 431, provided we arrange each partial product upon the principle that governs all multiplications—namely, that the unit figure of each partial product shall be placed under the digit with which we are multiplying. Thus 431×123 may be arranged in any of the six under-given ways.

(No. 1.)	(No. 2.)	(No. 3.)
431	431	431
123	123	123
1293	431	431
862	862	1293
431	1293	862
53013	53013	53013

(No. 4.)	(No. 5.)	(No. 6.)
431	431	431
123	123	123
862	862	1293
431	1293	431
1293	431	862
53013	53013	53013

Before I proceed further, in order to promote facility of expression, I will call (in my frame device) the bar of the same name or number of the unit-figure of the multiplier the "unit-bar;" the bar of the same name or number as the tens figure of the multiplier, the "tens bar;" the bar of the same name or number as the hundreds-figure of the multiplier the "hundreds-bar," and so on; and this, without any regard to the position the bars occupy in the frame, and without any regard to the number of digits which compose the multiplier or their digital value. Thus, when the multiplier is 23 the unit-bar is No. 3, the tens-bar is No. 2. When the multiplier is 85 the unit-bar is No. 5, the tens-bar is No. 8. When multiplier is 55 or 555 the unit-bar, tens-bar, and hundreds-bar are one and the same, or No. 5. For the same reason the first ring in use on the unit-bar may be called the "unit-ring," the first ring in use on the tens-bar the "tens-ring," the first ring on the hundreds-bar the "hundreds-ring," &c. Now, it is to be remembered that when the frame of my apparatus is placed as directed, bar No. 1 shows the product of the number at the head of the tablets in use by 1; bar No. 2 shows the product of said number by 2; bar No. 3 shows the product of said number by 3, &c.; hence, by placing frame in position over tablets 4 3 1, and then referring to figures below bars 1 2 3, we shall find the three partial products as above; and said products may be set down in the form of any one of the six variations given; but to obviate the necessity of setting them down the rings are attached to the bars and point out the partial products in one of the six variations—viz., No. 2. In order that they may do so, the unit-ring must occupy the left-hand position, (with regard to the other rings in use,) because, as shown above, the unit-figure of multipler into the unit-figure of multiplicand must be the first figure of the product; and, as the frame is moved from right to left and the rings stationary (on the frame) the left-hand ring will be the one that indicates the first figure of the result, (because it is the ring which first comes in contact with the tablets,) hence the left-hand ring must be on the bar numbered the same numerical value as the unit-figure of the multiplier; and, as shown by the six variations, it does not matter whether that bar be at the top, bottom, or intermediate; hence, the unit-ring may be on the first, ninth, or any intermediate bar, varying to suit the unit-figure of any multiplier. In brief, the rings point out the figures of the partial products in their tenfold increase from right to left, exactly in the order we set them down (for addition) in the usual method of multiplication; and having shown that the local value in an up-and-down scale may be disregarded, we arrive at this general principle for the setting up the multipliers, namely: Select the bars of the same name or number as the figures of the multiplier; move a ring on the unit-bar—that is, the bar of the same name as the unit-figure of the multiplier—so that it will occupy the left-hand position with reference to the other rings in use; move a ring on the tens bar, so that it will occupy a position one space to right of the first (or unit ring;) move a ring on the hundreds-bar, so that it will occupy a position one space to the right of the second or tens ring; move the rings in this manner till all the figures of the multiplier have been used. In other words, the tablets, admitting of every possible combination, placed side by side, will give the partial products for any multiplier whatsoever; that the rings on the bars of the same name as the figures of the multiplier, when removed to themselves, (from the other rings of the device,) indicate the partial products to be added; and when said rings are placed the reverse order of the way we set down, the ring on the unit-bar occupies the left-hand position of the rings in use, the ring on the tens-bar occupies next to the left-hand position, and so on; and these rings, when so adjusted and moved across the tablets from right to left, indicate the order in which the units, tens, hundreds, &c., of the partial products should be added to give the units, tens, hundreds, &c., of the final result. Thus in setting up the multiplier 23, bar No. 3 would be the unit-bar; hence we would move the ring on this bar, so that it would give room for tens-ring to occupy a position just to its right; hence (as there are but two figures in this particular case) this ring may occupy position No. 2, as marked on said third bar, (or any other position to the left of No. 2 mark.) For reasons already stated, bar No. 2 would be the tens-bar; hence move ring on this bar, so that it will occupy position next to the right of unit ring—that is, the ring on bar No. 3; but in the example first given in the specification the position of unit-ring is No. 2 mark; hence position of ring for tens would be one space to the right, or mark No. 1. To set up 55, the unit-figure is 5; hence we shift ring on bar No. 5, so that it will occupy a left-hand position with regard to the other rings in use in this particular multiplier; but as there are but two figures, said ring may be placed at mark No. 2; then as the tens figure is also 5 we must place ring No. 2 on same bar one place to the right of unit-ring, or in this case at mark No. 1. This is manifest, because multiplying twice by the same digit the partial products would be the same, differing only in local value, which is the same as the local value of the digits. When there are three figures of the same digital value, but of course different local values, we may have another ring, or else place the unit-ring according to the principle before stated, for as there are three figures in the multiplier the unit-ring would occupy third mark or position, then leave a blank for second position, then place second ring at the next place or position No. 1; then, in addition, we treat the blank so left as if it were a ring. If there are four figures, as 5555, leave two blanks and so on, leaving a blank for every additional digit of the same name. According to these general principles we have this special rule for setting up the multipliers where the spaces on the bars are numbered from right to left.

First. Raise the left side of the frame until all of the rings slide to the right side, then place the ring that is on the bar of the same name of the highest order of units (in this particular multiplier) at mark No. 1; the ring on bar that represents the next highest order of units at mark No. 2 on said bar; the ring on bar that represents the order of units next highest to the preceding order at mark No. 3, and so on until all the digits of the multiplier have been placed.

Second. When all the rings are against the left-hand of frame place ring on unit-bar one place to the right; ring on tens-bar two places to the right; ring on hundreds-bar three places to the right, &c. If the spaces were numbered from left to right, second rule would read thus: Place ring on unit-bar at mark No. 1, ring on tens-bar at mark No. 2, ring on hundreds-bar at mark No. 3, and so on, until all the numbers were used.

Remark, (to accompany the rule:) When the same figure is repeated we use the second ring on the bar, and when there are three or more place the rings at the two extremes—that is, one in the position of the highest, the other in the position of the lowest order of units (of this particular digit)—and count the blanks between as rings. This remark assumes that the digits follow each other in consecutive order. If they do not, but digits of different values intervene, the blanks may still be used, but a little more care will have to be taken in counting them.

For convenience the nine tablets may be colored differently, so that by a little familiarity with the color of each, we may select and place them in any position they may occupy without reference to the number at the top.

What I claim is—

1. The combination of the device or frame A, having a series of parallel bars corresponding to the nine digits extending between the lateral portions of said frame and the rings adapted to slide thereon, with tablets inscribed with the nine digits and multiples thereof arranged in vertical columns, as shown and described.

2. The combination, with tablets inscribed as shown, of the device A, consisting of a rectangular frame having nine parallel bars extending between its right and left sides and marked to indicate nine equidistant points, and provided with wheels, arranged parallel to said bars, to support and facilitate the movement of the device, as shown and described.

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