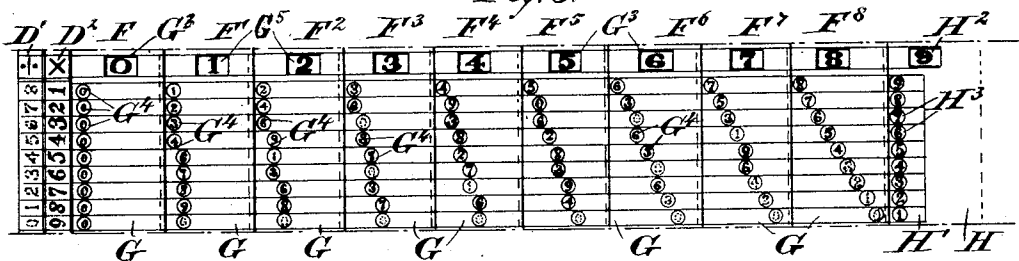
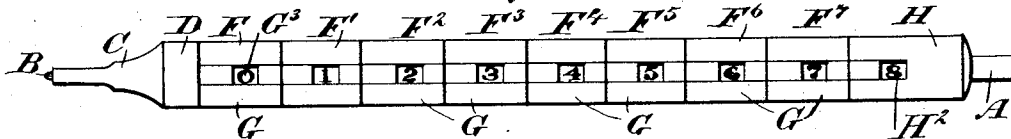
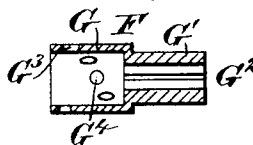
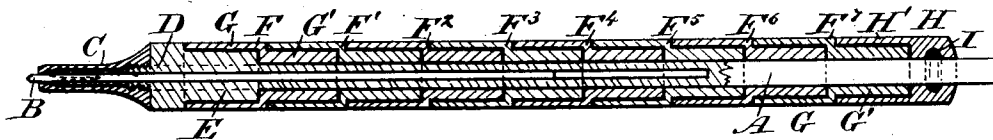


J. HERRAN Y BOLADO.
CALCULATOR.

Patented May 17, 1892.



F. G. O.									
D ¹	D ²	E	E	G ⁵	G'	G'	G ⁵	G'	G ⁵
1	2	3	4	5	6	7	8	9	
0	1	2	3	4	5	6	7	8	9
01	23	45	67	89	10	23	45	67	89
012	545	678	901	234	567	890	123	456	789
0123	4567	3901	2345	6789	0123	4567	8901	2345	6789
01234	56789	01234	56789	01234	56789	01234	56789	01234	56789
012345	678901	234567	890123	456789	012345	678901	234567	890123	456789
0123456	7890123	3456789	0123456	8901234	5678901	2345678	9012345	6789012	3456789
01234567	89012345	67890123	45678901	23456789	01234567	89012345	67890123	45678901	23456789
012345678	901234567	789012345	5678901234	678901234	567890123	456789012	345678901	234567890	123456789

WITNESSES:

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UNITED STATES PATENT OFFICE.

JOSÉ HERRAN Y BOLADO, OF AGUAS CALIENTES, MEXICO.

CALCULATOR.

SPECIFICATION forming part of Letters Patent No. 475,177, dated May 17, 1892.

Application filed June 13, 1891. Serial No. 396,151. (No model.)

To all whom it may concern:

Be it known that I, JOSÉ HERRAN Y BOLADO, of Aguas Calientes, Estado de Aguas Calientes, Mexico, have invented a new and Improved Calculator, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved calculator which is simple and durable in construction, can be easily carried in the pocket, and can be arranged to perform mechanically arithmetical and mathematical calculations—such as multiplication, division, exponential quantities, extraction of roots, and other problems treating of relative proportions.

The invention consists of a series of cylinders fitted to slide upon a common shaft.

The invention further consists of a lead-pencil having a hollow stem and carrying movable leads, and cylinders mounted to slide upon the said stem.

The invention also consists of certain parts and details and combinations of the same, as will be described hereinafter, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional side elevation of the improvement. Fig. 2 is a transverse section of the same. Fig. 3 is a sectional side elevation of one of the cylinders. Fig. 4 is a plan view of the improvement, and Figs. 5 and 6 are diagrammatic views of the exterior surfaces of the cylinders.

The improved calculator is provided with a stem A, which is hollow, so as to be adapted to receive a lead-pencil B, secured in place at the front end of the stem A by the usual nut C, screwing on the threaded end of the stem A and adapted to abut against the head D, formed integral with the stem A. The head D is provided with a reduced portion E, onto which fits the large end G of a cylinder F, having a reduced portion G', formed with a transversely-extending recess G², adapted to engage a key A', arranged longitudinally on the shaft A. The reduced portion G' of the cylinder F is adapted to be engaged by the large end G of the cylinder F', similar in construction to the cylinder F and likewise en-

gaged by a cylinder F², similar to the cylinders F and F'. This cylinder F² and the next following cylinders are all alike in construction, one having its large end fitted over the small or reduced end of the preceding one, as is plainly shown in Fig. 1. The several cylinders are held on the key A' of the shaft A, so as to be prevented from turning, and are free to slide lengthwise, so that the positions of the cylinders can be changed. The reduced portion G' of the last cylinder F⁷ (shown in Fig. 1) is engaged by the enlarged end H' of a cap H, provided in its reduced portion with a rubber gasket or ring I, fitted onto the end of the stem A, so as to hold the several cylinders in place on the said stem.

The head D is provided on its exterior surface with a set of numerals D', indicating division and ranging from "0" to "8," inclusive. The numerals of the division are preferably printed in red. Next to the set of numerals D' is a set of multiplying-numerals D² from "1" to "9," arranged successively, but in the opposite direction to the division-numerals D'.

On the reduced portion E of the head D is formed, printed, or otherwise arranged a large numeral E', representing "0," as is plainly shown in Fig. 6, and also a set of smaller numerals E², arranged in a triangle in the manner shown in said Fig. 6. The large numeral E' can be seen through an opening G³ in the enlarged end of one of the cylinders fitted over the reduced end of the head D. The numerals E² appear through openings G⁴, also arranged in the large ends G of the cylinders and arranged in the manner illustrated in Fig. 5. In a like manner the reduced portions G' of the cylinders F, F', F², and F³, &c., are likewise provided with numerals G⁵, corresponding to the numerals E' and seen through the respective openings G³ in the enlarged portion of the following cylinder. The large numerals G⁵ on the several cylinders F, F', F², &c., are arranged successively, beginning with 1 2 3, &c., respectively. The reduced parts G' of the cylinders F, F', F², F³, &c., are also provided with triangular sets of numerals G⁶, similar to the triangular set of numerals E² on the reduced part E of the head D. Some of the numerals in each set of numerals G⁶ are printed in black and the re-

maining ones in red, as indicated in full and dotted lines, respectively, in Fig. 6. The openings G^3 in the several cylinders $F F' F^2$, &c., are so arranged with relation to the grooves engaging the key A' that the said openings are in line with each other when placed on the stem A , as shown in Fig. 4.

The operation is as follows: In order to multiply, I proceed as follows: the several cylinders $F F' F^2 F^3$, &c., as well as the cap H , are removed from the stem A and are replaced on the stem according to the order indicated by the multiplicand, taking as a guide the large numerals G^5 , above described, and shown in Figs. 5 and 6. The set of black numerals D^2 corresponds to the multiplier, so that when the cylinders are once placed in such a position that the multiplicand is read in the small openings G^4 it is only necessary to write on a piece of paper the amount which appears in the said openings, taking the direction from left to right from each figure of the multiplier and afterward adding the figures to find the product sought.

For instance, if I desire to obtain the product of four hundred and twenty-five multiplied by thirty-six I will first have to place the cylinder F^3 , having the numeral "4" on its reduced end, on the stem A , so that the enlarged end of the said cylinder will fit over the reduced end E of the head D . The next cylinder placed on the stem A is F' , which contains the large numeral "2," so that the opening G^3 of this cylinder passes over the numeral "4" of the preceding cylinder, and consequently the large numeral "4" is visible. In a like manner the third cylinder F^4 , having the large numeral "5," is placed on the stem A , its large opening G^3 registering with the numeral "2" of the preceding cylinder. Finally the cap H is placed on the stem A to engage the last cylinder, so as to hold the several cylinders in place on the stem, being itself held in place by its rubber gasket I . Now the operator takes the numeral "6" of the set of numerals D^2 and following the direction from left to right, lengthwise of the calculator, he reads the quantity which appears through the round openings G^4 of the cylinders F^3 , F' , and F^4 , which is 2,550. Then I notice the numerals which appear through the round openings G^4 in the line of the numeral "3" of the set of numerals D^2 , and placing it one space to the left I write 1,275, which, added to the preceding product, gives 15,300, which equals the product of four hundred and twenty-five multiplied by thirty-six. When one of the red numerals in the sets of numerals G^6 appears through one of the openings G^4 , a unit must be added to the figure which precedes it at the left. In case there is a "0" in the multiplier the next following product is moved two spaces to the left instead of one, and is then written down the same as an ordinary multiplicand. For instance, if three hundred and forty-six is to be multiplied by one hundred and seven the multiplicand three

hundred and forty-six is put in the square openings G^3 and the numerals which appear in the openings G^4 are read in the direction of the numerals of the set D^2 , so that I have—

$346 \times 7 \dots\dots\dots 2,422$
 346×1 (leaving two places at the right) 346

The product sought..... 37,022

In order to divide, the device is used in a similar manner to that above described with relation to multiplying, the only difference being that instead of using the sets of numerals D^2 the sets of numerals D' (shown in red) are used. The small apertures show the quotients instead of showing the products; but they are considered as products. Thus to divide, the cylinders are placed according to the order of the dividend, a unit having been previously subtracted from the divisor, and thus modified I find the quotient of the dividend by each figure of the divisor. The partial quotients are found, which I write exactly as if they were products, and then add and separate as many decimal places as there are figures in the divisor, and the result is the first quotient. This first quotient is taken as the dividend, and by again placing the cylinders according to the whole numbers which they contain I repeat the above operation, so as to obtain a second quotient, which is written under the first. This second quotient serves in its turn as a dividend, the cylinders being again placed, according to their whole numbers, on the stem A , and the same operation is again repeated to obtain a third quotient, which is to be added to the former ones. In this manner a fourth, fifth, and sixth quotient is sought until a quotient "0" is found, which terminates the proceeding. Subsequently the several quotients are added to the first dividend, one or two units are added to the same, according to the number of decimal-figures, (of which no account was taken,) and afterward as many decimal-figures are separated from this sum as there are decimal-figures contained in the divisor, and the final result is the one sought.

For example, to divide three thousand two hundred and forty-five by seven hundred and forty-six I proceed as follows: First, a unit is subtracted from the divisor and I have $3,245 \div 745$. I proceed further by writing the following on a piece of paper, following the above rule.

Dividend	3,245
1st quotient.....	824
2d quotient	209
3d quotient	53
4th quotient.....	13
5th quotient.....	03
6th quotient. (In practice this result is not written).....	0
I add for decimals lost.....	2

Final quotient of $3,245 \div 746 \dots\dots\dots 4.349$
From the above it will be seen that the first and second quotients of the first example are

already each one the sum of the partial quotients given by the dividend for each figure of the divisor, so that the following rules have to be observed: When there is a "0" in the divisor, whether it is a final or intermediate figure, I must not omit to look for the partial quotient of the numeral "0" in the division set of numerals D', as in the apparatus no quantity divided by "0" will give "0." When the divisor contains a "9," I operate the same as when there is a "0" in the operation of multiplying—that is, I move the following amount two places to the left instead of only one place. For this reason any amount divided by "9" by the apparatus gives "0" for the partial quotient, and therefore the numeral "9" is omitted from the set of numerals D'.

Example: $23,548 \div 406$. After arranging the divisor I have $23,548 \div 405$. First, the dividend in the openings G^3 of the apparatus is observed and then the numerals in the openings G^4 are read, according to the numerals on the division set of numerals D'.

In line with figure "5" I have ..	94,192
In line with figure "0" I have,	
writing one place to the left..	211,932
In line with figure "4" I have..	
writing one place to the left..	117,740

This will be the first quotient 13,987,512
Further example: $16,408 \div 294$. The divisor is changed for operation with this apparatus and we have $16,408 \div 293$. I place the dividend in the several openings G^3 , as previously described, and then find in the openings G^4 in line with the respective numerals in the set of numerals D', first

In line with figure "3" I have..	98,448
As there is no quotient for "9" I	
next follow in line of figure "2"	
and I have, two places to left..	114,856

Thus I have obtained first quotient..... 11,584,048

In the last two examples I have only tried to find the first quotient, the second, third, &c., being found as described in the first example above given. The relative proportions are found by multiplying and dividing, as the case may require.

I do not limit myself to the special shape of the cylinders shown and described, as other forms may be selected with the numeral-tables arranged thereon to produce the same result.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a calculator, a series of cylinders fitted one upon the other and each provided with an enlarged portion having apertures, and a reduced portion having a set of numerals ap-

pearing through the apertures of the next following cylinder, substantially as shown and described.

2. In a calculator, the combination, with a lead-pencil having a hollow stem and carrying movable leads, of cylinders fitted to slide on the said hollow stem and one fitted upon the other, each cylinder being provided with an enlarged portion having apertures and a reduced portion having a set of numerals, the latter appearing through the apertures of the next following cylinder, substantially as shown and described.

3. In a calculator, the combination, with a stem formed with a key and a head having two sets of numerals, one for division and the other for multiplication, the said head being also provided with a reduced portion having a set of numerals, of a series of cylinders, each having an enlarged and a reduced part, of which the enlarged part fits on the reduced part of the preceding cylinder, the reduced part being formed with longitudinally-extending grooves engaging the key on the said stem, substantially as shown and described.

4. In a calculator, the combination, with a stem formed with a key and a head having two sets of numerals, one for division and the other for multiplication, the said head being also provided with a reduced portion having a set of numerals, of a series of cylinders, each having an enlarged and a reduced part, of which the enlarged part fits on the reduced part of the preceding cylinder, the reduced part being formed with longitudinally-extending grooves engaging the key on the said stem, each of the reduced parts being also provided with a large numeral and the enlarged part with a large opening, through which appears the large numeral of the preceding cylinder, substantially as shown and described.

5. In a calculator, the combination, with a stem formed with a key and a head having two sets of numerals, one for division and the other for multiplication, the said head being also provided with a reduced portion having a set of numerals, of a series of cylinders, each having an enlarged and a reduced part, of which the enlarged part fits on the reduced part of the preceding cylinder, the reduced part being formed with longitudinally-extending grooves engaging the key on the said stem, each of the reduced parts being also provided with a large numeral and the enlarged part with a large opening, through which appears the large numeral of the preceding cylinder, and a cap for holding the several cylinders in place on the said stem, substantially as shown and described.

JOSÉ HERRAN Y BOLADO.

Witnesses:

JESUS VALDEPAÑA,
NESTOR ZIMENEZ.