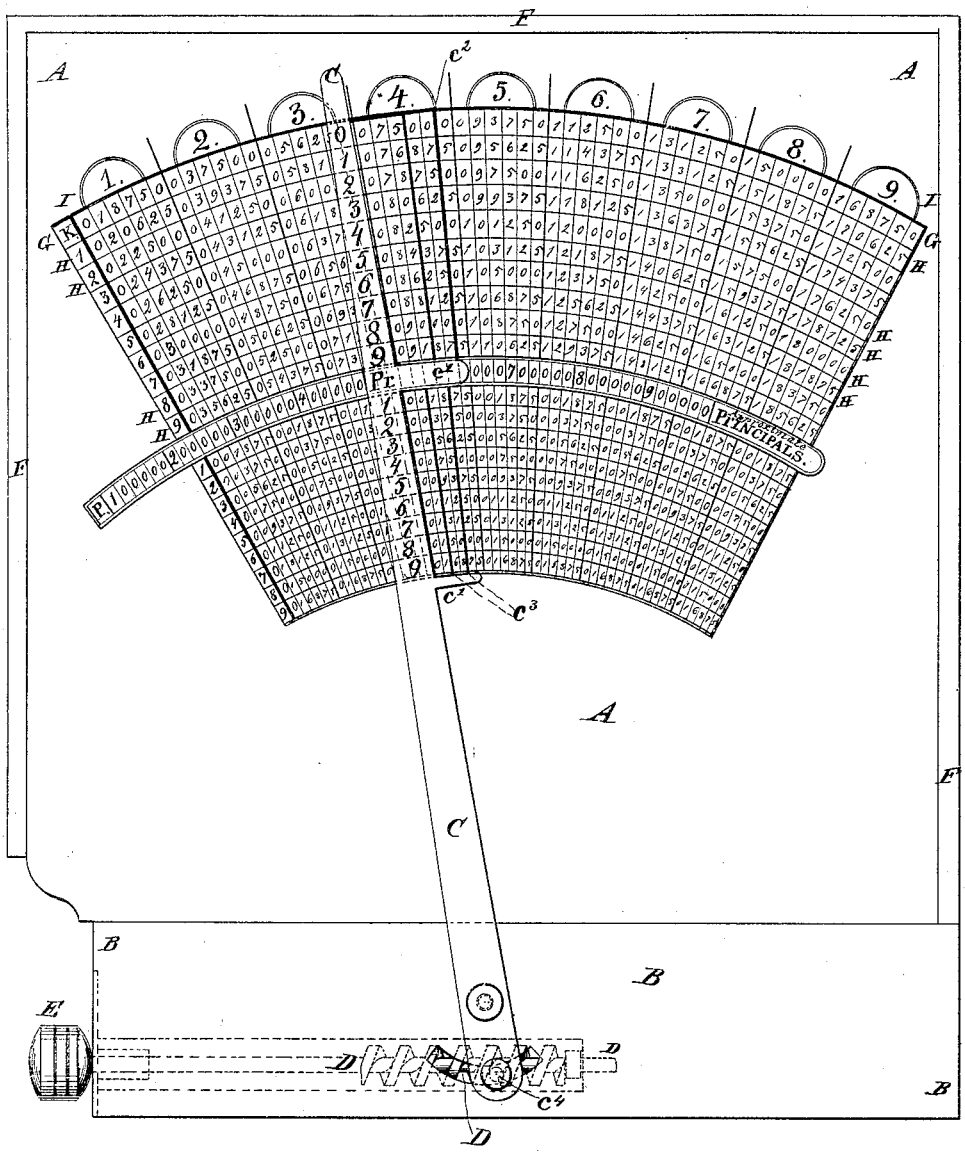
J. L. KNIGHT

Device for Calculating Percentage, &c.

No. 199,721. Patented Jan. 29, 1878.



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J. LEE KNIGHT, OF TOPEKA, KANSAS.

IMPROVEMENT IN DEVICES FOR CALCULATING PERCENTAGE, &c.

Specification forming part of Letters Patent No. **199,721**, dated January 29, 1878; application filed June 25, 1877.

To all whom it may concern:

Be it known that I, J. LEE KNIGHT, of Topeka, in the county of Shawnee and State of Kansas, have invented a new and useful Improvement in Device for Calculating Percentage, of which the following is a specification:

The figure is a front view of my improved device with the tables arranged for a tax or rate per cent. of eighteen three-fourth mills on the dollar, (decimally expressed .01875,) from which tables the amount of tax or percentage at the given rate on different sums or valuations is to be ascertained.

The object of this invention is to furnish an improved device for obtaining the results without the labor of making the calculations in calculating taxes and other percentages, and which shall be simple in construction, convenient in use, and accurate in its results.

The invention will first be described in connection with the drawing, and then pointed out in the claim.

A is a sheet of paper or its equivalent, upon which are formed tables, which will be hereinafter described.

The sheet A is laid upon a plate, B, with its lower edge resting against a shoulder formed upon said plate, is covered with a glass plate, and it and the glass plate are secured in place by a frame, F, slipped over the edges of the paper, glass, and plate, and secured detachably by screws or other suitable means. The plate B may also, for convenience in use, be supported in an inclined position by means of a brace attached, by hinge or otherwise, at the back of and near the top of the plate B.

C is an indicator or vernier, which is pivoted to the lower part of the plate B, so that it may sweep over the tables of the sheet A. Upon the right-hand edge of the indicator C are formed arms c^1, to which are attached wires c^2 c^3, which are arranged upon radii from the pivot of the indicator C. The lower end of the indicator C projects a little below its pivot, and to it is attached a short stud, c^4, which projects through a curved groove in the plate B, so as to come in contact with the threads of the endless screw D, swiveled in a hole in the plate B.

The screw D is turned to adjust the indicator C by means of a knob, E, attached to its outer end. The corner of the plate B may be cut away to form a recess for the knob E, to prevent it from projecting beyond the side edge of the said plate B, as shown in the figure.

The blanks for the tables are made in the shape of a section of a ring, and are divided into nine radial columns of six or more figures each by heavy radial lines, and the figures of each column are separated by light radial lines. The space of the upper table is divided into ten spaces by lines upon the arcs of circles, and the space of the lower table is divided into nine arc-spaces.

I will now define the terms used by me in describing the tables, and then describe the way in which the tables are formed.

The key-combinations G are the figures upon the upper arched space of the upper table, and are marked K at the left-hand end. The derived combinations H are the nine arched lines of figures below the key-combinations G, and are marked by the nine digits at their left-hand ends. A column of combinations is the key-combination G and the nine derived combinations included between each two heavy radial lines. A series of combinations are those in the same arched space across the table from left to right. The approximate principals are the numbers in the arched space between the two tables, and run from 100,000 or more to 900,000 or more.

The index I is the numbers from 1 to 9 inclusive, formed in the small semicircles above the columns of combinations. The nine columns of combinations above the approximate principals are called the "upper table," and the nine columns below the approximate principals are called the "lower table."

In forming the tables the given rate per cent. expressed decimally, and extended to six or more figures, is placed in the first or left-hand space G, and forms the key-combination of the first column. Multiply this by 2, and the product is the key-combination for the second column; multiply it by 3 and the product is the key-combination for the third column, and so on to the ninth.

For the first series of derived combination add one-tenth of the first key-combination to each of the nine key-combinations. For the second series of derived combinations add

one-tenth of the first key-combination to each of the first series of derived combinations, and so on to the ninth, in each case adding one-tenth of the first key-combination to each of the series of derived combinations last formed.

In the lower table all the columns are exactly alike, and each is formed by arranging the nine key-combinations vertically in regular order and placing them in the lower table.

Upon the upper part of the indicator C, and directly opposite the ten series of combinations of the upper table, are placed the ten digits in their regular order, and upon the lower part of the said indicator, directly opposite the nine series of combinations, are placed the nine significant figures.

In finding the percentage upon any given sum that can be represented by six or more figures, the left-hand figure of the sum is the index to the column containing the combination that will represent the required percentage. The number of figures in the sum is the guide by which to set the indicator. If there be but one significant figure in the sum, the amount of percentage is represented by the key-combination of the column over which such figure is found. If there be two significant figures in succession from the left, the second one is found upon the upper part of the indicator, and the combination upon the space opposite will be the amount of percentage. If there be three significant figures in succession from the left, to the amount of the first two found as above add the amount found in the lower table in the space opposite the figure in the lower part of the indicator corresponding to the said third figure from the left in the sum under consideration. If there be four significant figures in succession from the left, find the combination for the first two and reset the indicator for the next two; or, which is a longer operation, find the percentage for the first three figures from the left, as above described, and then find the percentage for the fourth, or the fourth and fifth, or the fourth, fifth, and sixth, or more, if there be so many, observing that for the third figure from the left the decimal-point is indicated by the right-hand wire guide; for the fourth figure, it is on the faint line between the two wire guides of the lower part of the indicator; for the fifth figure, it will be on the left-hand wire guide; and for the sixth figure it will be on the faint line between the left-hand wire guide and the right-hand side of the indicator.

The number of figures in the sum under consideration being the guide by which the indicator is set, let the indicator rest where the same number of figures in the approximate principal will be uncovered at the left of the said indicator that there are figures in the sum under consideration. If the sum be dollars only, the right-hand decimal-guide for the upper table of combinations will then be so located as to mark the point between dollars and cents in the several combinations, as indicated above. If the sum be composed of both dollars and cents, the left-hand wire guide will mark the decimal-point in the amount of percentage required. Should a cipher occur, with one or more significant figures at the right of it, in the sum under consideration, observe that if it be at the second place from the left the key-combination will give the amount of percentage for the first two figures—*i. e.*, for the index figure and the cipher following it—and the percentage for the third figure, the fourth, &c., will be found as hereinbefore described. But should the cipher occur in the third or fourth figure from the left, and should still have a significant figure at its right, the percentage for that figure will be found in the lower table. When the cipher stands in the third place from the left the decimal-point for the significant figure in the fourth place will be between the two guide-wires upon the lower table.

When the cipher stands in the fourth place from the left, and a significant figure in the fifth place, the left-hand guide-wire will be the decimal-point, observing always that the decimal-guide for the upper table is for the combination representing the percentage upon the first two figures from the left, the right-hand guide-wire in the lower table showing the decimal-point for the third figure from the left, the faint line between the two guide-wires showing the decimal-point for the fourth figure from the left, the left-hand guide-wire showing the decimal-point for the fifth figure from the left, and the faint line between the left-hand guide-wire, and the right-hand edge of the indicator showing the decimal-point for the sixth figure from the left.

It will be seen that the amount of percentage on any sum that can be represented by six or more figures can be found by the different guides without moving the indicator after once setting it; but in practice it is found most convenient to reset the indicator for each two figures of the sum under consideration, the lower or supplementary table being chiefly useful in case of three significant figures in succession, and for sums containing ciphers between significant figures.

Examples: What is the amount of tax on $3? Here the "index" is 3; hence we must look for the amount in the third column. There is but one figure; hence we set the indicator so the left-hand edge, at the place marked P, comes up to, but does not cover, the large figure 3 in the line of principals. Where there is but one significant figure, and the others are ciphers, the tax will always be expressed by one of the key-combinations, as we found, in forming these key-combinations, that they express the amount of tax on one dollar, two dollars, three dollars, &c. Having set the indicator, we find the wire-guide marks the decimal-point thus: .05625, or five cents six mills and a fraction. Suppose, however, we want the tax on $30. We simply move the indicator

to the right until one cipher besides the figure 3 is uncovered at the left of the indicator. We now find that the wire guide has changed the decimal-point; or that for the tax on $30 we have multiplied the amount of tax on $3 by ten, and it now reads 0.56250. Suppose, again, we want the amount on $300. We move the indicator over until three figures show at the left of the letter P of the indicator, when we find the wire guide marks $5.6250 as the amount of tax. If we move it to show four figures, we shall have the amount of tax on $3000, viz., $56.250, &c. If, however, we wanted to find the amount of tax on $31, or $35, or $37, &c., after setting the indicator to show two figures, as in the case of $30, for $31, we would take the combination opposite the figure 1 of the indicator, viz., 0.58125; for $35, the combination opposite 5 of the indicator; for $37, the combination opposite 7, and so on. In like manner for $310, or $350, or $370, and so on, we would take the same combinations; but having set the indicator to show three figures, as there would be three figures in the principal upon which we are calculating tax, we should find the wire guide dividing the combinations, so they would read $5.8125 for $310, $6.5625 for $350, and $6.9375 for $370, instead of 0.58125, 0.65625, and 0.69375, as in the case where our principal was composed of but two figures.

It is seen, then, that the left-hand figure of the sum on which tax is to be indicated is the index to the column where we find the combination that will give the tax, and the number of figures in the sum is the guide by which we set the indicator, in order that the wire guide may properly divide the combination into dollars and cents, and that, having set the indicator according to this rule, we have next to see what figure stands in the second place from the left in the sum on which tax is wanted, and that the combination opposite the corresponding figure found on the body of the indicator will be the proper amount for the two figures. For instance, we found above the tax on $370 was $6.9375; but should the sum have been $375, or any similar sum composed of three figures, and none of them ciphers, the combination $6.9375 would be the amount for the $370; and for the $5 we find 5 on the lower part of the indicator, and the combination opposite it, 0.9375, will be divided by the outer wire guide, (marked 3 on the lower projecting arm,) thus: 0.9375, which we add to the amount indicated in the upper table, and the sum of the two is the amount for $375. Again, suppose the sum composed of four figures, all significant, $3,758. We set on four figures, finding $69.375 indicated in the upper table as the amount for $3,700, and in the lower table, opposite 5 on the indicator, we find the wire guide 3 marks .9375 as the amount for $50; and for the $8 we take the combination opposite 8 on the indicator, the decimal-point for which will be between the two wire guides, on the faint line corresponding to 4, as marked on the lower arm of the indicator; and these three amounts are to be added together for the total tax on $3,758. And in like manner, if there be five or six figures in the sum, set the indicator to show five or six figures, as the case may be, when the upper table will give the amount of tax for the two figures at the left, and the lower table all the others, observing that, for the third figure from the left, the outer wire guide (marked 3 on the lower projecting arm) will mark the decimal-point in the combination opposite the corresponding figure. For the fourth figure from the left, the decimal-point will be on the faint line between the two wire guides, (marked 4 on the lower arm.) For the fifth figure from the left, the inner wire guide (marked 5) will be the decimal-point; and for the sixth figure from the left, the right-hand edge of the indicator (marked 6) will give the decimal-point.

A much shorter way than the above is to reset the indicator. For instance, $3,758. We set by four figures, and find in the upper table the amount for $3,700 is $69.375. This leaves $58, for which we set by two figures, and in the upper table the amount for $58 is $1.0875. These two amounts added together will give the same result as before from the addition of three sums.

If the sum were composed of six significant figures, three settings would be necessary—first on six figures, then on four, then on two.

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

The combination, with the two tables and the arc, of approximate principals of the indicator C, having upon its upper part the ten digits, and upon its lower part the nine significant figures, placed opposite the series of combinations of the two tables, pivoted at the center from which the arcs of said tables are struck, and adjusted by a swiveled screw and pin, or equivalent device, substantially as herein shown and described.

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Witnesses:
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