S. F. NUCKOLLS.

COMPUTER.

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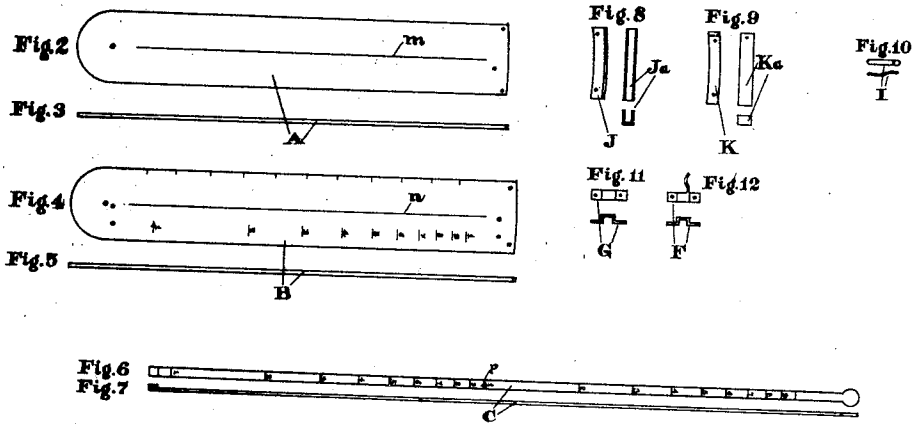
1,436,282.

Patented Nov. 21, 1922.



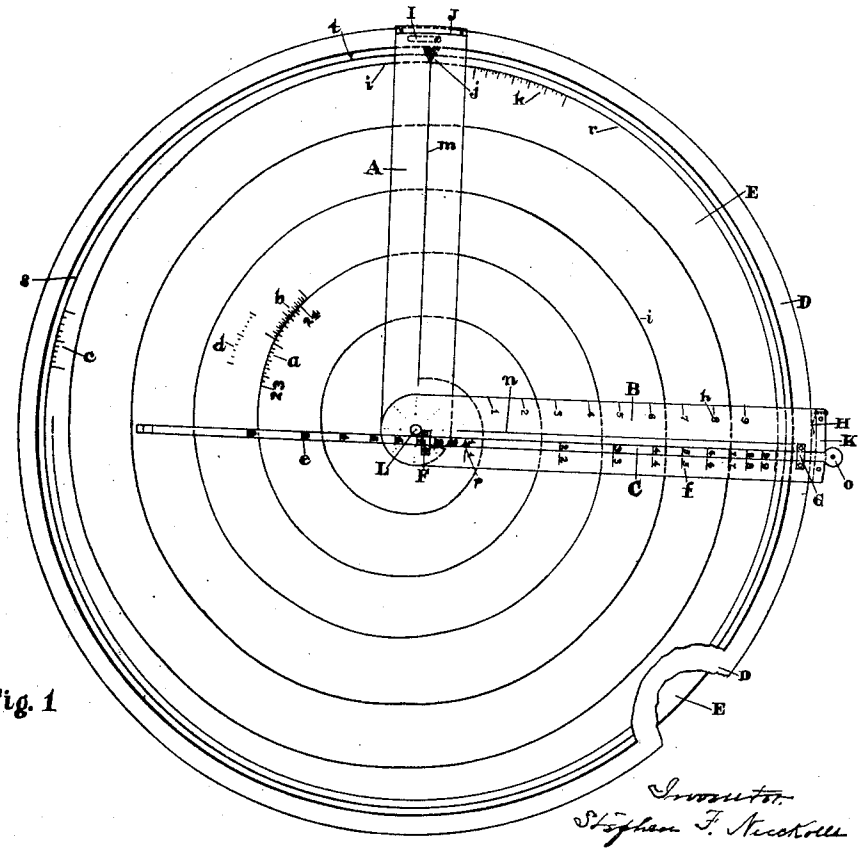


Fig. 1

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UNITED STATES PATENT OFFICE.

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COMPUTER.

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To all whom it may concern:

Be it known that I, STEPHEN F. NUCKOLLS, a citizen of the United States, residing at Bingham, in the county of Salt Lake and State of Utah, have invented certain new and useful Improvements in Computers, of which the following is a specification.

My invention relates to devices for making calculation of an intricate nature, and has for its object to provide a simple and efficient device whereby intricate calculations or computations may be accurately and quickly made, and to make it possible to have two or more graduations on each face of the device.

These objects I accomplish with the device illustrated in the accompanying drawings, in which similar letters and numerals of reference indicate like parts throughout the several views, and as described in the specification forming a part of this application and pointed out in the appended claims.

In the drawings, in which I have shown a substantial embodiment of my invention, Figure 1 is a plan view of the device with portions of five different graduations shown thereon. Figure 2 is a plan view showing one of the two slide plates used in pairs, and Figure 3 is an edge view of the same. Figure 4 is a plan view of one of the other pair of slide plates, and Figure 5 is an edge view of the same. Figure 6 is a plan view of the indicator slide, and Figure 7 is an edge view of the same. Figure 8 shows the side, plan and end elevation of the metal clamp which holds one end of the pair of slide plates shown in Figures 2 and 3. Figure 9 shows the side, plan and end elevation of the metal clamp plates which hold one end of the slide plates shown in Figures 4 and 5. Figure 10 is a plan and edge view of the friction spring used with the slide plates shown in Figures 2 and 4. Figure 11 is an edge view and a plan of one of the guides for the indicator slide, and Figure 12 is a plan view and edge view of the other form of guides for the indicator slide.

The present invention consists of a flat circular base disk D having a central opening therein which should be reinforced to prevent any possible wear. A pair of flat circular disks E are concentrically mounted for independent operation on opposite sides of said disk D. Each of said disks E has logarithmic graduations marked thereon in helical lines beginning near the center of said disks and terminating near the periphery. In order to give accurate position and direction to said helical graduations I draw the helical line *i* and mark said graduations by short radial lines extending inwardly from said line as at *a*, other graduations are drawn with the radial lines extending outwardly from said line *i* as at *b*, while other helical graduations may be drawn in the space between the convolutions of the said line *i*, as at *d*. The said disks D and E are held in concentric relation to each other by the pivot L, and also on said pivot is mounted two slide plates A, one on each side face of the device, with their outer ends secured together by the metal pieces J and J^a, which are fastened together and to each of said slide plates A, and which are curved to conform with the periphery of said disk D. A spring I is fastened at one end to the metal strip J and bears against the face of said disk E as a friction element. Each of said disks E has a longitudinally disposed central hair line *m* drawn from near each end. Another pair of slide plates B are also pivoted on said pivot pin L, with their inner end portions bearing against the face of the adjacent slide plate A, and their outer ends are fastened together by the metal strips K and K^a. The said slide plates B are spaced apart far enough and are of length sufficient to allow them to pass the slide plates A. A friction spring H similar to that shown at I provides suitable friction to retain said slide plates from unintentional movement. The said slide plates A and B are made of transparent material, and each of the plates B has a hair line drawn thereon as at *n*, similar to that shown as *m* on the other pair of slide plates A. Graduation scales are marked by short transverse lines *h* and *f* on the face of each of said plates B and conforming to the graduation on disks E. An indicator slide C, made of thin transparent material, is mounted for operation on the face of each of said plates B by being passed under the guides F and G. The said guides are thin metal strips bent to form a channel within which said slide C is operated, and a friction spring is attached to said guide G to retain said slide from unintentional movement. One end of each of said slides C has a stop piece and the other end is given a perforated circular form to provide a finger piece *o* by which said slides C are moved longitudinally and

the slide plates B are operated on the common pivot L. The face of said slide C is graduated by transverse lines similar to those on one edge of the slide plate B and with similar numerals running consecutively from 1 to 10, and for some uses an arrow point *p* is shown on said face at 1. I thus provide a base disk D and on each side face thereof, an independently operable disk and transparent slide plates all of which are pivoted together, and with a radially operable slide, which aids and is to be used with helically disposed graduations marked on the face of the movable disks to make intricate and difficult calculations. On the face of each of said disks E is formed an arrow point *j* which is on a radial line from the inner end of said helical line *i* to its termination or outer end, and the outer end of said line *i* merges into a concentric circle, shown as *r* in Figure 1, except that for clearness the said circle *r* is not completed.

The slide plate B has a graduated scale on one edge with anti-logarithmic graduations and numerals running consecutively from 1 to 9, as shown at *h*. The graduations and numerals on the slide plate B and on the indicator slide C are made semi-transparent in order not to interfere with correctly placing them on the helical line *i*. With the mechanical parts of my invention constructed as shown in the drawings, and having the graduations thereon as shown, I am able to make logarithmic calculation readily and much more accurately than other similar devices now on the market and in use. Also as so constructed and graduated I am able to make stadia computations quickly and accurately.

The device computes the following formula:

$I.K.\cos^2 a$=Horizontal distance. $I.K.\cos^2 a$, $\tan.a$=Vertical distance; I being the stadia intercept multiplied by 100, and K a stadia factor. Using the logarithmic numerals and graduations shown at *a*, and the logarithmic tangent graduations shown at *b*, with other logarithmic tangent graduations from 30′ to 5° 45′ shown at *d*; the indicator slide C is used from outer convolution of line *i* adjacent or corresponding to these graduations. The logarithmic $\cos^2$ graduations are laid off outside the helical line *i*, as shown at *k*, on the concentric circle *r*, as the $\cos^2$ up to 35° can be indicated and covered in one turn of the helical line. The factor K is a personal and instrumental factor, and when once determined for a certain transit can be indicated or laid off on the outside space or rim, by the operator using the device, with an arrow point, as shown at *t*, and in use this arrow point is used as an orientation point instead of the point *j*. In making stadia computations turn the disk E until the angle number appears under the hair line *m* of slide plate A using the $\cos^2$ graduation, then set hair line *n* of slide plate B over the stadia intercept, using numerical graduations, and orient, using constant K orientation point arrow *t*, when the corrected horizontal distance will appear under hair line *n* of slide plate B. Then turn the disk E until the angle appears under slide plate A, using tan.a graduation. The vertical distance now appears under slide plate B on hair line *n*. The operation of the indicator slide is the same as in other computations containing trigonometric functions and includes one setting of the distance, two settings of angles, and one orientation for constant K, the indicator is set but once. The special advantage of using my device is that the corrected horizontal distance is determined and not the horizontal correction. The stadia intercept is set off but once for horizontal and vertical readings. The constant K factor while sometimes overlooked is nearly always necessary in accurate stadia computations. With my device having a six-inch diameter of disk D the result will have an accuracy of four places throughout, which is a consistent degree of accuracy for practically all stadia computations with a transit. To make logarithmic computations it will be noticed that near the periphery of disk E is a concentric circle *s* graduated to even parts as at *c*. The graduations on this circle are numbered so that the numerals on the circle equal the logarithms of numbers on the same radial line on the helical line *i*, therefore the helical line being graduated from one to ten and portions thereof, this circle being equal to one convolution will be graduated into ten divided by the number of convolutions. For instance, with a disk having five convolutions, ten divided by five equals two; therefore with such disk the circle of even parts *s* is graduated into two segments of ten equal parts and subdivisions thereof. In looking up logarithms it will be noticed that the first figure in the circle of even parts is lacking. The purpose of this is to form a connection between each helical convolution and the circle, and the anti-logarithmic graduation numerals shown on the scale *h* are the missing first figures on the circle of even parts *s*.

In operation, to obtain the logarithm of a number, place hair line *n* over the number on the logarithmic helical line, read the first number of the mantissa on slide plate B anti-logarithmic scale, the following numbers of the mantissa on the circle *s*. To obtain the anti-logarithm of a number, place the hair line of slide plate B over the number on the circle *s*. It is seen that the first figure is lacking on this circle, but in this case with a five convolution disk the even numbers will be read from the right half of said circle *s* and the odd numbers from

the left half. That is, if the first figure of the mantissa is even, place the other figures under the hair line *n* on the right segment of circle *s*, and using the anti-logarithm scale *h* as an indicator, under the mantissa of said scale *h* will be located the anti-logarithm, which is read under hair line *n*. The anti-logarithmic scale is simply an indicator and acts in practically the same manner as the indicator slide C, with the exception that it is stationary to slide plate B. Thus it will be readily seen that the natural or logarithmic function of an angle can be easily obtained, and these functions are valuable in checking computations carried on by other means than by my invention. Also this makes possible the computation of powers and roots of trigonometric functions or numbers. The scale *f* in connection with the indicator slide C is used as a rough check on nearly all computations.

The indicator slide is of special importance, as it locates the answer, the decimal point and checks the answer. This holds true in nearly all cases. Substitution is used, as in the case of an angle the natural function is substituted—this natural function occurs on the same radial line and helical convolution. The main function of the indicator slide C, is to make possible the use of a spiral or helical line, thereby increasing the accuracy a great deal over the accuracy obtainable with circular graduations. The indicator slide also allows the use of any function thereby increasing the range of operations. The said indicator slide is simple in construction and operation and requires a minimum of time to operate it, thus making the computer practical for check purposes as examples to indicate some of the computations which may be made with my computer, I give the following:

Division.—954÷742.

Orient, place arrow *j* of disc under the hair line of slide A. Turn slide B until its hair line *n* is over 742 on spiral. Place the arrow P of indicator slide C also over 742 (that is, move arrow P to spiral convolution that contains 742) then turn disc E until 954 appears under hair line *n* of slide B. Directly over 954 on the indicator slide C is found the approximate check answer 128. Using this check answer as an indicator, the answer 1285 is read under hair line *m* of slide A. As the check answer appears on the outer section of the indicator slide, the number of digits in the answer is one plus the difference in digits between the dividend and divisor, or one; therefore, the answer is 1.285, or the decimal point may be determined by inspection in this case.

Multiplication.—98.65×.96.

Orient, place arrow *j* of disc under hair line *m* of slide A. Turn slide B until its hair line *n* is over 98.65, then place arrow P of indicator slide C over 98.65 and turn disc E until .96 appears under hair line *m* of slide A. Now under .96 on indicator slide is found the answer reading 94.70 under hair line *n* of slide B. As the inner section of the indicator slide only was used, the number of digits in the answer is the sum of the digits in the multiplier and multiplicand; therefore, the answer is 94.70. The check answer 947 approximately is found scale *f*.

Proportion.—76.98=47:×.

Set 76 under hair line *m* of slide A. Turn slide B until hair line *n* is over 98. Set 76 of indicator slide C over 98 then turn disc until 47 is under hair line *m* of slide A. Under 47 of indicator slide C is found the answer reading 60.60 under hair line of slide B. Decimal point being located as in multiplication, division or by inspection.

Having thus described my invention and its operation I desire to secure by Letters Patent and claim:—

1. The combination of a plane rotary spiral scale; an angularly movable slide; a radially and angularly movable double radial scale, each segment corresponding to the spiral scale, and acting in conjunction with the aforesaid angularly movable slide as an indicator in the manipulation of quantities on the spiral scale to make computations; and means to locate the resultant and determine the decimal point.

2. In a device of the class described the combination of a plane rotary spiral scale; an angularly movable radial scale corresponding to the spiral scale; a radially and angularly movable double radial scale, each portion being identical with the angularly movable radial scale and acting in conjunction with the said angularly movable radial scale as an indicator in the manipulation of quantities on the spiral scale; and means for checking the operations and the answer substantially as set forth.

In testimony whereof I have affixed my signature.

STEPHEN F. NUCKOLLS.