R. C. SMITH.

CALCULATING SCALE.

APPLICATION FILED MAR. 6, 1906. RENEWED DEC. 16, 1908.

920,497. **Patented May 4, 1909.**

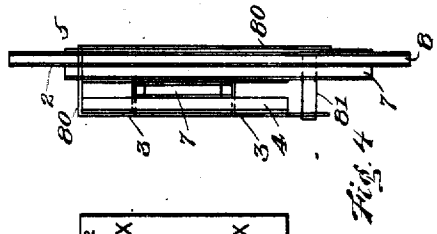


Fig. 4

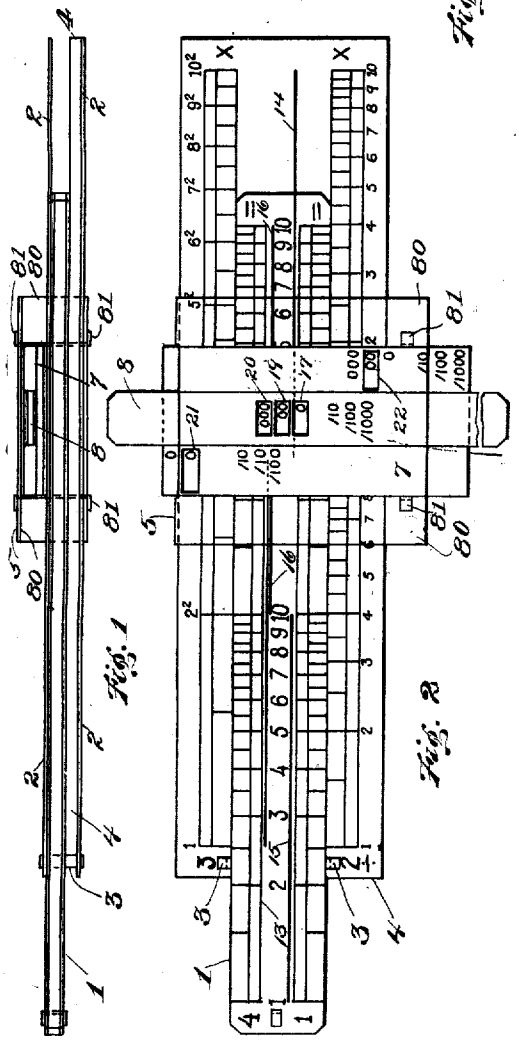


Fig. 1

Fig. 2

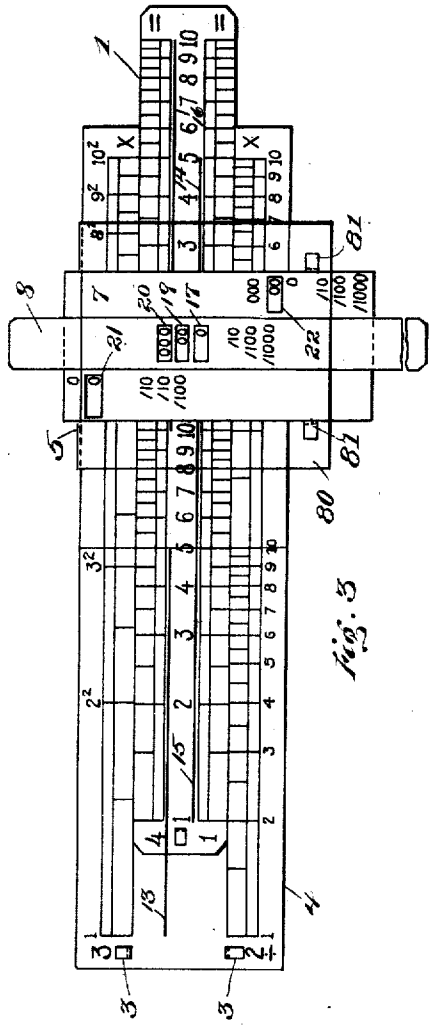


Fig. 3

Witness

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RUDOLPH C. SMITH, OF YONKERS, NEW YORK.

CALCULATING-SCALE.

No. 920,497. Specification of Letters Patent. Patented May 4, 1909.

Application filed March 6, 1906, Serial No. 304,546. Renewed December 16, 1908. Serial No. 467,808.

To all whom it may concern:

Be it known that I, RUDOLPH C. SMITH, a citizen of the United States, and a resident of Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Calculating-Scales, of which the following is a specification.

The object of my invention is to construct an instrument which will in every case register mechanically the correct local value of the first left figure of numbers used in the operation of a logarithmic scale for calculations. Such an instrument, as is well known, is of the greatest utility, as it does away with the many chances of error caused by the necessity of constant mental attention, while using the ordinary slide. In U. S. P. No. 746,889, Dec. 15, 1903, I have described a construction for this purpose of a cursor which in conjunction with the uniformly spaced equal divisions on the slide on the stationary part of a slide-rule with multiples of ten and with directive means on the ordinary logarithmic scale will register the local value of the first printed figures of a logarithmic slide-rule mechanically. The large printed figures of the slide-rule are the first left figures of the numbers used in the calculations and have the highest denomination, or the highest local value; for instance, in 550–(5) is the first left figure and its local value is 500.

My present invention consists of a cursor which registers the ciphers which must follow the first figure to give it its local value, in openings placed on the cursor to line with the horizontal row of their printed figures, and show their local value in ordinary notation. As a further improvement, I have added means coöperating automatically with the main slide which point to the particular opening in which the ciphers of the figures of the main slide must be made to appear and read.

Figure 1 is a longitudinal side elevation of the calculating scale embodying my invention. Fig. 2 is a top plan view of the same with the slide moved to the left. Fig. 3 is a top plan view of the calculating scale with the slide moved to the right. Fig. 4 is an end view.

The arrangement of the ordinary logarithmically-spaced slide-rule is well known and needs no detailed description. It consists of a stationary part and of a slidable part which can be moved to the desired place on the stationary part in proper guides. I prefer to use the construction described in my Patent No. 592,067, dated October 19, 1897, where the slide is held and guided by the celluloid flexible transparent cover or plate.

The main slide 1 is preferably an elongated strip of cardboard on which is printed the proper lines and characters and which is covered on its upper and lower surfaces by strips of transparent celluloid, as denoted at the left hand end of Fig. 1 and as is usual in this art. The stationary part or stock 4 of the main slide-rule is also preferably formed of cardboard and covered on its upper and lower surfaces by sheets 2 of transparent celluloid (as disclosed in my former patent 592,067) which are held in place at the left hand end of the part 4 by rivets 3 consisting of small strips of metal passing through the part 4 and transparent sheets 2 and bent over at their ends to form heads, as shown in Fig. 3. The slide 1 is, as usual, placed longitudinally upon the part 4 and below the upper celluloid sheet 2, as disclosed in my aforesaid former patent and as is shown in Fig. 1. The slide 1 as well as the stationary part 4 are provided with any of the well-known logarithmic Gunter scales; but in my improved instrument the slide 1 and the stock 4 are provided with directive pointers which for every section of the slide visibly point to the particular openings of the cursor where the proper number of ciphers for a section must be made to appear. The visible signs referred to in Patent No. 746,889, indicate, that the local value is to be taken in a special opening, but does not visibly point to the particular opening, as will be explained hereinafter.

The cursor 5 is arranged transversely and adjustably on the main slide-rule and comprises a main part or stock 7 of non-transparent material bearing the proper characters hereinafter referred to, a slide 8 of non-transparent material thereon also bearing the proper characters, and a transparent celluloid sheet 80 folded around the main slide-rule exterior to the celluloid coverings 2 thereon and upon the part 7 and slide 8 of the cursor, the ends of said sheet 80 where

they come opposite to each other at the lower edge of the main slide rule being fastened by pieces of metal 81 corresponding with the aforesaid rivets 3. The part 7 and slide 8 of the cursor are between the upper portion of the transparent sheet 80 and the upper surface of the main slide-rule and the slide 8 is upon the part 7; and at the upper edge of the main slide-rule the upper adjacent ends of the part 7 and slide 8 project through a slit in the folded edge portion of the sheet 80, while at the lower edge of the main slide-rule the lower adjacent ends of the part 7 and slide 8 project between the facing surfaces of the ends of the sheet 80 and also between the metal pieces or rivets 81, which serve as guides for said part 7. The upper portion of the sheet 80, which forms a part of the cursor 5, is provided with three index holes 17, 20, 19, coinciding with the equal spacing of the ciphers of the slide 8, by which the local value of the figures of the main slide is registered. The cursor 5 is also provided with index holes 21, 22, the hole 21 being preferably located in line with the printed figures on the main scale the ciphers of which it is intended to indicate, and the index hole 22 being preferably in line with the figures printed on the main scale the ciphers of which it is intended to indicate. The index hole 19 is preferably located in line with the printed figures on the main slide the ciphers of which it is intended to indicate. This arrangement just described of the index holes 21, 22 and 19 in register with the respective lines of printed numerals with which they coöperate affords an effectual guide to the user of the scale in making accurate readings thereof and consequently prevents mistakes.

The upper left half of the stationary part 4 is provided with a horizontal material line 13 extending from the left end of the scale to the center dividing the spacing of the stationary scales in two halves. The right lower left half is provided with a material line 14 extending from the middle to the right end. In the construction as shown, these lines are fixed to the transparent cover which is connected with the stationary part, but they can be fixed on the stationary part itself, when this is used without a transparent cover. The slide 1 has in line below the figures of the left half, a material line 15 or any other prominent visible means, as for instance, a raised or grooved line extending to the middle, and a similar line 16 above the figures of the right half extending from the middle of the slide to the right end. The Fig. 2 shows the slide moved to the left, a position which shows two lines 13 and 16 above the figures of the slide for the section between the end of the lines of the slide, and those of the stationary part. These two lines point to the upper opening, and indicate, that the figures of the section of the slide, where the edge of the cursor in fixing the position of the figure crosses two upper lines, have the ciphers indicating their local value in the opening to which these upper lines point. Fig. 3 shows the slide moved to the right and in this position there are two lower material lines pointing to the lower opening of the slide 8, in which the numbers of these figures on the section with the two lines must be read and taken. The figures of the outer section of the slide have their ciphers in the middle opening to which the two horizontal lines above and below the figures point. If in using this arrangement of pointers on the slide of the figures and openings for the ciphers of the same, on cursor 5, each ratio of figures set on the logarithmic slide is accompanied by a setting of the local value of the figures expressed, in the opening of the cursor, the correct result of calculations performed on the logarithmic slide-rule can be read.

The figures on the auxiliary slide 8, and its stationary part 7 of the scale for the local values, are in three rows which contain, respectively, the ciphers of the rows of figures on the main scale with which they are horizontally in line, which rows of figures of the main scale are marked 3, 4, 1 and 2 (not as numerals of reference), but as incorporated with the instrument, as shown on the left hand end of Figs. 2 and 3. It will be noticed, that the upper row of the figures of the main stationary scale contains the square roots of the lower row of figures, while the slides have the same row of figures as the lower row of figures on the stationary part. The openings of the cursor 17, 19, 20, must be of the same spacing as the ciphers on the slide 8, and the stationary part; and the openings 21, 22, must be located properly, that when 19 in normal position of slide and stationary part shows 00, the upper opening must show 0, and the lower one 00. With this vertical distance it follows that the lower opening will show the same number of ciphers as the middle one, and the upper one will show half the number of ciphers, and with the equal spacing of the ciphers the same ratio will be maintained. I have discovered that this construction of the instrument is capable of registering the ciphers mechanically, following a very simple rule of operation, viz: Repeat every move of the cursor 5 and slide 1 of the main scale with the cursor 5 and slide 8 of the decimal-scale, using the numbers on the main scale and the ciphers of their first figures on the decimal-slide. Read all decimals in line with the middle index 20 of the cursor 5: except for the figures on an inner section, if on such a section two lines point to the upper opening, the ciphers must be read in the upper opening,

and if the two lines on the slide point to the lower opening, the ciphers must be read and taken in the lower opening.

The instrument registers factors of ratios or proper and improper fractions, like:

$$\frac{1500}{600}\times\frac{80}{400}=0.5 \text{ or } 5/10.$$

by the following sequence of moves. At the commencement of the operation, the slides may be regarded as set in their respective zero positions, in which the figures on the slides coincide with those on their coöperating stationary parts. Then move the cursor 5 to aline with the figure "6" (this being the significant figure of the divisor "600" in our example) on the main slide 1; then move the stock 7 and slide 8 of the cursor 5 together until the two ciphers "00" on the slide 8 appear at the middle opening 19, and then move the slide 1 to the left until the fifteen division mark thereon (this being the first term of the ratio 1500) becomes in line with the left hand edge of the cursor. Then ordinarily or in the general use of the scale we would move the slide 8 but in this example we do not have to do so since the three ciphers "000" (which express the local decimal value of the first significant figure of 1500) on the slide 8 appear in the upper opening 20 to which the two upper lines 16 of the section where 15 is taken point, said three ciphers having, in this special example, attained their position in said opening 20 by the operation of placing the two ciphers in the middle opening 19 while fixing the value for "6." Now set the left hand edge of the cursor 5 to aline with "4" on the right-half of slide 1, and at this time we would ordinarily again move the slide 8 but it is not necessary in our example to do so since the two ciphers "00" already appear at the middle opening 19. Then move slide 1 to the right to replace the "4" by "8" at the left hand edge of the cursor, and at this time we would ordinarily or under the general rule move slide 8 but in our example it is not necessary to do so because the one cipher "0" already appears in the lower opening 17, having attained that position (with the lower lines 15 of the section containing the "8" pointing thereto) from the former operation; said one cipher representing the local value of the "8" in "80" or "0." To read the result of the multiplication in the example given: Move the parts 7 and 8 of the cursor together to show in the lower opening 22 the blank space on the part 7 which is between the "0" and "/10," which movement will also cause the "/10" on slide 8 to appear in the lower opening 17, since the two lower lines 15 of the slide 1 point to said lower opening 17. Over the figure "1" at the middle of the stationary part 4, we may then read the figure "5," which with the "/10" shown in the lower opening 17, stands for 5/10 or .5, and we thus read the result of the multiplication. The general rule for the operation of the scale is to repeat every move of the cursor 5 and slide 1 with the cursor 5 and slide 8 of the decimal scale, using the numbers on the main scale and the ciphers of their first figures on the decimal scale, but in the example above given some of the repeat moves becomes unnecessary for the reasons explained.

I do not limit myself to the precise construction and arrangement shown. It is evident that the same operation and result may be obtained on a disk or cylindrical surface, as on a plane.

I claim as my invention:

1. In combination with the logarithmic slide-rule, an auxiliary slide-rule of equal spacing and marked with a continuous series of the ciphers of powers of ten, a cursor with indexes of the same spacing as the auxiliary series of ciphers, pointers on the slide and stationary part of the logarithmic slide, said pointers to be in proper position to fix the special index for the ciphers determining the local value of the figures.

2. In combination with the logarithmic slide-rule a transparent cover, an auxiliary slide-rule of equal spacing and marked with a continuous series of the ciphers of powers of ten, a cursor with indexes of the same spacing, as the auxiliary series of ciphers, pointers on the slide and on the transparent cover, index holes and pointers in proper position to fix the special index for the ciphers, substantially as described.

3. In combination with the logarithmic slide-rule, an auxiliary slide-rule of equal spacing and marked with a continuous series of the ciphers of powers of ten, a cursor having index holes of the same spacing as the auxiliary series of ciphers, and pointers on the main slide and stationary part of the logarithmic slide-rule, said index holes being respectively in line with the printed numerals on the said main slide and stationary part, and said pointers being in position to fix the special index for the ciphers for said numerals.

4. In combination with the logarithmic slide-rule, a pointer line running on the upper part of the stationary part from the left end to the 1 belonging to the right hand half, a pointer line running from the lower 1 of the stationary part to the end of the right hand half, a pointer line running on the under part of the main slide from the left end to the 1 beginning the right hand half, and another running from the 1 to the end on the upper part, substantially as described.

5. In combination with the logarithmic slide-rule, a pointer line running on the

per part of the stationary part from the left end to the 1 belonging to the right hand half, a pointer line running from the lower 1 of the stationary part to the end of the right hand half, a pointer line running on the under part of the main slide from the left end to the 1 beginning the right hand half, and another running from the 1 to the end on the upper part, an auxiliary slide-rule of equal spacing and marked with a continuous series of the ciphers of powers of ten, a cursor with three indexes of the same spacing, as the auxiliary series of ciphers, pointers on the slide and on the transparent cover, index holes and pointers in proper position to fix the special index for the ciphers, substantially as described.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this third day of March 1906.

RUDOLPH C. SMITH.

Witnesses:
F. P. HOENEMAN,
W. H. BRADY.