Aug. 17, 1926.

R. UHLICH

1,596,129

SLIDE RULE

Filed Nov. 17, 1924

2 Sheets-Sheet 1

Fig. 1.

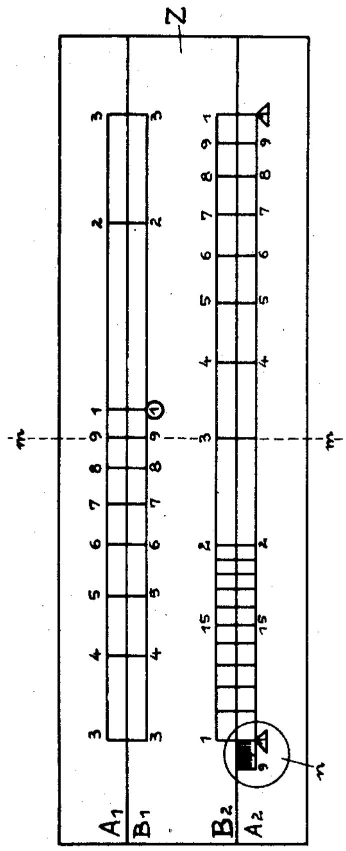


Fig. 2.

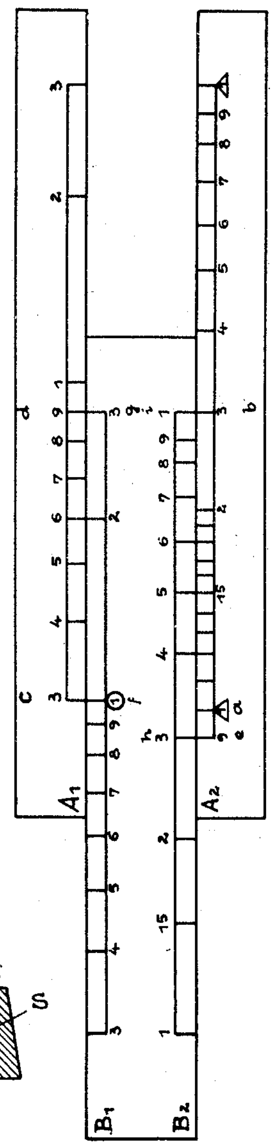


Fig. 6.

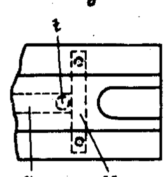
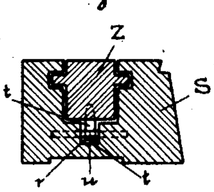


Fig. 5.



Witness:
A. A. Brand

Inventor:
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Fig. 3.

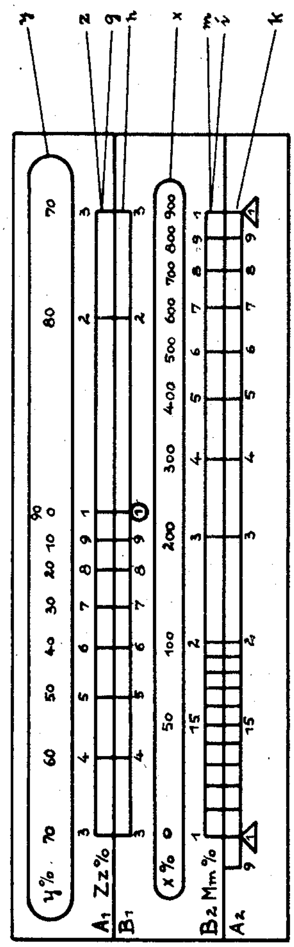
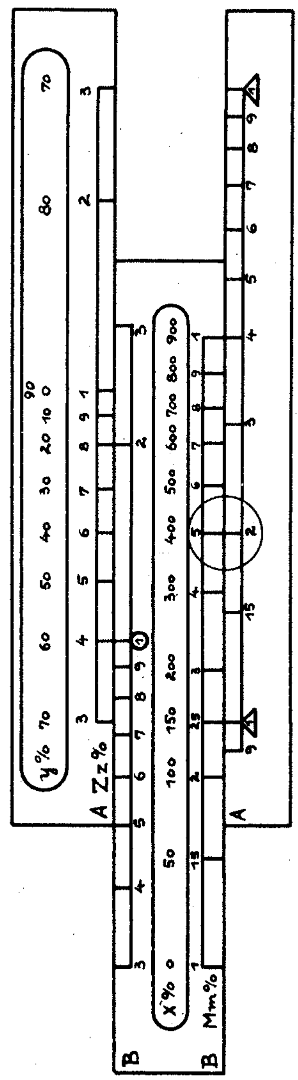


Fig. 4.



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Patented Aug. 17, 1926. **1,596,129**

UNITED STATES PATENT OFFICE.

RUDOLF UHLICH, OF LEIPZIG-PLAGWITZ, GERMANY.

SLIDE RULE.

Application filed November 17, 1924, Serial No. 750,246, and in Germany February 25, 1924.

My invention relates to slide rules, and it has particular relation to the provision of a rule whereupon all values can be directly read irrespective of the position of the sliding element.

In logarithmic slide rules of the type usually employed, the graduations are arranged so that one logarithmic unit is positioned on the lower body scale, and a corresponding length of one unit is positioned on the lower slide rule, while upper body and slide scales carry two logarithmic units, these latter units being equal in length. With such rules there is a distinct inconvenience present in that in some positions of the slide it is impossible to ascertain directly all of the numerical values which it may be necessary to read. In other words, for one portion of the numerical values, which portion becomes greater the further out the slide is pulled, a reverse adjustment of the slide is necessary. Moreover, when two logarithmic units are disposed side by side, as is the usual case in rules now employed, a small scale must be used at the expense of accuracy.

Finally, the use of reciprocal graduations makes the reading of the values difficult since it is necessary to consider them in an inverse direction, and under these circumstances only one calculation can be made for each position of the slide.

My invention, therefore, has for its object the provision of a slide rule so marked that at all positions of the slide, within predetermined limits, all numerical values can be read directly. Moreover, percentage rates and rates of proportion may be read directly according to their absolute value.

My invention will be better understood in all its aspects by reference to the accompanying drawings, in which:—

Figure 1 is a plan view of a slide rule embodying my invention, the scales of said rule being the simplest which may be employed;

Fig. 2 is a view of the rule shown in Fig. 1, with the slide pulled out to its maximum open position;

Fig. 3 is a plan view of a rule embodying my invention whereupon percentage values have been placed;

Fig. 4 is a view of the rule shown in Fig. 3 with the slide pulled to the left;

Fig. 5 is a sectional view taken across the rule on the line *m—m*; and

Fig. 6 is a plan view of one end of my rule showing certain limiting stops utilized therein.

It will be noted, of course, that the rules shown in Figs. 1 to 4 inclusive, are intentionally distorted in order to illustrate more clearly the principles embodied therein. Referring to Fig. 1, a rule is shown wherein the upper and lower body scales are designated A_1 and A_2, while the upper and lower slide scales are designated as B_1 and B_2, it being understood that all of the graduations shown are of the same scale, so that either the upper or lower graduations may be used if desired.

The graduations on the upper body and slide scales extend from 3 to 1 to 3, while the graduations on the lower slide and body scales extend from 1 to 1, these latter graduations being drawn to the same scale as those on the upper body and slide scales. It will be observed, therefore, that the upper logarithmic scale has been displaced three units to the left, while the lower scale remains as those with which we are now more or less familiar.

In order to be able to read all the results at every position of the slide Z within such limits as to allow all combinations, it is necessary that a full graduation 1 to 10 of the body scale always register with a full graduation 1 to 10 of the slide scale. The limits of the extreme positions of the slide, and it is in this predetermination that my rule presents novel characteristics, are arrived at as follows: When the slide is pulled to the left the division line 1 of the graduation B_1 must register with the left-hand figure 3 on the scale A_1, and when the slide is pulled to the right, the division line of graduation B_1 must register with the figure 3 of the graduation A_1. As above pointed out, in order to fulfill the requirements within required limitation, one full logarithmic division of the body portion of the rule always registers with one full logarithmic division of the slide, and, therefore, the scales A_1 and B_1 are, as noted, displaced to the left in such manner that the values of the graduations on A_1 and B_1 are always equal to three times the value of the graduations of A_2 and B_2. For example, in Fig. 1 the line *m*—*m* passes through the following graduations: on scale A_1 the figure 9; on scale B_1 the figure 9; on scale A_2 the figure 3; and on scale B_2 the figure 3, thus satisfying the above requirement.

In order to further facilitate the use of my rule the graduation A_2 is lengthened to the left to accommodate a further subdivision or graduation section 9 to 1, designated *n* in Fig. 1. However, even in this extreme left position, and considering the added division *n*, the above requirement as to equivalents is fulfilled; that is, on the body graduations *a*—*b*—*c*—*d*—*e*—*a* equals one logarithmic division which is also equal to *f*—*g*—*h*—*i* on the slide, as shown in Fig. 2.

It is of course understood that the graduations which are described in the above discussion as being at the top may be arranged below, and those which have been described as being at the bottom may be disposed at the top of the body and slide.

A further advantage incident to the use of a scale divided in accordance with my invention is realized when it is desired to calculate percentage or proportional relation, since with a rule divided as I have just described, and provided with percentage units, calculations can be carried out without any reverse readings or preliminary calculations being required. With this latter object in view, I provide further graduations on a scale constructed in accordance with my invention as shown in Figs. 3 and 4.

Referring to Fig. 3, the main logarithmic graduations are the same as those heretofore described in connection with Fig. 1. However, on the upper body portion and above the scale A_1, I have arranged a scale indicated as $y\%$, the units of this latter scale being displaced in the same order as are the units of the original scale A_1. In other words, the first two units of the logarithmic percentage table, it being remembered that this percentage table is inversely arranged with respect to the upper body scale, are positioned to the right and over the units 1 to 3 of the upper body scale; that is, 0% and 90% are over the figure 1 on the upper body scale.

On the slide, a scale indicated as $x\%$ is arranged over the slide scale B_2. Inasmuch as the main scales A_1 and B_2 may be utilized for subdivisions of the percentage scales just discussed, I have further marked these scales $Zz\%$ and $Mm\%$. With these scales so marked, it is possible to effect by direct reading, a variety of useful calculations, all of which come within the limitations heretofore indicated as to the maximum displacement of the slide. If for instance, A is the denominator (to be read on graduation A, either on A_1 or A_2), with B the numerator (to be read on graduation B, either on B_1 or B_2), $x\%$ $m\%$ the percentage relating to A, and $y\%$ $z\%$ the percentage relating to B, the absolute percentage is indicated on the scales $x\%$, $y\%$, the corresponding percentage for all different relations between A and B being indicated numerically on scales $m\%$ and $z\%$.

The following calculations may be carried out on my scale:

(1) $a=z\%$ on b.
(3) $a=y\%$ smaller than b.
(5) $a\div x\%=b$.
(7) $a\div y\%=b$.
(9) $a : b=z\%$.
(2) $b=m\%$ on a.
(4) $b=x\%$ greater than a.
(6) $b-y\%=a$.
(8) $b-x\%=a$.
(10) $b : a=z\%$ (b on A, a on B).

If the percentage is given the mark 1, or 1 is adjusted under the corresponding value and the corresponding values for *a* and *b* are read on the graduations A and B.

If *a* and *b* are known, *a* is adjusted on scale A and *b* on scale B, the one under the other and on the corresponding separate graduation, the different per cent relations and values can be read, without variations of the position of the slide.

In order to more clearly explain the manner in which my novel slide rule is employed, I will hereafter set forth a plurality of examples and describe in detail the manner in which, given a certain set of facts, said problems may be solved.

Beginning, for instance, with a simple problem in multiplication, we will assume that 55 is to be multiplied by 80;—to make this calculation, place the 1 in the circle appearing on scale B_1 under 55 on the scale A_1. If we now place the finder line over 8 on the scale B_1, we will read thereabove on scale A_1 the result 44, or, of course, adding the required zeros we have 4400.

If, however, we wish to multiply 5.5 by 4, it will be noticed that it is necessary to shift the inner scales to make such a calculation, that is, it would ordinarily be required to make such a shift, but by referring to the lower scales B_2, A_2, of my rule, the calculation can be made directly without moving the slide member, thus illustrating that any calculation may be made with one setting of the 1 in a circle of a certain number. For instance, to obtain the above result with the 1 still remaining under 5.5, we place the finder line over 4 on the scale B_2 and read the result as 22 on scale A_2.

The reverse of these operations should be gone through with in order to perform a division. That is, if we wish to divide 88 by 22 we place the figure 22 on scale B_1 directly under 88 on scale A_1, and read the result on scale A_1 directly over the 1 in a circle.

In the same manner we may obtain any division, even though the result does not lie on the upper scales, by reverting to the lower scales.

We may, of course, also perform any number of successive multiplications and divisions with one setting of the scale. If, for instance, we wish to divide 70 by 20 and multiply the result by 8, we proceed as follows:

Place 2 on the scale B_1 under 7 on the scale A_1 and we would normally read the result of this division as 3.5 on scale A_1 over the 1 in the circle on B_1. But it is not necessary to make this partial computation; we can immediately proceed to figure 8 on scale B_2 and directly thereunder we read the result 28 on scale A^2, the combined division and multiplication having been performed in the latter manner.

In much the same manner we may perform problems in proportion. For instance, let us fix any definite proportion, such as

$$5:8=15:x=40:x, \text{ etc.}$$

To obtain the unknown quantity we simply place the figure 8 on scale B_1 under the figure 5 on scale A_1; with this one setting we may obtain any set of proportional figures, such as finding 24 under 15, 64 under 40, etc.

If, however, we wish to find the proportion of figures, the upper number of which does not appear on scale A_1, within the range covered by scale B^1, we simply revert to the lower scales and read the result. For instance, 40 on scale B_2 lies over 25 on scale A_2, and since the problem is one of proportion, the latter two figures are, of course, reversed. By this latter method the calculation may be made without the necessity of operating the sliding member.

If it is desired to perform problems involving the use of percentages, the red scales on the rule are made use of. If, for instance, it is desired to calculate the net price when the list price and a certain discount percentage is given the problem is solved as follows:

If the list price is 50 and 20% discount is offered place the 1 in the circle on scale B_1 under the red 20 of the scale $y\%$ and read the net price 40 on scale A_1 over the gross price 50 on scale B_1. It will thus be seen that the subtraction of the discount amount is directly made in my slide rule without the necessity of making this calculation by first finding the discount and then subtracting With the slide in the same position, we can, of course, obtain the net price with any given list or gross price, by simply shifting the finder line as required.

If, however, we wish to obtain the net price, when we know the original price, and an additional percentage on that price must be added thereto, the problem must be solved as follows:

Assume, for instance, that we wish to find directly the selling price when the cost price is 70 and the increase is to be 50% of the cost price. To perform this calculation we place the mark 1 on the scale A_2, that is, the 1 in the triangle under the red 50 of the scale $x\%$ and then read directly the selling price 105 on scale B_1 under 70 on scale A_1; it being noticed that here again the calculation cannot be made on the two lower scales, but that no change of the slide is required, the result being readable directly on the upper scale. So far as the lower scale is concerned it will be seen that 150% of 2 is 3 or that 3 appears above 2 on the two lower scales.

In Figs. 5 and 6 I have illustrated the manner in which the movement and adjustment of the slide within predetermined limits is insured. A groove *r* is cut along the middle axis of the lower surface of the body *S* and into this groove projects a pin *t*, which latter pin is fixed to the lower surface of the slide Z. Cross-pins *u* are positioned at the ends of the aforesaid groove and limit the displacement of the slide in a direction longitudinal of the rule. The position of the aforesaid cross-pins is selected in such manner that when the slide is pulled out to the left, or to the right, the figure 1 on scale B_1 registers with the division line 3 on scale A_1. The effect of such limited displacement is to insure that the slide moves within such space that every full division 1 to 10 on the slide comes into registration with every full division 1 to 10 on the body, whereupon at every position of the slide all results can be directly read.

While I have described but two examples of rules embodying the novel features of my invention it is obvious that those skilled in the art may employ said features in other relations without departing from the spirit of my invention, and I desire, therefore, that the same be limited only by the scope of the appended claims or by the prior art.

Having described my invention what I claim as new and desire to secure by Letters Patent of the United States is:—

1. In a slide rule, upper and lower body portions having scales thereupon, a slide adapted to move between said body portions, upper and lower scales on said slide,

the upper body and slide scales extending from the left end thereof in order as 3, 4, 5, 6, 7, 8, 9, 1, 2, 3, the lower slide and body scales extending in like manner as 1, 2, 3, 4, 5, 6, 7, 8, 9, 1, or inversely, and the upper body and slide scale figures being so disposed that their value always amounts to three times the value of the lower slide and body scale figure normally thereunder.

2. In a slide rule, upper and lower body portions having scales thereupon, a slide adapted to move between said body portions, upper and lower scales on said slide, the upper body and slide scales extending from the left end thereof in order as 3, 4, 5, 6, 7, 8, 9, 1, 2, 3, the lower slide and body scales extending in like manner as 1, 2, 3, 4, 5, 6, 7, 8, 9, 1, or inversely, the upper body and slide scale figure being so disposed that their value always amounts to three times the value of the lower slide and body scale figures normally thereunder, and the lower body scale being extended to the left and beyond the upper body graduations in a section 9 to 1.

3. A slide rule as defined in claim 1 having a scale 0%–900% arranged over the lower slide scale in such manner that the sub-divisions of said lower slide scale may be used as percentage graduations between the main figures of said 0%–900% scale, and having another percentage scale 0%–90% reciprocally positioned over the corresponding figures of the upper body scale, said upper body scale sub-divisions serving as sub-graduations for the associated percentage scale.

In witness whereof, I have hereunto subscribed my name.

RUDOLF UHLICH.