Dec. 23, 1969 W. VOLK 3,485,447

SLIDE RULE

Filed Jan. 23, 1968 2 Sheets-Sheet 1

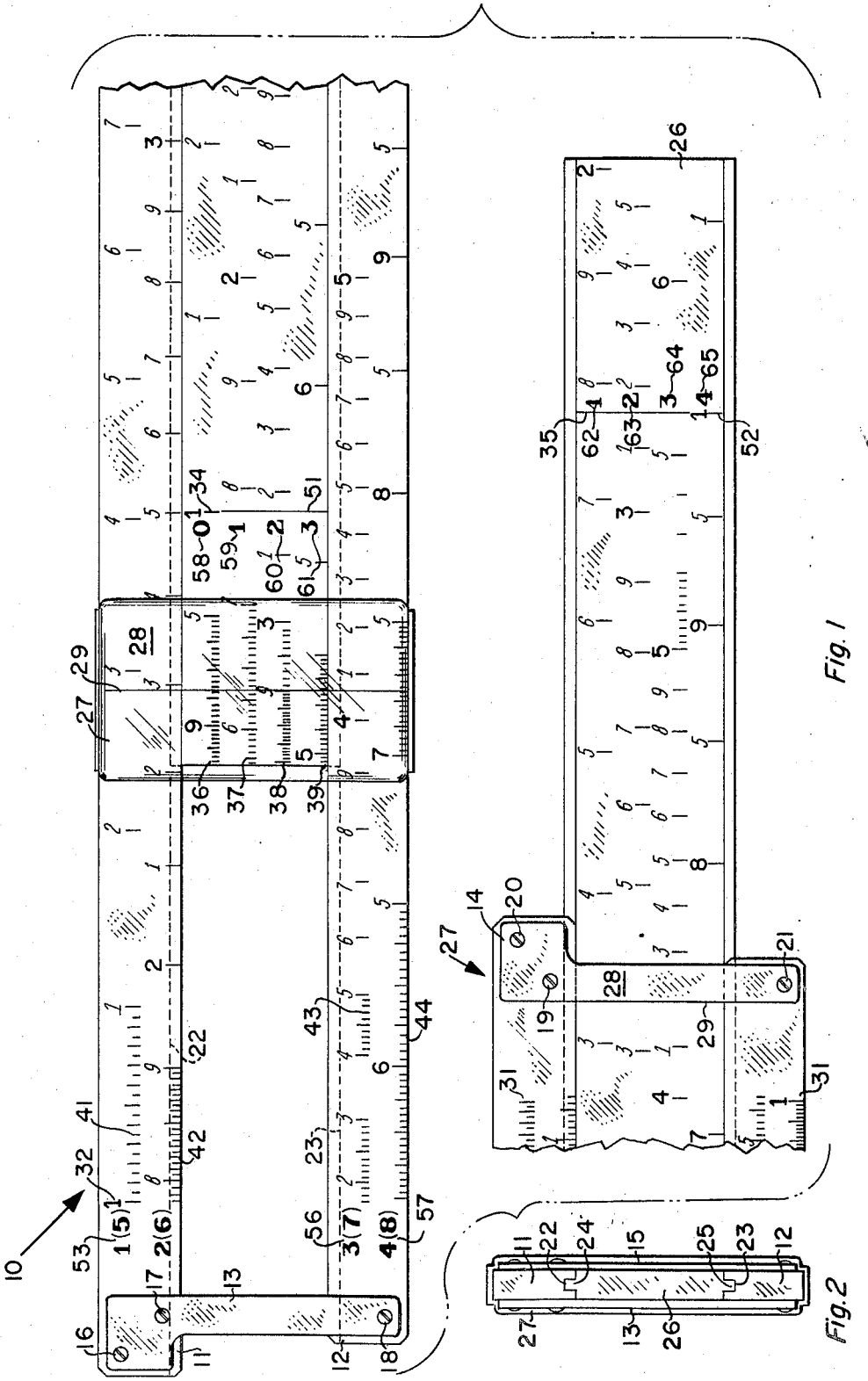

Fig. 1

Fig. 2

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SLIDE RULE

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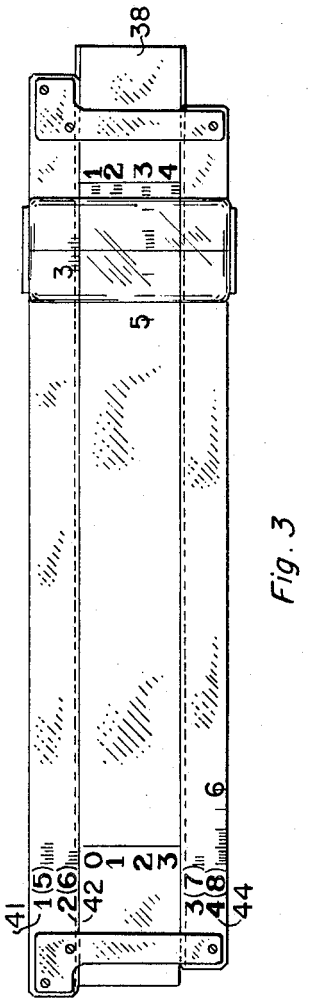

Fig. 3

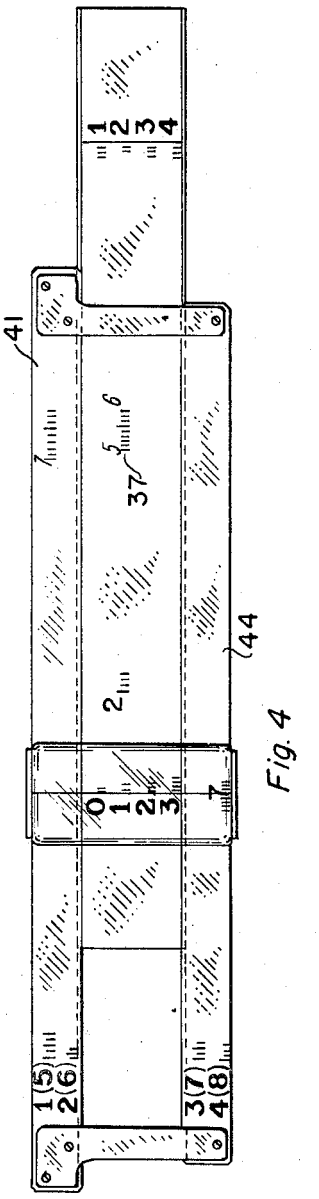

Fig. 4

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SLIDE RULE

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U.S. Cl. 235—70 1 Claim

ABSTRACT OF THE DISCLOSURE

A slide rule has scales formed by dividing a logarithmic scale from 1 to 10 into an integral number of divisions. Each of the fixed scales is identified by two numerals differing by the number of such divisions, and on the slide, the left hand index of the scales are identified by numerals that are lower by 1 than identifying numerals on the right hand index.

BACKGROUND OF THE INVENTION

It is well known that the precision of the commonly used logarithmic slide rule is a function of the length of the scale. Efficient use of the entire length of a slide rule for bearing scale graduation has, however, been prevented by two factors. Firstly, the cursor is required to have a substantial breadth in order to keep the hairline vertical. In conventional slide rules no scale graduations have appeared on those portions of the rule that cannot be reached by the hairline and due to the breath of the cursor this unmarked length may be substantial. Secondly, in the type of rule that bears scales on both faces, and this has been the most efficient type up to the present time, the brackets that hold the parallel plate members apart themselves limit the movement of the cursor and account for additional slide rule length that is not available for scales.

It was long ago suggested that the precision of a slide rule of a given length might be greatly increased by breaking up a longer scale at lengths representing integral roots of ten where the integer is greater than one, such as the square root, and fourth root of ten, and arranging the broken scale in parallel lines of the rule. This arrangement is suggested, for example in Anderson Patent 768,971 issued in 1904. In spite of the apparent advantages of the concept, however, slide rules made up in this manner are not commonly used. It may be reasonably proposed that one explanation for the commercial failure of the divided scale has been the inconvenience of having calculations where the required answer appears off-scale due to the fact that the wrong index, e.g., the right instead of the left index or vice versa, of the scale on the slide was initially employed. The folded and inverted scales that are well known to persons skilled in slide-rule calculating have been added to the known slide rules to alleviate this inconvenience. But when the slide rule area is used for divided scales there is no room available for the folded and inverted scales and they must be sacrificed. My present invention, which reduces the likelihood of reading off-sale, has, therefore, particular utility to slide rules with divided scales and makes such slide rules practical for every-day use.

By means of my invention I propose to make a practical slide-rule of increased precision for a given length. By means of my invention I propose further to greatly increase convenience of slide rules having divided scales.

SUMMARY OF THE INVENTION

I have invented a slide rule comprising two fixed elongated plates with means holding them in spaced parallel relation and a third elongated plate movable lengthwise between the fixed plates. Left and right indices are marked in equal spaced apart distances on the plates. Logarithmically spaced scales are graduated on the plates designating values between the right and left indices of exactly an integral root of the number ten. The scale graduations on the third, slidable, plate extend substantially to the left of the left index and to the right of the right index so that advantage is taken of the full length of the slide, and, to make the indices more legible they are extended across all the scales on the slidable plate. My slide rule also comprises a cursor having a hairline extending across the scales. In advantageous embodiments of my invention the integral root of the number ten is greater than one, such, particularly, as four.

To make it easier to determine which scale to read when using my slide rule consecutively each scale on the fixed plates bears two identifying numerals comprising a first numeral from 1 to N, where N is the integer of the integral root of 10 to which the scale is divided, and a second numeral equal to said first numeral plus N. The scales on the slide bear consecutive identifying numerals from 0 to (N–1) at the left and from 1 to N at the right.

A more thorough understanding of my invention can be gained from a study of the drawings as described hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 shows a broken front view of a slide rule made to my invention.

FIGURE 2 shows a view of the slide rule of FIGURE 1.

FIGURES 3 and 4 show the positions of my slide rule for calculations of multiplication and division.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIGURE 1 a slide rule indicated generally by the numeral **10** comprises an upper elongated plate **11** and a lower plate **12** held apart, but parallel, by brackets **13** and **15** (FIGURE 2) on one end and a bracket **14** and a matching bracket (not shown) on the other, cooperating with rivets **16–21**. The plate **11** has a lower groove **22** and the plate **12** an upper groove **23** matching tongues **24**, **25** in a sliding plate **26** that is free to slide between the plates **11** and **12**. A cursor **27** with a transparent plate **28** bearing a central hairline **29** will, when it is in its furthest right position, have the plate **28** almost abutting the bracket **14**. A right index **31** marks the right limit of the graduations on plates **11** and **12** and a left index **32** marks the left limit. The description of the slide rule **10** that has been given so far is typical of known slide rules and it is apparent that the length of such known rules from their left extremities such as that shown at **33** to the left index is wasted for purposes of calculation and a similar waste occurs at the right end of the rule.

The length of the distance between the left index **32** and the right index **31** is fixed and limits the precision or sensitivity of the rule. This exact distance is repeated between a left index **34** and a right index **35** of the sliding plate **26**. However it is novel in my slide rule that scales such as scales **36, 37, 38, 39**, which will be more fully described hereinbelow, on the slide **26** extend substantially leftward of the index **34** and rightward of the index **35**.

In FIGURE 1 the logarithmic scale has been divided into four lengths two of which appear on the plate **11** and two on the plate **12**, as follows. A scale **41** extends from **1** at the left hand index **32** to the fourth root of 10, of which 1.78 is an approximation, at the right hand index. A scale **42** extends from the fourth root of ten to the square root of ten, of which 3.16 is an approximation, at the right hand index. A scale **43** on the plate **12** extends from $10^{\frac{1}{4}}$ to $10^{\frac{3}{4}}$ of which 5.62 is an approximation, and a scale **44** extends from $10^{\frac{3}{4}}$ at the left hand index to **10** at the right hand index. In order to increase ease of reading, the scales on the fixed plates may be extended slightly past the indices in order to indicate a whole division but there is no advantage to make any substantial extension of these scales since the hairline **29** on the cursor could not reach them, as has been explained. In fact, for purposes of gaining the utmost precision from the available slide rule space, it is desirable to extend the left and right indices as far apart as possible on the fixed plates **11** and **12**.

Between the indices **34** and **35** on the slide **26** the scales **36–39** are identical to the scales **41–44** but I have extended the scales **36–39** beyond the indices **34** and **35** to the extremity of the slide. In a 5-inch slide rule the increased scale may extend as much as one inch or more on each end, a total increase of at least 40%. To illustrate the advantage of my extended scales let us suppose that it is desired to multiply "25" by "29," as illustrated in FIGURE 1, and the left index **34** of the slide **26** is placed in line with "25" on scale **42** of the upper plate **11**. When an attempt is made to move the cursor to the number "29" on scale **32** of the slide this number is found to be off scale. However, on my improved slide rule "29" also appears on scale **38** to the left of the left index and reading under this scale the correct product "725" is found under the hairline on scale **44** of the lower plate. Although there will still be occasions when the desired answer may be off scale, the 40% increase of graduations on the scale presents a highly significant advantage for my improved rule, indeed an increase of only 20% that is, an extension on a five-inch slide of one half inch on either end constitutes a significant advantage over present rules and makes the use of divided scale rules practical, in terms of the time that can be saved by the user.

Although the left index **34** is always identifiable by the graduations marking the number **1** on the scale **36** and the right index **35** by the graduations marking the number **10** on the scale **39** I have found that my slide rule can be more easily read if I extend the graduations from the left and right indices across all the scales by means of line markings **51, 52**.

Use of divided scale rules have, up to now, been resisted because of the possibility of reading the answer on the wrong scale. I have added novel markings to my rule that removes the basis for such resistance.

Thus I have marked the scale **41** with the numerals "1" and "5" as indicated at **53**, the scale **42** is marked at **54** by the numerals "2" and "6," the scale **43** is marked at **56** with numerals "3" and "7" and the scale **44** is marked at **57** with numerals "4" and "8." The first of the numerals in each case is a numbering from 1–N of the scales on the fixed plates. Since N represents the integral number of division that the log scale is divided into, and, in the illustrated case of FIG. 1, N=4. Other values of N may, of course, also be used and the greater N is, the more useful will be my present improvement. Although

I have shown the numerals **53–57** marked at the left they might also be repeated at the right within the scope of my invention, but since the fixed scales are always entirely visible a repetition is not necessary.

I have also marked the slide **26** with numerals to identify the scales. The scales **36–39** are marked with numerals "0," "1," "2," "3" at **58, 59, 60, 61** respectively at the left and with numerals "1," "2," "3," "4," at **62, 63, 64, 65** on the right. Here again N=4 since the scale has been divided at the fourth root of 10.

The numeral markings of the scale are used as follows. In multiplication, as is well known, an answer is found by setting one of the indices of the slide at a number, marked on the fixed plate, to be multiplied and reading the desired product, on the fixed plate, at the vertical line where the other number to be multiplied appears on the slide. In my invention the proper scale for the answer is represented by the numeral that is the sum of numerals marking the scales on which appear the numbers to be multiplied. Thus if (FIGURE 3) it is desired to multiply "57" by "53" the left index is moved over the graduation "57" on scale **44** and the answer is read over the graduation "53" on scale **38** as "3021" on scale **42**. The use of scale **42** to read the answer was determined as follows: scale **44** bears the numeral "4," scale **38** bears the numeral "2" (when the left hand index is used). The sum of these two numerals is "6," which represents scale **42**, where the answer is read. When the right hand index **35**, is used for multiplication, recourse is had to the numerals **62–65** for locating the answer according to the above method.

The operation of division can best be explained by recourse to another example as shown in FIGURE 4. Let us say that it is desired to divide "175" by "25." Then the graduation for "25" on scale **37** is placed under "175" on scale **41**. The answer "7" appears under the left index on scale **44**. In division the numeral on the slide is subtracted from the numeral on the fixed plate. In this case the numeral for the left index of scale **37** is "1" and the numeral for scale **41** is "5." Subtracting "1" from "5" results in "4" which represents the scale **44** on which the correct answer appears.

I have illustrated only one face of my slide rule **10**. It is advantageous to employ conventional scales on the opposing face but such use is not required to benefit from my discoveries.

The foregoing description has been exemplary rather than definitive of my invention for which I desire an award of Letters Patent as defined in the following claim.

What is claimed is:

1. In a slide rule comprising two fixed, elongated plates, means holding said plates in parallel spaced relation, a third elongated plate slidable lengthwise between said fixed plates, left and right indices marked in equal distances on said fixed and said slidable plates, at least logarithmically spaced scale graduated on at least one of said fixed plates and on said slidable plate, said scale designating values between said right and left indices of exactly an integral root of the number 10 where the integer of said integral root is greater than 1, and a cursor comprising a hairline extending across said scales, the improvement comprising:

(A) two identifying numerals marked consecutively on each of said scales on said fixed plates, on at least one end thereof, comprising,

(a) a first numeral from 1 to N, where N is said integer, corresponding to the number of the division of the total logarithmic scale associated with said numeral, and

(b) a second numeral, paired with said first numeral, and equal to said first numeral plus N, and

(B) identifying numerals marked consecutively on each of said scales on said slidable plate comprising,

(a) consecutive numerals from 1 to (N–1) at the left of each of said slidable plate scales, and

(b) consecutive numerals from 1 to N at the right of each of said slidable plate scales, each of said slidable plate scales thus having a numeral at its right end greater by 1 than the numeral at its left end,

whereby the proper scale for reading the answer to a multiplication on said slide rule will correspond to the numeral that is the sum of the numerals of the scales bearing the numbers being added.

References Cited

UNITED STATES PATENTS

768,971	8/1904	Anderson	235—70
1,250,379	12/1917	Stillman et al.	235—70
1,364,154	1/1921	Stillman et al.	235—70
2,998,915	9/1961	Wickenberg	235—70

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,485,447 Dated Dec. 23, 1969

Inventor(s) William Volk

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In claim 1, line 5, after "least" insert --one--.

SIGNED AND
SEALED
JUN 23 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents

PO-1050
(5/69)

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