N° 25,947 A.D. 1913

Date of Application, 12th Nov., 1913—Accepted, 9th Apr., 1914

COMPLETE SPECIFICATION.

Improvements relating to Slide Rules.

We, GREGOR RUDOLF FERDINAND HEINRICH CUNTZ, Engineer, of 2, Nachtigallenstrasse, Hamburg, and the Firm SCHACHT & WESTERICH, Paper Merchants, of 18—20, Grosse Bäckerstrasse, Hamburg, in the German Empire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a slide rule. It is the object of the invention to provide such a slide rule with extra scales which can be used for many different forms of calculations. Another object is to increase the size of the scales, and thus to obtain greater accuracy. A still further object is to facilitate the reading of the results by a tabulation of the values with the positions in which they lie.

It has been proposed previously to provide in a calculating machine scales parallel with the logarithmic scale of the numbers, the reciprocal of the numbers, the squares and cubes of the numbers, and the sines and tangents of angles corresponding to the numbers. It has also been proposed to provide a slide rule with a number of parallel scales arranged in geometrical progression of the base 10, or powers and roots of 10, and showing also sines and tangents of angles, and scales having as a base fractions of numbers.

According to the present invention a slide rule is provided with square and cube root scales divided into two and three parallel rows respectively, and scales for the circumference and areas of circles. The slide rule according to this invention, is also provided with signs to indicate the position of the decimal point in the result, for all forms of calculations provided by the rule.

The invention is illustrated in the drawing, wherein:—

Figure 1 shows a plan view,

Figure 2 an end view of the slide rule.

Figures 3 and 4 show enlarged plan views of the left and right hand ends of the slide rule respectively.

The slide rule consists of a stock b, a slide a and a cursor c. The slide a has a single scale corresponding with the scale n on the stock b. Multiplications and divisions with numbers, powers and roots of the second and third order, and with trigonometrical functions can be carried out with great accuracy by means of the scale n, n^2, n^3, on the stock, beneath the slider a, and corresponding scales $\sqrt[2]{}$, $\sqrt[3]{}$, s (sine), t (tangent) and st (sine-tangent). The values of the expressions can be read from the scales without moving the slider a, and by the simple use of the cursor c. From the stationary scale n, n^2, n^3 may be read:—

1. The number base of the logarithm on the line L, on which all the scales are based,

2. The squares of the numbers on the $\sqrt[2]{}$ scale.

3. The third powers of the numbers on the $\sqrt[3]{}$ scale.

4. The simple functions of angles from 5° 44′ to 90° on the scale s (sine), of angles from 5° 44′ to 45° on the scale t (tangent) and of small angles from 0° to 5° 44′ on the scale st (sines and tangents). A single scale is used for the sines and tangents of the small angles as for angles less than 5° 44′ sin. x = tan. x.

5. The diameters of circles, the circumferences of which are indicated on the scale $n\pi$, and *vice versa*.

[*Price 8d.*]

On the $\sqrt[2]{}$ scale are read

(*a*) The square roots of the numbers on the scale n, n^2, n^3 and

(*b*) The diameters of circles whose areas are shown on the scale $d^2\frac{\pi}{4}$. The scale $d^2\frac{\pi}{4}$ is derived by direct calculation from the $\sqrt[2]{}$ scale and thus gives the area of circles whose diameter is given on the $\sqrt[2]{}$ scale.

The values of the scale $\sqrt[3]{}$ are the cube roots of the numbers on the scale n, n^2, n^3.

The scale $1:n$ gives the reciprocal values of the numbers on the scale n, n^2, n^3.

By the use of the cursor c, the logarithms of numbers, of powers and roots of the second and third order, the reciprocal values, areas of circles, circumferences and diameters thereof can be read and used in calculations.

The letters of the alphabet U, T, H Θ, TΘ under the $\sqrt[2]{}$ and $\sqrt[3]{}$ signs indicate units, tens, hundreds, thousands, ten thousands, and so forth. If, for example, the $\sqrt[2]{}$ 4 is to be found, the cursor c is set to the number 4 on the scale n, n^2, n^3 and the number 2.0 is read on the line marked U of the $\sqrt[2]{}$ scale. The number beside the U gives the position of the decimal point. This number is 1, and the result therefore is 2. If the third power of 4 is to be found, the cursor c is set to 4 on the $\sqrt[3]{}$ scale, and the power 6—4—0 is read on the scale n, n^2, n^3. As four is a single figure number, one must now look beside the line on which the 4 stands for the indicator giving the position of the decimal point in the power, which applied to the 1. This is T, and the power therefore is to be read as a tens product, *i.e.* as 64.

The same applies to all other similar examples. For the circumference of circles, and diameters, the position of the decimal point is determined by the indicators placed at the right hand end of the scale $n\pi$. A vertical line through the number 1 of the scale $n\pi$ divides the scale into equal halves to right and left. According as the cursor c is set to the right or to the left of this line, the corresponding group of signs is to be chosen at the right or left of $\frac{C}{d}$ at the right hand end of the scale and the numbers there read give the corresponding diameters opposite d or circumferences opposite C. For example, in order to determine how great is the circumference of a circle 6 centimetres in diameter, the cursor c is set to the number 6 of the scale n, n^2, n^3 and on the line $n\pi$ the number 1—8—8 is read. The cursor c is to the right of the vertical line, and therefore the right hand group of signs is to be taken. For a diameter which is a single figure number and for which the reading is taken to the right of the vertical line, the circumference will be a 2-figure number, so that the circumference C = 18.8 centimetres. If the circumference is given, and it is desired to find the diameter, the process is reversed.

In order to obtain the area of the circle when the diameter is given, the indicators at the right hand end of the $\sqrt[2]{}$ scale must be used for giving the position of the decimal point in the result. The dividing vertical line passes in this case through the number 1 of the $d^2\frac{\pi}{4}$ line, the letters $\frac{A}{d}$ in the indicator corresponding with this line.

For the upper and lower lines of the $\sqrt[2]{}$ scale the corresponding indicators are arranged at the end of the corresponding lines. For example if the area of a circle is to be found whose diameter is 741 centimetres, the cursor is placed on the number 741 on the $\sqrt[2]{}$ scale and on the $d^2\frac{\pi}{4}$ scale the reading 432 is taken; the cursor is to the right of the 1 on the $d^2\frac{\pi}{4}$ scale so that the group of figures to the right of $\frac{A}{d}$ must be taken. 741 is also on the upper row of the $\sqrt[2]{}$ scale so that the right hand top group of figures must be taken. It will now be

found that a 3-place diameter corresponds with a 6-place area, therefore the result is 432,000 sq. centimetres. Again, in order to find how great is the diameter of a circle of 1385 square centimetres area, the procedure is reversed; the cursor *c* is placed on the number 1385 of the $d^2 \frac{\pi}{4}$ line, and on the $\sqrt{}$ scale the reading is taken; the cursor is to the right of the 1 on the $d^2 \frac{\pi}{4}$ scale so that the group of signs to the right of $\frac{A}{d}$ must be taken. The area is a 4-figure number. In the right hand group for 4-figure areas it will be found that the diameter, which is on the upper scale, is a 2-figure number, so that the diameter is 42 centimetres. For calculations with trigonometrical functions, the functions themselves may be used directly, the values of these being given by the outer values at the right and left hand ends of the corresponding lines between which these lie. The values on the scale *st* vary from 0.01 to 0.1 as indicated at the two ends of the scale, and the values on the scales *s* and *t* vary from 0.1 to 1 as indicated at the two ends of the scales.

The slide is also provided with the usual signs P – 1 and Q + 1 which indicate that if the slide is moved to the left for multiplication the product will have one place less than the number of places computed and that if the slide is moved to the right for division the quotient will have one place more than the number of places computed.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A slide rule wherein scales for the values of circumferences and areas of circles are provided in addition to the fixed normal logarithmically-divided scales, all the additional scales being above the slider, substantially as described.

2. A slide rule according to Claim 1 wherein the scales of the square and cube root values are extended in two and three lines respectively one above another, in such a manner that longer scales are accommodated without prolonging the rule, and so arranged relatively to the normal scale, that the square and cube roots of a number on the normal scale or of said number multiplied by 10, 100, 1,000 and so forth, can be adjusted at the one setting, and that the second and third powers or square and cube roots of a number can always be read from one and the same logarithmic unity, substantially as described.

3. A slide rule according to Claim 1, wherein the values of the normal logarithmic scale can at the same time serve as the diameters corresponding to circumferences $n\pi$ of circles, and the values of the square root scale as the diameters corresponding to the areas $d^2 \frac{\pi}{4}$ of circles, substantially as described.

4. A slide rule according to Claim 1, wherein the positions of the decimal points in the figures of the square and cube roots, and powers, and diameters, circumferences and areas of circles, are directly noted from indicators on the rule, substantially as described.

5. A slide rule constructed and adapted for use as a whole substantially as described in connexion with the accompanying drawings.

Dated this 12th day of November, 1913.

For the Applicants:

GILL & ELLIS,
Chartered Patent Agents,
55/56, Chancery Lane, London, W.C.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1914.

A.D. 1913. Nov. 12. № 25,947.

CUNTZ & *another's* COMPLETE SPECIFICATION.

(1 SHEET)

Fig. 1.

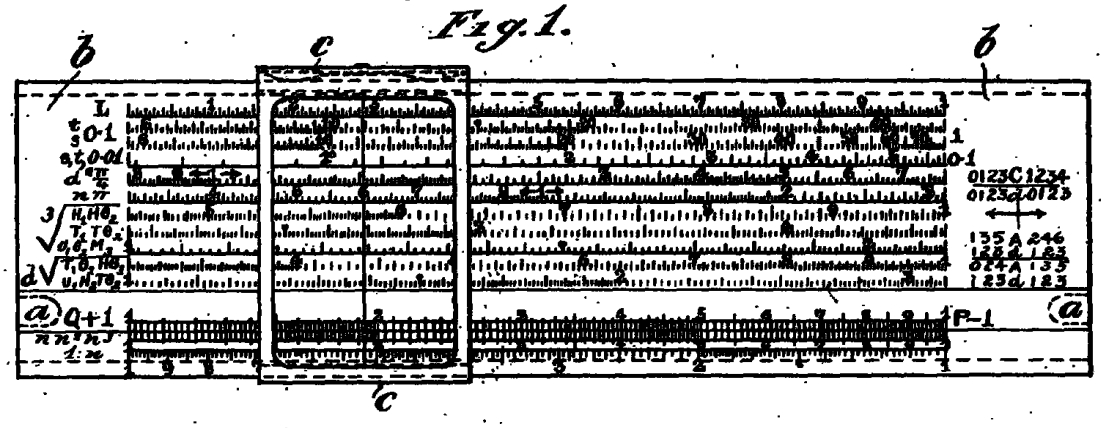


Fig. 3.

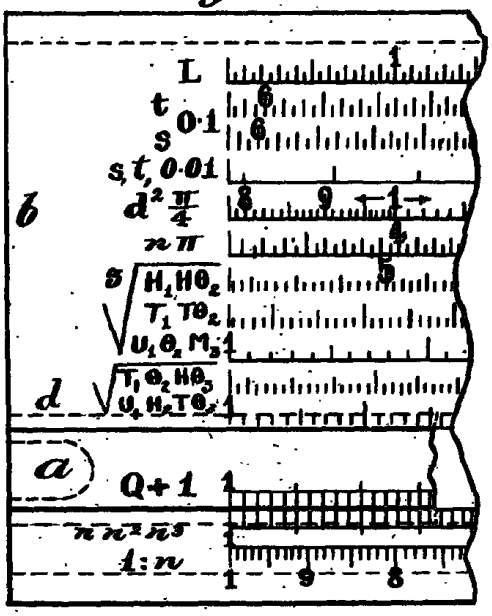


Fig. 4.

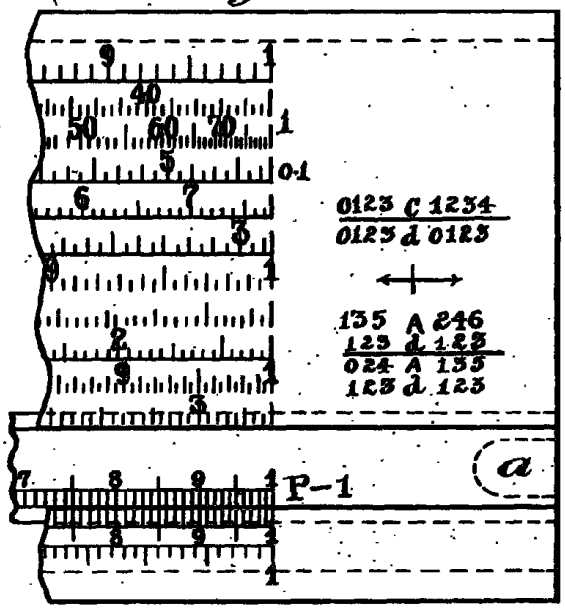
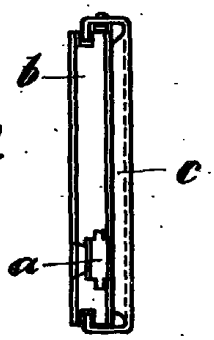


Fig. 2.



[This Drawing is a reproduction of the Original on a reduced scale.]