PATENT SPECIFICATION

778,556

Date of Application and filing Complete Specification:
March 16, 1956.
No. 8244/56.
Application made in Israel on March 22, 1955.
Complete Specification Published: July 10, 1957.

Index at acceptance:—Class 106(1), B5(C : F : J).
International Classification:—G05g.

COMPLETE SPECIFICATION

Improvements in or relating to Calculators

I, RAFAEL FISCHER, of 3, Harambam Street, Kiryath Motzkin, Israel, an Israeli Subject, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention has as its object to provide a logarithmic calculator similar in principle to a slide-rule as regards at least multiplication and division operations, but giving a far greater accuracy for a greater number of decimals. More particularly, the invention relates to helical calculators in which a logarithmic scale runs helically round a cylindrical core.

In contrast to known helical calculators, e.g. The Fuller Calculator, which are complicated desk instruments, the calculator according to the invention is a simple pocket instrument easy to manipulate. The calculator according to the invention comprises a cylindrical core carrying at least one logarithmic scale plotted along a helical line running round the core; a transparent sleeve slidable with friction on the core and having at least two marks spaced from one another by the same distance as are the beginning and the end of the scale, measured in the axial direction of the core, and being so disposed that they can be brought to register, respectively, with the beginning and end of the scale in the same position of the sleeve relative to the core;—and a transparent runner slidably surrounding the sleeve with friction and having at least one mark.

For making a multiplication, one of the marks of the sleeve is set to one of the factors, the mark of the runner is adjusted to the beginning of the scale, then the sleeve is moved along the scale, without simultaneous movement of the runner relative to the sleeve, until the mark of the runner points to the second factor. One of the marks of the sleeve now indicates the result. In making divisions, the sequence of the operations is inversed correspondingly.

In a preferred embodiment of the invention, the beginning and end of the scale lie on the same generatrix of the core, and the two marks of the sleeve are located on the same generatrix of the latter.

The sleeve and/or runner can be provided with further scales and marks for special purposes, enlarging the scope of operations that can be carried out with the calculator much in the same way as a usual slide-rule has markings and scales in addition to the simple logarithmic scales serving for multiplications and divisions.

If the logarithmic scale is doubled, i.e. two identical contiguous scales are provided, they are preferably plotted on one consecutive helical line. Similarly, if other scales are provided, e.g. a trigonometric scale or the like, these, too, are plotted on the continuation of the helical line along which the principal logarithmic scale is disposed.

The calculator may be provided with more than one sleeve and/or more than one runner. This enables the operator to keep the results of one calculation on record, while a second calculation is being carried out which is often desirable, e.g. in a sequence of calculations involving addition or subtraction in alternation with multiplication or division.

The sleeve which surrounds the core and bears the marks for cooperation with the scale of the core and on which the runner is disposed, may be made integral with an extension bearing at least one further helical scale, and serving as a second core which in turn is surrounded by another transparent sleeve provided with marks and with a runner.

The invention is illustrated, by way of example only, in the accompanying drawings in which:—

Fig. 1 is a perspective view of a calculator according to the invention (the logarithmic scale thereon being slightly distorted, as its true axonometric representation would make the picture less illustrative);

Fig. 2 shows the scale of the calculator according to Fig. 1 in evolution;

Figs. 3 to 6 are diagrammatic perspective views of a similar calculator with a very much simplified scale serving to illustrate some calculations; and

Fig. 7 is a perspective view of a calculator according to a further embodiment of the invention.

The calculator shown in Fig. 1 has a core 1 on which the scale 2 is provided in any suitable way for example, the core may be made from white celluloid, plastic, bone or the like, and the scale may be engraved and filled in with colouring matter, or else the scale may be printed on a separate sheet and pasted on the core, or be directly applied thereto by mechanical, photographic or other processes. The scale is constituted by a helical line along which a series of numerals from 1 to 10 are plotted with logarithmically divided distances between them, and with decimals and centesimals marked between the integers. The beginning and end of the scale are located on the same generatrix of the core.

The core is surrounded by a sleeve 3 of transparent material, such as glass, plastic or the like, which is slidable along the core with just so much friction that on the one hand the sliding does not require an effort nor destroy the scale, and on the other hand the sleeve does not move of its own accord along the core. The sleeve 3 may be cylindrical or have a slightly elliptic profile. It has two marks 4, 5 located on the same generatrix and spaced from one another by the same distance as are the first number 1 and last number 10 of the scale, measured along the axis of the core. Finally, a runner 6, likewise of transparent material, rides with friction on the sleeve 3. The runner has a mark 7. It is preferred that lines be drawn along the generatrix 8 on which the marks 4 and 5 of the sleeve 3 are located, and the generatrix 9 of the runner 6 on which the mark 7 is located. The sleeve and runner may be true cylinders, or they may be slotted longitudinally.

With this calculator, for example, the operations illustrated in Figs. 3 to 6 can be carried out.

Figs. 3 and 4 show the multiplication of "4.5" with "2", to give the result "9". The mark 5 of the sleeve 3 is set to the figure "4.5" on the scale, then the mark 7 of the runner 6 is set to the beginning of the scale. This is the position illustrated by Fig. 3. Thereafter, the sleeve 3 is turned and simultaneously slid to the left until the mark 7 of the runner points to the numeral "2" of the scale. The result can now be read by means of the mark 5 of the sleeve 3 which points out the figure "9" of the scale (Fig. 4).

In order to make a division with the same figures, that is in order to divide "9" by "2", one starts with the position of Fig. 4, by setting the mark 5 of the sleeve 3 to the figure "9" of the scale, and the mark 7 of the runner to the figure "2" of the scale. Then the sleeve 3 is turned and slid to the right without movement of the runner relative to the sleeve, until the mark 7 of the runner points to the beginning of the scale. The result "4.5" is now pointed out by the mark 5 of the sleeve 3 (Fig. 3).

The operation illustrated by Figs. 5 and 6 is also a simple multiplication, but one in which the scope of the scale between the marks of the sleeve and runner is exceeded and a second mark of the sleeve must be called in for reading the result. The operation is $5 \times 4 = 20$. First, the mark 5 of sleeve 3 is set to figure "5" of the scale, and the mark 7 of the runner to the beginning of the scale, like in Fig. 3. Then the sleeve 3 is turned and moved to the left without movement of the runner relative to the sleeve, until the mark 7 of the runner points to the figure "4" of the scale. However, the mark 5 of the sleeve is outside the scale, and the result must be read by means of the mark 4 of the sleeve which points to the figure "2" of the scale.

Division will again be effected by reversing the operation.

The calculator described above can conveniently be made in pocket size, and even so it affords a far greater accuracy than a conventional pocket-size slide rule, as the helical scale has a multiple of the length of the straight scale of the usual slide rule. The marks of the sleeve and runner may be made in different colours for facilitating the setting and reading.

The calculator illustrated in Fig. 7 is a still more compendious instrument which comprises a large number of different scales and enables a great variety of calculations to be effected, while being capable of being made in a small and convenient pocket size.

This calculator comprises an inner core 10 with coordinated transparent sleeve 11 and runner 12. The core 10 bears a scale 13, the sleeve 11 has marks 14, 14' and the runner 12 has a mark 15.

The sleeve 11 is made integral with a cylindrical extension 16 of a larger outer diameter, preferably larger than that of the runner 12. This extension forms a second or outer core and bears a scale 17.

The core 16 is surrounded by a second transparent sleeve 18 with marks 19, 19' and 19", and on this rides a second runner 20 with marks 21 and 21'. Either pair of

vicinal marks on the sleeve 18, i.e. either 19 and 19′, or 19′ and 19″, is the equivalent of the two marks 4 and 5 of the calculator according to Fig. 1. The use of the additional mark 19″ is sometimes required in continuous calculations in which the intermediate results are not noted down, but merely "memorised" temporarily by means of the marks on the sleeve. Moreover, the presence of three marks instead of only two allows a greater variability of readings on several scales. For example, in the position shown in Fig. 7, with the setting of mark 19″ to 30° the mark 19 shows the sine of 30° to be 0.500. At the same time mark 19 also shows that 0.050 is the sine of the angle 2° 52′ to which the mark 19′ is set. Mark 21 on the runner 20 is the equivalent of the mark 7 of the calculator according to Fig. 1. The additional mark 21′ is so disposed that the relative position of marks 21 and 21′ is the same as the relative positions of marks 19 and 19′, i.e. when mark 21 is brought to register with mark 19 mark 21′ will register with mark 19′. The purpose of mark 21′ is to reduce the number of operations required to perform certain calculations. For example, in the position shown in Fig. 7, mark 21 shows that 0.040 is the sine of the angle 2° 18′ to which the mark 21′ is set. Assume that it is required to perform the following calculation :—

$$\frac{\sin 2^\circ\ 52'}{\sin 2^\circ\ 18'} = \frac{0.050}{0.040} = 1.25$$

Then by setting mark 19′ to the angle 2° 52′ and mark 21′ to the angle 2° 18′, we have automatically set mark 19 to 0.050 and mark 21 to 0.040, i.e. we have already carried out the first step in the operation of dividing 0.050 by 0.040. The number of operations which have to be performed to divide sin 2° 52′ by sin 2° 18′ is thus not greater than the number of operations required to divide 0.050 by 0.040.

The entire calculator is thus equivalent to two complete calculators of the kind illustrated in Fig. 1, and the surface area available for the scales is greatly increased without undue increase in the bulk of the instrument.

The scale 13 on core 10 is an ordinary logarithmic scale in the part drawn with a thick line, and a log-log scale in the continuation thereof which has been drawn in a thin line. The scale 17 of the second core 16 is an ordinary logarithmic scale in its first part drawn with a thick line, and a logarithmic scale of sines in the continuation thereof which is drawn in a thin line.

What I claim is :—

1. A helical calculator, comprising a cylindrical core carrying at least one logarithmic scale plotted along a helical line running round the core, a transparent sleeve slidable with friction on the core and having at least two marks spaced from one another by the same distance as the distance between the beginning and the end of the scale measured in the axial direction of the core, and being so disposed that they can be brought to register respectively with the beginning and end of the scale in the same position of the sleeve relative to the core; and a transparent runner slidably surrounding the sleeve with friction and having at least one mark.

2. A calculator as claimed in claim 1 wherein the beginning and end of the scale lie on the same generatrix of the core, and the two marks of the sleeve are disposed on the same generatrix of the sleeve.

3. A calculator as claimed in claim 1 or 2, wherein lines are drawn on the sleeve and runner along the generatrices on which the marks are located.

4. A calculator as claimed in any of the preceding claims wherein the marks of the sleeve and runner are made in different colours.

5. A calculator as claimed in any of the previous claims, comprising more than one transparent sleeve and/or more than one transparent runner.

6. A calculator as claimed in any of the preceding claims comprising an inner core surrounded by a transparent sleeve and a co-ordinated runner, and a second core made integral with the sleeve of the inner core as an extension thereof, which bears at least one further helical scale and is surrounded by a second transparent sleeve with co-ordinated runner.

7. A calculator as claimed in claim 6, wherein the extension of the sleeve of the first core, which constitutes the second core, has a larger outer diameter than the sleeve proper.

8. Calculators, substantially as described hereinbefore and illustrated in Figs. 1 to 6 and Fig. 7 respectively, of the accompanying drawings.

W. P. THOMPSON & CO.,
12, Church Street, Liverpool, 1,
Chartered Patent Agents.

Sheerness: Printed for Her Majesty's Stationery Office, by Smiths, Printers and Duplicators.—1957
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

778,556 COMPLETE SPECIFICATION
3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

FIG.1.

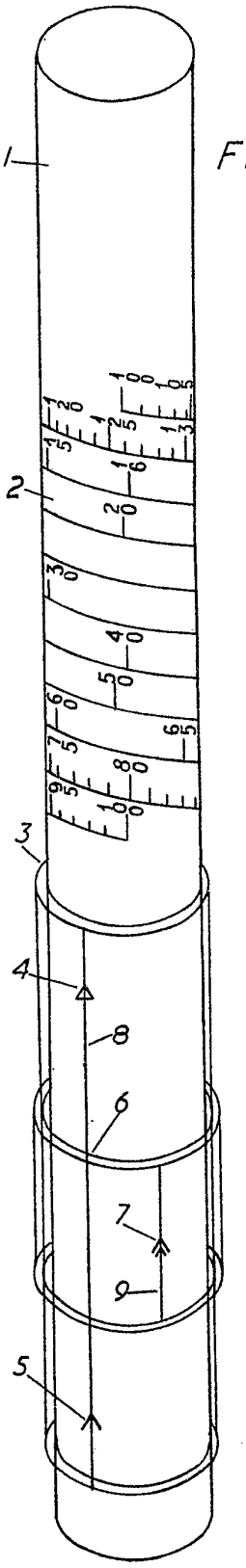


FIG.2.

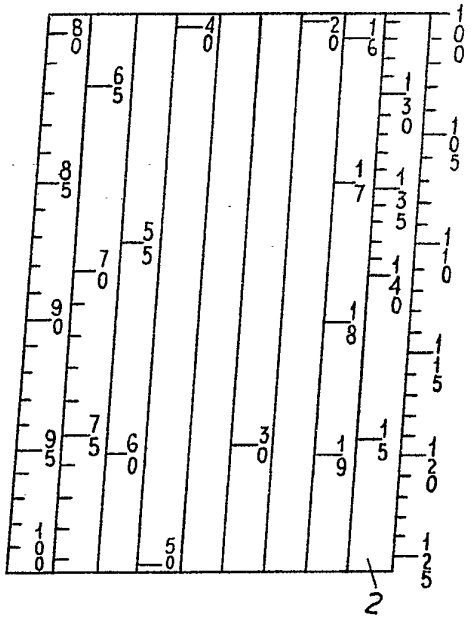


FIG. 3.

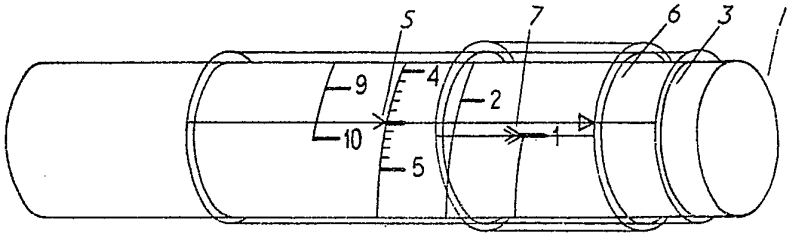


FIG. 4.

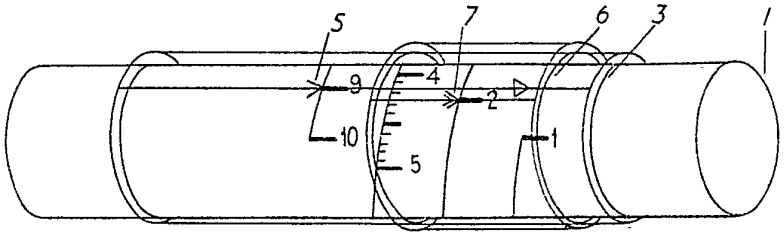


FIG. 5.

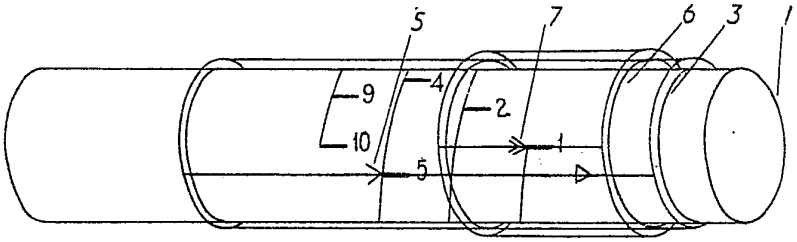
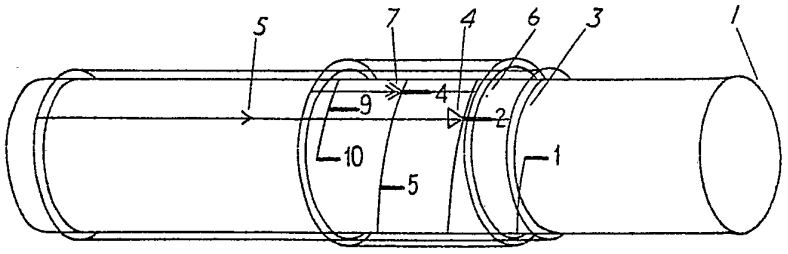


FIG. 6.



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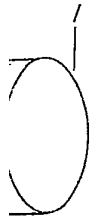
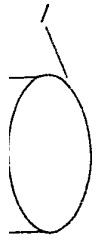
SHEETS 2 & 3





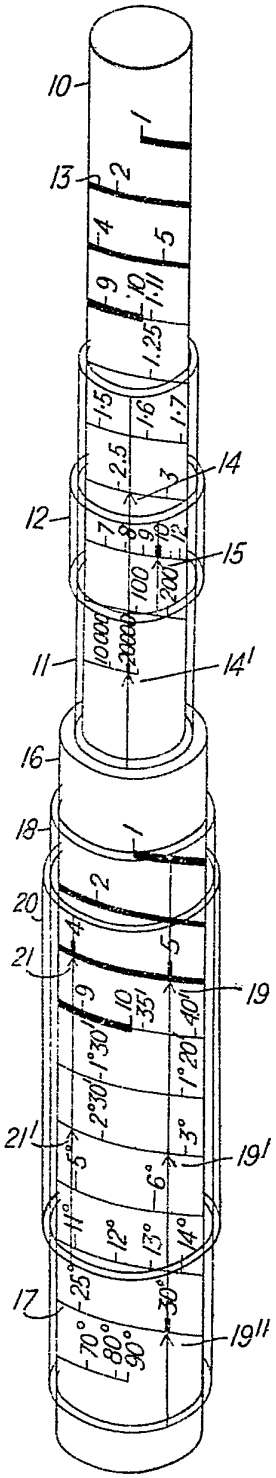


FIG. 7.

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SHEETS 2 & 3

FIG. 3.

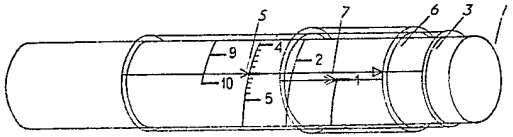


FIG. 4.

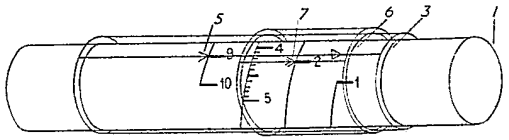


FIG. 5.

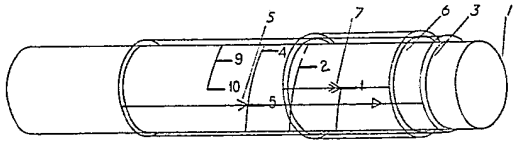
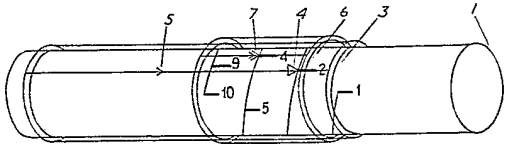


FIG. 6.



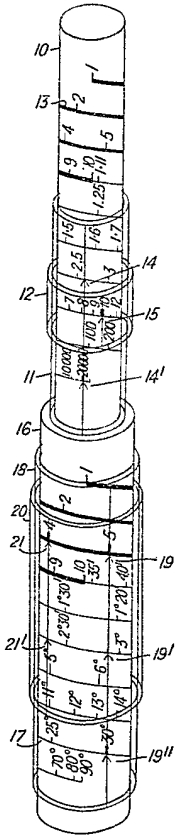


FIG. 7.