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PROVISIONAL SPECIFICATION

Improvements in Slide Rule Calculating Apparatus

I, RITCHIE HART LOCK, a British Subject, of "Lynford", 63, Grange Crescent, Chigwell, Essex, do hereby declare the nature of this invention to be as follows:—

This invention relates to slide rule calculators of the kind employing helical scales marked on cylindrical slide members one of which is axially slidable and rotatable within the other, a tubular cursor being provided which extends over the joint between the slide members and moves over the scales on both slide members.

In certain known calculators of this kind, both slide members have logarithmically divided scales for carrying out the calculating operations most commonly provided for in slide rule calculators, and in addition one of the slide members may be equipped with a uniformly divided scale which can be used in conjunction with a logarithmically divided scale on the other slide member to obtain logarithms of numbers. In order to accommodate this uniformly divided scale the overall length of the calculator must be increased or, alternatively, the lengths of the other scales provided must be shortened, thus reducing the accuracy of the instrument.

The object of the present invention is to provide a uniformly divided scale which can be used in conjunction with one or more of the logarithmically divided scales to obtain logarithms of numbers, without reducing the space available in the instrument for the logarithmically divided scales.

According to the invention, a portion of one of the slide members which carries a helical logarithmically divided scale is also marked with an axially extending scale which is uniformally divided at intervals equal to the pitch of the helical scale and, in order to provide for subdivisions of these intervals, the cursor is marked with a uniformly divided helical scale conforming to the helical scale on the slide member and marked with subdivisions of the uniformly divided scale on the slide member. The said extra axially extending scale will be referred to as the straight line scale, whilst the marking of the cursor will be termed the cursor scale.

The straight line scale may conveniently be formed by marking a straight line on the slide member so that it intersects the helical scale thereon at equal intervals, the points of intersection forming the divisions of the scale. For example, in the case where there are ten turns, each intersection may be numbered as a digit from 1 to 10 and in a different way, or colour, to the scale already marked thereon. To continue with this simple case, the tubular cursor is shaped at its reading edge, or if transparent is marked at the lower end, with a curve corresponding to the shape of one complete turn of the spiral, thus advancing in this case $^1/_{10}$th of the vertical height of the scale. This curve or curved edge, is graduated around its periphery in regular linear intervals or fractions of the complete turn, and constitutes the said cursor scale.

In order to obtain the logarithm of any number, it is only necessary to set the zero of the cursor scale against the mark on the helical scale corresponding to the number (anti-log) which is to be converted, and then to read the number last uncovered on the straight line scale which is the first number in the mantissa of the logarithm. Then the reading of the linear scale on the cursor corresponding to the straight line on the slide member, gives in order, the second, third, and so on, figures of the mantissa.

It follows that antilogarithms may be obtained by exactly the reverse procedure.

In the case where the number of spiral turns is a multiple of 10, say N times 10, the cursor scale may be divided into $\frac{100}{N}$ parts with the necessary subdivisions. In a common form of this kind of calculator, the number of turns on the helical scale is twenty so the cursor scale would, in this case, be divided into 5, 50, or 500 divisions, giving the second, third or fourth figure of the logarithm.

The reading on the straight line scale

[*Price* 1/-]

in this case may not be a whole number since the intersections will be marked 0.05, 0.1, 0.15, 0.2 and so on, hence it will be necessary to add the cursor reading to the straight line scale reading, e.g. 0.15 on the straight line scale plus 0.025 on the cursor scale equals 0.175. To make this reading simpler, alternate readings on the straight line scale may be marked in a different colour, e.g. 0.20 black, 0.25 red, 0.30 black, 0.35 red, and the cursor scale will then have numbers 0.005 to 0.05 marked in black and on the same scale 0.05 to 0.10 in red.

Both slide members may be similarly equipped with straight line scales. In the case of a slide member having a double scale the same treatment may also be used with the same markings of the straight line scale for each scale. Alternatively, with a straight line scale extending over a double logarithmic scale, the divisions may conveniently be arranged so that the readings on the straight line scale are the logarithms of the square roots of the numbers on the logarithmic scale.

The provision of this method of reading the logarithms provides a rapid means of finding the logarithm of a number at any stage of a calculation.

Dated this 26th day of April, 1944.
EDWIN C. AXE, A.I.M.E.,
27, Chancery Lane, London, W.C.2,
Agent for the Applicant.

COMPLETE SPECIFICATION

Improvements in Slide Rule Calculating Apparatus

I, RITCHIE HART LOCK, a British Subject, of "Lynford", 63, Grange Crescent, Chigwell, Essex, 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 cylindrical slide-rule calculator of the kind employing a helical logarithmic scale and the object of the invention is to provide an improved calculator of this kind having a compact arrangement of scales for carrying out the multiplying and dividing operations most commonly provided for in slide-rule calculators and also for quickly and easily obtaining logarithms and anti-logarithms.

In a cylindrical slide rule having a single helical logarithmic scale marked on the cylindrical slide and provided with a transparent index tube rotatable and axially slidable on the cylindrical slide, it has been proposed to provide a uniformly divided scale on the cylindrical slide by marking a line thereon so that it intersects the helical scale at equal intervals and to provide a circular scale on the index tube marked with subdivisions of the uniformly divided scale on the slide member.

In a slide-rule calculator having two cylindrical slide members each of which carries a helical logarithmic scale and one of which is axially slidable and rotatable within the other a tubular cursor extending over the joint between the slide members being movable over the helical scales, it has been proposed to provide one of the slide members with a uniformly divided scale for use in conjunction with the logarithmically divided scale on the other member to obtain logarithms and anti-logarithms; but, in order to accommodate this uniformly divided scale, it was necessary to increase the overall length of the calculator or alternatively to shorten the other scales, thus reducing the accuracy of the instrument.

According to the present invention a cylindrical slide-rule calculator of the kind referred to comprises two cylindrical slide members each of which carries a helical logarithmic scale and one of which is axially slidable and rotatable within the other; a tubular cursor extending over the joint between the slide members and movable over the scales thereon; and an axially extending scale marked on at least one of the slide members and uniformly divided at intervals equal to the pitch of the helical scale thereon, the cursor being marked with a uniformly divided helical scale or scales conforming to the helical scale or scales on the slide member or members and marked with sub-divisions of the uniformly divided scale or scales on the slide member or members.

The straight line scale may conveniently be formed by marking a straight line on the slide member starting at zero so that it intersects the helical scale thereon at equal intervals, the points of intersection forming the divisions of the scale. For example, in the case where there are ten turns, each intersection may be numbered as a digit from 1 to 10 and in a different way, or colour, to the scale already marked thereon. To continue with this simple case, the tubular cursor is shaped at its reading edge, or if transparent is marked at the lower end, with a curve corresponding to the shape of one complete turn of the

spiral, thus advancing in the case $^1/_{10}$th of the vertical height of the scale. This curve or curved edge is graduated around its periphery in regular linear intervals or fractions of the complete turn and constitutes the said cursor scale.

One embodiment of the invention is illustrated by way of example in the accompanying drawing in which the only Figure is a view of the device in an extended position.

The device comprises two hollow cylindrical slide members 1 and 2 which are interconnected telescopically, the member 1 being rotatable within the member 2 and being also axially slidable therein.

A tubular cursor 3, rotatably and slidably mounted on the members 1 and 2 so that it covers the joint between them, is provided at one end with an index or zero mark 4 adapted to move over a helical logarithmic scale 5 marked on the member 1 and at the other end with an index or zero mark 6 adapted to move over a helical logarithmic scale 7 marked on the member 2 and corresponding with the scale marked on the member 1.

Each of the members 1 and 2 is also marked with an axially extending straight-line scale 8 which is uniformly divided at intervals equal to the pitch of the helical scales. The scale 8 is formed by marking a straight line on the slide member so that it intersects the helical scale thereon at equal intervals, the points of intersection forming the divisions of the scale. Each intersection is marked with a digit as indicated at 9 on the drawing these digits being clearly distinguished from the markings of the scales 5 and 7, preferably by being differently coloured.

In order to provide for sub-divisions of the intervals equal to the pitch of the helical scales, the cursor is marked at each end with a uniformly divided helical scale 10 conforming to the helical scale on the slide member and marked with any required number of sub-divisions. As illustrated in the drawing, the ends of the cursor are shaped so that the helical scales 10 can be marked on the edges of the cursor. If desired, however, the cursor may be made of transparent material or may have transparent end portions and, in that case, the helical scales 10 could be marked on the cylindrical surface of the cursor near the ends thereof.

Although the drawing shows the slides 1 and 2 marked with scales 5 and 7 of equal length, it will readily be understood that any usual or preferred combination of logarithmic scales may be provided. For example the slide 2 may be marked with a scale of logarithms from 1 to 100 and the slide 1 may carry a scale of logarithms from 1 to 10 down to twice the scale of the first mentioned scale of logarithms so that it occupies the same overall length. The two scales can then be used for calculating squares and square roots as is well known.

The straight-line scales 8 in conjunction with the logarithmic scales 5 and 7 provide for reading off the logarithm of any number. To obtain the logarithm of any number, it is only necessary to set the slide 1 or 2 so that the zero of the cursor scale 10 lies over the mark on the helical scale 5 or 7 corresponding to the number (anti-log) which is to be converted, and then to read the number last uncovered on the straight line scale 8 which is the first number in the mantissa of the logarithm. Then the reading of the linear scale 10 on the cursor corresponding to the straight line 8 on the slide member, gives in order, the second, third, and so on, figures of the mantissa.

It follows that antilogarithms may be obtained by exactly the reverse procedure.

In the case where the number of spiral turns is a multiple of 10, say N times 10, the cursor scale may be divided into $\frac{100}{N}$ parts with the necessary sub-divisions. In a common form of this kind of calculator, the number of turns on the helical scale is twenty so the cursor scale would, in this case, be divided into 5, 50, or 500 divisions, giving the second, third or fourth figure of the logarithm.

The reading on the straight line scale in this case may not be a whole number since the intersections will be marked 0.05, 0.1, 0.15, 0.2 and so on, hence it will be necessary to add the cursor reading to the straight-line scale reading, e.g. 0.15 on the straight-line scale plus 0.025 on the cursor scale equals 0.175. To make this reading simpler, alternate readings on the straight-line scale may be marked in a different colour, e.g. 0.20 black, 0.25 red, 0.30 black, 0.35 red, and the cursor scale will then have numbers 0.005 to 0.05 marked in black and on the same scale 0.05 to 0.10 in red.

Although both slide members are equipped with straight-line scales, in the embodiment shown in the drawing, one only of the slide members may be so equipped if desired. In the case of a slide member having a double helical scale the same treatment may also be used with the same markings of the straight-line scale for each helical scale. Alternatively, with a straight-line scale extending over a double logarithmic

scale, the divisions may conveniently be arranged so that the readings on the straight-line scale are the logarithms of the square roots of the numbers on the logarithmic scale.

The provision of this method of reading the logarithms provides a rapid means of finding the logarithm of a number at any stage of a calculation.

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

1. A cylindrical slide-rule calculator of the kind referred to comprising two cylindrical slide members each of which carries a helical logarithmic scale and one of which is axially slidable and rotatable within the other; a tubular cursor extending over the joint between the slide members and movable over the scales thereon; and an axially extending scale marked on at least one of the slide members and uniformly divided at intervals equal to the pitch of the helical scale thereon, the cursor being marked with a uniformly divided helical scale or scales conforming to the helical scale or scales on the slide member or members and marked with subdivisions of the uniformly divided scale or scales on the slide member or members.

2. A slide-rule calculator according to Claim 1, wherein each axially extending scale is formed by marking a straight line on the slide member so that it intersects the helical scale thereon at equal intervals, the points of intersection forming the divisions of the scale.

3. A slide-rule calculator according to Claim 2, wherein each intersection is marked with a digit which is distinguished from the markings of the helical scale (e.g. by being differently coloured).

4. A slide-rule calculator according to Claims 1, 2 or 3 in which the cursor is marked on a scale with equal divisions corresponding in total value to the numerical interval represented by one complete turn of the helical scale.

5. A slide-rule calculator according to any of the preceding claims wherein the cursor is formed with a helical edge or edges and the uniformly divided helical scale or scales is or are marked on the helical edge or edges of the cursor.

6. A slide-rule calculator according to any of Claims 1 to 3 wherein the cursor is made of transparent material or has transparent ends and wherein the uniformly divided helical scale or scales is or are marked on the cylindrical surface of the cursor at or near the end or ends thereof.

7. A slide-rule calculator, constructed and adapted for use substantially as herein described and as illustrated in the accompanying drawing.

Dated this 25th day of April, 1945.

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