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Date of Application, 11th Dec., 1912—Accepted, 3rd Apr., 1913

COMPLETE SPECIFICATION.

Improvements in or relating to Logarithmic Calculating Apparatus.

I, WALTER ELSWORTHY LILLY, Engineer, of 39, Trinity College, Dublin, Ireland, 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 logarithmic calculating apparatus of the known type in which the logarithmically divided scale is arranged on a flat disc or on a cone in the manner hereinafter set forth.

A spiral having ten convolutions, or a set of ten concentric circles, is set out on the disc to receive the logarithmically divided scale and an outer concentric circle is provided that is divided decimally, the starting points of both scales being on the same radius. The logarithmic scale is marked from 1 to 10 and the logarithmic quantities to be set out vary from 0 to 1. Since there are ten convolutions, each of them represents ·1, and they are therefore numbered from 0 to 9; the first convolution provides the part of the logarithmically divided scale from 0·0 to 0·1, the second convolution from 0·1 to 0·2 and so on. It will be seen therefore that a radius drawn through the starting point of the scales cuts the successive convolutions at points indicating the numbers whose logarithms are 0, ·1, ·2, ·3 *etc.* These numbers however are not integers and it is more convenient to set out the integers by setting off their logarithmic distances or angles as follows.

The first figure of the mantissa of the logarithm of any number indicates on which convolution or circle the number corresponding to this logarithm will be placed. The next three figures of the mantissa are found on the outermost decimally divided circle and where the vector through the point thus obtained cuts the previously selected circle or convolution there is placed the number whose logarithm has thus been set out. To take a concrete example, the logarithm of 3 is ·4771; first selecting the convolution or circle marked 4, because 4 is the first figure of the mantissa, and then finding the point 771 on the outermost decimally divided scale, the intersection of the polar vector through this point with the circle or convolution "4" gives the point on the logarithmic scale which indicates 3.

The present invention consists in the combination with logarithmic calculating apparatus of the type above described of one or more radial arms which are not only adapted as heretofore for adjustment about a pivot at the pole of the spiral or centre of the apparatus and frictionally held relatively to one another, but also are provided with a scale proportional to the number of the different convolutions or circles measured along the zero vector from the pole of the spiral or the centre of the circles.

In the accompanying drawings.

Figure 1 represents a face view of a disc slide-rule showing the application to it of the present invention.

Figure 2 is a central section showing the construction of the radial arms.

At the pole of the spiral a pin A is mounted to turn freely in a bearing B in the disc C. On the top of the pin a pair of arms D, E are mounted, one edge of each arm being straight and in a straight line drawn through the

[*Price* 8*d.*]

pole of the spiral as shown in Figure 1. These arms are provided with a scale as described above and can be placed at any angle to one another and are held in position by friction, provision being made for this by means of the screw adjustment on the top of the pin.

The scale on the radial arms enables all the usual calculations to be carried out without any uncertainty as to the correctness of the solution. This can be best illustrated by taking a concrete example. Suppose it is required to multiply 65 by 27. One radial arm is placed at 1 on the logarithmic scale and the other at 65 which is indicated by *a*. It is noted that 65 is on convolution "8" and the reading a^1 of its vector upon the outermost circle is ·12. . . and therefore the mantissa of its logarithm is ·812. . . also since it is greater than 10 its logarithm is 1·812. . The arm at 1 is now shifted to 27 indicated by *b* and owing to the friction grip between the two arms the arm originally set on 65 is turned through the same angle. It will be noted that 27 is on convolution "4" and the reading b^1 of its vector on the outer circle is ·31. . . . giving ·431. . . . for its mantissa and 1·431. . . for its logarithm. The hand originally set at 65 now indicates the vector on which the product will be found. Adding the logarithms 1·812. . . and 1·431. . . gives 3·24 which indicates that the required product is greater than 1,000 and, by the first figure of the mantissa, that it will be found on convolution "2"; the reading of the first-mentioned arm on this convolution gives 1755 indicated at *c* which is the desired product.

It will be seen that the only mental calculations required are concerned with the characteristic and the first (in some instances the first two) figures of the mantissa, and the use of the scale upon the radial arms facilitates the operation of the apparatus.

It will be understood of course that the logarithmic scale can be used to indicate the trigonometrical functions in addition to the natural numbers, thus for example by suitably marking a scale of degrees, the sines and logarithms of the sines can be read directly; other trigonometrical functions can also be inserted if desired.

Various modifications may be made in the details of construction of the apparatus without departing from the spirit of the invention; thus, for example, the scale may be made to extend on both sides of the disc, the radial arms being suitably extended over the edge to both parts of the scale; or again, a handle may be provided on the disc to provide suitable means for holding it during operation; yet again, the arms may be provided with a fine thread stretched on a radial line or be otherwise shaped to facilitate the reading of the scales.

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. In logarithmic calculating apparatus of the type described the provision of one or more radial arms which are not only adapted for adjustment about a pivot at the pole of the spiral or centre of the apparatus and frictionally held relatively to one another, but are also provided with a scale proportional to the number of the different convolutions or circles measured along the zero vector from the pole of the spiral or centre of the circles.

2. The logarithmic calculating apparatus substantially as described or illustrated in the accompanying drawings.

Dated this 11th day of December, 1912.

BOULT, WADE & TENNANT,
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LILLY'S Complete Specification.

(1 SHEET)

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

Fig. 1.

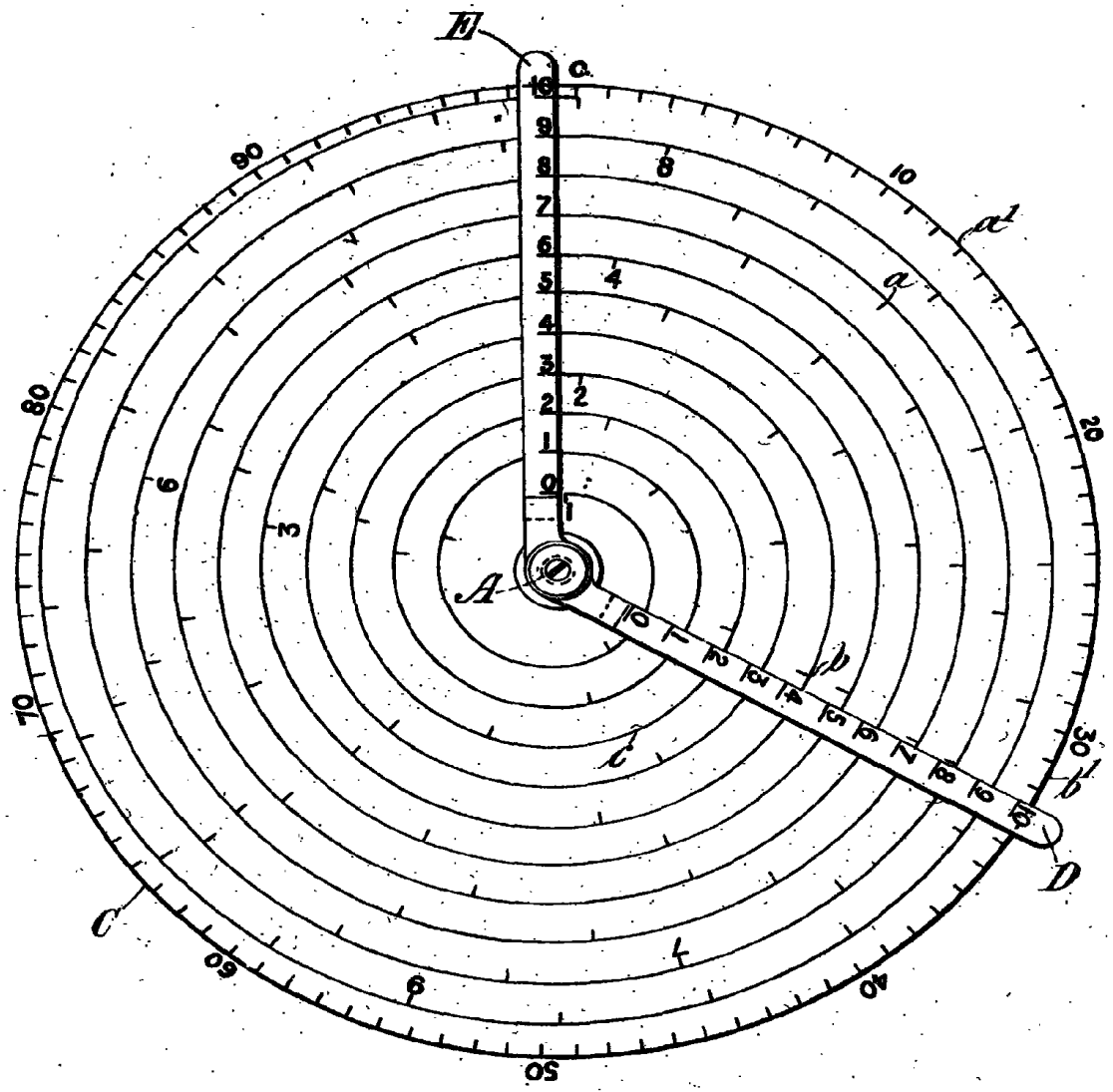
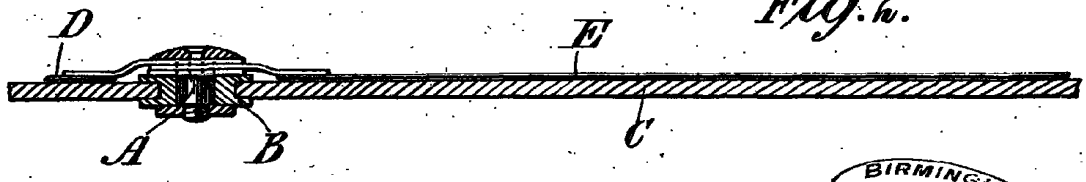


Fig. 2.



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