PATENT SPECIFICATION

Application Date: Mar. 28, 1920. No. 9067/20. GB162,895

Complete Left: Dec. 21, 1920.

Complete Accepted: May 12, 1921.

PROVISIONAL SPECIFICATION.

Improvements in Calculating Apparatus.

I, LEONARD CHARLES BYRNAVE, of 4, Beaumont Avenue, Richmond, Surrey, Engineer, do hereby declare the nature of this invention to be as follows:—

This invention relates to calculating devices of the type employing a cylindrical surface with a graduated helical line. In a well known example of this type of calculator, in which the readings are tabulated upon the surface of a cylinder, pointers are employed to transfer distances from one part of the cylinder to another. Such a device may be used for addition and subtraction if equally divided scales are used or for multiplication and division if logarithmic scales are employed. For solving particular problems log. log., log, trigonometrical functions and other well known scales may be used.

The number of operations required to solve a problem may be reduced by employing two graduated cylinders movable relative to one another and a calculator of this type is known having a graduated outer cylinder of transparent material sliding over an inner cylinder.

According to this invention two cylinders preferably of opaque material are employed, capable of movement relative to one another and means are provided to transfer distances from the surface of one cylinder to that of the other.

It is preferred to employ a tube for one cylinder and arrange for the other cylinder to slide within it. The means for transferring the distances may conveniently consist of pointers mounted on a ring sliding over the outer cylinder. An additional pointer may be employed fixed to one end of the outer cylinder and directed towards the surface of the inner cylinder. A stop may be fixed on the outer cylinder and the ring provided with a projection, so that the ring can be easily registered in a certain position on the outer cylinder. Some form of hair line cursor may be used instead of the pointers that have been described.

This invention is particularly useful in connection with formulæ involving two different functions, for instance for solving spherical triangles by the tangent cosine formulæ. The solving of spherical triangles is necessary for navigation at sea and in the air. A well known form of the problem is when the altitude and azimuth of an observed heavenly body have to be found for the dead reckoning position, the latitude hour-angle and declination being known. The formulæ connecting these variables may be expressed in the following form:—

1. Tan $y = \frac{\tan \delta}{\cos t}$

2. (a) λ and δ same name $Y = \epsilon + y$.
2. (b) λ and δ opposite names $Y = \epsilon - y$.

3. Tan $A = \frac{\cos y \tan t}{\cos Y}$

4. Tan $A = \cos A \tan Y$.

Where δ = declination, t = hour angle
λ = latitude, ϵ = co-latitude
A = azimuth, h = altitude

The equations 1, 3 and 4 may be readily and accurately solved by employing a calculator according to this invention, and graduating the inner cylinder with log, tangents and the outer cylinder with log, cosines. As these scales expand rapidly beyond 89° (and in the case of the log. tan. below 1°) the main scales are preferably not taken beyond these limits, separate scales being employed to cover the angles near 90° and very small angles.

[Price 1/-]

plotted to a much shorter base length. The scale may be numbered backwards from 90° to 180° to deal with hour angles above 90° and other large angles. A calculator constructed accordingly is shown in the accompanying drawing, in which the numeral, 1, is the inner cylinder graduated on a helical line with log. tangents; 2 is the outer cylinder graduated on a helical line with log. cosines; and 3 is the ring over the outer cylinder; all these parts being slidable and rotatable relatively to one another. 4 and 5 are the pointers of different lengths for transferring distances from one cylinder to the other. 6 is the stop on the outer cylinder, and 7 is the projection on the ring, so that the ring can readily be brought to zero by bringing the parts, 6 and 7, together.

Dated the 29th day of March, 1920.

A. C. DAY, Capt.,
Agent for the Applicant.

COMPLETE SPECIFICATION.

Improvements in Calculating Apparatus.

I, LEONARD CHARLES BYRRAVE, of 4, Beaumont Avenue, Richmond, Surrey, Engineer, British subject, 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 calculating devices of the type employing two cylinders graduated on a helical line and movable relative to one another. A calculator of this type is known having a graduated outer cylinder of transparent material sliding over an inner cylinder.

According to this invention a calculator comprises two cylinders preferably of opaque material graduated with logarithmic scales on helical lines and means for transferring distances from the surface of one cylinder to that of the other, said cylinder being rotatable and slidable relatively to said transferring means, or all said parts being slidable and rotatable relatively to one another.

It is preferred to employ a tube for one cylinder and arrange for the other cylinder to slide within it. The means for transferring the distances may conveniently consist of pointers mounted on a ring sliding over the outer cylinder. An additional pointer may be employed fixed to one end of the outer cylinder and directed towards the surface of the inner cylinder. A stop may be fixed on the outer cylinder and the ring provided with a projection, so that the ring can be easily registered in a certain position of the outer cylinder. Some form of hair line cursor may be used instead of the pointers that have been described.

The invention is particularly useful in connection with formulæ involving two different functions, for instance for solving spherical triangles by the tangent-cosine formulæ. The solving of spherical triangles is necessary for navigation at sea and in the air. A well known form of the problem is when the altitude and azimuth of an observed heavenly body have to be found for the dead reckoning position, the latitude, hour-angle and declination being known.

The formulæ connecting these variables may be expressed in the following form:—

1. Tan $y = \frac{\tan \delta}{\cos t}$
2. (a) λ and δ same name $Y = z + y$.
2. (b) λ and δ opposite names $Y = z - y$.
3. Tan $A = \frac{\cos y \tan t}{\cos Y}$
4. Tan $A = \cos A \tan Y$.

When δ = declination, t = hour angle
λ = latitude, z = co-latitude
A = azimuth, h = altitude

The equations 1, 3 and 4 may be readily and accurately solved by employing a calculator according to this invention and graduating the inner cylinder with log. tangents and the outer cylinder with log. cosines. As these scales expand rapidly beyond 80° (and in the case of the log. tan. below 1°) the main scales are preferably not taken beyond these limits. Separate scales may be employed, on each cylinder plotted to a much shorter base length, covering the same range as the main scales, with the addition of the angles near 90° and very small angles. These separate scales are used in conjunction with one another and not in conjunc-

tion with the main scales. The main and the separate scales may be numbered backwards from 90° to 180° to deal with hour angles above 90° and other large angles.

A calculator constructed according to the invention is shown in the drawing left with my Provisional Specification, in which the numeral, 1, is the inner cylinder graduated on a helical line with log. tangents; 2, is the outer cylinder graduated on a helical line with log. cosines; and 3 is the ring over the outer cylinder; all these parts being slidable and rotatable relatively to one another. 4 and 5 are the pointers of different lengths for transferring distances from one cylinder to the other. 6 is the stop on the outer cylinder, and 7 is the projection on the ring, so that the ring can readily be brought to zero by bringing the parts, 6 and 7, together. A distance piece longer than the pointers is preferably carried on the ring to prevent them from making contact with the head of the inner cylinder.

An alternative arrangement is shown in the accompanying drawing. In this case, the two cylinders are of the same diameter, and are mounted friction tight on the same spindle. The longer cylinder, 8, may be graduated with log. tangents and the shorter cylinder 9, with log. cosines. The two cylinders may be rotated independently or together as desired. In front of the cylinders, a tube, 12, is slidably mounted on a rod, 13, and in a bracket, 14. The tube carries a pointer, 11, fixed at one end, and a second pointer, 10, slidable thereon. The device may be used in the following manner. The pointer, 11, may be set to the zero of scale, 9, stops being provided if desired to render this operation easy and rapid. The cylinder, 8, is then rotated and the pointer, 10, slid along the tube, 12, until one of the given readings is under the pointer, 10. The two cylinders are then rotated as a whole, and the pointer, 11, moved along until the second given reading is under pointer, 11.

The result of the calculation can then be read off at pointer, 10, on cylinder, 8. It will thus be seen that the arrangement allows distances to be transferred from the surface of cylinder, 9, to the surface of cylinder, 8, or from cylinder, 8, to cylinder, 9.

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 calculating apparatus comprising two coaxial cylinders graduated with logarithmic scales on helical lines and means for transferring distances from the graduations of one cylinder to those of the other cylinder, said cylinders being rotatable and slidable axially relatively to said transferring means.

2. A calculating apparatus comprising two coaxial cylinders graduated with logarithmic scales on helical lines and means for transferring distances from the graduations on one cylinder to those on the other cylinder, all said parts being slidable axially and rotatable relatively to one another.

3. A calculating apparatus according to any of the preceding claims, wherein the scales are respectively graduated with log. tangents and log. cosines.

4. A calculating apparatus according to any of the preceding claims, wherein the graduations where they expand rapidly are marked in separate helical scales, plotted to a shorter base length than the main scales.

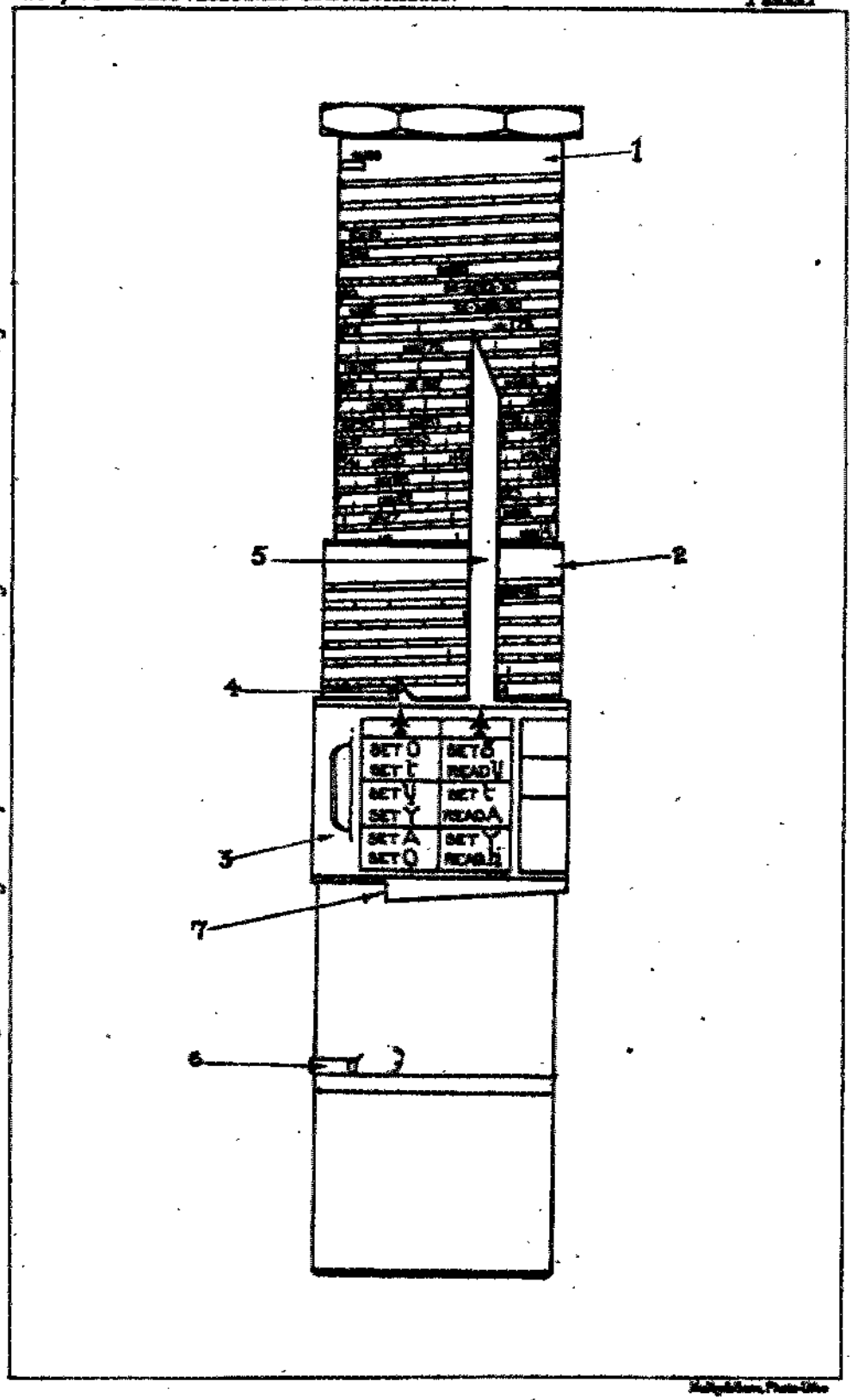
5. A calculating apparatus according to any of the preceding claims, wherein the scales are numbered backwards to deal with larger angles.

6. The improved calculating apparatus constructed and adapted to operate substantially as described or as shown in the drawings.

Dated this 20th day of December, 1920.

A. C. DAY,
Captain,
Agent for the Applicant.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1921.



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

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