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COMPLETE SPECIFICATION

Improvements in or relating to Computers of the Slide Rule Type

I, OSCAR EUGENE BATORI, a citizen of the United States of America, of Hotel Shelton, 527, Lexington Avenue, City of New York, State of New York, United States of America, 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 relates to computers of the slide rule type.

One object of the invention is to simplify and expedite the solutions of triangles, involving numerical and trigonometric functional values, encountered in navigation. Such triangles are the triangles of velocities, wind triangles, triangles of special problems as are for example interception, wind determination in flight, finding wind by double drift method, finding distance between two points on the earth's surface, finding radius of action with allowance for wind, etc.

For these and many other problems this invention provides new and simplified solutions.

Prior computers of the slide rule type have three members. In a simple division, with three arguments involved, they apply in general a base scale of numerical values on the base member for the dividend, an adjacent scale on the slide member of numerical values for the divisor and a third scale of angular values on the base member for the result expressed in angles. It will be understood, that in this specification, as it is customary with slide rules, the angles referred to represent trigonometric functions. To perform a computation of a division the first step is to set the divisor on the slide scale against the dividend on the base scale; the second step is to move the indicator to the starting point of the slide scale and read the angle required on the angle scale. Thus, two steps are required, with the result in terms of angles given at various places along the scale and in case of circular slide rules with the number in various, slant or upside down positions.

This invention to perform a division of numerical values and to express the quotient in terms of angles, requires one step, with the result (angle) given in a fixed exclusive result indicator with numbers always in upright position for convenient reading.

There are slide rules with fixed indicators, which, however, indicate the result and also one of the arguments of the computation and are therefore not exclusively for the result. Their operation requires the unison moving and setting of the base and slide members, an operation not practical in use. There are also slide rules, with angular scales on the slide member or on the reverse face of it, all requiring two steps to make said operation.

To these ends, the present invention broadly consists in providing a computer comprising a fixed circular base member having thereon a logarithmic scale of numerical values, a rotatable member in front of and smaller than said base member and rotatable relatively thereto, said rotatable member having an outer logarithmic scale of numerical values and an inner logarithmic scale of trigonometric functions, and a result indicator fixed to said base member, over-lying said rotatable member and of a diameter to conceal the inner scale and expose the outer scale on said rotatable member, said result indicator having an opening therethrough over said inner scale so as to reveal parts thereof, whereby the solutions of triangles are simplified and expedited.

In order that the invention may be more clearly understood and readily carried into effect, the same will now be described more fully with reference to the accompanying drawing in which:—

Fig. 1 is a plan view of the front face of the computer; and Fig. 2 is a cross-sectional view through the computer and showing the parts separated.

Referring to the drawings, the computer includes a fixed base member 1 of largest diameter having logarithmic scale K on its front face. Immediately on the front of the fixed member 1 is a ring member 2 of smaller outer diameter than member 1 and having an inner diameter of a size to accommodate an inner disc member 4. Ring member 2 has the scales J, L, P, O, M and N on the front face thereof, while disc member 4 is not provided with any scales and acts as a spacer and as a bearing for the rotation of ring member 2.

Outer disc member 3 hereinafter sometimes referred to as the result indicator member, is fixedly secured to base member 1 on top of movable ring member 2. Disc member 3 is of smaller diameter than ring member 2 but of larger diameter than disc member 4. In disc member 3 there is provided a window 11 to expose to view a part of inner scales O, M and N inscribed on ring member 2 and it is also provided with scale Q near its outer perimeter.

The members so far described are held in cooperative relationship by screw 9 and nut 5 upon which they are mounted concentrically. The inside diameter of disc member 4 is slightly larger than the outside diameter of nut 5 received therethrough, as can be observed at 12, so that it is possible to concentrically adjust the disc member 4 and therewith the ring member 2 before tightening the nut 5 and the screw 9 to fix the members 1 and 3 together. Accordingly, there is a certain amount of adjustment possible between the various discs in order to correct for defects in their concentricity.

A certain amount of frictional drag between the bearing surfaces of ring member 2 and its cooperating disc member 4 may be provided by means of chordal slots 13 cut in the periphery of disc member 4 thereby to provide spring arms 14 exerting radial spring pressure against the inners surfaces of ring member 2. This feature largely eliminates play between the cooperating bearing surfaces, unavoidable in mass production, and will also serve to retain movable disc member 2 in its set position against accidental displacement.

The face of the computer illustrated in Figure 1 is provided with a number of different logarithmic scales, and with two compass roses P and Q with equal distance graduations.

Fixed base member 1 carries a standard numerical logarithmic scale K numerically ranging from 10 to 1,000. Movable ring member 2 carries a standard numerical logarithmic scale J identical to scale K and cooperating therewith. These scales may be used for normal slide rule computations of multiplication and division. Ring member 2 also carries a short scale L which is a sine scale graduated in terms of latitude and which is used to determine the drift in pressure pattern navigation. The graduations are arranged in degrees of latitude from 20 to 80 degrees disposed counter-clockwise. It will be noted that scales K, J and L are fully exposed to view.

Ring member 2 is also provided with three concealed logarithmic scales M, N and O which are exposed to view only through the window 11 provided in fixed member 3. Scale M is a sine and tangent scale for angles from 0.6 to 5.6 degrees disposed counter-clockwise. Scale N is a tangent scale for angles from 6 to 45 degrees also disposed counter-clockwise. Scale O is a double scale representing sine and cosine values for angles from 6 to 90 degrees and from 0 to 84 degrees respectively. The sine values are given for the angles marked on the left of the graduation lines and are disposed in counter-clockwise direction. The cosine values stand to the right of the graduation lines and in the illustrated example they are provided with a superimposed line for convenience of identification. These cosine values are disposed clockwise.

A pointer 17 on fixed member 3 cooperates with scale O while a pointer 16 on the opposite side of window 11 cooperates with scale N. Both these pointers 16 and 17 are indicative for scale M.

The functional relations between the numerical scales K and J and the trigonometric scales M, N and O are these: Setting two numbers opposite one another on Scales K and J implies setting the proportion of the same two numbers, the quotient of which is the natural value of a trigonometric function of an angle, the angle being given in the result indicator 11, at pointers 16 or 17, as the case may be. In navigational terms, related to wind problems, setting the wind angle on scale O against pointer 17, the cross wind component is readily available on scale K, opposite wind force on scale J. Setting the wind angle on scale O, using the overlined numbers (cosine) against pointer 17, the head or tail wind component is readily available on scale K opposite the wind force on scale J. Furthermore setting air speed on scale J opposite cross-wind on scale K, the wind correction or drift angle is readily available on scale O opposite pointer 17.

Movable ring member 2 is provided with a compass rose P graduated in degrees from 0 to 360 disposed in clockwise direction. The outer edge of fixed result indicator member 3 is provided with four equal quadrants graduated alternatingly in clockwise and counterclockwise directions from 0 to 90 degrees. When a given angle of scale P is set opposite the pointer 15 the angle included between the pointer 15 and a direction given on scale P the wind angle proper is available on scale Q.

In the following three examples are presented to demonstrate the use of the computer in solving triangles and performing computations with three arguments of different values involved.

The first example relates to the solution of an oblique triangle, a triangle of velocity. The second relates to the solution of a right triangle as frequently encountered in pressure pattern navigation. The third example relates to the solution of a right triangle in finding course between two points on the earth's surface, used in sea and air navigation.

EXAMPLE 1.

This example relates to the solution of oblique triangles. The solution implies the breaking of the triangle in two right triangles. Using navigational terms it relates to the triangle of velocities. One side of the triangle is the wind force, the other air speed and the third one the ground speed. The angle between the wind direction and the track to be made good is called "wind angle." The angle included by the track and the heading is the wind "correction angle." Knowing two sides and one angle (opposite to one of the known sides) the other angle and the third side can be obtained. The solution is given with actual values in the following. The required track to be made good is 360 degrees north. The wind direction is from 230 degrees, wind force 30 knots. The aircraft has a true air speed of 250 knots. Required are the wind correction angle, the heading and ground speed. Step 1. For finding wind angle. Set 360 degrees on scale P, opposite O, on the top of scale Q. Opposite 230 degrees on scale P, read wind angle 50 degrees on scale Q. It is evident from the pictorial view of the setting that the wind is a tail wind and it is from the left of the aircraft. Step 2. For cross wind component. Set 50 degrees on scale O to pointer 17. Opposite wind force 30 knots on scale J, read cross wind component 23 knots on scale K. Step 3. For wind correction angle. Set air speed 250 knots on scale J, opposite cross wind component 23 knots on scale K; read drift angle 5.3 degrees at pointer 17 on scale M. It is evident that the wind correction angle has to be applied against the wind and deducted from the track 360 degrees, which will give the true heading as 355 degrees. Step 4. For tail wind component. Set wind angle 50 degrees to pointer 17 on scale O, using the smaller overlined numbers (cosine). Opposite wind force 30 on scale J, read tail wind component 19.3 on scale K. Adding tail wind component 19.3 to true air speed 250, equals ground speed 269.3 knots.

EXAMPLE 2.

This example relates to the solution of a right triangle, in connection with pressure pattern navigation. Known are the hypotenuse and the shorter side of the triangle. Required is the angle opposite the short side. The solution, with actual values, is given as follows: An airman flying over the ocean obtains the altimeter pressure difference of 150 feet during a level flight of 30 minutes, the aircraft covering an air distance of 150 nautical miles. The mid-latitude is given as 50 degrees north. Required are the cross wind component and the drift caused by geostrophic winds. Step 1. For cross wind component. Set against pressure difference 150 feet on scale K, air distance 150 nautical miles on scale J. Opposite latitude 50 degrees on scale L, read cross wind component 28 knots on scale K. Step 2. For drift angle. Set against 28 on scale K, ground speed 300 knots; read drift angle at pointer 17 in result indicator window on scale O, 5.4 degrees.

EXAMPLE 3.

This example relates to the solution of a right triangle, using the law of tangent in connection with navigational problems, to find direction between two points on the earth's surface when the difference of longitude and latitude between the two given points are known. (a) Difference of longitude between two points 1846 miles. This is the one short side of the right triangle. (b) Difference of latitude 393 miles. This is the other short side of the triangle. (c) Find the angle opposite the shortest side. Solution. Set 1846 on scale J opposite 393 on scale K. Read angle 12° against arrow 16 in indicator window 11 on scale N. This angle subtracted from the parallel (270°) gives the course 258° to be followed to get from the one point to the other. In the solution the proportion of two numerical values has been expressed in a tangent function of the corresponding angle.

The face of the fixed base member 1 opposite the computer just described, is provided with another computer similar in construction but having different scales than the present computer. This application has been divided, out of my co-pending Application No. 26450, filed October 30, 1950 (Serial No. 708,811) and which is directed to the subject matter of the computer on the other face of the fixed base member 1 which forms no part of the present invention.

What I claim is:—

1. A computer comprising a fixed circular base member having thereon a logarithmic scale of numerical values, a rotatable member in front of and smaller than said base member and rotatable relatively thereto, said rotatable member having an outer logarithmic scale of numerical values and an inner logarithmic scale of trigonometric functions, and a result indicator fixed to said base member, overlying said rotatable member and of a diameter to conceal the inner scale and expose the outer scale on said rotatable member, said result indicator having an opening therethrough over said inner scale so as to reveal parts thereof, whereby the solutions of triangles are simplified and expedited.

2. A computer according to claim 1, including a circular spacer member in front of and fixed to said base member and snugly fitting within an open central portion of said rotatable member.

3. The computer according to claim 2, wherein the circular spacer member is provided with chordal slots at the periphery thereof defining segmental spring arms which engage and exert radially outward pressure on the inner surface of the rotatable member.

4. The computer according to claim 2, wherein the base member, the result indicator, and the spacer member are all centrally axially apertured, a fastening member is passed through said apertures so as to secure said members together, the axial aperture of the spacer member is larger than the fastening member so that the spacer and the rotatable member may be adjusted concentrically in relation to the fixed members.

5. A computer according to any one of claims 1 to 4, wherein the inner logarithmic scale is of sine functions.

6. A computer accordng to any one of claims 1 to 4, wherein the inner logarithmic scale is of cosine functions.

7. A computer according to any one of claims 1 to 4, wherein the inner logarithmic scale is of tangent functions.

8. A computer according to any one of claims 1 to 4, wherein the inner logarithmic scale is a scale of composite values, consisting of a first scale representing sine and tangent functions of small angles, a second scale representing tangent functions of larger angles, a third scale representing sine functions of larger angles, and a fourth scale representing cosine functions of larger angles.

9. The computer according to any one of claims 5 to 8, wherein the rotatable member carries a logarithmic sine scale which is a function of the degrees of latitude.

10. The computer according to claim 1, wherein one of the fixed members and the rotatable member carry two co-operative scales, one of which is an exposed compass rose for angles from 0 degrees to 360 degrees, the other is an exposed compass rose for four quadrants, each quadrant extending from 0 degrees to 90 degrees in the reverse direction to the adjacent quadrants.

11. The computer according to claim 1, wherein the rotatable member carries an exposed compass rose for angles from 0 degrees to 360 degrees arranged clockwise, and said result indicator member carries an exposed compass rose of four quadrants, each quadrant extending from 0 degrees to 90 degrees in the reverse direction to the adjacent quadrants.

12. The computer having its parts constructed, arranged and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 11th day of July, 1952.

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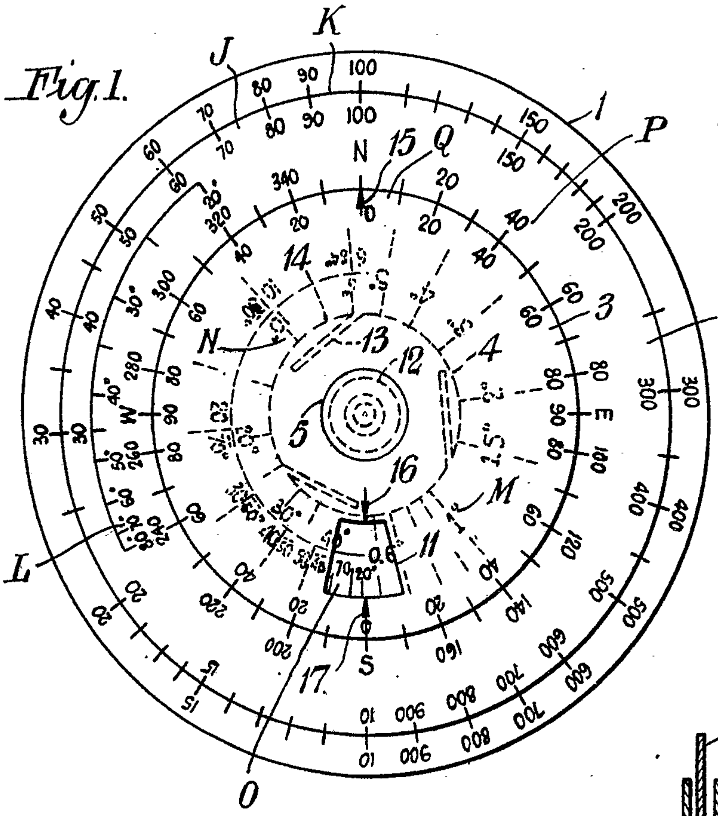
I SHEET

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

Fig. 1.



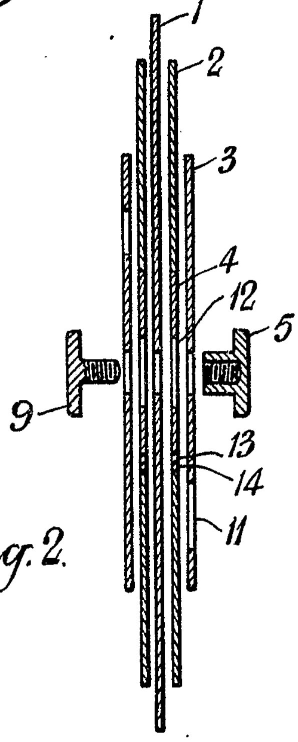


Fig. 2.