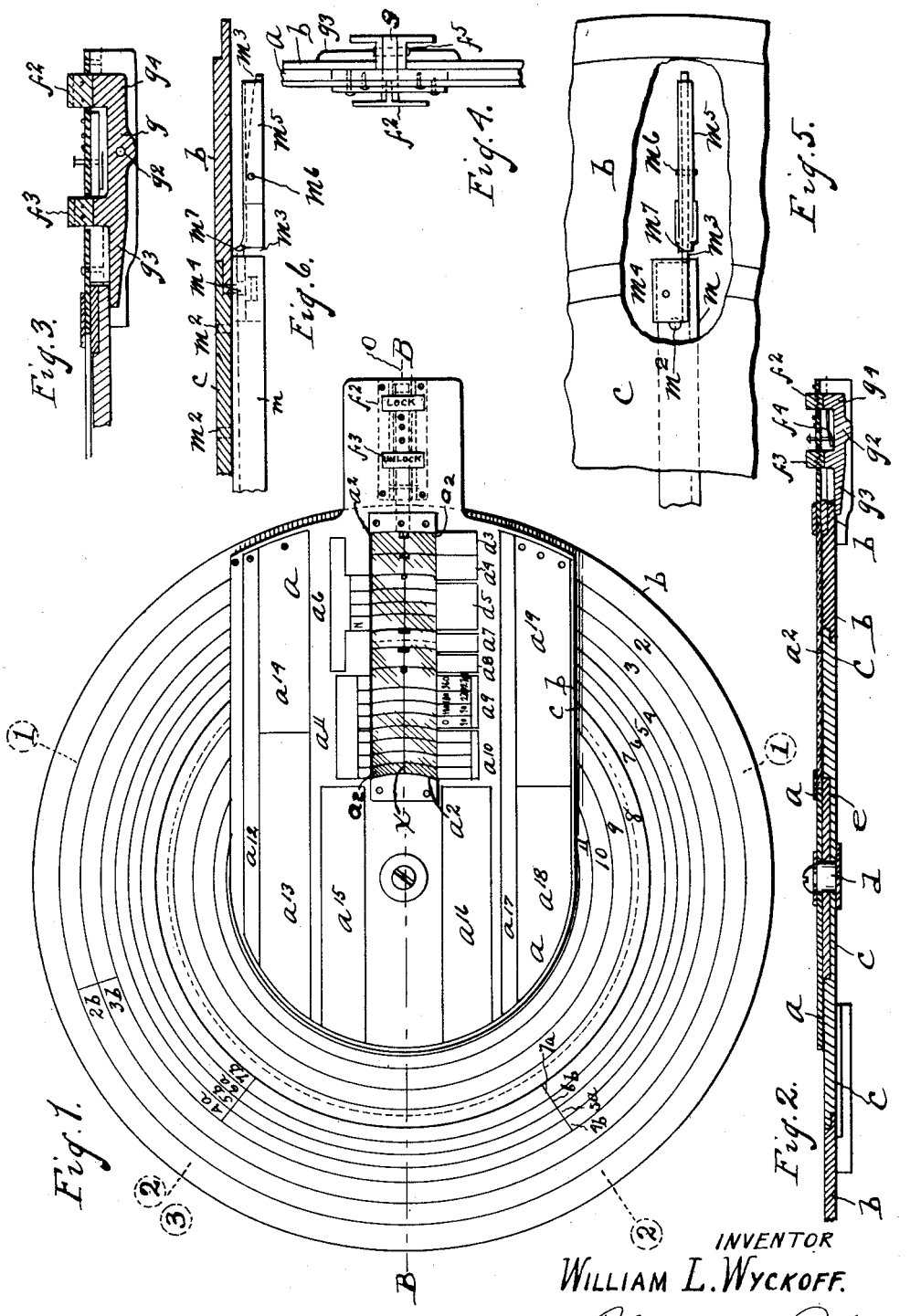
Dec. 26, 1922. 1,439,936

W. L. WYCKOFF.
CALCULATOR.
FILED FEB. 7, 1919. 3 SHEETS-SHEET 1



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3 SHEETS-SHEET 2

Fig. 8.

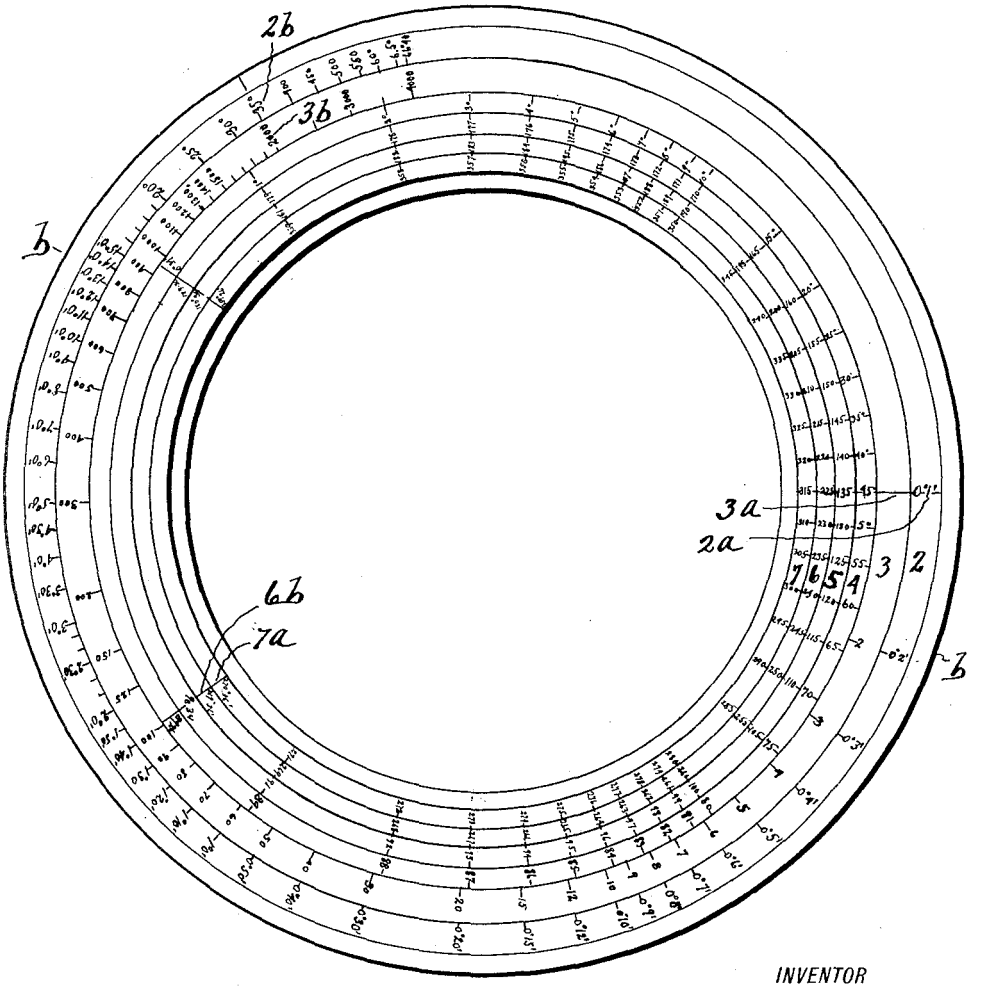

Fig. 7.

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Fig. 10.

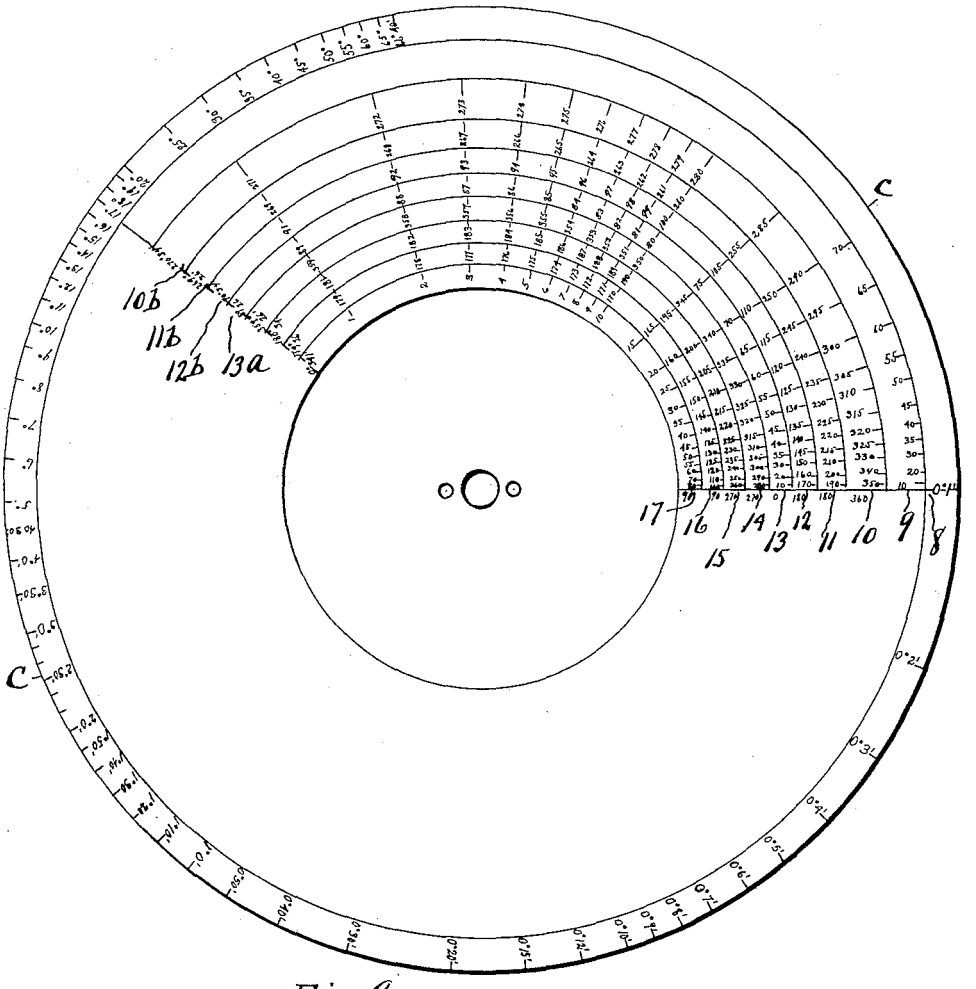

Fig. 9.

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Patented Dec. 26, 1922. 1,439,936

UNITED STATES PATENT OFFICE.

WILLIAM L. WYCKOFF, OF DETROIT, MICHIGAN.

CALCULATOR.

Application filed February 7, 1919. Serial No. 275,505.

To all whom it may concern:

Be it known that I, WILLIAM L. WYCKOFF, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Calculators, and declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to a calculator for navigators and an object of my improvements is to provide an instrument by which the course and dead-reckoning calculations can be readily and accurately made.

I secure this object in the device illustrated in the accompanying drawings in which,

Figure 1 is a plan view of an instrument embodying my invention.

Figure 2 is a section of the same on the line B—B of Fig. 1.

Figure 3 is a detail sectional view of the locking mechanism.

Figure 4 is a detail elevation of the locking and unlocking mechanism and adjacent parts looking from the right of Figure 1.

Figure 5 is a detail plan view partly broken away and illustrating an attachment for accurate adjustment of the relative position of the parts.

Figure 6 is a side elevation, partly in section, of the parts shown in Figure 5.

Figure 7 is a plan view of the outer ring, to an enlarged scale, separate from the rest of the instrument.

Figure 8 is a diametral section of the same.

Figure 9 is a plan view of the inner ring, or disk, to an enlarged scale, separate from the instrument.

Figure 10 is a diametral section of the same.

The instrument consists mainly of a rider a, the outer ring b and the inner ring c, all of which turn about a central pivot d. There is a spacing washer e surrounding the central pivot d sunk into the disk c and extending somewhat above its surface. The rider a rests upon this washer and is spaced thereby from the upper surface of the parts b and c. The inner edge of the ring b and the outer edge of the disk c are cut away so as to fit into each other, as shown most distinctly in Fig. 2, and turn with some friction upon each other.

The rider a is provided at its outer end with a handle and means for normally locking it to the ring b, or unlocking it therefrom, when this is required in the operation of the calculator. This means, as shown most clearly in Figures 2, 3 and 4, consists of the lever g pivoted to a depending part of the rider a and having one arm g^3 adapted to engage the underside of the ring b and its other arm g^4 extending in the opposite direction to the arm g^3 from the pivot g^2. There is a lug rising from the lever g upon the side of the pivot g^2 toward the ring b extending thru a slot in the rider a and provided with a key f^3 at its upper end. There is a similar lug upon the other side of the pivot which similarly extends above the rider and is provided with a key f^2. The first named key is designated by the word "Unlock" and the last named key by "Lock." When the key f^2 is depressed the rider is very firmly locked to the ring b by friction due to the pressure of the arm g^3 against the underside of the ring. When the other end of the lever g is pressed down by means of the key f^3 the rider is released from engagement with the ring and may move independently thereof. There is a spring f^4 which acts upon the lever g to turn the same about its pivot and engage the arm g^3 with the under surface of the ring b so as to normally hold the rider engaged to the ring b.

Referring particularly to Figures 1, 7 and 9. The outer ring b is provided with two series of concentric annular spaces upon its outer surface for receiving scales as hereinafter described. The first series is indicated by the reference numbers 2 and 3 and the second series by the numbers 4, 5, 6 and 7.

The inner disk, or ring, is provided with a concentric annular space 8 between its edge and a concentric circle engraved upon its surface, a second annular space 9 radially within the first named space, a series of similar spaces 10, 11, 12 and 13 and a second series of spaces 14, 15, 16, and 17.

The rider a is provided with a rectangular radially-extending opening thru its face marked a^2 and in this opening is placed a transparent substance upon which is engraved a straight line x running radially and thru the center of the opening.

This is the datum line and also serves to aline the scale divisions on the disk c and ring b which are seen thru the transparent material covering the opening a^2.

Upon the surface of the rider a are engraved the boundary lines of a rectangular space a^3 in which appear the words "Degrees and minutes." The ends of the sides that come to the edge of the opening a^2 correspond to the scale 2 upon the ring b and a similar rectangular space a^4 is so indicated which designates the scale 3 in the same way and has the word "Numbers" engraved therein. Adjacent to and to the left of the space a^4 is a third space a^5 with sides normal to the line x and indicating, at the edge of the opening a^2, the limits of the series of scales 4, 5, 6 and 7 upon the ring b, and in this space are engraved the words "Read course." Upon the opposite side of the opening a^2 there is indicated a space a^6 that is in the form of a T, the stem of which has its sides coming to the edge of the opening a^2 and coinciding with the limits of the series of scales 4, 5, 6, 7. In the cross-bar portion of the space a^6 is engraved "When position sought is between" and the stem is divided into four spaces by lines parallel to the sides of the stem, each of these spaces indicating one of the scales 4, 5, 6 or 7 and in each of these spaces are indicated two adjacent cardinal points. That is to say, the space at the left in this instance is marked "N & E" to indicate the first quadrant, the second space "S & E" to indicate the fourth quadrant, the third space "S & W" to indicate the third quadrant, and the fourth space "N & W" to indicate the second quadrant. The operator reads the scale opposite which appear the two cardinal points between which the destination lies. Next to the left of the space a^5 and adjacent thereto is the space a^7 having the designation therein "Degrees and minutes" and indicating the scale 8 on the surface of the disk c. Next to the left of the space a^7 is the space a^8 having the designation therein "Middle latitude" and indicating the scale 9 on the disk c. Next to the left of the space a^8 is the space a^9 indicating the series of scales 10, 11, 12 and 13 and having the words "Sine scale" across its outer end and divided into four divisions by lines parallel to the sides, each division designating one of the scales of the series as for instance the first space at the left which is marked zero to 90 degrees, the second space 90 degrees to 180 degrees, the third space 180 degrees to 270 degrees, and the fourth space 270 degrees to 360 degrees.

Next to the left of the space a^9 is the space a^{10} similar to the space a^9 and similarly marked except that "Cosine" replaces the word "Sine" and the order of the figures in the subdivision is reversed. The space a^{10} subtends and indicates the series of scales 14, 15, 16 and 17.

Upon the opposite side of the opening a^2 adjacent to its edge is a division a^{11} which subtends both series of scales 10, 11, 12, 13, and 14, 15, 16, 17 and this space is designated by the words "Direction in which degrees and minutes or miles are to be applied;" and at the part of said space next adjacent to the edge of the opening a^2 are subdivisions designating the two series of scales, separately. The space designating the inner series is indicated by the word "Latitude" and the separate scales beginning at the left and reading to the right are designated by the letters N. S. S. N. indicating cardinal points. The outer series is designated by the word "Longitude" and its separate scales as before are indicated by the letters E. W. W. E. also indicating cardinal points.

Upon the line at the center of the opening a^2 is engraved upon the transparent material closing said opening arbitrarily selected characters to designate the different scales as for instance upon each side of the space over the scale 2 are two open rectangles engraved, and on the inner side of the scale 3 is engraved an open circle; above each of the lines enclosing the space 8 is engraved a solid rectangle and above the inner boundary line of the space 9 is engraved a solid circle.

In constructing the apparatus embodying my invention the graduations on the various scales above noted are projected radially from a single master scale, the uniform divisions of which are in a circle concentric with the plate and ring c b and correspond to the logarithms of numbers from hundredths to thousands and the scale is divided into five equal main divisions designated by the characteristic of the logarithms within the respective divisions, thus: the first line of the first division may be designated by the characteristic —2, the dividing line between first and second division by —1, the third by 0, the fourth by 1, the fifth by 2, and the original first division, when regarded as the termination of the scale would be indicated by the number 3.

The graduations for numbers and angles on the scales also fall into five main divisions which are taken in the order given above; for the first division angles whose natural functions vary from hundredths to tenths; second division, angles whose natural functions are between tenths and one, third division, angles whose natural functions are between one and ten and numbers between one and ten and angles whose minutes are between one and ten; fourth division, angles whose natural functions are between tens and hundreds and numbers between tens and

hundreds, and angles whose minutes are between tens and hundreds; fifth division, numbers between hundreds and thousands and angles whose minutes are between hundreds and thousands.

In the annular space 3 are graduations of numbers from one to four thousand which are projected radially from the master scale according to the logarithms of the respective numbers. The numbers represent nautical miles of departure or minutes of latitude according to the operation being performed or to the calculation being made. In the space 2 are designations of the same scale in circular measure, that is to say, degrees and minutes and extending from one minute to $66\frac{2}{3}°$. The commencement of this scale, or these scales, is projected radially from the zero graduation of the logarithmic master scale and will be marked, respectively, 1 and 0° 1′ as indicated.

The series of scales 4, 5, 6, 7 is constructed as follows:

Their divisions represent the logarithms of the tangents of angles, for instance, the scale 4 commencing at 4^a and ending at 4^b begins with the angle whose tangent is .01 or 34′ extending to an angle at 89° 26′.

No attempt is made to graduate scales for angles whose functions are smaller than 0.01 or greater than 100 as the logarithm increases much more rapidly in proportion than the corresponding angle.

The second scale 5 commences at 5^a with the tangent of the angle 90° 34′ and extends to 5^b to an angle of 179° 26′. The third division 6 commencing at 6^a with an angle of 180° 34′ and extending to 6^b an angle of 269° 26′. The fourth division commences at 7^a at an angle of 270° 34′ and extends to 7^b at an angle of 359° 26′, all these scales lying at the right from the upper radial line and alternating in direction. The graduations of these scales are located according to the logarithms of the tangents of angles excepting at the cardinal points where the numerical values of the tangents approach infinity. It will be noted that as the angle increases and the value of the tangent increases, the numbers on the scale increase in a clockwise direction, but if the value of the tangent decreases as the angle increases the numbers on the scale increase in a counterclockwise direction.

The following scales are engraved upon the surface of the disk *c*.

The scale 8 extending from the scale-unit line at 8^a to a point 8^b corresponds in relative angular position to the scale division 2^a 2^b of the outer scale and is graduated to correspond to the outer scale, and its divisions are correspondingly marked to indicate degrees and minutes from one minute at the logarithmic zero line to $66\frac{2}{3}°$ at 8^b, running in the direction of the hands of a clock.

In the space 9 are engraved divisions located according to logarithms of cosines of angles from 0° to 70° and running in a counterclockwise direction from the limits 9^a to 9^b.

The divisions 10, 11, 12 and 13 are graduated between limits corresponding to the angular position of the limiting lines of the scales 4, 5, 6, 7, to correspond to the sines of angles from 0° 34′–359° 26′.

The concentric scales 14, 15, 16 and 17 are correspondingly graduated for the cosines of angles.

The method of using the above described device is as follows:

If one wishes to find the course—the latitude and longitude at the place at which one is located and the place to which he wishes to sail being known—he finds the difference in longitude between the two places, the difference of latitude between the two places and the middle latitude. He then unlocks the rider and moves it to the division corresponding to the difference of longitude on the scale 2. He then locks the rider to the ring *b* and moves both until the datum line *x* is over the number on the scale 8 which corresponds to the difference of latitude. He then unlocks the rider and moves it until the datum line is above the division on the scale 9 corresponding to the middle latitude.

Now he reads his course from that one of the scales 4, 5, 6, 7 which corresponds to the quadrant in which his destination is located, that is to say, the first, fourth, third or second quadrant as designated by N & E, S & E, S & W, and N & W on the rider *a*.

Or to find the distance to be sailed, he unlocks the rider and moves the datum line to the position on the scale 2 which corresponds to the difference in latitude and lock the rider in this position he then moves the disk *c* until the division on the cosine scale which corresponds to the angle of the course appears beneath the datum line, and then unlocks the rider and brings the datum line with the unit or zero line on the scale 8. The required distance in miles will appear under the datum line on the scale 3.

Or if one wishes to find the departure when course and distance are known, he unlocks the rider and moves the datum line to a position which corresponds to the distance in miles on the scale 3′, he then locks the rider to the ring *b* and moves both to the unit or zero line on the scale 8 or, what is the same thing, moves the disk *c* until the unit or zero line appears under the datum line. He then releases the rider and moves the datum line to a position on the sine scale which corresponds to the course. The departure may then be read on the scale 3 under datum line.

Or to find the difference in longitude when departure and middle latitude are

known, he releases the rider and moves datum line to a position which corresponds to the departure on scale 3′, he then locks the rider and moves the rider and ring to the position at which the middle latitude appears under the datum line on scale 9. Then he unlocks the rider and moves the datum line to the unit or zero line on the disk *c*. The difference of longitude in degrees and minutes will appear upon the scale 8.

To find the difference in latitude when the miles sailed and the course is known, unlock the rider and carry the datum line to the number of miles sailed on the scale 3; then lock the rider to the ring *b* and move the two until the unit or zero line appears under the datum line *x* on the disk *c*. Unlock the rider and move the datum line until the angle corresponding to the course appears under it on the cosine scale. The difference in latitude may be read under the datum line from the scale 9.

To find the difference in longitude when the miles sailed, the middle latitude, and course are known, unlock and move the datum line to the number on the scale 3 which corresponds to miles sailed, lock and move the datum line to the number corresponding to middle latitude on the scale 9, and then unlock and move the datum line to the number on sine scale which corresponds to the course. The difference in longitude will then appear on the scale 2 under the datum line *x*.

The directions for use will be engraved upon the surface of the rider *a* preferably in the different spaces indicated in Fig. 1. Thus, in the space a^{12} would be engraved "To find course and distance when position in and position sought, are known"; under this general heading, in the space marked a^{13} would be printed the above direction for finding the course when the difference of longitude and of latitude and the middle latitude are known. The various scales in these directions would be designated by the arbitrary characters above referred to upon the line *x*. In the space a^{14} would be the direction for finding the distance, the difference of latitude, and the course being known. In the space a^{15} will be engraved the direction for finding the departure when course and distance are known. In the space a^{16} would be the direction for finding the difference of longitude when departure and middle latitude are known. In the space a^{17} would be engraved the general heading "To find difference of latitude and longitude when position left, course and distance sailed are known" and, under this general heading in space a^{18} would be the direction to find the difference of latitude when the course and distance sailed are known and in the space a^{19} the direction for finding the difference of longitude—the middle latitude, the miles sailed, and the course being known.

Of course, these spaces may be varied according to the judgment or taste of the designer and different equivalent arrangements of the scales will be within the mechanical skill of the art. I have indicated what I regard as the best form and arrangement.

In order to bring the ring and disk *b c* with the required divisions of the scales accurately in line, I have provided the device shown most clearly in Figures 5 and 6. In this device *m* is a radially extending small rod of L-shape in cross section having one flange secured flat against the underside of the disk *c* and extending under the edge of the ring *b*. To the horizontal flange of the rod *m* I pivot at m^4 a second lever m^3 which extends radially outward and is itself provided with a vertically oscillating lever m^5 pivoted to it at m^6. The lever m^5 is provided at its inner end with an upwardly extending pin or spur m^7.

When the disk *c* and ring *b* have been turned relative to each other so as to make the desired division of scales come approximately in line the operator grasps and pulls downward on the outer end of the lever m^5, thus bringing the upper end of the spur m^7 into engagement with the under surface of the ring *b*. The outer arm of the levers m^3 and m^5 may now be moved horizontally, thus pivoting about the spur m^7 and moving the ring *b* and disk *c* slightly with reference to each other. In this way the scale divisions may be brought accurately in line.

What I claim is:

1. In a calculator, the combination of a circular inner disk; an outer ring rotatably encircling the disk, said disk and ring being provided with concentric annular scales; a radially disposed rider surmounting the disk and ring and having a pivotal connection with the former; said rider being provided with a handle for turning it and with sight openings in register with the several scales on the disk and ring; and a lever for coupling the rider to the ring for movement as a unit relative to the disk, said lever engageable at one end with said ring and having separate keys for moving it into and out of such engagement.

2. In a calculator, the combination of a circular inner disk; an outer ring rotatably encircling the same, said disk and ring being provided with concentric annular scales; a lever system connecting the disk and ring for effecting fine relative adjustments of the graduations of the scales thereon; a rider pivotally connected to the center of the disk and extending radially outward across said disk and the ring; said rider being provided with a handle for turning it and with sight openings in register with the several scales on the disk and ring; and a lever on the rider

engageable with said ring to couple the two together for movement as a unit relative to the disk.

3. In a calculator, the combination of a circular inner disk; an outer ring rotatably encircling the same, said disk and ring being provided with concentric annular scales; a connection between the disk and ring for effecting fine relative adjustments of the graduations of the scales thereon; said connection comprising a rod secured to the underside of the disk and extending beneath the edge of the ring, a lever pivoted to said rod and extending radially outward, and a vertically oscillating lever pivotally connected to the first lever and having at its inner end an upstanding spur to engage the underside of said ring when its outer end is depressed; a rider pivotally connected to the center of the disk and extending radially outward across said disk and the ring; said rider being provided with a handle for turning it and with sight openings in register with the various scales on the disk and ring; and means for releasably coupling the rider and ring together for movement as a unit relative to the disk.

4. In a calculator, the combination of a circular inner disk; an outer ring rotatably encircling the same, said disk and ring being provided with concentric annular scales; a rider pivotally connected to the center of the disk and extending radially outward across said disk and the ring; said rider having sight openings in register with the various scales on the disk and ring, and also having a handle for turning it and which is provided with a pair of spaced slots; and a lever fulcrumed on the wider side of said handle at a point between said slots and engageable at its inner end with the under side of the ring to couple the latter and the rider together for movement as a unit relative to the disk; said lever having a pair of keys projecting upwardly from it through said slots for alternatively effecting or terminating such engagement.

In testimony whereof, I sign this specification.

WILLIAM L. WYCKOFF.