K. HORINE.

COMPUTER.

APPLICATION FILED JAN. 2, 1917.

1,306,379.

Patented June 10, 1919.

2 SHEETS—SHEET 1.

Fig. 1

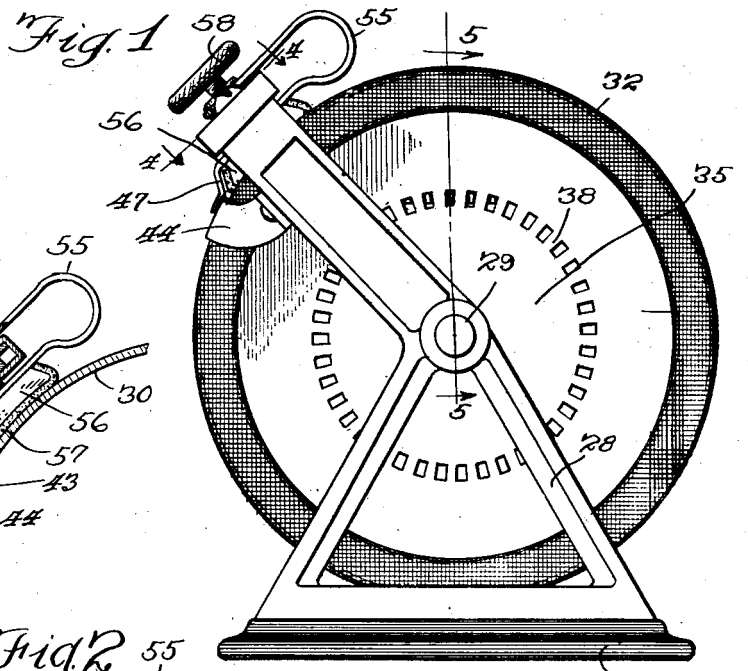

Fig. 3

Fig. 2

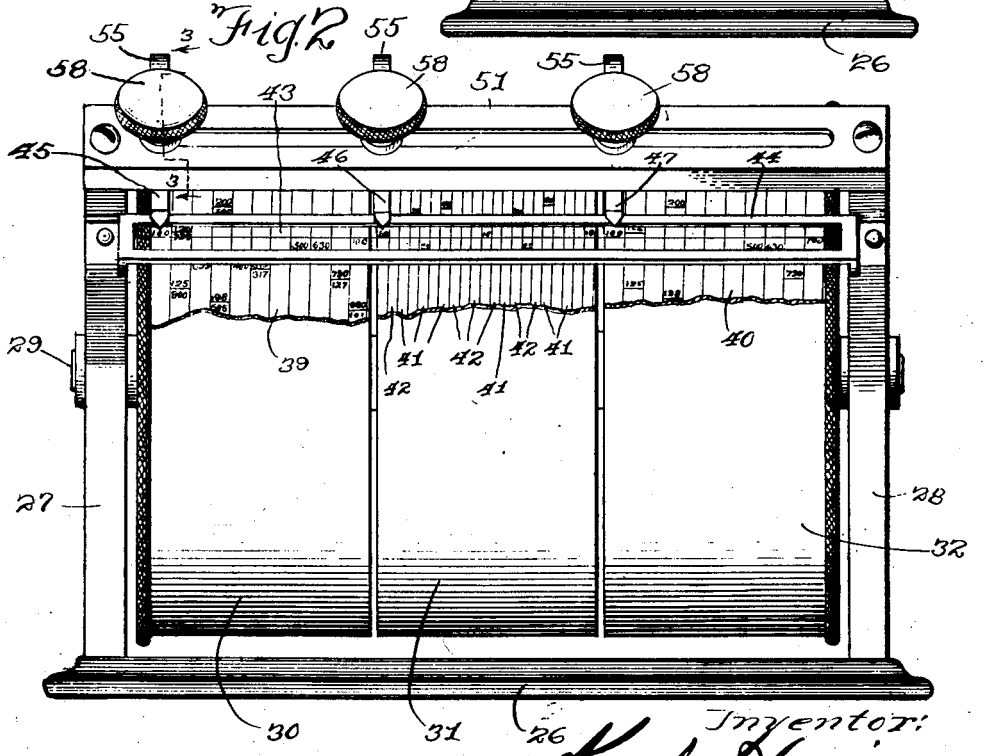

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Fig. 4

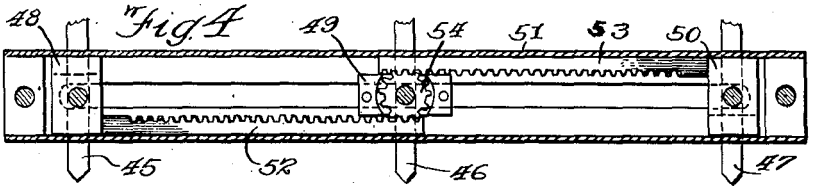


Fig. 5

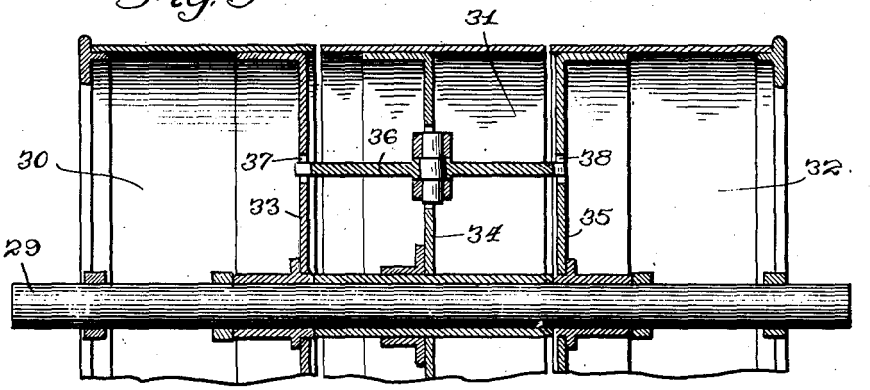


Fig. 6

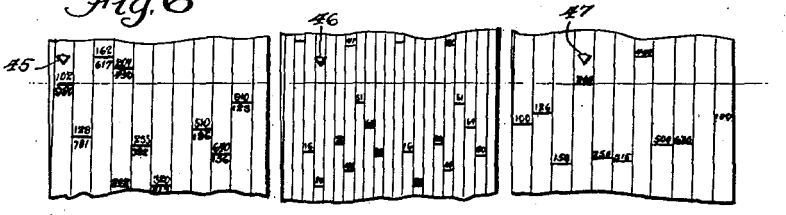


Fig. 7

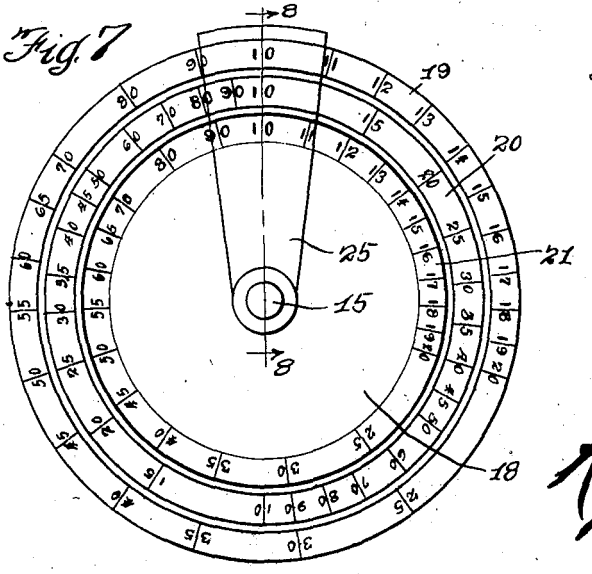
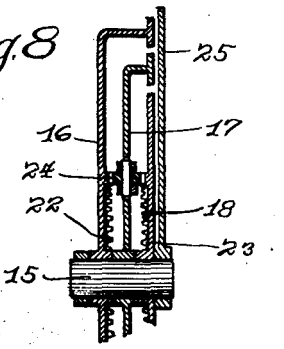


Fig. 8



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UNITED STATES PATENT OFFICE.

KARL HORINE, OF EVANSTON, ILLINOIS.

COMPUTER.

1,306,379. Specification of Letters Patent. Patented June 10, 1919.

Application filed January 2, 1917. Serial No. 140,113.

To all whom it may concern:

Be it known that I, KARL HORINE, a citizen of the United States, and a resident of Evanston, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Computers, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to computers of the type involving a plurality of related scales which are movable relative to each other, and it has for its principal object the provision of means for controlling the movement of the scales relative to each other such that the movement of any two scales relative to each other produces the desired corresponding movement of the third scale. It is another object of my invention to provide a new and improved means, in a computer employing one or more scales each comprising a plurality of adjacent columns or portions, for determining the column or portion of one scale to be read in connection with the column or portion of the other scale. It is another object of my invention to provide a computer comprising three logarithmic scales which are movable in a differential relation to each other whereby the movement of one scale in one direction relative to a second scale produces an equal movement of the third scale relative to the second scale but in the opposite direction. It is another object of my invention to improve computers of this general type in sundry details hereinafter pointed out. The preferred means by which I have accomplished my several objects are illustrated in the drawings and are hereinafter specifically described. That which I believe to be new and desire to cover by this application is set forth in the claims.

In the drawings,—

Figure 1 is an end view of a computer comprising the preferred form of my invention;

Fig. 2 is a front view of the device shown in Fig. 1, with the scales partly broken away;

Fig. 3 is a vertical cross-section taken substantially on line 3—3 of Fig. 2;

Fig. 4 is a section taken substantially on line 4—4 of Fig. 1;

Fig. 5 is a central vertical section taken substantially on line 5—5 of Fig. 1;

Fig. 6 is a diagrammatic view showing a changed position of the scales from that shown in Fig. 2;

Fig. 7 is a front view of a modified form of computer;

Fig. 8 is a central vertical section taken substantially on line 8—8 of Fig. 7.

Referring to Figs. 7 and 8, which show the modified form of structure and in connection with which the principle of the invention can best be set forth,—15 indicates a short shaft having mounted thereon three disks 16, 17 and 18 upon the outer edges of which are located scales 19, 20, and 21, respectively. The disks 16, 17 and 18 are connected together by means of circular racks or gears 22 and 23 carried by the disks 16 and 18, respectively, and a pinion 24 revolubly mounted upon the disk 17 and meshing with the circular racks or gears 22—23. By means of this type of connection, whenever the disk 16 is moved in one direction relative to the disk 17, the disk 18 is moved an equal distance angularly in the opposite direction relative to the disk 17.

The scales carried by the disk 16 and 18 are precisely similar, being in the construction shown logarithmic scales similar to the scales C—D of an ordinary Mannheim slide-rule. The scale 20 carried by the disk 17 is a logarithmic scale similar to the A and B scales of an ordinary Mannheim slide-rule. That is to say, the outside scales 19—21 are of double dimensions (angularly) as compared to the intermediate scale 20. Each of the scales 19 and 21 comprises an integral number of turns (one) divided into an integral number of complete cycles (one). The intermediate scale 20 comprises an integral number of turns (one) divided into an integral number of complete cycles (two). The scales 19, 20 and 21 are so located upon

the disks 16, 17 and 18 that when one of the two initial points of the scale 20 is brought opposite to the initial point of one of the scales 19—21, the initial point of the other one of the scales 19—21 is likewise brought opposite, the position in opposition being indicated by means of a hair line or base carried by a transparent member 25 of any suitable type.

The arrangement of the logarithmic scales and of the connections between the scales is such that, when the scales are brought to any angular position relative to each other which will be permitted by the type of connection between the scales, the products of any two numbers to be read at the base line upon the scales 19 and 21 can be read at the base line on the scale 20.

It will also be understood that an operation in division may be performed by turning the disk 17 so as to read the dividend on the scale 20 at the base line and turning one of the disks 16—18 so as to read the divisor on the corresponding scale 19—21 at the base line, the quotient being then readable at the base line on the other one of the scales 19—21.

Referring now to Figs. 1 to 6, which embody the preferred form of my invention,—26 indicates a base from which rise two standards 27—28 supporting a cross-bar or shaft 29. Three drums 30—31—32 are revolubly mounted upon the shaft 29 by means of webs 33—34—35, respectively. A gear 36 is revolubly mounted upon the web 34 of the drum 31 upon an axis at right angles to the axis about which the drum is revoluble, the gear 36 being in mesh with gears 37—38 formed in the webs 33—35. By this means the drums 30, 31 and 32 are connected in the same relationship relative to each other as are the disks 16, 17 and 18 in the construction above described.

The drums 30 and 32 are provided with scales 39 and 40 which correspond to the scales 19 and 21 of the construction shown in Fig. 7, each scale 39—40 extending in helical form a number of times about its drum and each comprising a complete cycle of a logarithmic scale. The drum 31 is provided with two logarithmic scales 41—42 each in helical form, with their initial points arranged at a distance of 180° from each other circumferentially of the drum. The scales 39—40 correspond to the D scale of a slide-rule, while the scales 41—42 correspond to the A slide-rule scale.

When the drums are held in their normal position, as shown in Fig. 2, each turn of the scale 41 is midway between the corresponding turns of the scales 39 and 40. With the drums in the position shown in Fig. 2, the first turn of the scale 42 is midway between the first turn of the scale 39 and the second turn of the scale 40 or between the second turn of the scale 39 and the first turn of the scale 40. Inasmuch as the helices of the several scales correspond in form, it would follow that the second turn of the scale 41 is midway between the first turn of the scale 39 and the third turn of the scale 40 or between the third turn of the scale 39 and the first turn of the scale 40. The arrangement and connections of the parts of the structure shown in Fig. 2 are such that when the drums are turned relative to each other to any position attainable by reason of their connection as above described, the product of any two numbers which are readable upon any two turns of the logarithmic scales 39—40 upon any longitudinally-extending line will be readable at such longitudinally-extending line upon the turn of the scale 41 or 42 midway between the said turns of the scales 39 and 40. A longitudinally-extending base line for assistance in reading is provided by means of a plate 43 of glass or other suitable material supported by a longitudinally-extending frame 44 held in position by the standards 27—28.

Means is provided for designating the column in which a desired product can be found—that is to say, for indicating the column or turn on the intermediate drum which is located midway between any two columns or turns on the drums 39—40. This means comprises pointers 45—46—47 which are movable relative to the several scales, such pointers being connected together in such a manner that the pointer 46 is maintained at all times midway between the pointers 45—47. In the construction shown the means for connecting the pointers, 45, 46 and 47 comprises slide-blocks 48, 49 and 50 to which said pointers are connected, said blocks being movable along a longitudinally-extending casing 51 which is connected at its ends to the standards 27—28. The blocks 48 and 50 are provided with rack-bars 52—53, respectively, which mesh with a pinion 54 connected with the block 49 (see Fig. 4), whereby the pointer 46 is maintained in position midway between the pointers 45—47.

Means is provided for locking any one of the pointers against movement across the drums and for locking the adjacent drum against rotation. This means in connection with each pointer comprises a spring 55 fixed to the slide-block and carrying in suitable position thereon a brake-shoe 56 provided with a facing 57 of felt or other suitable material. Each of the blocks 48—49—50 is provided with a thumb-screw 58, the lower end of which is adapted to bear upon the spring 55 for forcing the brake-shoe 56 against the surface of the

drum, serving in this way to hold the drum against rotation and to hold the pointer which in the construction shown is formed integral with the spring against movement relative to the drum,

In Fig. 2 the scale 39 is shown as being provided with numbers both above the longitudinally-extending graduating lines and also below such lines, the numbers below the lines being the reciprocals of the numbers above. It will be understood that any one of the scales may be provided with any other graduations, as desired, without departing from my invention. I have not illustrated in detail the provision of a scale of equal parts, a scale showing trigonometric functions, nor an inverted logarithmic scale, but it will be understood that my device is adapted for use in connection with any appropriate set of related scales, as may be desired, and it is believed to be unnecessary to illustrate in detail the various combinations which may be employed.

The method of using my improved drum structure for effecting an operation in division will be readily understood, being analogous to that already described in connection with the device shown in Fig. 7. With the drum 31 turned in position to read the dividend at the base line on either one of the scales 41—42, one of the drums 30—32 is turned into position to read the divisor at the base line on the scale 39 or 40 carried by that drum. The quotient is then readable at the base line on the other scale 39 or 40. As the pointer 46 indicates the middle turn when the pointers 45 and 47 have been moved into position in an operation of multiplication, in the same way in an operation of division the pointer 47 indicates the turn at which the quotient may be read when the pointers 45 and 46 have been moved into position.

That which I claim as my invention, and desire to secure by Letters Patent, is,—

1. In a computer, the combination of three related scales revoluble relative to each other about the same axis, each comprising an integral number of turns about said axis, means serving, when one of said scales is revolved relative to a second scale, to cause the third scale to revolve in a predetermined relation to said second scale, and indicating means comprising pointers adapted when set for any two turns of the outer scales to indicate the corresponding turn of the intermediate scale and comprising means for indicating the points along the scales at which readings are to be made.

2. A device of the character described comprising three coaxial members coördinated to move in differential relation, and provided on corresponding faces with numbered mathematical graduations, the graduations of the central member being so proportioned relative to those of the outer members as to disclose at a given point an appropriate function of any two numbers on the outer members brought into line with each other at such point.

3. In a computer, the combination of two logarithmic scales revoluble relative to each other about the same axis and each comprising a plurality of complete turns about said axis divided into a single complete logarithmic cycle, and a third logarithmic scale revoluble about said axis between said first-named two scales and comprising the same number of turns divided into two complete logarithmic cycles, the arrangement being such that when the initial points of said three scales are brought into alinement the first turn of said third scale stands substantially midway between the first turns of said first-named two scales and the second turn of said third scale stands substantially midway between the second turns of said first-named two scales.

4. In a computer, the combination of two logarithmic scales revoluble relative to each other about the same axis and each comprising an integral number of complete turns about said axis divided into an integral number of complete logarithmic cycles, two other logarithmic scales revoluble about said axis each comprising the same number of turns as said first-named two scales but divided into double the number of logarithmic cycles, and means adapted, when the initial points of said first-named two scales are brought into alinement, to cause the initial point of one of said second-named two scales to stand also in alinement with the initial points of said first-named two scales and at the same time to cause the initial point of the other of said second-named two scales to stand at a position one hundred and eighty degrees about said axis from the alined initial points of said first-named two scales.

5. In a computer, the combination of three related scales revoluble relative to each other about the same axis, each comprising an integral number of turns about said axis, means serving, when one of the outer scales is revolved relative to the intermediate scale, to cause the third scale to revolve to an equal extent in the opposite direction relative to said intermediate scale, and indicating means movable relative to said scales, comprising three alined pointers the intermediate one of which is adapted to be maintained midway between the outer two.

6. In a computer, the combination of a logarithmic scale comprising a complete logarithmic cycle, two other logarithmic scales of double dimensions as compared to said first-named scale each also comprising a complete logarithmic cycle and both progressing in the same direction as said first-

named scale, and means for controlling the positions of said scales adapted, when the initial point of said first-named scale and the initial point of one of said second-named two scales are brought into alinement to cause the initial point of the other scale at the same time to be brought to the same line, and adapted when one of said second-named scales is moved along said first-named scale to cause the other of said second-named scales to move equally in the opposite direction along said first-named scale.

KARL HORINE.